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Observation 1 - Inherency

Our current Landsat capability can fail at any moment

**Clark 10** (Stephen, Spaceflight Now, Jan. 13, <http://spaceflightnow.com/news/n1001/13landsat/> accessed 7/4/110 CJQ

**The** nearly **26-year-old Landsat 5** remote sensing **satellite has cheated death once again, but** Earth **scientists will have to wait three more years for a fresh spacecraft to meet all their research needs.  One of Landsat 5's radio transmitters** responsible for downlinking science imagery **failed in December,** but in a remarkable turn of fortune, another radio declared failed almost 23 years ago has been unexpectedly revived. "Lo and behold, it works," said Bruce Quirk, chief of the United States Geological Survey's land remote sensing program. Science operations could resume this week, according to Quirk. "It's like taking your car and driving into the garage, then coming back 23 years later and starting it up," Quirk said. "For it to work like this, I think it's really remarkable. I wasn't giving it a big chance of working, but Landsat 5 is kind of like the (Energizer) bunny -- it just keeps running and running." Landsat 5 was launched on March 1, 1984, on a three-year mission to continue the Landsat program's legacy of collecting Earth science data for a wide range of applications. **"We have brought it from the brink of death and back to life so many times over the last seven years**," said Kristi Kline, Landsat program manager at the USGS Earth Resources Science and Observation Center in Sioux Falls, S.D. "**It's just amazing what our flight operations team and our engineers are able to do with that spacecraft**." Landsat 5 has also recently struggled with other problems, including an August incident that sent the spacecraft tumbling out of control. The satellite's multi-spectral scanner is also not working. "**It's the oldest spacecraft of its type still functioning,**" Kline said. "We've certainly gotten our money's worth out of it."

The future of Landsat is in doubt, both 5 and 7 could fail at any time, and the Continuity Mission does not guarantee Landsat presence

Wigbels et al 8 (Lyn, Senior Fellow/Assistant Professor at the Center for Aerospace Policy Research at George Mason University, a Senior Associate at the Center for Strategic and International Studies Space Initiatives Program, G. Ryan Faith, adjunct fellow at CSIS, Vincent Sabathier, senior associate with the CSIS Technology and Public Policy Program, CSIS, July, http://csis.org/files/media/csis/pubs/080725\_wigbels\_earthobservation\_web.pdf, accessed 7-6-11, JMB)

In the United States, Landsat satellites have never been considered a fully operational capability, and no single US. government agency has had the responsibility for meeting US needs for operational moderate-resolution ground imaging. Over the years, many attempts were made to commercialize the provision of moderate-resolution ground imaging data, but a viable commercial option never emerged. Consequently, the United States has been unable to adequately address the expected gap in U.S. moderate-resolution land imaging data. Technical problems with the current Landsat 5 and 7 satellites are expected to result in their unavailability prior to the 2011 launch of the LDCM. In addition, there currently is no successor mission to LDCM nor a replacement satellite should LDCM fail at launch or early in its operational life. The new National Land Imaging Program provides a focal point in the US government for understanding land imaging requirements and planning and budgeting for missions to meet these requirements. USGS has begun working within the Department of the Interior to begin to migrate the current Land Remote Sensing Program into the National Land Imaging Program. However, the Interior Department did not receive additional funding last year to implement these new responsibilities, and only $2 million was requested for this by the administration for FY 2009. USGS is currently coordinating and promoting the uses of land imaging data within the Department of the Interior.

The USGS has inherited control of Landsat without the necessary funds to support the mission

Simpson 3/17 (Mike, Interior Subcommittee chairman, 2011, http://appropriations.house.gov/\_files/031711InteriorUSGeologicalSurveySimpson.pdf, accessed 7-5-11, JMB)

Third, by inheriting the full funding responsibility for LandSat 9 and 10 from NASA without any of NASA's $19 billion budget, and by offsetting the $48 million increase for LandSat from other core science programs, this budget is a sign of the untenable situation we're likely to be in two years from now when the Administration sends up a budget request for LandSat that is nearly 10 times the increase proposed for FY12. We might just as well rename USGS to National Land Imaging Agency.

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USGS has budgetary issues due to Landsat transfer now, can’t keep the mission running without increased support

GAP 3/29 (Government Affairs Program, summary of the 3/17/11 House hearing on the 2012 USGS budget request, http://www.agiweb.org/gap/legis112/appropsfy2012\_interior.html#hearings, accessed 7-5-11, JMB)

Ranking Member Jim Moran (D-VA) agreed “strongly” with the chairman’s points. He argued that the Landsat transfer included in the “deeply troubling” budget request does not make sense and that the proposed elimination of 230 full time employee positions is not acceptable. USGS Director Marcia McNutt began her statement with a description of USGS efforts that led to the safe capping and sealing of the runaway well in the BP Deepwater Horizon disaster in the Gulf last year. She expressed her sympathy to the Japanese people in the wake of a 9.0 magnitude earthquake and subsequent tsunami off the coast of Japan on March 11 that has caused severe devastation. She commended Japan for being the most advanced nation in the world in terms of earthquake hazards preparation and reduction. McNutt defended the Landsat program changes, comparing USGS’s proposed role to the responsibility that the National Oceanic and Atmospheric Administration (NOAA) has of its weather satellites. Representative Moran began by asking McNutt whether the $48 million increase to the Landsat program and the proposed future increases will come at the expense of vital USGS biological and geologic programs, such as mapping. McNutt agreed that USGS will need to communicate with the administration to ensure that a growing Landsat program would not “erode” the core missions of USGS. She told the committee that the Office of Management and Budget (OMB) told USGS that the cuts in the FY 2012 request were not associated with the Landsat increase, though Representative Moran responded that the OMB claim could not be true. Chairman Simpson agreed that with added responsibility, USGS should have received additional funding from NASA’s budget. He recommended that USGS investigate extending the operational lifetime of Landsat 8, which is set to launch in December 2012, in order to delay the launches of Landsats 9 and 10. The extra time would allow USGS to resolve this budgetary issue, he suggested.

Plan – The United States federal government should guarantee funding for the National Land Imaging Program to maintain multiple operational Landsat satellites

Advantage 1 is Water –

Landsat data key to water managements – solves water management, increasing efficiency and reducing international conflict

Rocchio 7 (Laura, Senior Outreach Scientist at Science Systems and Applications, MA from U Baltimore, cites Richard Allen, PhD, PE Professor, Water Resources Engineering, NASA, April 17, http://landsat.gsfc.nasa.gov/news/news-archive/soc\_0011.html, accessed 7-3-11, JMB)

Conserving water with Landsat Increased demand for scarce water supplies has shifted water management strategy from increasing water supply to innovatively managing water use at sustainable levels. To more effectively allocate limited water supplies, water resources managers must understand water consumption patterns over large geographic areas. Detailed water consumption maps can be made quickly and easily with Landsat because of its 30 m spatial resolution and thermal imaging capability. Landsat has been proclaimed “the best and least expensive way to quantify and locate where water is used and in what quantity,” by Anthony Morse and Richard Allen, two water management specialists from Idaho. Former World Bank economist, Dr. Chris Perry, predicts that, “We may expect significant improvements in the productivity of water—the crop per drop—by the analysis and debate facilitated by better data.” Landsat data have been used successfully not only to quantify water consumed by irrigation, but also to establish water rights, to facilitate the transfer of water entitlements, and to estimate aquifer depletions and quantify net ground-water pumpage in areas where water extraction from underground is not measured. Understanding Landsat's role Landsat data, including visible, near infrared, mid-infrared, and thermal information, for a particular geographic region are fed into a relatively sophisticated energy balance model that outputs evapotranspiration maps. Evapotranspiration (ET) refers to the conversion of water into water vapor by the dual process of evaporation from the soil and transpiration (the escape of water though plant’s stomata). For vegetated land, ET is synonymous with water consumption. Maps of water consumption made with moderate resolution Landsat data enable water resources managers and administrators to determine how much water was consumed from individual fields. And, because the spatial nature of Landsat data lends itself to the monitoring of seasonal evapotranspiration trends, managers can use the information to determine which complex irrigation schedules should be pursued and how to time water releases from dams. “Remote sensing, applied to the measurement of ET over large areas, provides analysts of irrigation systems with extraordinary

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new tools for the objective assessment of consumption and production—constituting a quantum leap in the assessment of irrigation system performance,” Perry wrote in 2003. Accuracy "Satellite analysis provides a far more objective and consistent set of information about who is consuming what than the ‘traditional’ methods of analysis." - Dr. Chris Perry “Satellite analysis provides a far more objective and consistent set of information about who is consuming what than the ‘traditional’ methods of analysis, which rely on complex equations and huge data sets to give information that has relatively low validity beyond the point of computation––thus being readily challenged by interested parties on the grounds that conditions are different where they irrigate,” Dr. Perry says. Traditional ground-based estimates of ET have substantial uncertainly and are cumbersome, slow and expensive to implement for large areas. Landsat-derived ET has shown much better certainty. Dr. Wim Bastiaanssen, director of Scientific Affairs & Irrigation at WaterWatch BV (Netherlands) and the main creator of the Surface Energy Balance Algorithm for Land (SEBAL) which uses Landsat data to calculate ET, reports that, “for a range of soil wetness and plant community conditions, the typical accuracy at field scale is 85% for one day and it increases to 95% on a seasonal basis.” Accuracy for Landsat-derived ET is judged in comparison to either records from pumping stations, wells and diversion points or data from precision weighing lysimeters (scientific measuring tools for calculating ET). How Landsat has helped in the U.S. Water resources management in New Mexico, California, Montana, Florida, Washington, Nevada, and Idaho has been aided by Landsat-derived ET maps. Landsat ET estimates have also helped states honor their water consumption limits set by interstate compacts. For example, the waters of the Bear River are divided among the states of Idaho, Utah and Wyoming, and each state needs to know how many acres of land they can develop with irrigation before exceeding their water apportionment. In an effort to conserve water and thereby restore Idaho's Lemhi River to a prime salmon habitat, local ranchers started converting flood irrigation systems to sprinkler irrigation systems, like the wheel line sprinkler system shown here. In Idaho, water resources managers rely on Landsat ET maps for water rights management, regulation, sale, and agreement negotiations. Their use of Landsat data was recently recognized as one of the Top 50 innovations in American government for 2007 by the prestigious Ash Institute for Democratic Governance and Innovation, part of Harvard University’s Kennedy School of Government. In Washington, Landsat ET estimates have helped to increase the flow of the Yakima River while maintaining the monetary level of crop production. In New Mexico, Landsat ET maps have helped water managers strike a balance between irrigation demands and riparian vegetation requirements. And in California, Landsat has helped create a statewide water use plan that helps farmers determine their actual irrigation needs. Landsat on the international scene “Satellite imagery, especially in the thermal bands, can and will revolutionize the establishment of water rights in the many parts of the world where they are insecure,” says Perry, who has worked on many water resources projects in developing countries. Outside of the U.S., the contentious issue of securing water rights can be limited by data. “There are numerous aid programs

from large donors such as the World Bank and Asian Development Bank that want to help manage water resources more effectively and productively, but nobody has the proper data,” Bastiaanssen says, but he continues, “with Landsat we can map out soil moisture, water consumption, water stress, crop yield.” Increasingly, the World Bank must deal with the overdraft of aquifers. They have labeled the unsustainable water mining “critical” in the North China Plain, Jordan, Mexico, Northern India, Israel, Palestine and Yemen. Meanwhile, Landsat has helped the World Bank successfully manage water projects in China, Mexico, and Yemen, as well as Egypt, Saudi Arabia, Uzbekistan, and Kazakhstan. In Turkey, Pakistan, Sri Lanka, India and China remote sensing has been demonstrated as a key tool for the strategic planning of water productivity on a basin wide scale.

Continued US Landsat data is key to worldwide water management

**Clark 10** (Stephen, Spaceflight Now, Jan. 13, <http://spaceflightnow.com/news/n1001/13landsat/> accessed 7/4/110 CJQ

"We use Landsat 5 principally to determine how much water is consumed by vegetation on a monthly and annual basis," Allen said. "**Our primary areas of focus are irrigated agriculture**, forests, **wetlands and native plants." Landsat satellites are currently collecting** more than **300 scenes per day globally**. **Those images go into an** online **archive, providing free access to scientists** over the Internet. "What we're seeing is people building up their own archives, and not only pulling down the most recent data over their sites, but they're going back in time and pulling down some of the thematic mapper data from the '80s," Quirk said. Tucker said **there are no international satellites offering free access to to Landsat-type data, elevating the urgent need for a U.S. follow-on spacecraft. "This is what the United States has done, and this is why U.S. data are widely used by everyone,**" Tucker said. "**The same is not true of China, the same is not true of India, and the same is not been true of other countries before**." A European Space Agency Sentinel satellite scheduled for launch in about four years will collect data comparable to the Landsat system and provide it to international researchers at low costs, but LDCM should be operational by then. **It's up to a dedicated control team to keep the remarkable Landsat legacy intact for another three years, long enough for a fresh satellite to take over the mantle**.

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**Water wars go global—it's an essential resource; countries will do anything to maintain their stream.**

**Postel and Wolf 1** (Sandra and Aaron, Global Water Policy @ Amherst and Asst. Prof. Geo. @ OSU, <http://www.globalpolicy.org/component/content/article/198/40343.html#postel>, accessed 7/7/11) CJQ

Others argue, however, that **when it comes to water the past will not be a reliable guide to the future**. A renewable but not infinite resource, **fresh water is becoming increasingly scarce**: The amount available to **the world** today **is** almost **the same as it was when the Mesopotamians traded blows**, even as global demand has steadily increased. Just since 1950, the renewable supply per person has fallen 58 percent as world population has swelled from 2.5 billion to 6 billion. Moreover, **unlike oil and** most **other strategic resources, fresh water has no substitute** in most of its uses. **It is essential** for growing food, manufacturing goods, and safeguarding human health. And while history suggests that **cooperation** over water has been the norm, it **has not been the rule. One fourth of water-related interactions during the last half century were hostile.** Although the vast majority of these hostilities involved no more than verbal antagonism, rival countries went beyond name-calling on 37 recorded occasions and fired shots, blew up a dam, or undertook some other form of military action. **Lost amidst this perennial debate over whether there will be water wars has been a serious effort to understand** precisely how and **why tensions develop**, beyond the simplistic cause-and-effect equation that water shortages lead to wars. First, whether or not **water scarcity** causes outright warfare between nations in the years ahead, it already **causes enough violence and conflict within nations to threaten social and political stability**. And as recent events in the Balkans and sub-Saharan Africa demonstrated, **today's civil conflicts have a nasty habit of spilling over borders and becoming tomorrow's international wars**. Second, water **disputes** between countries, though typically not leading to war directly, **have fueled decades of regional tensions, thwarted economic development, and risked provoking larger conflicts before eventually giving way to cooperation**. The obsession with water wars begs more important questions: What are the early signs and likely locations of water-related disputes, and what can governments and international agents do to prevent the eruption of violence and political instability?

**Water wars will escalate – billions of people at risk**

**Peterson 99** (Scott, Staff Writer @ Christian Science Monitor, [http://www.csmonitor.com/1999 /0714/p1s3.html/(page)/2](http://www.csmonitor.com/1999%20/0714/p1s3.html/%28page%29/2), accessed 7/7/11) CJQ

With Israel's new Prime Minister Ehud Barak promising to restart peace with the Palestinians and Syria, the issue of water - often forgotten by outsiders, but all-important in the parched Holy Land - will take center stage. After all, **destroying an enemy's water** and its **sources has been a strategic aim in every war fought in the Mideast** during the past two generations. And severe water shortages here **- the Middle East is experiencing its driest spell in 50 years** - could complicate any talks. "**If we solve every other problem** in the Middle East but do not satisfactorily **resolve the water problem, our region will explode**," once warned the late Israeli Prime Minister Yitzhak Rabin, one of the architects of the Mideast peace process. As crops shrivel, river and reservoir levels drop, and new dams and competing claims loom, experts are striving to cope with dwindling water resources. "The Malthusian specter is real in the Middle East," says Thomas Stauffer, a Washington-based Mideast water and energy analyst. Water resources are "fully utilized," while the population continues to grow - ingredients the economist Malthus predicted would lead to conflict. "The consequences are profound**. Scarcity means conflict, so oil wars are less likely than water wars."** His concerns are echoed by the results of a two-year study carried out by the US National Academy of Sciences alongside Israeli, Jordanian, and Palestinian water experts. "Fresh-water supplies in the Middle East now are barely sufficient to maintain a quality standard of living," said Gilbert White, a University of Colorado geographer who led the team. Increasing water use across the largely arid region, the team found, guarantees that "the area's inhabitants will almost assuredly live under conditions of significant water stress in the near future." **Already, at least 400 million people live in regions with severe water shortages. Within 50 years, that figure is expected to soar to 4 billion. There is no more water on the planet than there was 2,000 years ago, when the population was just 3 percent what it is today. "Our concerns about global warming are trivial compared to the issues that we face over water**," a senior official of NASA's Earth Sciences Directorate has said.

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Advantage 2 is Famine –

**Landsats are crucial to predictable agricultural reports—the alternative is unpredictable markets and food shortages.**

**NASA 7** (Laura Rocchio, <http://landsat.gsfc.nasa.gov/news/news-archive/soc_0010.html>, 7/6/11) CJQ

Market **intelligence about global crop production ensures that food supply is consistent with demand. If,** for example, **Australia has a bumper crop of wheat, U.S. farmers can avoid a wheat glut** (and protect against a precipitous price drop**) by not planting** wheat, **and vice versa.  Accurate** crop **estimates thereby translate into dependable food prices** by enabling producers to make wise planting decisions and by equipping U.S. agricultural commodity traders with the knowledge they need to set realistic and reasonable prices. The Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture (USDA) has the responsibility of providing this market intelligence in the form of timely, objective, unclassified, global crop condition and production estimates, for all major commodities, for all foreign countries. **These estimates are an integral part of the** World Agricultural Production and **World Agricultural Supply & Demand** numbers used by the U.S. Office of Management and Budget (OMB) as Principle Federal Economic Indicators. To accomplish this Herculean task, FAS synthesizes information from its global network of marketing experts, agricultural economists, meteorologists and remote sensing scientists. While FAS attachés collect crop production information from foreign government reports and fields visits, it is the comprehensive view afforded by space-based Earth-observing satellites, such as **Landsat**, that **provide** the **unbiased, global, farm-level observations necessary to objectively verify** these **reports. Unbiased** report **verification means food supply estimates can be used with confidence. “Less confidence** in the food supply **translates into more volatile markets where food shortages and over-stocks** are more likely to **occur**,” says Dr. Bradley Doorn a Technical Remote Sensing Coordinator with FAS. It was a grain shortage 35 years ago that initially led FAS to use Landsat data.

**Landsats exponentially increase agricultural output—energy measurement, soil detection, soil mapping and spatial planning make possible agricultural revolution.**

**Singh et al 10** (Pradeep Kumar Singh, Feroz Ahmed Parry, Kouser Parveen, Sumati Narayan, Asima

Amin and Ashis Vaidya, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, <http://www.journalcra.com/sites/default/files/Download_331.pdf>,accessed 7/7/11) CJQ

**Remote sensors are** generally categorized as aerial or **satellite sensors. They** can **indicate variations in field colour that corresponds to changes in soil type, crop development**, field boundaries, roads, water etc. Remote science in agricultural terms means viewing crop from overhead (from a satellite or low flying aircraft) without coming into contact, recording what is viewed and displaying the image and provide the map to pinpoint the field problems more earlier and more effectively. In remote sensing, information transfer is accomplished by use of electromagnetic radiation (EMR). EMR is a form of energy that reveals its presence by the observable effects it produces when it strikes the matter. **Due to remote sensing we have been able to observe large regions suitable for agriculture**, making use of sensors to **measure energy at wavelengths which are beyond the range of human vision** (ultraviolet infrared, etc.) and globally monitoring earth possible from nearly any site. Remote sensing technology can be used to provide valuable information on various agricultural resources which influences production (Roa, 1999). Some of the broad agricultural application areas are: i. Crop production forecasting: **It includes the identification of crops**, acreage estimation and yield forecasting. **Reliable and timely estimates of crop acreage and production are important for the formation of marketing strategies and price fixation**. Identification of crop is based on the fact that each crop has a unique spectral signature, which is influenced by the leaf area index, per cent ground cover, growth stage, difference in cultural practices, stress conditions and canopy architecture, yield of crop is influenced by large number of factors such as crop genotype, management practices, weather conditions of soil characteristics. **Remote sensing data related to** yield parameters are used in yield modeling for yield forescasting. ii. **Soil mapping**: Soil maps **afford the information on the suitability and limitation of the soil for agricultural production, which are helpful in selection of proper cropping system and optimal land use** planning. iii. Wasteland mapping: **Information on degraded and wasteland** e.g. salt affected areas, acidic soils, eroded soils, water logged area, dryland etc. Landuse/land cover information **is important for spatial planning management and utilization of land for various purposes like agriculture**, forestry, environmental studies and to find out the additional land resources that could be tilled. The information generated on landuse pattern also help identify suitable cropping patterns to convert single cropped area to double cropped **and allows cultivation of land for increasing the food production.**

Landsats 1AC

**Accurate predictions of crop yield are crucial to maintaining economic stability and planning for disasters. Only Landsats allow planners to manage crises.**

**Doraiswamy et al 7** (Paul C., Bakhyt Akhmedov b , Larry Beard c , Alan Stern a and Richard Mueller c a USDA, b Science Systems and Associates, Inc. c USDA, [http://www.ars.usda.gov/SP2UserFiles/person/ 1430/ISPRS\_AGRIFISH\_Final.pdf](http://www.ars.usda.gov/SP2UserFiles/person/%201430/ISPRS_AGRIFISH_Final.pdf) , accessed 7/8/11) CJQ

**Accurate and timely monitoring of agricultural crop conditions and estimating potential crop yields are essential processes for** operational **programs. Assessment of** particularly **decreased production** caused by a natural disaster, such as drought or pest infestation, **can be critical for countries** or locales **where the economy is dependent on the crop harvest. Early assessment of yield reductions could avert a disastrous situation and help in** strategic **planning to meet demands**. The National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA) monitors crop conditions and makes the Official USDA production assessments in the U.S., providing monthly production forecasts and end-of-year estimates of crop yield and production. NASS has developed methods to assess crop growth and development from several sources of information, including several types of surveys of farm operators and field-level measurements. Field offices in each state are responsible for monitoring the progress and health of the crop and integrating crop condition with local weather information. Information on crop condition and progress is also distributed in a biweekly report on regional weather conditions. NASS offices provide monthly information to the Agriculture Statistics Board, which assesses the potential yields of all commodities based on crop condition information acquired from different sources. This research complements efforts to independently assess crop condition at the county and state levels. The **timely evaluation of potential yields is increasingly important because of the huge economic impact of agricultural products on world markets** and strategic planning. County **statistics** are noted as a driving force for rural economic development, and **are essential to proper management of** USDA’s many **farm, education, and natural resources** management programs. Many allocations of federal resources to states and counties are determined by their production of farm commodities. Demand for accurate commodity estimates at the lowest level of aggregation, and at the earliest possible time, has and continues to increase substantially. **Literally millions of business decisions rely on this basic production data** produced by USDA/NASS. In the early 1960s, NASS initiated “objective yield” surveys for crops such as corn, soybeans, wheat, and cotton in States with the greatest acreages (Allen et al., 1994). These surveys establish small sample units in randomly selected fields which are visited monthly to determine maturity, numbers of plants, numbers of fruits (wheat heads, corn ears, soybean pods, etc.), and weight per fruit. Yield forecasting models are based on relationships of samples of the same maturity stage in comparable months during the past four years in each State. These indications are then compared to farmer-based survey results to produce monthly yield forecasts. Additionally, the Agency implemented a midyear Area Frame Survey that enabled creation of probabilistic based acreage estimates. For major crops, sampling errors are as low as 1 percent at the U.S. level and 2 to 3 percent in the largest producing States. **Accurate crop production forecasts require accurate estimates of acreage** at harvest, its **geographic distribution, and the associated crop yield determined by local** growing **conditions**. There can be significant year-to-year variability which requires a systematic monitoring capability. **To quantify the complex effects of environment**, soils, **and management practices**, both **yield** and acreage **must be assessed. A yield forecast** within homogeneous soil type, land use, crop variety, and climate **preclude the necessity for use of a complex forecast model.**

Landsats 1AC

Food crises escalate into food wars and regional conflicts

**Smith 98** (Paul J., Asia-Pacific Center for Sec'y Studies, [http://www.apcss.org/Publications/ Report\_Food\_Security\_98.html](http://www.apcss.org/Publications/%20Report_Food_Security_98.html), accessed 7/8/11) CJQ

**Food security and political stability are** often **inextricably linked** in many countries. Historically, significant **malnutrition and famine have been caused by the disruption of food supplies** through wars and civil strife.[53](http://www.apcss.org/Publications/food-ftnt-46-64.htm)  Yet, **the concepts** of food security and political stability **are** often **mutually dependent and reinforcing. Food security**, for example, **can influence the political stability of countries**. Simultaneously, **political instability (such as wars** or other forms of civil strife) **can influence food security**, as can be seen recently in the case of Indonesia. **One** seminar participant noted that **the greatest risk** for regime stability **is** the risk of **urban riots**—riots that are sometimes **sparked by food shortages or sudden price increases** among food products. Generally, starvation in the countryside does not result in political instability. This is because those who experience the brunt of food shortages tend to be rural and have little political voice. A recent example of this phenomenon occurred in India where rising food prices led to urban riots directed at India’s ruling political party—the Bharatiya Janata Party. Similarly, when the price of rice soared in Indonesia, thereby making it prohibitively expensive for a large segment of the population, food riots erupted in eastern Java. The government deployed military forces around markets to prevent looting. Moreover, China’s sharp rejection of the Lester Brown thesis that China needs to import massive amounts of grain from the world market in the coming century was partially rooted in a persistent fear within the Chinese government that food insecurity could potentially provoke widespread anger against the Communist Party and perhaps lead to civil unrest. Thus, **the sensitivity that many Asian governments have about food security may be linked to fears of social instability and** perhaps even **political revolution. Food security** thus **becomes an issue of regime survival**. **Another** security **concern** prominent in many Asian capitals **is** the prospect for increased **economic migration** as a result of food shortages. **Internal migration is the first concern for** many **governments**, especially **as internal migration is often a natural "coping response" in times of famine**. When North Korea experienced severe floods in September 1995, South Korea responded by creating refugee camps to deal with the possible flood of people who might have fled toward the south. Similarly, Indonesia’s food crisis in 1997 was partly responsible for the outflow of thousands of Indonesian migrants to Malaysia. As the crisis in Indonesia intensified in early 1998, many neighboring countries feared that many more "hungry Indonesians [would] take to boats in search of a better life."[54](http://www.apcss.org/Publications/food-ftnt-46-64.htm) Many **countries in East Asia are extremely sensitive** and wary **about** immigration—especially **mass** migration **or illegal migration. The recent surge** in labor and economic migration throughout the region **has catapulted the immigration issue to the highest levels of government**. Immigration disputes, moreover, have broken out between nations—such as the in case of Singapore and the Philippines in 1995—regarding illegal immigration and repatriation policies. Few governments in the region officially desire more immigration. To the extent that food insecurity might spur greater migration, then it may be viewed by many governments in the region as a security concern.

Food shortages collapse the global economy, lead to multiple scenarios for war

AFP 2k8 [IMF warns rising food prices raising risk of war, Apr 12, 2008, <http://afp.google.com/article/ALeqM5hL9XafrtiaulCYd-cHwk4eonPFGw>]

WASHINGTON (AFP) — Rising food prices could have terrible consequences for the world, including the risk of war, the IMF has said, calling for action to keep inflation in check. "Food prices, if they go on like they are doing today ... the consequences will be terrible," International Monetary Fund managing director Dominque Strauss-Kahn said. "Hundreds of thousands of people will be starving ... (leading) to disruption of the economic environment," Strauss-Kahn told a news conference at the close of the IMF spring meeting here. Development gains made in the past five or 10 years could be "totally destroyed," he said, warning that social unrest could even lead to war. "As we know, learning from the past, those kind of questions sometimes end in war," he said. If the world wanted to avoid "these terrible consequences," then rising prices had to be tackled. Skyrocketing prices on rice, wheat, corn and other staple foods like milk particularly hurt developing nations, where the bulk of income is spent on the bare necessities for survival.Higher energy prices, too, are driving up the cost of food, as well as stoking broader inflation.In recent months, rising food costs have lead to social unrest in several countries such as Haiti and Egypt. Thirty-seven countries currently face food crises, according to the Food and Agriculture Organization.

Landsats 1AC

Advantage 3 is Biodiversity –

Landsat is key to quantifying biodiversity loss, and enables successful habitat preservation

Turner et al 3 (Woody Turner1, Sacha Spector2, Ned Gardiner2, Matthew Fladeland3, Eleanor Sterling2 and Marc Steininger4 1NASA Office of Earth Science, 2Center for Biodiversity and Conservation, American Museum of Natural History, 3Earth Science Division, NASA Ames Research Center, 4Center for Applied Biodiversity Science at Conservation International, TRENDS in Ecology and Evolution Vol.18 No.6 June, p. 306-314 “Remote sensing for biodiversity science and conservation” JMB)

The potential for modern sensors to identify areas of significance to biodiversity, predict species distributions and model community responses to environmental and anthropogenic changes is an important research topic. Underlying this effort is the assumption that certain key environmental parameters, with remotely detectable biophysical properties, drive the distribution and abundance of species across landscapes and determine how they occupy habitats. New imagery and data sets are now enabling remote sensing, in conjunction with ecological models, to shed more light on some of the fundamental questions regarding biodiversity. These tools should prove useful to those seeking to generate basic knowledge about why organisms are found where they are, as well as those asking the more applied question of where to invest conservation funds. Here, we use the term ‘biodiversity’ in its organismal sense to refer to species and certain characteristics of species, in particular their distribution and number within a given area. We also use ‘biodiversity’ more broadly to mean species assemblages and ecological communities (i.e. groups of interacting and interdependent species). There are two general approaches to the remote sensing of biodiversity. One is the direct remote sensing of individual organisms, species assemblages, or ecological communities from airborne or satellite sensors. New spaceborne systems with very high spatial (also known as hyperspatial) resolutions are now available from commercial sources. For the first time, the direct remote sensing of certain large organisms and many communities is possible with unclassified satellite imagery. Likewise, new hyperspectral sensors slice the electromagnetic spectrum into many more discrete spectral bands, enabling the detection of spectral signatures that are characteristic of certain plant species or communities. The other approach is the indirect remote sensing of biodiversity through reliance on environmental parameters as proxies. For example, many species are restricted to discrete habitats, such as a woodland, grassland, or seagrass beds that can be clearly identified remotely. By combining information about the known habitat requirements of species with maps of land cover derived from satellite imagery, precise estimates of potential species ranges and patterns of species richness are possible. Just such an approach has been employed extensively in the US GAP analysis program [1]. Of course, it is probable that no single environmental parameter drives patterns of species distribution and richness. Many possible drivers have been proposed (Table 1). Here, we focus on three often-cited environmental parameters that now lend themselves particularly well to detection because of recent advances in remote-sensing technology: primary productivity, climate and habitat structure (including topography) [2–5]. For the conservation biologist, remotely sensed imagery exposes land-cover changes at spatial scales from local to continental, letting one monitor the pace of habitat loss and conversion [6,7]. These measurements of habitat loss can be converted into quantitative estimates of biodiversity loss through the use of the species–area relationship (Box 2), which underlies many current estimates of biodiversity decline [8–12].Remote sensing provides the area component of the equation. Public and nongovernmental conservation organizations worldwide leverage their understanding of species–area relationships with imagery-based habitat classifications to estimate species losses associated with changes inland cover and land use(Box3).The challenge is to go beyond this approach to a more detailed understanding of which species are being lost and why. How can we match existing and emerging remote-sensing technologies to parameters that have clear implications for organisms and ecosystems? Here, we review evidence that indicates that we might be close to improving greatly the detection of species, ecological communities and patterns of species richness with remote sensing. We explore recent advances in technology, addressing direct and indirect approaches to the remote sensing of biodiversity. Following the discussion of each technology, we offer examples of applications of that technology to the issue at hand.

Landsats 1AC

Conservation efforts require data – limited resources mean effective choices must be made

Harris et al 5 (Grant M., Clinton N. Jenkins, and Stuart L. Pimm, Nicholas School of the Environment and Earth Sciences at Duke, http://www.terpconnect.umd.edu/~cnjenkin/Harris\_et\_al\_2005.pdf, accessed 7-6-11, JMB)

Tropical forest destruction is severe, resulting in the highest extinction rates of any global ecosystem ( Wilson 1992; Skole & Tucker 1993; Pimm et al. 1995; Myers et al. 2000; Pimm & Raven 2000). In large part, stemming these losses requires protecting what forest remains and setting priorities for such actions. Globally, we know where the priorities are. There is close agreement among the hotspots of Myers et al. (2000), the endemic bird area (EBA) analyses by BirdLife (Stattersfield et al. 1998), ecoregions (Olson et al. 2001), and other quantitative mapping exercises (Wege & Long 1995; Manne et al. 1999; Jetz & Rahbek 2002; Myers 2003). The next course of action is to refine conservation priorities down to scales at which managers can work. There is already an extensive literature on prioritizing areas for conservation. Some computationally sophisticated methods prioritize areas based on a detailed knowledge of species distributions (e.g., Jennings 2000; Cowling et al. 2003a, 2003b). These approaches, so compelling for species-rich and taxonomically well-surveyed places (such as the United States and South Africa), rarely extend to tropical forests, where distributional data are few. With rare exceptions, they have not been applied to hotspots, where, by definition, there are high levels of both species endemism and habitat loss (Myers et al. 2000). Here, we describe a method that helps identify areas of a practical size to help prioritize, conserve, and manage species-rich tropical forests. To exemplify the approach, we focused on threatened birds endemic to Brazil’s Atlantic Forest. Our procedure advances the science of conservation prioritization by identifying forest fragments of a few tens of square kilometers that contain the most threatened birds from an ecoregion of more than 1 million km2 . The process is simple, intuitive, and relatively fast. The method also helps with generating practical goals to produce concrete results. These characteristics will facilitate its understanding and appeal for people charged with managing tropical biodiversity. Moreover, because production costs are low, it eliminates quibbling over whether conservation dollars are better spent on improved prioritization schemes or on protecting more land. Determining what areas are important for conservation requires knowing where habitat remains. Information on species distributions is also vital. Detailed knowledge of species ranges, however, is not necessarily required. A more moderate approach is to assume one must know both the detailed distribution of species and remaining habitats. Even if one accepts this approach, a key practical consideration is how expensive (in time or resources) it will be to uncover the distribution of species versus the distribution of remaining habitats. The expense of the former is self-evident, but what about the latter? In some cases the task of setting priorities is disconcertingly simple. As an extreme example, Cebu in the Philippines has only one small patch of forest remaining (Pimm 2001). It holds the island’s known endemics and, almost certainly, its unknown ones too. When habitat loss becomes this acute, whatever habitat remains becomes the priority. On average, tropical forest hotspots covered roughly 1 million km2 , of which 100,000 km2 remain (Myers et al. 2000). Protecting the remainder is the priority (Pimm et al. 2001) and probably the most influential action that can reduce future extinctions (Pimm & Raven 2000). Unfortunately, the costs of protecting hotspots are high (Pimm et al. 2001) because the remaining habitat is still too large for immediate protection. Is all remaining habitat equally important? The answer is surely, no. Even within a hotspot certain areas hold more threatened species than others. In addition, some fraction of the remaining forest may be in patches too small and isolated to have much conservation value (Brooks et al. 1999; Ferraz et al. 2003). Unless special circumstances warrant their attention (e.g., the last refuge of an endemic species), small fragments should receive lower priority relative to larger, more connected areas

Landsats 1AC

Landsat data continuity is uniquely key to preserving biodiversity

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

The Landsat program is no exception to this tendency towards adaptive applications, as the Mack quotation above indicates. Many applications became apparent only after the program was well underway (Mack, 1990). Landsat’s most unique feature, and greatest source of applications potential, is its longevity. Landsat provides the longest data record to address land use and land cover changes and their environmental impacts globally (Roughgarden et al., 1991; Lauer et al., 1997; Goward and Williams, 1997). NASA launched Landsat 1 (originally called Earth Resources Technology Satellite, or ERTS-1) in 1972, initiating the now more than 30-year Landsat mission (USGS, 2003a). Over time, the Landsat program would come to consist of a succession of six satellites (Landsat 6 never achieved orbit, due to problems with its launch platform) circling the Earth on polar orbits, collecting and transmitting satellite data and pictures covering the globe. These pictures and data today collectively constitute the largest consistent satellite database available for natural resource management (Draeger et al., 1997). Throughout the past decade or longer, the Landsat program has been at the core of global change research programs internationally (Goward et al., 1999, 2000). Global change research has been mostly focused on Earth sciences. Our paper attempts to quantify the importance of the Landsat program for applied and basic research in conservation biology, and ultimately for management and conservation of natural resources and biodiversity. Natural resource managers and conservation biologists were not a deﬁned target audience for NASA’s satellite monitoring programs, but nonetheless the data produced by these programs may have had a signiﬁcant effect on conservation biology research, or at least on the emergence and development of broad-scale ecological disciplines such as conservation biology and landscape ecology.

**Loss of biodiversity causes extinction**

Diner 94 (David N., Judge Advocate General’s Corps of US Army Military Law Review, Winter, 143 Mil. L. Rev. 161, LN)JFS

No species has ever dominated its fellow species as man has. In most cases, people have assumed the God-like power of life and death -- extinction or survival -- over the plants and animals of the world. For most of history, mankind pursued this domination with a single-minded determination to master the world, tame the wilderness, and exploit nature for the maximum benefit of the human race. n67 In past mass extinction episodes, as many as ninety percent of the existing species perished, and yet the world moved forward, and new species replaced the old. So why should the world be concerned now? The prime reason is the world's survival. Like all animal life, humans live off of other species. At some point, the number of species could decline to the point at which the ecosystem fails, and then humans also would become extinct. No one knows how many [\*171] species the world needs to support human life, and to find out -- by allowing certain species to become extinct -- would not be sound policy. In addition to food, species offer many direct and indirect benefits to mankind. n68 2. Ecological Value. -Ecological value is the value that species have in maintaining the environment. Pest, n69 erosion, and flood control are prime benefits certain species provide to man. Plants and animals also provide additional ecological services -- pollution control, n70 oxygen production, sewage treatment, and biodegradation. n71 3. Scientific and Utilitarian Value. -- Scientific value is the use of species for research into the physical processes of the world. n72 Without plants and animals, a large portion of basic scientific research would be impossible. Utilitarian value is the direct utility humans draw from plants and animals. n73 Only a fraction of the [\*172] earth's species have been examined, and mankind may someday desperately need the species that it is exterminating today. To accept that the snail darter, harelip sucker, or Dismal Swamp southeastern shrew n74 could save mankind may be difficult for some. Many, if not most, species are useless to man in a direct utilitarian sense. Nonetheless, they may be critical in an indirect role, because their extirpations could affect a directly useful species negatively. In a closely interconnected ecosystem, the loss of a species affects other species dependent on it. n75 Moreover, as the number of species decline, the effect of each new extinction on the remaining species increases dramatically. n76 4. Biological Diversity. -- The main premise of species preservation is that diversity is better than simplicity. n77 As the current mass extinction has progressed, the world's biological diversity generally has decreased. This trend occurs within ecosystems by reducing the number of species, and within species by reducing the number of individuals. Both trends carry serious future implications. Biologically diverse ecosystems are characterized by a large number of specialist species, filling narrow ecological niches. These ecosystems inherently are more stable than less diverse systems. "The more complex the ecosystem, the more successfully it can resist a stress. . . . [l]ike a net, in which each knot is connected to others by several strands, such a fabric can resist collapse better than a simple, unbranched circle of threads -- which if cut anywhere breaks down as a whole." n79 By causing widespread extinctions, humans have artificially simplified many ecosystems. As biologic simplicity increases, so does the risk of ecosystem failure. The spreading Sahara Desert in Africa, and the dustbowl conditions of the 1930s in the United States are relatively mild examples of what might be expected if this trend continues. Theoretically, each new animal or plant extinction, with all its dimly perceived and intertwined affects, could cause total ecosystem collapse and human extinction. Each new extinction increases the risk of disaster. Like a mechanic removing, one by one, the rivets from an aircraft's wings, [hu]mankind may be edging closer to the abyss.

Landsats 1AC

Observation 2 is Solvency -

Commitment to having multiple operational Landsats is key to maintaining continuous data and improves the quality of Landsat data

Wulder et al 11 (Michael A. Wulder a,⁎, Joanne C. White a, Jeffrey G. Masek b, John Dwyer c, David P. Roy d a Canadian Forest Service, Pacific Forestry Centre, Natural Resources Canada b Biospheric Sciences Branch, NASA Goddard Space Flight Center, c United States Geological Survey, Center for Earth Resources Observation and Science d Geographic Information Science Center of Excellence, South Dakota State University, Remote Sensing of Environment 115 p. 747–751, http://globalmonitoring.sdstate.edu/faculty/roy/Wulder\_2011\_RSE\_Landsat-update\_115.pdf, accessed 7-3-11, JMB)

In the future, Landsat systems should be launched at shorter intervals to ensure data continuity. Consideration should be given to having multiple Landsat systems in orbit at a given time, or to having a system built and ready for launch should such need arise. The ideal solution would be to launch new missions at 5-year intervals with a 10-15 year design life, thus increasing the frequency of repeat coverage and minimizing data gaps due to component failures. Further, options to integrate observations from lower-cost sensors with the Landsat data could be explored, with Landsat serving as a reference standard (for geometry, radiometry, etcetera) and the lower cost systems providing denser coverage as well as a continuity of observations. Additional “reference” missions would also bolster data continuity. The European Space Agency is planning to launch a pair of Sentinel-2 missions that deploy a sensor with imaging characteristics similar to that of LDCM, with the first mission scheduled for launch in 2013. With a larger image extent than Landsat (with a 290 km swath) and plans for two satellites to be launched for concurrent operation the capacity for landscape-scale terrestrial characterizations globally is enhanced. The potential for NASA and the USGS to work with the ESA to harmonize across programs to ensure long-term overlap in observations (continuity) and to aid in enabling global coverage is also present. Development of a long term acquisition plan (LTAP) that incorporates observations across sensors would aid in ensuring global and seasonal coverage while also enabling an increase in acquisitions over persistently cloudy regions. The ESA has announced intentions of an open data policy analogous to that of Landsat, although details have yet to be determined (deSelding, 2010). Through this communication we do not wish to understate the tenuous state of the current Landsat missions; our intent is to indicate the current mission status and to be open of the mission status and to communicate possible opportunities. Further, the on-going intention for singular Landsat missions does not sufficiently mitigate the risk to acquisitions that have borne out over the life of the Landsat missions. As evidenced by Landsat-6, failure at launch can occur. Multiple Landsat class satellites will increase the effective temporal resolution of observations, and as the satellites have different overpass time will increase the opportunity for cloud free observations, and so increased data for compositing, and a reduction of risk to data gap through a critical Landsat failure. A goal of multiple concurrently operating Landsat satellites, or complementary satellites that may be lower cost but that buttress against the high standards of Landsat geometric and radiometric characteristics should be seriously considered.

Landsats 1AC

The USGS branch of the Department of the Interior is the best place to manage Landsat data and operations

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

Selection and Justification of the U.S. Department of Interior as Lead Agency In the judgment of the FLI IWG and the stakeholder agencies it represents, the U.S. Department of the Interior (DOI) is the most appropriate U.S. agency to fulfill this Single Agency role. This recommendation is based on: • the extensive history of the DOI in proposing early U.S. efforts to design, build, and deploy a U.S. land imaging satellite system (the Earth Resources Technology Satellite in 1972, later called Landsat 1), more recently operating the Landsat series of satellites, and maintaining the current U.S. National Satellite Land Remote Sensing Data Archive, which contains the Nation’s historic satellite imagery of the Earth’s land surface; • the responsibilities assigned to the DOI under the 1992 Land Remote Sensing Policy Act and the subsequent National Science and Technology Council (NSTC-3) memorandum designating the DOI as the Program Manager of Landsat alongside the National Aeronautics and Space Administration (NASA); • the 2006 National Space Policy, which assigns to DOI the responsibility to “…collect, archive, process, and distribute land surface data to the United States Government and other users and determine operational requirements for land surface data;” this is supplemented by the 2003 U.S. Commercial Remote Sensing Space Policy under which DOI gathers near-term civil government requirements for U.S. commercial remote sensing data; • the responsibilities assigned to the DOI for managing the territorial interests of the U.S., overseeing U.S. land management and land use planning, and managing the civil geospatial programs and interests of the U.S., including aerial and satellite land imaging systems and technology, as derived from the DOI and USGS Organic Acts of 1849 and 1879, respectively; • the DOI’s extensive history of conducting Earth science, land management, imagery data distribution, and remote sensing applications development and providing intra- and intergovernmental services to users who have responsibility for conducting science related to geology, morphology, and ecology of the Earth’s land surface; and • the commitment expressed in a memorandum from the DOI to the Office of Science and Technology Policy on May 2, 2006, stating that the DOI is “…ready to accept the challenge of this new century and assume leadership for the Nation’s civilian operational land imaging program.” The message contained in this memorandum was accepted and endorsed by all the FLI IWG participating agencies and conforms with the views of the national and international Landsat user community.

Landsat imaging is still managed haphazardly, this prevents effective use of the data. United the Landsat program under a single agency solves.

Wigbels et al 8 (Lyn, Senior Fellow/Assistant Professor at the Center for Aerospace Policy Research at George Mason University, a Senior Associate at the Center for Strategic and International Studies Space Initiatives Program, G. Ryan Faith, adjunct fellow at CSIS, Vincent Sabathier, senior associate with the CSIS Technology and Public Policy Program, CSIS, July, http://csis.org/files/media/csis/pubs/080725\_wigbels\_earthobservation\_web.pdf, accessed 7-6-11, JMB)

There are also many questions and concerns surrounding the agency-level management of Earth observation systems, particularly space-based capabilities. NASA has traditionally procured space-based Earth observation systems, such as the weather and land imaging satellites, even when other agencies have been responsible for their operation. Under the new National Land Imaging Program, NASA will continue to procure Landsat satellites, although USGS for the first time is acquiring the ground segment under the Landsat Data Continuity Mission (LDCM) program. A tri-agency approach was adopted for the NPOESS system. NOAA, NASA, and the Department of Defense are jointly responsible for developing, acquiring, managing, and operating NPOESS. The involvement of three federal agency bureaucracies in the acquisition phase has proven to be challenging. No clear answers have emerged suggesting the most effective and efficient division of roles and responsibilities for Earth observations programs during the research, transition, and operational phases. This planning shortfall becomes a critical issue with the potential implementation of the so-called cap and trade agreements for carbon emission management. Cap and trade agreements will both need strong verification mechanisms and as an understanding of how royalties from cap and trade programs will be managed. The management experiences associated with NPOESS and other programs will be important lessons when making decisions on the management of the next generation Earth observation system.

Now Key – Landsat Failure Imminent

**We don’t have sufficient Landsat coverage, Landsat 5 can fail at any moment**

**Clark 10** (Stephen, Spaceflight Now, Jan. 13, <http://spaceflightnow.com/news/n1001/13landsat/> accessed 7/4/110 CJQ

**The** nearly **26-year-old Landsat 5** remote sensing **satellite has cheated death once again, but** Earth **scientists will have to wait three more years for a fresh spacecraft to meet all their research needs.  One of Landsat 5's radio transmitters** responsible for downlinking science imagery **failed in December,** but in a remarkable turn of fortune, another radio declared failed almost 23 years ago has been unexpectedly revived. "Lo and behold, it works," said Bruce Quirk, chief of the United States Geological Survey's land remote sensing program. Science operations could resume this week, according to Quirk. "It's like taking your car and driving into the garage, then coming back 23 years later and starting it up," Quirk said. "For it to work like this, I think it's really remarkable. I wasn't giving it a big chance of working, but Landsat 5 is kind of like the (Energizer) bunny -- it just keeps running and running." Landsat 5 was launched on March 1, 1984, on a three-year mission to continue the Landsat program's legacy of collecting Earth science data for a wide range of applications. **"We have brought it from the brink of death and back to life so many times over the last seven years**," said Kristi Kline, Landsat program manager at the USGS Earth Resources Science and Observation Center in Sioux Falls, S.D. "**It's just amazing what our flight operations team and our engineers are able to do with that spacecraft**." Landsat 5 has also recently struggled with other problems, including an August incident that sent the spacecraft tumbling out of control. The satellite's multi-spectral scanner is also not working. "**It's the oldest spacecraft of its type still functioning,**" Kline said. "We've certainly gotten our money's worth out of it."

The future of Landsat is in doubt, both 5 and 7 could fail at any moment

Wigbels et al 8 (Lyn, Senior Fellow/Assistant Professor at the Center for Aerospace Policy Research at George Mason University, a Senior Associate at the Center for Strategic and International Studies Space Initiatives Program, G. Ryan Faith, adjunct fellow at CSIS, Vincent Sabathier, senior associate with the CSIS Technology and Public Policy Program, CSIS, July, http://csis.org/files/media/csis/pubs/080725\_wigbels\_earthobservation\_web.pdf, accessed 7-6-11, JMB)

In the United States, Landsat satellites have never been considered a fully operational capability, and no single US. government agency has had the responsibility for meeting US needs for operational moderate-resolution ground imaging. Over the years, many attempts were made to commercialize the provision of moderate-resolution ground imaging data, but a viable commercial option never emerged. Consequently, the United States has been unable to adequately address the expected gap in U.S. moderate-resolution land imaging data. Technical problems with the current Landsat 5 and 7 satellites are expected to result in their unavailability prior to the 2011 launch of the LDCM. In addition, there currently is no successor mission to LDCM nor a replacement satellite should LDCM fail at launch or early in its operational life. The new National Land Imaging Program provides a focal point in the US government for understanding land imaging requirements and planning and budgeting for missions to meet these requirements. USGS has begun working within the Department of the Interior to begin to migrate the current Land Remote Sensing Program into the National Land Imaging Program. However, the Interior Department did not receive additional funding last year to implement these new responsibilities, and only $2 million was requested for this by the administration for FY 2009. USGS is currently coordinating and promoting the uses of land imaging data within the Department of the Interior.

Now Key – Delays Kill the Program

Landsat delay crushes the program – narrow flight window

Brinton 3/14 (Turner, Space News, 2011, http://www.spacenews.com/civil/110314-nasa-racing-launch-next-landsat-mission-before-2013.html, accessed 7-5-11, JMB)

NASA and its industry partners are racing to complete development and launch the next Landsat imaging spacecraft by the end of 2012 to avoid launch range conflicts with several high-priority national missions. The U.S. space agency is formally committed to having the $941 million Landsat Data Continuity Mission (LDCM) ready to launch no later than June 2013. But the program has long been managing to a more aggressive December 2012 target to minimize the chances of the current Landsat craft going dark before LDCM reaches orbit. NASA contracted with United Launch Alliance of Denver in 2009 to launch LDCM in December 2012 from Vandenberg Air Force Base, Calif., on an Atlas 5 rocket. Because the Atlas 5 manifest is crowded in 2013 with Defense Department and intelligence community launches, NASA cannot afford to miss the 2012 launch date, according to Steve Volz, the NASA Earth Science Division’s associate director for flight programs. “We’re treating this almost as a planetary launch window,” Volz said. If LDCM is not ready to launch on time, it may have to wait to launch until late 2013. Not only would this increase the mission’s costs, it also would cause the satellite to miss the spring growing season in the northern hemisphere, an important objective for the five-year mission, Volz said. Both Landsat 5 and Landsat 7 are projected to last beyond spring 2013, but the likelihood of one or both failing increases with each passing month, he said. The most challenging piece of LDCM development has been the Thermal Infrared Sensor (TIRS) being built in-house by Goddard Space Flight Center in Greenbelt, Md. The sensor — a late edition to the LDCM project — has been in fabrication for about a year, and a number of technical issues have left it with little schedule margin, Volz said in a March 10 interview. One of the issues concerned circuit boards inside TIRS’ main electronics box. Although the boards had been used in earlier flight projects, testing discovered that they were not meeting LDCM’s thermal stability requirements. Fixing the problem cost $3.8 million, according to a March 3 report by the U.S. Government Accountability Office

Inherency – Data Management

Landsat imaging is still managed haphazardly, this prevents effective use of the data

Wigbels et al 8 (Lyn, Senior Fellow/Assistant Professor at the Center for Aerospace Policy Research at George Mason University, a Senior Associate at the Center for Strategic and International Studies Space Initiatives Program, G. Ryan Faith, adjunct fellow at CSIS, Vincent Sabathier, senior associate with the CSIS Technology and Public Policy Program, CSIS, July, http://csis.org/files/media/csis/pubs/080725\_wigbels\_earthobservation\_web.pdf, accessed 7-6-11, JMB)

There are also many questions and concerns surrounding the agency-level management of Earth observation systems, particularly space-based capabilities. NASA has traditionally procured space-based Earth observation systems, such as the weather and land imaging satellites, even when other agencies have been responsible for their operation. Under the new National Land Imaging Program, NASA will continue to procure Landsat satellites, although USGS for the first time is acquiring the ground segment under the Landsat Data Continuity Mission (LDCM) program. A tri-agency approach was adopted for the NPOESS system. NOAA, NASA, and the Department of Defense are jointly responsible for developing, acquiring, managing, and operating NPOESS. The involvement of three federal agency bureaucracies in the acquisition phase has proven to be challenging. No clear answers have emerged suggesting the most effective and efficient division of roles and responsibilities for Earth observations programs during the research, transition, and operational phases. This planning shortfall becomes a critical issue with the potential implementation of the so-called cap and trade agreements for carbon emission management. Cap and trade agreements will both need strong verification mechanisms and as an understanding of how royalties from cap and trade programs will be managed. The management experiences associated with NPOESS and other programs will be important lessons when making decisions on the management of the next generation Earth observation system.

Inherency – No USGS Budget – Long-Term Damage

Landsat was transferred to USGS without increase in budget – compromises long-term science capability

Schiffries 4/15 (Dr. Craig M., Director for Geoscience Policy at the Geological Society of America, congressional testimony, http://www.geosociety.org/geopolicy/news/0411-HouseTestimonyOnUSGS.pdf, accessed 7-5-11, JMB)

President Obama’s FY 2012 budget request for the U.S. Geological Survey is $1.118 billion, a decrease of $15 million or 1.3 percent below the USGS budget request for FY 2011. Although there is a $6 million or 0.5% increase in the total USGS budget request for FY 2012 compared to the FY 2010 enacted level, the FY 2012 budget request contains $89.1 million in budget cuts in core science programs that would be offset by increases in other areas, including a $48 million increase in a new account for National Land Imaging. The proposed budget cuts would have significant negative impacts on the scientific capabilities of the USGS. Proposed reductions in the FY 2012 USGS budget request include -$9.8 million for Biological Information Management and Delivery, -$9.6 million for Mineral Resources, -$8.9 million for National Water Quality Assessment, -$6.5 million for Water Resources Research Act Program, and -$4.7 million for Earthquake Hazards. The Geological Society of America urges Congress to appropriate at least $1.2 billion for the USGS in FY 2012. It appears that responsibilities for Landsat satellites have been transferred from NASA to USGS without a corresponding transfer of budget authority. In the USGS budget request for FY 2012, a $48 million increase for National Land Imaging would be offset by budget decreases for core USGS science programs. This trend cannot continue without compromising the mission of the U.S. Geological Survey. Experience with other satellites indicates that the cost of operating Landsat is likely to rise significantly in future years with the launch of Landsat 8, 9, and 10. The USGS budget has been nearly stagnant in real dollars since 1996. The USGS budget for FY 2010 was below the USGS budget for FY 2001 in real dollars. The decline in funding for the USGS during this time period would have been greater if Congress had not repeatedly restored proposed budget cuts. Federal funding for non-defense R&D has increased significantly while funding for the USGS stagnated for more than a decade. During this time, natural hazards, mineral and energy resources, and water availability and quality have become increasing important to the nation.

No transfer of budgetary authority for Landsat now – dooms the future

Simpson 3/17 (Mike, Interior Subcommittee chairman, 2011, http://appropriations.house.gov/\_files/031711InteriorUSGeologicalSurveySimpson.pdf, accessed 7-5-11, JMB)

Third, by inheriting the full funding responsibility for LandSat 9 and 10 from NASA without any of NASA's $19 billion budget, and by offsetting the $48 million increase for LandSat from other core science programs, this budget is a sign of the untenable situation we're likely to be in two years from now when the Administration sends up a budget request for LandSat that is nearly 10 times the increase proposed for FY12. We might just as well rename USGS to National Land Imaging Agency.

USGS has budgetary issues due to Landsat transfer now

GAP 3/29 (Government Affairs Program, summary of the 3/17/11 House hearing on the 2012 USGS budget request, http://www.agiweb.org/gap/legis112/appropsfy2012\_interior.html#hearings, accessed 7-5-11, JMB)

Ranking Member Jim Moran (D-VA) agreed “strongly” with the chairman’s points. He argued that the Landsat transfer included in the “deeply troubling” budget request does not make sense and that the proposed elimination of 230 full time employee positions is not acceptable. USGS Director Marcia McNutt began her statement with a description of USGS efforts that led to the safe capping and sealing of the runaway well in the BP Deepwater Horizon disaster in the Gulf last year. She expressed her sympathy to the Japanese people in the wake of a 9.0 magnitude earthquake and subsequent tsunami off the coast of Japan on March 11 that has caused severe devastation. She commended Japan for being the most advanced nation in the world in terms of earthquake hazards preparation and reduction. McNutt defended the Landsat program changes, comparing USGS’s proposed role to the responsibility that the National Oceanic and Atmospheric Administration (NOAA) has of its weather satellites. Representative Moran began by asking McNutt whether the $48 million increase to the Landsat program and the proposed future increases will come at the expense of vital USGS biological and geologic programs, such as mapping. McNutt agreed that USGS will need to communicate with the administration to ensure that a growing Landsat program would not “erode” the core missions of USGS. She told the committee that the Office of Management and Budget (OMB) told USGS that the cuts in the FY 2012 request were not associated with the Landsat increase, though Representative Moran responded that the OMB claim could not be true. Chairman Simpson agreed that with added responsibility, USGS should have received additional funding from NASA’s budget. He recommended that USGS investigate extending the operational lifetime of Landsat 8, which is set to launch in December 2012, in order to delay the launches of Landsats 9 and 10. The extra time would allow USGS to resolve this budgetary issue, he suggested.

Inherency – No USGS Budget – Long-Term Damage

USGS won’t have enough money to fund landsat

Moran 3/17 (Mike, Representative, congressional hearing on 2012 USGS budget, http://findarticles.com/p/news-articles/political-transcript-wire/mi\_8167/is\_20110320/rep-mike-simpson-holds-hearing/ai\_n57124204/?tag=mantle\_skin;content, accessed 7-5-11, JMB)

I owe you big time. Well, let's focus first of all on the $48 million increase for the outyear Landsat missions because it's coming from base programs that we feel are vital. And that is clearly on both sides of the aisle here. Now, I've seen a chart that shows the plan is for the USGS share of Landsat 9 and 10 missions, the two skyrocket, now, because that's a pun that the staff put in there deliberately. But -- but here we are, zero and in F.Y. '11, it goes to 48 million, of course, and this new budget in F.Y. '12, but then a 159 million in F.Y. '13 and 410 million in F.Y. '14. I mean, at -- in just two years from now, 410 million to a $1 billion agency, that's obviously over 40 percent of the entire agency.

Inherency – Landsat TOs with USGS

Landsat trades off with other USGS priorities

Moran 3/17 (Mike, Representative, congressional hearing on 2012 USGS budget, http://findarticles.com/p/news-articles/political-transcript-wire/mi\_8167/is\_20110320/rep-mike-simpson-holds-hearing/ai\_n57124204/?tag=mantle\_skin;content, accessed 7-5-11, JMB)

I hope we do have time to talk about lessons learned from that oil disaster, because there is an important role for both enhanced federal regulation and enhanced federal science. The -- as say though, Mr. Chairman, I couldn't agree more with you that this budget request is deeply troubling. It does include a large funding increase, but for a new responsibility the cost of future Landsat rockets. There is an overall increase of 50 million for Landsat, but many of the core reliable, and necessary science programs at the USGS have been cut to make room for Landsat. That doesn't make sense. So, I hope we can work together to figure this out and to rectify the -- I think the wrongheaded decision frankly, that the administration has made. The nation does need Landsat. But there are also needs the research as the Chairman says, on water quality, on groundwater stream gauges, mineral science, mapping, biology, earth sciences, all of those a cut in this request. The budget requires the loss of 230 full-term equivalent positions.

Solvency – Clarity

**Landsats provide the clearest images.**

**Goetz 6** (Alexander, University of Colorado at Boulder, http://landsat.gsfc.nasa.gov /about/Application6.5.html, , accessed 7/5/11) CJQ

Alexander Goetz, professor of geological sciences at the University of Colorado is leading a research team to create an effective way to assess how the High Plains will be affected by future climate change. Using Landsat 5 data from 1984 to the present, Goetz' team has completed a detailed study of land cover change in northeastern Colorado and is creating a 15-year database of land cover and human-induced land cover changes in the region. One of the more striking observations is the dramatic shift from dry-land farming and flood irrigation to center-pivot irrigation since 1985. **Some** of the **pivots are located in the dune areas and these spots would become dune reactivation sites if the irrigation were discontinued,** according to Goetz. **Combining land-cover data with meteorological and future climate data in a regional climate model, Goetz plans to produce a model-based method for estimating future dune reactivation and identifying the areas with the highest potential for reactivation**. The team will also investigate the potential effect of abandoning farmed and irrigated lands on dune reactivation. **Landsat 7 data provides the researchers with many more images than were previously available, since the team can acquire images from every pass of the satellite over the region. With multiple images during a growing season, they can more precisely distinguish crop types and change.** Goetz expects that by extending the Landsat data set beyond 2000, he will be able to catch a significant drought year, which will help to validate models for the effect of low rainfall in the High Plains.

Solvency – Thermals – Tracking

**Thermal band use is the only internal link to effective usage tracking.**

**NASA 7** (<http://landsat.gsfc.nasa.gov/pdf_archive/soc_0011.pdf>, accessed 7/4/11)CJQ

Four important characteristics of Landsat explain its prominence in water resources management. Most importantly, **Landsat collects thermal imagery. It also collects visible, near infrared, and shortwave** infrared **data** all **at a** reasonably **high spatial resolution**, plus, the data have been collected regularly and archived since 1982. Thermal imaging “**The thermal imager of Landsat is a critical component of the surface energy computations that we conduct to determine evapotranspiration**,” explains Allen. 29 **The thermal band allows managers to calculate** the full surface energy balance **and** thereby **estimate water consumption by** both agricultural **irrigation and** urban **landscaping that is much more accurate than estimates made using short-wave data alone**. 30 Resolving power Landsat’s spatial resolution (30 m for the reflective bands, and 60 to 120 m for the ETM+ and TM **thermal bands**, respectively) **fills a special niche in the world of water resources management.** Landsat’s swath is wide enough to provide a synoptic view of a large region while at the same time its resolution is high enough to identify individual fields––which are typically ten to 160 acres (180 to 750 m per side) in the U.S. 31 “**Actual consumptive use of water is needed if misuse of water is to be proved or water scarcity confirmed, and generally this needs to be done on a field-by-field basis,”** according to Morse. 32 While there are other Earth-observing satellites that regularly collect thermal imagery, their low resolution makes field-level ET analysis impossible.

Solvency – Timeframe

**Landsats disseminate information quickly—they allow farmers to adjust their management practices in order to meet market needs. Effective farming overcomes environmental damage.**

**Wu et al 9** (Bingfang Wu, Jihua Meng, Feifei Zhang, Xin Du, Liming Niu, and Miao Zhang Institute of Remote Sensing Applications (China) Jianzhi Li Beijing's Treasures SIN Technology Co., Ltd. (China), <http://spiedigitallibrary.org/proceedings/resource/2/psisdg/7841/1/78410W_1?isAuthorized=no>, accessed 7/7/11) CJQ

**A new generation of farmers can use** aerial and **satellite remote sensing** imagery **to** help them **manage their croplands more efficiently. By measuring precisely the way their fields reflect** and emit **energy in the visible and infrared wavelengths**, precision **farmers can monitor a wide range of variables that affect their crops. The management of their cropland can be adjusted** dynamically **based on the crop and environment status in their field**. The key to precision farming is to acquire crop and environment information effectively. With the background of an extremely complex agricultural landscape in China, the limitations on applying remote sensing in field level crop and environment parameter monitoring to support precision farming were analyzed in detail and three major factors were identified: temporal and spatial resolution, accuracy and information dissemination service. A pilot study was provided in Yucheng, Shangdong Province of China. **The crop and environment information were acquired instantly with remote sensing and delivered to farmers through a portable information** servicing **system. The information service has been proved to be effective in improving farmers' production while reducing the negative impacts of farming on the environment** that are due to overapplication of chemicals.

Solvency – AT: Unreliable

Landsats have the best solvency—most accurate EOS in space

Metrodata 11 (7/6, <http://www.metrodata-defense.com/forces/space-agencies/nasa-landsat-7.html>, accessed 7-6-11, CH)

The Landsat Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey. Since 1972, Landsat satellites have collected information about Earth from space. This science, known as remote sensing, has matured with the Landsat Program. Landsat satellites have taken specialized digital photographs of Earth’s continents and surrounding coastal regions for over three decades, enabling people to study many aspects of our planet and to evaluate the dynamic changes caused by both natural processes and human practices. Landsat 7 is the most accurately calibrated Earth-observing satellite, i.e., its measurements are extremely accurate when compared to the same measurements made on the ground. Landsat 7’s sensor has been called “the most stable, best characterized Earth observation instrument ever placed in orbit.” Landsat 7’s rigorous calibration standards have made it the validation choice for many coarse-resolution sensors.

Landsats self-correcting—georectification solves

Chun & Atluri 00 (Soon Ae & Vijayalakshmi . Associate Professor of Informaton Systems @ College at Staten Island& Prof. Digital Government @ Rutgers U, Rutgers U, “Protecting Privacy From Continuous High-Resolution SatelliteSurveillance”, accessed 7-4-11, CH)

Each satellite image undergoes the process of georectification which involves two steps: georegistration and geocorrection. Geocorrection of the image is needed since the distances and directions in satellite images do not correspond to true distances and directions on the ground due to the variability of satellite position. Georegistration process registers each image with a known coordinate system (e.g. longitude, latitude), and reference units (e.g. degrees) and coordinates of left, right, top and bottom edges of the image.

Solvency Advocate – 5-yr intervals

The US should commit to launching new landsat missions at 5-year intervals with 10-15 year design life – key to stop data gaps

Wulder et al 11 (Michael A. Wulder a,⁎, Joanne C. White a, Jeffrey G. Masek b, John Dwyer c, David P. Roy d a Canadian Forest Service, Pacific Forestry Centre, Natural Resources Canada b Biospheric Sciences Branch, NASA Goddard Space Flight Center, c United States Geological Survey, Center for Earth Resources Observation and Science d Geographic Information Science Center of Excellence, South Dakota State University, Remote Sensing of Environment 115 p. 747–751, http://globalmonitoring.sdstate.edu/faculty/roy/Wulder\_2011\_RSE\_Landsat-update\_115.pdf, accessed 7-3-11, JMB)

In the future, Landsat systems should be launched at shorter intervals to ensure data continuity. Consideration should be given to having multiple Landsat systems in orbit at a given time, or to having a system built and ready for launch should such need arise. The ideal solution would be to launch new missions at 5-year intervals with a 10-15 year design life, thus increasing the frequency of repeat coverage and minimizing data gaps due to component failures. Further, options to integrate observations from lower-cost sensors with the Landsat data could be explored, with Landsat serving as a reference standard (for geometry, radiometry, etcetera) and the lower cost systems providing denser coverage as well as a continuity of observations. Additional “reference” missions would also bolster data continuity. The European Space Agency is planning to launch a pair of Sentinel-2 missions that deploy a sensor with imaging characteristics similar to that of LDCM, with the first mission scheduled for launch in 2013. With a larger image extent than Landsat (with a 290 km swath) and plans for two satellites to be launched for concurrent operation the capacity for landscape-scale terrestrial characterizations globally is enhanced. The potential for NASA and the USGS to work with the ESA to harmonize across programs to ensure long-term overlap in observations (continuity) and to aid in enabling global coverage is also present. Development of a long term acquisition plan (LTAP) that incorporates observations across sensors would aid in ensuring global and seasonal coverage while also enabling an increase in acquisitions over persistently cloudy regions. The ESA has announced intentions of an open data policy analogous to that of Landsat, although details have yet to be determined (deSelding, 2010). Through this communication we do not wish to understate the tenuous state of the current Landsat missions; our intent is to indicate the current mission status and to be open of the mission status and to communicate possible opportunities. Further, the on-going intention for singular Landsat missions does not sufficiently mitigate the risk to acquisitions that have borne out over the life of the Landsat missions. As evidenced by Landsat-6, failure at launch can occur. Multiple Landsat class satellites will increase the effective temporal resolution of observations, and as the satellites have different overpass time will increase the opportunity for cloud free observations, and so increased data for compositing, and a reduction of risk to data gap through a critical Landsat failure. A goal of multiple concurrently operating Landsat satellites, or complementary satellites that may be lower cost but that buttress against the high standards of Landsat geometric and radiometric characteristics should be seriously considered.

Solvency Advocate – DOI

Department of the interior is the best agent – extensive laundry list

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

Selection and Justification of the U.S. Department of Interior as Lead Agency In the judgment of the FLI IWG and the stakeholder agencies it represents, the U.S. Department of the Interior (DOI) is the most appropriate U.S. agency to fulfill this Single Agency role. This recommendation is based on: • the extensive history of the DOI in proposing early U.S. efforts to design, build, and deploy a U.S. land imaging satellite system (the Earth Resources Technology Satellite in 1972, later called Landsat 1), more recently operating the Landsat series of satellites, and maintaining the current U.S. National Satellite Land Remote Sensing Data Archive, which contains the Nation’s historic satellite imagery of the Earth’s land surface; • the responsibilities assigned to the DOI under the 1992 Land Remote Sensing Policy Act and the subsequent National Science and Technology Council (NSTC-3) memorandum designating the DOI as the Program Manager of Landsat alongside the National Aeronautics and Space Administration (NASA); • the 2006 National Space Policy, which assigns to DOI the responsibility to “…collect, archive, process, and distribute land surface data to the United States Government and other users and determine operational requirements for land surface data;” this is supplemented by the 2003 U.S. Commercial Remote Sensing Space Policy under which DOI gathers near-term civil government requirements for U.S. commercial remote sensing data; • the responsibilities assigned to the DOI for managing the territorial interests of the U.S., overseeing U.S. land management and land use planning, and managing the civil geospatial programs and interests of the U.S., including aerial and satellite land imaging systems and technology, as derived from the DOI and USGS Organic Acts of 1849 and 1879, respectively; • the DOI’s extensive history of conducting Earth science, land management, imagery data distribution, and remote sensing applications development and providing intra- and intergovernmental services to users who have responsibility for conducting science related to geology, morphology, and ecology of the Earth’s land surface; and • the commitment expressed in a memorandum from the DOI to the Office of Science and Technology Policy on May 2, 2006, stating that the DOI is “…ready to accept the challenge of this new century and assume leadership for the Nation’s civilian operational land imaging program.” The message contained in this memorandum was accepted and endorsed by all the FLI IWG participating agencies and conforms with the views of the national and international Landsat user community.

Solvency Advocate – Single Agent

Single agency model best – streamlining, single voice

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

In a unanimous judgment, the FLI IWG selected the “government-owned/single agency” governance model as the option that best met the specified criteria, posed the least amount of risk and offered the greatest degree of flexibility to the U.S. Government with respect to data continuity and program risk, and, in most cases, provided the best alignment with current space-related laws and policies. This judgment resonated with recommendations from both the user community and the U.S. Government agencies involved in the FLI IWG process. Justification The Single Agency governance model ranked most favorably overall because of positive evaluations against the evaluation criteria discussed above. The FLI IWG gave a very high priority to minimizing management complexity and bureaucratic hurdles associated with multiple or integrated agency governance models. In addition, the Group noted the importance of having a single U.S. voice speak on behalf of U.S. land imaging and represent its goals and interests. These benefits were judged to have been lacking in the past and to be the most important to establish. The only governance criterion where this model was less favorably ranked was “scientific, technical, and managerial leadership,” since it was recognized that multiple U.S. Government agencies would be able to provide specialized expertise related to their particular uses of land imaging data. To reflect and capture this single advantage of the “multiple agency” governance model, the Group discussed how a single agency could conduct a U.S. land imaging program in accord with government, commercial, and international users, while also formally acknowledging the role of other U.S. Government agencies. Such roles could include sponsoring the development of advanced land remote sensing systems and technologies (i.e., the National Aeronautics and Space Administration), or representing key stakeholder purposes and applications, roles, and constituencies (e.g., the U.S. Department of Agriculture, the U.S. Department of Defense, or the National Oceanic and Atmospheric Administration). It was determined that the best Single Agency model is one that gives full recognition of each participating agency’s role and set of constituencies, including full recognition of the data and operational system needs that exist throughout the U.S. and across the jurisdictional boundaries of the various agencies of the U.S. Government. The mission for the lead Single Agency would include effective management designed to best satisfy the U.S. Government’s needs across the full range of land imaging capabilities. The Single Agency would also have responsibility for user requirements coordination and integration, system acquisition and operations, data acquisition and archiving, developing new methodologies for data distribution to the widest range of users, and management of a comprehensive program of land management research and applications. The latter responsibility would especially be intended to demonstrate promising future technologies and applications across the broad spectrum of land imagery uses.

Single agency key to financial stability

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

It should be noted that the selection of the Single Agency governance model was strongly influenced by the importance of the financial and budgetary stability of this program, a criterion that has never been met previously for the Landsat program. This financial stability would include a single integrated budget request that addresses all facets of systems, data acquisition, operations, data management and distribution, and development and promotion of new experimental techniques, applications, and services relevant to the best use of land imagery by the Nation. This approach would also streamline Executive Branch consideration of a single integrated program budget and allow the U.S. Congress to oversee and discharge its oversight of this essential national program. The DOI as the Single Agency should manage the NLIP budget formulation and execution processes consistent with U.S. law and regulations. As such, the NLIP should be managed in such a way as to preclude competition for funds with other internal functions of the DOI, including other operational, management, or science programs. This will ensure that funds appropriated for U.S. land imaging are expended solely for the purpose of acquiring, operating, managing, and distributing national land imagery systems and data on behalf of the U.S. Government and the Nation.

AT: Sats bad – Natives

**GIS tools good for preservation of indigenous rights**

**Harmsworth 98** (Garth, MSc (Hons) Earth Sciences @ Waikato University, iapad.org/publications/ppgis/indigenous\_values\_and\_GIS-a\_method\_and\_a\_framework.pdf, DA 7/8/11, OST)

**In New Zealand**, geographic information systems (**GIS) are becoming increasingly important in all areas of** resource **management and** environmental **planning**.  **There is growing interest among the Maori, the indigenous people of New Zealand, in the use of GIS to help them achieve some of their goals and aspirations.** **This article describes recent efforts to identify Maori values which are part of Maori traditional knowledge** (maatauranga Maaori). **I**t then **presents a method and framework for incorporating these values into GIS tools**. The Maori, the indigenous people of New Zealand, make up 14% of the country's total population of 3.7 million. **Close to three-quarters of Maaoris** (Hapi 1996) **have a strong sense of belonging to regional or geographically concentrated** "iwi" (tribes) and "hapuu" (sub-tribes). Land, water, and air are central to Maori life and values, and they regard themselves as the "kaitiaki", or guardians of all natural resources. **The rights of the Maori people to their lands, estates, forests, fisheries and everything else they hold dear, including language and natural resources, are laid down in the Treaty of Waitangi** (1840). **According to present legal requirements, Maori values must be taken into account in land-use planning. However, the scarcity and sensitivity of the information on Maori values, as well as the issue of confidentiality, have made it difficult to meet these requirements. This, in combination with the need to record vast amounts of spatial information related to historic land grievances, has led to a growing interest in the development of GIS tools geared specifically to the Maaori**.

**GIS tech helps preserve values of indigenous peoples**

**Harmsworth 98** (Garth, MSc (Hons) Earth Sciences @ Waikato University, iapad.org/publications/ppgis/indigenous\_values\_and\_GIS-a\_method\_and\_a\_framework.pdf, DA 7/8/11, OST)

The present research, which made use of participatory methods involving a number of Maori organizations and **individuals in New Zealand, established a number of culturally acceptable methods for recording, organizing and making available information on Maori values in a textual and computerized form** (Harmsworth 1995, 1997b). All such information was classified accord in g to specific geographic tribal areas (ranging in size from 500 km2 to 5000 km2). **This produced models linking traditional knowledge— often in both oral and textual form—to GIS and multi-media systems. These models made it possible to store information on Maori values** (see table 1) **and biophysical information, for the benefit of environmental management planning, while protecting confidentiality and addressing intellectual property rights. Before making use of GIS technology, all information was recorded and organized within a framework** (see t able 2).

**GIS allows maintenance of traditions and cultural identity**

**Harmsworth 98** (Garth, MSc (Hons) Earth Sciences @ Waikato University, iapad.org/publications/ppgis/indigenous\_values\_and\_GIS-a\_method\_and\_a\_framework.pdf, DA 7/8/11, OST)

**Information too sensitive or confidential to store in a GIS is linked via a database directory to an individual person. This allows additional information to be obtained from an alternative knowledge source**. Some of the available options are shown in table 3. By following the options in table 3, **highly sensitive or confidential information can be displayed in the form of a label on a map; alternatively, it can be simply flagged in the GIS as a sensitive or restricted area** and the enquirer directed to another information source. This latter option relies on the availability of people with accurate traditional knowledge. Sadly, traditional indigenous knowledge is diminishing at an alarming rate as the population ages (Maundu 1995).

AT: T—its

Landsats are government-owned

Chakroborty 7(RC, Visiting Prof @ JIET, Maulana Azad National Institute of Technology, 12/11, <http://www.myreaders.info/02_Satellite_Image_Information_threat__to__National_Security.pdf>, accessed 7-3-11, CH)

Extracts from Sec. 3. Definitions : apply - The term ‘Landsat system’ means Landsats 1, 2, 3, 4, 5, and 6, and any follow-on land remote sensing system operated and owned by the United States Government, along with any related ground equipment, systems, and facilities owned by the United States Government. - The term % Landsat 6 contractor' means the private sector entity which was awarded the contract for spacecraft construction, operations, and data marketing rights for the Landsat 6 spacecraft. - The term 'Landsat 7' means the follow-on satellite to Landsat 6.

\*\*\*DA Answers\*\*\*

AT: Spending

**Landsats overcome spending-crop yields solve the internal link: North Africa proves.**

**NASA 7** (<http://landsat.gsfc.nasa.gov/pdf_archive/soc_0011.pdf>, accessed 7/4/11)CJQ

Like most decisions, political and otherwise, having a thermal band on future Landsat missions is a matter of money. In order to show the intrinsic worth of a thermal band, **water managers have attempted to quantify the monetary benefits of the improved water efficiency made possible with thermal data** from Landsat. The benefit of Landsat-induced water efficiency can best be quantified by examining improved food yields. In the industry, **water mangers talk about** the “crop per drop” number, **how much food can be produced with a given amount of water**. 41 **An example of improved crop per drop can be found in North Africa.** Egypt and Sudan control about 80 cubic kilometers per year of Nile River flow for irrigation. The productive value of that water, meaning the value of the wheat, rice, cotton and other agricultural products produced using this controlled water, is $0.05 to $0.10 per cubic meter. 42 Conservative estimates state that better water allocation could improve that productivity by more than 10 percent per year, which is a value of $400M to $800M per year. 43 (Note: in Nile Delta study areas monitored between 1995 and 2002, crop yield increases were much more dramatic: rice yields up by 53% and cotton yields up by 41%). 44 In the U.S., irrigated crops are worth $70 billion per year, 45 so, **sustaining the productivity of irrigated land is paramount** to the U.S. By another metric, **the value of Landsat’s thermal band to water managers can be estimated by looking at the potential savings that Landsat-based calculations offer as opposed to traditional** calculation **methods**. Traditional methods of calculating water consumption involve monitoring pumping stations, wells and diversion points. This involves many man-hours and can rarely provide all of the necessary information for effective resource management. For the eastern Snake River Plain in Idaho, t**he cost of this type of traditional monitoring costs the state half a million dollars per year**. In comparison, **the same monitoring done with Landsat data is $80,000. When looking at the western states together, Morse has estimated a potential ten-year savings as high as $1B.**

**Benefits from Landsats far outweigh the costs of implementation.**

**Allen 6** (Richard, G., Dept. of Agricultural and Biological Engineering, Dept. of Civil Engineering, U. Idaho, <http://www.idwr.idaho.gov/GeographicInfo/Landsat/PDFs/case_for_thermal_imager_on_Landsat.pdf>, accessed 7/5/11) CJQ

We see a tremendous future for the use of high resolution **Landsat thermal band** information in water resources management in the United States that **would justify the cost of a complete,** fortified, stand-alone **Landsat program**. **Morse** 18 has conservatively **estimated** cost **savings of ground-water pumping** monitoring over a ten year period for the western United States **through the use of Landsat** to estimate water consumption by agriculture as opposed to expensive and problematic pump flow measurements, site visits, and checking of electrical power consumption records. **He has estimated the ten-year value of using Landsat imagery at about 1 billion dollars, which far exceeds the total cost for the Landsat 8 program**. The potential savings for this one application, alone, are enormous. Mapping of consumptive use is critical for surface water management.

AT: Politics – Landsat Popular

Landsat popular

Rosenburg 11 (Matt, former adjunct university faculty member in geography, about.com, 2011, http://geography.about.com/od/geographictechnology/a/landsat.htm, accessed 7-8-11, JMB)

Some of the most popular and valued remote sensing images of the earth are obtained from the Landsat satellites which have been orbiting the earth for over thirty years. Landsat is a joint venture between NASA and the U.S. Geological Survey. On April 15, 1999, NASA launched Landsat 7 from Vandenberg Air Force Base in California, the last Landsat to be deployed since 1984. Prior to the launch of Landsat 7, two Landsats were in operation - Landsat 4 (operating from 1982 to decommission in June 2001) and Landsat 5 (operating since March 1984). Landsat 6 was launched in 1993 but it failed to attain proper orbit. The Landsat satellites make loops around the earth and are constantly collecting images of the surface through the use of a variety of sensing devices. Since the beginning of the Landsat program in 1972, the images and data have been available to all countries around the world. Images are used to measure rain forest loss, assist with mapping, determine urban growth, and population change.

Earth observation popular

Werner 9 (Debra, 12/31, http://www.spacenews.com/civil/091231-nasa-budget-earth-science-lags-behind.html, accessed 7-9-11, JMB)

Over the past decade, NASA has convinced the White House, Congress and the public of the importance of investigating the Earth’s atmosphere, oceans and land from space.

That success has led to increasing pressure to extend NASA’s Earth monitoring program by launching new spacecraft and instruments, but not to the funding needed to carry out the new missions, said Michael Freilich, director of NASA’s Earth Science Division at the agency’s Washington headquarters. “There is relentless pressure to expand the scope of our contributions,” Freilich said Dec. 17, during a meeting here of the American Geophysical Union. “People want us to do more. They for some reason don’t see a way of getting us additional resources.”

LDCM popular – comparatively

Werner 9 (Debra, 12/31, http://www.spacenews.com/civil/091231-nasa-budget-earth-science-lags-behind.html, accessed 7-9-11, JMB)

One of those decadal survey missions, the Landsat Data Continuity Mission, scheduled to launch in December 2012, has been expanded to include a thermal infrared sensor. “We were given $10 million from the generosity of Congress to make that addition which cost about $160 million,” Freilich said. In contrast, budgetary pressures are forcing the space agency to scrap plans to include a low-inclination orbiter as part of the Global Precipitation Measurement mission, a joint U.S.-Japanese Aerospace Exploration Agency effort. “The Global Precipitation mission continues on track with the core observatory which will launch in July of 2013,” Freilich said. “Changes in agency budgeting practices, where they are asking us to budget for what it really is going to cost, forced me to de-scope GPM so that the low inclination orbiter now is no longer fully funded. We are, however, building the instrument, and we have money for its integration on a partner spacecraft. We have money for all the data downlink and data processing associated with it. We are going to be working next year hard to find a partner to fly the mission.”

AT: Politics – Landsat Popular – Oil Lobby

Oil lobby supports landsat

Short 10 (Nicholas M., Publisher, Federation of American Scientists, Apr. 28, http://rst.gsfc.nasa.gov/Sect5/Sect5\_5.html, accessed 7-9-11, JMB)

Landsat results in geological applications excited many in the petroleum and mining industries. Various companies banded together as a consortium, starting in 1976, in what became known as The Geosat Committee. Their avowed aims were along three lines: 1) to share information and conduct studies using space imagery to search for petroleum and minerals (mainly metallic ores); 2) to "lobby" NASA and Congress for a continuation and expansion of the Earth-Observing Satellite program; and 3) to provide inputs in determining and improving sensors in future satellites. One of their principal study sites was the Patrick Draw oil field near the Beaver Creek field in Wyoming. (see summary online at this website: Patrick Draw oil field). Hydrocarbons appear to be leaking as gases at various points above the oil field. This map shows the results of a field study (ground cored typically to depths of 3-4 m) that retrieved samples analyzed for propane:

AT: Politics – Landsat Bipart

Landsat bipart – resolution proves

Prather 7 (Alisha, House Science and Technology Committee News, Dec. 18, http://landsat.gsfc.nasa.gov/news/news-archive/news\_0117.html, accessed 7-8-11, JMB)

Today U.S. Rep. Mark Udall (D-CO), Chairman of the House Committee on Science and Technology’s Subcommittee on Space and Aeronautics, introduced a bipartisan House resolution to celebrate 35 years of space-based observations of the Earth by Landsat spacecraft – an accomplishment that has helped revolutionize our understanding of the Earth’s land surface as well as enable a wide range of applications of Landsat data that have had significant societal benefits.

Landsat bipart

NASA 8 (http://www.scribd.com/doc/48794703/Landsat-Brochure, accessed 7-8-11, JMB)

The Landsat Mission has evolved from an experimental system in the 1970’s to a required capability for the 21st century. It has enjoyed bipartisan support and challenge. Its capabilities have been honed by political and scientific debate. Its history reflects well the leadership of the United States in space, and its future ensures our ability to explore, to characterize, to monitor, and to manage the land surfaces of the Earth

Landsat bipartisan – supported by Bush and Obama

GIS talk 3/15 (Paltiello was public witness at a congressional hearing, 2011, http://www.educationgis.com/2011/03/mapps-not-happy-with-usgs-initiatives.html, accessed 7-9-11, JMB)

"On the bright side," Palatiello said, "we are pleased the budget request includes an increase, or reallocation, of $48 million to support the current and future mission of the National Land Imaging Program, principally through LANDSAT. The moderate resolution data provided by LANDSAT does not compete with the private sector and is an appropriate government investment. It provides for data that is primarily used in research and scientific applications, much of it funded by the government, which complements higher resolution satellite and airborne capabilities available from the private sector. This funding by the Obama Administration continues implementation of the 'Future of Land Imaging' program initiated in the Bush Administration. We support this bipartisan program. MAPPS supports the increase, or reallocation, of $48 million to support the NLIP, principally through LANDSAT. The bipartisan program provides government funding for satellites that will ensures data continuity, which compliments higher resolution satellite and airborne capabilities from the private sector."

AT: Politics – USGS Bipart

Bipartisan support for increasing USGS budget

Simpson 3/17 (Mike, Republican Representative, congressional hearing on 2012 USGS budget, http://findarticles.com/p/news-articles/political-transcript-wire/mi\_8167/is\_20110320/rep-mike-simpson-holds-hearing/ai\_n57124204/?tag=mantle\_skin;content, accessed 7-9-11, JMB)

SIMPSON: Again, thanks for being here today. We appreciate it. I think as our opening statements and our comments suggest, there are areas were even in this climate of trying to reduce budgets Republicans and Democrats agree, and one of them is that the value of the USGS is one of the valuable science agencies in this -- in this government. And we have some real concerns about the direction that is -- that the budget is heading whether it's from OMB or whoever. It causes us all a great deal of concern when we are reducing the resources for water management and water science. And for them to suggest that -- and I guess what they were saying is your budget will be taking these cuts regardless of whether Landsat went over to USGS or not.

AT: Politics – USGS Popular

Key committee members support USGS – earthquake programs

Hearing on USGS budget 3/17 (Marcia McNutt, director of USGS, and Mike Moran, ranking member of the sci and tech subcommittee, http://findarticles.com/p/news-articles/political-transcript-wire/mi\_8167/is\_20110320/rep-mike-simpson-holds-hearing/ai\_n57124204/?tag=mantle\_skin;content, accessed 7-9-11, JMB)

But as a real example of the effects of these cuts to our external grants programs in earthquake hazards, yesterday, the president of Caltech, Jean-Lou Chameau, paid me a visit to talk about areas of common interest. And as he was leaving, he happened to let drop, he said, "I have to thank the USGS because," he said, "the fact that I'm here in this country and the fact that I'm president of Caltech is thanks to the USGS because," he said, "I came here to the USGS on a one year fellowship to do a master's degree at Stanford University. And after that one year, I was in danger of being deported. And I was saved to complete a Ph.D here thanks to a USGS earthquake research grant that allowed me to stay and complete a Ph.D at Stanford." And his earthquake research grant was to do a detailed study of strong ground and ocean shaking in the Marina district of San Francisco, just years before that area was strongly hit by the Loma Prieta earthquake and his analysis of the shaking in that district, the Marina district, actually very well matched the actual damage that was done and allowed planners in that area to prepare infrastructure in advance of that earthquake. So that's the kind of work that's done. That's the kind of person that's supported and that's the kind of leader we have in this country now, thanks to USGS. MORAN: It's a great story. I do think that I will mention to the Ranking Member of the full committee that in looking down the cities that are at highest risk for active volcanoes, Seattle and Tacoma Washington are at the top of the list. Mr. Dicks may have some interest in that fact.

Multiple organizations oppose USGS cuts

Soil and Water Conservation Society 2 (Apr. 1, http://www.swcs.org/index.cfm?nodeID=6788&action=display&newsID=428, accessed 7-9-11, JMB)

The Soil and Water Conservation Society has joined with a number of organizations interested in water resources to oppose the proposed cuts to USGS water monitoring programs. The Soil and Water Conservation Society has joined with a number of organizations interested in water resources to oppose the proposed cuts to USGS water monitoring programs. American Rivers \* American Society of Civil Engineers \* American Water Works Association Association of Metropolitan Sewerage Agencies \* Association of Metropolitan Water Agencies The Groundwater Foundation \* Groundwater Resources Association of California National Ground Water Association \* National Society of Professional Engineers \* Sierra Club Soil and Water Conservation Society \* Water Environment Federation\* WaterWatch of Oregon

Minerals associations oppose USGS funding cuts

O’Driscoll 4/8 (Mike, 2011, http://www.indmin.com/Article/2804358/Mineral-assocations-join-to-oppose-budget-cuts-to-USGS.html, accessed 7-9-11, JMB)

Minerals associations in North America have joined forces to opposed planned funding cuts to the US Geological Survey (USGS) by the US government. The Industrial Minerals Association-North America (IMA-NA) and the Society of Mining, Metallurgy, and Exploration (SME) joined 13 other US trade associations in a letter advising Congress of the negative impact a proposed budget on US industry. The letter opposes the Obama administration's substantial funding cut, S2.7m., or 17%, to the financial year (FY) 2012 US Geological Survey's Mineral Resources Program.

Congress supports USGS – restored its funding

Schiffries 4/15 (Dr. Craig M., Director for Geoscience Policy at the Geological Society of America, congressional testimony, http://www.geosociety.org/geopolicy/news/0411-HouseTestimonyOnUSGS.pdf, accessed 7-9-11, JMB)

The USGS budget has been nearly stagnant in real dollars since 1996. The USGS budget for FY 2010 was below the USGS budget for FY 2001 in real dollars. The decline in funding for the USGS during this time period would have been greater if Congress had not repeatedly restored proposed budget cuts. Federal funding for non-defense R&D has increased significantly while funding for the USGS stagnated for more than a decade. During this time, natural hazards, mineral and energy resources, and water availability and quality have become increasing important to the nation.

AT: Politics – Earth Science Popular – AT Spending Link

Plan perceived as useful spending – it’s R and D which supports businesses

Schiffries 4/15 (Dr. Craig M., Director for Geoscience Policy at the Geological Society of America, congressional testimony, http://www.geosociety.org/geopolicy/news/0411-HouseTestimonyOnUSGS.pdf, accessed 7-9-11, JMB)

Likewise, the National Commission on Fiscal Responsibility and Reform, headed by Erskine Bowles and Alan Simpson, said: Cut and invest to promote economic growth and keep America competitive. We should cut red tape and unproductive government spending that hinders job creation and growth. At the same time, we must invest in education, infrastructure, and high-value research and development to help our economy grow, keep us globally competitive, and make it easier for businesses to create jobs. Earth science is a critical component of the overall science and technology enterprise. Growing support for Earth science in general and the U.S. Geological Survey in particular are required to stimulate innovations that fuel the economy, provide security, and enhance the quality of life. Earth Science provides knowledge and data essential for developing policies, legislation, and regulations regarding land, mineral, energy, and water resources at all levels of government

\*\*\*CP Answers\*\*\*

Landsats Key – AT: Other Sats Solve

Landsat irreplaceable with other programs

Wulder et al 11 (Michael A. Wulder a,⁎, Joanne C. White a, Jeffrey G. Masek b, John Dwyer c, David P. Roy d a Canadian Forest Service, Pacific Forestry Centre, Natural Resources Canada b Biospheric Sciences Branch, NASA Goddard Space Flight Center, c United States Geological Survey, Center for Earth Resources Observation and Science d Geographic Information Science Center of Excellence, South Dakota State University, Remote Sensing of Environment 115 p. 747–751, http://globalmonitoring.sdstate.edu/faculty/roy/Wulder\_2011\_RSE\_Landsat-update\_115.pdf, accessed 7-3-11, JMB)

Currently there are no other missions analogous to Landsat that have global observation capabilities or accumulated global archives. In cases where there are data that have been or could be acquired to augment Landsat holdings, data sharing agreements and political considerations can hinder such activities. Sensors from non-Landsat missions may meet some baseline requirements to emulate Landsat image characteristics, but it is unlikely that sufficient similarity exists to enable direct integration or interoperability, especially from operations perspectives where known relationships and algorithms will no longer function.

Landsats Key – AT: Planes solve

**LandSat data is cheaper than aerial surveillance**

**Bjorgo 1** (Einar, United Nations High Commissioner for Refugees, 74.125.155.132/scholar?q=cache:HF5pLHdthbEJ:scholar.google.com/+hurricanes+landsats+refugees+einar&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

It is a general assumption among UN humanitarian organizations that satellite imagery is expensive data. This is to a certain extent correct, but it depends on the type of imagery, and to what one compares the cost. The cost of data ranges from zero (DMSP data used by WHO for night time light mapping) to above $3500 (single 1 m resolution Ikonos scene). Consequentially, humanitarian organizations, with highly limited budgets for purchasing earth observation data, tend to go for the less expensive solutions, although more expensive imagery has been used occasionally. Cost is therefore one of the factors limiting extensive use of several types of imagery. Fortunately, **the price-policy of Landsat 7 data is very promising, and the US$600/scene is affordable for most organizations**. Hopefully, the quality of Landsat 7 combined with the less expensive data will make other data providers, such as SPOT, which operates similar satellites, to also reduce their prices. This could greatly benefit the humanitarian assistance community, as more organizations would be able to afford satellite imagery. Nevertheless, cost of satellite data and corresponding processing and analyses (which can constitute the main part of the overall cost for imagery-derived products) must always be compared to the cost of obtaining similar information, if at all possible, through other means. These can e.g. be field surveys or aerial photographs. **If a survey covers a large area, it is time consuming, and thus expensive, to collect the data. In these cases satellite imagery can be cost-efficient**. **Also, when in need of remote sensing imagery** (aerial photos or satellite imagery), **the cost of renting a plane with pilot, fuel, equipment etc. quickly exceeds that of satellite imagery**. UNHCR has directly compared in-stock aerial photos with new satellite imagery from the Ikonos satellite. The resolution of the images is comparable (1 m), but the quality of the Ikonos imagery is better. Also, the satellite imagery is delivered in a geo-coded format, which is often not the case with aerial images. Such geo-coding and corresponding “mosaicing” adds to the cost of image post-processing for aerial images.

**Satellites solve best**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

**GEO has been a leader in supporting early warnings of natural and manmade hazards, not only through satellite remote sensing and other space technology**, but through earth observation technology in general, using such instrument as ocean buoys, meteorological balloons and stations, seismic and **GPS** (Global Positioning System) **stations**, computerised forecasting models, sea and aircraft, and meteorological **and remote sensing satellites** (Figure 5.1). Furthermore, **important advances to its programmes have come from individual governmental and nongovernmental agency contributions, particularly to its GEOSS programme**.

AT: Private CP – Data Sharing

**Gov key to LandSat data sharing**

**NASA 10** (http://landsat.gsfc.nasa.gov/news/news-archive/news\_0316.html, November 30, DA 7/4/11, OST)

**A joint report from the World Bank and United Nations** titled Natural Hazards, UnNatural Disasters: The Economics of Effective Prevention examines the economic and human cost of natural disasters**. The report**, released earlier this month, **concludes that there are many methods of prevention that governments can pursue that will not be prohibitively expensive. One such method is the sharing of weather and other Earth observation data. The report says, “even modest increases in spending [on forecasting data]— and greater sharing of data internationally—can have enormous benefits, especially to warn people of impending hazards.”**

**Landsats key to google earth**

**NASA 10** (landsat.gsfc.nasa.gov/news/news-archive/news\_0320.html, 12/8, DA 7/4/11, OST)

**Much of the publicly available satellite imagery that the Google Earth Engine provides for analysis has been collected by the Landsat program**. This series of satellites, the world's longest continuing earth observation program (since 1972), is operated by the U.S. Geological Survey from our Earth Resources Observation and Science (EROS) Center in Sioux Falls, S.D. “**Landsat satellites give us both a broad view of the landscape—with a perspective of over 12,000 square miles per scene**—and a much more focused view. They can accurately describe the condition of a land area as small as the infield in a baseball diamond. In one instant look from over 400 miles in space, a single **Landsat scene can record, at this level of accuracy, hundreds of thousands of acres of grassland, agricultural crops, or forests**.

AT: Private CP – General

Privatization of landsat fails – empirics, no market, risk

Szajinfarber et al 9 (Zoe Szajnfarber,i Thomas G. Beatty,ii Matthew W. Petersen,iii Anna Vasilyeva,iv D. Brent Whitev and Annalisa L. Weigelvi Massachusetts Institute of Technology, i Doctoral Research Assistant, Engineering Systems Division, 17-110; Cambridge MA, 02139, AIAA Student Member ii Graduate Research Assistant, Department of Physics, iii Undergraduate Research Assistant, Department of Aeronautics & Astronautics, iv Graduate Research Assistant, Department of Aeronautics & Astronautics, v Doctoral Research Assistant, Department of Aeronautics & Astronautics, vi Assistant Professor of Aeronautics and Astronautics and Engineering Systems, 11/3, http://seari.mit.edu/documents/preprints/SZAJNFARBER\_SP\_AIAA09.pdf, accessed 7-5-11, JMB)

Privatization, however, proved to be a failure. The government lowered its funding for commercialization and did not guarantee data purchasing. Various observations were missed because “there was no obvious and immediate buyer”18 while the price of Landsat imagery sharply increased. EOSAT’s responsibility was then renegotiated to developing only Landsat 6. Recognizing its failure, Congress passed the Land Remote Sensing Policy Act of 1992, repealing the 1984 act on commercialization and retaking funding responsibility from the private sector. It designated the DOC to complete and launch Landsat 6, and NASA and DoD to develop and launch Landsat 7. It was acknowledged that one of the greatest challenges of the future of environmental monitoring in the U.S. is the development of a coherent policy structure that balances both government and private data collection needs with US economic and security needs. Partly in response to this need, President Bush set forth a U.S. Commercial Remote Sensing Policy in 2003 to “advance and protect U.S. national security and foreign policy interests by maintaining the nation’s leadership in remote sensing space activities, and by sustaining and enhancing U.S. remote sensing industry.”19 Through this policy, government use of commercially produced remote sensing data is encouraged while the U.S. government’s focus will be on providing remote sensing systems that “cannot be effectively, affordably, and reliably satisfied by commercial providers”.vi This policy can be seen in action with the release of OSTP's 2007 “A Plan for a U.S. National Land Imaging Program”, for which USGS has received a budget line. It is but one step towards developing a plan of action for the US regarding the future of remote sensing.xvi In addition to introducing many of the key stakeholders in the remote sensing system – NASA, NOAA, DoD, USGS, USDA – this brief history highlights some of the key trade-offs that will be explored in more depth throughout the remainder of this report. Firstly, the primary users of space-based data do not have the expertise to collect it, or even operate the satellites. For example, where USGS was historically wholly responsible for all aspects of geological surveys, now with the advent of satellite imagery, USGS must rely on other government agencies (i.e., NASA, NOAA, DoD and at times commercial entities) to build and operate the satellites and provide them with the required data. This creates a coordination challenge, both in terms of the allocation of public resources and the hand-off of responsibility from one government agency to another. Secondly, while it is relatively well recognized that the government has no place managing a commercializable commodity, the failure to commercialize Landsat is illustrative of the difficulty in determining when a technology is sufficiently mature to be designated “operational/commercializable.” While the failure can be partially attributed to an overestimation of the addressable market, an important reason for the lack of interest among commercial contractors stems from the enormous program risk associated with advanced satellite development.

Commercialization fails

Conway 8 (Erik, historian, NASA, 3/3, <http://history.nasa.gov/sp4801-part2.pdf>, accessed 7-3-11, CH)

Finally, the last applications satellite type I’ll discuss in this extended editorial essay is land use. As Pam Mack has shown in her book on Landsat, there were many possible and interested users of satellite-based land imaging during its developmental period, and their competing goals and interests made development of the system very difficult. 30 And partly because of this, and also partly due to pentagon restrictions on allowable spatial resolution (because of ill-conceived congressional efforts to force “privatization” of Landsat), Landsat has never achieved a large enough user base to pay for itself. instead, its imagery has been used by researchers, not by the economic interests that might be able to afford it on a commercial basis. 31 Indeed, the primary buyer of the data has been the intelligence community, which apparently finds that Landsat data serves as an effective supplement to its own classified imagery sources. The satellite series itself has lurched from one crisis to the next, with each administration since Reagan willing to commit to only one more mission prior to commercialization; with commercialization never succeeding, each new administration has had to cope with the question of how to continue the series. The fundamental policy issues of what agency should maintain the capability and who should pay for it have not been resolved. So Landsat has been a technical success, but programmatically its history has been tortured. At the very least, there’s a good policy study here for someone interested in the subject.

AT: Private CP – General

Privatization fails

Sepp 00 (Eric, Lt Colonel USAF, May, Air War College, <http://www.au.af.mil/au/awc/awcgate/cst/csat14.pdf>, accessed 7-4-11, CH)

Congress also sought to facilitate commercialization of land remote sensing satellites by privatizing the government’s Landsat program through the 1984 Land Remote Sensing Commercialization Act ( P.L. 98-365). Such satellites provide imagery of the Earth that can be used for land-use planning, environmental studies, mineral exploration, and many other purposes. After a tumultuous eight years that saw the effort to privatize Landsat fail, Congress repealed that act and replaced it with the Land Remote Sensing Policy Act of 1992 (P.L. 102-555), bringing Landsat back under government sponsorship. Landsat 5 and 7, built and operated by the government, are now in orbit. The act also promoted development of new systems by the private sector. Coupled with a 1994 Clinton Administration policy, these actions led several U.S. companies to initiate programs to build remote sensing satellites and offer imagery on a commercial basis. Those companies must obtain an operating license from NOAA for such systems. Three U.S. companies (see below) currently have commercial remote sensing satellites in orbit. The market for their products is limited, however, and they reportedly are struggling financially. Partially in response to that concern, President Bush signed a new commercial remote sensing policy on April 25, 2003 that is intended to sustain and enhance the U.S. remote sensing industry.

Privatization unsustainable—corporate interests prevent comprehensive research

Mack 2 (Pam, NASA, Prof. History of Technology@ Clemson College, 1/22, <http://history.nasa.gov/SP-4219/Chapter10.html>, accessed 7-6-11, CH)

The attempt at privatization failed in 1992. Because the corporate owner had never had significant new resources to invest in the system, little had been accomplished during the privatization period. The Land Remote Sensing Policy Act of 1992 ended "the 'experiment' which had so negatively affected the research use of remote sensing data acquired from the Landsat satellites."54 The new law repealed the commercialization act of 1984 and transferred responsibility for Landsat from the Department of Commerce to NASA and the Department of Defense, which had found the broad coverage of Landsat data useful during Desert Storm.55 After disagreements over funding the Department of Defense withdrew in 1994, and NASA resumed sole responsibility for Landsat, with plans to launch one more satellite.56 Failure of Landsat 6 in October 1993, frequent changes in NASA's overall remote sensing plans, and increasing competition from other countries and possibly from private industry, left the future of the program uncertain .57 While Landsat commercialization had failed, interest in commercial remote sensing continued to grow.58 Private industry could almost certainly sustain an Earth resources satellite that provided data similar to Landsat (though probably lacking some of the features scientists want) if the government would guarantee a significant purchase of data each year, or if the owner could offer commercial users exclusive use of certain data for a higher price. However, such a satellite would most likely not provide data of as much scientific value as that provided by Landsat. A private company would probably only collect data as ordered, rather than providing comprehensive coverage to build up a historical archive of data for later comparison, and would probably not invest as much in the precision of the sensors, since such precision is needed for only a few uses, mostly scientific. The proper roles of the government and private industry became less and less clear as technology advanced. Landsat became less dauntingly "big technology," new innovations in the 1990s made it possible to design a much smaller and less expensive satellite with similar capabilities. Such a satellite was no longer too expensive for private companies to undertake without Federal subsidy. Landsat was a relatively small project by NASA standards, but because of its practical goals it shows particularly clearly the problems of building a constituency for big science and technology projects and the complexities involved in determining the proper role of the government in the spectrum between research and practical applications. While the NACA had successfully served industry needs by providing background research rather than building whole new systems, NASA leaders found big projects with practical benefits much more problematic than projects oriented towards scientific research or exploration. NASA could justify a certain amount of basic science as worth doing for its own sake, but once a project was justified on the basis of its practical benefits then why was the government doing it rather than leaving it to private industry who presumably could make a profit by selling such beneficial data? At least for NASA, the public good has become increasingly difficult to define and use as a justification. One long-time participant in the program wrote in frustration: "One of the great conundrums of the Federal programs of the space age is that the more likely something is to be useful the more difficult it will be to sustain it."

AT: Private CP – Fails – Empirics

Private companies empirically fail at doing landsats

NASA no date (Date is after Jan 30, 2006, site run by James R. Irones and Laura Rocchio, http://landsat.gsfc.nasa.gov/about/landsat5.html, accessed 7-3-11, JMB)

The year Landsat 5 was launched Congress decided that land satellites could be privatized (1984 Land Remote Sensing Commercialization Act). NOAA, the agency in charge of all Landsat operations, was instructed to find a commercial vendor for Landsat data. NOAA selected Earth Observation Satellite Company (EOSAT). The contract gave EOSAT the responsibility for archiving, collecting and distributing current Landsat data as well as the responsibility for building, launching and operating the following two Landsat satellites (with government subsidies). Commercialization proved troublesome, EOSAT had limited commercial freedom due to provisions of the 1984 law. Given these constraints, NOAA and then EOSAT raised image prices from $650 to $3700 to $4400 and restricted redistribution. While the U.S. monopoly of Landsat-like data made this 600% increase feasible, the practice priced out many data users. (As a result, many data users migrated to the free low-resolution land data being captured by meteorological satellites.) In 1986, a French Landsat-like satellite launch broke the U.S. monopoly. During the EOSAT commercialization era, Landsat coverage standards languished. Many observations from 1984 to 1999 were missed because there was no obvious and immediate buyer. With commercial data marketing, it makes sense to only collect data for which there is an established customer, whereas a true scientific mission collects as much global data as possible for future scientific study. During commercialization, Landsat 4 and 5 system calibration and characterization lapsed. By 1989, the program was in such shambles that NOAA directed EOSAT to turn off the satellites (no government agency was willing to commit augmentation funding for continued satellite operations and data users were unwilling to make the hefty investments in computer processing hardware if future data collection was uncertain). The program was only saved by a strong protest from Congress and foreign and domestic data users, and an intervention by the Vice President. Given this outcry and the unexpected outcome of privatization, the Bush Administration facilitated the Land Remote Sensing Policy Act of 1992, which instructed Landsat Program Management to build a government-owned Landsat 7. Two years after the launch of Landsat 7, Space Imaging (formerly EOSAT) returned operational responsibility for Landsat 4 and Landsat 5 back to the U.S. Government

Privatization of landsat fails – doesn’t get the data to users and empirically increases costs

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

Whereas this option conforms to U.S. national security and U.S. commercial satellite interests, the option does not ensure that future U.S. long-term continuity needs will be met nor that they can be met inexpensively. Deferment of U.S. obligations does not ensure that future costs for data will not be excessive and extraordinary means may be required to ensure long-term continuity of U.S. systems and data. While this option does not preclude that U.S. user needs can be met, it does not provide the U.S. Government with full access to the range of means necessary to do so. Also, this option may make it more difficult for the U.S. Government to address its foreign policy interests in future years, in particular the requirements associated with GEOSS. U.S. Government attempts to form public-private partnerships with U.S. industry are the norm, not the exception, in moderate-resolution land imaging. From 1985 through 2001, and again in 2003, the U.S. Government attempted to “commercialize” Landsat through structured agreements that relied on U.S. industry to fund future satellite acquisition costs. In 1985, EOSAT was formed as a joint venture of Hughes Aircraft Company and RCA Corporation under contract to NOAA, to build and operate Landsat 6 and exclusively market and distribute imagery and data from Landsat 4, 5, and 6. EOSAT also retained all rights to sales of data to international ground stations worldwide. At the time, the U.S. Government agreed to continue to bear all operating costs of the satellites, and also assumed responsibility to fund development of Landsat 6 by EOSAT. Future commercial Landsat satellites were to be built at EOSAT’s expense. This plan led to steep increases in the cost of Landsat imagery for all users, with dramatic impact to government, science, and academic users of the data. In a recent survey of Landsat data users, the high cost of this data and the inability of product developers to rely on future government commitments to Landsat were the main reasons given for the failure of commercial development of the satellite system. In 1992, the U.S. rescinded this plan and initiated conventional government procurement of Landsat 7. The U.S. also adopted P.L.102-555, The Land Remote Sensing Policy Act of 1992, which imposed new controls over the distribution and future sale of U.S. land imaging data. After yet another failed attempt in 2003 to commercialize Landsat, as was required by law, the U.S. Government chose to end these efforts and move towards a more conventional development and acquisition approach to ensure future continuity of U.S. land imaging data. As a result, the LDCM is currently under development by NASA and will be owned and operated by the U.S. Department of the Interior (DOI) after its launch. The DOI intends to honor all existing provisions of law pertaining to the acquisition and sale of U.S. land imaging data and products, including assurance of easy access and low cost of this data.

AT: International CP – Fails – Tech

International agents fail – no tech

Behrens 10 (Carl E., Specialist in Energy Policy for the Congressional Research Service, Sept 17, http://www.fas.org/sgp/crs/misc/R40594.pdf, accessed 7-3-11, JMB)

Some Landsat product users have suggested that moderate resolution optical imaging satellites of other nations may supply data to fill the anticipated Landsat gap. A review of this option in the FLI-IWG report indicates that the global coverage of the Landsat orbiters and their ground-based receivers could not be duplicated by foreign moderate resolution satellites, but they could provide a partial, short-term fix to limit losses of some Landsat data and imagery.10 A Landsat Data Gap Study team formed by USGS and NASA in 2005 found that no international satellite program, current or planned, has the onboard recording capacity, the direct receiving station network, and the data production systems to routinely perform the full Landsat mission.11 The Data Gap Study team did conclude, however, that capturing and archiving data from comparable systems could reduce the impact of a data gap. It identified sensors aboard India’s ResourceSat satellite and the China Brazil Earth Resources Satellite (CBERS) as the most promising sources of Landsat-like data. USGS is pursuing the options with a Landsat Data Gap Implementation Plan, to identify costs and accessibility and the technical process of integrating data from other sources into the existing framework.12

AT: International CP – Credibility

International agents reduce the credibility of data

US Chamber of Commerce No Date (Space Enterprise Council, After August 13, 2004, White Paper, “Landsat: The Next Generation” Exhibit 6 of “A PLAN FOR A U.S. NATIONAL LAND IMAGING PROGRAM” http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

As the politics, economics and ultimately consequences of global environmental changes become more critical in international relations, the U.S. Government would be ill advised to become dependent on a foreign entity to 68 ensure the calibration, accuracy and integrity of the world’s most reputable source for global earth monitoring data. While the level of contribution to global environmental changes caused by what is referred to as the human dimensions may be in dispute, the fact our earth is changing is not. Landsat is the only undisputedly credible system the world has depended on for data that now has a 30-year archive. Changing to a foreign system increases the risk that anomalies in the data really attributable to artifacts of the different instruments are misinterpreted.

AT: International CP – US Key – Earth Observation

US key to leading earth observation initiatives

EPA 11(1/25, <http://www.epa.gov/geoss/fact_sheets/earthobservation.html>, accessed 7-9-11, CH)

Over the next decade, a global Earth Observation System will revolutionize our understanding of the Earth and how it works. With benefits as broad as the planet itself, U.S.-led initiative promises to make peoples and economies around the globe healthier, safer and better equipped to manage basic daily needs. The aim is to make 21st century technology as interrelated as the planet it observes, predicts and protects, providing the science on which sound policy and decision-making must be built. Building an integrated, comprehensive and sustained global Earth Observation System opens a world of possibilities. Imagine a world in which we could: Forecast next winter's weather months in advance Predict where and when malaria, West Nile virus, SARS and other diseases are likely to strike Reduce U.S. energy costs by about $1 billion yearly More effectively monitor forest fires and predict the effect of air quality on sensitive populations in near real-time Provide farmers with immediate forecasts essential to maximizing crops yields Predict the pattern of the North American monsoon -- Arizona derives two-thirds of its water from the monsoon weather pattern Global architecture that reflects how our world actually works is key to making such visions operational.

US lead GEOSS, support for observation satellites key to maintaining leadership

Williamson 5 (Prof @GWU Space Policy Institute, Space Ref, 4/28, <http://www.spaceref.com/news/viewsr.html?pid=16385>, accessed 7-9-11, CH)

Having established its leadership in GEOSS, the United States must now follow through on its implementation. This will require sufficient funding for the U.S. effort, the Integrated Earth Observation System (IEOS) both in continuing NASA's Earth science program at a robust level, and in supporting the involvement of other agencies in the endeavor. As noted in a recent report by the American Meteorological Society, "there will have to be a long-term robust research program designed to add value to the operation of IEOS." [4] Such support should also include research on the expected benefits from such expenditures and sustained efforts to include the inputs of information users�the final stakeholders in the IEOS process. After all, there is only so much public money to go around, especially in an era of increasing budget deficits, and understanding the areas likely to return the greatest benefits will help NASA managers and Congress make better funding decisions among the many worthy research projects and proposals.

AT: International CP – US Key – Water Wars

US key to promoting Middle Eastern stability—promoting water and refugee aid now

The White House 99 (<http://www.au.af.mil/au/awc/awcgate/nss/nssr-1299.pdf>, accessed 7-9-11, CH)

On the Palestinian front, Israelis and Palestinians are turning to the core issues that have defined their conflict for the past fifty years, seeking to build a lasting peace based on partnership and cooperation. They have agreed to seek to reach a permanent status agreement by September 2000 and the United States will do everything within its power to help them achieve that goal. At the same time, both sides will continue to implement the remaining issues in the Interim Agreement, the Wye River Memorandum, and the Sharm el-Sheikh agreement. Our goal remains the normalization of relations between Israel and all Arab states. Through the multilateral working groups on security, refugees, water and the environment, we are seeking to promote regional cooperation to address transboundary environmental issues that affect all parties.

AT: International CP – US Key – Refugees

US key to leading refugee aid

Commission on Immigration Reform 97 (June, <http://www.au.af.mil/au/awc/awcgate/congress/refugee-report.pdf>, accessed 7-9-11, CH)

Since its very beginnings, America has been a refuge for the persecuted— a “city on the hill” beckoning the victims of political, religious, ethnic, and other forms of repression. That tradition continues to this day. Through both our admissions policies and, equally importantly, through our support for international protection and assistance, the United States leads the world in responding to refugee and related humanitarian crises. On its overseas site visits, the Commission witnessed the desperate plight of those forced to flee their homes. Existence in refugee camps is often tenuous. The Somali women of Dadaab, Kenya refugee camp, for example, face frequent rapes and assaults; many Sudanese adolescent males are dying from malnutrition-caused anemia; youngsters are forcibly recruited for military service; children born and raised in refugee camps have little hope for the future.

US must lead refugee efforts—motivates international efforts

Commission on Immigration Reform 97 (June, <http://www.au.af.mil/au/awc/awcgate/congress/refugee-report.pdf>, accessed 7-9-11, CH)

Despite the small percentage of the world's refugees who can be resettled in the United States, U.S. resettlement policies nevertheless can greatly influence the international response to refugees. U.S. pledges of resettlement and support for the protection mandate of UNHCR encourage other nations to provide first asylum to new arrivals and serve as an example to other resettlement nations

No international refugee response without US initiatives—means the US must lead the effort

Commission on Immigration Reform 97 (June, <http://www.au.af.mil/au/awc/awcgate/congress/refugee-report.pdf>, accessed 7-9-11, CH)

With the vast majority of the world’s refugees and displaced persons remaining overseas, the U.S. must focus first and foremost on international refugee policy and programs. Our leadership can take many forms, including policy direction and guidance in international fora, financial contributions to assistance and protection programs, and last but not least, the example set through our own domestic refugee resettlement and asylum policies. The Commission urges the federal government to continue demonstrating leadership in generating international responses to refugee and related humanitarian crises. The vast majority of the world’s refugees and displaced persons are outside of the United States. The Commission is charged with taking a broad view of U.S. refugee policy to include not only domestic but also international policies and programs. The leadership the U.S. provides in responding to international crises is a key component of our refugee policy. The number of refugees and displaced persons requiring international assistance and protection continues to grow. Thus, the need for a continued, effective U.S. response remains. U.S. refugee policy should: Anticipate and take action, when possible, to prevent refugee and related humanitarian emergencies from occurring

AT: Japan CP – No Solvency – Tech

Japanese satellites fail, major EOS DAICHI is dead

UPI 11 (5/12, <http://www.upi.com/Science_News/2011/05/12/Japanese-satellite-declared-dead-in-orbit/UPI-89411305248446/>, accessed 7-9-11, CH)

TOKYO, May 12 (UPI) -- Japan's space agency says its Earth-observing satellite Daichi is dead in orbit, three weeks after a mysterious anomaly crippled the spacecraft. The Advanced Land Observing Satellite unexpectedly powered itself down April 22 for reasons that remain unclear. The Japanese Aerospace Exploration Agency spent weeks attempting to re-establish communication with Daichi, but finally gave up the effort, SPACE.com reported Thursday. "We decided to complete its operations by sending a command from the ground to halt its on-board transmitter and batteries at 10:50 a.m. on May 12 (Japan Standard Time), as we found it was impossible to recover communication with the satellite," JAXA officials said in a statement. The Daichi satellite was launched in January 2006 as an all-purpose Earth surveyor, mapping the planet, searching for resources and quantifying changes in land cover such as deforestation. Daichi captured about 6.5 million images of Earth from an altitude of about 435 miles during its five-year lifespan, including images of Japan's ravaged eastern coast after the earthquake and tsunami of March 11, 2011, JAXA officials said.

Japanese EOS fails—current satellite power faces same powering shortfalls as previous one

Clark 11 (Stephen, 4/22, <http://spaceflightnow.com/news/n1104/22alos/>, accessed 7-9-11, CH)

The spacecraft switched to a low-power mode around 7:30 a.m. Japan time Friday (2230 GMT Thursday), where the satellite's three observation instruments shut down to conserve electricity. Telemetry indicated ALOS lost all power later Friday, according to JAXA. "Since then, the power generation has been rapidly deteriorating, and we currently cannot confirm power generation," a JAXA press release said. Nicknamed Daichi, the Japanese word for land, ALOS launched aboard an H-2A rocket Jan. 24, 2006. The satellite unfurled a 72-foot-long solar panel, the largest single deployable array on any Japanese spacecraft. It was designed to produce at least 4 kilowatts of power at the end of the satellite's life. The ALOS mission was supposed to last at least three years, and the craft narrowly achieved JAXA's stated goal of five years of operations. "JAXA is investigating the cause of this phenomenon while taking necessary measures," the statement said. Two other electrical system failures have ended major Japanese satellite observation missions in the last 15 years. The ALOS anomaly signature is similar to the failure of the Advanced Earth Observing Satellite 2, or ADEOS 2, which lost electricity in October 2003 and was never heard from again. ADEOS 2 replaced another satellite that succumbed to structural damage on its solar panel less than a year after it launched. JAXA did not announce what part of the power generation system could be at fault on ALOS, or if the declining electricity levels were a symptom of another issue.

AT: Japan CP – No Solvency – JAXA

Chaos in Japanese space program

Berner 5 (Steven, National Security Researcher, RAND, 7/8, <http://www.rand.org/pubs/technical_reports/2005/RAND_TR184.pdf>, accessed 7-9-11, CH)

Ten years later, in 2004, the Japanese space program has been described by some as undergoing a crisis of confidence. NASDA has had a succession of satellite and launcher failures. ISAS’s Mars probe, Nozomi, failed to reach orbit around Mars. Japanese companies have yet to compete successfully as prime contractors in the international satellite communications market. The space program has been reorganized, and a new Japanese space policy is expected soon. At the same time Japan has launched its first military/intelligence reconnaissance satellites.

AT: Japan CP – No Solvency – Funding

No funding for Japanese civilian space programs

Berner 5 (Steven, National Security Researcher, RAND, 7/8, <http://www.rand.org/pubs/technical_reports/2005/RAND_TR184.pdf>, accessed 7-9-11, CH)

The Japanese space industry largely lacks these benefits. Until 1998 there was no direct defense contribution to Japan’s space program. The space sector had to get along on the basis of a civil space budget of around $2 billion or less. That has changed with the start of Japan’s satellite reconnaissance program. However spending to date on the program has averaged only about $570 million per year for the period from 2000 to 2003. Should Japan increase their defense space funding to 4% of the defense budget, as the U.S. currently does, funding of the Japanese military space program would be at about $1.8 billion. This would roughly triple the current funding level, and put funding of the military space program at the same level as the current civil program. Japanese space firms still would not begin to approach the levels of government funding their U.S. counterparts receive, but would approach a level similar to the French space industry. Japan also is seeking to play a larger role in the area of theater missile defense, and some of the technologies for missile defense also can be of benefit to their space program. As we discuss below, a significant increase in its military space program is one of the options that may emerge from Japan’s space policy review.

Economic fallbacks in Japan force cuts

Normile 10 (Dennis, Japan correspondent, Science Mag, 8/31, <http://news.sciencemag.org/scienceinsider/2010/08/japans-government-aims-high.html>, accessed 7-9-11, CH)

Even standing still will be an accomplishment given Japan's financial situation. To rein in a growing national debt, the government instructed ministries to cut budgets 10% across the board. But it opened a back door in the form of a $12 billion fund for projects that will be competitively reviewed at the Cabinet level. The 4% requested increase for R&D hinges on the education ministry getting its fair share of that pot of money. Given the uncertainties, "We'll have to see what we have in December," when the budget is finalized, says Kazuaki Kawabata, the ministry's director of research and development policy (no relation to the minister).

AT: Japan CP – Perm

Perm solves best—Japanese data only works as a supplement to other satellites

Space Activities Commission 5 (Special Subcommittee for Earth Observation, July, <http://www.mext.go.jp/b_menu/shingi/uchuu/reports/05120701/002.pdf>, accessed 7-9-11, CH)

Japan’s technologies for sensors, analyses of satellite data, and related areas have advanced to a level comparable with any other country due accumulated development experience. However, long-term and continuous responses to user needs are still insufficient in Japan due to the satellite development focused on novel technologies, and the limited launching opportunities. Therefore, satellite data in Japan is restricted to supplementary utilization for research or to complementing other observation data, except in limited fields such as weather forecasting. Satellite data are thus not vigorously utilized by a wide range of users.

Japan not independent, Japanese satellites launched with US support

Talmadge 9 (Eric, Japan correspondent, Huffington Post, 1/23, <http://www.huffingtonpost.com/2009/01/23/japan-launches-satellite-_n_160413.html>, accessed 7-9-11, CH)

TOKYO — Japan on Friday launched the first satellite to monitor greenhouse gases worldwide, a tool to help scientists better judge where global warming emissions are coming from, and how much is being absorbed by the oceans and forests. The orbiter, together with a similar U.S. satellite to be launched next month, will represent an enormous leap in available data on carbon dioxide and methane in the atmosphere, now drawn from scattered ground stations.

AT: ESA CP – Perm

Mars proves, ESA won’t embark on large space missions without US support

De Selding 6/30 (Peter B., staff@MSNBC, Space News, <http://www.spacenews.com/civil/110630-esa-defer-work-mars-orbiter.html>, accessed 7-9-11, CH)

PARIS — The European Space Agency (ESA) on June 30 withdrew its proposal to begin full-scale work on a 2016 Mars orbiter mission with NASA following receipt of a letter from NASA’s administrator saying the U.S. agency could not commit to a companion 2018 Mars rover mission, a senior ESA official said June 30. The decision by ESA Director-General Jean-Jacques Dordain to remove the ExoMars contract decision from the agenda of ESA’s Industrial Policy Committee, which met June 29-30, illustrates the continued instability of the joint ESA-NASA Mars exploration program that in principle was decided two years ago. Briefing reporters here, Eric Morel de Westgaver, ESA’s director for procurement, financial operations and legal affairs, said ESA coupled its decision not to approve the full contract for the 2016 telecommunications relay orbiter with an agreement to fund just enough work on it so as to be able to throttle up to full contract work soon enough to make the 2016 launch date. ESA will begin immediate negotiations with Thales Alenia Space of France and Italy, the prime contractor for the ExoMars orbiter, to determine the minimum payments needed right away to keep the orbiter on track for the 2016 launch date, Morel de Westgaver said. “No irreversible paths” were taken at the meeting of the Industrial Policy Committee (IPC), he said. ESA, he said, has authority under an existing ExoMars contract to direct limited monies for another couple of months. He declined to disclose the maximum budget authorization the agency has at its disposal. At ESA, both the 2016 telecommunications orbiter — with its trace-gas sensor and an entry, descent and landing demonstration package — and the 2018 rover are considered a single mission called ExoMars, which is budgeted at 1 billion euros ($1.4 billion). In the contracting sense, the 2016 mission cannot be given full go-ahead funding until issues surrounding the 2018 mission are resolved. Those issues are several. ESA and NASA since this spring have been working on a joint rover mission for 2018 following NASA’s announcement that its budget does not permit it to provide a separate U.S.-built rover to be launched alongside ESA’s rover. A joint rover is being designed, but an exact determination of which side will provide what elements will not be made until this fall. That has led some of ESA’s ExoMars contributing nations, notably France and Britain, to ask that the 2016 mission be put on hold, or cut back, to preserve the maximum amount of resources for the 2018 rover launch. The U.K. Space Agency in particular had expressed its desire that its ExoMars contribution not be used to place British industry in a junior partner’s position relative to U.S. industry for a rover that, until recently, was supposed to be built in Britain. ESA officials have said they cannot put 2016 on hold without raising the risk that the mission will not be ready for a 2016 launch. Both Dordain and ESA Science Director Alvaro Gimenez said in separate interviews the week of June 22 that Thales Alenia Space needed to get cracking on the 2016 orbiter immediately, especially given the program delays since April as ESA has digested NASA’s abandonment of a U.S.-built rover for 2018.

AT: ESA CP – No Solvency – Funding

ESA budget freeze prevents spending

Messier 10 (Doug, communications expert, Parabolic Arc, 6/9, <http://www.parabolicarc.com/2010/06/09/esa-grapples-tight-budgets-dlr-escapes-budget-cuts/>, accessed 7-9-11, CH)

Spaceflight Now reports that ESA is going through some belt tightening as it deals with the global recession: The European Space Agency’s spending freeze is not delaying missions yet, but all options will be on the table as the cash-strapped agency prepares for even tighter budgets in 2011 and 2012, the organization’s top financial official said. Ludwig Kronthaler, ESA’s director of resources management, said the space agency should have enough money to avoid a moratorium on contract signings this year. But more serious consequences may be in store for the next two years. “For 2010, I don’t see a huge problem in the budget,” Kronthaler said. “But it’s clear we have to prepare ourselves that 2011 and 2012 might be tighter.” ESA is freezing spending for 2010 and 2011 at last year’s level of 3.35 billion euros, or $4 billion. The space agency’s budget remains higher, but ESA’s expenditures will be stretched out through contract modifications.

AT: ESA CP – No Solvency – Refugees

Won’t solve genocide—EU not motivated to provide assistance to aid refugees of ethnic conflict

Ezra 4 (Esther, Doctorate Candidate for Degree of Philosophy, Ludwig-Maximiliens U, 4/16, <http://edoc.ub.uni-muenchen.de/2680/1/Ezra_Esther.pdf>, accessed 7-9-11, CH)

In the beginning of negotiations on February 11, 2000 the Presidency listed the articles in the Treaty of the European Union (TEU) where a shift to qualified majority was thought necessary. These included sensitive policy areas such as taxation, social policy, common commercial policy, visas, asylum, and migration 548 On February 22, 2000 it was argued . That in the field of Justice and Home Affairs a distinction should be made between asylum, visas, and immigration and provisions on police and judicial cooperation in criminal matters (TEU Title VI). The Presidency argued that it would be difficult to cooperate in the field of criminal matters, as this is an area of great political sensitivity to all the Member States: “This is a field to which the Community decision-making process does not apply and the Presidency considers that in these circumstances it would be very difficult at this point to contemplate a move to qualified majority voting in this area for the adoption of basic legislation” 549 With regard to asylum, however, the Presidency was . rather optimistic, suggesting that decisions in asylum could be governed by a qualified majority procedure 550 Moreover, it suggested that Member States should identify areas . within specific articles of the Treaty of the European Union such as Articles 62 and 63 (referring to control of crossing internal and external borders, asylum, and immigration policy) which could move to qualified majority vote after the entry into force of the new Treaty 551 After several months of debate, by April 2000, negotiations among EU . Member States were able to reach the point where, “a measure of openness has been expressed in relation extending QMV for certain matters under Title IV of the TEU on visas, asylum and immigration” 552 In September, however, it became evident that member States had gradually changed their opinion about the extensive use of qualified majority voting in the decision making process. Indeed, the Presidency presented only a few amendments with respect to asylum policy, replacing the idea of a qualified majority with the co-decision procedure 553 Thus, most measures on asylum and migration . remained under unanimity rule but with the possibility of being decided by the codecision procedure. The result was that qualified majority voting applied, as before Nice, only to matters related to visa policy and perhaps with regard to Article 63 (2) (b) that is, sharing of the burden between Member States in the care of refugees and displaced persons. On October 26, 2000, the latter option was also abolished. Thus the Council continues to require unanimous voting on all asylum issues with the exception of visa policy 554 The reasons for this more restrictive change most likely lie in the refusal of member States to give up their veto power in asylum matters. Though Member States originally declared their intention to reform European decision-making processes to accommodate the coming enlargement, they continued to cling to the unanimity rule in a number of areas they viewed crucial to their national sovereignty. One of the major proponents of this view was Germany 555 , who argued that a move to qualified majority would jeopardize its national interests. This claim was based on the German experience on Yugoslavia; whereas Germany admitted the vast majority of the refugees froYugoslavia (350.000 Bosnians and 160.000 Kosovars) 556 , other EU Member States have shown little interest to share the burden with it by taking on some of its refugees. Not surprisingly, then, Germany refused to relinquish its veto in the area of asylum and immigration policy.

AT: ESA CP – No Solvency – ESA Corruption

ESA corrupted—ulterior motives, funding schemes

Booker 11 (Christopher, EU columnist, The Telegraph, 1/22, <http://www.telegraph.co.uk/comment/columnists/christopherbooker/8276191/The-costs-of-the-EUs-Galileo-satellite-system-are-still-skyrocketing.html>, accessed 7-9-11, CH)

The offence of Mr Berry Smutny, the now-suspended CEO of a German firm which has a £500 million contract to build 14 satellites for the Galileo global positioning system, was that in 2009, according to Wikileaks, he told senior Americans at a private dinner party that it was a “stupid idea”, intended only to serve French interests at the expense of EU taxpayers. This was only a hint – and even this was enough to get him suspended – that the real purpose of Galileo, the EU’s rival to the American GPS system, is quite different from what the world has been told. The cover story for Galileo, from the time of its launch in 2000, was that it was a civil project, largely to be paid for by private investors, who could then charge its users. GPS, on the other hand, is funded by US taxpayers as an openly military project, which is why its spin-off uses, such as to the owners of sat-navs, are free. It was hoped that Galileo could be paid for through a satellite-based road-charging scheme across the EU. But in 2007, after it became clear that this was not viable, the private partners pulled out, landing the entire, ever-rising bill on EU taxpayers.

AT: one sensor PIC

**All three sensors are key to early warning systems**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

Furthermore, **there are three main characteristics of the satellites and sensors that need to be specifically considered for the early warnings** of different hazards: temporal requirements of satellites, and spatial and spectral requirements of sensors (Table 3.1**). Some natural hazards that require a specific combination of these requirements are storms, volcanic eruptions, earthquakes, forest fires, landslides, algae blooms, El Niño and tsunamis** (Holdaway, 2001)

\*\*\*Addons\*\*\*

Science Leadership - Solvency

Landsats key to science leadership

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

Even more difficult to quantify than information—but readily apparent—is the value of U.S. technical and scientific leadership in land imaging and its benefits to society. Well before global climate change science was recognized as a distinct area of inquiry, Landsat enabled the U.S. to demonstrate international leadership in globalscale Earth-systems science.23 When climate change research first began to appear in the 1980s, it was moderate-resolution land imagery that was used for calibration and “ground-truthing” of data to ensure that climate model research had a foundation in fact, not just theory. Today, Landsat is the only moderate-resolution satellite monitoring system capable of acquiring seasonal global land surface data that are useful for assessing worldwide land surface and land use changes. The Landsat 7 Long-Term Acquisition Plan (LTAP), the method used to identify the data collection plan for Landsat, was the world’s first successful automated global targeting plan for land imaging that observes every land surface area of the Earth multiple times per year. Also, this type of automated land observing strategy not only saved money by more frequently targeting those land surfaces that experienced frequent changes, but it ensured that information about land surface changes would be available for sophisticated techniques in climate and Earth modeling.24 Once again, the societal benefit of cost savings in research and model advancement cannot be quantified in dollars, but exemplifies how Landsat has provided many indirect benefits to society. Likewise, many years in advance of the world’s recognition of the importance of having a Global Earth Observing System of Systems (GEOSS), the Landsat program established the most extensive international ground-station cooperator network in the world. Today, the Landsat network includes 15 ground stations that are managed through agreements with 11 national and multi-national space agencies. Despite the advanced age of Landsat 5, over 13,500 scenes are still being downloaded from it annually by international partners.25 The economic value to the U.S. in goodwill, trade exports, contributions to peace, economic development, and security in the world is a “societal benefit” that cannot be quantified in dollars. However, Landsat exemplifies the legacy of the best of U.S. contributions of space technology to the world’s benefit by providing leadership for solving Earth resource problems, consistent with the original premise of the 1958 Space Act.

Hegemony - Solvency

LandSats maximizes space potential—that’s key to heg

US Army 10 (6/9, <http://www.army.mil/aps/97/CH5.HTM>, accessed 7-3-11, CH)

As we enter the 21st century, the Army will continue to use space products. Space systems provide communications; weather and earth resource monitoring; reconnaissance, surveillance, and tar

get acquisition; position, navigation, and digital mapping; missile defense warning. As we look to the next century, space products will help us turn a smaller Army into an even more effective national security asset. The Army uses space products in virtually every operation. During Desert Shield, early operations were directly supported by graphical maps produced using LandSat imagery. During Desert Storm, satellite communications and navigation provided the land component commander a viable means of controlling the rapid movement of widely dispersed formations. The commander used real time weather data from polar orbiting satellites to anticipate weather effects. During UPHOLD DEMOCRACY in Haiti, space products provided deployed forces with critical video teleconferencing connectivity, near real-time intelligence reports, and high resolution maps. Space - a force multiplier - is key to future warfighting missions. Space systems enhance operations by providing timely situational awareness. The Army will continue to organize and train forces using space capabilities that make forces more responsive, flexible, interoperable, and survivable. By aggressively exploiting space products, the Army will maintain land force dominance in the 21st century.

Reconnaissance satellites key to space leadership—solves hegemony

DoD, no date (<http://www.dod.gov/execsec/adr97/chap19.html>, accessed, 7-4-11, CH)

The United States conducts activities in outer space to defend the nation. Space is a medium -- like the land, sea, and air -- within which military operations take place by Department of Defense space forces. These forces consist of both space-based and terrestrial systems, plus their associated facilities and personnel. During the past decade, national security space systems have played an increasingly important role in the Department's overall warfighting capability. Consistent with the National Space Policy, Department of Defense space forces will continue to support military operations worldwide, monitor and respond to strategic military threats, and monitor arms control and nonproliferation agreements and activities. DoD will exploit and, if required, control space to assist in the successful execution of the National Security Strategy and National Military Strategy. In the future, space power will be as important as sea power and air power are today. The control and utilization of space as a warfighting medium will help to enable the United States to establish and sustain dominance over an area of military operations. Establishing such dominance will be a key to achieving success during a crisis or conflict.

Landsat capabilities key to hegemony

DoD, no date (<http://www.dod.gov/execsec/adr97/chap19.html>, accessed, 7-4-11, CH)

The United States is the unparalleled world leader in the use of space for defense and intelligence purposes. U.S. space forces, especially the constellations of reconnaissance, surveillance, communications, navigation, and weather satellites, have contributed significantly both to U.S. successes during the Cold War and in military operations around the globe since then. Utilization of these space systems has evolved from an initial focus on providing support to national decision makers and strategic nuclear operations to a more extensive integration into the overall military force structure and much broader use by warfighters. Currently, U.S. national security space assets are playing a crucial role in supporting national security objectives in many areas around the globe, including the former Republic of Yugoslavia, Korea, and the Middle East. Space systems have become an integral part of the overall deterrent posture of the U.S. armed forces. They help confer a decisive advantage upon U.S. and friendly forces in terms of combat timing, battlespace awareness, operating tempo, synchronization, maneuverability, and the application of firepower. Any nation contemplating an action inimical to U.S. national security interests must be concerned about U.S. space capabilities because they help to ensure that hostile actions will be discovered by the United States in a timely manner

Power Projection - Solvency

Landsat key to the military – Gulf War proves

Future of Land Imaging Interagency Working Group 7 (National Science and Technology Council, Office of Science and Technology Policy, headed by John H. Marburger III, Science Advisor to the President, August, http://www.landimaging.gov/fli\_iwg\_report\_print\_ready\_low\_res.pdf, accessed 7-3-11, JMB)

Whereas the specific applications of Landsat for national security are typically for classified uses and therefore cannot be discussed in this report, Landsat plays a role in U.S. military operations and intelligence gathering. Anecdotal evidence suggests that Landsat greatly improved global surveillance during the 1990 Gulf War and improved tactical management of troops maneuvering in unfamiliar terrain using uncharted regional road networks. An unclassified assessment of the operations and impact of those space operations conducted by the U.S. Space Command and its components stated that: “The military utility of multi-spectral imagery (MSI) was clearly demonstrated during Desert Shield and Desert Storm. Many of the maps that the U.S. forces carried with them of Kuwait City and the area of operations (AO) were made from MSI products. The planning and execution of strike operations were often dependent on MSI data provided by the U.S. commercial LANDSAT spacecraft and its French counterpart, SPOT (Satellite Probatoire d’Observation de la Terre (Exploratory Satellite for Earth Observation)).”17 See the Classified Annex to this report for more details about the value of moderateresolution land imagery for intelligence uses and other aspects of national security operations.

Landsats key to security

Chakroborty 7(RC, Visiting Prof @ JIET, Maulana Azad National Institute of Technology, 12/11, <http://www.myreaders.info/02_Satellite_Image_Information_threat__to__National_Security.pdf>, accessed 7-3-11, CH)

Land Remote Sensing Act of 1992 This act enabled U.S. to maintain its leadership in land remote sensing by: - providing data continuity for the Landsat program, - establishing a new national Land Remote Sensing Policy, - implementing a fundamental change, rejecting full commercialization in favor of a more long-term, and protective development of the remote sensing industry under the guidance of the DoD and NASA. The relevant extracts from this act of 1992: Sec.2 Findings, Sec.3 Definitions , and Sec. 103 Data Policy are stated below. ^ Extracts from Sec. 2. Findings : declared - The continuous collection and utilization of land remote sensing data from space are of major benefit in studying and understanding human impacts on the global environment, in managing the Earth's natural resources, in carrying out national security functions, and in planning and conducting many other activities of scientific, economic, and social importance. –

Landsats key to military

National Science and Technology Council 7 (8/7, <http://www.landimaging.gov/fli_iwg_report_print_ready_low_res.pdf>, accessed 7-3-11, CH)

Land imaging satellites, a specialized class of Earth observation tools whose origins lie in a diverse range of fields, were also considered ripe for commercial development and use since the early years of the space age. High-resolution imaging satellites, whose historic roots lay in aerial photography, have always been considered important for U.S. military surveillance and intelligence operations and are increasingly significant in a number of civil fields, including mapping, urban planning, and disaster management. Landsat set a standard for international cooperation due to its adoption of an Open Skies remote sensing data policy, including both U.S. and international open access to Landsat data and direct transmission of satellite data to numerous nations around the world as Landsat passes over their territory.

Landsats key to military dominance—intel, surveillance, tracking

National Science and Technology Council 7 (8/7, <http://www.landimaging.gov/fli_iwg_report_print_ready_low_res.pdf>, accessed 7-3-11, CH)

Whereas the specific applications of Landsat for national security are typically for classified uses and therefore cannot be discussed in this report, Landsat plays a role in U.S. military operations and intelligence gathering. Anecdotal evidence suggests that Landsat greatly improved global surveillance during the 1990 Gulf War and improved tactical management of troops maneuvering in unfamiliar terrain using uncharted regional road networks. An unclassified assessment of the operations and impact of those space operations conducted by the U.S. Space Command and its components stated that: “The military utility of multi-spectral imagery (MSI) was clearly demonstrated during Desert Shield and Desert Storm. Many of the maps that the U.S. forces carried with them of Kuwait City and the area of operations (AO) were made from MSI products. The planning and execution of strike operations were often dependent on MSI data provided by the U.S. commercial LANDSAT spacecraft and its French counterpart, SPOT (Satellite Probatoire d’Observation de la Terre (Exploratory Satellite for Earth Observation)).” 17 See the Classified Annex to this report for more details about the value of moderateresolution land imagery for intelligence uses and other aspects of national security operations.

Reconnaissance - Solvency

Landsats key to reconnaissance satellites—thermal imagery detects facilities

Sepp 00 (Eric, Lt Colonel USAF, May, Air War College, <http://www.au.af.mil/au/awc/awcgate/cst/csat14.pdf>, accessed 7-4-11, CH)

As the capabilities and flexibility of satellites for gathering accurate and highly detailed intelligence information continue to increase, their role is becoming more central to intelligence operations, including the ability to detect deeply buried facilities. For example, reconnaissance satellites use an array of high resolution imaging and sensors, such as the Landsat's multispectral scanner, to provide clues about the existence of Underground facilities and their activities. This relies on infrared, thermal, and multispectral imaging of the surrounding land and the facility. Furthermore, reconnaissance satellites can be used to estimate what is being produced at a particular site based on the size of storage tanks, number of rail cars, size of the roads, and other external features. Landsat's thermal imagery can detect, in sections of land that are the size of a front lawn, vent duct arrays or the heat generated by underground facilities if they are close enough to the surface. Its blue-band filter can also detect the smoke and gases that are emitted from underground vents. While underground facilities are difficult to locate, roads or tracks leading into the side of a mountain or disappearing underground often help to reveal their location. Furthermore, commercial firms have developed the software that detects changes between images that are generated over time, which is known as change detection software. Acquiring images of the same terrain over a period of time is a common way for using satellites to monitor activities and changes in areas where deeply buried facilities are suspected to exist.

Disasters – Solvency

Landsats key to disaster prevention and management

Lebowitz 6/21 (Jonathan, Staff, USA Today, http://content.usatoday.com/communities/sciencefair/post/2011/06/satellite-programs-aid-emergency-management-teams-battling-arizona-wildfires-/1, accessed 7-3-11, JMB)

Multiple firefighting agencies are using imagery -- provided by federally funded Landsat 5 and 7, Aqua and Terra satellites -- to combat wildfires that continue to blaze across Arizona. The satellites capture images of the Earth's surface and then, using color enhancements, firefighters can identify different regions most susceptible to wildfire burning. In the images, burn scars are red, ongoing fires are bright red, vegetation is green, smoke is blue and bare ground is tan-colored. When the location of a wildfire is found, emergency managers can evacuate people in the path of the fire and pinpoint where water and firefighters need to go. "In addition to providing information used to map the susceptibility of the forests to wildfires, the satellites can also provide emergency management agencies with data to gauge the extent of damage that was done over burnt areas," says Jim Irons, Landsat Data Continuity Mission (LDCM) project scientist. Once a satellite has taken a photograph of the land after the wildfire has been contained, emergency managers can distinguish areas of land that have suffered extensive burning from those that remain intact. From this, officials can work to determine the cause of the wildfire and work towards preventing another one from happening. The Landsat Program, a joint venture between NASA and the U.S. Geological Survey, has recently helped emergency managers survey the damage caused by Hurricane Katrina, Mississippi River flooding, and a tornado that ripped through Springfield, Mass

Environment – Solvency

**Landsats check environmental factors—key to understanding natural damage which other satellites fail to account for.**

**Schroeder et al 6** (Todd A., Warren B. Cohen, Conghe Song, Morton J., Canty, Zhiquiang Yang, Dept. Forest Science, UO, Forest Science Lab, Dep. Geo @ North Carolina, Systems Analysis @ Munich, <http://ddr.nal.usda.gov/bitstream/10113/38625/1/IND44322324.pdf>, accessed 7/5/11) CJQ

**Landsat sensors record reflected and emitted energy from Earth in various wavelengths of the electromagnetic spectrum.**  The electromagnetic spectrum includes all forms of radiated energy from tiny gamma rays and x-rays all the way to huge radio waves.  The human eye is sensitive to the visible wavelenghs of this spectrum; we can see color, or reflected light, ranging from violet to red.  Today, **Landsats 5 and 7 "see" and record blue, green, and red light in the visible spectrum** as well as near-infrared, mid-infrared, **and** thermal-infrared **light that human eyes cannot perceive** (although we can feel the thermal-infrared as heat).  **Landsat records this information digitally and it is downlinked to ground stations**, processed, and stored in a data archive. **It is this digital information that makes remotely sensed data invaluable. “Observations from Landsat are now used in almost every environmental discipline,**” explains John Barker, a Landsat 7 Associate Project Scientist and award-wining calibration expert. **Landsat data have been used to monitor water quality, glacier recession, sea ice movement, invasive species encroachment,** coral reef health, **land use change, deforestation rates and population growth**.  (Some fast food restaurants have even used population information to estimate community growth sufficient to warrant a new franchise.)  **Landsat has also helped to assess damage from natural disasters such as fires, floods, and tsunamis, and subsequently, plan disaster relief and flood control programs**.

Environmental Standards – Solvency

**Landsats are key to mapping agriculture and enforcing environmental standards.**

**Holton 2000** (W. Conard, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637957/pdf/envhper00304-0032-color.pdf>, accessed 7/7/11) CJQ

As the agency with its eyes on the sky, **NASA has long played a role in supporting U.S. agriculture**. The Commercial Remote Sensing Program (CRSP), run out of Stennis Space Center, Mississippi, has the charter to take what has been a duel military/civilian technology and target its commercial uses. Nathan Sovik, manager of applications research and development at the CRSP, says that **NASA can help private companies develop and prove their remote sensing technology and can develop new applications** on its own. "**Geological exploration and vegetation mapping have been the traditional civilian applications for remote sensing**," he says. "**Now we're looking to open up new areas such as** high-resolution forest inventory and **precision farming." Landsat satellites have been the most consistent suppliers of information to** the **agricultural research** community, from the 1972 launch of the first one, which carried a four-band multispectral scanner, to the launch in April 1999 of Landsat 7 with an eight-band scanner. Resolution from the most recent satellite varies between approximately 15 and 60 m, depending on the spectral band. Approximately 80 more Earthobserving satellites are scheduled to be launched in the next 15 years. The IKONOS satellite, launched in September 1999 by Space Imaging of Thornton, Colorado, is authorized by the U.S. government to release images at 1-m resolution and is the first of several commercial imaging satellites scheduled to be launched. Sovik says that NASA is also contributing the latest in remote sensing capability by using the Advanced Thermal and Land Applications Sensor (ATLAS), installed on a Lear 23 jet. ATLAS can scan 15 spectral bands and is capable of 2-m resolution. **It has proven its value in** numerous agricultural settings, from **tracking drought conditions** on farms **to testing for atmospheric effects of moisture and aerosols** on images collected by remote sensing equipment and compared to data collected by satellites or ground-based systems. Sovik says **an application being considered is the use of remote sensing to enforce environmental standards compliance by farmers.** For example, he asks, "If a farm field abuts a stream and you get an algal bloom downstream, how do you know whether it is a natural occurrence or caused by the farmer's behavior? Unless you are flying over at exactly the right moment, it's very difficult to determine.

Pesticides – Solvency

**Landsats reduce the need for large amounts of pesticides and chemicals: 40% net reduction.**

**Holton 2000** (W. Conard, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637957/pdf/envhper00304-0032-color.pdf>, accessed 7/7/11) CJQ

"**To determine when and where to apply insecticides,** some people claim that **the** spectral **signal** can be correlated to the stress on a plant, but that is very tough to do, given that images are taken at different times and in different terrain," says Richard Campanella, a remote sensing GIS specialist at Spectral Visions. Instead, Campanella **looks at the health of the cotton plants as indicated by their water content to identify when they are most likely to be attacked by the plantbug**. In one experiment, **20 sets of images were gathered** by a NASA CRSP plane carrying a multispectral sensor comprising three Kodak charge-coupled device cameras with a narrow-band filter on each camera. **These** A 132 Volume 108, Number 3, March 2000 \* Environmental Health PerspectivesInnovations \* Farming from a New Perspective data, **when combined with information gathered from the ground on existing infestations, led to insecticide applications that varied by location.** Early **results show a 30-40% decrease in overall chemical use.**

Spending – Solvency

**Landsats are faster and therefore cheaper than traditional methods.**

**Holton 2000** (W. Conard, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1637957/pdf/envhper00304-0032-color.pdf>, accessed 7/7/11) CJQ

**Time and** thus **cost become major constraints. One tool to deal with this** problem **has been** developed by Susan Maxwell, deputy manager of the science and applications branch of Raytheon Company, which runs the Earth Resources Observation System Data Center in Sioux Falls, South Dakota, where Landsat data are processed. Maxwell and colleagues from Colorado State University and the National Cancer Institute **propose a method for automating crop mapping using Landsat imagery**. In health studies such as one of agricultural chemical use and the occurrence of cancer, **accurate crop maps of large geographic regions are essential. Software developed by the team extracted spectral data from Landsat maps of 13 counties in Nebraska and produced a map for com in less than 15 minutes. The dassification accuracy of 89% was comparable to traditional methods** requiring days of interpretation.

\*\*\*Famine Advantage\*\*\*

Famine – Solvency – Precision Farming

**Remote sensing technologies make possible precision farming—increases efficiency and profit.**

**Singh et al 10** (Pradeep Kumar Singh, Feroz Ahmed Parry, Kouser Parveen, Sumati Narayan, Asima

Amin and Ashis Vaidya, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, <http://www.journalcra.com/sites/default/files/Download_331.pdf>,accessed 7/7/11) CJQ

**Agriculture is the backbone of our** country and **economy**, which accounts for almost 30 per cent of Gross Demand Product (GDP) and employs 70 per cent of the population. **Agricultural technology available in the 1940s could not have been able to meet the demand of food for today’s population**, in spite of the green revolution. Similarly, it is very difficult to assume that food requirement for the population of 2020 AD will be supplied by the technology of today. To meet the forthcoming demand and challenge we have to divert towards new technologies, for revolutionizing our agricultural productivity. Green revolution succeeded in India to increase the farmer’s income, yield of major crops and made India self-reliant in food production, with the introduction of highyielding varieties and use of synthetic fertilizers and pesticides (Ghosh et al., 1999 In the post-green revolution period agricultural production has become stagnant, and horizontal expansion of cultivable lands became limited due to burgeoning population and industrialization. In 1952, India had 0.33 ha of available land per capita, which is likely to be reduced to 0.15 ha by the end of year 2006 (Singh et al., 2000). **As the availability of land has decreased, application of fertilizers and pesticides became necessary to increase production. The major effect is that our agriculture became chemicalized**. In this situation**, it is essential to develop eco-friendly technologies for maintaining crop productivity**. Since long, it has been recognized that crops and soils are not uniform within a given field (Cassman and Plant, 1992). The farmers have always responded to such variability to take actions, but such actions are inappropriate and less frequent. Over the last decade, **technical methods have been developed to utilize modern electronics to respond to field variability. Such methods are known as spatially variable crop** production, global positioning system based agriculture, site-specific and **precision farming**. Precision farming is a management philosophy or approach to the farm and is not a definable prescriptive system (Dawson, 1997). **It identifies the critical factors where yield is limited by controllable factors**, and determines intrinsic spatial variability. **It is** essentially more precise farm management **made possible by modern technology**. The variations occurring in crop or soil properties within a field are noted, mapped and then management actions are taken as a consequence of continued assessment of the spatial variability within that field. Development of geomatics technology in the later part of the 20 th century has aided in the adoption of site specific management systems using remote sensing (RS), GPS and geographical information system (GIS). This approach is called precision farming or site specific management (Palmer, 1996). **Precision farming is a farming system concept which involves the development and adoption of knowledge based technical management systems with the main goal of optimizing profit**. This management system will enable micromanagement concepts, which are the ability to appropriately manage if it is technically and economically advantageous to manage at that level. The system will likely include the ability to vary or tailor the rate of application of all inputs such as tillage, seeds, weed, insect and disease control, cultivation and irrigation.

Famine – Solvency – Crop Yields

**Landsats coupled with data inputs accurately track crop yields.**

**Doraiswami et al 4** (P.C., U.S. Dept. Agriculture, Hatfield, National Soil Tilth Lab, Jackson, U.S. Dept. Agriculture, Akhmedov, U.S. Dept. Agriculture, Prueger, Nat'l Soil Tilth Lab, Stern, U.S. Dept. Agriculture, <http://ddr.nal.usda.gov/bitstream/10113/36735/1/IND44300354.pdf>, accessed 7/6/11) CJQ

An improvement of this method is to use a radiative transfer model such as Scattering by Arbitrary Inclined Leaves (SAIL) to predict canopy reflectance (Verhoef, 1984). **Simulation requires biophysical inputs**, e.g., LAI, leaf optical properties, canopy architecture, sun-sensor-target geometry, and soil reflectance. **These** inputs **can be measured** or estimated **and LAI is simulated in a crop growth model**. Moulin et al. (1995) successfully used this approach for wheat by coupling a crop growth model with SAIL model simulating the VIS and NIR reflectance equivalent to SPOT/HRV satellite (20 m) by varying the crop model parameters. Simulated temporal reflectance profiles were compared with SPOT observations to select suitable leaf angle distribution for wheat crop. A similar approach by Moulin et al. (2002) coupled two process models and the SAIL model to simulate the energy balance, soil moisture, plant growth and canopy reflectance. The canopy reflectance results from the simulations were comparable with SPOT/HRV data. Constraining the model parameters with satellite observations enabled retrieval of key parameters of soil moisture and above ground plant biomass. Doraiswamy et al. (2003) simulated LAI for spring wheat in North Dakota using single date NOAA AVHRR data. Bands 1 and 2 reflectance from single date imagery was used to simulate LAI that was input to a crop yield model. **The development of an accurate crop classification from Landsat imagery was critical for retrieval of crop specific reflectance. The spatial resolution** (250 m) and temporal (daily) **coverage** of MODIS data **offers potential for retrieval of crop biophysical parameters and improved accuracy in crop yield assessment**. Although **Landsat** TM **data** would be more suitable in areas where the field sizes are small, the temporal frequency and cloud cover limits the retrieval of crop biophysical parameters that are changing during the season. Biophysical parameters such as LAI retrieved from satellite-measured reflectances **coupled with a crop yield model facilitate analyses of temporal and spatial variability of crop conditions and yield.**

Famine – Solvency – Agro Heg

**Landsats are crucial to agricultural hegemony—glitches have made the US totally reliant on Indian, Chinese and French satellites.**

**NASA 7** (Laura Rocchio, <http://landsat.gsfc.nasa.gov/news/news-archive/soc_0010.html>, 7/6/11) CJQ

Over the past three decades, the objective **global crop production estimates made with Landsat data have contributed to U.S. food** security, **economic** security, national security, **and** more recently, **homeland security.** Post-9-11, the FAS mandate was expanded to include foreign crop supply estimates needed for critical response to any catastrophic crop failures or bio-terrorist attacks (think of the recent E. coli spinach scare on a much larger scale). **Unfortunately, the FAS has become** increasingly **reliant on foreign** Earth-observing **satellites** since 2004. Through 2003, FAS relied on about 3000 Landsat scenes per year for global crop production estimates and support of domestic programs.¹ In late May 2003**, a hardware glitch aboard** the **Landsat 7** satellite **reduced the amount of usable data** per scene by about 25%**, and forced FAS to look to foreign satellites** for the **data they required. Today, FAS** is almost **completely reliant on data purchased from an Indian satellite** (IRS). Additionally, **FAS uses data from the French** SPOT satellite **and** theyare investigating the use of data from a Brazilian and **Chinese satellite** (CBERS). **With the current** global coverage **limitations of Landsat, data** from Landsat 5 and Landsat 7 **are only used for historical comparisons**, domestic gap filling, and data validation and verification. And, after several changes in implementation strategy , the **launch of the next U.S. Landsat-like satellite is still** several **years away**. While it is fortunate that foreign satellites have been able to fill the void left by the Landsat 7 instrument anomaly, the merit of depending on foreign data for matters of national, economic, and homeland security is debatable. “**A loss in** the **Landsat coverage is equivalent to losing an irreplaceable**, objective, timely, and reliable **intelligence source**,” Doorn admits. “Increasingly **global markets affect commodity prices and our imports/exports**,” he continues. In 2005, the U.S. exported over $63B of agricultural products (approximately 10% of U.S. exports). But **in this age of globalization, U.S. economic dominance in agriculture is being challenged** and the marketing edge that FAS crop estimates give to U.S. producers has never been more important. In 2003**, South America surpassed the U.S. in soybean production** for the first time in history. **A year later, a dispute with Brazilians** over Brazil’s soybean production estimates **highlighted how** FAS **crop production numbers affect the U.S.’s ability to effectively argue estimates**. “The nature of how FAS uses Landsat imagery is most visible when problems, disagreements, or anomalies occur,” Doorn says. **Today, FAS must increasingly rely on foreign-based satellite information**.  It remains to be seen if FAS’s reliance on foreign-based satellites will affect their ability to respond to events.

Famine – Solvency – Agriculture

**Remote sensing exponentially increases agricultural output—energy measurement, soil detection, soil mapping and spatial planning make possible agricultural revolution.**

**Singh et al 10** (Pradeep Kumar Singh, Feroz Ahmed Parry, Kouser Parveen, Sumati Narayan, Asima

Amin and Ashis Vaidya, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, <http://www.journalcra.com/sites/default/files/Download_331.pdf>,accessed 7/7/11) CJQ

**Remote sensors are** generally categorized as aerial or **satellite sensors. They** can **indicate variations in field colour that corresponds to changes in soil type, crop development**, field boundaries, roads, water etc. Remote science in agricultural terms means viewing crop from overhead (from a satellite or low flying aircraft) without coming into contact, recording what is viewed and displaying the image and provide the map to pinpoint the field problems more earlier and more effectively. In remote sensing, information transfer is accomplished by use of electromagnetic radiation (EMR). EMR is a form of energy that reveals its presence by the observable effects it produces when it strikes the matter. **Due to remote sensing we have been able to observe large regions suitable for agriculture**, making use of sensors to **measure energy at wavelengths which are beyond the range of human vision** (ultraviolet infrared, etc.) and globally monitoring earth possible from nearly any site. Remote sensing technology can be used to provide valuable information on various agricultural resources which influences production (Roa, 1999). Some of the broad agricultural application areas are: i. Crop production forecasting: **It includes the identification of crops**, acreage estimation and yield forecasting. **Reliable and timely estimates of crop acreage and production are important for the formation of marketing strategies and price fixation**. Identification of crop is based on the fact that each crop has a unique spectral signature, which is influenced by the leaf area index, per cent ground cover, growth stage, difference in cultural practices, stress conditions and canopy architecture, yield of crop is influenced by large number of factors such as crop genotype, management practices, weather conditions of soil characteristics. **Remote sensing data related to** yield parameters are used in yield modeling for yield forescasting. ii. **Soil mapping**: Soil maps **afford the information on the suitability and limitation of the soil for agricultural production, which are helpful in selection of proper cropping system and optimal land use** planning. iii. Wasteland mapping: **Information on degraded and wasteland** e.g. salt affected areas, acidic soils, eroded soils, water logged area, dryland etc. Landuse/land cover information **is important for spatial planning management and utilization of land for various purposes like agriculture**, forestry, environmental studies and to find out the additional land resources that could be tilled. The information generated on landuse pattern also help identify suitable cropping patterns to convert single cropped area to double cropped **and allows cultivation of land for increasing the food production.**

**Landsats are crucial to predictable agricultural reports—the alternative is unpredictable markets and food shortages.**

**NASA 7** (Laura Rocchio, <http://landsat.gsfc.nasa.gov/news/news-archive/soc_0010.html>, 7/6/11) CJQ

Market **intelligence about global crop production ensures that food supply is consistent with demand. If,** for example, **Australia has a bumper crop of wheat, U.S. farmers can avoid a wheat glut** (and protect against a precipitous price drop**) by not planting** wheat, **and vice versa.  Accurate** crop **estimates thereby translate into dependable food prices** by enabling producers to make wise planting decisions and by equipping U.S. agricultural commodity traders with the knowledge they need to set realistic and reasonable prices. The Foreign Agricultural Service (FAS) of the U.S. Department of Agriculture (USDA) has the responsibility of providing this market intelligence in the form of timely, objective, unclassified, global crop condition and production estimates, for all major commodities, for all foreign countries. **These estimates are an integral part of the** World Agricultural Production and **World Agricultural Supply & Demand** numbers used by the U.S. Office of Management and Budget (OMB) as Principle Federal Economic Indicators. To accomplish this Herculean task, FAS synthesizes information from its global network of marketing experts, agricultural economists, meteorologists and remote sensing scientists. While FAS attachés collect crop production information from foreign government reports and fields visits, it is the comprehensive view afforded by space-based Earth-observing satellites, such as **Landsat**, that **provide** the **unbiased, global, farm-level observations necessary to objectively verify** these **reports. Unbiased** report **verification means food supply estimates can be used with confidence. “Less confidence** in the food supply **translates into more volatile markets where food shortages and over-stocks** are more likely to **occur**,” says Dr. Bradley Doorn a Technical Remote Sensing Coordinator with FAS. It was a grain shortage 35 years ago that initially led FAS to use Landsat data.

Famine – Solvency/IL – Landsats

**Crop instability empirically translates into famine in impoverished nations—Landsats solve.**

**NASA 7** (Laura Rocchio, <http://landsat.gsfc.nasa.gov/news/news-archive/soc_0010.html>, 7/6/11) CJQ

**After a number of years with abnormal weather** in the early 1970s, **wheat crops** in much of the world **failed. At the same time**, very successful **wheat crops in the U.S. had led to large** U.S. **stockpiles** of wheat. **In only six weeks**, and before the U.S. realized there was a global wheat shortage, **shrewd Soviets traders were able to surreptitiously purchase** $750 million worth of **U.S. wheat at low** subsidized **prices. By time the U.S. became aware that there was a shortage** of wheat on the global market, **the Soviets had bought 15 million tons of U.S. wheat** (up from 300,000 tons in years past). **With the** U.S. grain **supply suddenly low, wheat prices soared** (reported increases range from 200% to **350%**) from June 1972 to February 1974. “**Food prices rose dramatically** and the impact on the world grain markets and food availability was dramatic,” Doorn explains. Steep **price increases meant that** many **undeveloped nations could not afford to buy grain, and** grain-producin**g nations were forced to pay a premium for the extra fuel** and fertilizer **needed to meet demand**. To put this in perspective, imagine that yesterday you bought a loaf of bread from your local grocery story for $2.89. Can you imagine paying between $5.78 and $10.12 for that same loaf of bread in 2009? That’s what happened in the early 1970s in what has come to be known as the Great Grain Robbery. Determined never to be blindsided on the commodities market again due to a lack of information, OMB instructed FAS to establish a global crop surveillance and reporting system. “**FAS has been mandated to provide a global crop reporting system** including a global crop surveillance program since the mid-**1970s starting with Landsat 1,”** Doorn says. Coincidently, the first Landsat satellite was launched the same year as the Great Grain Robbery. Data from Landsat 1 made it possible for FAS to meet OMB’s mandate to monitor global crop.

Famine – Solvency/IL – Predictions

**Accurate predictions of crop yield are crucial to maintaining economic stability and planning for disasters. Only Landsats combine the breadth of vision and detail of image which allow planners to manage crises.**

**Doraiswamy et al 7** (Paul C., Bakhyt Akhmedov b , Larry Beard c , Alan Stern a and Richard Mueller c a USDA, b Science Systems and Associates, Inc. c USDA, [http://www.ars.usda.gov/SP2UserFiles/person/ 1430/ISPRS\_AGRIFISH\_Final.pdf](http://www.ars.usda.gov/SP2UserFiles/person/%201430/ISPRS_AGRIFISH_Final.pdf) , accessed 7/8/11) CJQ

**Accurate and timely monitoring of agricultural crop conditions and estimating potential crop yields are essential processes for** operational **programs. Assessment of** particularly **decreased production** caused by a natural disaster, such as drought or pest infestation, **can be critical for countries** or locales **where the economy is dependent on the crop harvest. Early assessment of yield reductions could avert a disastrous situation and help in** strategic **planning to meet demands**. The National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA) monitors crop conditions and makes the Official USDA production assessments in the U.S., providing monthly production forecasts and end-of-year estimates of crop yield and production. NASS has developed methods to assess crop growth and development from several sources of information, including several types of surveys of farm operators and field-level measurements. Field offices in each state are responsible for monitoring the progress and health of the crop and integrating crop condition with local weather information. Information on crop condition and progress is also distributed in a biweekly report on regional weather conditions. NASS offices provide monthly information to the Agriculture Statistics Board, which assesses the potential yields of all commodities based on crop condition information acquired from different sources. This research complements efforts to independently assess crop condition at the county and state levels. The **timely evaluation of potential yields is increasingly important because of the huge economic impact of agricultural products on world markets** and strategic planning. County **statistics** are noted as a driving force for rural economic development, and **are essential to proper management of** USDA’s many **farm, education, and natural resources** management programs. Many allocations of federal resources to states and counties are determined by their production of farm commodities. Demand for accurate commodity estimates at the lowest level of aggregation, and at the earliest possible time, has and continues to increase substantially. **Literally millions of business decisions rely on this basic production data** produced by USDA/NASS. In the early 1960s, NASS initiated “objective yield” surveys for crops such as corn, soybeans, wheat, and cotton in States with the greatest acreages (Allen et al., 1994). These surveys establish small sample units in randomly selected fields which are visited monthly to determine maturity, numbers of plants, numbers of fruits (wheat heads, corn ears, soybean pods, etc.), and weight per fruit. Yield forecasting models are based on relationships of samples of the same maturity stage in comparable months during the past four years in each State. These indications are then compared to farmer-based survey results to produce monthly yield forecasts. Additionally, the Agency implemented a midyear Area Frame Survey that enabled creation of probabilistic based acreage estimates. For major crops, sampling errors are as low as 1 percent at the U.S. level and 2 to 3 percent in the largest producing States. **Accurate crop production forecasts require accurate estimates of acreage** at harvest, its **geographic distribution, and the associated crop yield determined by local** growing **conditions**. There can be significant year-to-year variability which requires a systematic monitoring capability. **To quantify the complex effects of environment**, soils, **and management practices**, both **yield** and acreage **must be assessed. A yield forecast** within homogeneous soil type, land use, crop variety, and climate **preclude the necessity for use of a complex forecast model.**

Famine – Solvency/IL – Predictions

**Accurate predictions can avert crisis—lets planners do their thing.**

**Doraiswamy et al 7** (Paul C., USDA, Sophie Moulin, INRA/Unite Climat, Paul W. Cook, USDA, Alan Stern, USDA, accessed 7/8/11) CJQ

**Monitoring agricultural crop conditions** during the growing season **and estimating the potential crop yields ar**e both **important for the assessment of seasonal production. Accurate and timely assessment** of particularly decreased production caused by a natural disaster, such as drought or pest infestation, **can be critical for countries where the economy is dependent on the crop harvest. Early assessment** of yield reductions **could avert a disastrous situation and help in strategic planning to meet the demands.**  The National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (USDA) monitors crop conditions in the U.S. and provides monthly projected estimates of crop yield and production. NASS has developed methods to assess crop growth and development from several sources of information, including several types of surveys of farm operators. Field offices in each state are responsible for monitoring the progress and health of the crop and integrating crop condition with local weather information. This crop information is also distributed in a biweekly report on regional weather conditions. NASS provides monthly information to the Agriculture Statistics Board, which assesses the potential yields of all commodities based on crop condition information acquired from different sources. **This research complements efforts to independently assess crop conditions** at the county, agricultural statistics district, and state levels. In the early 1960’s, NASS initiated “objective yield” surveys for crops such as corn, soybean, wheat, and cotton in States with the greatest acreages (Allen, et al., 1994). These surveys establish small sample units in randomly selected fields which are visited monthly to determine numbers of plants, numbers of fruits (wheat heads, corn ears, soybean pods, etc.), and weight per fruit. Yield forecasting models are based on relationships of samples of the same maturity stage in comparable months during the past 5 years in each State. Additionally, the Agency implemented a mid-year Area Frame that enabled creation of probabilistic based acreage estimates. For major crops, **sampling errors are as low as 1 percent** at the U.S. level and 2 to 3 percent in the largest producing States. **Accurate crop production forecasts require accurate forecasts of acreage at harvest**, its **geographic distribution, and the associated crop yield determined by local** growing **conditions**. There can be significant year-to-year variability and requires a systematic monitoring capability. To quantify the complex effects of environment, soils and management practices, both yield and acreage must be assessed at sub-regional levels where a limited range of factors and simple interactions permit modeling and estimation. A yield forecast within homogenous soil type, landuse, crop variety and climate preclude the necessity for use of a complex forecast model

Famine – IL – Predictions

**Landsats independently increase crop yield—predictions allow the market to adapt and farmers to harvest enough.**

**Doraiswamy et al 7** (Paul C., Bakhyt Akhmedov b , Larry Beard c , Alan Stern a and Richard Mueller c a USDA, b Science Systems and Associates, Inc. c USDA, [http://www.ars.usda.gov/SP2UserFiles/person/ 1430/ISPRS\_AGRIFISH\_Final.pdf](http://www.ars.usda.gov/SP2UserFiles/person/%201430/ISPRS_AGRIFISH_Final.pdf) , accessed 7/8/11) CJQ

**Timely and accurate prediction of crop yields is critical for agricultural markets, planning and development.** Daily frequency of MODIS data acquisition at 250 m pixel resolution offers a great potential for use of the data and products in operational yield prediction programs. In this study, a simple algorithm that uses near-real time MODIS imagery and products was developed to predict crop yields at county and state levels. The algorithm includes crop-specific classification and yield prediction prior to crop harvest. The **crop classification was developed using a decision tree algorithm** that relied on the characteristics of crop growth phenology **without the need for ground-based data. The classification accuracies were compared with** the USDA NASS **Landsat based classification data and found to be acceptable for yield predictions. The correlation** between NDVI and crop yields and between surface temperature and crop yields **are integrated in a multidimensional regression model** for predicting yields at the county and state levels. Differences between the NASS state level yield estimates and the regression algorithm predictions for both Iowa and Illinois for the 2006 season was less than 4 b/ac for corn and less than 2 b/ac for soybeans. The quality of MODIS data is very critical for crop yield predictions and this paper describes some of the steps that we achieved to enhance the quality of data for cloud cover and atmospheric effects. **The computational scale appeared to make a difference in the tolerance on the imagery data quality.**  Although the same algorithm was used for both state and county level yield predictions, the county yield predictions appeared to be more sensitive to quality of the images and the yield predictions were not as well correlated with the NASS estimated yields. Another important factor in this lower coefficient of determinations at the county level was that the NASS estimates have an error that is not reported. However, assuming an error in the NASS county yield estimates, the predictions are well within a 20% standard deviation of the estimates.

Famine – IL – China Wheat

**Chinese wheat crunch coming now—drought means they'll have to import wheat; crashes economy.**

**Bradsher 11** (Keith, Hong Kong Bureau Chief of the NYT, [http://www.nytimes.com/2011/02/14 /world/asia/14china.html?\_r=1](http://www.nytimes.com/2011/02/14%20/world/asia/14china.html?_r=1), accessed 7/8/11) CJQ

HONG KONG — It is weather with global breadbasket implications. Even as senior Chinese officials exhort local officials to do everything possible to cope with a severe drought in the country’s wheat belt, the government is trying to reassure the public that [food prices](http://topics.nytimes.com/top/reference/timestopics/subjects/f/food_prices/index.html?inline=nyt-classifier) will not rise. **China’s drought-control headquarters** posted a [statement](http://sfdh.chinawater.com.cn/zxdt/20110213/201102130001.htm) on its Web site on Sunday that **described conditions as “grim” across a wide area of the wheat belt in Northern China and called for emergency** irrigation **efforts**. Agricultural experts say it is too early to assess the damage to the wheat harvest. “We are **in the winter** months now, when **it is typically drier anyway**, so the seedlings should still be alive,” said an expert at [Shandong Agricultural University](http://www.sdau.edu.cn/esdau/new/) who would provide only his family name, Wang. “**But if the weather turns warmer** and there is still no rain, **then we will not be talking about lower agricultural production, but rather zero production,** because the seedlings will all be dead.” The worries go beyond China, which has essentially been self-sufficient in grain for decades. **The concern is that China**, with 1.3 billion mouths to feed, **may need to import wheat** in volume, **creating shortages elsewhere. Wheat prices** in Chicago **jumped** nearly **2 percent** on Tuesday **when the**[**United Nations’ food agency issued a rare alert**](http://www.nytimes.com/2011/02/09/business/global/09food.html)**that China’s crop was in trouble, and prices remain near their highest level** since a [steep spike in commodity prices in 2008](http://www.nytimes.com/2008/02/13/business/13wheat.html). Light snow and rain fell on north-central areas of China’s wheat belt on Wednesday and Thursday, partly because meteorologists had fired artillery shells and truck and aircraft-mounted rockets loaded with the [cloud-seeding](http://www.scientificamerican.com/article.cfm?id=cloud-seeding-china-snow) chemical silver iodide. Because of the recent precipitation, drought-control officials said last week that about one-tenth of the drought-stricken area had received adequate moisture for now. Prime Minister [Wen Jiabao](http://topics.nytimes.com/top/reference/timestopics/people/w/wen_jiabao/index.html?inline=nyt-per) assured the public in televised remarks late last week that the supply and demand of grain were “basically” in balance and that large stockpiles were available. The Finance Ministry has begun offering emergency subsidies of $9 to $11 an acre to help farmers pay for irrigation. Local and provincial governments are also providing financial help. Chen Shuwei, the vice president and chief analyst at Beijing Orient Agribusiness Consultant, a Beijing firm with close links to the Agriculture Ministry, said that the winter wheat crop supplied over 90 percent of the country’s supply and was typically harvested in June, with the rest grown over the summer. **China is the world’s largest wheat grower, accounting for one-sixth of the world output** in good years. **The government has** wheat **stockpiles equal to half the** country’s **normal harvest**. Beijing’s top priority this year is to fight inflation, and food **accounts for a third of China’s** [**consumer price index**](http://topics.nytimes.com/top/reference/timestopics/subjects/c/consumer_price_index/index.html?inline=nyt-classifier). China’s leadership appears to have become alarmed after Mr. Wen toured drought-stricken regions in late January and then held a cabinet meeting to discuss the problem.

Famine – IL – China Rice

**China will face rice crisis in 2015—internal solutions fail.**

**Bradsher 11** (Keith, Hong Kong Bureau Chief of the NYT, [http://www.nytimes.com/2011/02/14 /world/asia/14china.html?\_r=1](http://www.nytimes.com/2011/02/14%20/world/asia/14china.html?_r=1), accessed 7/8/11) CJQ

**The risk of a grain shortage in China is on the rise due to** increasing natural disasters and **rising costs**, even though the country has managed to increase its grain production for seven consecutive years, a Chinese agricultural official said. Deputy Agriculture Minister Wei Chaoan said in an interview with the People's Daily that while overall grain production meets current demand, issues facing long-term agricultural development remain, along with other emerging challenges. China's grain production totaled 1,092.8 billion catties (546.4 billion kilograms) in 2010, the fourth year that the figure topped the 1,000 billion catties mark, Wei said. **Currently, China is self-sufficient in meeting demand for** long-grained **rice, wheat and corn. The supply of** round-grained **rice**, which is generally grown in northern and southwestern China however, **is tight, and could see a shortfall in 2015 when consumption is expected to surpass 25 billion catties.** Additionally, **the country** already **relies on imports of soybeans to meet** increasing **demand, since domestic production only supplies 30 percent** of the market. China imported 42.55 million tons of soybeans in 2009 and that figure is set to top 50 million in 2010. With an annual grain loss of over 100 billion catties due to natural disasters, Wei said that **the weather remains a deciding factor in China's agricultural production. Limited resources and rising labor** and energy **costs have also had negative effects** on the sector. **Continuing to increase farm land will no longer be a viable approach** to increasing grain production to feed China's 1.3 billion population, while expanding production of cash crops like cotton at the same time, Wei said. During the 12th five-year period that begins this year, Wei said that China will work on keeping overall grain production above 1,080 billion catties, while maintaining total farm land at more than 1.6 billion mu (1,066.67 billion square meters). Furthermore, Wei said that China will focus on expanding round-grained rice production, while ensuring continuing self-sufficiency in long-grained rice, wheat and corn. To create a competitive sector, China will also increase farms of high-yielding cash crops in 2011 by over 10,000 mu.

Famine – IL – Russia Wheat

**Russian wheat failures spur crunch—empirically leads to civil instability.**

**Hassan 10** (Amro, reporter, <http://latimesblogs.latimes.com/babylonbeyond/2010/08/egypt-fears-of-a-crisis-after-russias-wheat-export-ban.html>, accessed 7/8/11) CJQ

**Russia's decision to**[**ban**](http://www.dailymail.co.uk/news/article-1300204/Drought-hit-Russia-bans-wheat-exports-start-possible-food-war.html)**grain exports is fueling anxiety among Egyptians that an international** wheat **crisis could lead to massive food shortages** in the Arab world's most populous country.   Egypt **is the world's top** wheat **importer**, annually buying 6 million to 7 million tons from the international market. About **50%** of that **comes from Russia**. However, **record** high **heat**, accompanied by wildfire **and**[**drought**](http://uk.reuters.com/article/idUKTRE66S4L420100729)**, has forced Moscow to abandon its commitments on wheat exports** in order to protect Russian needs. That means **Egypt will not receive 540,000 tons of wheat that was scheduled for delivery** by Sept. 10. Nomani Nomani, head of the General Authority for Supply Commodities, has tried to downplay concerns of a potential food shortage. Nomani said Egypt has a four-month stockpile of wheat for local markets, and that the government will purchase an extra 60,000 tons a month from other countries. Nonetheless, Ali Sharaf Eddin, head of the Egyptian Chamber for Cereal, said the government is to blame for  producing only about 8 million tons of domestic wheat a year. "Now **the country's treasury will have to spend an extra 5 billion** Egyptian pounds **to cope with the international increase in wheat prices**," he said. Egyptians' greatest fear is a possible increase in the price of subsidized wheat products, such as bread, which are heavily relied upon by millions of poor citizens. According to U.N. figures, one-fifth of Egypt's population of 80 million are living on less than $1 per day. "We have no intention of raising the prices of subsidized commodities," said Ali Moseilhi, Minister of Social Solidarity.  **International markets have already witnessed a 40%**[**increase**](http://www.businessweek.com/ap/financialnews/D9HDHB800.htm)**in** wheat **prices**. The United Nation's Food and Agriculture Organization, [FAO,](http://www.fao.org/) warned of "serious implications for world wheat supplies in 2010/2011 should the Russian drought continue." **In 2007, wheat prices tripled worldwide and resulted in vast shortages of subsidized bread across Egypt. Several people died as**[**thousands fought**](http://www.telegraph.co.uk/finance/economics/2787714/Egyptians-riot-over-bread-crisis.html)**in lines outside public bakeries for limited amounts of bread**, forcing President Hosni Mubarak to order [military](http://news.bbc.co.uk/2/hi/middle_east/7300899.stm) intervention to end the conflict.

Famine – Impact – AIDS

**Famine creates the conditions for the spread of AIDS: malnutrition combined with survival sex guarantee infection.**

**Himmelgreen and Romero-Daza 8** (David A., Nancy, University of South Florida, <http://www.aaanet.org/pdf/upload/49-7-Himmelgreen-Romero-Daza-In-Focus.pdf>, accessed 7/8/11) CJQ

During the 1970s and 1990s, Africa experienced worsening poverty, drought and malnutrition. Of the 19 famines registered globally between 1975 and 1998, 18 occurred in the continent. This led to massive migration to areas where burgeoning refugee camps emerged. In time, **food shortages and unsanitary conditions made**  these **settings ripe for the rapid spread of** infections, including **HIV/AIDS** (Von Braun et al’s Famine in Africa 1999). As Scrimshaw and SanGiovanni note in “Synergism of Nutrition, Infection, and Immunity” (Journal of Clinical Nutrition 66[2]), **HIV can adversely affect nutritional status through reduced absorption** of nutrients, **altered** nutrient **storage and insufficient food intake.** Likewise, **malnutrition can heighten the risk of infection, including increased susceptibility to HIV strains. Malnutrition plays a role in the onset of AIDS-related diseases** in people living with HIV/AIDS, increases susceptibility to the disease among non-infected people and facilitates vertical transmission. The new Variant famine Theory In resource-poor settings, **the synergy of HIV/AIDS and food insecurity facilitates the spread of the virus as people resort to** strategies such as **the exchange of sex for food**. Furthermore**, the epidemic depletes household assets and reduces people’s capacity to escape poverty** (Masanjala, “The Poverty-HIV/AIDS Nexus in Africa,” Social Science & Medicine 64). De Waal and Whiteside (“New Variant Famine,” Lancet 362[9391]) argue that the new variant famine theory can be used to understand the role AIDS plays in intensifying the food crisis in Southern Africa. The impact of AIDS on the economy of SubSaharan Africa (SSA) is severe, with an estimate of up to 35% reduction in labor force by 2020. HIV/AIDS and food insecurity also limit the ability of households to produce or secure food, leading to under-nutrition and malnutrition (Gillespie and Kadiyala, “HIV/AIDS and Food and Nutrition Security,” Food Policy Review 7).

Famine – Impact – Starvation

**Climate change and food shortages guarantee coming famine for the poor.**

**Rosenthal 7** (Elisabeth, New York Times, <http://www.physics.rutgers.edu/~karin/140/articles/nyt-shrinking-food-12-18-2007.pdf>, accessed 7/8/11) CJQ

ROME — **In an “unforeseen** and unprecedented” **shift, the world food supply is dwindling rapidly and food prices are soaring** to historic levels, the United Nations’ top food and agriculture official warned Monday. The changes created “a very serious risk that **fewer people will be able to get food,” particularly in the developing world,** said Jacques Diouf, head of the United Nations Food and Agriculture Organization. The agency’s food price index rose by more than 40 percent this year, compared with 9 percent the year before — a rate that was already unacceptable, Mr. Diouf said. New figures show that **the total cost of food imported by the neediest countries rose 25 percent** in the last year, to $107 million. At the same time, **reserves of cereals are severely depleted**, the agency’s records show. World **wheat stores declined 11 percent** this year, **to the lowest level since** 1980. That corresponds with 12 weeks of the world’s total consumption, much less than the average of 18 weeks’ consumption, in storage during the 2000-2005 period. There are only 8 weeks of corn left, down from 11 weeks in the same five-year period. **Prices of wheat and oilseeds are at record highs**, Mr. Diouf said Monday. Wheat prices have risen by $130 a ton, or 52 percent, since a year ago. United States wheat futures broke $10 a bushel for the first time Monday, a psychological milestone. Mr. Diouf said the crisis was a result of a confluence of recent supply and demand factors that, he said, were here to stay. On the supply side, **the** early **effects of global warming have decreased crop yields in some crucial places**. So has a shift away from farming for human consumption to crops for biofuels and cattle feed. Demand for grain is increasing as the world’s population grows and more is diverted to feed cattle as the population of upwardly mobile meat-eaters grows. “We’re concerned that **we are facing the perfect storm for the world’s hungry,”** said Josette Sheeran, executive director of the World Food Program, in a telephone interview. She said that her agency’s food procurement costs had gone up 50 percent in the last five years and that some poor **people were being “priced out of the food market**.” To make matters worse, **high oil prices have doubled shipping costs in the last year, putting stress on poor nations that need to import food and the humanitarian agencies that provide it.** Climate specialists say the poor’s **vulnerability will only increase.**

Famine – Impact – Disease

**Famine leads to disease—minor scratches develop into massive infections which ensure death. Accurate predictions allow for planning which can solve.**

**Tamas 8** (R. Tamas, Hungarian Defence University, [http://caribbean.scielo.org/scielo.php ?script=s ci\_arttext&pid=S0043-31442008000100016&lng=en&nrm=iso](http://caribbean.scielo.org/scielo.php%20?script=s%20ci_arttext&pid=S0043-31442008000100016&lng=en&nrm=iso)**,**  accessed 7/8/11) CJQ

**In famine, there are usually not enough doctors** or nurses; **hospital beds and equipment are insufficient; drugs and vaccines are scarce. The efficient organization of relief depends on accurate assessments of the** course of the **famine. The number of people** likely to be **in need** of relief in the near future **must be forecast. Great disasters seldom arise** suddenly and **without warning**. If possible, **the causes of death and the nature of the diseases** requiring hospital treatment **should be stated**. An adequate supply of sanitary stores, including vaccines, and disinfectants, should be available also in war-time, with sufficient reserves kept in medical stores to meet any further emergency. In the early stages of famine, rapid recovery frequently follows a few days of feeding and attention to minor ailments. **If treatment is neglected** at this stage, **the condition of the patient may rapidly deteriorate. It is therefore** very **important to give the best medical care to persons with even minor illnesses**. In summary, famine relief in war-time inevitably presents many and diverse problems. **It is often difficult for a worker on the spot to sort out what is essential from what is only desirable**. It is hoped that this paper would stimulate thought on the principles of relief, for in famine, forethought is the best antidote to disaster.

Famine – Impact – War

**Famine leads to warfare, which leads to malnutrition—once the genie is out of the bottle it won't go back in. Food wars spark massive revolutions—regimes will backlash and crush the population.**

**Smith 98** (Paul J., Asia-Pacific Center for Sec'y Studies, [http://www.apcss.org/Publications/ Report\_Food\_Security\_98.html](http://www.apcss.org/Publications/%20Report_Food_Security_98.html), accessed 7/8/11) CJQ

**Food security and political stability are** often **inextricably linked** in many countries. Historically, significant **malnutrition and famine have been caused by the disruption of food supplies** through wars and civil strife.[53](http://www.apcss.org/Publications/food-ftnt-46-64.htm)  Yet, **the concepts** of food security and political stability **are** often **mutually dependent and reinforcing. Food security**, for example, **can influence the political stability of countries**. Simultaneously, **political instability (such as wars** or other forms of civil strife) **can influence food security**, as can be seen recently in the case of Indonesia. **One** seminar participant noted that **the greatest risk** for regime stability **is** the risk of **urban riots**—riots that are sometimes **sparked by food shortages or sudden price increases** among food products. Generally, starvation in the countryside does not result in political instability. This is because those who experience the brunt of food shortages tend to be rural and have little political voice. A recent example of this phenomenon occurred in India where rising food prices led to urban riots directed at India’s ruling political party—the Bharatiya Janata Party. Similarly, when the price of rice soared in Indonesia, thereby making it prohibitively expensive for a large segment of the population, food riots erupted in eastern Java. The government deployed military forces around markets to prevent looting. Moreover, China’s sharp rejection of the Lester Brown thesis that China needs to import massive amounts of grain from the world market in the coming century was partially rooted in a persistent fear within the Chinese government that food insecurity could potentially provoke widespread anger against the Communist Party and perhaps lead to civil unrest. Thus, **the sensitivity that many Asian governments have about food security may be linked to fears of social instability and** perhaps even **political revolution. Food security** thus **becomes an issue of regime survival**. **Another** security **concern** prominent in many Asian capitals **is** the prospect for increased **economic migration** as a result of food shortages. **Internal migration is the first concern for** many **governments**, especially **as internal migration is often a natural "coping response" in times of famine**. When North Korea experienced severe floods in September 1995, South Korea responded by creating refugee camps to deal with the possible flood of people who might have fled toward the south. Similarly, Indonesia’s food crisis in 1997 was partly responsible for the outflow of thousands of Indonesian migrants to Malaysia. As the crisis in Indonesia intensified in early 1998, many neighboring countries feared that many more "hungry Indonesians [would] take to boats in search of a better life."[54](http://www.apcss.org/Publications/food-ftnt-46-64.htm) Many **countries in East Asia are extremely sensitive** and wary **about** immigration—especially **mass** migration **or illegal migration. The recent surge** in labor and economic migration throughout the region **has catapulted the immigration issue to the highest levels of government**. Immigration disputes, moreover, have broken out between nations—such as the in case of Singapore and the Philippines in 1995—regarding illegal immigration and repatriation policies. Few governments in the region officially desire more immigration. To the extent that food insecurity might spur greater migration, then it may be viewed by many governments in the region as a security concern.

Famine - Impact – Ethics

We have an ethical obligation to mitigate or prevent famine

LaFollette 2k3 [Hugh, Cole Chair in Ethics University of South Florida St. Petersburg, "World Hunger" Blackwell Companion to Applied Ethics, ed. Ray Frey and Christopher Heath Wellman, Blackwell 2003, <http://www.stpt.usf.edu/hhl/papers/World.Hunger.htm>]

Those who claim the relatively affluent have this strong obligation must, among other things, show why Hardin's projections are either morally irrelevant or mistaken. A hearty few take the former tack: they claim we have a strong obligation to aid the starving even if we would eventually become malnourished. On this view, to survive on lifeboat earth, knowing that others were tossed overboard into the sea of starvation, would signify an indignity and callousness worse than extinction (Watson 1977). It would be morally preferable to die struggling to create a decent life for all than to continue to live at the expense of the starving.

\*\*\*Biodiversity Advantage\*\*\*

Bio-D – Solvency – General

Landsat key to conservation – 10 major areas

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

Among forest habitats the focus has been on temperate forests, about 47% of the published papers (Figure 1c). This is followed by research on tropical rainforests (37%). All other forest types seem to be little monitored or studied using Landsat satellite imagery. That temperate edges out tropical by such a margin is a bit surprising considering that NASA had a special research program – the Landsat Pathﬁnder Program – that focused largely on changes in humid tropical forest ecosystems in the Amazon basin and Southeast Asia. However, the U.S. Forest Service and its university extensions were probably among the largest users of Landsat imagery, and clearly focused their efforts on temperate forest ecosystems in the continental U.S. In addition, one component of the Pathﬁnder program was actually focused on North American forests. Much of this work found easy access to the scientiﬁc journals, many of which are published in the United States. We identiﬁed 10 major subject areas that were addressed in conservation biology through analysis of different aspects of Landsat imagery (Table II). The list of subjects is lead by research on land cover change, but also addresses more speciﬁc areas such as gap analysis, a method developed in the U.S. to identify gaps in the protection of biological diversity on a state-by-state basis (Scott et al., 1993). Most of the publications address biological changes, ranging from broadly-addressed land cover changes to, more speciﬁcally, deforestation, habitat loss and fragmentation, ﬁre monitoring, erosion and climate change. The biodiversity monitoring and gap analysis research are targeted especially towards using land cover types identiﬁed from remote sensing analysis of Landsat imagery to approximate biodiversity across the landscape and determine its current status and potential future threats. Lastly, the landscape ecological studies generally pertain to research that assesses effects on ecological processes of heterogeneity in the spatial arrangement of ecosystems or habitat types.

Landsat data key to conservation, and its use is increasing

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

From our analysis of published research, it appears that over time Landsat data have become more widely available and utilized throughout the conservation biology community. However, even allowing for the existence of a considerable amount of gray literature, which was not included in our bibliographic search, the use of Landsat-derived data in conservation biology publications is not as extensive as we had expected. This may reﬂect the difﬁculties in developing scientiﬁcally rigorous ways for linking ecological processes across scale, i.e. linking the behavior of an organism or patterns in biodiversity at the local scale to changes in the biosphere at the regional, continental or even global scale. Glimpses of these scale issues become apparent in recent reviews of ecological and conservation applications of satellite remote sensing (Kerr and Ostrovsky, 2003; Turner et al., 2003). Signiﬁcant advances have already occurred, and, as conservation biologists continue to tackle scaling issues, it is clear Landsat use in conservation research will continue to expand. Many of these conservation uses of Landsat-derived data occurred in the early 1990s, almost 20 years after the launch of the ﬁrst Landsat satellite. While they paralleled NASA’s and the U.S. government’s recognition that Landsat data were truly useful for Earth system science and global change research (Goward et al., 1999, 2000), applications of Landsat data for conservation biology received little attention. Considering the pattern of use in light of the early evolution of the Landsat program explains some of this imbalance:

Bio-D – Solvency – Research

Landsat data key bio research

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

Today, Landsat satellite imagery and comparable products clearly belong in the toolboxes of landscape ecologists and many conservation biologists. Many of these researchers are probably relying on free or cheap Landsat data that is being distributed by various universities and conservation organizations via the Internet. Purchase of larger numbers of images for conservation biology research is probably mostly restricted to government agencies and U.S. universities. Surprisingly, these user communities have not yet widely voiced concerns about the future of the Landsat program and what this might mean for their applied and basic conservation research.

Landsat key to biodiversity studies – multiple environments

Urho and Niemela 9 (Niko, Ministry of the Environment of Finland and Jari, Urban Ecology Research Group, U Helsinki, 1/15, http://www.biostrat.org/Sustainable%20use%20of%20biodiversity%20-%20FI.pdf, accessed 7-6-11, JMB)

Several studies have shown that satellite-based land cover images combined with topographic data are useful in identifying farmland areas important for biodiversity. Landsat TM satellite images from South-West Finland were studied and found useful for mapping semi-natural grasslands (Toivonen & Luoto 2003), which are considered highly important for biodiversity. Other studies have shown that environmental variables derived from Landsat TM images and topographic data can be used to assess plant species diversity (Luoto et al. 2002) and bird species richness (Luoto et al. 2004) in agricultural landscapes. Remote sensing data has been used during the period 2000- 2006 to identify high biodiversity farmland areas and to monitor recent changes of land use in the MYTVAS follow-up study of the biodiversity effects of the agri-environmental scheme (see chapter 2.2). The results suggest that satellite images and GIS provide an approximate cost-efficient method to estimate the biodiversity status of wide areas on a broad scale thus have given rise for a new tool for sustainable land use planning. These studies can be considered as a starting point for further studies that have been made to identify HNV farmland discussed below.

Bio-D – Solvency – Quantification

Remote sensing is key to quantifying bio-d loss for organizations – tech advancements increase its usefulness

Turner et al 3 (Woody Turner1, Sacha Spector2, Ned Gardiner2, Matthew Fladeland3, Eleanor Sterling2 and Marc Steininger4 1NASA Office of Earth Science, 2Center for Biodiversity and Conservation, American Museum of Natural History, 3Earth Science Division, NASA Ames Research Center, 4Center for Applied Biodiversity Science at Conservation International, TRENDS in Ecology and Evolution Vol.18 No.6 June, p. 306-314 “Remote sensing for biodiversity science and conservation” JMB)

The potential for modern sensors to identify areas of significance to biodiversity, predict species distributions and model community responses to environmental and anthropogenic changes is an important research topic. Underlying this effort is the assumption that certain key environmental parameters, with remotely detectable biophysical properties, drive the distribution and abundance of species across landscapes and determine how they occupy habitats. New imagery and data sets are now enabling remote sensing, in conjunction with ecological models, to shed more light on some of the fundamental questions regarding biodiversity. These tools should prove useful to those seeking to generate basic knowledge about why organisms are found where they are, as well as those asking the more applied question of where to invest conservation funds. Here, we use the term ‘biodiversity’ in its organismal sense to refer to species and certain characteristics of species, in particular their distribution and number within a given area. We also use ‘biodiversity’ more broadly to mean species assemblages and ecological communities (i.e. groups of interacting and interdependent species). There are two general approaches to the remote sensing of biodiversity. One is the direct remote sensing of individual organisms, species assemblages, or ecological communities from airborne or satellite sensors. New spaceborne systems with very high spatial (also known as hyperspatial) resolutions are now available from commercial sources. For the first time, the direct remote sensing of certain large organisms and many communities is possible with unclassified satellite imagery. Likewise, new hyperspectral sensors slice the electromagnetic spectrum into many more discrete spectral bands, enabling the detection of spectral signatures that are characteristic of certain plant species or communities. The other approach is the indirect remote sensing of biodiversity through reliance on environmental parameters as proxies. For example, many species are restricted to discrete habitats, such as a woodland, grassland, or seagrass beds that can be clearly identified remotely. By combining information about the known habitat requirements of species with maps of land cover derived from satellite imagery, precise estimates of potential species ranges and patterns of species richness are possible. Just such an approach has been employed extensively in the US GAP analysis program [1]. Of course, it is probable that no single environmental parameter drives patterns of species distribution and richness. Many possible drivers have been proposed (Table 1). Here, we focus on three often-cited environmental parameters that now lend themselves particularly well to detection because of recent advances in remote-sensing technology: primary productivity, climate and habitat structure (including topography) [2–5]. For the conservation biologist, remotely sensed imagery exposes land-cover changes at spatial scales from local to continental, letting one monitor the pace of habitat loss and conversion [6,7]. These measurements of habitat loss can be converted into quantitative estimates of biodiversity loss through the use of the species–area relationship (Box 2), which underlies many current estimates of biodiversity decline [8–12].Remote sensing provides the area component of the equation. Public and nongovernmental conservation organizations worldwide leverage their understanding of species–area relationships with imagery-based habitat classifications to estimate species losses associated with changes inland cover and land use(Box3).The challenge is to go beyond this approach to a more detailed understanding of which species are being lost and why. How can we match existing and emerging remote-sensing technologies to parameters that have clear implications for organisms and ecosystems? Here, we review evidence that indicates that we might be close to improving greatly the detection of species, ecological communities and patterns of species richness with remote sensing. We explore recent advances in technology, addressing direct and indirect approaches to the remote sensing of biodiversity. Following the discussion of each technology, we offer examples of applications of that technology to the issue at hand.

Bio-D – Solvency – Deforestation

Landsat key to regional forestry analysis

Harris et al 5 (Grant M., Clinton N. Jenkins, and Stuart L. Pimm, Nicholas School of the Environment and Earth Sciences at Duke, http://www.terpconnect.umd.edu/~cnjenkin/Harris\_et\_al\_2005.pdf, accessed 7-6-11, JMB)

Generating forest maps at regional scales requires satellite imagery analysis. It is important to match this objective with suitable types and formats of input imagery. A primary consideration is the imagery’s spatial resolution. Generally, the smaller an image’s spatial resolution ( pixel size), the less area it maps. For example, were we to use Landsat ETM+ imagery (30 × 30 m) to map the entire Atlantic Forest, it would require approximately 75 scenes. The computational issues are significant (and the imagery costs are expensive, up to US$45,000). Additionally, we already know that more than 90% of the region is deforested and has little, if any, conservation value ( Harris & Pimm 2004). Our application demands mapping the entire region, but applying considerable effort to cover vast areas we know are deforested seems inappropriate. Region wide, an ecologically relevant map does not require high spatial detail. For example, the resolution of regional sensors spans 250 m to 1 km. Such imagery supplies adequate resolution for prioritizing subregions from an expanse >1 million km2 . Overall, maps generated from regional sensors provide an accurate picture of where forested habitat remains. To evaluate the types of satellite imagery designed for regional analyses, we used three different sources (AVHRR, SPOT VGT, and MODIS). We also evaluated the ability of a jpg composite based on Landsat TM data (the GeoCover Landsat TM mosaic, produced by the Earth Satellite Corporation, Rockville, Maryland) to map the Atlantic Forest. Lastly, our analysis included two preclassified products (MODIS Continuous Fields and a MODIS derived landcover based on MODIS imagery)

Landsat provides higher-accuracy forest data

Harris et al 5 (Grant M., Clinton N. Jenkins, and Stuart L. Pimm, Nicholas School of the Environment and Earth Sciences at Duke, http://www.terpconnect.umd.edu/~cnjenkin/Harris\_et\_al\_2005.pdf, accessed 7-6-11, JMB)

To evaluate the location and quality of forest mapped, we compared each prediction’s spatial attributes against the Landsat ETM+-based forest cover (Fig. 3). All comparisons had forest fragments of <1 km2 removed. Such areas generally have little long-term conservation value for birds (Willis 1979; Stouffer & Bierregaard 1995; Brooks et al. 1999; Ferraz et al. 2003) other than their usefulness in building corridors at finer scales. We began by quantifying the percentage of the Landsat ETM+ forest prediction inside every 1 × 1 km pixel on the other maps. (This was also performed at 500 × 500 m for relevant predictions.) These percentages were binned into 10 equal categories, with the bin values corresponding to the proportion of Landsat ETM+ forest predicted in the coarser cells (Fig. 3, horizontal axis). The larger the bin value, the more Landsat ETM+ forest area was predicted in each of the coarser cells (indicating greater amounts of forest). Fragmented areas formed bins 5 and below ( less than 50% forest coverage). We calculated the intersection between these bins and all pixels predicted to be forest for each of the maps. For example, the upper left grid (Fig. 3) contains 16 hypothetical cells. The values in each cell represented the percentage of the Landsat ETM+ forest predicted inside them (now at the same resolution as the regional sensor with which it is being compared). The light gray shading indicates another forest map that also predicts some of these cells as forest. Of the four pixels that contained 95% forest according to Landsat ETM+ (bin 10), our coarser forest map captured three of them (75%). In other words, it predicted three cells that are 95% covered with the Landsat ETM+ forest prediction. The coarser forest prediction also mapped 60% of the pixels in bin 8 (71–80% covered by the Landsat ETM+ prediction), 67% in bin 7, and 50% in bins 3 and 4. We evaluated the six forest covers in this manner and calculated the percentage of times they intersected the bins (Fig. 3, vertical axis). Because the GeoCover Landsat TM mosaic is also resolved at 30 × 30 m, before this comparison we calculated its percent forest in 500 × 500 m pixels and considered pixels ≥60% to be forest. Lastly, we investigated the fractal dimension of areas in the Landsat ETM+ forest prediction missed by the coarser forest maps (mixed pixels). At times, the coarser resolution sensors predicted forest for pixels that were only half covered with forest according to the finer resolved Landsat ETM+ sensor ( bin 5). If the spatial arrangement of the 30 × 30 m pixels predicted to be forest by the Landsat ETM+ were spread out, it would help explain why the1 × 1 km or 500 × 500 m sensors did not map them. On the other hand, the coarse sensors may include these pixels as forest if their distribution were clumped. We found no differences in fractal dimension between these mixed pixels classified and unclassified as forest by the coarse sensors.

Bio-D – Solvency – Deforestation

Landsat key to monitoring deforestation

Joseph et al 9 (S. Joseph · B. Gharai · S. Sudhakar · M. S. R. Murthy Forestry and Ecology Division, National Remote Sensing Agency, S. Joseph, GIS Centre, Department of Physical Geography and Ecosystem Analysis, Lund University, G. A. Blackburn Department of Geography, Lancaster University, S. Joseph · A. P. Thomas School of Environmental Sciences, Mahatma Gandhi University, Environ Monit Assess 158:169–179, http://www.lancs.ac.uk/staff/blackbga/Joseph%20et%20al%20EMAS%202009%20printed%20version.pdf, accessed 7-6-11, JMB)

Land cover change is one of the most critical dynamic elements of ecosystems. Tropical forests, which play critical roles as repositories of biological diversity and regulators of global biogeochemical and hydrological cycles (Houghton 1999; Cairns et al. 2000; Myers et al. 2000) have undergone rapid land cover changes especially in the last few decades. (Bockstael et al. 1995; Pijanowski et al. 2000). Global estimates show that deforestation in the tropics during 1990–2000 was 14.2 million ha per year while reforestation was 1.9 million ha, which resulted in a net loss of 12.3 million ha of forest per year (FAO 2001). South Asia experienced a negative rate (0.13% per annum) of forest cover change, which was approximately half the negative rate of change in the world (0.22% per annum) and double the negative rate of change for the whole Asian region (0.07% per annum). These trends point out the prevalence of complex and multidirectional changes in forest cover dynamics which could be attributed to local level management measures. Remote sensing offers an important means of detecting and analyzing temporal changes and since the early 1970s satellite data have been commonly used for change detection studies (Jensen et al. 1993). The use of remotely sensed data for monitoring tropical deforestation and assessing the drivers of deforestation has been operationalised by a range of programs. Noteworthy programs include NASA’s (National Aeronautics and Space Administration) Landsat Pathﬁnder Project on Deforestation in the Humid Tropics (Townshend et al. 1995; Kalluri et al. 2001) and the TREES (Tropical Ecosystem Environment Observations by Satellite) project (Stibig and Achard 2003). Such work has demonstrated that satellite remote sensing can provide satisfactory results for regional forest cover mapping and for obtaining up-to-date and uniform estimates of the total forest area in a region. Furthermore, a range of change detection techniques have been developed for monitoring land cover dynamics from remotely sensed imagery (see reviews by Coppin et al. 2004; Lu et al. 2004). Such techniques have been used to explore the relationships between shifts in vegetation patterns and factors such as human activities, natural disturbances and topography (Turner et al. 1996; Cohen et al. 2002). Moreover, remote monitoring of deforestation as well as successional regrowth has yielded valuable insights into processes such as the dynamism of ecotones, rates of succession, and invasion of weeds, which, in turn has provided substantial evidence concerning the drivers of land cover change (Nelson and Holben 1986; Sader et al. 1990; Mausel et al. 1993).

Bio-D – Solvency – Land Management

Remote-sensing key to improving land management strategies

Joseph et al 9 (S. Joseph · B. Gharai · S. Sudhakar · M. S. R. Murthy Forestry and Ecology Division, National Remote Sensing Agency, S. Joseph, GIS Centre, Department of Physical Geography and Ecosystem Analysis, Lund University, G. A. Blackburn Department of Geography, Lancaster University, S. Joseph · A. P. Thomas School of Environmental Sciences, Mahatma Gandhi University, Environ Monit Assess 158:169–179, http://www.lancs.ac.uk/staff/blackbga/Joseph%20et%20al%20EMAS%202009%20printed%20version.pdf, accessed 7-6-11, JMB)

This study has demonstrated that remotely-sensed based assessments of land cover dynamics can have an important contribution to monitoring the consequences of land management strategies and deepening our understanding of the processes that underpin land use changes. The vegetation type map of the Indira Gandhi Wildlife Sanctuary derived from IRS P6 LISS III data showed that the area is currently dominated by deciduous and evergreen forests. Land cover change assessment for a period of 33 years helped to identify the rates and characteristics of land cover transformations. Two major and divergent trends, degradational and successional, were observed in the study. The degradational trend was indicated by the transformation of undisturbed forest to disturbed forest and other non-forest categories. These changes can be attributed to a number of causes, principally livelihood dependence, agricultural expansion and infrastructure development resulting from population growth in and around the area and uncoordinated policies of the different government agencies. The positive successional changes resulting from protection of the area showed the resilience of the system even after prolonged disturbances on vegetation cover. The observed degradational transitions exceed the rates of successional changes. Hence, the sanctuary appears susceptible to continuing disturbances under the current management regime, however, the impacts of such processes are substantially lower than in surrounding unprotected areas.

**Remote sensing is key to land management**

**Glenn, Nagler and Huete 10** (E.P., Univ. AZ, P.L., USGS, A.R., Dept. Ag, AZ, <http://www.springerlink.com/content/w17411820146j015/>, accessed 7/7/11) CJQ

**Estimates of terrestrial evapotranspiration** (ET) **are needed for land management tasks** at local, regional and continental scales of measurement, **and to project potential changes in the global hydrological cycle** under different climate change scenarios (e.g., Allen 2005; Teuling et al. 2009). **Remote sensing is** perhaps **the only feasible means of estimating ET over wide areas of mixed landscape** types, typical of applications for which regional water budgets are required. **Some** of the **speciﬁc tasks for which remote sensing estimates of ET are used are: determining consumptive water use by crops** in irrigation districts, to construct district-wide water budgets (e.g., United States Bureau of Reclamation 2009); reﬁning crop coefﬁcients for individual crops to match local conditions (e.g., Hunsaker et al. 2007); characterizing water use patterns of plants in natural ecosystems in ecological studies (e.g., Groeneveld et al. 2007; Dennison et al. 2009); develop**ing wide-area estimates of ET to construct catchment water budget models** (e.g., Guerschman et al. 2009); and scaling ﬂux tower measurements of ET and carbon exchange over biomes and continents, to be used in climate change studies (e.g., Leuning et al. 2008; Fisher et al. 2008). In most of these applications, **time-series satellite imagery is used to project ET over spatial and temporal scales that cannot be achieved by point estimates of ET measured on the ground**.

Bio-D – Solvency – Vegetation

Remote sensing of vegetation allows understanding of ecosystem function

Kerr and Ostrovsky 3 (Jeremy T., and Marsha, both from the Dept. of Biology at U Ottawa, TRENDS in Ecology and Evolution Vol.18 No.6 June, p. 299-305, http://mysite.science.uottawa.ca/jkerr/pdf/tree2003.pdf, accessed 7-6-11, JMB)

Unlike ﬁeld-based measurements of ecosystem function, which cannot easily be converted to estimates of function across entire ecosystems, remote sensing can provide simultaneous estimates of ecosystem function over wide areas. Remote sensing of vegetation offers promising and urgently needed measurements of ecosystem function at spatial scales that are most comparable to the extents of human-caused environmental change (Box 2). Net primary productivity (NPP) represents one aspect of integrated ecosystem function for which the normalized difference vegetation index (NDVI, Box 1) is used, particularly when reﬁned with meteorological and soil data [16]. NDVI also correlates strongly with absorbed photosynthetically active radiation (APAR), which has helped lead to its common use as an estimator of aboveground NPP [17,18]. Similar to NPP, NDVI is sensitive to changes in both temperature and precipitation [16,19].

Bio-D – Solvency – Wildlife Reserves

Remote sensing key to maintaining wildlife reserves

Gillespie et al 8 (Thomas W., Giles M. Foody, Duccio Rocchini, Ana Paula Giorgi, Sassan Saatchi, California Center for Population Research, UCLA, December, Progress in Physical Geography; 32; 203, http://escholarship.org/uc/item/6rb716b0#page-1, accessed 7-6-11, JMB)

Remote sensing may also be valuable after the establishment of reserves, not least because competing pressures, such as those associated with economic development and population growth, place great stress on reserves and the surrounding lands (Nagendra eial.. 2004). The spatial coverage provided by remote sensing offers, however, the potential to monitor the effectiveness of protected areas, allowing comparisons of changes inside and outside of reserves to be evaluated (Southworth et at.. 2006; Wright ei al.. 2007). The ability to monitor the areas outside formally protected reserves is also attractive as these may have a major role to play in conserving biodiversity (Putz ei al., 2001). For example, even relatively severely logged forest outside a reserve may represent a significant resource for biodiversity conservation {Cannon ei al., 1998) and secondary forests are an often overlooked resource that may be managed to help reduce pressures elsewhere (Bawa and Seidler. 1998). Thus, actions inside and outside the protected areas are important, supporting the view that biodiversity conservation activities should be undertaken at the level or scale of the landscape (Nagendra and Gadgil. 1999b; Margules and Pressey. 2000; Potvin et al., 2000; Hannah era/.. 2002). This activity may benefit from remote sensing as its synoptic overview provides information on the entire landscape.

Bio-D – Solvency – Assessment

Remote sensing key to overall bio-d assessment

Gillespie et al 8 (Thomas W., Giles M. Foody, Duccio Rocchini, Ana Paula Giorgi, Sassan Saatchi, California Center for Population Research, UCLA, December, Progress in Physical Geography; 32; 203, http://escholarship.org/uc/item/6rb716b0#page-1, accessed 7-6-11, JMB)

Remote sensing may be a useful component to general biodiversity assessments, especially in providing data at appropriate spatial and temporal scales. For example, the biodiversity intactness index was proposed recently as a general indicator of the overall state of biodiversity to aid monitoring and dec is ion-ma king (Scholes and Biggs. 2005). Although there are concerns for its use. notably with the impacts of land degradation, remote sensing may be an important source of data for its derivation (Rouget et al., 2006).

Bio-D – Solvency/IL – Coral Reefs

Coral reefs in danger now – key to global bio-d – new data from Landsat key to manage them

Knudby 7 (Anders, Ellsworth LeDrew and Candace Newman, Dept. of Geography at U Waterloo, Progress in Physical Geography 31(4) pp. 421-434, EBSCO, JMB)

I Introduction Coral reefs are the most biodiverse marine ecosystems on the planet, estimated to harbour nearly one million species globally (Reaka-Kudla. 1997: 93). They can be places of extraordinary beauty, and are essential to the livelihoods of people who depend on them for food, coastal protection, tourism-based income and more (Birkeland, 1997: 2). However, the health of coral reefs is declining at a global scale (Wilkinson, 2004: 7), and the threats that have precipitated this decline range from overfishing, nutrient enrichment and coral diseases at the local scale to worldwide ocean warming, acidification, and sea-level rise. Most of these threats are expected to worsen their impact in the coming decades (Hoegh-Guldberg. 1999: Kleypasera/., 1999; Pittock, 1999), leaving an uncertain future for coral reefs. The decline of coral reefs, both past and projected, is of much more than academic interest: it is a serious threat to global biodiversity, an important part of our natural heritage. Because of the complexity of coral reef ecosystems and the multitude of threats, identification of the important threats and the necessary management for a given reef is difficult. Nevertheless, the global area of coral reef under some form of management is growing, and so is the need for information on which to base management measures (Wilkinson, 2004:!}. A manager of a protected area needs assessments of various aspects of reef health, which provide both a basis from which zonation plans and management regulations can be developed, and a baseline from which changes can be assessed. Reef health is an intangible concept, and is typically mapped and monitored using a number of proxies. Live coral cover is often used for practical reasons (Mumby etai., 2004b), and so is diversity or abundance of ecologically important or vulnerable species (Hodgson et ai, 2004). However, owing to the difficulties and expense associated with conducting extensive field surveys under water, spatially distributed data of the appropriate type and detail are rarely available. Remote sensing technologies have therefore been used to map coral reefs since the early days of Landsat (Smith et a/., 1975), and research into the use of remote sensing technology continues with the advent of new sensors and data processing methods (Kutser et ai., 2006). Classification of broad substrate types is now routinely possible in clear and shallow water, and water depth can be derived from a variety of data sources with varying accuracy. The interference of the water column, however, continues to pose problems for classification accuracy, and so do the similarities in spectral signatures between important substrate types. New technologies show promise for mapping aspects of coral reef health beyond substrate types, including water quality and reef structural complexity, thus providing complementary information for mapping of coral reef biodiversity. In this paper we aim to review coral reef biodiversity and its spatial distribution, the influence of habitat characteristics on biodiversity, and remote sensing approaches to mapping coral reef habitats, with a focus on mapping habitat variables known to influence biodiversity.

Bio-D – Solvency/IL – Coral Reefs

Mapping of coral reefs provides useful info for managers – habitat variables are correlated with biodiversity

Knudby 7 (Anders, Ellsworth LeDrew and Candace Newman, Dept. of Geography at U Waterloo, Progress in Physical Geography 31(4) pp. 421-434, EBSCO, JMB)

III Habitats as indicators of coral reef biodiversity As noted, several environmental variables have been shown to influence the biodiversity of a given habitat. Mapping such habitat variables could indicate the likely spatial distribution of biodiversity at a local scale and suggest priority areas for conservation, at least for the species for which habitat-biodiversity relationships have been identified. A survey of the literature relating biodiversity and habitat variables yields a complex picture. Studies have focused on a variety of taxonomic or functional groups, have employed different measures of biodiversity, and have measured different habitat variables in different ways. A brief overview is presented in Table I. Detailed relationships are obscured by the number of different variables used, and the different temporal and spatial scales studied (Jones and Syms, 1998). It can thus be argued that a species-specific approach is more appropriate, as habitat associations of many individual species are well known and well defined (Allen et al, 2003). For a few highly significant species such an approach may be useful but, with approximately 10,000 species of described fish, and a total of one million species in all taxonomic groups estimated to exist on coral reefs, a species-specific approach is unfeasible for studies of general biodiversity patterns. Despite these problems, several conclusions can be drawn from the literature: (i) several habitat characteristics influence local biodiversity; (ii) the number of studied biodiversity and habitat variables is large and relationships are not restricted to a few variables: (iii) some habitat variables, namely depth, live coral cover and reef structural complexity, influence more biodiversity variables than others, and show stronger correlations than others; and (iv) common biodiversity measures, including species abundance, richness and diversity, show correlations with these habitat variables. Several causative mechanisms have been proposed for the relations between habitat and biodiversity. The influence of depth has been cited as an example of intermediate disturbance positively influencing species richness at intermediate depth (Huston, 1994: 383), whereas the influence of live coral cover has been related to larval settlement success and to survival of corallivorous and coral-dwelling species (Jones et at., 2004). Reef structural complexity provides physical heterogeneity and refuge for prey species -spaces big enough for them to enter but too small for their predators (Friedlander and Parrish, 1998). This illustrates the important relation between the body sizes of organisms and the spatial scale of the structure providing refuge. Habitat influences on biodiversity also extend to the temporal domain: loss of fish biodiversity can often be attributed to loss of coral cover (Jones et ai, 2004) or loss of physical structure following hurricanes or severe bleaching (Connell et ai, 1997; Garpe era/., 2006: Graham et ai, 2006). Mapping coral reef habitats can therefore provide coral reef managers with important information on the likely spatial distribution of biodiversity in their area and, in the absence of frequent field surveys, can warn about changes in biodiversity to be expected from changing habitats.

Remote sensing key to climate change and coral monitoring

Kerr and Ostrovsky 3 (Jeremy T., and Marsha, both from the Dept. of Biology at U Ottawa, TRENDS in Ecology and Evolution Vol.18 No.6 June, p. 299-305, http://mysite.science.uottawa.ca/jkerr/pdf/tree2003.pdf, accessed 7-6-11, JMB)

Remote sensing data have provided convincing evidence that climate has been changing rapidly [30], complementing ecological discoveries of poleward shifts in the ranges of many species [31,32]. Although the distributions of species have also responded to concurrent land use changes [33], time series AVHRR data demonstrate that substantial alteration to vegetation structure, primary productivity and growing season length have occurred even over the past 20 years. In boreal forests, which studies increasingly indicate to be crucial sinks for carbon dioxide, long-term analysis (1981–1999) of NDVI trends show a general increase in growing season length, annual primary productivity and northward extension of the treeline [34,35]. Integrated NDVI (the sum of NDVI measurements from all AVHRR composites measured throughout the growing season) correlates with ﬁeldbased measurements of net primary productivity, biomass accumulation and temperature. Warming, moistening trends have also been detected with the use of AVHRR and more specialized sensors over marine systems [36], providing important corroborative evidence of climate change. Widespread, synchronous coral bleaching events are due primarily to increasing sea temperatures and can be monitored with the use of Landsat 7 ETM + data [37]. Several biological consequences of climate change can be observed remotely, but ﬁeld-based research also provides convincing corroboration of biotic consequences of climate change.

Bio-D – Solvency/IL – Conservation

Medium resolution data like Landsat key to preserving bio-d by focusing conservation efforts -- bypasses national boundaries

Fuller and Jessup 8 (D.O., Department of Geography and Regional Studies at U Miami and T.C., AusAID, Australian Embassy in Indonesia, 9/2, http://www.as.miami.edu/geography/research/climatology/Fuller\_Jessup\_EKal\_2008.pdf, accessed 7-6-11, JMB)

Conservationists face many decisions on how to invest scarce resources to maximize conservation of biological diversity. In recent years, international conservation organizations and researchers have conducted a variety of planning exercises to target their investments based on a combination of biological and socioeconomic criteria (O’Connor et al. 2003). The conservation planning process often results in categorical, vector-based maps that reveal units of different conservation value or threat to biodiversity within ecoregions or biodiversity hotspots (e.g., Dinerstein et al. 1995; Olson & Dinerstein 1998). Bailey (1998) defined ecoregions as “major ecosystems resulting from large-scale, predictable patterns of solar radiation and moisture, which in turn affect the kinds of local ecosystems and animals and plants found within,” while Myers et al. (2000) defined the latter as “areas featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat.” Maps depicting ecoregions and hotspots are often quite coarse spatially and may therefore subsume or ignore areas of high conservation value that lie within homogeneous polygons. Thus, there is growing recognition that finer-scale data are needed to better identify areas within ecoregions that may merit conservation investment (Harris et al. 2005). Despite limitations imposed by scale, ecoregions and hotspots have helped conservation organizations reduce redundancy and achieve complementarity in their selection of sites for conservation investment (Olson & Dinerstein 1998). Because they transcend political boundaries, some authors (e.g., Wikramanayake et al. 2002) argue that conservation planning and investment should target entire ecoregions and hotspots to maintain the functional integrity of large ecological units. Although basing conservation planning on entire ecoregions and hotspots is preferable to planning based on political boundaries, this holistic approach can be problematic when applied to ecoregions and hotspots that span political boundaries where conservation laws, governance and enforcement practices may differ greatly (O’Connor et al. 2003). In addition, biological and socioeconomic data are sometimes collected and compiled using different sampling methods and criteria within different political units. Thus, decisions regarding land use are generally taken at the level of existing political units such as nations, states, provinces and counties and therefore planning exercises generally devolve to the local, political level as the most effective way to engage relevant decision makers. The use of remote sensing to map biodiversity (Rey-Benayas 1995; Gould 2000) holds significant promise for providing fine-scale information on ecosystem condition within specific hotspots and ecoregions. In particular, remote sensing at medium (<100m) to high (0.5-5m) spatial resolutions provides a way to collect common information across political boundaries. For example, Landsat and other optical systems are used to map plant canopy structure and condition, which are key determinants of species richness in forested ecosystems (Ozanne et al. 2003), to extract transportation infrastructure and waterways that provide access to key terrestrial habitats, and to pinpoint recent patterns of degradation caused by land use (Turner et al. 2007). Imagery of moderate-to-high spatial resolution has proven effective for determining threats to biodiversity such as habitat fragmentation, degradation, and reserve integrity (Lambin 1997; Fuller 2001; Sanchez-Azofeifa et al. 2003; Curran et al. 2004; Trigg et al. 2006). The spatial resolution of satellite sensors currently used by conservation biologists to assess habitat and biodiversity generally ranges from 30 m to 1 km, which allows production of maps 5 that can capture subtle gradients of land use, vegetation cover, and habitat type. Since the data structure of satellite images is raster-based, maps derived from these observations generally integrate well with dynamic climate-vegetation models that predict changes in plant functional types in response to changes in climate and other parameters (Kleidon & Mooney 2000; Hannah et al. 2002). Thus, cell or raster-based approaches may facilitate integration of conservation planning with dynamic or transient phenomena such as wildfires and climatic change, which are arguably two of the greatest future threats to biodiversity in the humid lowland tropics (Cochrane 2003)

Bio-D – Solvency/IL – Resource Limits

Limited money and increasing species extinctions force consolidation of resources to protect bio-d – imaging is key

Groves et al 2 (Craig R., director of conservation planning for The Nature Conservancy, Deborah B. Jensen, presidentelect, Society for Conservation Biology, and the president and chief executive officer of the Weedland Park Zoo, Laura L. Valutis, senior conservation planner for The Nature Conservancy, and Kent H. Redford, ice president, International Program, Wildlife Conservation Society, Bioscience. Washington: Jun. Vol. 52, Iss. 6; pg. 499, 14 pgs, Proquest, JMB)

The growing recognition that the species extinction crisis has deepened and that there are limited conservation dollars to address this crisis has had a profound influence on the planning methods and conservation strategies of governmental and nongovernmental organizations. For example, World Wildlife Fund (WWF) and Conservation International have pinpointed priority ecoregions and biodiversity "hotspots," respectively, that represent some of the most significant remaining regions for conserving the world's biological diversity (Olson and Dinerstein 1998, Myers et al. 2000). Both The Nature Conservancy (TNC) (Master et al. 1998) and World Wildlife Fund (Abell et al. 2000) have set conservation priorities at the scale of large watersheds for freshwater ecosystems in the United States. The National Gap Analysis Program (GAP) of the US Geological Survey's Biological Resources Division is using biological survey data, remote sensing, and geographic information systems (GIS) technology at the state level to identify those native species and ecosystems that are not adequately represented in existing conservation lands-in other words, the aim of the program is to detect conservation "gaps" (Jennings 2000). Some state governments in the United States are also developing their own biodiversity conservation plans (e.g., Kautz and Cox 2001). Internationally, more than 175 countries are mandated, as signatories to the United Nation's Convention on Biological Diversity, to prepare National Biodiversity Strategy and Action Plans (Secretariat of the Convention on Biological Diversity 2000). All of these assessments and priority-setting exercises have a common trait: They focus on relatively large spatial areas or regions inhabited by thousands of species and hundreds of identifiable natural communities. To implement conservation actions on priorities identified in these coarse-scale assessments requires a practical yet science-based planning framework for the conservation of biodiversity within these regions. Recognizing that most conservation efforts are reactive and that its own conservation investments needed to be more strategic, The Nature Conservancy has been developing such a framework for conservation planning in terrestrial, freshwater, and near-shore marine environments (Groves et al. 2000). This framework has been tested and revised through the preparation and implementation of over 45 ecoregional and regional conservation plans in the United States (figure 1), Latin America, the Caribbean, Micronesia, and Yunnan, China. The framework's methods are based on theories and principles from ecology and conservation biology and have been developed in consultations with scientists from research, natural resource management, and conservation institutions and organizations. It has been applied across many types of ecosystems by numerous scientists and practitioners under a variety of levels of funding and availability of information. In this article, we report the lessons learned from implementing TNCs planning framework as a model for the many agencies and institutions around the world that face similar challenges in conservation planning. Four significant scientific advances in the last decade of the 20th century have shaped the development of this framework. First, the growing list of endangered species highlighted the need for approaches to conservation that are proactive and complement the reactive measures of most endangered species programs. Second, scientists increasingly recognized the importance of conserving the underlying ecological processes that support the patterns of biological diversity (e.g., Balmford et al. 1998). Third, we began to realize that biodiversity occurs at multiple spatial scales and levels of biological organization (Schwartz 1999) and that a greater emphasis to conserve this diversity must be placed at all appropriate levels and scales (Poiani et al. 2000). Finally, we learned that systematic conservation planning approaches are more effective at conserving biological diversity than are the ad hoc approaches of the past (Margules and Pressey 2000). These ad hoc approaches have resulted in a biased distribution of lands and waters set aside for conservation purposes, with the majority of these areas occurring at relatively higher elevations and on steeper slopes and poorer soils (Pressey et al. 1996, Scott et al. 2001). TNC's seven-step, conservation planning framework incorporates all four of these scientific advances (see box 1). We have applied the framework to ecoregions-large areas of the earth's surface that have similarities in faunal and floral composition due to large-scale, predictable patterns of solar radiation and moisture (Bailey 1998). Most ecoregional classifications are based upon criteria such as climate, soils, geology, vegetation cover types, or in the case of marine systems, oceanographic factors (Bailey 1998), because these environmental variables are assumed to have a major influence on the evolutionary history and distribution of many species and communities. The US Forest Service and the US Environmental Protection Agency developed ecoregional classifications for the United States (Omernik 1987, Bailey 1995, 1998), and the World Wildlife Fund has done so for every continent (Olson et al. 2001). For this planning framework, we used a modified version of Bailey's (1995) ecoregions for the United States and relied on WWF's ecoregional classifications for other countries. Although intended for application at an ecoregional scale, this framework should be applicable to other types of planning regions (e.g., Conservation International's biodiversity hotspots) at similar spatial scales. Redford and colleagues (forthcoming) provide an overview of approaches that various organizations use to conserve biodiversity, including the spatial scale at which these different approaches are intended to operate. The primary product of applying this framework is the identification of a portfolio or network of lands and waters for conserving the elements of biodiversity within an ecoregion. We refer to these lands and waters as conservation areas. We separate the identification of conservation areas from their design and management (Scott and Csuti 1997). We emphasize that the primary purpose of regional-scale conservation planning as articulated in this article is to identify a set of conservation areas that best represents the native species and ecosystems of the region and the underlying ecological processes that sustain them. Determining how those areas are best designed and managed requires a more detailed analysis, usually at finer spatial scales. Planning at the scale of conservation areas (e.g., Nature Conservancy preserve, national park, national or state wildlife refuge) aims to maintain or improve the ecological condition of targeted biological or environmental features of these areas and to abate threats to these features (Poiani et al. 1998). Noss and Cooperrider (1994) and Meffe and Carroll (1997) provide overviews of the design and management of conservation areas.

Bio-D – IL – Data – Conservation

Conservation efforts require data – limited resources mean effective choices must be made

Harris et al 5 (Grant M., Clinton N. Jenkins, and Stuart L. Pimm, Nicholas School of the Environment and Earth Sciences at Duke, http://www.terpconnect.umd.edu/~cnjenkin/Harris\_et\_al\_2005.pdf, accessed 7-6-11, JMB)

Tropical forest destruction is severe, resulting in the highest extinction rates of any global ecosystem ( Wilson 1992; Skole & Tucker 1993; Pimm et al. 1995; Myers et al. 2000; Pimm & Raven 2000). In large part, stemming these losses requires protecting what forest remains and setting priorities for such actions. Globally, we know where the priorities are. There is close agreement among the hotspots of Myers et al. (2000), the endemic bird area (EBA) analyses by BirdLife (Stattersfield et al. 1998), ecoregions (Olson et al. 2001), and other quantitative mapping exercises (Wege & Long 1995; Manne et al. 1999; Jetz & Rahbek 2002; Myers 2003). The next course of action is to refine conservation priorities down to scales at which managers can work. There is already an extensive literature on prioritizing areas for conservation. Some computationally sophisticated methods prioritize areas based on a detailed knowledge of species distributions (e.g., Jennings 2000; Cowling et al. 2003a, 2003b). These approaches, so compelling for species-rich and taxonomically well-surveyed places (such as the United States and South Africa), rarely extend to tropical forests, where distributional data are few. With rare exceptions, they have not been applied to hotspots, where, by definition, there are high levels of both species endemism and habitat loss (Myers et al. 2000). Here, we describe a method that helps identify areas of a practical size to help prioritize, conserve, and manage species-rich tropical forests. To exemplify the approach, we focused on threatened birds endemic to Brazil’s Atlantic Forest. Our procedure advances the science of conservation prioritization by identifying forest fragments of a few tens of square kilometers that contain the most threatened birds from an ecoregion of more than 1 million km2 . The process is simple, intuitive, and relatively fast. The method also helps with generating practical goals to produce concrete results. These characteristics will facilitate its understanding and appeal for people charged with managing tropical biodiversity. Moreover, because production costs are low, it eliminates quibbling over whether conservation dollars are better spent on improved prioritization schemes or on protecting more land. Determining what areas are important for conservation requires knowing where habitat remains. Information on species distributions is also vital. Detailed knowledge of species ranges, however, is not necessarily required. A more moderate approach is to assume one must know both the detailed distribution of species and remaining habitats. Even if one accepts this approach, a key practical consideration is how expensive (in time or resources) it will be to uncover the distribution of species versus the distribution of remaining habitats. The expense of the former is self-evident, but what about the latter? In some cases the task of setting priorities is disconcertingly simple. As an extreme example, Cebu in the Philippines has only one small patch of forest remaining (Pimm 2001). It holds the island’s known endemics and, almost certainly, its unknown ones too. When habitat loss becomes this acute, whatever habitat remains becomes the priority. On average, tropical forest hotspots covered roughly 1 million km2 , of which 100,000 km2 remain (Myers et al. 2000). Protecting the remainder is the priority (Pimm et al. 2001) and probably the most influential action that can reduce future extinctions (Pimm & Raven 2000). Unfortunately, the costs of protecting hotspots are high (Pimm et al. 2001) because the remaining habitat is still too large for immediate protection. Is all remaining habitat equally important? The answer is surely, no. Even within a hotspot certain areas hold more threatened species than others. In addition, some fraction of the remaining forest may be in patches too small and isolated to have much conservation value (Brooks et al. 1999; Ferraz et al. 2003). Unless special circumstances warrant their attention (e.g., the last refuge of an endemic species), small fragments should receive lower priority relative to larger, more connected areas

Good mapping key to determining what areas to conserve

Harris et al 5 (Grant M., Clinton N. Jenkins, and Stuart L. Pimm, Nicholas School of the Environment and Earth Sciences at Duke, http://www.terpconnect.umd.edu/~cnjenkin/Harris\_et\_al\_2005.pdf, accessed 7-6-11, JMB)

Many conservationists wish to preserve the entire remaining land area of biological hotspots, which are rich in species but low in habitat, such as the Atlantic Forest of Brazil. Although conservation wants the lot, funding, politics, and the amount and spatial extent of remaining forest complicate this goal. Moreover, in each hotspot, not all the remaining habitat is equally important. To make hotspot conservation manageable, the remainder must be prioritized. Refining hotspot conservation means identifying specific locations (individual habitat patches) of realistic size and scale for managers to protect and politicians to support. This goal requires a map of remaining habitat, and we explored six satellite imagery sources and products to generate one. Although we used SPOT VGT imagery in our example, each of the products would have led us to the same subregion of conservation importance.

Bio-D – IL – Data – Conservation

More data key to focus conservation resources – also attracts more donor funding

Brooks et al 6 (T. M. Brooks, 1,2,3 \* R. A. Mittermeier, 1 G. A. B. da Fonseca, 1,4 J. Gerlach, 5,6 M. Hoffmann, 1 J. F. Lamoreux, 3 C. G. Mittermeier, 1 J. D. Pilgrim, 7 A. S. L. Rodrigues 5, 1 Conservation International, 2 World Agroforestry Centre (ICRAF), University of the Philippines, . 3 Department of Environmental Sciences, University of Virginia, 4 Departamento de Zoologia, Universidade Federal de Minas Gerais, 5 Department of Zoology, University of Cambridge, 6 Nature Protection Trust of Seychelles,. 7 BirdLife International in Indochina, Science, Vol. 313, July 7, p. 58-61, http://web.duke.edu/~mmv3/biocon/documents/Brooks2006.pdf, accessed 7-7-11, JMB)

Global conservation planning is key for strategic allocation of flexible resources. Despite divergence in methods between the different schemes, an overall picture is emerging in which a few regions, particularly in the tropics and in Mediterranean-type environments, are consistently emphasized as priorities for biodiversity conservation. It is crucial that the global donor community channel sufficient resources to these regions, at the very minimum. This focus will continue to improve if the rigor and breadth of biodiversity and threat data continue to be consolidated, which is especially important given the increased accountability demanded from global donors. However, it is through the conservation of actual sites that biodiversity will ultimately be preserved or lost, and thus drawing the lessons of global conservation prioritization down to a much finer scale is now the primary concern for conservation planning

Data key to conservation efforts

Brooks et al 6 (T. M. Brooks, 1,2,3 \* R. A. Mittermeier, 1 G. A. B. da Fonseca, 1,4 J. Gerlach, 5,6 M. Hoffmann, 1 J. F. Lamoreux, 3 C. G. Mittermeier, 1 J. D. Pilgrim, 7 A. S. L. Rodrigues 5, 1 Conservation International, 2 World Agroforestry Centre (ICRAF), University of the Philippines, . 3 Department of Environmental Sciences, University of Virginia, 4 Departamento de Zoologia, Universidade Federal de Minas Gerais, 5 Department of Zoology, University of Cambridge, 6 Nature Protection Trust of Seychelles,. 7 BirdLife International in Indochina, Science, Vol. 313, July 7, p. 58-61, http://web.duke.edu/~mmv3/biocon/documents/Brooks2006.pdf, accessed 7-7-11, JMB)

Limitations of data have thus far generally restricted global conservation prioritization to specialist estimates of irreplaceability, to habitat loss as a measure of vulnerability, and to coarse geographic units defined a priori. Over the past 5 years, spatial data sets have been compiled with the potential to reduce these constraints, particularly for mammals, birds, and amphibians (5). When these maps are combined with assessment of conservation status, they enable the development of threat metrics directly based on threatened species (36). So far, the main advances to global prioritization enabled by these new data are validation tests of existing templates (31). Encouragingly, global gap analysis of priorities for the representation of terrestrial vertebrate species in protected areas (36) and initial regional assessment of plants (37) yield results similar to existing approaches (fig. S2).

Bio-D – Landsat Key – Data

Landsat data key to the bio-d community

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

As we explore below, by the 1990s, despite the program’s roller-coaster development, Landsat data were being used far more for conservation-oriented purposes. For example, by 1992 the global change community had become very interested in Landsat data coverage of 20 years of Earth changes (Mack and Williamson, 1998). With global change becoming an important environmental topic in the 1990s, the research based on Landsat data also moved towards investigating patterns, processes, and effects of land cover changes on the biosphere and atmosphere. The obvious implications of land cover changes for biodiversity conservation contributed to increasing the numbers of Landsat users in the conservation biology community.

Landsat key – fills in data gaps

Fuller and Jessup 8 (D.O., Department of Geography and Regional Studies at U Miami and T.C., AusAID, Australian Embassy in Indonesia, 9/2, http://www.as.miami.edu/geography/research/climatology/Fuller\_Jessup\_EKal\_2008.pdf, accessed 7-6-11, JMB)

For this analysis we collected much of the baseline information from satellite images, which are becoming more affordable and more widely used to assess habitat condition and extent (Harris et al. 2005). In Indonesia, spatial data are often difficult to obtain through government agencies and therefore Landsat imagery has provided a way to fill in gaps in existing global data sets. However, it should be mentioned that Landsat 7 has recently experienced technical problems related to scan-line correction, although this problem does not necessarily limit ETM+ as a tool for monitoring forest and 15 developing new GIS data layers (Trigg et al. 2006). Fortunately, greater availability of regional and global data sets such as those cited in Table 2 provide new opportunities for refining ecoregional and hotspot classifications in other tropical areas where precise subregional threats assessment is needed.

Bio-D – Landsat Key – Data Continuity

Landsat data continuity key to earth observation – huge data-set

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

It is difficult to assess all the consequences of these circumstances. Still, policy makers, environmental and conservation biologists, and natural resource managers may ask, what is most at risk? On a general level, that question is easily answered. Satellite monitoring has become one of the most powerful tools for monitoring global change, and yet we seem to be losing Landsat coverage, a benchmark tool, without replacement. The last decade of Landsat use has demonstrated the program's importance for global change and Earth observation sciences (Goward and Williams, 1997; Goward ctal, 1999,2000), with Landsat data revealing rapid, dramatic and far-reaching changes in land cover and land use patterns. These changes, without doubt, will have significant impact on the future management and conservation of Earth's natural resources. Similarly, the near-certain loss of Landsat data continuity will itself have a deleterious effect on future natural resource conservation and management efforts. No other satellite monitoring program has produced a global data set with comparable accuracy or spatial and spectral resolution. Derivative Landsat products such as a global wall-to-wall coverage of orthorectified Landsat images for the late 1970s, circa 1990 and circa 2000, are now readily accessible via the Internet to academia and the public (Tucker et at, 2004). Most other satellite monitoring programs do not provide low-cost imagery covering the entire globe (SPOT, IRS), or their sensor data are lacking spatial resolution (AVHRR, MOD1S).

Landsat key to global change research – data continuity – especially for biology

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

The Landsat program is no exception to this tendency towards adaptive applications, as the Mack quotation above indicates. Many applications became apparent only after the program was well underway (Mack, 1990). Landsat’s most unique feature, and greatest source of applications potential, is its longevity. Landsat provides the longest data record to address land use and land cover changes and their environmental impacts globally (Roughgarden et al., 1991; Lauer et al., 1997; Goward and Williams, 1997). NASA launched Landsat 1 (originally called Earth Resources Technology Satellite, or ERTS-1) in 1972, initiating the now more than 30-year Landsat mission (USGS, 2003a). Over time, the Landsat program would come to consist of a succession of six satellites (Landsat 6 never achieved orbit, due to problems with its launch platform) circling the Earth on polar orbits, collecting and transmitting satellite data and pictures covering the globe. These pictures and data today collectively constitute the largest consistent satellite database available for natural resource management (Draeger et al., 1997). Throughout the past decade or longer, the Landsat program has been at the core of global change research programs internationally (Goward et al., 1999, 2000). Global change research has been mostly focused on Earth sciences. Our paper attempts to quantify the importance of the Landsat program for applied and basic research in conservation biology, and ultimately for management and conservation of natural resources and biodiversity. Natural resource managers and conservation biologists were not a deﬁned target audience for NASA’s satellite monitoring programs, but nonetheless the data produced by these programs may have had a signiﬁcant effect on conservation biology research, or at least on the emergence and development of broad-scale ecological disciplines such as conservation biology and landscape ecology.

Bio-D – Landsat Key – Data Continuity

Landsat is key to our long-term heritage – consistent data continuity

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

Concluding from these observations, we suggest there is a justiﬁed need for global satellite monitoring of Earth resources that provides rapid, inexpensive and consistent access to this type of information. Existing data, already increasingly accessible via the Internet, represent historical records of our natural heritage and should be made even more easily available to the public just as is being done with the holdings of major libraries and archival collections. Maintaining such accessible data repositories will not only be invaluable for short- and mid-term environmental policy decisions; by complementing other varieties of historical records, including natural history museum collections and land tenure data, these satellite-derived data repositories will provide future generations with accurate evidence of changes in human culture and value systems. Ongoing satellite monitoring programs need to be developed to create a consistently comparable record extending indeﬁnitely the lineage of this historical resource. Data continuity should always be a major consideration in the development of future programs. Much of the Landsat program’s success can be attributed to a) its 30-m spatial resolution that allows for enough detail to detect land use changes; b) its long data continuity, providing records of how the Earth’s land has changed over two to three decades, and c) recent Landsat data acquisition strategies permitting cloud-free images and seasonal assessments while providing global coverage. Calls for a new Landsat satellite should be formulated as calls for a guaranteed continued operational Earth resource satellite program with similar or even improved attributes. New, and different, satellites and sensors launched since the late 1990s, as components of NASA’s new Earth Observing System (EOS), may provide data continuity fulﬁlling the basic requirements for such a program. However, so far these data are not as accessible as Landsat data. The imagery comes from newly developed and hence still largely experimental sensors. Currently most of these data seem not to be collected with the goal of global environmental monitoring. Although it may be technically possible, regular and complete coverage of Earth is not presently achieved by these satellite-based monitoring systems. In those cases where coverage is global, the spatial resolution is much lower than with Landsat. For example, the Moderate-Resolution Imaging Spectroradiometer (MODIS) offers only a spatial resolution of between 250 and 1,000 m. No clear plans have been communicated to a broader user community detailing a) how these sensors may ﬁll the Landsat gap; b) whether the data acquired will adequately cover the entire globe and c) how, and at what cost, the data will be provided to end-users or archived for future use.

Bio-D – Landsat Key – AT: Need Higher Res

Landsat comparatively better at monitoring bio-d than higher resolution imagery

Nagendra et al 10 (Harini Nagendra 1,2, Duccio Rocchini 3 , Rucha Ghate 4 , Bhawna Sharma 1 and Sajid Pareeth 1; 1 Ashoka Trust for Research in Ecology and the Environment (B.S.); (S.P.) 2 Center for the Study of Institutions, Population, and Environmental Change (CIPEC), Indiana University, 3 IASMA Research and Innovation Centre, Fondazione Edmund Mach, Environment and Natural Resources Area, (D.R.) 4 SHODH: The Institute for Research and Development, Feb. 2, Remote Sens., 2, p. 478-496, http://www.mdpi.com/2072-4292/2/2/478/pdf, accessed 7-6-11, JMB)

High resolution satellite imagery, with pixel sizes of the size of 2–5 m, corresponding well to the size of individual tree crowns, has been declared as having much greater potential for mapping vegetation diversity and distributions [2,4,13,14]. In the past decade, the launch of very high spatial resolution satellite sensors like IKONOS, QuickBird, OrbView-3 and the Panchromatic band of IRS LISS-3 have provided researchers with the opportunity to study ecological systems at far greater detail than previously possible. These data have been used in multiple studies for plant diversity assessment in habitats with a smaller number of tree species, such as mangroves, temperate forests and boreal forests (e.g., [15-18]). Yet the fine spatial resolution provided by these sensors can lead to problems. When pixel dimensions shrink to a point where individual pixels are smaller than the size of individual tree crowns, then pixel-pixel variability increases dramatically. For instance, some pixels may cover a leaf in sunshine while others cover a leaf of the same tree in shade, in gaps between leaves, or even on tree bark—making it hard to handle relatively simple tasks like delineating tree canopies, let alone assigning signatures to different species [11]. Further, in comparison to hyperspatial data, medium resolution sensors such as Landsat have a greater number of bands and are able to record additional information in the middle infrared range, which relates to a range of critical plant properties including leaf pigment, water content, and chemical composition, and can be very useful for discriminating tree species [19-22]. Landsat also provides data over a longer period of time than most other remote sensing platforms, which makes it of great use for monitoring programs [14,23].

Even if hyperspatial imagery is good, combining it with Landsat is key

Olson et al 2 (David M., Eric Dinerstein, George V. N. Powell, and Er D. Wikramanayake, Conservation Science Program, World Wildlife Fund, Conservation Biology, p. 1-3, Vol. 16, No. 1, Feb, EBSCO, JMB)

Table 1 describes the spatial and spectral resolution, the geographic coverage, temporal frequency and cost of the satellite sensors and platforms routinely used for biodiversity studies and vegetation mapping today. While hyperspectral data are generated at medium spatial resolutions of 20–30 m at best, hyperspatial data are usually multispectral, spanning 4–5 bands. The increased cost of these data limits their use in scientific studies (Gillespie et al. 2008). Further, unlike older satellite programs such as Landsat, hyperspectral and hyperspatial sensors, whether airborne or satellite borne, do not routinely cover all areas of the globe at repeated intervals of time (Loarie et al. 2007). Instead, they collect images when commissioned. Thus, obtaining archival data for a specific area and time period is a matter of chance, even if one has the money available for such research. Given the relatively recent arrival of these instruments, and their limited geographic spread, their utility will only be realized to the full when they will be coupled with existing large scale monitoring systems that currently utilize moderate resolution multispectral data like SPOT, ASTER, and Landsat TM/ETM+ to great effect (Duro et al. 2007)

Bio-D – Landsat Key – AT: Need Higher Res

Landsat comparatively equivalent or better than higher-res satellites at protecting biodiversity

Nagendra et al 10 (Harini Nagendra 1,2, Duccio Rocchini 3 , Rucha Ghate 4 , Bhawna Sharma 1 and Sajid Pareeth 1; 1 Ashoka Trust for Research in Ecology and the Environment (B.S.); (S.P.) 2 Center for the Study of Institutions, Population, and Environmental Change (CIPEC), Indiana University, 3 IASMA Research and Innovation Centre, Fondazione Edmund Mach, Environment and Natural Resources Area, (D.R.) 4 SHODH: The Institute for Research and Development, Feb. 2, Remote Sens., 2, p. 478-496, http://www.mdpi.com/2072-4292/2/2/478/pdf, accessed 7-6-11, JMB)

Through outlets such as Google Earth, high resolution satellite images have become increasingly popular, making detailed images of large parts of the Earth easily available to the larger public. Yet, the scientific applicability of these images remains limited due to technical issues ranging from calibration and geometric correction [35], to atmospheric correction [36], and spatial enhancement [37]. Due to these limitations, as well as the difficulty and expense related to acquiring these data, their use for ecological studies remains limited. This is particularly true in the tropics, where such data is not as easily available. Yet this study, one of the few field assessments of the utility of high resolution satellite data for vegetation diversity assessment in the tropics, clearly demonstrates that Landsat data, which are more readily available over all parts of the Earth, and which will soon be made available free to the global research community [7], appear to be more informative for purposes of plant diversity assessment. The correlation coefficients observed between spectral data and field estimations of diversity at the plot level compare favourably overall with those noted in other studies [24,38,39]. It is somewhat puzzling to observe that, while Landsat derived vegetation indices of Greenness, NDVI and MIRI show a significant positive relationship with plant diversity (as expected and also as observed by other studies in similar landscapes, see [39]), the IKONOS derived Greenness index was significantly negatively correlated with plant diversity. We speculate that this may be an artifact of the fine resolution of IKONOS imagery, where a larger number of pixels in vegetation rich areas may be picking up numerous small patches of shade cast by vegetation canopies (see [7]), leading to lower perceived values of Greenness. Similar findings have been observed in a study conducted in a pine forest, where the IKONOS derived Enhanced Vegetation Index was found to have a negative relationship with the Leaf Area Index [40]. Although the maximum correlations achieved are less than 0.5, the intent here was to compare different satellite platforms and not to use these imagery in themselves for absolute predictions. In fact it is unlikely that accurate predictions of vegetation species diversity can be completed using spectral variables alone, as even shown by the general flatness of LOWESS models. Instead, satellite-based variables may represent a set of good predictors within more complex models that include information on habitat types, soil, climate, and other variables such as autocorrelation [Yet, overall trends clearly indicate that Landsat imagery appears to be better suited for assessing plant abundance and biodiversity compared to IKONOS data. This is largely due to the scale of data, which clearly makes a difference when deriving meaningful measures of landscape heterogeneity that relate to distributions of tree density and diversity. The scale of IKONOS data is too low for the purpose of plant diversity assessment in this landscape, with some of the 1 m pixels falling in tree shade, and others in sunlit areas. In contrast, Landsat imagery at the scale of 30 m appears more suited for the purpose of vegetation diversity assessment in this landscape. As with other ecological data, the observation of plant biodiversity is scale dependent, and outcomes depend upon the spatial grain of study [1,2,7,17]. Ideally, the spatial resolution used should be such that information is obtained to an adequate degree of accuracy, using the least amount of data [11]. If the spatial resolution is too low, such that the size of a satellite image pixel is orders of magnitude less than the distribution of organisms (here, trees and higher plants), discrimination of organisms into different species or other categories becomes difficult. This is the aspect that has most often been emphasized in discussions of hyper spatial satellite imaging platforms, leading to the assumption that increasing image spatial resolution will always result in increased information on ecological distributions. For instance, Hernandez-Stefanoni and Dupuy [42] write that ‗using a satellite image from a higher spatial resolution sensor like IKONOS could have yielded a more accurate estimation of species density, but would have been far more costly‘. Such implicit assumptions of the greater utility of high resolution satellite imagery are widespread, but do not always hold true. As an example, Rocchini [17] compared hyperspatial Quickbird (3 m pixel) against medium resolution Landsat (30 m pixel) imagery. He found that hyperspatial spectral data had similar correlations with species diversity compared to Landsat, which he attributed to the higher spectral resolution of Landsat data.

Bio-D – Landsat Pricing Key – Conservation

Landsat data pricing key to conservation biology – publication numbers prove

Leimgruber et al 5 (Peter, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Catherine A. Christen, same, and Alison Laborderie, Durrell Institute of Conservation and Ecology at U Kent, Environmental Monitoring and Assessment 106: p. 81–101, http://nationalzoo.si.edu/Publications/ScientificPublications/pdfs/E48D1034-C95B-4400-ABB5-66A1E5A32EC8.pdf, accessed 7-6-11, JMB)

Another likely reason for the adoption of Landsat data by conservation biologists during the mid-1990s was the signiﬁcant reduction in Landsat data image pricing at that time. During the 1980s through mid-1990s, Landsat data were very high-cost (Draeger et al., 1997). The number of publications seems to track nicely major policy changes that affected pricing for Landsat imagery (Figure 2). When Landsat data were “commercial,” and being marketed by EOSAT in 1985, a single 185 by 170 kilometer “scene” typically cost as much as $4,400. Though the pricing was multi-tiered – allowing users in Federal agencies to purchase the data at much lower rates – this steep price increase eventually led to a reduced use of the imagery across the board. It appears the high price inﬂuenced many researchers to use AVHRR satellite imagery that was available for free (Hemphill, 2001), despite that sensor’s much lower spatial resolution and fewer spectral bands. Finally in 1992, the Land Remote Sensing Policy Act allowed for cheaper prices (as low as $800 per scene) by charging the USGS with returning to its earlier responsibilities of management and sales of Landsat imagery (Johnson, 1998). With the newly available computational power and new lower prices, the number of publications in conservation biology using Landsat imagery started to increase (Figure 2). Because there is no copyright extant on satellite scenes, prices for archived images – images that have already been processed for another user, available at government or non-government data depositories – have dropped from $2,000 to $50 or even no cost. The new pricing for Landsat 7 ($475–$600 per scene) and the details of the Landsat 7 image acquisition plan – guaranteeing at least one satellite image for every place on Earth each year – means the new Landsat 7 program operation allows conservation biologists and nongovernmental environmental organizations greater access to these images, despite their limited budgets. Multi-tiered pricing has been eliminated (Reichhardt, 1999; Sheffner, 1994)

\*\*\*Water Advantage\*\*\*

Water – Inherency/Solvency – Thermal

Landsat thermal imaging key to water management but there’s no guaranteed commitment to thermal imagers on future Landsats

Rocchio 7 (Laura, Senior Outreach Scientist at Science Systems and Applications, MA from U Baltimore, cites Richard Allen, PhD, PE Professor, Water Resources Engineering, NASA, April 17, http://landsat.gsfc.nasa.gov/news/news-archive/soc\_0011.html, accessed 7-3-11, JMB)

Four important characteristics of Landsat explain its prominence in water resources management. Most importantly, Landsat collects thermal imagery. It also collects visible, near infrared, and shortwave infrared data all at a reasonably high spatial resolution, plus, the data have been collected regularly and archived since 1982. Thermal imaging “The thermal imager of Landsat is a critical component of the surface energy computations that we conduct to determine evapotranspiration,” explains Allen. The thermal band allows managers to calculate the full surface energy balance and thereby estimate water consumption by both agricultural irrigation and urban landscaping that is much more accurate than estimates made using short-wave data alone. Landsat 7 thermal band (top) compared to the MODIS thermal band (bottom). See larger image. A closer look Landsat’s spatial resolution (30 m for the reflective bands, and 60 to 120 m for the ETM+ and TM thermal bands, respectively) fills a special niche in the world of water resources management. Landsat’s swath is wide enough to provide a synoptic view of a large region while at the same time its resolution is high enough to identify individual fields––which are typically ten to 160 acres (180 to 750 m per side) in the U.S. “Actual consumptive use of water is needed if misuse of water is to be proved or water scarcity confirmed, and generally this needs to be done on a field-by-field basis,” according to Morse. While there are other Earth-observing satellites that regularly collect thermal imagery, their low resolution makes field-level ET analysis impossible. A continuous look The ASTER satellite with its thermal band and smaller pixel size could potentially be used for field-based analysis, but it does not have a regular collection schedule and its archive is minimal. Landsat not only has an appropriate spatial resolution for field-based analysis, it has regular global coverage and a robust data archive. The ability to identify trends in water consumption caused by vegetation growth and weather systems requires frequent coverage. Landsat 7 systematically images the U.S. every 16 days. Landsat 5 has the same repeat cycle but it is eight days out of phase with Landsat 7, so until 2003, Landsat images of the U.S. were available every eight days. The failure of the Scan Line Corrector aboard Landsat 7 in May 2003 has largely diminished the utility of the data for ET calculations. A retrospective look Conflict resolution in matters of water resources management can involve quantifying historical water consumption trends for a given region. Because there has been a thermal imager on the Landsat satellites since 1982 and there is regular data collection, which USGS faithfully archives, such retrospective looks can easily be done with Landsat, unlike other high-resolution platforms that only acquire data when specially scheduled. Growing use Since 2000 there has been an “explosive increase in use of Landsat data” for water management according to Allen. This increase in the use of Landsat data for ET mapping is attributed to the decreased data cost, successful research in developing countries, dependable processing routines, and advances in computational power and storage. There has also been an increase in water rights litigation and pressure from state water resources entities for an operational product. A future without a Landsat thermal band and an international plea No thermal band is currently planned for the Landsat 7 follow-on satellite mission, known as the Landsat Data Continuity Mission (LDCM). The prospect of the U.S. launching a Landsat satellite without thermal imaging capability has led to a cry of protest from water resources managers around the world. With a likelihood of no thermal band on LDCM, the World Bank has lobbied the European Space Agency (ESA) for a suitable thermal imager. Douglas Olson, a Principal Water Resources Engineer for the World Bank recently sent a letter to ESA specifically asking for a thermal band on their SENTINEL satellite. Show me the money Like most decisions, political and otherwise, having a thermal band on future Landsat missions is a matter of money. In order to show the intrinsic worth of a thermal band, water managers have attempted to quantify the monetary benefits of the improved water efficiency made possible with thermal data from Landsat. The benefit of Landsat-induced water efficiency can best be quantified by examining improved food yields. In the industry, water mangers talk about the “crop per drop” number, how much food can be produced with a given amount of water. An example of improved crop per drop can be found in North Africa. Egypt and Sudan control about 80 cubic kilometers per year of Nile River flow for irrigation. The productive value of that water, meaning the value of the wheat, rice, cotton and other agricultural products produced using this controlled water, is $0.05 to $0.10 per cubic meter. Conservative estimates state that better water allocation could improve that productivity by more than 10 percent per year, which is a value of $400M to $800M per year. (Note: in Nile Delta study areas monitored between 1995 and 2002, crop yield increases were much more dramatic: rice yields up by 53% and cotton yields up by 41%). The DOI Water 2025 report shows which western cities are at risk for water crises and conflicts. Image credit: DOI In the U.S., irrigated crops are worth $70 billion per year, so, sustaining the productivity of irrigated land is paramount to the U.S. By another metric, the value of Landsat’s thermal band to water managers can be estimated by looking at the potential savings that Landsat-based calculations offer as opposed to traditional calculation methods. Traditional methods of calculating water consumption involve monitoring pumping stations, wells and diversion points. This involves many man-hours and can rarely provide all of the necessary information for effective resource management. For the eastern Snake River Plain in Idaho, the cost of this type of traditional monitoring costs the state half a million dollars per year. In comparison, the same monitoring done with Landsat data is $80,000. When looking at the western states together, Morse has estimated a potential ten-year savings as high as $1B.

Water – Solvency – US

**Landsats expose water management conflicts in the US.**

**NASA 1** (<http://earthobservatory.nasa.gov/IOTD/view.php?id=1743>, accessed 7/4/11)CJQ

**For more than 100 years, groups in the western United States have fought over water**. During the 1880s, **sheep ranchers and cattle ranchers argued over drinking water** for their livestock on the high plains. In 1913, **the city of Los Angeles began to draw water away from small agricultural communities** in the Owen Valley, **leaving a dusty dry lake bed.** In the late 1950s, construction of the Glen Canyon Dam catalyzed the American environmental movement. **Today, farmers are fighting fishermen, environmentalists, and Native American tribes over the water in the Upper Klamath River Basin**. A below-average winter snowpack and low rainfall throughout the year had caused an extreme drought in the area along the California/Oregon border. In April 2001, a U.S. District Court stopped water deliveries to farms in the Klamath Irrigation District to preserve adequate water levels in Upper Klamath Lake to protect two endangered species of Mullet fish (called suckers). Water was also reserved for the threatened Coho Salmon which need enough water to swim downstream from their spawning grounds to the ocean. In addition, **several Native American tribes have rights to Klamath River water**. Further complicating the situation are **a handful of wildlife refuges which usually receive enough irrigation wastewater to support upwards of a million migratory birds and 900 Bald Eagles**. In 2001, however, several of the refuges were potentially threatened with not having enough water for the birds which arrive each year in early fall. **The severity of the drought was underscored by** the town of Bonanza, **Oregon**. Famous for its natural springs, and entirely dependent on wells for drinking water, the town’s water supply was contaminated with pesticides, fertilizer, and manure. **The water quality was so bad that it was not even safe to bathe in**, much less drink. **The problem stemmed from a very low water table.** The drop in underground water levels was caused directly by the drought, and indirectly from the increased irrigation from underground aquifers to compensate for the lack of water from Upper Klamath Lake. As the water table dropped, clean water stopped flowing from the springs and wells, and dirty water from fields flowed into the water beneath Bonanza. Area farmers, many of them entirely dependent on irrigation, immediately launched protests when the court’s decision to stop irrigation flows was announced, leading to national media coverage. On July 24, the Department of the Interior approved the release of some irrigation water from Upper Klamath Lake, but the flow lasted only until August 23. The water was enough to save some fields growing winter feed for livestock, but some other crops were unsalvageable, and water didn’t reach every farmer who needed it. The Klamath Project dates back to 1903, when the Reclamation Service (now the Bureau of Reclamation, a branch of the U.S. Department of the Interior) investigated the possibility of converting rangeland, wetlands, and natural lakes into irrigated farmland. Construction began in 1906, the first water deliveries were made in 1907. The project was completed in 1924. The Bureau of Reclamation supplies water to the farmers at the cost of delivery, without charging for the water. Fodder, barley, oats, potatoes, and wheat are the principal crops on the 225,000 acres of irrigated land. In addition, the irrigation dams control floodwaters, and the Link River Dam supplies hydroelectric power. The images above show the northeast portion of the Klamath Basin in 2000 (top) and 2001 (lower). These **true-color images were acquired by the Enhanced Thematic Mapper Plus sensor aboard the Landsat 7 satellite**, launched by NASA and operated by the U.S. Geological Survey. Upper Klamath Lake, with its endangered sucker fish, is at the upper left, with the town of Klamath falls immediately below it. Bonanza is to the right of Klamath Falls. Tule Lake, which has been partially converted to farmland, is at the lower right and is surrounded by the Tule Lake National Wildlife Refuge. To the left of Tule Lake are the remains of Lower Klamath Lake and the marshes of the Lower Klamath National Wildlife Refuge. Farms left dry by the water shortage appear brown in the bottom (drought) image. Most of the farms without irrigation water were between Upper Klamath Lake and Tule Lake. The land immediately surrounding Tule Lake did receive irrigation water, and as a result was greener than the fields to the north. Some farms relied on wells and not Klamath Project water, and many of these remained green, as well.

Water – Solvency – US

**Landsats key to effective water usage in the US**

**Beck 9** (Ron, Us. Dept. Interior, <http://www.usgs.gov/newsroom/article.asp?ID=2309>, accessed 7/4/110 CJQ

**Data from earth-observing Landsat satellites plays a central role in a new**, award-winning **type of mapping that tracks water use. Water-use maps** help save taxpayer money by increasing the accuracy and effectiveness of public decisions involving water – for instance, in monitoring compliance with legal water rights. The maps **are especially important in dry western states where irrigated agriculture accounts for** **about 85 percent of all water consumption**. Using Landsat imagery supplied by the U.S. Geological Survey in combination with ground-based water data, the Idaho Department of Water Resources and the University of Idaho developed a novel method to create water-use maps that are accurate to the scale of individual fields. The Ash Institute at Harvard University recently cited Idaho’s original design for these maps as an [outstanding innovation in American government](http://ashinstitute.harvard.edu/corporate_site/innovations/innovations_news/mapping_evapotranspiration_wins_innovations_in_american_government_award). “**The** USGS **Landsat archive**, dating back to1972, **has proven to be a versatile source of consistent data about land surface conditions**,” said Bryant Cramer, USGS Associate Director for Geography. “This advance by the Idaho water monitoring team is both brilliant and practical. Looking forward, it’s indicative of what researchers in many countries can accomplish with the data.” The value of the USGS Landsat archive was endorsed by Richard Allen of the University of Idaho, one of the honored team members. “Archival support from USGS gave Idaho researchers the means to determine changes in water consumption over time by agricultural, residential and wildland systems,” he said. “**These historical records were indispensable in calibrating many aspects of current data.” As agricultural irrigation needs** and swelling city populations **amplify demand for scarce water supplies, water management strategy has been forced to shift from increasing water supply to more effectively managing water use at sustainable levels**. Thus, accurate water-use mapping is critical. **The Landsat-based method can be as much as 80 percent more accurate than traditional measurement methods**. With initial assistance from NASA, the Idaho Department of Water Resources began cooperating with the University of Idaho in 2000 to develop a computer model, METRIC (Mapping EvapoTranspiration at high Resolution with Internalized Calibration), to estimate and map water use in vegetated areas. The mapping method has since been adopted in other states including Montana, California, New Mexico, Utah, Wyoming, Texas, Nebraska, Colorado, Nevada and Oregon. **The objective nature of the technique assists these states in negotiating Native American water rights, assessing urban water transfers, managing aquifer depletion**, monitoring water **right compliance, and protecting endangered species**. Internationally, Spain, South Africa and Morocco have already begun to employ Landsat-based water-use maps. “I congratulate Richard Allen, Anthony Morse, William Kramber and their Idaho colleagues on their inventive work. The recognition of this prestigious award is well deserved,” Cramer said. “I believe this success is a marker for more to come,” he continued. “The USGS policy of releasing the full Landsat archive over the Internet at no cost opens the door to a much larger pool of researchers worldwide. More researchers will lead to even more data applications that tackle major environmental issues.”

Water – Solvency – Management

Landsat data key to water managements – solves water management, increasing efficiency and reducing international conflict

Rocchio 7 (Laura, Senior Outreach Scientist at Science Systems and Applications, MA from U Baltimore, cites Richard Allen, PhD, PE Professor, Water Resources Engineering, NASA, April 17, http://landsat.gsfc.nasa.gov/news/news-archive/soc\_0011.html, accessed 7-3-11, JMB)

Conserving water with Landsat Increased demand for scarce water supplies has shifted water management strategy from increasing water supply to innovatively managing water use at sustainable levels. To more effectively allocate limited water supplies, water resources managers must understand water consumption patterns over large geographic areas. Detailed water consumption maps can be made quickly and easily with Landsat because of its 30 m spatial resolution and thermal imaging capability. Landsat has been proclaimed “the best and least expensive way to quantify and locate where water is used and in what quantity,” by Anthony Morse and Richard Allen, two water management specialists from Idaho. Former World Bank economist, Dr. Chris Perry, predicts that, “We may expect significant improvements in the productivity of water—the crop per drop—by the analysis and debate facilitated by better data.” Landsat data have been used successfully not only to quantify water consumed by irrigation, but also to establish water rights, to facilitate the transfer of water entitlements, and to estimate aquifer depletions and quantify net ground-water pumpage in areas where water extraction from underground is not measured. Understanding Landsat's role Landsat data, including visible, near infrared, mid-infrared, and thermal information, for a particular geographic region are fed into a relatively sophisticated energy balance model that outputs evapotranspiration maps. Evapotranspiration (ET) refers to the conversion of water into water vapor by the dual process of evaporation from the soil and transpiration (the escape of water though plant’s stomata). For vegetated land, ET is synonymous with water consumption. Maps of water consumption made with moderate resolution Landsat data enable water resources managers and administrators to determine how much water was consumed from individual fields. And, because the spatial nature of Landsat data lends itself to the monitoring of seasonal evapotranspiration trends, managers can use the information to determine which complex irrigation schedules should be pursued and how to time water releases from dams. “Remote sensing, applied to the measurement of ET over large areas, provides analysts of irrigation systems with extraordinary new tools for the objective assessment of consumption and production—constituting a quantum leap in the assessment of irrigation system performance,” Perry wrote in 2003. Accuracy "Satellite analysis provides a far more objective and consistent set of information about who is consuming what than the ‘traditional’ methods of analysis." - Dr. Chris Perry “Satellite analysis provides a far more objective and consistent set of information about who is consuming what than the ‘traditional’ methods of analysis, which rely on complex equations and huge data sets to give information that has relatively low validity beyond the point of computation––thus being readily challenged by interested parties on the grounds that conditions are different where they irrigate,” Dr. Perry says. Traditional ground-based estimates of ET have substantial uncertainly and are cumbersome, slow and expensive to implement for large areas. Landsat-derived ET has shown much better certainty. Dr. Wim Bastiaanssen, director of Scientific Affairs & Irrigation at WaterWatch BV (Netherlands) and the main creator of the Surface Energy Balance Algorithm for Land (SEBAL) which uses Landsat data to calculate ET, reports that, “for a range of soil wetness and plant community conditions, the typical accuracy at field scale is 85% for one day and it increases to 95% on a seasonal basis.” Accuracy for Landsat-derived ET is judged in comparison to either records from pumping stations, wells and diversion points or data from precision weighing lysimeters (scientific measuring tools for calculating ET). How Landsat has helped in the U.S. Water resources management in New Mexico, California, Montana, Florida, Washington, Nevada, and Idaho has been aided by Landsat-derived ET maps. Landsat ET estimates have also helped states honor their water consumption limits set by interstate compacts. For example, the waters of the Bear River are divided among the states of Idaho, Utah and Wyoming, and each state needs to know how many acres of land they can develop with irrigation before exceeding their water apportionment. In an effort to conserve water and thereby restore Idaho's Lemhi River to a prime salmon habitat, local ranchers started converting flood irrigation systems to sprinkler irrigation systems, like the wheel line sprinkler system shown here. In Idaho, water resources managers rely on Landsat ET maps for water rights management, regulation, sale, and agreement negotiations. Their use of Landsat data was recently recognized as one of the Top 50 innovations in American government for 2007 by the prestigious Ash Institute for Democratic Governance and Innovation, part of Harvard University’s Kennedy School of Government. In Washington, Landsat ET estimates have helped to increase the flow of the Yakima River while maintaining the monetary level of crop production. In New Mexico, Landsat ET maps have helped water managers strike a balance between irrigation demands and riparian vegetation requirements. And in California, Landsat has helped create a statewide water use plan that helps farmers determine their actual irrigation needs. Landsat on the international scene “Satellite imagery, especially in the thermal bands, can and will revolutionize the establishment of water rights in the many parts of the world where they are insecure,” says Perry, who has worked on many water resources projects in developing countries. Outside of the U.S., the contentious issue of securing water rights can be limited by data. “There are numerous aid programs <CONTINUED>

Water – Solvency – Management

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from large donors such as the World Bank and Asian Development Bank that want to help manage water resources more effectively and productively, but nobody has the proper data,” Bastiaanssen says, but he continues, “with Landsat we can map out soil moisture, water consumption, water stress, crop yield.” Increasingly, the World Bank must deal with the overdraft of aquifers. They have labeled the unsustainable water mining “critical” in the North China Plain, Jordan, Mexico, Northern India, Israel, Palestine and Yemen. Meanwhile, Landsat has helped the World Bank successfully manage water projects in China, Mexico, and Yemen, as well as Egypt, Saudi Arabia, Uzbekistan, and Kazakhstan. In Turkey, Pakistan, Sri Lanka, India and China remote sensing has been demonstrated as a key tool for the strategic planning of water productivity on a basin wide scale.

Water – Solvency – Spillover

**Other countries make use of US landsat data.**

**Clark 10** (Stephen, Spaceflight Now, Jan. 13, <http://spaceflightnow.com/news/n1001/13landsat/> accessed 7/4/110 CJQ

"We use Landsat 5 principally to determine how much water is consumed by vegetation on a monthly and annual basis," Allen said. "**Our primary areas of focus are irrigated agriculture**, forests, **wetlands and native plants." Landsat satellites are currently collecting** more than **300 scenes per day globally**. **Those images go into an** online **archive, providing free access to scientists** over the Internet. "What we're seeing is people building up their own archives, and not only pulling down the most recent data over their sites, but they're going back in time and pulling down some of the thematic mapper data from the '80s," Quirk said. Tucker said **there are no international satellites offering free access to to Landsat-type data, elevating the urgent need for a U.S. follow-on spacecraft. "This is what the United States has done, and this is why U.S. data are widely used by everyone,**" Tucker said. "**The same is not true of China, the same is not true of India, and the same is not been true of other countries before**." A European Space Agency Sentinel satellite scheduled for launch in about four years will collect data comparable to the Landsat system and provide it to international researchers at low costs, but LDCM should be operational by then. **It's up to a dedicated control team to keep the remarkable Landsat legacy intact for another three years, long enough for a fresh satellite to take over the mantle**.

Water – Solvency – Resolution

**Landsats are key to checking water usage, key to management**

**Allen 6** (Richard, G., Dept. of Agricultural and Biological Engineering, Dept. of Civil Engineering, U. Idaho, <http://www.idwr.idaho.gov/GeographicInfo/Landsat/PDFs/case_for_thermal_imager_on_Landsat.pdf>, accessed 7/5/11) CJQ

Moderately High resolution. **The** 30 m **short-wave resolution and** 60 to 120 m **thermal resolution of Landsat satellites is critical for the computation and mapping of evapotranspiration** from individual irrigated fields. **Water rights regulation and administration are critically tied to identification and quantification of water consumption on a field by field basis. The current ET mapping** by the Idaho Department of Water Resources (IDWR**) could not have been developed if the highresolution Landsat images with thermal** (temperature) **images had not been available. The** high-resolution Landsat **images provide a means for identifying the crop type for each field that is useful for characterizing trends in evapotranspiration** and for establishing relationships between water consumption and crop type (for example work by the U.S. Bureau of Reclamation in California and Arizona). The detailed and accurate computation of evapotranspiration using Landsat satellite data is not possible with the 1 km resolution of MODIS and AVHRR satellites.

Water – Solvency – Hydrology

**Modern hydrology relies on Landsats—can’t work without them.**

**Qin et al 8** (Changbo, Dept. Water Res. Beijing, Yangwen Jia, Dept. Water Res. Beijing, Z.(Bob) Su, Int'l Inst. For Geo-Inf. Sci. & Earth Obs.—Netherlands, Yaqin Qiu, Dept. Water Res. Beijing, Shen Suhui, Dept. Water Res. Beijing, <http://www.mdpi.org/sensors/papers/s8074441.pdf>, accessed 7/6/11) CJQ

**With** the **rapid development and** increased **application** of remote sensing technology, **evapotranspiration calculation methods using remote sensing techniques have become a major trend for hydrological research** in recent years. **The** data obtained from visible, near-infrared and **thermal band can reflect the spatial and temporal distribution of surface features, which have a great importance in simulating the energy balance**. The SEBAL (Surface Energy Balance Algorithm for Land) proposed by Bastiaanssen et al. [43], which is based on land surface parameters acquired with remote sensing techniques. It is a semi-empirical model applied in calculating the evapotranspiration and the main difficulty is to determine the “hot” pixel and the “cold” pixel which has a great effect on the final results. Norman and Kustas [44] proposed the TSEB (Two-Source Energy Balance) algorithm to calculate the evaporation from bare soil and transpiration from vegetation separately based on remote sensing data. The Surface Energy Balance System (SEBS) was developed by Su [28] to estimate the atmospheric turbulent fluxes and evaporative fraction using satellite earth observation data, in combination with meteorological information at proper scales. **The system retrieves evapotranspiration** (ET) **using measurements of incoming surface radiation**, surface **skin temperature, surface meteorology, and** surface and **vegetation properties** [45]. One of the advantages in this algorithm is applying both Bulk Atmospheric Similarity (BAS) and the Monin-Obukov atmospheric surface layer (ASL) similarity in the model, which can be used for regional and local scales respectively to determine the turbulent fluxes. Another important merit of SEBS is the inclusion of a physical model which takes surface heterogeneity into account in the estimation of the roughness height for heat transfer. **The SEBS algorithm has been successfully applied for many applications of evaporation estimations** in many different places **with different scale** [46-51].

Water – Solvency – Accuracy

**Landsats solve—atmospheric correction is crucial to accuracy.**

**Schroeder et al 6** (Todd A., Warren B. Cohen, Conghe Song, Morton J., Canty, Zhiquiang Yang, Dept. Forest Science, UO, Forest Science Lab, Dep. Geo @ North Carolina, Systems Analysis @ Munich, <http://ddr.nal.usda.gov/bitstream/10113/38625/1/IND44322324.pdf>, accessed 7/5/11) CJQ

**Detecting and characterizing continuous changes in** early **forest succession** using multi-temporal satellite imagery **requires atmospheric correction procedures that are both operationally reliable, and that result in comparable units** (e.g., surface reflectance). This paper presents a comparison of five **atmospheric correction methods** (2 relative, 3 absolute) **used to correct a nearly continuous 20-year Landsat TM/ETM+ image data set** (19-images) covering western Oregon (path/row 46/29). In theory, **full absolute correction** of individual images in a time-series **should effectively minimize atmospheric effects resulting in a series of images that appears more similar in spectral response than the same set of uncorrected images**. Contradicting this theory, evidence is presented that demonstrates how absolute correction methods such as Second Simulation of the Satellite Signal in the Solar Spectrum (6 s), Modified Dense Dark Vegetation (MDDV), and Dark Object Subtraction (DOS) actually make images in a time-series somewhat less spectrally similar to one another. Since the development of meaningful spectral reflectance trajectories is more dependant on consistent measurement of surface reflectance rather than on accurate estimation of true surface reflectance, correction using image pairs is also tested. The **relative methods tested are variants of an approach referred to as “absolute-normalization”, which matches images in a time-series to an atmospherically corrected reference image using pseudo-invariant features and reduced major axis (**RMA) **regression**. An advantage of “absolute-normalization” is that **all images in the time-series are converted to units of surface reflectance while simultaneously being corrected for atmospheric effects**. Of the two relative correction methods used for “absolute-normalization”, the first employed an automated ordination algorithm called multivariate alteration detection (MAD) to statistically locate pseudo-invariant pixels between each subject and reference image, while the second used analyst selected pseudo-invariant features (PIF) common to the entire image set. Overall, relative correction employed in the “absolute-normalization” context produced the most consistent temporal reflectance response, with the automated MAD algorithm performing equally as well as the handpicked PIFs. **Although both relative methods performed nearly equally in terms of observed errors, several reasons emerged for preferring the MAD algorithm**. The paper concludes by demonstrating how “absolutenormalization” improves (i.e., reduces scatter in) spectral reflectance trajectory models used for characterizing patterns of early forest succession.

Water – Landsats Key

**Landsats are key—five reasons.**

**NASA 7** (<http://landsat.gsfc.nasa.gov/pdf_archive/soc_0011.pdf>, accessed 7/4/11)CJQ

The Landsat satellites have a number of characteristics that make them well suited for water-use mapping: **(1) The spatial resolution of Landsat enables water managers to map water use for individual** agricultural fields **and thereby manage on a field-by-field basis. With coarser-resolution data this doesn't work**. Landsat's “resolution helps us to resolve water consumption on the scales of anthropogenic interaction and land ownership,” Allen explains. **(2) Landsat's spectral resolution includes a thermal infrared band. This** thermal information **is essential for water-use mapping because the** mapping **process is predicated on** the fundamental **principle that evaporating water absorbs energy**, i.e. the more water fields are losing through ET, the cooler they are. **(3) There is now an archive containing a quarter of a century worth of global Landsat data that** has the spatial resolution, spectral coverage, and thermal imagery needed for water-use mapping. “Landsat **provides continuity to assess change in ET over time** and to document historical water consumption,” Allen says—an essential capability in the U.S. West, where water rights often are established by historical precedence. As Levitt puts it, “METRIC allows water resource administrators to go back in time and see consumptive use.” **(4) The Landsat satellites' orbit place them overhead during morning hours, avoiding common** afternoon **cloud cover. (5) The entire Landsat archive is freely available**. As Morse highlights, “all parties to a water dispute have equal access to a primary data source.”

**Landsats successfully track water usage and are crucial to further water rights and management**

**NASA 7** (<http://landsat.gsfc.nasa.gov/pdf_archive/soc_0011.pdf>, accessed 7/4/11) CJQ

Detailed **water consumption maps can be made quickly** and easily **with Landsat because of its** 30 m **spatial resolution and thermal imaging capability. Landsat has been proclaimed “the best and least expensive way to quantify** and locate **where water is used and in what quantity**,” by Anthony Morse and Richard Allen, two water management specialists from Idaho. 11 Former World Bank economist, Dr. Chris Perry, predicts that, “**We may expect significant improvements in the productivity of water**—the crop per drop—**by the analysis and debate facilitated by better data.”** 12 **Landsat data have been used** successfully **not only to quantify water consumed by irrigation, but also to establish water rights**, to facilitate the transfer of water entitlements, **and to estimate aquifer depletions** and quantify net ground-water pumpage in areas where water extraction from underground is not measured. 13 A closer look at Landsat’s role **Landsat data**, including visible, near infrared, mid-infrared, and thermal information, for a particular geographic region are **fed into a relatively sophisticated energy balance model that outputs evapotranspiration maps**. 14 Evapotranspiration (ET) refers to the conversion of water into water vapor by the dual process of evaporation from the soil and transpiration (the escape of water though plant’s stomata). 15 For vegetated land, ET is synonymous with water consumption. 16 Maps of water consumption made with moderate resolution Landsat data enable water resources managers and administrators to determine how much water was consumed from individual fields. And, **because the spatial nature of Landsat data lends itself to the monitoring of seasonal** evapotranspiration **trends, managers can use the information to determine which complex irrigation schedules should be pursue**d and how to time water releases from dams. “**Remote sensing,** applied to the measurement of ET over large areas, **provides analysts of irrigation systems with extraordinary new tools** for the objective assessment of consumption and production—**constituting a quantum leap in the assessment of irrigation system performance,”** Perry wrote in 2003. 17

**Thermal band use is crucial to establishing water rights—multiple countries.**

**NASA 7** (<http://landsat.gsfc.nasa.gov/pdf_archive/soc_0011.pdf>, accessed 7/4/11)CJQ

“**Satellite imagery**, especially **in the thermal bands**, can and **will revolutionize the establishment of water rights in the many parts of the world** where they are insecure,” says Perry, who has worked on many water resources projects in developing countries. 24 **Outside of the U.S., the contentious issue of securing water rights can be limited by data. “There are numerous aid** programs from large donors such as the World Bank and Asian Development Bank **that want to help manage water resources more** effectively and productively, **but nobody has the proper data**,” Bastiaanssen says, but he continues, “**with Landsat we can map out soil moisture, water consumption, water stress, crop yield**.” 25 Increasingly, the World Bank must deal with the overdraft of aquifers. **They have labeled the unsustainable water mining “critical” in** the North **China** Plain, **Jordan, Mexico**, Northern **India, Israel, Palestine and Yemen**. 26 Meanwhile, Landsat has helped the World Bank successfully manage water projects in China, Mexico, and Yemen, as well as Egypt, Saudi Arabia, Uzbekistan, and Kazakhstan. 27 In Turkey, Pakistan, Sri Lanka, India and China remo**te sensing has been demonstrated as a key tool for the strategic planning of water productivity on a basin wide scale.**

Water – I/L – Syria

**Syria experiencing water crunch now—quick transition to effective management scheme solves escalation.**

**Sands 10** (Phil, Journalist @ The Nat'l, <http://www.thenational.ae/news/worldwide/middle-east/syrias-water-shortage-causes-alarm>, accessed 7/7/11) CJQ

DAMASCUS// **Immediate action is needed to stop a water crisis in Syria from getting worse**, international experts have warned.  The recommendation came after a Damascus conference on water use reported that national supplies had been cut in half between 2002 and 2008, partly through high rates of wastage. During that six-year period, **water resources fell from a** relatively **comfortable** annual **level of 1,200 cubic metres per person to fewer than 750 cubic metres**, according to figures presented by researchers. The 700-cubic-metre threshold puts a country in the ranks of those unable to meet domestic demand. Scientists and water engineers at the conference, which concluded last week, expressed alarm that **Syria**, until **recently considered water rich** for the Middle East, **had** so **rapidly moved to the brink of scarcity**. They said **the country could meet its needs only if less water was wasted**.  "What upsets me are the inefficiencies in the system, and that's not excusable," said Ghassan Ejjeh, the conference chairman and a leading expert on water reuse. Based in Brussels, he was born and grew up in Damascus, a place he remembers as once lush with orchards and streams, conditions he contrasted with today's car-dominated urban crush. "Being short of water when there is nothing you can do about it is one thing, but it's quite another to be short when the situation could be alleviated through better use of supplies," he said. After the conference, arranged by the Levant Desalination Association and Nosstia, an organisation of expatriate Syrian scientists, Mr Ejjeh rejected suggestions that Syria had not reached a crisis point: the figures "speak for themselves". "You can call it whatever you want, but as things stand, **Syria doesn't have enough water to meet its needs,"** he said. "If they have 750 cubic metres a year, that's a water crisis and **it will quickly become something worse unless action is taken.** Supplies dropped from 1,200 cubic metres to 750 very quickly and at that rate, there is going to be a real problem very soon."  Syria's eastern Jazeera region, **the country's breadbasket, has suffered from** four years of **drought so devastating that international aid agencies have been handing out emergency packages to feed the local population**. The UN estimates that 600,000 people have fled because of water shortages. The north-eastern province of Hasika has been hardest hit, with the Khabur River, once a major water source in the area, now dry. **The effect** of the drought, considered a result of global climate change by environmental experts, **was magnified by years of poor water management,** according to Fouad Abousamra, a United Nation's scientist who gave a presentation at the Damascus conference "The issue started in the north-east with an excessive extraction of water from groundwater supplies, then, slowly with climate change and the reduction of rainfall, the problem was amplified," he said. Mr Abousamra, who is also Syrian, said **the country could "not afford to wait" to address water problems** in the north-east, although he characterised the situation as less pressing in Damascus. The problems can be solved with "proper management, clear policies and it will take money", he said. "The government knows how serious the problem is and they are beginning to take some steps, but **more needs to be done**." Senior government officials have stressed the need for more effective water policies and, on Monday, Nader al Bunni was replaced as irrigation minister by George Malaki Sawmi, a leading Syrian authority on the subject. He has been tasked with pushing through an extensive modernisation plan. Experts criticised Syria's inefficient techniques for agricultural irrigation, which accounts for 80 per cent of Syria's water use. **Out-dated irrigation methods mean more than 70 per** cent of that amount **goes to waste.** Nidal Hilal, a leading water scientist from Swansea University in the UK, said cutting waste would be a simple and effective way of stemming the water crisis. "People are using water excessively," he said. "**The message of reduce, recycle and reuse needs to be heard in** Syria, from the young people in schools right up to the highest authorities." Since 2002, Syria has been developing a major engineering plan to pump water from its western coastal area to Damascus. Engineers at the conference dismissed it as expensive and complicated.

Water – I/L – Pakistan

**Despite floods, lack of technology ensure Pakistan fails to cope with droughts—management solves.**

**Express Tribune 11** (June 22, <http://tribune.com.pk/story/193729/water-crisis-from-food-bowl-to-dust-bowl/>, accessed 7/7/11) CJQ

NUST Rector Engr Muhammad Asghar said that it is essential **to raise awareness** among media and policymakers **regarding two silent tsunamis of water and food shortage that can** potentially **harm the future** of the country. He asserted the dia**logue would serve as a stepping stone in devising water management techniques.** Dr Shahbaz **Khan**, Chief of Section on Sustainable Water Resources Development and Management, UNESCO, France, presented a comprehensive comparative analysis of Pakistan’s water problems. He pinpointed the four fundamental water-related challenges facing the country including its geo-political vulnerability to rapid population increase and climate change. He **laid emphasis on efficient water management through technological advancement** in this vital sector. “**We are not prepared** technologically **and that makes us more susceptible to**[**water crisis**](http://tribune.com.pk/story/193582/water-crisis-as-suburban-residents-dig-deeper-the-citys-water-base-plummets/)**in comparison with other countries. Knowledge investment can lead to better water future**,” he said. UNESCO Pakistan Chapter Director Dr Kozue Kay Nagata, while addressing the gathering, stressed the need for taking urgent steps with regard to natural disaster management in Pakistan. She said that **though natural disasters are beyond human control, the risk factor can be reduced by means of utilising the immense potential of science** and technology. She said that **Pakistan is unique in that not only does it witness floods** of “biblical proportion” **but is also afflicted by droughts** from time to time.

Water – I/L – Jordan

**Lack of management strategies in Jordan lead to unconventional and ecologically damaging policies—provides access to contaminated water.**

**Red Sky News 11** (<http://redskynews.com/?p=8926>, accessed 7/7/11) CJQ

**In its desperate efforts to battle chronic water shortages, Jordan**, one of the world’s 10 driest countries, **is mulling** “unconventional” and “**environmentally unfriendly” plans**, experts say. The challenge is huge for this tiny country where desert covers 92 percent of the territory and the population of 6.3 million is growing. Critics say **the government’s efforts to manage the country’s limited water resources** **and generate new ones are being hindered by a strategy which** at best **is chaotic. Jordan is tapping into the ancien**t southern **Disi aquifer, despite concerns about** high levels of **radiation**, while studies are underway to build a controversial canal from the Red Sea to the Dead Sea. “Unconventional **projects, like Disi** for example, **are environmentally unfriendly**,” water expert Dureid Mahasneh, a former Jordan Valley Authority chief, told AFP. The 990-million-dollar project seeks to extract 100 million cubic metres (3.5 billion cubic feet) of water a year from the 300,000-year-old Disi aquifer, 325 kilometres (200 miles) south of Amman, officials say. The plan is to provide the capital Amman with water for 50 years, said water ministry official Bassam Saleh, who is in charge of the project that was launched in 2008 and is due to be completed in 2012. A 2008 study by Duke University, in the United States, shows that Disi’s water has 20 times more radiation than is considered safe, with radium content that could trigger cancers. “Our research shows that **the Disi aquifer is heavily contaminated with radium**,” according to the study done by the Durham, North Carolina team which tested 37 pumping wells in **the** aquifer. Mahasneh said “Disi **water should not be touched**.” “How can you go for a non-renewable water resource that is contaminated with radiation and needs treatment?” But the government has brushed aside such concerns. “We know there is radiation in Disi because it is underground water but we will treat it by diluting it with an equal amount of water from other sources,” said Saleh. Jordan University professor Elias Salameh agreed. “The radioactivity can be treated, and it is not a complicated matter.” Munqeth Mehyar, of the Jordanian-Israeli-Palestinian non-governmental group Friends of the Earth Middle East (FoEME), warned against abusing the water resource. “**If we overpump the Disi water, we will suffer** from problems like **sinkholes** for example. And there are no studies that tell you for sure how long the aquifer water would last,” he said. Jordan has also agreed in principle to build, along with its Palestinian and Israeli neighbours, a four-billion-dollar pipeline from the Red Sea to refill the rapidly shrinking Dead Sea. But the world’s lowest and saltiest body of water lies below the Red Sea and the pipeline must cross higher land in order to reach it — a project that will entail a major pumping effort. A desalination plant would also be built to remove the salt and provide 200 million cubic metres of potable water to Jordan each year. “This project is worrisome. It will cause indescribable damage,” Mehyar warned. A feasibility study is being carried out by the World Bank but environmentalists fear that an influx of seawater could undermine the Dead Sea’s fragile ecosystem. The degradation of the Dead Sea began in the 1960s when Israel, Jordan and Syria began to divert water from the Jordan River — the Dead Sea’s main supplier. Over the years **95 percent of the river’s flow has been diverted by the three neighbours for agricultural and industrial use**, with Israel alone diverts more than 60 percent of it, according to FoEME. **The impact on the Dead Sea has been compounded by a drop in groundwater levels** as rain water from surrounding mountains dissolved salt deposits that had previously plugged access to underground caverns. Industrial and tourist operations around the shores of the lake exacerbate the situation. “We ask the government to keep an open mind while examining the plan,” said Mehyar. The government acknowledges the project will be a challenge. “Six studies on the Red-Dead plan’s impact on the environment are currently being conducted,” said Fayez Batainah, who heads the project at the water ministry. “We are coordinating and cooperating with the World Bank and all concerned sides.” But Mahasneh said the authorities did not have a comprehensive strategy. “**There is chaos in the country’s water polices. We do not have a real strategy** and efficient water management, **and the current plans did not consider what independent experts think** or say,” he said. “The country for example is still cultivating crops that consume a lot of water. We should import these crops and save our water,” he said, singling out tomatos and bananas. More than 60 percent of Jordan’s annual water consumption of 900 million cubic metres goes to agriculture, which contributes 3.6 percent to gross domestic product, according to official figures. “**We have water… but we suffer from massive water mismanagement,”** Mehyar said.

Water – I/L – Uzbekistan

**Uzbekistan facing water crisis now: failure to reform management regimes spreads tuberculosis, creates food shortages and instability.**

**Bukharbaeva 5** (Galima, writer, <http://iwpr.net/report-news/new-uzbek-water-crisis>, accessed 7/7/11) CJQ

**Uzbekistan is facing a new water crisis, as a result of drought**, rapid population growth and the shrinking of the Aral Sea. But despite its problems, Tashkent curiously refuses to negotiate with its neighbours, Tajikistan and Kyrgyzstan, over sharing water resources. One of the worst hit areas of Uzbekistan is Karakalpakstan in the northwest. **As a consequence** of severe dought, **the region received only 42 per cent of its average annual supply of water last year. This has devastated agriculture**, the main sector of the local economy. **Many rice and cotton plantations** are said to **have perished. Pastures are so withered that cattle have had to be slaughtered.** Last year drought devastated around 300,000 hectares of crops in the region, directly affecting the livelihood of about 50,000 families. **People were forced to drink poor quality water, which resulted in a rise in diseases such as** hepatitis and **tuberculosis**. Vadim Antonov of the ministry of agriculture and water resources lays the blame on population growth which has increased four-fold to 25 million over the last hundred years, according to official statistics. **The population is** currently growing by about 500,000 a year, **requiring enormous amounts of land to be turned over to agriculture, exhausting water supplies and draining the Aral Sea.** Within 10 years, says Antonov, **Uzbekistan won't have the water resources to meet its needs** Some experts have suggested exploiting large reserves of fresh underground water in the northeast of the southern Aral Sea area. They propose building a plant to bottle the supply to provide the population with drinking water. But in the long term, it seems, the only solution will be to use supplies from outside the country. One suggestion is to revive a plan to divert Siberian rivers to Central Asia. The project was dropped several years ago after critical press reports. "Russia is prepared to revive the plan," said Antonov. "Because if we use their water, we can in turn supply people in Siberia and the Urals with fruit and vegetables, which are in short supply. Some people have never seen grapes, let alone watermelons." The project would involve the construction of a canal costing around US$16 billion, but none of the countries in the region have this sort of money. The cost could explain why high-ranking Uzbek officials prefer to ignore the water problem altogether. International organizations - the World Bank in particular - are reluctant to back such schemes too. A grant for preliminary analysis was refused. They say that **Uzbekistan's problem has less to do with shortages than mismanagement of existing water resources**, and that distribution systems must be reformed first.

Water – I/L – Latin America

**Mismanagement of water resources guarantee a Latin American water crisis.**

**Beeson 8** (Bart, Center for International Policy, <http://www.alternet.org/water/84145/?page=2>, accessed 7/7/11) CJQ

With the most annual rainfall of any region in the world, **the water crisis in Latin America is particularly perplexing. Latin American countries face** many of **the same problems as countries with chronic** fresh water **shortages**. And **less than 20 percent have access to adequate sanitation systems**. So why do so many people lack access to clean water, when water abounds in the region? In 2006, the United Nations Development Program (UNDP) reported the answer clearly: "**The scarcity at the heart of the global water crisis is rooted in power, poverty and inequality, not** in **physical availability**." And **since Latin America has one of the most inequitable income distribution rates in the world, water access in the region is equally skewed**. What's more, a 2006 World Bank study shows average water bills in Latin America are the highest of all regions in the developing world. **Poor people bear the brunt of problems associated with water contamination and "scarcity**." Additional studies have found the poor pay more for clean water, spend more time and effort collecting water, and are much more likely to suffer health problems from contaminated water. The UNDP report adds, "**People suffering the most from the water and sanitation crisis -- poor people in general and poor women in particular -- often lack the political voice needed to assert their claims to water.**" Yet the water movements brewing in Latin America are beginning to make their collective political voice heard.

Water – Impact Helper – Escalation

**Water crisis is coming soon: critical internal link to any future conflict.**

**Jacobson and Tropp 10** (Maria and Hakan, Programme Officer and Director at the UNDP Water Governance Facility, [http://www.google.com/search ?sourceid=chrome&ie=UTF-8&q=Maria+Jacobson+ %E2%80%A2+Ha%CB%9Akan+Tropp](http://www.google.com/search%20?sourceid=chrome&ie=UTF-8&q=Maria+Jacobson+%20%E2%80%A2+Ha%CB%9Akan+Tropp), accessed 6/7/11) CJQ

**With the onset of climate change and a business as-usual approach, the world’s water crisis is bound to deepen** as water is the primary medium through which climate change will have an impact on people’s livelihood, ecosystems and economies. **In Africa** alone by 2020, 75–**250 million people are** expected to be **exposed to increased water stress due to climate change** (World Water Development Report 2009). Climate **changes are likely to be rapid and events of ﬂooding and droughts are expected to become more intense and frequent** in many parts of the world. **Such changes would result in increasing** risk and **vulnerability to** not only environmental sustainability but also **economic growth and poverty reduction**. For example, **the Maldives**, facing dire consequences of sea-level rise, **are** already **considering buying land on the South Asia mainland as a coping mechanism to the risks of sea water destroying** fresh water sources and eventually ﬂooding great parts of **the Islands**. In addition to the rising demands for water due to climate change, **overuse and pollution**, poor governance (including **corruption), population and economic growth and** with that **changing consumer preferences** all **contribute to the widening gap between available water and water demands. Water scarcity leads to economic losses, increased competition, social tension, conﬂict and more.**

Water – Impact Helper – Escalation

**Water wars ensure sustained instability and eventual nuclear retaliation.**

**Collins 11** (Terry, writer, <http://www.eurekalert.org/pub_releases/2011-05/ic-vil053111.php>, accessed 7/7/11) CJQ

Saying that "**international water leadership is** virtually **nonexistent**," the retired leaders say the panel will work to elevate the issue's political prominence in an effort to avert a looming "water crisis." The 20 members of the InterAction Council attending this year's three-day annual meeting in Quebec City included former US President Bill Clinton, former Mexican Presidents Vicente Fox and Ernesto Zedillo, and former prime ministers Yasuo Fukuda (Japan) and Gro Brundtland (Norway). Co-chairing the meeting: former Canadian Prime Minister Jean Chretien and former Austrian Chancellor Franz Vranitzky, At the meeting's conclusion, the group urged a new international water ethic and offered today's political office-holders some 21 recommendations for world water management moving forward. The top recommendation: "placing water at the forefront of the global political agenda." Others include: link climate change research and adaptation programs to water issues, make the right to water legally enforceable, raise the price of water to reflect its economic value while making provisions for people in poverty, prefer the growth of food over biofuel crops in places where water supplies are threatened, and encourage the UN Security Council to take up water as an important focus. They welcomed both a high level of dialogue and cooperation on water-allocation in the Mekong River delta between China and India and the work done by the Clinton/Bush Haiti Fund, which aims to rebuild housing in Haiti with adequate sanitation to avoid public health disasters through water contamination. In addition to the water crisis, the Council touched on other environmental topics, warning of the "intensification of natural phenomenon caused by climate change as demonstrated by floods, hurricanes, earthquakes and tornadoes ravaging the globe." On other topics, the Council expressed deep condolences to the Japanese people who endured the recent earthquake, tsunami and nuclear crisis. **They warned of potentially "prolonged instability" in North Africa and the Middle East and of inflationary dangers caused by escalating government debt** loads. And they called on governments to eliminate nuclear weapons of mass destruction, the theme of the Council's 2010 meeting in Hiroshima, Japan, saying "**the continuing existence of nuclear weapons is an unacceptable and disproportionate threat to every living thing on the planet**. The only enduring solution to this threat lies in the verifiable and irreversible elimination of these weapons." "**As long as nuclear weapons exist in the hands of any state, they will be sought also by others.** As long as nuclear weapons exist they will be used one day, either by deliberate action or by accident. **Any use of nuclear weapons would be a human, ecological, economic, political and moral catastrophe.** States continue to seek nuclear weapons for a number of reasons. The question of proliferation needs to be recognized and addressed."

Water – Impact Helper – Escalation

**Water wars will escalate—Middle East is uniquely susceptible to conflict: Death toll is in the billions.**

**Peterson 99** (Scott, Staff Writer @ Christian Science Monitor, [http://www.csmonitor.com/1999 /0714/p1s3.html/(page)/2](http://www.csmonitor.com/1999%20/0714/p1s3.html/%28page%29/2), accessed 7/7/11) CJQ

With Israel's new Prime Minister Ehud Barak promising to restart peace with the Palestinians and Syria, the issue of water - often forgotten by outsiders, but all-important in the parched Holy Land - will take center stage. After all, **destroying an enemy's water** and its **sources has been a strategic aim in every war fought in the Mideast** during the past two generations. And severe water shortages here **- the Middle East is experiencing its driest spell in 50 years** - could complicate any talks. "**If we solve every other problem** in the Middle East but do not satisfactorily **resolve the water problem, our region will explode**," once warned the late Israeli Prime Minister Yitzhak Rabin, one of the architects of the Mideast peace process. As crops shrivel, river and reservoir levels drop, and new dams and competing claims loom, experts are striving to cope with dwindling water resources. "The Malthusian specter is real in the Middle East," says Thomas Stauffer, a Washington-based Mideast water and energy analyst. Water resources are "fully utilized," while the population continues to grow - ingredients the economist Malthus predicted would lead to conflict. "The consequences are profound**. Scarcity means conflict, so oil wars are less likely than water wars."** His concerns are echoed by the results of a two-year study carried out by the US National Academy of Sciences alongside Israeli, Jordanian, and Palestinian water experts. "Fresh-water supplies in the Middle East now are barely sufficient to maintain a quality standard of living," said Gilbert White, a University of Colorado geographer who led the team. Increasing water use across the largely arid region, the team found, guarantees that "the area's inhabitants will almost assuredly live under conditions of significant water stress in the near future." **Already, at least 400 million people live in regions with severe water shortages. Within 50 years, that figure is expected to soar to 4 billion. There is no more water on the planet than there was 2,000 years ago, when the population was just 3 percent what it is today. "Our concerns about global warming are trivial compared to the issues that we face over water**," a senior official of NASA's Earth Sciences Directorate has said.

Water – Impact – Spillover

**Water wars go global—it's an essential resource; countries will do anything to maintain their stream. Internal conflicts mandate that countries lash out and guarantee that wars get bloodier.**

**Postel and Wolf 1** (Sandra and Aaron, Global Water Policy @ Amherst and Asst. Prof. Geo. @ OSU, <http://www.globalpolicy.org/component/content/article/198/40343.html#postel>, accessed 7/7/11) CJQ

Others argue, however, that **when it comes to water the past will not be a reliable guide to the future**. A renewable but not infinite resource, **fresh water is becoming increasingly scarce**: The amount available to **the world** today **is** almost **the same as it was when the Mesopotamians traded blows**, even as global demand has steadily increased. Just since 1950, the renewable supply per person has fallen 58 percent as world population has swelled from 2.5 billion to 6 billion. Moreover, **unlike oil and** most **other strategic resources, fresh water has no substitute** in most of its uses. **It is essential** for growing food, manufacturing goods, and safeguarding human health. And while history suggests that **cooperation** over water has been the norm, it **has not been the rule. One fourth of water-related interactions during the last half century were hostile.** Although the vast majority of these hostilities involved no more than verbal antagonism, rival countries went beyond name-calling on 37 recorded occasions and fired shots, blew up a dam, or undertook some other form of military action. **Lost amidst this perennial debate over whether there will be water wars has been a serious effort to understand** precisely how and **why tensions develop**, beyond the simplistic cause-and-effect equation that water shortages lead to wars. First, whether or not **water scarcity** causes outright warfare between nations in the years ahead, it already **causes enough violence and conflict within nations to threaten social and political stability**. And as recent events in the Balkans and sub-Saharan Africa demonstrated, **today's civil conflicts have a nasty habit of spilling over borders and becoming tomorrow's international wars**. Second, water **disputes** between countries, though typically not leading to war directly, **have fueled decades of regional tensions, thwarted economic development, and risked provoking larger conflicts before eventually giving way to cooperation**. The obsession with water wars begs more important questions: What are the early signs and likely locations of water-related disputes, and what can governments and international agents do to prevent the eruption of violence and political instability?

**Water crises in one country affect the internal politics of those across the globe—small instabilities butterfly effect until whole governments are overthrown.**

**Economist 9** ("Water Shortages are a Growing Problem, but Not for the Reasons most People Think," <http://www.economist.com/node/13447271>, accessed 7/7/11) CJQ

**THE overthrow of Madagascar’s president** in mid-March **was** partly **caused by water problems—in South Korea. Worried by the difficulties of increasing food supplies** in its water-stressed homeland, Daewoo, **a South Korean conglomerate, signed a deal to lease no less than half Madagascar’s arable land to grow grain for South Koreans**. Widespread **anger at the terms of the deal** (the island’s people would have received practically nothing) **contributed to the president’s unpopularity**. One of **the new leader’s first act**s **was to scrap the agreement**. Three weeks before that, on the other side of the world, Governor Arnold Schwarzenegger of California declared a state of emergency. Not for the first time, he threatened water rationing in the state. “It is clear,” says a recent report by the United Nations World Water Assessment Programme, “that **urgent action is needed if we are to avoid a global water crisis**.” Local water shortages are multiplying. Australia has suffered a decade-long drought. Brazil and South Africa, which depend on hydroelectric power, have suffered repeated brownouts because there is not enough water to drive the turbines properly. So much has been pumped out of the rivers that feed the Aral Sea in Central Asia that it collapsed in the 1980s and has barely begun to recover.by individual acts of mismanagement or regional problems, are one thing. A global water crisis, which impinges on supplies of food and other goods, or affects rivers and lakes everywhere, is quite another. Does the world really face a global problem?

Water – Impact – Mid East

**Water crisis is coming soon: Failure to solve Euphrates river collapses middle East stability.**

**Klaas 3** (Prof. Animal Ecology, Iowa State, "Potential for Water Wars in the 21st Century, <http://www.public.iastate.edu/~mariposa/waterwars.htm>, accessed 7/6/11) CJQ

**Syria and Iraq are not much more cordial with each other than they are with Turkey**, but **after Turkey and Israel agreed to a military alliance** a few years ago, **Iraq and Syria agreed to cooperate**, at least **on water issues. They signed an agreement** in 1990 **to share the Euphrates**, 52 percent for Iraq and 48 percent for Syria, but they almost went to war on several occasions. **Iraq has threatened** several times **to** **blow up the Assad Dam** in Syria. **Turkey also blames Syria for sheltering** Marxist Kurdish **guerrillas who have promised to blow up the Atatürk Dam** and who have killed more than 29,000 Turkish civilians over 15 years. **The Marsh Arabs in southern Iraq have been** severely **persecuted by Saddam Hussein and his government**. Iraq has built a 330-mile artificial canal called the Saddam River that starts near Baghdad and ends near Basra. This project resulted in large areas of the southern plains being drained and the Marsh Arabs have been either killed or pushed aside.

Water – Impact – Golan Heights

**Continued Syrian crunch leads to conflict over the Golan Heights and displaces a million people.**

**NYT 10** (Daniel Williams, <http://www.nytimes.com/2010/03/03/world/middleeast/03iht-letter.html>, accessed 7/7/11) CJQ

**The water shortage has contributed** in the past **to conflict with Israel over the Golan Heights, which the Israelis conquered in the 1967 Middle East War** and Syria wants back. **The area contains watersheds that flow into the Sea of Galilee**, a major source of Israel’s water, **and control of these resources has been a sticking point when the countries have met in negotiations**. Repeated requests to discuss the drought and water policies went unanswered by the government of President Bashar al-Assad, 44, who has ruled Syria for a decade. **The lack of water has caused more than 800,000 people in eastern Syria to lose “almost all of their livelihoods and face extreme hardship,**” according to a report by the U.N. humanitarian office. **About 80 percent of the hardest hit “live on a diet consisting of bread and sugared tea,”** the report said.

Water – Impact – Water Wars

**Diminishing supplies of water require new modes of management—status quo flashes wars around the globe.**

**Namrouqa 11** (Hana, Jordan Times, <http://www.jordantimes.com/?news=35992>, accessed 7/7/11) CJQ

He emphasised that **climate change**, which is altering rainfall patterns, **coupled with** a rapid human **industrial development, is worsening the water situation globally. “The world is only now waking up to a frightening new reality**, a new global challenge: **the growing gap between the demand for water and** the **diminishing availability** of water,” added Prince Feisal, who is chairman of the Royal Water Committee. He underscored that **water supply by the end of the 20th century evolved to become a global issue,** one that is not only socially, politically and human rights-related, but a security issue. “… Indeed, many experts now believe that **water could become a flashpoint for regional instabilities,”** the Prince said. He expressed hope that the Efficient 2011, an international water event held in Jordan for the first time, will help come up with activities that integrate water demand management concepts and practices in the region. During the five-day event, experts will explore the impacts of drought, climate change and water loss among other global challenges on water resources and come up with recommendations on incorporating water demand management in urban water planning. The conference, organised by the Ministry of Water and Irrigation, USAID and the IWA, seeks to shed light on the current global water crisis and find solutions to water challenges, particularly for countries that suffer from water scarcity such as Jordan. Minister of Water and Irrigation Mohammad Najjar pointed out that the conference is being held at a vital time and place, referring to the dropping levels of the Dead Sea. “**Rising water stress levels around the globe are undermining the continued efforts towards achieving sustainability of ecosystems,** societies **and economics**,” he noted during the opening ceremony. The minister added that Jordan, the fourth water poorest nation in the world, is drawing up corrective water policies and innovative solutions that adopt a supply-oriented approach to water management. USAID Acting Mission Director Dana Mansouri said water scarcity is emerging as one of the greatest challenges of the current time, noting that growing populations, expanding economies, and climate change are putting fresh water resources under increasing pressure in many parts of the world. “Today’s **solutions** to water scarcity **are** three: to transport freshwater in at great expense; to create fresh water from salt water at even greater expense; and **to use water more efficiently, which actually saves money**,” she highlighted.

Water – Impact – Central Asia

**Water crisis coming in Central Asia—failure to change management strategies continues food, humanitarian and political crises and risks escalation.**

**Linn 11** (Johannes, Ex. Dir. Wolfensohn Center for Development, [http://www.brookings.edu/opinions/ 2008/0619\_central\_asia\_linn.aspx](http://www.brookings.edu/opinions/%202008/0619_central_asia_linn.aspx), accessed 7/7/11) CJQ

**Central Asia is fundamentally an arid region**, with its most fertile regions former deserts made arable by vast irrigation systems. Most of the water comes from the mountain ranges of Kyrgyz Republic and Tajikistan (and to a lesser extent from Afghanistan) channeled downstream to Kazakhstan, Turkmenistan and Uzbekistan through the Amu Darya and Syr Darya rivers. **Over the last century Soviet engineers harnessed** these **water** resources **with an extensive system of dams and irrigation** canals **to support the rapidly growing populations of the downstream countries** and their agricultural production that in turn supported the Soviet Union. The dams also produce electricity, but peak demand for electricity is in the cold winter months, when water needs to be stored for summer irrigation release. During Soviet days downstream countries provided the upstream countries with gas and coal in the winter to allow them to generate heat and power without releasing water. **With the breakup of the Soviet Union the elaborate set of water and energy sharing agreements among the Soviet republics** of Central Asia **largely broke down** and the previously integrated regional water and electricity infrastructure became fragmented and suffered from lack of maintenance. **With** overuse and **poor water management agricultural yields stagnated or fell**, and the water levels of the Aral Sea dropped precipitously, leaving behind a mere remnant of what was previously one of the largest inland seas in the World. As a result the provinces around the Aral Sea, in particular the Karakalpakstan region of Uzbekistan, suffered great hardships and increases in poverty. **While the Central Asian republics of the Former Soviet Union avoided open conflict and military hostilities over scarce water resources, their relations have been strained**, especially between Tajikistan and Kyrgyz Republic on the one side and Uzbekistan on the other. Against this backdrop, **a water and energy situation that is already difficult and tense at best during years of normal weather can quickly deteriorate into a major humanitarian**, economic **and political crisis for the region.** This and next year shape up to be particularly problematic, since normal climatic cycles (probably linked to the El Nino-La Nina phenomenon) appear to be intensifying and are overlaid on the long-term effects of global warming. The last major drought in the region occurred in 2000-01. It affected not only the republics of the Former Soviet Union, but also Afghanistan, Iran, Pakistan and Mongolia, with devastating effects on the region’s agricultural production. According to the International Institute for Research on Climate Prediction in 2001 half of Tajikistan’s grain crop failed and cereal production dropped 15% below that of the previous year.[[1]](http://www.brookings.edu/opinions/2008/0619_central_asia_linn.aspx%22%20%5Cl%20%22_ftn1) A UN team reported during the same year that the regional drought severely affected some 550,000 to 600,000 people in Uzbekistan.[[2]](http://www.brookings.edu/opinions/2008/0619_central_asia_linn.aspx#_ftn2) International agencies organized a major relief initiative at the time.[[3]](http://www.brookings.edu/opinions/2008/0619_central_asia_linn.aspx#_ftn3) This year the situation in the region may well turn out worse. The summer of 2007 was unusually hot and dry in much of Central Asia, followed by an exceptionally cold and dry winter. **The winter had its most severe impact in Tajikistan, where parts of the country had to do without electricity** altogether for weeks at a time, **shutting down schools and limiting hospital operations**, and forcing families to live without heat or light during the winter months when temperatures as low at -30 degree Celsius were not uncommon. Even Dushanbe was severely affected by power cuts to the point that international organizations were on the verge of evacuating their personnel, including locally hired staff, for humanitarian reasons. **Tajikistan’s situation was aggravated by the fact that Uzbekistan**, plagued by its own winter energy shortages, **suspended gas exports and limited transfer of electricity through its territory**. At the same time, **the food situation** in the country **deteriorated, as farmers had to eat or sell their seed stock,** cattle ran short of feed, **aquaculture suffered from frozen ponds and streams**, and food supplies from neighboring countries dwindled along with rising prices.[[4]](http://www.brookings.edu/opinions/2008/0619_central_asia_linn.aspx%22%20%5Cl%20%22_ftn4) **Kazakhstan**, the main grain exporter in the region, **banned exports**, including to its neighbors, **reinforcing the damage done by the world food crisis beyond its borders**. While **spring and early summer** brought welcome relief from sub-zero winter temperatures, it **turned out to be another dry season**, with reports of pastures in the south of the country parched already early in the year. **With water levels in the reservoirs as low as they are already now and no relief in sight for the rest of the year, the next winter even if less severe than the last, will again bring months with little or no electricity for seven million Tajiks.**

Water – Impact – Indo/Pak

**Water wars between India and Pakistan go nuclear—conflict is inevitable absent transition to effective management techniques.**

**Zahur 11** (Musharaf, National Defence University @ Islamabad, <http://writerasia.blogspot.com/2011/06/water-crisis-can-trigger-nuclear-war-in.html>, accessed 7/7/11) CJQ

**South Asia is among one of those regions where water needs are growing** disproportionately to its availability. **The high increase in population** besides large-scale cultivation **has turned South Asia into a water scarce region**. The **two nuclear neighbors** Pakistan and India **share the** waters of **Indus Basin. All the major rivers** stem from the Himalyan region and **pass through Kashmir** down to the planes of Punjab and Sindh empty into Arabic ocean. It is pertinent that the strategic importance of Kashmir, a source of all major rivers, for Pakistan and symbolic importance of Kashmir for India are maximum list positions. Both the countries have fought two major wars in 1948, 1965 and a limited war in Kargil specifically on the Kashmir dispute. Among other issues, the newly born states fell into water sharing dispute right after their partition. Initially under an agreed formula, Pakistan paid for the river waters to India, which is an upper riparian state. After a decade long negotiations, both the states signed Indus Water Treaty in 1960. Under the treaty, India was given an exclusive right of three eastern rivers Sutlej, Bias and Ravi while Pakistan was given the right of three Western Rivers, Indus, Chenab and Jhelum. The tributaries of these rivers are also considered their part under the treaty. It was assumed that the treaty had permanently resolved the water issue, which proved a nightmare in the latter course. India by exploiting the provisions of IWT started wanton construction of dams on Pakistani rivers thus scaling down the wateravailability to Pakistan (a lower riparian state). The treaty only allows run of the river hydropower projects and does not permit to construct such water reservoirs on Pakistani rivers, which may affect the water flow to the low lying areas. According to the statistics of Hydel power Development Corporation of Indian Occupied Kashmir, India has a plan to construct 310 small, medium and large dams in the territory. **India has already started work on 62 dams** in the first phase. The **cumulative** dead and live **storage** of these dams **will be so great that India can easily manipulate the water of Pakistani rivers**. India has set up a department called the Chenab Valley Power Projects to construct power plants on the Chenab River in occupied Kashmir. India is also constructing three major hydro-power projects on Indus River which include Nimoo Bazgo power project, Dumkhar project and Chutak project. On the other hand, it has started Kishan Ganga hydropower project by diverting the watersof Neelum River, a tributary of the Jhelum, in sheer violation of the IWT. **The gratuitous construction of dams by India has created serious water shortages in Pakistan**. The construction of Kishan Ganga dam will turn the Neelum valley, which is located in Azad Kashmir into a barren land. **The water shortage** will not only affect the cultivation but it **has serious social, political and economic ramifications for Pakistan. The farmer associations have already started protests** in Southern Punjab and Sindh against the non-availability of water. These protests are so far limited and under control. The reports of international organizations suggest that the **water availability in Pakistan will reduce further in the coming years**. If the situation remains unchanged, **the violent mobs of villagers across the country will be a major law and order challenge for the government.  The water shortage has also created mistrust among the federative units**, which is evident from the fact that the President and the Prime Minister had to intervene for convincing Sindh and Punjab provinces on water sharing formula. The Indus River System Authority (IRSA) is responsible for distribution of water among the provinces but in the current situation it has also lost its credibility. The provinces often accuse each other of water theft.  In the given circumstances, Pakistan desperately wants to talk on water issue with India. The meetings between Indus Water Commissioners of Pakistan and India have so far yielded no tangible results. The recent meeting in Lahore has also ended without concrete results. **India is** continuously **using delaying tactics** to under **pressure Pakistan**. The Indus Water Commissioners are supposed to resolve the issues bilaterally through talks. The success of their meetings can be measured from the fact that Pakistan has to knock at international court of arbitration for the settlement of Kishan Ganga hydropower project. The recently held foreign minister level talks between both the countries ended inconclusively in Islamabad, which only resulted in heightening the mistrust and suspicions. **The water stress in Pakistan is increasing day by day**. The construction of dams will not only cause damage to the agriculture sector but India can manipulate the riverwater to create inundations in Pakistan. The rivers in Pakistan are also vital for defense during wartime. The **control over the water will provide an edge to India during war with Pakistan.  The failure of diplomacy**, manipulation of IWT provisions by India and growing waterscarcity in Pakistan and its social, political and economic repercussions for the country **can lead both the countries toward a war. The existent A-symmetry between** the conventional **forces** of both the countries **will compel the weaker side to use nuclear weapons to prevent the opponent from taking** any **advantage** of  the situation. Pakistan's nuclear programme is aimed at to create minimum credible deterrence. **India has a declared nuclear doctrine which intends to retaliate massively** in case of first strike by its' enemy. In 2003, India expanded the operational parameters for its nuclear doctrine. Under the new parameters, it will not only use nuclear weapons against a nuclear strike but will also use nuclear weapons against a nuclear strike on Indian forces anywhere. Pakistan has a draft nuclear doctrine, which consists on the statements of high ups. Describing the nuclear thresh-hold in January 2002, General Khalid Kidwai, the head of Pakistan's Strategic Plans Division, in an interview to Landau Network, said that **Pakistan will use nuclear weapons in case India occupies large parts of its territory**, economic strangling by India, **political disruption and if India destroys Pakistan's forces.**

Water – Solvency – India

**Only changing management practices can solve the Indian water crisis.**

**Brooks 7** (Nina, Arlington Institute, <http://www.arlingtoninstitute.org/wbp/global-water-crisis/606>, accessed 7/6/11) CJQ

The tragedy of **India’s water scarcity** is that the crisis **could have been** largely **avoided with better water management practices. There has been a distinct lack of attention to water legislation**, water conservation, **efficiency** in water use, water recycling, **and infrastructure**. Historically **water has been viewed as an unlimited resource that did not need to be managed as a scarce commodity** or provided as a basic human right. These attitudes are changing in India; there is a growing desire for decentralized management developing, which would allow local municipalities to control water as best needed for their particular region. **Since independence India’s** primary **goals have been economic growth and food security, completely disregarding water conservation**. This has caused serious ramifications being felt today, as many citizens still operate under these principles. **Unlike many other developing countries,** especially those with acute water scarcity issues such as China, **Indian law has virtually no legislation on groundwater.** Anyone can extract water: homeowner, farmer or industry as long as the water lies underneath their plot of land.[[30]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn30%22%20%5Co%20%22_ftnref30) The development and distribution of cheap electricity and electric pumps have triggered rapid pumping of groundwater and subsequent depletion of aquifers. There are approximately 20 million individual wells in India that are contributing to groundwater depletion.[[31]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn31%22%20%5Co%20%22_ftnref31) The owners of these wells do not have to pay for this water, so there is no incentive to conserve or recycle it; in fact they are incentivized to overdraw resources. Generally, the more water they use, the more they can produce. Industry applies the same logic, and rather than reusing the water used for cooling machines, they dump it back into rivers and canals, along with the pollution it has accumulated. Even Prime Minister Manmohan Singh has warned against over-pumping, but local officials won’t take any action, such as raising electricity tariffs, that would upset the huge farm lobbies.[[32]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn32%22%20%5Co%20%22_ftnref32) **India needs to keep boosting agricultural production in order to feed its growing population, but to do so without jeopardizing the amount of water** available, farmers must switch to less water intensive crops. **The central government** in India also **lacks the ability to store and deliver potable water** to its citizens, especially as supply shrinks. There is currently a water storage crunch, because means for storage, such as temple tanks and steep wells, have fallen apart. **China is able to store 5 times as much water per person as India**[[33]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn33%22%20%5Co%20%22_ftnref33), **making it blatantly clear how poor India’s water management is**. The government claims that 9 out of 10 people have access to water. Yet, even if this were factual, it disregards the fact that almost of all of that water is too contaminated to use.[[34]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn34%22%20%5Co%20%22_ftnref34) **None of the 35 Indian cities with a population of more than one million distribute water for more than a few hours per day**.[[35]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn35%22%20%5Co%20%22_ftnref35) The water situation in the capital, New Delhi, is typical of most cities in India, in that New Delhi does not lack water, merely good infrastructure.

Water – I/L – India

**Water crunch in India will happen by 2025—only changing water management methods will have any hope of solving.**

**Heimbuch 9** (Jaymi, Cal Polytech, <http://www.treehugger.com/files/2009/05/water-shortages-rising-across-the-globe-but-especially-india.php> accessed 7/6/11) CJQ

**By 2025, India,** China and select countries in Europe and Africa **will**[**face water scarcity**](http://www.treehugger.com/files/2009/03/global-water-crisis-nations-avert.php) **if** adequate and **sustainable water management initiatives are not implemented**, and an estimated 3 Billion people will be living below the water stress threshold. **Although** low and middle income **developing countries currently have low per capita water consumption**, rapid growth in population and **inefficient use of water across sectors is expected to lead to a water shortage in the future.** **Developed countries will need to focus on reducing consumption through better management** and practices. **By 2050, per capita water availability in India is expected to drop by** about **44%** due to growing populations and higher demand, as well as higher pollution levels. [**The report**](http://www.grailresearch.com/pdf/ContenPodsPdf/Water-The_India_Story.pdf)**takes a fascinating look at how water demands are changing,** the policies currently in place, projected policies, **and the future of fresh water across the planet,** but with a very specific look at India. **The numbers**, while frightening, **also show where change is possible and disaster avoidable...if the warning signs are heeded.**

Water – I/L – India

**India will soon face a massive water crunch—the crisis is totally anthropogenic and management reforms can solve.**

**Brooks 7** (Nina, Arlington Institute, <http://www.arlingtoninstitute.org/wbp/global-water-crisis/606>, accessed 7/6/11) CJQ

**More than two billion people** worldwide **live in regions facing water scarcity****[[2]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn2%22%20%5Co%20%22_ftnref2)and in India this is a particularly acute crisis. Millions of Indians** currently **lack access to clean drinking water, and the situation is only getting worse. India’s demand** for water **is growing at an alarming rate. India currently has the world’s second largest population**, which is expected to overtake China’s by 2050 when it reaches a staggering 1.6 billion,[[3]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn3%22%20%5Co%20%22_ftnref3) **putting increase strain on water resources as the number of peosple grows.** A rapidly growing economy and a large agricultural sector stretch India’s supply of water even thinner. Meanwhile, **India’s supply of water is rapidly dwindling due primarily to mismanagement** of water resources, although over-pumping and pollution are also significant contributors. **Climate change is expected to exacerbate the problem** by causing erratic and unpredictable weather, **which could drastically diminish the supply of water coming from rainfall and glaciers.**As demand for potable water starts to outstrip supply by increasing amounts in coming years, India will face a slew of subsequent problems, such as food shortages, intrastate, and international conflict. **India’s** water **crisis is** predominantly a **manmade** problem. India’s climate is not particularly dry, nor is it lacking in rivers and groundwater. **Extremely poor management**, unclear laws, government corruption, and industrial and human waste **have caused this water supply crunch and rendered what water is available** practically **useless due to** the huge quantity of **pollution. In managing** water **resources, the Indian government must balance competing demands** between urban and rural, rich and poor, the economy and the environment. However, because people have triggered this crisis, by changing their actions they have the power to prevent water scarcity from devastating India’s population, agriculture, and economy. This paper is an overview of the issues surrounding India’s water scarcity: demand and supply, management, pollution, impact of climate change, and solutions the Indian government is considering.

Water – Impact – India Economy

**Access to water is crucial to India's economy—the market will exhaust resources if left alone, changing management practices is crucial to solving.**

**Brooks 7** (Nina, Arlington Institute, <http://www.arlingtoninstitute.org/wbp/global-water-crisis/606>, accessed 7/6/11) CJQ

**Water is both an** important **input for** many different **manufacturing** and industrial **sectors and used as a coolant for machines,** such as textile machines. **Cheap water that can be** rapidly **pumped from underground aquifers has been a major factor in the success of India’s economic growth**. For example, the garment industry in Tirupur, a city in the southern state of Tamil Nadu, was growing faster than anyone thought possible for several decades. By 1990’s, however, the town was running out of water, which is a critical input for dyeing and bleaching.[[14]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn14%22%20%5Co%20%22_ftnref14) **Despite the many benefits from a thriving economy, industrial waste is** largely **responsible for the high levels of pollutants** found in India’s rivers and groundwater. **Many corporations end up polluting the very water they later need as an input**. According to the Ministry of Water Resources, **industrial water use in India stands at about 50 billion cubic meters** or nearly 6 per cent of **total freshwater abstraction**.[[15]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn15%22%20%5Co%20%22_ftnref15) **This** demand **is expected to increase dramatically in the next decade**, given the enormous forecasts of 9% growth for 2007 alone.[[16]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn16%22%20%5Co%20%22_ftnref16)

Water – Impact – India

**India will hit the crunch by 2020 but there's still hope—management changes can successfully gauge water. Failure to resolve the crisis triggers international water wars, crashes the global economy and leads to worldwide famine.**

**Brooks 7** (Nina, Arlington Institute, <http://www.arlingtoninstitute.org/wbp/global-water-crisis/606>, accessed 7/7/11) CJQ

**India is facing a looming water crisis that has implications** not only for its 1.1 billion people, but **for the entire globe. India’s demand** for water **is growing even as it stretches its supplies**. Water infrastructure is crumbling, preventing the government from being able to supply drinking water to its citizens. Pollution is rampant due to unfettered economic growth, poor waste management laws and practices. **Although** many analysts believe that **demand will outstrip supply by 2020**[[48]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/606%22%20%5Cl%20%22_ftn48%22%20%5Co%20%22_ftnref48), **there is still hope for India. Water scarcity** in India **is** predominantly **a manmade problem**; therefore if India makes significant changes in the way it thinks about water and manages its resources soon, it could ward off, or at least mollify, the impending crisis. India has had success with water infrastructure development, which allowed the country to take advantage of its water resources in the first place and achieve food security. These projects did enable the expansion of urban and industrial sectors and increased availability of safe drinking water, but then they were allowed to dilapidate. India needs to make water supply a national priority the way it has made food security and economic growth priorities in the past. **India’s need for a comprehensive management program is so severe because of its rapidly depleting water supply,** environmental problems, **and growing population**. If the country continues with a business as usual mentality the consequences will be drastic. **India will see a sharp decrease in agricultural production, which will negate all of the previous efforts at food security. India will become a net importer of grain, which will have a huge effect of global food prices, as well as the global supply** of food. **A rise in food prices will aggravate** the already widespread **poverty** when people have to spend larger portions of their income on food. **In addition to devastating** the agricultural sector of **India’s economy**, the water crisis will have a big effect on India’s industrial sector, possibly stagnating many industries. Finally, **India could become the stage for major international water wars because so many rivers that originate in India supply water to other countries.** India has the power to avoid this dark future if people take action immediately: start conserving water, begin to harvest rainwater, treat human, agricultural, and industrial waste effectively, and regulate how much water can be drawn out of the ground.

Water – Solvency – China

**Chinese water management is obsessed with displays of strength—focus on building dams rather than accurate analysis kills biodiversity, causes poverty and loses water.**

**CNN 10** (<http://articles.cnn.com/2010-09-13/world/china.water.crisis_1_water-shortages-water-supplies-drinking-water?_s=PM:WORLD>, accessed 7/7/11) CJQ

**Management of China’s water resources has been extremely inefficient**, leading to extensive water loss. **Water is highly subsidized by the central government,** making it practically free for users thereby leaving no incentive to save water. **The general attitude** towards water use **is to use as much as possible as fast as possible**. China’s irrigation system, choice of water intensive crops, obsession with dams, and **overexploitation** of surface and groundwater resources **have** all **contributed to the highly inefficient use and management of water resources**. The irrigation system is “less than 50% efficient which can mean that 8.5 % of the world’s water is being wasted.”[[32]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457#_ftn32) **Much of the water in open channel irrigation systems leaks back into the ground before it can be utilized**, although unfortunately not fast enough to replenish groundwater resources. According to China’s Ministry of Construction, inefficient irrigation has led to a loss of 400 million cubic meters of water every year.[[33]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457#_ftn33) In addition to an inefficient irrigation system, many crops that China grows are impractically water-intensive, such as wheat and rice. **Many will have to leave grain production altogether, or at least stop planting of rice, wheat and other** water-intensive **crops**. For decades farmers and politicians have ignored all warnings and done practically nothing to fix the system. **The government** also relies **on dams to manage the water resources and to reach its stated goal of becoming the largest producer of hydroelectric power** in the world.[[34]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457#_ftn34) Not only are many of these dams poorly constructed, but there has been a move away from the use of large dams after the 2000 World Commission on Dams issued a critical report. The report announced that many “**large dam projects had fallen far short of their physical** and economic **targets, resulting in huge losses of forest lands**, wildlife habitat, **and** aquatic **biodiversity**. All existing dams should be reviewed and no more should be built without the agreement of the people likely to be affected by them.”[[35]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457#_ftn35) **Dams destroy fish runs**, flood agriculture lands, **displace local communities**, dry up and pollute downstream wetlands, **and are extremely inefficient** because significant amounts of water are lost due to evaporation. In spite of this report and the resulting shift by many developed countries away from dams, China now openly boasts of owning over half of the world’s dams.[[36]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457%22%20%5Cl%20%22_ftn36%22%20%5Co%20%22_ftnref36) China is also overexploiting both its surface water and groundwater resources significantly faster than they are being replenished by rain. According to the Ministry of Water Resources, the utilization rate of water resources is around 60% for a number of rivers, including the Huai, Liao, and Yellow, and as high as 90% for the Hai River. These numbers are all notably above international standards, which are set with the intention of conserving water, of 30-40%.[[37]](http://www.arlingtoninstitute.org/wbp/global-water-crisis/457%22%20%5Cl%20%22_ftn37%22%20%5Co%20%22_ftnref37) **As rivers become increasingly polluted and run dry and lakes disappear with escalating pace, China will be forced to rely even more heavily on its underground aquifers,** unfortunately using up today what should be tomorrow’s water.Although increasing the efficiency of water use will not solve the underlying problem of water scarcity in China, it will buy them considerable time to tackle the bigger aspects of this issue.

Water – I/L – China

**Chinese water crisis is unstable: inevitable leads to class wars and destabilizes the region as the PRC steals water from neighbors.**

**CNN 10** (<http://articles.cnn.com/2010-09-13/world/china.water.crisis_1_water-shortages-water-supplies-drinking-water?_s=PM:WORLD>, accessed 7/7/11) CJQ

In southwest China's Guizhou province in August, a drought affected more than 600,000 people and nearly 250,000 heads of livestock, according to Xihua. Parched soil in rice fields was covered with cracks. **Beijing's water shortage will soon reach** 200 million to **300 million cubic meters**, even **as the city waits for a new diversion of water from southern China**, according to state-run media. **Hundreds of** other Chinese **cities face varying levels of water shortages and deteriorating water quality**, even as industries continue to pollute water. **China's quest for water has stressed downriver countries as well. Bangladesh, Burma, Laos, Cambodia, India**, Thailand and Vietnam say **China's aggressive dam-building is depriving their citizens**, especially subsistence farmers and other poor people, of water. Such deprivation by China is hard to document. **Those other countries also lack the money or political ability to build dams** and reservoirs **as quickly as China** has. Chinese officials routinely build infrastructure and relocate residents despite opposition. **Chinese water use has surged with a growing number of factories and power plants**, as well as with personal consumption. Swelling numbers of Chinese can now afford piped water, private bathrooms, washing machines, homes with gardens, cars that need washing, and more food, which needs growing. Buying power also has led to a growing number of golf courses, and ski resorts that use man-made snow. Across the country, China has spent tens of billions of dollars to dam rivers, build reservoirs and dig deeper wells. Beijing also has tapped underground water to meet its needs, with the water level in the plains falling to 11 meters to 24 meters below sea level over the past decade, according to Xinhua. **Such demand for water is unsustainable**. The World Bank warns that **dwindling water supplies will pit rich against poor,** and rural against urban**, in China. Without dramatic changes** in water use, tens of **millions of Chinese will turn into environmental refugees over the next decade,** the World Bank says.

Water – Impact – China

**Chinese water crisis would divert water from the rest of Asia, spread disease, cause a food shortage and trigger civil war.**

**CNN 10** (<http://articles.cnn.com/2010-09-13/world/china.water.crisis_1_water-shortages-water-supplies-drinking-water?_s=PM:WORLD>, accessed 7/7/11) CJQ

**If China continues to overexploit its** scarce **water** resources **a serious** water **crisis looms in its future, which could** even **set off consequences for the rest of the world. As the North continues to rely more heavily on water that comes from the South**, regionally **conflicts** over water **could erupt**. In addition, **competition** between sectors for water supply **could develop into something more violent** and cause serious civil unrest. The Qinghai-Tibetan Plateau is the source of rivers that reach India, Bangladesh, Burma, Bhutan, Nepal, Cambodia, Pakistan, Laos, Thailand, and Vietnam. **When China begins to run out of water, it may try to hoard the remaining water supply for its own people**, thereby **diverting water that would have reached** these **countries in South** and Southeast **Asia**. Many of **these countries**, specifically India, **are already facing their own severe water crises**, which will only be exacerbated if China diverts rivers that would have delivered much needed water. Having extensively contaminated its own major rivers through unbridled industrialization, **China now threatens the ecological viability of river systems tied to** South and Southeast **Asia in its bid to meet its thirst for water and energy**.Both diverting water that would have flowed to other countries and allowing increasingly polluted water to run through other countries has already angered neighboring countries and will continue to do so. Political **relations could be** further **strained by massive migration of people from regions facing severe water shortages that could spill over into other countries**. In fact, many analysts argue that the **oil wars** of the 20th century **will be replaced by water wars** in the 21st century. Polluted water has been linked to the spread of numerous diseases, including cancers. Increasing levels of pollution could lead to more serious and widespread health problems, dehydration, and the increased prevalence of cancer in Chinese people. **Because China’s rivers run through so many different countries in the region, disease could rapidly spread to large numbers of people. China’s food supply is incredibly vulnerable to water shortages**. Rapid industrialization inevitably leads to a heavy loss of cropland, which can override any increase in land productivity and lead to an absolute decline in food production. China’s grain harvests have already fallen short of demand for the past several years, causing China to import their grain. According to Lester Brown of the Worldwatch Institute, consumption outstrips production by over 45 million tons a year. **It is very possible that in the near future China will become the largest importer of agricultural goods, which could shock the world’s grain markets and trigger higher food prices around the world.**

\*\*\*Refugees Advantage\*\*\*

Refugees – UQ – Forecasts fail

**Current hurricane forecasts aren’t reliable enough to evacuate in time**

**Andronache et al 6**(Constantin PHD @ GIT, Rudolph Hon PHD @ MIT, Barbara Mento Prof. @ Notre Dame, Rani Dalgin Research Associate GIS, proceedings.esri.com/library/userconf/proc06/papers/papers/pap\_2320.pdf, DA 7/6/11, OST)

In Figure 13, we note significant total population as the area affected by flood is densely populated. We try to understand population behavior and response to a mandatory evacuation order. **Studies show that the State of Louisiana preference for advanced notification time of minimum 72 hours,** the longest time in the country (some states have a requirement of advanced notification of 12 hours) for Category 5 hurricane (Wolshon et al, 2001). **Current forecasts are not precise enough to give a reliable notification of 72 hours, and in practice the order was given about one day in advance. Previous studies also established evacuation plans and procedures and presented possible problems of the so called low mobility groups. The number of people without access to transportation in New Orleans is about 25-30 percent of the population**. Moreover, destitute, elderly, prisoners, infirm and tourists contribute to the low mobility group. The problem was addressed by emergent management agencies to provided buses for the evacuation of low mobility groups. Earlier reports and experience of Katrina showed that New Orleans did not have the adequate supply of busses to transport all low mobility people (Wolshon, 2001).

**Current observation satellite data lacks necessary accuracy**

**Bjorgo 1** (Einar, United Nations High Commissioner for Refugees, 74.125.155.132/scholar?q=cache:HF5pLHdthbEJ:scholar.google.com/+hurricanes+landsats+refugees+einar&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

In order to make efficient use of geographic information collected prior to or during humanitarian operations, the data should be stored and analyzed in a GIS. This requires that the data are geo-referenced, and ideally in a standardized format, so that they can be swiftly uploaded to the GIS. Satellite images can all be delivered with geographic coordinates for referencing when purchased through a data provider. **However, the geometric accuracy of the data and rectified end-products may vary. This accuracy depends on how the geo-referencing was carried out, as well as the quality and number of ground control points used**. If e.g. only satellite-orbit characteristics were used, the accuracy may vary from less than one pixel (a pixel is the smallest image-element, here defined to be the same as the spatial resolution of the image), to several pixels. If several known ground control points are used to reference the image, e.g. collected by relief-staff in the field using Global Positioning System (GPS) hand-held receivers, the accuracy normally is less than one pixel. Thus, satellite images should be geo-referenced according to the application and level of accuracy the information managers need, large area overviews of e.g. geo-locating damaged infrastructure in war torn areas or detailed refugee camp planning. The values of the acquired data signals must of course also be accurate in order to be used in decision-making processes. If an area is classified as deforested, then this image-derived information must be true. This type of accuracy is related to technical parameters, such as radiometric and spectral accuracy and will not be further described here, as that would be a highly technical discussion. The fact is, though, that most satellite sensors used by UN humanitarian organizations have been tested for many years and data analysis algorithms have been verified. **One should** nevertheless **be aware of that satellite images consist of information collected from 400 to 36,000 km above the earth’s surface, and several parameters, such as haze and on-the-ground meteorological conditions may affect the data sensed from space.** That is why image processing, analyses and interpretation should be carried out by experts.

**Refugees – Solvency – Mapping**

**Land sats collect data every 16 days data is used for population mapping**

**Rosenburg 3/2** (Matt, Geographer, http://geography.about.com/od/geographictechnology/a/landsat.htm, 2011, DA 7/4/11, OST)

The **Landsat satellites make loops around the earth and are constantly collecting images of the surface** through the use of a variety of sensing devices. Since the beginning of the Landsat program in 1972, the images and data have been available to all countries around the world**. Images are used to** measure rain forest loss, assist with mapping, **determine urban growth, and population change. The different Landsats each have different remote sensing equipment**. Each sensing device records radiation from the surface of the earth in different bands of the electromagnetic spectrum. Landsat 7 has more sensing equipment than any other Landsat. It even includes a new panchromatic scanner with an impressive resolution of 15 meters (the highest resolution until Landsat 7 was 30m). This means that buildings or other objects which are 15 meters across will show up on the Landsat images. The Landsats orbit the earth from the north to south poles and vice versa. Landsat 7 completes a full orbit of the earth in about 99 minutes, allowing the satellite to achieve over 14 orbits per day**. The satellites make a complete coverage of the earth every 16 days.**

**Satellites help track human movement**

**NASA 6** (http://landsat.gsfc.nasa.gov/news/news-archive/news\_0055.html, 12/27, DA 7/4/11, OST)

A new USGS publication – Rate, Trends, Causes, and Consequences of Urban Land-Use Change in the United States (Professional Paper 1726) – studies the change in land use associated with increasing urbanization and its impacts at local, regional, and national scales**. Based on the broad view of satellite imagery, the twenty scientific contributions that make up the publication examine urban land change** in the United States **from many perspectives – historical, geographic, economic, and** **ecological**. Together **the analyses provide new insights into critical issues of concern for** both science and **society**. “The knowledge of how and why urban land-use change occurs coupled with a projection of its direction and likely effect can be helpful in informing local, regional, and national decisions about land use,” said Barbara Ryan, Associate USGS Director for Geography. “**These public decisions will not only shape communities, but will substantially affect citizens’ lives and livelihood**, the economy, and the environment for years to come.” As part of its mission to describe and understand the Earth, the USGS systematically monitors land surface change by observing the Earth with remote sensing satellites, studies the connections between people and those changes with geographic analysis, and provides individuals and society with relevant science information they can use to manage the consequences of those changes.

**Landsats can watch human movement**

**NASA 10** (landsat.gsfc.nasa.gov/news/news-archive/news\_0276.html, Mar 10, DA 7/4/11, OST)

In an article titled “Modeling the human invader in the United States,” USGS scientists Thomas Stohlgren, Catherine Jarnevich, and Chandra **Giri modeled humans** as an “invasive species” **as they “spread**” in the conterminous U.S. from 1992 to 2001. **Using the Landsat-derived National Land Cover Data** (NLCD) together with a modeling program they mapped urbanization. (An area the size of Massachusetts was urbanized during the nine-year period studied and agricultural lands and forests were most likely to be urbanized.) **The model, called Maxent, predicts species spread** based on environmental factors. **The authors used Maxent to model and map human spread** from 1992 to 2001 and then compared it to the Landsat NLCD information. Using selected environmental variables (temperature, humidity, elevation, slope, geology) the model was 92.5 percent accurate. Based on their model results the authors concluded that humans have a highly predictable urbanization or “spread” pattern based on the environmental drivers of topography (elevation and slope) and climate (temperature and humidity).

**Refugees – Solvency – Mapping**

**Early warning systems key to prevent massive refugee flows**

**Kanji 8** (Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

**Disaster Management is crucial to countless people, with seventeen of the world’s twenty largest cities susceptible to major natural disasters** (Holdaway, 2001), and with about three million people who lost their lives as a result of natural disasters over the last twenty years (Rodriguez and Rao, 1993). Particularly, Coastal Disaster Management, within a larger integrated coastal management framework, has received great attention and support since the 2004 Indian Ocean Tsunami, Hurricane Katrina in 2005 and the recent cyclone in Myanmar, in part because of the sheer scale of the resulting disasters. Yet, the world’s coasts are drawing evermore people, with **thirteen of the fifteen largest cities located along the coast** (Tralli and Blom et al., 2005). Therefore, those responsible for the safety of coastal areas are increasingly conducting research into new technology, and further developing existing technology, to issue early warnings to coastal populations for hazards threatening their lives, livelihoods and property. **Early warnings are important to give enough time for coastal communities to successfully evacuate their people, as well as facilitate effective rescue, relief and rehabilitation activities, and on a larger time scale, can minimise disasters by allowing sufficient time to plan and implement preparedness and mitigation measures** (Groat, 2004; Group on Earth Observations, 2008; Holdaway, 2001; Rodriguez and Rao, 1993; Tralli and Blom et al., 2005). **Early warning systems have contributed to a tenfold decrease in casualties over the last fifty years**, although economic loses have increased (Golnaraghi and Migraine, 2007).

**Refugees – Solvency – Hurricanes**

**LandSats are key to mitigating hurricanes**

**NASA 10** (nasa.gov/mission\_pages/hurricanes/features/katrina-retrospective.html, 8/24, DA 7/4/11, OST)

By the time the hurricane subsided, Katrina had claimed more than 1,800 human lives and caused roughly $125 billion in damages. As **scientists and rescue organizations worked on the ground to prepare for the hurricane and assist in its wake**, **NASA provided data gathered from a series of Earth-observing satellites to help predict the hurricane's path and intensity. In the aftermath, NASA satellites also helped identify areas hardest hit.**  In this 3 1/2-minute video created by NASA-TV producer Jennifer Shoemaker at NASA's Goddard Space Flight Center in Greenbelt, Md., viewers will see many different kinds of data NASA satellites gathered about the storm. The video contains a sampling of the kinds of things NASA studies about hurricanes. Various additional data products are created in hurricane and post-hurricane research that are not depicted in the video.

**LandSats key to early warning for hurricanes**

**NASA 10** (nasa.gov/mission\_pages/hurricanes/features/katrina-retrospective.html, 8/24, DA 7/4/11, OST)

The video opens with **Atlantic Ocean sea surface temperatures data from an instrument called AMSR-E** (Advanced Microwave Scanning Radiometer - Earth Observing System) **that flies aboard NASA's Aqua satellite.** **Warm ocean waters** (of 80 degrees Fahrenheit or warmer) **provided energy to fuel the growing storm.** Next, **the MISR** (Multi-angle Imaging SpectroRadiometer) **instrument on NASA's Terra satellite captured the growth of cloud tops in the gathering storm.**  Just before landfall, the Tropical Rainfall Measuring Mission (TRMM) satellite data revealed "hot towers" hidden within the hurricane -- powerful thunderstorms that helped intensify Katrina. **TRMM also captured data on rainfall amounts throughout the hurricane's lifecycle.**  Finally, the video shows Landsat satellite imagery of New Orleans before and during the flooding, as well as a more recent view of a city still rebuilding from the hurricane some five years later.

**Landsats key to hurricane early warning**

**Haymet 7** (Tony Director of Scripps Institution of Oceanography, washingtonpost.com/wp-dyn/content/article/2007/05/09/AR2007050902451\_pf.html, 5/10, DA 7/4/11, OST)

NASA not only launches shuttles and builds space stations, it also builds and operates our nation's satellites that observe and monitor the Earth. These **satellites collect crucial global data on winds, ice and oceans.** **They help us forecast hurricanes, track the loss of Arctic sea ice and the rise of sea levels, and understand and prepare for climate** changes. NASA's budget for science missions has declined 30 percent in the past six years, and that trend is expected to continue. As more dollars are reallocated to prepare for missions back to the moon and Mars, sophisticated new satellites to observe the Earth will be delayed, harming Earth sciences. The National Academy of Sciences has noted that the Landsat satellite system, which takes important measurements of global vegetation, is in its fourth decade of operation and could fail without a clear plan for continuation. **The same is true for the QuikSCAT satellite, which provides critical wind data used in forecasting hurricanes and El Niño effects**.

**Refugees – Solvency – Hurricanes**

**Sattelites help us mitigate disasters**

**Haymet 7** (Tony Director of Scripps Institution of Oceanography, washingtonpost.com/wp-dyn/content/article/2007/05/09/AR2007050902451\_pf.html, 5/10, DA 7/4/11, OST)

**Satellites provide coverage of vast, remote regions of our planet that would otherwise remain unseen,** especially the oceans, which play an important role in climate change. **Without accurate data on such fundamentals as sea surface height, temperatures and biomass, as well as glacier heights and snowpack thickness, we will not be able to understand the likelihood of dangers such as more severe hurricanes along the Gulf Coast or more frequent forest fires in the Pacific Northwest.** Climate change is the most critical problem the Earth has ever faced. Government agencies and the private sector, as well as individual citizens, need to better grasp the risks and potential paths of global climate change. **Mitigating these risks and preparing for the effects of warming will require scientific understanding of how our complex planet operates, how it is changing, and how that change will affect the environment and human societ**y. John F. Kennedy's brilliant call to put a man on the moon by the end of the 1960s set an arbitrary deadline, but the deadline we face today is set by nature. NASA must continue to play a vital role in helping find ways to protect our planet for (and perhaps from) its intelligent life. Exploration of space is a noble quest. But we can't afford to be so starry-eyed that we overlook our own planet.

**Landsats provide rapid disaster relief data**

**NASA 6/27** (http://www.nasa.gov/topics/earth/features/flooding-20110627.html, 2011, DA 7/4/11, OST)

**The Souris River finally crested on June 26, but not before more than 4,000 homes and hundreds of businesses were flooded. About one-fourth of Minot’s 40,000 residents evacuated the city. Residents expect a long recovery as the river slowly retreats.**  The Souris River reading at Minot’s Broadway Bridge around 11:00 p.m. on June 25 reached nearly four feet higher than the all-time high set in 1881. The Landsat Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey**. Landsat satellites have been consistently gathering data about our planet since 1972**. **They continue to improve and expand this unparalleled record of Earth’s changing landscapes, for the benefit of all.** The next Landsat satellite is scheduled to launch in December 2012.

Refugees – Solvency – Hurricanes

**GIS can be used to predict weather patterns**

**Andronache et al 6**(Constantin PHD @ GIT, Rudolph Hon PHD @ MIT, Barbara Mento Prof. @ Notre Dame, Rani Dalgin Research Associate GIS, proceedings.esri.com/library/userconf/proc06/papers/papers/pap\_2320.pdf, DA 7/6/11, OST)

The Atmospheric Special Interest Group (SIG) was formed in 2003 and established a dialog between ESRI and the atmospheric sciences community about data representation issues. The Atmospheric SIG focused on two areas: temporal data management and improved raster data support. This involves the development of Network Common Data Format (NetCDF) converters for ingesting data into ArcGIS, and developing combined support for NetCDF, HDF, and GRIB formats through a single API. **Significant progress is seen in various areas of GIS use with weather and climate data. Examples include the use of GIS with radar data** (Berkowitz, D. and R. Steadham, 2005; Shipley et al., 2005**), climate data** (Higgins, 2005), **weather warnings** (Waters et al., 2005), watershed modeling (Wasson et al., 2002**), weather-related business problems** (Sznaider, 2002), hydro meteorological applications (Yates et al, 2002). **The list of applications is longer and software tools were developed to address various aspects of GIS use with weather data for practical applications.**

**GIS mitigates most of the effects of hurricanes**

**Andronache et al 6**(Constantin PHD @ GIT, Rudolph Hon PHD @ MIT, Barbara Mento Prof. @ Notre Dame, Rani Dalgin Research Associate GIS, proceedings.esri.com/library/userconf/proc06/papers/papers/pap\_2320.pdf, DA 7/6/11, OST)

In addition to applications that use weather and climate data, other **GIS applications were developed to be used with population evacuation and hurricane disaster management**. L'S **Corps of Engineers working with** Federal Emergency Management Agency (**FEMA) after** hurricane **Katrina, employed GIS in various projects: assessment of post-disaster damage; rescuing and recovering; building temporary homes; removing debris, pumping fioodwater; identify impacted communities** (Castanga, 2005). L'SGS National Wetlands Research Center use remote sensing and GIS to analyze land-water change caused by Katrina and Rita hurricanes, and future work includes hurricane recovery, and restoration of land (Barras, 2006). **Another significant area of GIS application is in connection with population evacuation models. The hurricane and evaluation** (HL'RREVAC) **program uses GIS in formation to correlate demographic data with shelter locations and their proximity to evacuation routes to improve evacuation decisions** (Wolhson et al., 2001). Significant GIS effort is also ongoing for rebuilding after Katrina related projects, in which multiple disciplines and agencies are involved (Hart et al., 2006).

**GIS allow crucial decision making information**

**Andronache et al 6**(Constantin PHD @ GIT, Rudolph Hon PHD @ MIT, Barbara Mento Prof. @ Notre Dame, Rani Dalgin Research Associate GIS, proceedings.esri.com/library/userconf/proc06/papers/papers/pap\_2320.pdf, DA 7/6/11, OST)

Intense rainfall, high surge and levees failure created unprecedented flooding in about 80% of the city (as seen in Landsat image above on September 7, 2005, Figure 11). **The floods that buried New Orleans had noticeably subsided by September 15, 2005, when the top image was taken by the Landsat 7 satellite**. In the two and a half weeks that had passed since Hurricane Katrina flooded the city, pumps had been working nonstop to return the water to Lake Pontchartrain. The progress in draining the city is evident when the September 15 image is compared with an image taken one week earlier. In **the** lower **image, taken by the Landsat 5 satellite on September 7, black flood water covers much of the city while by September 15, most of the dark flood water disappeared**. Note also that September 7 image does not show the full extent of the flooding. We use Census data 2000 to illustrate some demographic characteristics in the New Orleans, especially in the area impacted by severe flood. We illustrate our results at census tract level, while **current census data and ArcGIS allow investigation at a higher spatial resolution, which is necessary for decision makers. We must note first that New Orleans population increased significantly over the last century** (Figure 12), which is in trend with the population increase in the coastal regions of the United States.

**Refugees – Solvency – Earthquakes**

**Satellites can predict earthquakes**

**Kanji 8** (Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

Locations of earthquakes can be quite accurately predicted since they occur exclusively along fault lines; however, **predicting when an earthquake will occur is a major challenge**. The literature is rich with information about **how satellite remote sensing can be used to monitor land, oceanic and atmospheric precursors to earthquake activity, largely attributed to an early start in research in this area**; yet, because of the particular challenges posed by the oceans, research into the use of satellite remote sensing for predicting submarine earthquakes is rather limited. In fact, land precursors can be entirely excluded from this study. Instead, **earthquake warnings for coastal areas rely on perturbations of gravity waves in the ionosphere,** and more recently, on fluctuations of chlorophyll concentrations in theoceans.

**Infrared sensors key to earthquake predictions**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

Imminent **earthquakes can produce gravity perturbations in the ionosphere that are detectable by** dedicated **satellite sensors** from one to **five days in advance** (Pulinets, 2006). **These perturbations occur because nonstationary** **Joules are heated in the ionosphere by the electric field generated above the epicenter** (Haegai and Kim et al., 2006; Pulinets, 2006). Figure 4.8 illustrates this relationship in detail. Examples of such satellite missions that have detected the ionospheric precursor include CHAMP (German), GRACE (American), GOCE (European), INTERCOSMOS-BULGARIA-1300 (Bulgarian), GEOS-2 (European), BeiDou- 2 (Chinese), QuakeSat (American), DEMETER (French), ESPERIA (Italian) and Ukrainian Variant (Gousheva and Glavcheva et al., 2006; Pulinets, 2006; Tralli and Blom et al., 2005). These satellites can detect the variations in gravity waves because they are different from other high frequency variations, such as those produced as a result of tides (Tralli and Blom et al., 2005) and of solar-magnetospheric origin (Gousheva and Glavcheva et al., 2006). 18 GRACE, launched in 2002, was able to detect large changes in the gravity fields prior to the 2002 Alaska and 2003 Hokkaido earthquakes (Tralli and Blom et al., 2005). Grousheva and Glavcheva (2006) observed the following: • effects of increase (bulge) in the quasi-static electric fields up to 7 mV, days and hours before the earthquake, for low- and mid-latitudes; • effects of increase (bulge) in the quasi-static electric fields, 7 and more hours after the earthquake occurrence, as post-effect (these effects are well observed for shallow earthquakes with depths down to 33 km and less for intermediate earthquakes with depths 70–300 km); and • sometimes the above mentioned effects cannot be observed due to the limited threshold of the instruments.

**Satellites can predict earthquakes**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

In addition to the ionospheric precursor just discussed, submarine earthquakes also seem to be lead by an oceanic precursor; that is an increase in chlorophyll-a concentrations around the epicenter. **The mechanism stems from the thermal energy released prior to an earthquake, which is transported to the surface, because its density is less relative to the surrounding water, and causes an increase in sea surface temperature and surface latent heat flux**. This enhances upwelling and transport of nutrient-rich water to the surface which promotes an algal bloom. **Furthermore, this sequence of events leading to an algal bloom will begin earlier and occur faster in the face of higher magnitude earthquake**s (Singh and Dey, 2006). What’s more, **algal blooms have long been recorded using satellites**, such as MODIS and Landsat, which are capable of imaging in the visible spectrum; therefore, the technology is not new and it can be used for a multitude of applications, making it a more desirable option.

**Refugees – AT: can’t mitigate earthquakes**

**Earthquakes can be mitigated**

**Constantinou et al** **98** (Michael C. Constantinou, Tsu T. Soong, Gary F. Dargush, mceer.buffalo.edu/publications/monographs/98-MN02.pdf, DA 7/8/11, OST)

Earthquakes are potentially devastating natural events which threaten lives, destroy property, and disrupt life-sustaining services and societal functions. In 1986, the National Science Foundation established the National **Center for Earthquake Engineering Research to carry out systems integrated research to mitigate earthquake hazards in vulnerable communities and to enhance implementation efforts through technology transfer, outreach, and education.** Since that time, **our Center has engaged in a wide variety of multidisciplinary studies to develop solutions to the complex array of problems associated with the development of earthquake-resistant communities.**

**Refugees – Solvency – Disaster management**

**GIS key to solve spatial issues of disaster mitigation**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

**In dealing with these extreme events, many of the critical problems that arise are inherently spatial. Whether an analyst is assessing the potential impact of a hazard, or an emergency manager is identifying the best evacuation routes during a disaster**, or a civil engineer is planning a rebuilding effort following a disaster, **all of these individuals face tasks with a strong spatial component**. For this reason, geographical space is a valuable framework for reasoning about many problems that arise in the context of emergency management**. GIS were designed to support geographical inquiry and, ultimately, spatial decision making. The value of GIS in emergency management arises directly from the benefits of integrating a technology designed to support spatial decision making into a field with a strong need to address numerous critical spatial decisions**. For this reason, new applications of GIS in emergency management have flourished in recent years along with an interest in furthering this trend. In addition to this growing interest, the adoption of GIS into the emergency management arena has been bolstered in some countries by favourable legislation regarding the use of spatial information in emergency (see, for example, Mondschein 1994).

**GIS technology aids in all 4 parts of disaster management**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

This chapter examines **the role of GIS in emergency management through the lens of comprehensive emergency management (CEM) and its four phases: mitigation, preparedness, response, and recovery**. **The primary concern before a potential disaster is mitigating the impact of a hazard. Here GIS is gaining favour in risk assessment and the development of long-term mitigation strategies**. In the preparedness and response phases, **GIS may serve either as the integrating centrepiece for a comprehensive disaster preparedness and response system or as a portable, on-site source of spatial information.** **In the wake of a disaster, GIS is becoming integral in supporting damage assessment, rebuilding, and public education.** The chapter concludes with an example application of GIS in emergency planning: evacuation vulnerability mapping.

Refugees – Solvency – Disaster management

**GIS services apply to all stages of disaster management**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

**In examining** the **GIS** literature, perhaps it is more appropriate **to reduce the four phases of comprehensive emergency management into three phases: mitigation, preparedness and response, and recovery**. This is simply because many **GIS developed in the preparedness phase are utilised in the response phase.** In other words, systems designed to help emergency managers respond to an actual disaster are frequently utilised to train emergency personnel and develop preparedness plans. From a GIS perspective, this serves to blur the preparedness and response phases into a single phase. However, **GIS applications in the phases of mitigation (e.g. risk mapping) and recovery (e.g. damage assessment) are clearly distinct from the proposed merged preparedness and response phases.**

**GIS enables modeling to predict future disasters**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

In the emergency management phase well before a disaster, or more appropriately **‘between disasters’, the** overarching **goal is mitigation**. Perhaps the most active role of **GIS in this area relates to** analytical **modelling**. **This is a phase characterised by the opportunity to conduct long-term assessment, planning, forecasting, and management.** Table 1 shows some of the spatial questions that have been posed in this phase along with the resulting application area and representative examples from the GIS literature.

**GIS modeling can be overlayed on preexisting predictions to create evacuation routes**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

**Another GIS role in the preparedness and response phases relates to hazard modelling, which differs slightly from the hazard modelling in risk assessment**. In this context the disaster is occurring, and it is possible to gather many of the environmental parameters to aid in short-term prediction. One example of this class of hazard models is the US National Oceanic and Atmospheric Administration’s (NOAA) sea, lake, and overland surge from hurricane (SLOSH) model (Griffith 1986). **SLOSH is a simulation model that uses current wind speed, direction, precipitation predictions, and topography to predict land areas most likely to be submerged during a storm, to aid in evacuation planning**. **The model output can be integrated into a GIS as another spatial layer to support further inquiry**. CAMEO (Cartwright 1990) is another well known hazard model in use by HAZMAT teams in the USA that supports response efforts during chemical spills. CAMEO has three modules that allow a user to identify hazardous chemicals and their risks, display spatial information about an area, and model atmospheric plume dispersal respectively. It is designed to be carried on emergency vehicles, an anticipated trend in GIS development for this phase.

**GIS key to contingency escape routes**

**Cova 99** (Thomas J., Director Center for Natural & Technological Hazards, 74.125.155.132/scholar?q=cache:AUe7QGDHnv0J:scholar.google.com/+GIS+hurricane+mitigation&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

**Another preparedness and response strategy that has received attention in GIS and emergency management is evacuation planning.** Dunn (1992) has examined **the potential role of GIS in generating alternative evacuation route**s, Silva et al (1993) have developed **and integrated an evacuation simulation model into a GIS to support the development of evacuation contingency plans** around nuclear facilities, and Cova and Church (1997) describe a GIS-based method for revealing potential evacuation difficulties in advance of a disaster.

Refugees – Solvency – Disaster management

**Sats key to effective disaster early warming**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

**Early warnings** of coastal hazards **are important to give enough time to coastal communities for successful evacuation**, as well as facilitate effective rescue, relief and rehabilitation activities, and on a larger time scale, can minimise disasters by allowing sufficient time to plan and implement preparedness and mitigation measures. **One technology that has been explored for its use in early warnings** since the 1970s **is satellite remote sensing** and other space technology, as they are becoming more accessible to the layman and they effectively link environmental data and decision-making tools. **Using satellite remote sensing to forecast storms is the most advanced application as storms can be observed directly**. A combination of other space technology and earth observing systems are particularly important for forecasting earthquakes and tsunamis. **These include GPS stations, communication satellites and ocean buoys.** However, the technology used to predict hazards is not the only component of early warning systems; the interaction with the end users is paramount as they are the ones who will be potentially affected if a coastal hazard makes landfall.

**Satellites solve earthquake readiness, sea level rise warnings and costal warnings**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

This paper investigates the current and **potential uses of satellite remote sensing for early warning of coastal natural hazards** through a desktop review. Although this technology is widely applied in land based applications as well, this review will focus only on natural hazards that are unique to coastal areas**. In particular, it will look into satellite remote sensing uses for early warnings of coastal storms and sea level rise** that result in coastal inundation – the most important threat to the world’s coasts. Furthermore, tsunami detection using satellite remote sensing is still very much in its infancy; however, this paper will also investigate **its use in predicting submarine earthquakes as this can be a useful component of tsunami warnings. R**ecognising that a wide array of space technology is needed to establish adequate multihazard early warning systems, Section 5 will introduce some of this other technology, particularly space technology.

**Satellites key to early warming for disasters**

**Kanji 8 (**Fareedal, Masters in Sci @ AIT, fareedali-kanji.com/files/Applications\_of\_space\_technology\_-\_Fareedali\_Kanji\_2008.pdf, may, DA 7/7/11, OST)

**For coastal hazard early warning applications, it is clear that the most advanced application of satellite remote sensing is for storms such as cyclones. These storms can be directly monitored well in advance of becoming a threat to any coastal populations, thereby allowing for sufficient time to take necessary actions to protect them.** Other coastal hazards discussed in this paper – sea level rise, earthquakes and tsunami – can only be assessed indirectly using satellite remote sensing by monitoring other environmental phenomena as proxies to the actual hazards. Observing glaciers in order to deduce climate trends and predict sea level changes is a common practise and widely accepted because global warming is resulting in glacier melting, which in turn, is resulting in sea level rise. However, earthquake warnings based on ionospheric or oceanic precursors have never been issued; the connection between the two, although interesting, is not so simple or logical. Finally, the only tsunami warning satellite remote sensing can contribute to is that based on the earthquake precursor.

Refugees – Solvency – Co-op

**GIS key to cooperative disaster management**

**Andronache et al 6**(Constantin PHD @ GIT, Rudolph Hon PHD @ MIT, Barbara Mento Prof. @ Notre Dame, Rani Dalgin Research Associate GIS, proceedings.esri.com/library/userconf/proc06/papers/papers/pap\_2320.pdf, DA 7/6/11, OST)

Some solutions that emerge from Katrina ease or storms with comparable effects in New Orleans area are: a) upgrade levees and drainage to withstand Category' 4 and 5 hurricanes; b) design flood protection based on rates of local subsidence, rainfall, and sea-level rise; c) minimize drain and fill activities that enhance local subsidence; d) improve evacuation routes; e) protect and restore coastal defenses**. Part of the effort in current and future natural disaster management is to prepare reliable forecasts, and disseminate information to decision factors. GIS is already playing an important role in this process, and future work is needed to integrate data from various sources into GIS and increase our ability to solve multidisciplinary complex problems.**

Refugees – Solvency – Aid

**GIS key to numerous humanitarian aid organizations – No data means no assistance**

**Bjorgo 1** (Einar, United Nations High Commissioner for Refugees, 74.125.155.132/scholar?q=cache:HF5pLHdthbEJ:scholar.google.com/+hurricanes+landsats+refugees+einar&hl=en&as\_sdt=0,48, DA 7/6/11, OST)

United Nations (UN) humanitarian organizations, as listed by the UN Office for Coordination of Humanitarian Affairs (OCHA), include the UN High Commissioner for Refugees (**UNHCR**), World Food Programme (**WFP**), UN Development Programme (**UNDP**), UN Children’s Fund (**UNICEF)**, Food and Agriculture Organization (**FAO**), World Health Organization (**WHO**), UN High Commissioner for Human Rights (**UNHCHR**), and UN Population Fund (**UNFPA**) , as well as OCHA itself. **These organizations are all in need of relevant geographic information to better prepare for and respond to natural and man-made disasters. By organizing collected information in a geographic information system (GIS), UN humanitarian organizations can more effectively analyze situations and co-ordinate relief effort**s. It is in this context that satellite images have a contributing role. The objective of this paper is to provide an up-to-date overview on the current and potential use of satellite imagery within the United Nations humanitarian organizations and their operations.

Refugees – IL – Prep key – Planning

**Current norms for refugee flow are based on preparation and rely on organization**

**Ek & Karadawi 91** (Ragnhild, Snr Reintegration Consultant at UNHCR & Ahmed, jstor.org/stable/4313822, DA 7/8/11, OST)

Stales have set normative standards in order to depoliticize the presence of refugees. The Organization of African Unity (OAU) in particular, has designed norms on the treatment of refugees (2**). The granting of asylum should be considered as a peaceful and humanitarian act (3). and the reception of refugees should not be considered as unfriendly or antagonistic acts. On the other hand, refugees should refrain from any act that might be interpreted as harmful or subversive (4). These norms were established on the assumption that while in exile, refugees often appear to develop their political awareness and engage in activities which aim to influence the situation in their countries of origin**. They are either actively involved in the conflict that caused their exodus, or act as a broad constituency for political groupings challenging the territorial shape or the power structure of the state of origin. Hence, the conflict spills over to the host country as it is turned into a base for political activities, with or without the support of the host government, and as fighting continues cither among the original contending parties or as factionalism among the opposition groups.

**Refugee – Impact – Instability**

**Disorganized refugee flows cause regional instability and can exacerbate war and famine**

**Ek & Karadawi 91** (Ragnhild, Snr Reintegration Consultant at UNHCR & Ahmed, jstor.org/stable/4313822, DA 7/8/11, OST)

**The presence of refugees may entail economic and political effects on both the domestic and foreign policies of their host country. The refugees' presence also has the potential for regional instability, and to spill over into the broader framework of international relations**. The aim of this paper is to discuss **possible linkages between the presence of refugees and political instability at interstate and intrastate levels**, and to examine the implications of refugee flows from Ethiopia on political developments in the Sudan**. It will address the political effects of the refugee presence in the host country, particularly the potential spillover effects of the conflicts and the recent interaction between drought, famine and war with refugee flows which has further enhanced the perception of refugees as a threat to political stability** in the Sudan. It's focus is on Eritrean and Ethiopian refugees 11) in the Eastern Sudan region, concentrating on the time of President JaafarNimicri's regime. 1969-1985.

\*\*\*Genocide Advantage\*\*\*

Genocide – Solvency – Prevention

**Satellite data has been used to map out areas of genocides**

**LANDSAT MSS 4** (iwmidsp.org/dsp2/rs-gis-data/National/Cambodia/01-Landsat-MSS-220m-mosaaics/ReadMe/readme-first.pdf, 8/5, DA 7/4/11, OST)

This folder contains two additional folders of JPEG image products created in ArcGIS using the enclosed GIS files and image mosaics. **The /GSP**/final\_cambodia\_products/ folde**r contains** JPEG **images of Cambodia, western Cambodia, and south-central Cambodia and the burial grounds, prisons, and memorials from the genocide time period. These image products contain legends for easy identification of map items**. The /GSP/products\_no\_legends/ folder contains similar images without legends. These files may be more useful for backgrounds or other projects where images, rather than maps, are required. /key\_GIS\_files\_cambodia/ This folder contains a subset of the available GIS data related to the Cambodian genocide. The GIS files in this folder are the files used to create the image products in the /Cambodia\_products/ folder. **The files map prisons, memorials, burial grounds, rivers, roads, and the Cambodian country boundary.**

**Landsats help to document and prevent genocide**

**Enotes 8** (http://www.enotes.com/forensic-science/remote-sensing, 11/16, DA 7/4/11, OST)

Remote sensing is broadly defined as the act of obtaining images or data from a distance, typically using a manned spacecraft, a satellite, or a high-altitude spy aircraft. The term was invented in the 1950s to distinguish early satellite images from aerial photographs traditionally obtained from fixed wing aircraft. As such, remotely sensed images can be considered to be one kind of geospatial imagery. Although the application of unclassified remote sensing images to civil and criminal investigations has been limited, they have proven to be useful for documenting international atrocities in areas that are otherwise inaccessible to outside observers. Sufficiently detailed **satellite imagery has been used to document international crimes such as possible genocide in the Darfur region of Sudan and the existence of concealed mass graves in Iraq**. **In Iraq, potential gravesites were identified with the help of satellite image** and aerial photograph interpretation and then investigated in more detail using ground-penetrating radar and other methods. **A total of 270 mass graves were reported, of which 53 had been confirmed by early 2004, with some 400,000 bodies discovered**. Features such as mass graves are generally not directly visible. Instead, analysis reveals features such as otherwise inexplicable areas of freshly moved earth or signs of heavy construction equipment used to excavate the graves. Comparison of publicly available **Landsat satellite images obtained in 2003 and 2004 was also used to document the burning of 44 of the villages in the Darfur region of Sudan during a** period of civil strife, which some observers believe amounted to **genocide**. Burning was inferred in areas where the albedo, or amount of radiation reflected by the ground surface, had changed significantly during the times at which the two images were obtained. This was accomplished by using a computer algorithm to calculate albedo from the satellite data, then subtracting one albedo map from the other to calculate the change. This kind of mathematical operation on entire maps or digital images, as opposed to single numbers, is known as map algebra.

**LandSats lead to global accountability which deters humanitarian abuses**

**Bachelet 11** (Michelle, Former president of Chile, globalsolutions.org/files/public/documentes/Minerva38.pdf, April, DA 7/4/11, OST)

Following up on Amnesty International’s “**Eyes On Darfur” initiative, launched in 2007 and “generally credited for breaking ground” on use of satellite technology “to monitor, perhaps deter, humanitarian abuses”** (Richard Solash, Radio Free Europe / Radio Liberty, 12 January 2011), the Satellite Sentinel Project — a collaboration between Google, the UN Operational Satellite Applications Programme (UNOSAT), the Harvard Humanitarian Initiative, and various NGOs — was formed in hope of watchfully discouraging violence related to the January referendum in southern Sudan. Satellite imagery used to have “an almost exclusive, military connotation,” notes Patrick Meier, co-founder of the Crisis Mapping Project at the Harvard Humanitarian Initiative. “Now it’s demystified. I think what we’re seeing… is **going from this kind of state-centric, proprietary, extremely expensive technology** that then is classified and only limited to a few individuals **to a more** **opensource, open-data, very public, non-state approach to employing and leveraging these technologies, in a way, for some of the same ends — to really monitor and do surveying and [derive] in some form or another some accountability.”**

Genocide – Solvency – Prevention

**Satellite imaging allows rapid response and prevention of genocides as well as forcing the accountability of actors through the ICC**

**Bachelet 11** (Michelle, Former president of Chile, globalsolutions.org/files/public/documentes/Minerva38.pdf, April, DA 7/4/11, OST)

The usefulness of satellite images to corroborate information obtained by other methods is increasingly recognized. The RFE/RL account cites as examples: Amnesty International, “**at the forefront of using satellites images in its monitoring activities”, being able to confirm reports from the ground of shelling of civilian homes in South Ossetia during the 2008 Russia-Georgia war; and satellite images giving a better sense of the geographical scope of violence in southern Kyrgyzstan in the summer of 2010, identifying ethnic populations at risk beyond specific neighborhood**s where reporters were located. **This can help reduce the “insufficient verification excuse” for stalling reaction and sometimes prevention**. Says Patrick Meier: “I think the idea here is to look at [each situation] as an ecosystem and the Sentinel Project, for example, as one node in this ecosystem**, complementing other efforts to try to hold actors accountable**.” He reportedly hopes that **the next step will be using satellite imagery as evidence in proceedings at the International Criminal Court** — “an idea still in its infancy”.

**Satellite data raises public awareness of humanitarian abuses and drives action**

**Blout 8** (P. J., Prof law @ U of Mississippi, rescommunis.wordpress.com/2008/01/page/3/, 1/18, DA 7/4/11, OST)

After a short break, Michelle Aten presented “Geospatial Imagery Search Engines: What People are Seeing and Why They Are Talking About What They are Seeing.” Ms. Aten is the Assistant Director of the National Center for Remote Sensing, Air, and Space Law at the University of Mississippi School of Law. Ms. Aten’s started with a discussion about Google Earth. She asserted that **Google Earth has raised awareness of Geospatial Data and its uses within the general public**. She illustrated this point with a project that uses **Google Earth to help prevent genocide by displaying remotely sensed images from the humanitarian crisis in Darfur.** She discussed how **organizations are using geospatial data through Google Earth to reach audiences** with their messages. Next, Ms. Aten showed how **satellite imagery found on Google Earth can influence public opinion.** This point was illustrated with an image of a building that appears as a swastika from above and the controversy that has surrounded the building after its image was found on Google Earth. This point was also bolstered with a discussion of imagery activism in which people find images and use them to support causes. Ms. Aten also demonstrated how this technology is used in search and rescue operations. In the case of Steve Fosset’s disappearance, using GeoEye Imagery distributed by Amazon’s Mechanical Turk in order to allow the general public participate in the search and rescue operations.

**Satellite imaging key to prevent genocides**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

Since the publication of the first issue of Conflict Trends in 1998, several **African governments** − most notably Nigeria, South Africa, Algeria, Egypt and Kenya − **have increasingly applied space science and technology (S&T) to improve human development in their countries.** This was confirmed by, inter alia, the Second African Space Leadership Conference hosted by the South African Department of Science and Technology in Pretoria in 2007. Space S&T is no longer the domain of a small clique of so-called space-faring nations such as the United States (US), France, India and Brazil. Increasingly, commercial actors are operating in the space industry, which makes satellite images, for example, available to its clients**. Google Earth1, is also freely available, but it is predominantly a US-driven system, and is sometimes barred in countries with poor human rights records**. Whereas **satellite imagery** has traditionally been applied by states for military and strategic purposes (not discussed here), **it is increasingly being used by the United Nations (UN) and international humanitarian groups such as Amnesty International (AI) and Human Rights Watch (HRW) to track human security in Africa, the Middle East and Asia. The notion that ‘a picture is worth a thousand words’ is particularly significant in cases where governments have either denied human rights abuses, or denied access to international humanitarian groups.**

Genocide – Solvency – Prevention

**Land Sats can prevent genocide**

**Toney et al 10** (Jeffrey H. Toney Dean of Natural Applied & Health Sciences Kean, Hank Kaplowitz Prof. Psych, Rongsun Pu Ph.D Biology, Feng Qi M.S. in GIS, George Chang Prof Computer Science, November, DA 7/4/11, OST muse.jhu.edu/journals/human\_rights\_quarterly/v032/32.4.toney)

Lars Bromley, a geoinformation specialist and Project Director of the Science and **Human Rights Program at the AAAS, has been using high-resolution digital imagery obtained from satellites to help document large-scale crisis zones in Darfur, Burma, Ethiopia, and other regions**.32 In partnership with human rights organizations including Amnesty International and Human Rights Watch, AAAS **obtains images from commercial satellites based on the spatial coordinates of the regions in crisis and analyzes them for evidence of refugee camps, burned villages, leveled fields, and mass graves**.33 In a series of historical satellite images compiled in 2007, using coordinates provided by Physicians for Human Rights (36.65° latitude, 65.70° longitude), Bromley located and analyzed the suspected site of a mass grave in northern Afghanistan (see Figure 1). The images were acquired by QuickBird, Ikonos, TopSat, and SPOT-5 satellites, operated by a combination of US, British, and French companies.34 **The satellite images from 2004 indicated the absence of pits** at 36.65° latitude, 65.70° longitude, **while an image from August 2006 indicated the presence of one pit, as well as two vehicles with dimensions and appearance consistent with those of a dump truck and a hydraulic excavator on top of what later developed into a second pit**.35 Images from January and October 2007 indicated the presence of both pits. **The timeline of the appearance of the pits and soil disturbance in the alleged site supported allegations of the existence of a mass grave.**36 As web-based virtual globes are making the once limited-access imageries available to the general public, large-scale human rights violations all around the world can be witnessed, and such information can be distributed broadly and instantly.37 **The US Holocaust Memorial Museum and Google Earth have collaborated to post enormous amounts of evidence of the human rights crisis in Darfur, Sudan**.38 Together with the recently available historical [End Page 1016] image viewing function provided by Google Earth, **the archived imageries and documents make visible the destructions of over three thousand villages in the region**.39 **Geospatial tools such as remote sensing and GIS offer a transparent recording of the earth's surface unlike anything available before. Would awareness of an "Eye in the Sky" give a dictator pause, or prevent altogether, an atrocity such as genocide**?

**Satellite imaging helps to prevent killings and brings attention to the oppressed**

**Hargreaves & Hattotuwa 10** (Caroline & Sanjana, ict4peace.org/wp-content/uploads/2010/11/ICTs-for-the-Prevention-of-Mass-Atrocity-Crimes1.pdf, DA 7/4/11, OST)

It is important to note that **in addition to preventing mass atrocity crimes, efforts must be made to ensure that if it tragically does occur, it must never occur again – and those responsible for it held accountable for their actions. Embedding ICTs in reconciliation, transitional justice initiatives, truth seeking and accountability mechanisms as well as alternative dispute resolution mechanisms post war / post genocide can strengthen these often fragile initiatives**, encourage greater civil society participation and importantly strengthen community level resilience and healing. **An good example is the Soweto ’76 archives in South Africa, which is currently building a community based, multi media digital archive for addressing gender roles in the struggle against apartheid, as an effort to document and preserve long silenced voices as well as strengthen social justice in marginalized communities.**8 **This initiative is suggestive of the emancipatory potential of ICTs. Furthermore, it is pivotal to recognise that even though genocide cannot be easily proved under international law, the perception amongst peoples** (especially those at risk or survivors of sustained attacks) **that genocidal violence has taken place must be taken into consideration in policies and practices dealing with regimes and States with poor democratic credentials, human rights abuse and a known record of systemic communal oppression.** Increasingly, the legal requirement for evidence based investigations of genocide – which takes time, often years and even decades – is being contested by victim narratives and eyewitness accounts made possible by the proliferation and use of ICTs

Genocide – Solvency – Prevention

**Satellite imaging solves genocide**

**Hargreaves & Hattotuwa 10** (Caroline & Sanjana, ict4peace.org/wp-content/uploads/2010/11/ICTs-for-the-Prevention-of-Mass-Atrocity-Crimes1.pdf, DA 7/4/11, OST)

**With growing access to new technologies** and channels of communication, such as new media and mobile phones, **an increasing number of hitherto marginalized, compelling accounts of violence are being recorded for posterity.** **These accounts can contribute to increased awareness on genocide and crimes against humanity.** Crawford & Cole (2007) argue that ICTs can be used to build lasting peace through: providing information, helping people access information, improving decision making, reducing scarcity, supporting relationships and helping people understand each other.15 ICTs can aid these tactics in many ways – high quality citizen journalism and low cost technologies have helped in processes of transitional justice, accountability, truth seeking and reconciliation alongside other initiatives, including those by government. Civil society is becoming increasingly involved in the search and design of digital innovations for addressing the challenges of genocide**. A recent example is Project 10^100, a competition hosted by Google, where the idea of creating a genocide monitoring and alert system was one of the sixteen finalists. The ideas included reducing crimes against humanity by aggregating data, including pertinent statistics, the history and geography of specific conflicts, local cultures, geostrategic interests, by using e.g. updated dynamic web maps and hand held GPS devices**.16 Another example is found a scientific in a recent report Amnesty International entitled ‘**Geospatial Technologies’, where technologies such as satellite image**s, GPS, virtual globes and infrared/multispectral sensing **are assigned the purpose of assisting, monitoring and advocating the protection of populations at risk and advanced warning of crises**.**17 Done well and over the long term, initiatives like these can prevent recurrence of genocide and mass atrocity crimes**.

Genocide – Solvency – Intervention

**Satellite images form the basis for international intervention**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

In 2003, **after years of conflict in the DRC, the deforested corridors have widened to such an extent that they almost merge,** as Figure 2 indicates. **Images such as these can form the basis for international efforts** similar to the Kimberley Process Verification Scheme, **which aims to prevent and curb the trade in so-called ‘blood diamonds’**. Figure 3 depicts two images of the Zambezi River in Mozambique. The top image was taken on 15 January 2008, and the bottom image on 26 December 2007. These images show the Zambezi River downstream from the Cahora Bassa lake, close to the borders of the Sofala, Tete and Zambézia provinces. Here the water is dark blue or black in the images, and the surrounding plant-covered land is bright green. Scattered clouds are pale blue and white. **The flooding that occurred in January 2008 rivalled the flooding that occurred in 2000-2001, which killed almost 700 people and displaced 500 000 people**.

**Images act as a force multiplier for humanitarian aid**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

Somalia has been described as one of Africa’s total collapsed states. For several years, pirates have used its geo-strategic location to hijack ships. By September 2008, Somali pirates held as many as 10 ships, demanding millions of dollars’ ransom, and threatening regional stability as well as preventing urgent humanitarian assistance to Somalis.7 **The United Nations** World Food Programme (**WFP) is relying on the** Dutch, French, Danish and Canadian **navies to escort WFP ships delivering food to almost three million Somalis facing starvation**.8 If the Djibouti Agreement between the Transitional Federal Government (TFG) and the Alliance for the Re-Liberation of Somalia (ARS), which was signed on 19 August 2008, is not properly implemented and proper state structures restored, **there is little hope that piracy will end. In this case, satellite images will continue to be used to protect humanitarian and cargo ships. The Somalia piracy example illustrates the complex threats to human security in Africa. Satellite imagery can be a cost-effective ‘force multiplier’ (**an added resource) for decision-makers **to alleviate human and natural disasters.**

**LandSats help get water to refugees and prevent conflicts from arising**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

Since 2004, the United Nations High Commissioner for Refugees (**UNHCR) has been using satellite data to identify underground water resources for almost 200 000 Sudanese refugees** in nine UNCHR refugee camps in eastern Chad. Figure 5 is an example of satellite data that identified underground water for these camps.1 Figure 5: Satellite Image of Underground Water for Refugee Camps in Eastern Chad12 More recently, the UN Development Programme (UNDP) released Africa. Atlas of Our Changing Environment, which predominantly includes space S&T such as EO and remote sensing to highlight environmental insecurity on the continent, and to help improve decision-making in this regard**. Apart from environmental analyses, the Atlas also includes images of the transboundary movement of people and refugees in conflict areas such as the Parrot’s Beak region in Guinea and Darfur**.1

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**Satellites lead to transparency and allow the persecution and prevention of human rights abuses**

**Van Wyk 8** (Jo-Ansi, lecturer on International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

In the case of the conflict in Ethiopia’s Ogaden region, **international humanitarian organisations use satellite images to prove incidences of village burnings and destruction by the army, which is usually denied by the Ethiopian government.** In this case, HRW applied images collected by the Science and Human Rights Project of the American Association for the Advancement of Science **(AAAS), which developed a system to assist human rights groups to access high-resolution satellite images and monitor the activity of military groups. The images obtained for this project indicated the removal and burning of numerous structures and complete villages, as well as the forced relocation of people. It also reported on the destruction of new structures. In its reports on the activities of the Ethiopian government and army through Collective Punishment14, HRW, drawing on this project’s satellite images, concludes that these actions amount to ‘crimes against humanity’**.

**Satellite imagery key to intervention and relief**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

Since 2005**, the AAAS has also provided satellite images of 12 villages in Darfur to AI to monitor attacks, and the movement and activities of rebel groups and the Arab militia group**, the Janjaweed. AI’s ‘Eyes on Darfur’ project makes specific use of satellite imagery to highlight conflict trends in Darfur and the rest of Sudan. Figures 6 and 7 include satellite images of the destruction of villages in Darfur.16 **These images show the destruction of homes and other structures. It is also possible to determine how, when and where this destruction took place, using the images. This can assist humanitarian organisations in their advocacy and relief work. For organisations such as AI and Save the Children, this type of monitoring has become essential, as the Sudanese government continues to deny entry permits into Darfur**.

**Satellite images are crucial to justify any action on human rights**

**Van Wyk 8** (Jo-Ansi, lecturer in International Politics, 74.125.155.132/scholar?q=cache:JkD1EUCtBqUJ:scholar.google.com/+remote+sensing+prevent+genocide&hl=en&as\_sdt=0,48&as\_vis=1, DA 7/4/11, OST)

In 2005**, while the government of Zimbabwe was still denying that human rights abuses occurred during its Operation Murambatsvina,** AI and Zimbabwe **Lawyers for Human Rights produced satellite images showing strong evidence of the government’s destruction** during Operation Murambatsvina as part of the ruling party’s political campaign against opponents.24 **These satellite images** (see Figure 10) **showed the complete destruction and forced relocation of a settlement that once housed almost 10 000 people** outside Harare. An official government operation, Operation Murambatsvina was the government’s programme of mass forced eviction and the demolition of homes and informal businesses, aimed at forcibly relocating the urban poor to rural areas, and contributing to rising numbers of internally displaced Zimbabweans.

Genocide – Solvency – Intervention

**Satellite imaging reveals genocides**

**Toney et al 10** (Jeffrey H. Toney Dean of Natural Applied & Health Sciences Kean, Hank Kaplowitz Prof. Psych, Rongsun Pu Ph.D Biology, Feng Qi M.S. in GIS, George Chang Prof Computer Science, November, DA 7/4/11, OST muse.jhu.edu/journals/human\_rights\_quarterly/v032/32.4.toney)

**In a satellite image** captured 2 July 2004 (Figure 1: left-hand image), **soil above the purported mass grave** at Dasht-e-Leili **appeared to be undisturbed**, according to Lars Bromley, director of the AAAS Geospatial Technologies and Human Rights project.25 **A satellite image captured 5 August 2006** (Figure 1: right-hand image) **revealed a large pit on one side of the roadway, and two large vehicles on the other side of the roadway. Based on their dimensions and appearance, the vehicles could have been a hydraulic excavator and a dump truck**.

**Satellites key to observation and mitigation of killings**

**Katayama 7** (Lisa, Staff Writer NYT, wired.com/techbiz/people/magazine/15-12/st\_bromley, 11/27, DA 7/4/11, OST)

For the past two years, **Bromley**, a 32-year-old geo-information specialist at the American Association for the Advancement of Science, **has been using satellite photography to help NGOs document atrocities in isolated crisis zones like Darfur and Zimbabwe. When on-the-ground watchdogs send him coordinates, Bromley buys images from commercial satellites and combs them for visual proof — refugee camps, burned villages, massing militias.**

**Satellite images assist in human rights abuse prosecution**

**AAAS 7** (http://shr.aaas.org/geotech/whatcanGISdo.shtml, 9/25, DA 7/4/11, OST)

The human rights community has taken notice of these technologies, with several examples of their use arising in recent years. The QuickBird imagery used by the Department of State and USAID, together with other high-resolution imagery, has proven especially valuable as it can show damage to small houses, orchards, fields, and other features. **Given the unequivocal time of image acquisition it can authoritatively document changes to these features, and in printed form the imagery helps corroborate and synthesize witness reports during interviews. Such imagery has been successfully used by Eritrea in presenting evidence of Ethiopian misconduct during the occupation of villages during their armed conflict. During hearings in The Hague at the Eritrea-Ethiopia Claims Commission, Eritrea succeeded in using high resolution imagery, the only photographic evidence available for the area in question, in showing unlawful damage to homes, public buildings, and agriculture** (5). Human Rights Watch has also explored applications of geospatial technologies in their work. Specifically, **Human Rights Watch used high resolution imagery and other geospatial data to understand how and why civilians were killed or injured during Operation Iraqi Freedom** (6). Human Rights Watch was also able to make use of an archive of high-resolution imagery to document the systematic destruction of homes by Israeli Defense Forces in the Gaza Strip (7). Amnesty International Denmark has conducted trial uses as well, contracting with an engineering firm to analyze low resolution Landsat 7 imagery. **A further example is provided by the U.S. Committee for Human Rights in North Korea, which combined high resolution imagery and defector interviews to produce an unprecedented and systemic study of the extensive North Korean political prison camp system** (8). The Genocide Studies Program at Yale University has also long explored such applications in Cambodia, the Sudan, East Timor and other places. (9).

Genocide –Impact

Genocide is the ultimate impact and is categorically different from all other calculations. Failure to act on-face and without delay is one hundred percent complicity, even if our strategy has no definitive endpoint

**Vetlesen 2k** (Arne Johan, Department of Philosophy, U of Oslo, July, *Journal of Peace Research*, “Genocide: A Case for the Responsibility of the Bystander,” p. 520-522)

Most often, in cases of genocide, for every person directly victimized and killed there will be hundreds, thousands, perhaps even millions, who are neither directly targeted as victims nor directly participating as perpetrators. The moral issues raised by genocide, taken as the illegal act par excellance, are not confined to the nexus of agent and victim. Those directly involved in a given instance of genocide will always form a minority, so to speak. The majority to the event will be formed by the contemporary bystanders. Such bystanders are individuals; in their private and professional lives, they will belong to a vast score of groups and collectives, some informal and closely knit, others formal and detached as far as personal and emotional involvement are concerned. In the loose sense intended here, every contemporary citizen cognizant of a specific ongoing instance of genocide, regardless of where in the world, counts as a bystander. Bystanders in this loose sense are cognizant, through TV, radio, newspapers, and other publicly available sources of information, of ongoing genocide somewhere in the world, but they are not - by profession or formal appointment — involved in it. Theirs is a passive role, that of onlookers, although what starts out as a passive stance may, upon decision, convert into active engagement in the events at hand. I shall label this category passive bystanders. This group should be distinguished from bystanders by formal appointment: the latter bystanders have been professionally Engaged as a ‘third party’ to the interaction between the two parties directly involved in acts of genocide. The stance of this third party to an ongoing conflict, even one with genocidal implications, is in principle often seen as one of impartiality and neutrality, typically highlighted by a determined refusal to ‘take sides.’ This manner of principled non-involvement is frequently viewed as highly meritorious (Vetlesen, 1998). A case in point would be UN personnel deployed to monitor a ceasefire between warring parties, or (as was their task in Bosnia) to see to it that the civilians within a UN declared ‘safe area’ are effectively guaranteed ‘peace and security’, as set down in the mandate to establish such areas. By virtue of their assigned physical presence on the scene and the specific tasks given to them, such (groups of) bystanders may be referred to as bystanders by assignment. What does it mean to be a contemporary bystander? To begin with, let us consider this question not from the expected view- point — that of the bystander - but from the two viewpoints provided by the parties directly involved in the event. To put it as simply as possible: From the viewpoint of an agent of genocide, bystanders are persons possessing a potential (one needing to be estimated in every concrete case) to halt his ongoing actions. The perpetrator will fear the bystander to the extent that he [or she] has reason to believe that the bystander will intervene to halt the action already under way, and thereby frustrate the perpetrators goal of eliminating the targeted group, that said, we immediately need to differentiate among the different categories of bystanders introduced above. It is obvious that the more knowledgeable and other wise resourceful the bystander, the more the perpetrator will have reason to fear that the potential for such resistance will translate into action, meaning a more or less direct intervention by military or other means. Deemed efficient to reach the objectives of halting the incipient genocide. Of course, one should distinguish between bystanders who remain inactive and those who become actively engaged. Nonetheless, the point to be stressed is that, in principle, even the most initially passive and remote bystander possesses a potential to cease being a mere onlooker to the events unfolding. Outrage at what comes to pass may prompt the judgement that ‘this simply must be stopped’ and translate into action promoting that aim. But is not halting genocide first and foremost a task, indeed a duty, for the victims themselves? The answer is simple: The sheer fact that genocide is happening shows that the targeted group has not proved itself able to prevent it. This being so, responsibility for halting what is now unfolding cannot rest with the victims alone, it must also be seen to rest with the party not itself affected but which is knowledgeable about -which is more or less literally witnessing — the genocide that is taking place. So whereas for the agent, bystanders represent the potential of resistance, for the victims they may represent the only source of hope left. In ethical terms, this is borne out in the notion of responsibility of Immanuel Levinas (1991), according to which responsibility grows bigger the weaker its addressee. Of course, agents of genocide may be caught more or less in delicto flagrante. But in the age of television - with CNN being able to film and even interview doers as well as victims on the spot, and broadcast live to the entire television-watching world (such as was the case in the concentration camp Omarska in Bosnia in August 1992) (see Gutman, 1993) — physical co-presence to the event at hand is almost rendered superfluous. One need not have been there in order to have known what happened, The same holds for the impact of the day-to-day reporting From the ground by newspaper journalists of indisputable reputation. In order to be knowledgeable about ongoing genocide, it suffices to watch the television news or read the front pages of a daily newspaper. But, to be more precise, what exactly does it mean to act? What is to count as an action? We need to look briefly at the philosophical literature on the notion of action — as well as the notion of agent responsibility following from it - in order to gel a better grasp of the moral issues involved in being a bystander to genocide, whether passive or active. ‘I never forget', says Paul Ricoeur in Oneself as Another, 'to speak of humans as acting and suffering, The moral problem', he continues, ‘is grafted onto the recognition of this essential dissymmetry between the one who acts and the one who undergoes, culminating in the violence of the powerful agent.' To be the 'sufferer' of a given action in Ricoeur's sense need not be negative; either 'the sufferer appears as the beneficiary of esteem or as the victim of disesteem, depending on whether the agent proves to be someone who distributes rewards or punishments'. Since there is to every action an agent and a sufferer (in the sense given), action is interaction, its structure is interpersonal (Ricoeur. 1992:145). But this is not the whole picture. Actions are also omitted, endured, neglected, and the like; and Ricoeur takes these phenomena to remind us that ‘on the level of interaction, just as on that of subjective understanding, not acting is still acting: neglecting, forgetting to do something, is also letting things be done by someone else, sometimes to the point of criminality. (Ricoeur, 1992:157) Ricoeur's systematic objective is to extend the theory of action from acting to suffering beings; again and again he emphasizes that 'every action has its agents and its patients' (1992; 157). Ricoeur's proposed extension certainly sounds plausible. Regrettably, his proposal stops halfway. The vital insight articulated, albeit not developed, in the passages quoted is <CONTINUED>

Genocide - Impact

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that not acting is still acting. Brought to bear on the case of genocide as a reported, on going affair, the inaction making a difference is the inaction of the bystander to unfolding genocide. The failure to act when confronted with such action, as is involved in accomplishing genocide, is a failure which carries a message to both the agent and the sufferer: the action may proceed. Knowing, yet still not acting, means-granting acceptance to the action. Such inaction entails letting things be done by someone else - clearly, in the case of acknowledged genocide, 'to the point of criminality', to invoke one of the quotes from Ricoeur. In short, inaction here means complicity; accordingly, it raises the question of responsibility, guilt, and shame on the part of the inactive bystander, by which I mean the bystander who decides to remain inactive. In the view I am advancing, the theory of action is satisfactorily extended only when it is recognized that the structure of action is triadic, not dyadic. It takes two to act, we are tempted to say — no more and no less. But is an action really the exclusive possession — a private affair — between the two parties immediately affected as agent and sufferer? For one thing, the repercussions of a particular piece of action are bound to reach far beyond the immediate dyadic setting. As Hannah Arendt (1958) famously observed, to act is to initiate, to make a new beginning in the world, to set in motion - and open-endedly so. Only the start of a specific action allows precise localization in space and time, besides our attributing it to a particular agent, as her property and no one else’s. But, as for the repercussions, they evade being traced in any definite manner, to any final and definitive endpoint.

**Genocide should be rejected categorically – it precedes other political considerations**

**Harff & Gur 81** (Barbara, Prof of Political Science Emerita @ U.S. Naval Academy in Annapolis, MD, “Humanitarian Intervention As A Remedy For Genocide,”, p. 40)

One of the most enduring and abhorrent problems of the world is genocide, which is neither particular to a specific race, class, or nation, nor is it rooted in any one, ethnocentric view of the world. **Prohibition of genocide** **and affirmation of its opposite, the value of life, are an eternal ethical verity, one whose practical implications** **necessarily outweigh possible theoretical objections and as such should lift it above prevailing ideologies or** **politics. Genocide concerns and potentially effects all people.** People make up a legal system, according to Kelsen. Politics is the expression of conflict among competing groups. Those in power give the political system its character, i.e. the state. The state, according to Kelsen, is nothing but the combined will of all its people. This abstract concept of the state may at first glance appear meaningless, because in reality not all people have an equal voice in the formation of the characteristics of the state. **But I am not concerned with the characteristics of** **the state but rather the essence of the state – the people. Without a people there would be no state or legal** **system. With genocide eventually there will be no people. Genocide is ultimately a threat to the existence of all.** True, sometimes only certain groups are targeted, as in Nazi Germany. Sometimes a large part of the total population is eradicated, as in contemporary Cambodia. Sometimes people are eliminated regardless of national origin – the Christians in Roman times. Sometimes whole nations vanish – the Amerindian societies after the Spanish conquest. And sometimes religious groups are persecuted – the Mohammedans by the Crusaders. The culprit changes: sometimes it is a specific state, or those in power in a state; occasionally it is the winners vs. the vanquished in international conflicts; and in its crudest form the stronger against the weaker. **Since virtually** **every social group is a potential victim, genocide is a universal concern.**

Genocide – AT: Genocide Inev

**Genocide isn’t inevitable**

**Nelkin 10** (Melanie, Boardmember GPGC, enoughproject.org/blogs/genocide-not-inevitable, 1/27, DA 7/6/11, OST)

**The crime of genocide is not inevitable, and** clearly, **prevention is much cheaper than intervention.** **Prevention would ensure that when there is political will to respond, the U.S. is prepared to do it more effectively**. In December of 2008 the Genocide Prevention Task Force, co-chaired by Madeline Albright and William **Cohen, released a blueprint policy that the US could put in place to increase the capacity to prevent and respond more effectively to genocide and mass atrocities**. The price tag would be $250 million a year – less than a dollar for every American each year – and a far cry from the billions spent on humanitarian aid in Darfur alone.

**If action is taken genocide can be prevented**

**Nelkin 10** (Melanie, Boardmember GPGC, enoughproject.org/blogs/genocide-not-inevitable, 1/27, DA 7/6/11, OST)

**Sudan has a long history of bloody wars. Violence and political tensions in the South and border areas was up in 2009.** There is an impending risk of more atrocities through the upcoming national elections in April. Many signs point to the South seceding and forming an independent country, a choice granted to southerners through the 2005 Comprehensive Peace Agreement between the ruling parties of the North and South, but even this landmark peace deal is very fragile. While President Obama has appointed a Special Envoy for Sudan, he has not brought together a meaningful international coalition. **There will be no dearth of important and intelligent people and groups advising President Obama on which priorities he should choose for his second year in office. So far it seems we have not learned from historical precedents. But among all the voices, President Obama should listen to his two immediate predecessors. It’s been well reported that President Clinton’s greatest regret is not acting in 1994 to prevent “hundreds of thousands” of Rwandan deaths. Similarly, shortly after leaving office President Bush lamented not being able to stop what his government called “genocide” in Darfur.** My hope is that our current president doesn’t choose FDR’s approach, the one I saw portrayed in the movies at the Atlanta Jewish Film Festival last week. Now is the time for President Obama to build a different and more transparent legacy.