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# 1AC

#### Plan: The United States Federal Government should substantially increase transportation infrastructure investment in GPS augmentation and anti-spoofing technologies for GPS receivers in the United States.

## **CONTENTION ONE: War in the Skies**

#### Researchers have identified several weaknesses in the GPS systems of UAV’s – the FAA is currently considering a round of new drones for commercial use in the near future, now is the key time to augment the drones for protection from spoofing.

UPI 6/29 United Press International Technology, UPI NewsTrack Science and Technology News, June 29th, 2012, http://www.upi.com/Science\_News/Technology/2012/06/29/UPI-NewsTrack-Science-and-Technology-News/UPI-42571341011100/#ixzz1zKZOdOp3

Researchers at the University of Texas say they've demonstrated the Global Positioning System signals of unmanned aerial vehicles can be hacked. Engineering Professor Todd Humphreys and his students were invited by the U.S. Department of Homeland Security to attempt the demonstration in New Mexico in late June. Using hardware and software they developed, the UT team repeatedly took control of navigational signals going to a small but sophisticated UAV, a university release reported Friday. Known as "spoofing," the technique creates false GPS signals to trick the vehicle's GPS receiver into steering a navigational course chosen by the outside hacker. Humphreys said his research team wanted to demonstrate the potential risks associated with spoofing as the Federal Aviation Administration considers mandated rules that would allow government and commercial drones in U.S. airspace by 2015. "We're raising the flag early on in this process so there is ample opportunity to improve the security of civilian drones from these attacks, as the government is committed to doing," Humphreys said.

#### AND, Domestic drones are on civilian channels which are unencrypted and can be turned into weapons

GCN 6/29 Government Computer News, June 29, 2012, “Domestic drones can be hijacked, turned into weapons, researchers show” http://s.tt/1gmqT

Domestic drones can be hijacked, turned into weapons, researchers show By Kathleen Hickey Jun 29, 2012 A research team from the University of Texas at Austin's Radionavigation Laboratory recently demonstrated to federal officials that anyone with $1,000 and technological know-how can take over a drone for nefarious purposes, potentially leading to the United States facing attacks from its own drones. Professor Todd Humphreys and his team performed the demonstration June 19 at the White Sands Missile Range in New Mexico, showing officials from the Homeland Security Department and the Federal Aviation Administration how they used spoofing technology to hijack the drones. Spoofing tricks a Global Positioning System device into thinking false information sent to it is real. Until now, the primary concern with unmanned aerial vehicles was GPS jamming, which was suspected when Iran downed a U.S. drone in December. Successful spoofing would allow an attacker to take control. Speaking to FoxNews after the demonstration, Humphreys noted that in five or 10 years, the United States could have 30,000 drones operating within its borders. “Each one of these could be a potential missile used against us,” he said. For example, a drone used by FedEx to deliver packages could be hijacked and used as a missile. They could be used to crash into other planes or buildings, killing people. “That’s the same mentality the 9-11 attackers had,” he said. Most drones that will fly over the U.S. will rely on civilian GPS, which is not encrypted and open to infiltration.

## CONTENTION TWO: End of An Empire

**US military success and drone usage centers on effective GPS but global threats from jamming and spoofing are on the rise**

**Drummond 6/13/**12 (Katie, “When GPS Goes Down, Pentagon Still Wants a Way to Fight”, <http://www.wired.com/dangerroom/2012/06/darpa-gps/>, CMR)

**The navigational system used by the military for just about everything** **from guiding drones to dropping bombs is increasingly under threat of attack**. Now, the Pentagon’s desperate to replace it. Or, at least, reinforce it enough to stave off a looming storm of strikes. That’s the thrust of a new venture from Darpa, the military’s premier research arm and the brains behind GPS’ initial development in the 1950s. On Tuesday, the agency announced the second phase of their program, “All Source Positioning and Navigation (ASPN),” that’s trying to “enable low-cost, robust and seamless navigation solutions … with or without GPS.” The program, which Darpa quietly kicked off last year with two awards for theoretical research, is one part of a larger military effort that’s trying to steer the Pentagon away from its GPS dependency. Why? First off, **there’s the growing risk of GPS signals being jammed by adversarial forces. Enemies on the ground can also “spoof” a GPS system** — essentially tricking it into showing an incorrect location. And these are far from hypothetical risks: Mere weeks ago, a fatal drone crash in South Korea was attributed to GPS signal jamming from north of the border. Last year, Iranians (perhaps dubiously) claimed they jammed the GPS signals navigating an American spy drone, then spoofed the system to land in Iran’s clutches. And those **GPS-thwarting capabilities continue to grow — at a pace that’s exceeded the military’s ability to keep pace — largely because of a booming commercial market for GPS-jamming tech**nology. Such electronic warfare “was once the province of a few peer-adversaries,” Darpa deputy director Ken Gabriel told the House Armed Services Committee’s panel on emerging threats earlier this year. “**It is now possible to purchase commercial off-the-shelf components for more than 90 percent of the electronics needed in an [electronic warfare] system**.”

#### Scenario One: Terrorism

**GPS is key to US military objectives and success in the war on terrorism**

**Johnson ‘6** (Dana J, Ph.D., Overcoming Challenges to Transformational Space Programs, October, <http://www.northropgrumman.com/analysis-center/paper/assets/Overcoming-Challenges-to-Trans.pdf>, CMR)

**Transformational space programs** are at the front and center of debates between the current Administration and the Congress regarding the future of U.S. national security space activities and programs. They **offer potentially revolutionary capabilities to provide critically needed info**rmation **for decision-making through persistent imagery of targets and areas of interest to policy-makers and military planners, expanded accuracy and timeliness of information to meet dynamic operational requirements, and new concepts of operations that integrate multiple phenomenologies and platforms.** Consequently, **successful acquisition and deployment of these capabilities will greatly enhance U.S. national security objectives, support U.S. and coalition military operations, and strengthen the contribution of intelligence to the on-going global war on terrorism**. However, these programs face not only technological challenges but also acquisition, operational, organizational, and policy challenges along the path to deployment and operation. Developing these programs and sustaining them politically and financially over the long term can be a daunting effort. An approach offering potentially useful insights for such efforts is to assess earlier space programs that experienced similar challenges. The most notable example is the Global Positioning System (**GPS**), a space-based constellation of satellites **provid**ing **positioning, navigation, and timing for worldwide utility**. GPS is a tremendous and critical success, not only as a military system but also for numerous civil, commercial, economic, and global applications unforeseen when the program was initiated. A review of GPS’ history, as described in this paper, reveals the hurdles that GPS had to overcome to emerge as a leading example of what today would be considered as a transformational space program. Examining these hurdles as they developed in the program’s early history should offer important insights for those decision-makers pursuing transformational space programs today.

**Specifically, Drones are key to preventing future terrorist attacks**

McClatchy-Tribune 6/25 (“Drone attacks remain best tool to fight terrorists”, <http://www.bradenton.com/2012/06/25/4090990/drone-attacks-remain-best-tool.html>, CMR)

The United States has been at war with a shadowy, elusive enemy for more than a decade. It is a war without borders and front lines, fought by an enemy that hides behind civilian populations and in dark corners. The terrorist group **al-Qaida** carried out an infamous and devastating attack on Sept. 11, 2001, and **has been plotting attacks** ever since; its members would love to repeat that success. **It is only through** the vigilance, courage and **successful tactics** of the men and women in the U.S. armed forces and intelligence services **that those plots have been thwarted**. **A key weapon** in that fight **has been the drone**, a pilotless craft that can be sent against a very specific target and eliminate it without risk to U.S. forces. The drone again proved its value in this twilight struggle when, earlier this month, **a drone strike killed al-Qaida's No. 2** leader at a house in northern Pakistan. Abu Yahya al-Libi was the sixth top al-Qaida leader killed in Pakistan and Yemen over the past year. That success has devastated the terrorist group and no doubt saved the lives of innocents. It is the best argument for continuing the drone attacks. But the drone itself has come under attack, and its frequent use by the Obama administration has become controversial. Critics say it is responsible for the deaths of nearby civilians, that it creates more new enemies than it kills and that the attacks are targeted too broadly. Those criticisms have some validity. There have been too many civilian deaths. Taking out a terrorist leader and his guards is one thing; targeting the funeral procession for that leader is quite another. While such an attack will kill more supporters of that leader, it is also likely to kill innocent civilians, including children. Aside from the moral implications, that does create new enemies. Robert Grenier, who headed the CIA's counterterrorism center from 2004 to 2006, told the British newspaper the Guardian that the attacks are too broadly targeted. He emphasized that the attacks need to be "targeted much more finely" and against specific identified targets who have been tracked and monitored to a place where a strike is feasible. He's right; identifying all military-age males in a strike zone as militants, as the administration has been accused of doing, is far too broad. The Obama administration, which has used drones far more extensively than its predecessor, also needs to address issues of rules of engagement and how much the president should be involved in the selection of targets. And an international debate leading to international rules on the use of drones is also warranted. The U.S. is not the only country with this technology, and it is setting precedents for their future use. If it's OK for use in other countries' sovereign territory against terrorist groups, what about use against dissidents in other countries? Sometimes, one person's terrorist is another person's freedom fighter. But while some changes in policy and more discussion are certainly warranted, **the drones remain a most effective and precise weapon** - certainly more precise than anything else the U.S. now has at its disposal to target terrorists. Using other weapons would mean even more civilian and U.S. casualties. And **doing nothing** against a foe as implacable as al-Qaida **is not an option**. By all means, have that debate, but **until al-Qaida is** effectively **destroyed, drones remain the best tool** in the tool shed.

**Terrorist attack causes global nuclear war and extinction**

**Ayson ’10** – Professor of Strategic Studies and Director of the Centre for Strategic Studies: New Zealand at the Victoria University of Wellington (Robert, “After a Terrorist Nuclear Attack: Envisaging Catalytic Effects,” Studies in Conflict & Terrorism, Volume 33, Issue 7, July, Available Online to Subscribing Institutions via InformaWorld)

A terrorist nuclear attack, and even the use of nuclear weapons in response by the country attacked in the first place, would not necessarily represent the worst of the nuclear worlds imaginable. Indeed, there are reasons to wonder whether **nuclear terrorism should** ever **be regarded as** belonging in the category of truly existential threats. A contrast can be drawn here with the global catastrophe that would come from a massive nuclear exchange between two or more of the sovereign states that possess these weapons in significant numbers. Even the worst terrorism that the twenty-first century might bring would fade into insignificance alongside considerations of what a general nuclear war would have wrought in the Cold War period. And it must be admitted that as long as the major nuclear weapons states have hundreds and even thousands of nuclear weapons at their disposal, there is always the possibility of a truly awful nuclear exchange taking place precipitated entirely by state possessors themselves. But these two nuclear worlds—a non-state actor nuclear attack and a catastrophic interstate nuclear exchange—are not necessarily separable. It is just possible that some sort of terrorist attack, and especially an act of **nuclear terrorism, could precipitate** a chain of events leading to **a** massive exchange of nuclear weaponsbetween two or more of the states that possess them. In this context, today’s and tomorrow’s terrorist groups might assume the place allotted during the early Cold War years to new state possessors of small nuclear arsenals who were seen as raising the risks of a catalytic nuclear war between the superpowers started by third parties. These risks were considered in the late 1950s and early 1960s as concerns grew about nuclear proliferation, the so-called n+1 problem. It may require a considerable amount of imagination to depict an especially plausible situation where an act of nuclear terrorism could lead to such a massive inter-state nuclear war. For example, in the event of a terrorist nuclear attack on the United States, it might well be wondered just how Russia and/or China could plausibly be brought into the picture, not least because they seem unlikely to be fingered as the most obvious state sponsors or encouragers of terrorist groups. They would seem far too responsible to be involved in supporting that sort of terrorist behavior that could just as easily threaten them as well. Some possibilities, however remote, do suggest themselves. For example, how might the United States react if it was thought or discovered that the fissile material used in the act of nuclear terrorism had come from Russian stocks,40 and if for some reason Moscow denied any responsibility for nuclear laxity? The correct attribution of that nuclear material to a particular country might not be a case of science fiction given the observation by Michael May et al. that while the debris resulting from a nuclear explosion would be “spread over a wide area in tiny fragments, its radioactivity makes it detectable, identifiable and collectable, and a wealth of information can be obtained from its analysis: the efficiency of the explosion, the materials used and, most important … some indication of where the nuclear material came from.”41 Alternatively, if the act of nuclear terrorism came as a complete surprise, and American officials refused to believe that a terrorist group was fully responsible (or responsible at all) **suspicion would shift immediately to state possessors**. Ruling out Western ally countries like the United Kingdom and France, and probably Israel and India as well, authorities in Washington would be left with a very short list consisting of North Korea, perhaps Iran if its program continues, and possibly Pakistan. But at what stage would Russia and China be definitely ruled out in this high stakes game of nuclear Cluedo? In particular, if the act of nuclear terrorism occurred against a backdrop of existing tension in Washington’s relations with Russia and/or China, and at a time when threats had already been traded between these major powers, would officials and political **leaders** not be tempted to **assume the worst**? Of course, the chances of this occurring would only seem to increase if the United States was already involved in some sort of limited armed conflict with Russia and/or China, or if they were confronting each other from a distance in a proxy war, as unlikely as these developments may seem at the present time. The reverse might well apply too: should a nuclear terrorist attack occur in Russia or China during a period of heightened tension or even limited conflict with the United States, could Moscow and Beijing resist the pressures that might rise domestically to consider the United States as a possible perpetrator or encourager of the attack? Washington’s early response to a terrorist nuclear attack on its own soil might also raise the possibility of an unwanted (and nuclear aided) confrontation with Russia and/or China. For example, in the noise and confusion during the immediate aftermath of the terrorist nuclear attack, **the** U.S. **president might** be expected to **place the country’s** armed forces, including its **nuclear arsenal, on** a **high**er stage of **alert**. In such a tense environment, when careful planning runs up against the friction of reality, it is just possible that **Moscow and**/or **China might mistake**nly read **this as a sign of U.S. intentions to use** force (and possibly **nuclear force)** against them. In that situation, the temptations to preempt such actions might grow, although it must be admitted that any preemption would probably still meet with a devastating response. As part of its initial response to the act of nuclear terrorism (as discussed earlier) **Washington might** decide to **order a significant** conventional (or **nuclear)** retaliatory or disarming **attack against** the leadership of the **terrorist** group and/or states seen to support that group. Depending on the identity and especially the location of these targets, Russia and/or China might interpret such action as being far too close for their comfort, and potentially as an infringement on their spheres of influence and even on their sovereignty. One far-fetched but perhaps not impossible scenario might stem from a judgment in Washington that some of the main aiders and abetters of the terrorist action resided somewhere such as Chechnya, perhaps in connection with what Allison claims is the “Chechen insurgents’ … long-standing interest in all things nuclear.”42 American pressure on that part of the world would almost certainly raise alarms in Moscow that might require a degree of advanced consultation from Washington that the latter found itself unable or unwilling to provide. There is also the question of how other nuclear-armed states respond to the act of nuclear terrorism on another member of that special club. It could reasonably be expected that following a nuclear terrorist attack on the United States, both Russia and China would extend immediate sympathy and support to Washington and would work alongside the United States in the Security Council. But there is just a chance, albeit a slim one, where the support of Russia and/or China is less automatic in some cases than in others. For example, what would happen if the United States wished to discuss its right to retaliate against groups based in their territory? If, for some reason, **Washington** found the responses of Russia and China deeply underwhelming, (neither “for us or against us”) **might** it also **suspect that they** secretly **were in cahoots with the group, increasing** (again perhaps ever so slightly) **the chances of a** major exchange. If the terrorist group had some connections to groups in Russia and China, or existed in areas of the world over which Russia and China held sway, and if Washington felt that Moscow or Beijing were placing a curiously modest level of pressure on them, what conclusions might it then draw about their culpability? If Washington decided to use, or decided to threaten the use of, nuclear weapons, the responses of Russia and China would be crucial to the chances of avoiding a more serious nuclear exchange. They might surmise, for example, that while the act of nuclear terrorism was especially heinous and demanded a strong response, the response simply had to remain below the nuclear threshold. It would be one thing for a non-state actor to have broken the nuclear use taboo, but an entirely different thing for a state actor, and indeed the leading state in the international system, to do so. If Russia and China felt sufficiently strongly about that prospect, there is then the question of what options would lie open to them to dissuade the United States from such action: and as has been seen over the last several decades, the central dissuader of the use of nuclear weapons by states has been the threat of nuclear retaliation. If some readers find this simply too fanciful, and perhaps even offensive to contemplate, it may be informative to reverse the tables. Russia, which possesses an arsenal of thousands of nuclear warheads and that has been one of the two most important trustees of the non-use taboo, is subjected to an attack of nuclear terrorism. In response, Moscow places its nuclear forces very visibly on a higher state of alert and declares that it is considering the use of nuclear retaliation against the group and any of its state supporters. How would Washington view such a possibility? Would it really be keen to support Russia’s use of nuclear weapons, including outside Russia’s traditional sphere of influence? And if not, which seems quite plausible, what options would Washington have to communicate that displeasure? If China had been the victim of the nuclear terrorism and seemed likely to retaliate in kind, would the United States and Russia be happy to sit back and let this occur? In the charged atmosphere immediately after a nuclear terrorist attack, how would the attacked country respond to pressure from other major nuclear powers not to respond in kind? The phrase “how dare they tell us what to do” immediately springs to mind. Some might even go so far as to interpret this concern as a tacit form of sympathy or support for the terrorists. This might not help the chances of nuclear restraint.

#### Scenario Two: Hegemony

#### GPS is the lynchpin of US technological and military primacy

**Schippert ’10** (Steve, “American Achilles Heel: GPS”, June 1, <http://threatswatch.org/rapidrecon/2010/06/american-achilles-heel-gps/>, CMR)

Many of us have made note of this before, but it's worth your attention again, because the dynamics of reliance have not changed. In fact, **our reliance on GPS** systems **for** our **National Security have** predictably **grown**. As the Associated Press reports, a recent glitch shows how much the US military relies on GPS. **A problem that rendered** as many as **10,000 U.S. military GPS receivers useless for days is a warning to safeguard a system that enemies would love to disrupt**, a defense expert says. The Air Force has not said how many weapons, planes or other systems were affected or whether any were in use in Iraq or Afghanistan. But **the problem**, blamed on incompatible software, **highlights the military's reliance on** the **G**lobal **P**ositioning **S**ystem **and the need to protect tech**nology **that has become essential for protecting troops, tracking vehicles and targeting weapons.** "**Everything that moves uses it**," said John Pike, director of Globalsecurity.org, which tracks military and homeland security news. "**It is** so **central** **to the American style of war** that you just couldn't leave home without it." **What gives us military technological primacy** **also gives us** what comes as close to a technician's worst nightmare - **a single point of failure**. Our reliance upon GPS systems in our weaponry is immense. And it is also the great equalizer. China and Russia haev long known this, which is why they have been developing anti-satellite systems with a fervor equal to our development of the next generations of 'bunker buster' missiles. **GPS is our Achilles' heel**. **Defending our space-based assets is paramount**.

#### Decline of hegemony isn’t inevitable – America can achieve dominance if it maintains critical assets

**Cox, ‘11** – Michael, Professor of International Relations at the London School of Economics, “America's future is secure: Professor Cox,” 8-30, ABC, <http://www.abc.net.au/lateline/content/2011/s3306142.htm>, CMR

ALI MOORE: Let's look at America - the other side of this equation for a minute - and you say **predictions of America's demise are greatly exaggerated**, but when a country can dig a hole full of debt the size the US has done for itself, and then argue to the brink of calamity about what to do with it, it doesn't exactly give the impression of a country that is completely in control of its destiny? MICHAEL COX: Well, **I don't think any great empire has ever been fully in control of its destiny**, from the Roman to the British Empire, anyway. Empire and imperial power is not the same thing as omnipotence. America has never been omnipotent even when it's been at its most powerful. Indeed, until 1991 it faced the challenge in the form of the Soviet Union. But your question is a very good one. Basically **America has gone through a series of real problems: post 9/11, the legacy of the Bush presidency, the 2008 financial crisis and the repetition of a new financial economic crisis** over the last few weeks as we've seen. **I would want, however, to make a distinction between** what I would call ... it does sound maybe not entirely convincing, but I think what I call the "**shorter-term problems" which the United States are facing** - which are big and are not going to be solved easily, and the debt is one of these problems - **with what I call the "fundamental structural strengths" of the American system. It has still 75 of the best universities in the world. It spends 14 times more than China on its military. It is** a politically very attractive society. 20 million people have emigrated there over the last 15 years. **It still sits at the centre of the world's financial system.** It still has innovation to die for. **So in some fundamental structural sense there is still a lot of strength within that order. It has hard power, it has soft power, it has economic power, it has military power, so therefore I do think we need to distinguish between** what are very **deep short-term problems** - I don't understand them for one second. **There are still some deep structural strengths of the American political order.**

#### US dominance is key to solve multiple hotspots that escalate to global war

Robert **Kagan** (Senior Associate at the Carnegie Endowment for International Peace and Senior Transatlantic Fellow at the German Marshall Fund) **2007** “End of Dreams, Return of History,” Hoover Institution, No. 144, August/September, http://www.hoover.org/publications/policy-review/article/6136

The jostling for status and influence among these ambitious nations and would-be nations is a second defining feature of the new post-Cold War international system. Nationalism in all its forms is back, if it ever went away, and so is international competition for power, influence, honor, and status. American predominance prevents these rivalries from intensifying — its regional as well as its global predominance. Were the United States to diminish its influence in the regions where it is currently the strongest power, the other nations would settle disputes as great and lesser powers have done in the past: sometimes through diplomacy and accommodation but often through confrontation and wars of varying scope, intensity, and destructiveness. One novel aspect of such a multipolar world is that most of these powers would possess nuclear weapons. That could make wars between them less likely, or it could simply make them more catastrophic.It is easy but also dangerous to underestimate the role the United States plays in providing a measure of stability in the world even as it also disrupts stability. For instance, the United States is the dominant naval power everywhere, such that other nations cannot compete with it even in their home waters. They either happily or grudgingly allow the United States Navy to be the guarantor of international waterways and trade routes, of international access to markets and raw materials such as oil. Even when the United States engages in a war, it is able to play its role as guardian of the waterways. In a more genuinely multipolar world, however, it would not. Nations would compete for naval dominance at least in their own regions and possibly beyond. Conflict between nations would involve struggles on the oceans as well as on land. Armed embargos, of the kind used in World War i and other major conflicts, would disrupt trade flows in a way that is now impossible. Such order as exists in the world rests not merely on the goodwill of peoples but on a foundation provided by American power. Even the European Union, that great geopolitical miracle, owes its founding to American power, for without it the European nations after World War ii would never have felt secure enough to reintegrate Germany. Most Europeans recoil at the thought, but even today Europe ’s stability depends on the guarantee, however distant and one hopes unnecessary, that the United States could step in to check any dangerous development on the continent. In a genuinely multipolar world, that would not be possible without renewing the danger of world war. People who believe greater equality among nations would be preferable to the present American predominance often succumb to a basic logical fallacy. They believe the order the world enjoys today exists independently of American power. They imagine that in a world where American power was diminished, the aspects of international order that they like would remain in place. But that ’s not the way it works. International order does not rest on ideas and institutions. It is shaped by configurations of power. The international order we know today reflects the distribution of power in the world since World War ii, and especially since the end of the Cold War. A different configuration of power, a multipolar world in which the poles were Russia, China, the United States, India, and Europe, would produce its own kind of order, with different rules and norms reflecting the interests of the powerful states that would have a hand in shaping it. Would that international order be an improvement? Perhaps for Beijing and Moscow it would. But it is doubtful that it would suit the tastes of enlightenment liberals in the United States and Europe. The current order, of course, is not only far from perfect but also offers no guarantee against major conflict among the world ’s great powers. Even under the umbrella of unipolarity, regional conflicts involving the large powers may erupt. War could erupt between China and Taiwan and draw in both the United States and Japan. War could erupt between Russia and Georgia, forcing the United States and its European allies to decide whether to intervene or suffer the consequences of a Russian victory. Conflict between India and Pakistan remains possible, as does conflict between Iran and Israel or other Middle Eastern states. These, too, could draw in other great powers, including the United States. Such conflicts may be unavoidable no matter what policies the United States pursues. But they are more likely to erupt if the United States weakens or withdraws from its positions of regional dominance. This is especially true in East Asia, where most nations agree that a reliable American power has a stabilizing and pacific effect on the region. That is certainly the view of most of China ’s neighbors. But even China, which seeks gradually to supplant the United States as the dominant power in the region, faces the dilemma that an American withdrawal could unleash an ambitious, independent, nationalist Japan. In Europe, too, the departure of the United States from the scene — even if it remained the world’s most powerful nation — could be destabilizing. It could tempt Russia to an even more overbearing and potentially forceful approach to unruly nations on its periphery. Although some realist theorists seem to imagine that the disappearance of the Soviet Union put an end to the possibility of confrontation between Russia and the West, and therefore to the need for a permanent American role in Europe, history suggests that conflicts in Europe involving Russia are possible even without Soviet communism. If the United States withdrew from Europe — if it adopted what some call a strategy of “offshore balancing” — this could in time increase the likelihood of conflict involving Russia and its near neighbors, which could in turn draw the United States back in under unfavorable circumstances. It is also optimistic to imagine that a retrenchment of the American position in the Middle East and the assumption of a more passive, “offshore” role would lead to greater stability there. The vital interest the United States has in access to oil and the role it plays in keeping access open to other nations in Europe and Asia make it unlikely that American leaders could or would stand back and hope for the best while the powers in the region battle it out. Nor would a more “even-handed” policy toward Israel, which some see as the magic key to unlocking peace, stability, and comity in the Middle East, obviate the need to come to Israel ’s aid if its security became threatened. That commitment, paired with the American commitment to protect strategic oil supplies for most of the world, practically ensures a heavy American military presence in the region, both on the seas and on the ground. The subtraction of American power from any region would not end conflict but would simply change the equation. In the Middle East, competition for influence among powers both inside and outside the region has raged for at least two centuries. The rise of Islamic fundamentalism doesn ’t change this. It only adds a new and more threatening dimension to the competition, which neither a sudden end to the conflict between Israel and the Palestinians nor an immediate American withdrawal from Iraq would change. The alternative to American predominance in the region is not balance and peace. It is further competition. The region and the states within it remain relatively weak. A diminution of American influence would not be followed by a diminution of other external influences. One could expect deeper involvement by both China and Russia, if only to secure their interests. 18 And one could also expect the more powerful states of the region, particularly Iran, to expand and fill the vacuum. It is doubtful that any American administration would voluntarily take actions that could shift the balance of power in the Middle East further toward Russia, China, or Iran. The world hasn ’t changed that much. An American withdrawal from Iraq will not return things to “normal” or to a new kind of stability in the region. It will produce a new instability, one likely to draw the United States back in again.

#### Specifically, GPS systems are key to prompt global strike

**Woolf ’12** (Amy F, “Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues”, Feb 13, <http://www.fas.org/sgp/crs/nuke/R41464.pdf>, CMR)

General Cartwright and others emphasized that **the substitution of conventional warheads for nuclear warheads in the U.S. war plan would require significant improvements in the accuracy of U.S. long-range ballistic missiles**. **If missiles could deliver their payloads more precisely to their targets, then**, for some categories of targets, **they may not need the explosive yield of a nuclear weapon to destroy the target**. Both **the Navy and** the **Air Force are exploring advanced guidance and targeting tech**nologies, **such as the use of GPS guidance**, **that might provide their missiles with these improvements in accuracy**. This effort has been underway for nearly two decades. General Cartwright sought a study that would allow him to determine what proportion of the targets in the U.S. war plan could be attacked with conventional weapons. An industry analyst has estimated that this proportion could be between 10% and 30% of the existing targets.23

**Prompt global strike deters global adversaries**

**Kerber & Stein 9** – Co-Chairs of the Defense Science Board [Dr. Ronald Kerber (Visiting Professor at Darden Business School at the University of Virginia and Masters and Doctorate degrees in engineering science from California Institute of Technology) & Dr. Robert Stein (Raytheon's Director of Advanced Programs), “Time Critical Conventional Strike from Strategic Standoff,” Report of the Defense Science Board Task Force, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, March 2009] CMR

**The U.S. strategic deterrence and strike environment has changed as our adversaries and their tactics have changed. Terrorists and rogue nations as well as future potential peers are well aware that asymmetric tactics are proving very effective against our forces**. In the past, a weapon of mass destruction (WMD) was a weapon of last resort for virtually all of the Nation’s primary adversaries – it now may be moving closer to the weapon of choice, at least for some. Terrorist leaders are more willing to take risks, tend to place much less value on the life of individuals, have much less to lose, and are somewhat protected by “statelessness.” Avowed tactics included massive targeting of innocents, martyrdom of “soldiers,” and operating within a civilian environment. Operational “fuzziness” makes Indications and Warnings (I&W) much more difficult and/or fleeting. WMD technology is broadly available, and the cost of entry is much lower than for traditional, indigenously developed, nuclear weapons. At the same time rogue nations are aggressively pursuing nuclear weapon capability. Deterrence has become more elusive in terms of identifying and locating adversaries, understanding adversary values, and understanding what of the adversaries the United States (U.S.) can hold at risk. **Our future global strategic strike capability must recognize today’s realities, be highly effective, quickly and easily usable, yet in many situations inflict minimal collateral damage while maintaining the threshold for nuclear weapons use at the high level we observe today**. **This all gives rise to the need fo**r a **prompt, conventional strike capability**, deliverable to almost anyplace on the globe. Time critical conventional strike from long standoff ranges into restricted or denied territory has been an operational, policy, and acquisition challenge for a long time, and this topic appeared in many studies and reports as a hard problem for which no satisfactory solution appeared to be readily available. In situations in which time is not a factor and/or in which sufficient U.S. forces are deployed nearby, the U.S. has demonstrated its ability to strike at identified threats effectively. However, **in situations in which time is a factor and no nearby forces are present**, if Courses of Action (COA) are requested, **only two options are currently available**; nuclear Intercontinental Ballistic Missile Systems (**ICBMs**)/Submarine/Sea-Launched Ballistic Missile (**SLBMs**) **or no military action**. **Many circumstances have been postulated in which a standoff strike capability could be critical to defeating a threat to U.S. interests; countering terrorism, countering WMD, countering proliferation, countering an emerging disruptive capability** to name a few. While a weapon system or systems may be a critical component for a military option, there are also key enablers that must be effective if a time critical strike from standoff is to be successful. Foremost among the enablers is a robust Intelligence, Surveillance, Reconnaissance (ISR) capability that can provide warning, target identification and target location while functioning within the adversary’s decision cycle to provide positive warning, localization and identification that meets the national decision maker’s threshold to proceed with a strike. An integrated Command, Control, and Communication (C3) is a second key enabler that is critical to effectively providing national leadership with a prompt global strike option.

## CONTENTION THREE: Spoofing a Collapse

#### Disruptions in GPS technology hurts US competitiveness because commercial GPS applications impact every sector of the economy – both through direct innovation and downstream expansion of industries

Pham 11

Nam, founder and Managing Partner of ndp consulting, **Ph.D. in economics from George Washington University with concentrations in international trade andfinance, economic development and applied microeconomics**, “The Economic Benefits of Commercial GPS Use in the U.S. and The Costs of Potential Disruption,” June 22, 2011, <http://www.saveourgps.org/pdf/GPS-Report-June-22-2011.pdf>

The commercial stakes are high. The downstream industries that rely on professional and high precision GPS technology for their own business operations would face serious disruption to their operations should interference occur, and U.S. leadership and innovation would suffer. Although recreational and military applications for GPS equipment are larger in terms of equipment sales volume, commercial applications generate a large share of economic benefits for society. As shown later in this report, the direct economic benefits of GPS technology on commercial GPS users are estimated to be over $67.6 billion per year in the United States. In addition, GPS technology creates direct and indirect positive spillover effects, such as emission reductions from fuel savings, health and safety gains in the work place, time savings, job creation, higher tax revenues, and improved public safety and national defense. Today, there are more than 3.3 million jobs that rely on GPS technology, including approximately 130,000 jobs in GPS manufacturing industries and 3.2 million in the downstream commercial GPS-intensive industries. The commercial GPS adoption rate is growing and expected to continue growing across industries as high financial returns have been demonstrated. Consequently, GPS technology will create $122.4 billion benefits per year and will directly affect more than 5.8 million jobs in the downstream commercial GPS-intensive industries when penetration of GPS technology reaches 100 percent in the commercial GPS-intensive industries. As is the case in all other innovative industries, the GPS industry directly creates jobs and economic activities, which spur economic growth. Evidence shows that innovative industries, such as the GPS industry, create both high- and low-skilled jobs during economic expansions and downturns, pay their employees higher-than-national-average wages, raise output and sales per employee, increase U.S. competitiveness, which is reflected in increased exports and reduced U.S. trade deficits, and spend large sums on R&D and capital investment. In addition to creating these direct economic benefits, innovative industries create productivity benefits to the downstream industries, including increased sales, profits, and investment returns. Empirical studies have shown sustained productivity benefits support further growth and job creation in downstream industries and the U.S. economy as a whole.

#### Spoofing can shut down markets and create sudden liquidity crises

Humphries 12

(Todd E. Humphreys is an assistant professor in the department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin Fox News, GPS at risk from terrorists, rogue nations, and $50 jammers, expert warns., Read more: http://www.foxnews.com/scitech/2012/02/23/gps-emerging-threat/#ixzz1z3gN3lgt)

Hijacking a cargo container is one thing. Spoofing the global financial system is quite another. In his London presentation, Humphreys warned about another emerging GPS threat -- the worldwide network of stock and commodity trades. Every trade is time-stamped using GPS clocks. Computer programs monitor those time stamps down to the millisecond. If something seems amiss, many programs are designed to pull out of the market. Humphreys says a hacker could fairly easily interfere with those time stamps, triggering trading programs, creating a sudden liquidity crisis and potentially a mini market crash. Then, there’s the high-dollar reward of manipulating time. An unscrupulous trader -- or criminal organization could make millions by delaying time even by a heartbeat. “You’re able to match the prices between the networks in a way that’s different from everyone else in the world,” Humphreys said. “Everyone else in the world might be 20 milliseconds off and you happen to know the actual timing. And so you’re able to buy low in one market and sell high in another market.” The system is so vulnerable to attack because signals coming from the network of GPS satellites orbiting the earth are very weak. They’re about 12,000 miles away. It doesn’t take much to disrupt them.

#### Economic collapse causes global nuclear war

Mead 9**—Senior Fellow in US Foreign Policy Studies @ Council on Foreign Relations**

Walter Russell, Only Makes You Stronger, The New Republic, 2-4-09, http://www.tnr.com/politics/story.html?id=571cbbb9-2887-4d81-8542-92e83915f5f8&p=1

The greatest danger both to U.S.-China relations and to American power itself is probably not that China will rise too far, too fast; it is that the current crisis might end China's growth miracle. In the worst-case scenario, the turmoil in the international economy will plunge China into a major economic downturn. The Chinese financial system will implode as loans to both state and private enterprises go bad. Millions or even tens of millions of Chinese will be unemployed in a country without an effective social safety net. The collapse of asset bubbles in the stock and property markets will wipe out the savings of a generation of the Chinese middle class. The political consequences could include dangerous unrest--and a bitter climate of anti-foreign feeling that blames others for China's woes. (Think of Weimar Germany, when both Nazi and communist politicians blamed the West for Germany's economic travails.) Worse, instability could lead to a vicious cycle, as nervous investors moved their money out of the country, further slowing growth and, in turn, fomenting ever-greater bitterness. Thanks to a generation of rapid economic growth, China has so far been able to manage the stresses and conflicts of modernization and change; nobody knows what will happen if the growth stops.India's future is also a question. Support for global integration is a fairly recent development in India, and many serious Indians remain skeptical of it. While India's 60-year-old democratic system has resisted many shocks, a deep economic recession in a country where mass poverty and even hunger are still major concerns could undermine political order, long-term growth, and India's attitude toward the United States and global economic integration. The violent Naxalite insurrection plaguing a significant swath of the country could get worse; religious extremism among both Hindus and Muslims could further polarize Indian politics; and India's economic miracle could be nipped in the bud. If current market turmoil seriously damaged the performance and prospects of India and China, the current crisis could join the Great Depression in the list of economic events that changed history, even if the recessions in the West are relatively short and mild. The United States should stand ready to assist Chinese and Indian financial authorities on an emergency basis--and work very hard to help both countries escape or at least weather any economic downturn. It may test the political will of the Obama administration, but the United States must avoid a protectionist response to the economic slowdown. U.S. moves to limit market access for Chinese and Indian producers could poison relations for years. For billions of people in nuclear-armed countries to emerge from this crisis believing either that the United States was indifferent to their well-being or that it had profited from their distress could damage U.S. foreign policy far more severely than any mistake made by George W. Bush. It's not just the great powers whose trajectories have been affected by the crash. Lesser powers like Saudi Arabia and Iran also face new constraints. The crisis has strengthened the U.S. position in the Middle East as falling oil prices reduce Iranian influence and increase the dependence of the oil sheikdoms on U.S. protection. Success in Iraq--however late, however undeserved, however limited--had already improved the Obama administration's prospects for addressing regional crises. Now, the collapse in oil prices has put the Iranian regime on the defensive. The annual inflation rate rose above 29 percent last September, up from about 17 percent in 2007, according to Iran's Bank Markazi. Economists forecast that Iran's real GDP growth will drop markedly in the coming months as stagnating oil revenues and the continued global economic downturn force the government to rein in its expansionary fiscal policy. All this has weakened Ahmadinejad at home and Iran abroad. Iranian officials must balance the relative merits of support for allies like Hamas, Hezbollah, and Syria against domestic needs, while international sanctions and other diplomatic sticks have been made more painful and Western carrots (like trade opportunities) have become more attractive. Meanwhile, Saudi Arabia and other oil states have become more dependent on the United States for protection against Iran, and they have fewer resources to fund religious extremism as they use diminished oil revenues to support basic domestic spending and development goals. None of this makes the Middle East an easy target for U.S. diplomacy, but thanks in part to the economic crisis, the incoming administration has the chance to try some new ideas and to enter negotiations with Iran (and Syria) from a position of enhanced strength. Every crisis is different, but there seem to be reasons why, over time, financial crises on balance reinforce rather than undermine the world position of the leading capitalist countries. Since capitalism first emerged in early modern Europe, the ability to exploit the advantages of rapid economic development has been a key factor in international competition. Countries that can encourage--or at least allow and sustain--the change, dislocation, upheaval, and pain that capitalism often involves, while providing their tumultuous market societies with appropriate regulatory and legal frameworks, grow swiftly. They produce cutting-edge technologies that translate into military and economic power. They are able to invest in education, making their workforces ever more productive. They typically develop liberal political institutions and cultural norms that value, or at least tolerate, dissent and that allow people of different political and religious viewpoints to collaborate on a vast social project of modernization--and to maintain political stability in the face of accelerating social and economic change. The vast productive capacity of leading capitalist powers gives them the ability to project influence around the world and, to some degree, to remake the world to suit their own interests and preferences. This is what the United Kingdom and the United States have done in past centuries, and what other capitalist powers like France, Germany, and Japan have done to a lesser extent. In these countries, the social forces that support the idea of a competitive market economy within an appropriately liberal legal and political framework are relatively strong. But, in many other countries where capitalism rubs people the wrong way, this is not the case. On either side of the Atlantic, for example, the Latin world is often drawn to anti-capitalist movements and rulers on both the right and the left. Russia, too, has never really taken to capitalism and liberal society--whether during the time of the czars, the commissars, or the post-cold war leaders who so signally failed to build a stable, open system of liberal democratic capitalism even as many former Warsaw Pact nations were making rapid transitions. Partly as a result of these internal cultural pressures, and partly because, in much of the world, capitalism has appeared as an unwelcome interloper, imposed by foreign forces and shaped to fit foreign rather than domestic interests and preferences, many countries are only half-heartedly capitalist. When crisis strikes, they are quick to decide that capitalism is a failure and look for alternatives. So far, such half-hearted experiments not only have failed to work; they have left the societies that have tried them in a progressively worse position, farther behind the front-runners as time goes by. Argentina has lost ground to Chile; Russian development has fallen farther behind that of the Baltic states and Central Europe. Frequently, the crisis has weakened the power of the merchants, industrialists, financiers, and professionals who want to develop a liberal capitalist society integrated into the world. Crisis can also strengthen the hand of religious extremists, populist radicals, or authoritarian traditionalists who are determined to resist liberal capitalist society for a variety of reasons. Meanwhile, the companies and banks based in these societies are often less established and more vulnerable to the consequences of a financial crisis than more established firms in wealthier societies. As a result, developing countries and countries where capitalism has relatively recent and shallow roots tend to suffer greater economic and political damage when crisis strikes--as, inevitably, it does. And, consequently, financial crises often reinforce rather than challenge the global distribution of power and wealth. This may be happening yet again. None of which means that we can just sit back and enjoy the recession. History may suggest that financial crises actually help capitalist great powers maintain their leads--but it has other, less reassuring messages as well. If financial crises have been a normal part of life during the 300-year rise of the liberal capitalist system under the Anglophone powers, **so has war.** The wars of the League of Augsburg and the Spanish Succession; the Seven Years War; the American Revolution; the Napoleonic Wars; the two World Wars; the cold war: The list of wars is almost as long as the list of financial crises. Bad economic timescan breed wars. Europe was a pretty peaceful place in 1928, but the Depression poisoned German public opinion and helped bring Adolf Hitler to power. If the current crisis turns into a depression, what rough beasts might start slouching toward Moscow, Karachi, Beijing, or New Delhito be born? The United States may not, yet, decline, but, if we can't get the world economy back on track, we may still have to fight.

## CONTENTION FOUR: Augmented Reality

#### **Assimilator technologies are safer, cheaper, and more secure than currently proposed upgrades**

Humphreys, Bhatti, and Ledvina, 10

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The Assimilator concept is based on the principle that from virtually any modern environment one can extract a wealth of navigation and timing-related information. Thus, the Assimilator behaves opportunistically, scanning ambient radio waves for PNT information while also accepting baseband data from an inertial navigation system (INS), an external time source, or directly from the user. All extracted PNT information is fused to yield an optimal navigation and timing solution. Up to this point, the Assimilator is no different from other proposed systems for robust navigation and timing that employ an all available means" philosophy. For these proposed systems, as for the Assimilator, GPS is but one of several potential sources of PNT data. Having obtained a fused PNT solution, however, the Assimilator takes an unusual additional step: it embeds the PNT solution in a consistent set of synthesized GPS L1 C/A signals, the common-denominator of all existing GNSS equipment. By casting its solution into this output format, the Assimilator can deliver the additional accuracy, robustness, and security of its solution to any GNSS device by simply injecting its output into the RF input of the target device. Thus, the Assimilator acts as a conduit for funneling ambient PNT information to existing GNSS equipment, without requiring hardware or software changes to the equipment. Despite the inefficiency of regenerating GPS RF signals after already having obtained a PNT solution, the assimilative approach is warranted in cases where, due to tight embedded coupling with expensive downstream equipment or due to user familiarity, it becomes more cost-effective or safer to augment existing equipment than to replace it.

#### Assimilator technologies prevent spoofing and jamming – it can even allow modest operational functionality after a complete GPS blackout

Humphreys, Bhatti, and Ledvina, 10

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The Assimilator's PNT solution is, by virtue of the diverse navigation and timing data that feed it, inherently robust against GNSS signal obstruction and jamming. Signals from cell phone base stations, Iridium satellites, and LORAN transmitters are tens of dB stronger than those from GNSS satellites. Thus, not only is the Assimilator robust to GNSS outages, it can also withstand substantial blockage, jamming, or other interference in the cell phone (1.9 GHz), Iridium (1.6 GHz), and LORAN (100 kHz) frequency bands. Naturally, in a complete GNSS signal blackout, the PNT solution that the Assimilator feeds to the target receiver will be degraded, but by leveraging nonGNSS navigation and timing sources, the Assimilator limits this degradation substantially. Baseband aiding from an INS or stable frequency reference lowers the Assimilator's tracking threshold for GNSS signals and permits the Assimilator to \coast" through periods of complete RF blackout. Ionospheric scintillation poses another challenge for GNSS receiver robustness. The deep power fades and accompanying fast phase transitions induced by equatorial ionospheric scintillation stress a receiver's carrier tracking loops, and, as severity increases, can lead to navigation bit errors, cycle slipping, and complete loss of carrier lock. The Assimilator makes best use of incoming GNSS signals by incorporating carrier phase tracking loops that are specially designed for scintillation robustness (for maximum navigation accuracy, all carrier tracking loops within the Assimilator track carrier phase, not just frequency). One simple technique for extending the mean time between cycle slips (and decreasing the chances of frequency unlock) is to wipe off the navigation data bits from data-bearing channels so that a traditional full-cycle carrier tracking loop can be employed instead of a half-cycle Costas loop [9]. The navigation data generator within the Assimilator's embedded signal simulator stores a signal-specific data bit library for each GPS L1 C/A signal. Because the C/A navigation message repeats every 12.5 minutes, this library can be used to predict the value of data bits that are received during scintillation-induced power fades. A network connection on the Assimilator permits data bit libraries to be downloaded from a remote server. Also, the Assimilator benefits from access to modernized GNSS signals whose pilot (data-free) channels are by design more scintillation-robust than the legacy GPS C/A signal.

#### **The next five years is critical – a new generation of receivers is coming, but current GPS receivers lack protection against jamming and spoofing threats that exist right now, only augmentation solves in the short term**

Humphreys and Bhatti 11

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What will GNSS receivers look like five years from now? The answer, of course, depends on the application. Mass-market receivers used in applications that do not require precision positioning and timing (e.g., hand-held units for hikers) will likely remain simple single-frequency L1-C/A-based GPS devices. On the other hand, a growing segment of military and civilian GNSS users will demand greater accuracy and reliability from their receivers than can be offered by single-frequency GPS. They will want their GNSS devices to be multi-frequency to combat ranging errors due to ionospheric delay, and multi-system to improve satellite availability and robustness against signal interference. Major commercial GNSS receiver manufacturers already have product roadmaps in place that anticipate these demands. Manufacturers realize that they will be at a competitive disadvantage relative to their peers if they only offer a subset of available GNSS signals to sophisticated users. "Why should I have to choose between signals?'' their customers will complain, "I'd like all of them!'' Then there is the issue of GNSS security. There was a time, perhaps 20 years ago or more, when computer users were largely unconcerned with the security of their personal computers. That time has passed. As any victim of a computer virus knows,firewalls, anti-virus software, and protocols for secure data transfer are no longer optional, but required. Likewise, the deepening dependence of the civil infrastructure on GNSS—especially for timing synchronization—and the potential for financial gain or high-profile mischief make civil GNSS jamming and spoofing a gathering threat. Since the publication of the U.S. Department of Transportation's Volpe Report on GPS dependence nearly a decade ago, GNSS security researchers have repeatedly warned that civil GPS is not yet secure, and that users trust its signals at their peril. As Professor David Last commented at a recent conference on GNSS security, ``Navigation is no longer about how to measure where you are accurately. That's easy. Now it's how to do so reliably, safely, robustly.'' Secure positioning, navigation, and timing (PNT) will require use of all available means: inertial navigation systems, stable frequency sources, multiple antennas, cryptographic authentication, and all radio frequency signals from which PNT information can be extracted—including non-GNSS signals and signals never intended to be used for PNT. In short, PNT devices in critical applications five years from now will likely be remarkably capable and secure devices that adhere to an all-signals-in-view, all-available-means philosophy. Meanwhile, however, the overwhelming majority of GNSS receivers—even those in critical applications—are simple L1 C/A-based devices that fail when signals are blocked or jammed, complaining ``Need clear view of sky.'' What is more, no commercially-available civil GNSS receiver, as far as the authors are aware, incorporates even rudimentary defenses against spoofing. Are these receivers to be considered obsolete? Perhaps. And perhaps the prudent course of action is to replace them with secure and reliable modern devices. A decision to replace existing receivers, however, cannot be made lightly. The hundreds of thousands of deployed GNSS receivers across the globe today represent an enormous investment in equipment and training. Moreover, in many cases the GNSS receiver is only an embedded subcomponent of a larger PNT-reliant system. It may be inconvenient, unsafe, or expensive to replace these embedded devices with modern counterparts. Nonetheless, the vulnerability of existing receivers, embedded and otherwise, to signal obstruction, jamming, and spoofing, and their inability to make use of modernized GNSS signals and other signals of opportunity, leaves much to be desired. As an alternative to replacement of existing equipment, we propose augmentation. A technique has been developed for upgrading existing GNSS user equipment to address their shortcomings without requiring hardware or software modifications to the equipment. The technique re-purposes the portable civil GPS spoofer described here to generate ``friendly'' spoofing signals whose implied navigation solution is derived from a fusion of GPS and other observables. The technique is embodied in a device, called the GPS Assimilator, whose output is injected directly into the radio frequency (RF) input of existing GPS equipment to immediately robustify the equipment against GPS outages and interference.

# Extensions

## \*\*\*Inherency

### Current Upgrades Fail

#### Current upgrades have been failures and have shut the GPS system down for months

Space News 10

Military GPS Disabled Upgrade Space News; May 7, 2010 http://availabilitydigest.com/public\_articles/0506/gps\_upgrade.pdf

The U.S. Air Force is deploying a new GPS satellite system to replace the aging system now in service. In anticipation of this deployment, the Air Force upgraded the software in its GPS ground-control systems in early 2010 to be able to handle signals not only from the current GPS satellites but also from the new satellites. The software in the 800,000 military GPS receivers currently in service were also upgraded to be compatible with both satellite systems. To everyone’s dismay, when the new ground-control systems were brought into operation, 10,000 of the Air Force’s GPS receivers wouldn’t work. The systems they supported were effectively down. It took two weeks to come up with a temporary fix and months to test and deploy a permanent fix. The capabilities of GPS have become a backbone technology for the U.S. military. How could such a critical system fail so miserably?

### More UAV’s Coming

#### **New legislation will dramatically increase the number of drones in US airspace**

GCN 6/29 Government Computer News, June 29, 2012, “Domestic drones can be hijacked, turned into weapons, researchers show” http://s.tt/1gmqT

Keep your eyes on the skies. A bill working its way through Congress could dramatically increase the number of drones allowed in U.S. airspace, the Wall Street Journal reports. The House of Representatives on Feb. 3 passed a Federal Aviation Administration funding bill that would ease restrictions on the places unmanned aerial vehicles are allowed to fly. The robotic aircraft have mostly been used by law enforcement agencies and by the military in combat zones, and the FAA has limited their widespread use in national airspace because of concerns that their lack of "detect, sense and avoid" technology could raise the risk of midair collisions, according to the Los Angeles Times. The bill would direct the FAA to find a way of bringing many smaller UAVs into general and commercial air traffic by September 2015. It would set up six test areas around the country for demonstrating safety technology to minimize the risk of UAVs colliding with larger aircraft. The military has used drones in Iraq, Pakistan and Afghanistan, and the Homeland Security Department has employed them along the U.S. border with Mexico, according to the Washington Post. As of Dec. 1, the FAA reported more than 270 active authorizations for the use of several types of drones. The Defense Department held 35 percent of the permissions, NASA held 11 percent, and DHS had 5 percent, the Post reported. The rest were granted to other law enforcement agencies such as the FBI, academic institutions and companies that manufacture UAVs. The Wall Street Journal reports that if the drone provision becomes law, state and local governments and private companies could launch large drone fleets in the foreseeable future.

## \*\*\*Spoofing and Jamming

### Spoofing Happens

#### Spoofing is a risk

Homeland Security News Wire October 2, 2008

http://www.homelandsecuritynewswire.com/more-danger-gps-spoofing?page=0,0

[Richard Langley](http://gge.unb.ca/Personnel/Langley/Langley.html), a professor in the Department of Geodesy and Geomatics at the University of New Brunswick, in Canada, who has worked extensively with GPS, says that this potential weak spot in the technology has, in fact, been known for years, although little has been done to date to protect the civilian system against it. “You would think that more would have been developed by now,” he says, “but maybe it takes the demonstration that these guys have carried out to show how easily a GPS receiver can be spoofed.” Langley notes that solutions are some distance away. Although the European navigation system — Galileo — will have the ability to send encrypted signals for civilian use, it is not scheduled to be fully operational until 2013. It would be possible to add encryption to the existing system, but Langley says that the likely cost and disruption make this an unlikely solution. The best bet in the near term, he says, is to add security features to normal GPS receivers. **One option would be to add more antennas to receivers. The attack relies on the fact that most consumer GPS receivers use just a single antenna to receive signals from multiple satellites. By adding multiple antennas, a normal receiver could recognize that the spoofed signals in fact come from only one source.** Langley notes, though, that there would be a cost trade-off. “Manufacturers have to get a return on any investment they make in antispoofing technology,” he says.

### Spoofing Possible

#### Low signal power means GPS prone to interference

Zhao ‘12

[Hongwei; Baowang Lian, Juan Feng; *Physics Procedia*, Vol. 33, p. 1060-7]

**As the GPS signal power is relatively low, the GPS system is more vulnerable to interference. Therefore, to study the anti-jamming technology of GPS systems will be of great significance**. The traditional anti-jamming technology uses time and frequency domain filtering, which is implemented in the digital IF. And it mainly used DFT techniques, front-end filtering technique, achieving the RF interference check-up with AGC and so on. **The anti-jamming technology in time and frequency domain can filter the interferences out of band of desired signal. And it is easy to achieve these with low cost.** But these technologies are powerless in the case of wideband interference suppression.

#### **GPS signals prone to interruption**

Duncan ‘09

[Mitch J., Centre for Social Science Research, CQUniversity (Australia); Hannah Badland, W. Kerry Mummery; *Science and Medicine in Sport*, Vol. 12, p. 551]

The accuracy and reliability of any instrument is central to its application in research. **GPS is commonly believed to be the ‘gold standard’ in positional and distance measurement, yet this is not the case. As outlined previously, GPS requires uninterrupted signals from a minimum of four satellites to estimate position, and interference to these signals affects the accuracy of the GPS. Interruptions to the signal can be caused by blockages due to buildings** (particularly in urban canyons), **heavy foliage, travel on public transport, travel through tunnels and local topography, causing either degradation of the quality and accuracy of the signal or causing a drop out in the signal during monitoring periods. Signal dropout occurs when the receiver temporarily loses satellite reception and creates a gap in the data that can range from several seconds to several minutes.** This has obvious implications for monitoring TPA engagement, particularly as short trips could be missed altogether if the unit experiences a large period of signal drop out. A useful summary of studies examining the accuracy of GPS, differential GPS and GPS receivers using Wide Area Augmentation Systems is provided elsewhere as are details of approaches to deal with missing data due to signal drop out.

#### GPS vulnerable to spoofing

Humphreys, Kintner, Psiaki, Ledvina, and Hanlon **‘**09

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http://www.gpsworld.com/defense/security-surveillance/assessing-spoofing-threat-3171?page\_id=2

Seven years after the Volpe Report warned that "[a]s GPS further penetrates into the civil infrastructure, it becomes a tempting target that could be exploited by individuals, groups, or countries hostile to the U.S.," civil GPS receivers remain as vulnerable as ever to this threat. Among other types of interference, the Volpe report considers civil GPS spoofing, a pernicious type of intentional interference whereby a GPS receiver is fooled into tracking counterfeit GPS signals. More sinister than intentional jamming, spoofing deceives the targeted receiver, which cannot detect a spoofing attack and so cannot warn users that its navigation solution is untrustworthy. The Volpe report noted the absence of any off-the-shelf defense against civilian spoofing and lamented that "[t]here also is no open information on . . . the expected capabilities of spoofing systems made from commercial components." It recommended studies to characterize the spoofing threat: "Information on the capabilities, limitations, and operational procedures [of spoofers] would help identify vulnerable areas and detection strategies." We recently canvassed four manufacturers of high-quality GPS receivers. They revealed that they were aware of the spoofing vulnerability but had not taken steps to equip their receivers with even rudimentary spoofing countermeasures. The manufacturers expressed skepticism about the seriousness of the threat and noted that countermeasures, if required, had better not be too expensive. Such attitudes propel further examination of the threat and practical countermeasures.

#### Jamming coming now – North Korea, Iran, Lebanon, Syria, Russia

Jersusalem Post ‘11 (Yaakov Katz, November 18, 2011, “Security and Defense: In a jam over precision munitions”, http://www.jpost.com/Features/FrontLines/Article.aspx?id=246026, CMR)

In March, one of the Western world’s worst nightmares came true. **The U**nited **S**tates **and South Korea began their annual joint military exercise**, code-named “Foal Eagle,” involving over 10,000 American soldiers and an additional 200,000 South Korean troops. **One of the scenarios played out during the drill**, simulating a potential military conflict between the two sides of the peninsula in the event that longtime North Korean leader Kim Jong II dies and his son Kim Jong Un is incapable of establishing control, seemed more than realistic. **Toward the end of the exercise, global positioning systems started to fail**, particularly in areas such as the capital, Seoul and the city of Paju. Most affected were US Tomahawk cruise missiles as well as Joint Direct Attack Munition (JDAM) bomb kits, which are supposed to turn regular bombs into smart bombs and accurate satellite-guided weapons. After a short investigation, **South Korean intelligence discovered that North Korea had activated two different systems to jam the satellite signal**. The first was a vehicle-mounted device North Korea had purchased from Russia in the early 2000s, which is believed to be capable of jamming GPS signals from 50 to 100 km. away. The second system was a spinoff and upgrade of the Russian system manufactured domestically in North Korea that is believed to cost less but has the ability to jam GPS reception within a radius of 400 km. Israel, which for years has feared and prepared for the possibility that in a future conflict with Hezbollah in Lebanon, Hamas in the Gaza Strip, Syria or Iran, its GPS systems will fail, followed these developments closely. **The Israel Defense Forces has already considered the possibility that North Korea has sold its GPS jamming system to Middle East countries including Lebanon, Syria and Iran**. Just last month, **Russia announced that it had sold a series of advanced radar jammers to Iran**. Called Avtobaza, the electronic intelligence system might also be able to jam GPS-guided platforms and munitions. “We are preparing and expect that **this will be a challenge we will have to deal with in a future war**,” a senior IDF officer explained recently. “**Our enemies are** also **building up capabilities**.” The ability to jam GPS systems has been a taboo subject within the Israeli defense establishment for years, but with a new conflict looming on the horizon – possibly following an Israeli strike against Iran’s nuclear facilities – there is no ignoring the likelihood that in a future war Israeli smart bombs will be rendered satellite-less. The development of GPS began in the 1970s by the Pentagon and today consists of two dozen satellites that provide global coverage for receivers to determine their precise location within a few meters. The satellites revolve around the earth at an altitude of 20,000 km. and complete one orbit roughly every 12 hours. Over the years, **GPS has become an integral part of** civilian life and not just of **the military**. It is used by ships to navigate at sea, by cars to travel by land and by the civil aviation industry as well. Most cellular phones come with GPS chips and its capabilities are often taken for granted. The IDF took its first major step into the world of GPS in 2000 when it became the first foreign customer outside of the US to receive JDAM kits. These were fitted onto 2,000-pound Mk-84 bombs, turning them into precision satellite-guided smart bombs. JDAMs enable Israel Air Force pilots to launch bombs from a standoff position without needing to fly directly over targets where they could be threatened by enemy air defense missile systems. An example of how importance JDAMs are for Israel was provided during Operation Cast Lead in the Gaza Strip almost three years ago. Out of all the bombs dropped, 81 percent were smart bombs, the largest percentage of precision guided weapons ever used in conflict anywhere in the world. But **with the reliance come the risks, as jamming systems are more easily available today on the open market**. There is also the lingering fear that one day – possibly to prevent Israel from taking military action – the US will shut down the GPS satellites. Maj.-Gen. (res.) Eitan Ben-Eliyahu was commander of the IAF when Israel placed its first order of JDAM kits. “I pushed very hard for the JDAMs since I understood that they were going to provide us with new capabilities that would change the way we operate,” he said. “There are potential problems but when calculating the risks together with the benefits, it is definitely worth relying on such systems.” Israel’s doesn’t just rely on GPS in the air. Take navigation for ground forces as an example. In today’s IDF, Merkava tanks, Namer armored personnel carriers and artillery howitzers are all connected to the Tzayad Digital Army Program (DAP), which shows the position of all friendly and enemy forces. “**If a country doesn’t take any precautions to protect GPS then it will be in trouble, since jammers are something that will likely be on a future battlefield,**” explained Nir Lavi, director of marketing at Rokar, a Jerusalem-company based that has developed technology to make GPS systems immune to jamming. According to David Last, a former president of the Royal Institute of Navigation and a GPS consultant to the British government, Hezbollah could theoretically place a special radio transmitter on an elevated surface – like a tall mountain in southern Lebanon – and potentially block Israeli GPS from working within a radius of several kilometers. “**It takes so little jamming to remove GPS and to jam over a very considerable area – it only requires a radio transmitter that is portable and is easily obtained. If you place it in an elevated location, you can cover a large area**,” Last said.

#### GPS susceptible to spoofing

**Humphreys** **et al** Kintner, Psiaki, Ledvina, and Hanlon **‘09**

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<http://www.gpsworld.com/defense/security-surveillance/assessing-spoofing-threat-3171?page_id=3> accessed 7-3

The menace posed by such an attack is diminished by the fact that it is likely easy to detect, because of the difficulty of synchronizing a simulator's output with the GPS signals in its vicinity. An unsynchronized attack effectively acts like signal jamming, and may cause the victim receiver to lose lock and have to undergo a partial or complete reacquisition. Such a forced re-acquisition would raise suspicion of a spoofing attack. If the unsynchronized attack somehow avoids causing loss-of-lock, it will nonetheless cause an abrupt change in the victim receiver's GPS time estimate. The victim receiver could flag jumps of more than 100 nanoseconds as evidence of possible spoofing. The spoofer can attempt to counter this defense by intentionally jamming first and then spoofing, but an extended jamming is itself telltale evidence of interference. Of course, the fact that a simulator-type attack is easy to defend does not increase security.. Intermediate Attack. One of the challenges that must be overcome to carry out a successful spoofing attack is to gain accurate knowledge of the target receiver antenna's position and velocity. This knowledge is required to precisely position the counterfeit signals relative to the genuine signals at the target antenna. Without such precise positioning, a spoofing attack is easily detected. An attack via portable receiver-spoofer, portrayed in FIGURE 2, overcomes this difficulty by construction. The receiver-spoofer can be made small enough for inconspicuous placement near the target receiver's antenna. The receiver component draws in genuine GPS signals to estimate its own position, velocity, and time. Due to proximity, these apply approximately to the target antenna. Based on these estimates, the receiver-spoofer then generates counterfeit signals and generally orchestrates the spoofing attack. The portable receiver-spoofer could even be placed somewhat distant from the target receiver if the target were static and its position relative to the receiver-spoofer had been pre-surveyed. Each channel of the target receiver is brought under control of the receiver-spoofer as illustrated in the inset at the upper right of Figure 2. The counterfeit correlation peak is aligned with the peak corresponding to the genuine signal. The power of the counterfeit signal is then gradually increased. Eventually, the counterfeit signal gains control of the delay-lock loop tracking points that flank the correlation peak. As one might imagine, there are no commercially available portable receiver-spoofer devices. This of course decreases the present likelihood of the receiver-spoofer attack mode. Nonetheless, the emergence of software-defined GPS receivers significantly erodes this barrier. As we demonstrate here, the hardware for a receiver-spoofer can be assembled from inexpensive off-the-shelf components. The software remains fairly sophisticated, but it would be unwise to assume it was beyond the capabilities of clever malefactors. The civil GPS signal structure is, after all, completely detailed in a publicly available interface control document, and entire books have been written on software-defined GPS receivers. In perhaps the most worrisome scenario, anticipated in Scott's 2003 paper, the software definition of a receiver-spoofer may someday be available for download from the Internet. The expertise required to download and exercise the code would surely be within the reach of many potential malefactors. An attack via portable receiver-spoofer could be difficult to detect. The receiver-spoofer can synchronize its signals to GPS time and, by virtue of its proximity to the target antenna, align the counterfeit and genuine signals. A receiver equipped with a stable reference oscillator and a low-drift inertial measurement unit (IMU, for receivers on dynamic platforms) could withstand an attack via receiver-spoofer for several hours. Eventually, however, a patient receiver-spoofer would gain undetected control by keeping its perturbations to time and position within the envelope allowed by the drift rates of the target receiver's oscillator and IMU. The only known user-equipment-based countermeasure that would be completely effective against an attack launched from a portable receiver-spoofer with a single transmitting antenna is angle-of-arrival discrimination. With a single transmitting antenna, it would be impossible to continuously replicate the relative carrier phase between two or more antennas of an appropriately equipped target receiver. While an intermediate attack is not presently likely because the requisite device is not readily available, the emergence of software-defined GPS receivers increases its future likelihood. Furthermore, this mode of attack could defeat most known user-equipment-based spoofing countermeasures.

#### gps systems can be spoofed

By [Anne Ju](mailto:amj8@cornell.edu), “Researchers raise uncomfortable questions by showing how GPS navigation devices can be duped” Sept. 19, 2008.

<http://www.news.cornell.edu/stories/Sept08/GPSSpoofing.aj.html>

**Just like flat-screen televisions, cell phones and computers, global positioning system (GPS) technology is becoming something people can't imagine living without**. So if such a ubiquitous system were to come under attack, would we be ready? It's an uncomfortable question, but one that a group of Cornell researchers have considered with their research into "spoofing" GPS receivers. **GPS is a U.S. navigation system of more than 30 satellites circling Earth twice a day in specific orbits, transmitting signals to receivers on land, sea and in air to calculate their exact locations. "Spoofing," a not-quite-technical term first coined in the radar community, is the transmission of fake GPS signals that receivers accept as authentic ones.** The Cornell researchers, after more than a year of building equipment and experimenting in Rhodes Hall, presented a paper on their findings at a meeting of the Institute of Navigation, Sept. 19 in Savannah, Ga. **To demonstrate how a navigation device can be fooled, the researchers,** led by Cornell professors Paul Kintner and Mark Psiaki, **programmed a briefcase-size GPS receiver, used in ionospheric research, to send out fake signals.** Paper co-authors Brent Ledvina, Cornell Ph.D. '07 and now an assistant professor of electrical and computer engineering at Virginia Tech, and first author Todd Humphreys, Cornell Ph.D. '07, described how the "phony" receiver could be placed in the proximity of a navigation device, where it would track, modify, and retransmit the signals being transmitted from the GPS satellite constellation. Gradually, the "victim" navigation device would take the counterfeit navigation signals for the real thing. Handheld GPS receivers are popular for their usefulness in navigating unfamiliar highways or backpacking into wilderness areas. **But GPS is also embedded in the world's technological fabric.** Such large commercial enterprises as utility companies and financial institutions have made GPS an essential part of their operations. **"GPS is woven into our technology infrastructure, just like the power grid or the water system,"** said Kintner, Cornell professor of electrical and computer engineering and director of the Cornell GPS Laboratory. "If it were attacked, there would be a serious impact." By demonstrating the vulnerability of receivers to spoofing, the researchers believe they can help devise methods to guard against such attacks. "Our goal is to inspire people who design GPS hardware to think about ways to make it so the kinds of things we're showing can be overcome," said Psiaki, Cornell professor of mechanical and aerospace engineering. **The idea of GPS receiver spoofing isn't new; in fact, the U.S. government addressed the issue in a December 2003 report detailing seven "countermeasures" against such an attack.** But, according to the researchers, such countermeasures would not have successfully guarded against the signals produced by their reprogrammed receiver. **"We're fairly certain we could spoof all of these, and that's the value of** our **work**," Humphreys said.

#### Spoofing is real

Nils Ole Tippenhauer Dept. of Computer Science ETH Zurich, Switzerland, <http://www.syssec.ethz.ch/research/ccs139-tippenhauer.pdf>

The fundamental reasons why GPS spooﬁng works have been discussed in the literature before, and spooﬁng attacks have been demonstrated on single receivers experimentally. In this work, we show under which conditions the attacker can establish the correct parameters to launch a successful spooﬁng attack on one or more victims, and later in the experiments, how inaccuracies in these parameters inﬂuence the lock takeover during the attack. This analysis enables us to identify which attacks are theoretically possible and which attacks would be noticeable as (potentially nonmalicious) signal loss at the GPS receivers. This is important for proposing effective receiver-based countermeasures, which are not implemented yet in current standard GPS receivers. Our work is further motivated by the real-life spooﬁng attacks, e. g. the one reported in [24]. In this scenario, a cargo truck (the victim), had a GPS unit that was housed in a tamper-proof casing and was sending cryptographically authenticated status updates with a ﬁxed rate to a monitoring center. The attacker planned to steal the truck to get access to its loaded goods at a remote place. He got close to the victim and started transmitting forged (spoofed) signals in order to modify the location computed by the receiver

### Spoofing IL to Econ and Heg

#### GPS interference is a major threat to US econ and Heg, also kills competitiveness

Leibach, 11’

Dale Leibach (Managing Director at Powell Tate Senior Vice President at Ogilvy & Mather Public Affairs Communications Director at Sen. Tom Harkin Assistant Press Secretary at The White House) <http://www.saveourgps.org/pdf/Economic_Study_News_Release_June_22.pdf> June 22, 2011 Acc://7/3/12 WaruAHY

More than 3.3 million U.S. jobs in agriculture and industries rely heavily on Global Positioning System (GPS) technology and the disruption of interference with GPS posed by LightSquared’s planned deployment of 40,000 ground stations threatens direct economic costs of up to $96 billion to U.S. commercial GPS users and manufacturers, according to an economic study released today. The study by Dr. Nam D. Pham of the Washington, D.C.-based NDP Consulting Group warns of “serious economic repercussions for the U.S. economy” if LightSquared’s plans proceed and points out that the $96 billion economic figure represents the equivalent of 0.7 percent of the U.S. economy. The $96 billion figure is the total of up to $87.2 billion in costs to commercial GPS users and up to $8.8 billion in costs to commercial GPS manufacturers. The commercial benefits of GPS are largely enabled by high precision GPS technologies. The study states that the commercial adoption of GPS continues to grow at a high rate and is expected to annually create $122.4 billion in benefits and grow to directly affect more than 5.8 million jobs in the downstream commercial GPS-intensive industries. The study makes clear that its analysis is confined to the economic benefits of GPS technology to commercial GPS users and GPS manufacturers, mainly high precision GPS users, and the economic costs of GPS signal degradation to only those sectors. The report therefore does not capture the considerable benefits and costs to consumer users of GPS, other noncommercial users and military users. The analysis shows that GPS equipment revenues in North America in the 2005-2010 time period averaged $33.5 billion per year and that commercial sales accounted for 25 percent of the total, while the consumer and military markets respectively made up 59 percent and 16 percent of the total. The report notes that the U.S. government has already invested $35 billion in taxpayer money in the GPS satellite constellation and continues to invest in GPS at a rate of about $1 billion a year. Referring to LightSquared’s plans, the report states, “The commercial stakes are high. The downstream industries that rely on professional and high precision GPS technology for their own business operations would face serious disruption to their operations should interference occur, and U.S. leadership and innovation would suffer.” The analysis and views in the study, which was commissioned by the Coalition to Save Our GPS, are solely those of the author, Dr. Pham, a managing partner of NDP Consulting Group who was formerly a Scudder Kemper Investments vice president, chief economist of the Asia region for Standard & Poor’s DRI and World Bank economist. Representatives of several Coalition member organizations had comments: Ken Golden, director of global public relations at John Deere: “The use of GPS technology is vital to thousands of people who make their living with agricultural and construction equipment. It is simply not acceptable to allow this new network to interfere with these important industries when all indications are that there is no practical solution to mitigate this interference. In agriculture, the loss of a stable GPS system could have an impact of anywhere from $14 to $30 billion each year. That could significantly erode the strong competitive global position of U.S. farmers in the world agricultural economy. Serious impacts to the productivity of those in the construction business also will be apparent.” Siamak Mirhakimi, general manager, Caterpillar Electronics & Systems Integration: “High precision GPS continues to be widely adopted technology in heavy construction and civil engineering due to the benefits of increased productivity, improved job site safety, faster completion times for projects and reduced fuel and rework costs. The test results clearly show substantial interference to high precision GPS which in turn will impact our products and customers. Allowing any company to cause interference to the GPS band would be a major step backward and significantly impact this domestic industry, which has invested billions of dollars in GPS enabled products and which employs over a million people in the U.S.” Jim Kirkland, vice president and general counsel of Trimble: “This analysis highlights the massive economic benefits of GPS technology to the U.S. economy and adds a critical perspective to the current debate over LightSquared’s plans. This study also highlights how LightSquared’s recently announced ‘solution’ to the interference problem, which LightSquared admits will not reduce interference for high precision GPS uses, is no solution at all. High precision GPS uses represent nearly $ 10 billion in historical investment by GPS users over the last five years and $30 billion in annual economic benefits.”

### Jammers are Cheap

#### Jammers are easily available for any consumer and can knock out signals up to a thousand mile radius.

Brewin 11Bob Brewin, Editor “What's New in Defense IT”, November 22 2011, “The 1,000 Mile GPS jammer” Nextgov

You can buy short range personal GPS jammers for well under a hundred dollars from literally thousands of web retailers, and an outfit in China (where else?) has raised the technology ante on these nefarious gizmos. C.T.S. Technology Co. Ltd. stands ready to sell anyone a GPS jammer that can knock out signals in a 500 to 1,000 mile range, and it's easily hooked up to a car cigarette lighter socket for juice. This illegal gizmo has a power output of 100 watts, or four times the power of the GPS satellite transmitter and could completely overwhelm GPS signals within a radius of thousands of miles on the ground. C.T.S Technology did not post a price on this high powered jammer, but I'm sure they're ready to deal.

### UAV’s IL

**Drones can be commandeered via spoofing**

**Mixon 12** Melissa Mixon, Cockrell School of Engineering, UT Austin, “Todd Humphreys' Research Team Demonstrates First Successful GPS Spoofing of UAV’ 2012

**A** **University of Texas** at Austin **research team successfully demonstrated for the first time that** the **GPS signals of** **a**n unmanned aerial vehicle (UAV), or **drone**, **can be commandeered by an outside source — a discovery that could factor heavily into the implementation of a new federal mandate to allow thousands of civilian drones into the U.S. airspace by 2015.** Cockrell School of Engineering Assistant Professor Todd Humphreys and his students were invited by the U.S. Department of Homeland Security to attempt the demonstration in White Sands, New Mexico in late June. Using a small but sophisticated UAV along with hardware and software developed by Humphreys and his students, the research team repeatedly overtook navigational signals going to the GPS-guided vehicle. Known as "**spoofing**," the technique **creates false civil GPS signals that trick the vehicle's GPS receiver into thinking nothing is amiss** — even as it steers a new navigational course induced by the outside hacker. Because spoofing fools GPS receivers' on both their location and time, some fear that most GPS-reliant devices, infrastructure and markets are vulnerable to attacks. That fear was underscored — but not proven — when a U.S. military drone disappeared over Iran late last year and showed up a week later, intact, and in the care of Iranians who claimed to have brought the vehicle down with spoofing. The recent demonstration by University of Texas at Austin researchers is the first known unequivocal demonstration that **commandeering a UAV via GPS spoofing is technically feasible.**

## \*\*\*Primacy

### Military fails in SQO

#### Military systems don’t work consistently to prevent the everyday use of GPS jammers

The Economist '11

The Economist, March 10th, 2011, “No Jam Tomorrow” <http://www.economist.com/node/18304246>

In America there is already a military system to spot GPS interference: the GPS Jammer Detection and Location (JLOC) system run by the National Geospatial Intelligence Agency. According to Navsys, the company that developed JLOC, it involves a network of GPS receivers capable of detecting regions of higher than normal signal levels and low signal-to-noise ratios, either of which can indicate interference. But it is unknown how many sensors there are in the JLOC system, or how accurately it can determine the location of a jammer. Some experts in the field are sceptical that it will be possible to develop cost-effective systems to locate low-power, short-range jammers around civilian infrastructure. It would require a very dense network of sensors, says Dr Last. “I suspect we have reached the stage where close to any major highway you cannot expect to operate a high-availability GPS system without it failing from time to time,” he says.

**Heg Links**

#### GPS is the lynchpin of all US military operations and PGS guidance – preventing interference is key

Sanchez ’11 (Elaine, “Department Seeks to Protect GPS Operations”, Sept 16, <http://www.defense.gov/news/newsarticle.aspx?id=65355>, CMR)

LightSquared’s new terrestrial network has the potential to wreak havoc on **GPS systems** that **are vital to the military and used in a host of applications,** Teresa Takai, the DOD’s chief information officer, and Air Force Gen. William L. Shelton, commander of Air Force Space Command, told members of the House Armed Services Committee’s Subcommittee on Strategic Forces yesterday. “**GPS is vital to national security and is relied upon by our service**men and women **for a wide array of capabilities,”** Takai said in written testimony. **GPS is the cornerstone of the Defense Department’s positioning, navigation and timing services, and is integrated into** nearly **every aspect of the nation’s military operations**, she said. **GPS signals are used to ensure the accuracy of precision-guided munitions**, **guide troop movements**, **synchronize communications networks**, **enable battle-space situational awareness**, **and conduct search and rescue missions.** “**The ability of GPS to operate without harmful interference remains of paramount importance to the department**,” Takai said at the hearing.

#### US GPS systems are at risk – that compromises vital military assets

Keller 6/26/12 (John, “How to maintain reliable military navigation capability without GPS”, <http://www.militaryaerospace.com/articles/2012/06/how-to-maintain-reliable-military-navigation-capability-without-gps.html>, CMR)

THE MIL & AERO VIDEO BLOG, 26 June 2012. The Global Positioning System (GPS) has been a monumental improvement for safety and commerce, but military leaders need more. The **GPS can be jammed or spoofed,** so the military needs reliable navigation capability without GPS. This is the promise of the DARPA All Source Positioning and Navigation sensor-fusion program. The GPS satellite navigation system has been perhaps the most important and influential navigation technology since the invention of the marine chronometer nearly three centuries ago. The importance of GPS to commerce and safety since its constellation of orbiting satellites went online in the 1980s cannot be overstated. The GPS originally was developed for military use only, but an aviation disaster 30 years ago put it on the fast track to the widespread civil use we see today. On September first, 1983, Korean Airlines flight double-oh-seven, en-route from Anchorage to Seoul, veered far off course and into Soviet airspace. A Soviet jet fighter, believing the commercial flight was a military intruder, shot the 747 jumbo jet down, killing all 269 aboard. After that, the U.S. government said never again would navigational error put so many lives at risk, and civil use of the fledgling Global Positioning System went to the head of the line. Yet despite the monumental importance of **GPS**, this technology **still makes some people in the military nervous whose systems absolutely, positively have to navigate accurately no matter the conditions**. The GPS constellation uses triangulation among satellites and receivers to fix position and altitude. Each satellite also has an accurate clock, so the system can measure speed, as well as position. The weak link in the GPS, however, is the radio links among satellites in space and receivers on the ground, at sea, and in the air. **RF links can be jammed by enemies, turned off at a moment's notice during a national security crisis, or even could be knocked off line permanently if an adversary could find a way to destroy orbiting GPS satellites.** **That vulnerability simply is not acceptable** **to those who depend on accurate navigation for mission- and life-critical tasks such as munitions guidance**.

#### GPS is the key internal link – it’s a force multiplier and locks-in all elements of primacy

Broniatowski et al. ‘9 (David A. Broniatowski, Balancing the Needs for Space Research and National Security in the ITAR, <http://web.mit.edu/mgr/www/Portfolio/Balancing%20the%20Needs%20for%20Space%20Research%20and%20National%20Security%20in%20the%20ITAR.pdf>, CMR)

**The U**nited **S**tates **enjoys primacy in military affairs around the globe due** in large part **to the relative strength of its scientific and engineering establishment. The U.S. military is able to apply a wide array of tech**nologically **enabled tools in conventional engagements and nuclear deterrence**. This technological superiority today stems from the World War II era experience that investment in scientific research and development can win wars. Recent conflicts in the Persian Gulf, Kosovo, and Afghanistan dramatically illustrate the prowess of the United States military against conventional military forces. **The U**nited **S**tates’ **ability to leverage tech**nology **enables the U.S. to outmatch potential adversaries in military capability while committing far fewer troops to the conflict**. Globally, **the U.S. National Security Council is provided unmatched power projection capabilities by** stealth aircraft, global positioning system (**GPS) guided munitions**, unmanned aerial vehicles, nuclear submarines, and ten carrier battle groups.1 **The relative scientific advantage enjoyed by the United States is a critical enabler of our military capabilities**. Space technology in particular has become a vital component of the United States military. **The U.S. military utilizes space for many key aspects of military operations: communications; navigation; missile warning; weather forecasting; and intelligence, surveillance, and reconnaissance**. Satellites are efficient means to collect, transmit, and distribute information to the warfighter.2

#### GPS will determine global conflicts – preventing jamming is key

Mitch ’12 (Ryan H, B.S. degree in mechanical engineering from the University of Pittsburgh, “Innovation: Know Your Enemy”, Jan 1, <http://www.gpsworld.com/gnss-system/innovation-know-your-enemy-12475>, CMR)

**GPS IS AT WAR. It is a major asset for U**nited **S**tates and allied **military forces** **in a number of operating theaters around the world** in both declared and undeclared conflicts. But GPS is at war on the domestic front, too — at war against a proliferation of jamming equipment being marketed to cause deliberate interference to GPS signals to prevent GPS receivers from computing positions to be locally stored or relayed via tracking networks. **There have been many notable examples of deliberate jamming of GPS receivers. Many more likely go undetected each day.** In 2009, outages of a Federal Aviation Administration reference receiver at Newark Liberty International Airport close to the New Jersey Turnpike were traced to a $33, 200 milliwatt GPS jammer in a truck that passed the airport each day. The driver was reportedly arrested and charged. In July 2010, two truck thieves in Britain were jailed for 16 years. They used GPS jammers to prevent the trucks from being tracked after the thefts. And in Germany, some truck drivers have been using jammers to evade the country’s GPS-based road-toll system. The U.S. and some foreign governments have enacted laws to prohibit the importation, marketing, sale or operation of these so-called personal privacy devices. Nevertheless, a certain number of jammers are in the hands of individuals around the world and they continue to be available from manufacturers and suppliers in certain countries. So, GPS jamming is a continuing threat both at home and abroad and a detailed understanding of how the available jammers work is necessary to judge their effectiveness and limitations. This information will also help in developing countermeasures that could be incorporated into GPS receivers to limit the impact of jammers. **Jammers constitute an enemy force,** **and as** the Chinese General **Sun Tzu stated** in the Art of War more than 2,000 years ago, **battles will be won by knowing your enemy**. In the last verse of Chapter Three, he states: So it is said that if you know your enemies and know yourself, you can win a hundred battles without a single loss. If you only know yourself, but not your opponent, you may win or may lose. If you know neither yourself nor your enemy, you will always endanger yourself.

#### GPS is a critical component of every part of the US military

Elliott ’10 (Dan, “Glitch highlights U.S. military reliance on GPS “, 6/1, <http://www.msnbc.msn.com/id/37451462/ns/us_news-security/t/glitch-highlights-us-military-reliance-gps/#.T-tiqMU_Tl8>, CMR)

The Air Force has not said how many weapons, planes or other systems were affected or whether any were in use in Iraq or Afghanistan. But the problem, blamed on incompatible software, highlights the military's reliance on the **G**lobal **P**ositioning **S**ystem and the need to protect technology that **has become essential for protecting troops, tracking vehicles and targeting weapons.** "**Everything that moves uses it,**" said John Pike, director of Globalsecurity.org, which tracks military and homeland security news. "**It is so central to the American style of war that you just couldn't leave home without it."**

**Nuclear Deterrence Link**

#### GPS is vital to accuracy improvements which ensure US nuclear primacy

Lieber and Press ‘7 (Keir A. Lieber is Assistant Professor of Political Science at the University of Notre Dame and the author of War and the Engineers: The Primacy of Politics Over Technology, Daryl G. Press is Associate Professor of Government at Dartmouth College and the author of Calculating Credibility: How Leaders Assess Military Threats, “U.S. Nuclear Primacy and the Future of the Chinese Deterrent”, Winter, <http://www.wsichina.org/%5Ccs5_5.pdf>, CMR)

U.S. Missile Accuracy Blair and Chen argue that our assessment of U.S. nuclear primacy rests on unwarranted confidence in U.S. missile accuracy. They note that we consider the possibility that U.S. weapons may perform below expectations – i.e., as much as 20 percent below expectations – but they claim that we ignore the possibility that actual U.S. missile performance may be even lower: perhaps 40-50 percent below our expectations. They thus charge that we “do not adequately inform the reader that the probabilities of destroying Russian hard targets such as missile silos would plummet if U.S. missiles missed their targets by a considerably greater distance than assumed by their model.”26 This criticism is factually incorrect. We published much more sensitivity analysis than Blair and Chen acknowledge on both of the key variables that drive the results of the model: the accuracy of U.S. delivery vehicles and the reliability of U.S. weapon systems. Contrary to Blair and Chen’s claims, we show that the results of our model do not change even when we allow the accuracy and reliability of U.S. weapons to fall below expectations by 40 or 50 percent. 27 Why are our results so robust? During the past 15 years, **the U**nited **S**tates **has done** so **much to upgrade its first strike capabilities** – most notably by deploying Trident II D-5 missiles throughout the entire ballistic missile submarine (SSBN) fleet, placing high-yield W88 warheads on many of those missiles, and deploying stealthy B-2 bombers – that today **a first strike could succeed even if the performance of key U.S. weapon systems fell far short of their expected accuracy, reliability, or both**. Furthermore, **the U**nited **S**tates **continues to work to increase the lethality of its nuclear forces**, thereby **reducing even more the significance of any actual deviations from expected levels of accuracy**. For example, **the U.**S. Navy recently **experimented with** using Global Positioning System (**GPS) signals to provide terminal guidance for Trident II reentry vehicles (which would dramatically improve the warhead’s accuracy)** and it is enhancing its Trident II W76 warheads with a new fuze to permit ground-bursts (which will greatly enhance the warhead’s lethality against hardened targets).**28 Achieving GPS-like accuracy with submarine-launched ground-burst warheads would mark a tremendous leap in U.S. counterforce capabilities, providing gains in performance that could substitute for potential inaccuracy in other weapon systems.** The point is that our analysis is not sensitive to plausible levels of uncertainty about U.S. accuracy, and will become even less sensitive in the future as U.S. weapons grow even more capable.

#### Checks the escalation of all nuclear conflict

Keir A. Lieber, Associate Professor in the Security Studies Program at Georgetown University's Edmund A. Walsh School of Foreign Service, Daryl G. Press, Associate Professor of Government at Dartmouth College and Coordinator of the War and Peace Studies Program at the John Sloan Dickey Center for International Understanding, December 2009, Foreign Affairs, The Nukes We Need

Unfortunately, deterrence in the twenty-first century may be far more difficult for the United States than it was in the past, and **having the right mix of nuclear capabilities to deal with** the **new challenges will be crucial.** The United States leads a global network of alliances, a position that commits Washington to protecting countries all over the world. Many of its **potential adversaries have acquired, or appear to be seeking, nuclear weapons. Unless the world's major disputes are resolved**--for example, on **the Korean Peninsula**, across the **Taiwan Strait**, and around the **Persian Gulf**--or the U.S. military pulls back from these regions, **the U**nited **S**tates **will sooner or later find itself embroiled in conventional wars with nuclear-armed adversaries. Preventing escalation in those circumstances will be far more difficult than peacetime deterrence** during the Cold War. **In a conventional war**, U.S. **adversaries would have powerful incentives to brandish or use nuclear weapons because their lives**, their families, **and the survival of their regimes would be at stake.** Therefore, as **the U**nited **S**tates considers the future of its nuclear arsenal, it **should judge its force not against the relatively easy mission of peacetime deterrence but against the demanding mission of deterring escalation during a conventional conflict**, when U.S. enemies are fighting for their lives. Debating the future of the U.S. nuclear arsenal is critical now because the Obama administration has pledged to pursue steep cuts in the force and has launched a major review of U.S. nuclear policy. (The results will be reported to Congress in February 2010.) The administration's desire to shrink the U.S. arsenal is understandable. Although the force is only one-fourth the size it was when the Cold War ended, it still includes roughly 2,200 operational strategic warheads--more than enough to retaliate against any conceivable nuclear attack. Furthermore, as we previously argued in these pages ("The Rise of U.S. Nuclear Primacy," March/April 2006), **the current U.S. arsenal is vastly more capable than its Cold War predecessor, particularly in the area of "counterforce"**--the ability to destroy an adversary's nuclear weapons before they can be used. **Simply counting U.S. warheads or measuring** Washington's **counter-force capabilities will not**, however, **reveal what type of arsenal is needed for deterrence** in the twenty-first century. **The only way to determine that is to work through the grim logic of deterrence: to consider what actions will need to be deterred, what threats will need to be issued, and what capabilities will be needed to back up those threats.** The Obama administration is right that **the U**nited **S**tates **can safely cut its nuclear arsenal, but it must pay careful attention to the capabilities it retains. During a war, if a desperate adversary were to use its nuclear force to try to coerce the U**nited **S**tates--**for example**, by threatening a U.S. ally or even by launching nuclear strikes against U.S. overseas bases--**an arsenal comprised solely of high-yield weapons would leave U.S. leaders with terrible retaliatory options. Destroying Pyongyang or Tehran in response to a limited strike would be vastly disproportionate, and doing so might trigger further nuclear attacks in return. A deterrent posture based on such a dubious threat would lack credibility.** Instead, **a credible deterrent should give U.S. leaders a range of retaliatory options, including the ability to respond to nuclear attacks with either conventional or nuclear strikes, to retaliate with strikes against an enemy's nuclear forces rather than its cities, and to minimize casualties. The foundation for this flexible deterrent exists. The current U.S. arsenal includes a mix of accurate high- and low-yield warheads, offering a wide range of retaliatory options--including the ability to launch precise, very low-casualty nuclear counterforce strikes. The U**nited **S**tates **must preserve that mix of capabilities**--especially the low-yield weapons--as it cuts the size of its nuclear force.

### CounterTerror

#### GPS critical to counter terrorism

Bolton & Yoo ’12 (John R. Bolton, a senior fellow at the American Enterprise Institute, was ambassador to the United Nations from 2005 to 2006. John C. Yoo, a law professor at the University of California, Berkeley and a former Justice Department official, “Hands Off the Heavens”, March 8, <http://www.nytimes.com/2012/03/09/opinion/hands-off-the-heavens.html>, CMR)

**OUTER space has become the next frontier for American national security** and business. **From space, we follow terrorists and intercept their communications**, detect foreign military deployments, and monitor a proliferation of unconventional weapons. **Our G**lobal **P**ositioning **S**ystem **gives us targeting and tactical advantages, spacecraft create image-rich maps, and satellites beam data around the world**.

#### GPS contributes to counter-terrorism through profile formation and network disruption

Rozencranc ’11 (German, “GPS Tracking and the Fourth Amendment: The New Frontier in Counterterrorism Efforts”, 12-1, <http://erepository.law.shu.edu/cgi/viewcontent.cgi?article=1011&context=student_scholarship>, CMR)

**Officers**, accordingly, **rely on GPS** technology **to gather invaluable insight as to the present location of tracked suspects**.148 **Especially helpful to counterterror**ism **efforts is the ability to compose a location profile of monitored individuals**.149 **Profile formation**, **using GPS tracking**, **has proven to accurately model human behavior and provide private insight into people’s lives**.150 In addition to successfully monitoring individuals, GPS tracking provides for a greater threat unearthing. **Terrorists often work in cells and GPS tracking of one suspected terrorist could easily unearth a network of terrorists** with relatively few logistical costs. 151 Requiring officers to obtain individual permission to GPS track would unduly burden law enforcement agents, decelerate terrorism prevention, and work to contradict the intent behind the Act’s promulgation. Warrantless GPS tracking, therefore, is necessary to permit for an efficient, minimally invasive system to tracking that helps law enforcement agents quickly preempt terrorist threats.

#### GPS used for counterterrorism tracking and prosecuting

Rozencranc 11, German, "GPS Tracking and the Fourth Amendment: The New Frontier in Counterterrorism Efforts" (2012). Student Scholarship. Paper 11. http://erepository.law.shu.edu/student\_scholarship/11

It is the position of this paper that warrantless GPS tracking can be rationalized through the “special needs” exception to the Fourth Amendment warrant requirement. Using the United States v. Berger two-step assessment, it is clear that in the wake of September 11, 2001, GPS tracking is necessary for national security and counterterrorism efforts. Moreover, the practice is made permissible through an existing statutory scheme, the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act. 5 Finally, the capability to use GPS tracking data for suspect profile creation has become an indispensible tool for achieving a compelling government interest, the halting of terroristic threats.

#### GPS tracking used for counterterrorism tracking and preemption

Rozencranc 11, German, "GPS Tracking and the Fourth Amendment: The New Frontier in Counterterrorism Efforts" (2012). Student Scholarship. Paper 11. http://erepository.law.shu.edu/student\_scholarship/11

Officers, accordingly, rely on GPS technology to gather invaluable insight as to the present location of tracked suspects.148 Especially helpful to counterterrorism efforts is the ability to compose a location profile of monitored individuals.149 Profile formation, using GPS tracking, has proven to accurately model human behavior and provide private insight into people’s lives.150 In addition to successfully monitoring individuals, GPS tracking provides for a greater threat unearthing. Terrorists often work in cells and GPS tracking of one suspected terrorist could easily unearth a network of terrorists with relatively few logistical costs. 151 Requiring officers to obtain individual permission to GPS track would unduly burden law enforcement agents, decelerate terrorism prevention, and work to contradict the intent behind the Act’s promulgation. Warrantless GPS tracking, therefore, is necessary to permit for an efficient, minimally invasive system to tracking that helps law enforcement agents quickly preempt terrorist threats.

### Attacks Coming

#### GPS Terrorism is already disruptive

National PNT Advisory Board-Jamming the Global Positioning System - A National Security Threat: Recent Events and Potential Cures-PDF- 2010

Much of **our infrastructure is critically dependent on Positioning and Time from GPS.** Two such dependencies illustrate this. *First*, ***most telephone cell towers* require GPS time to insure they are synchronized and cooperate. Recent instances of jamming in New York have rendered whole neighborhoods without cell service including Emergency Service Providers.** *A* ***Second*** *example is the use of GPS for* ***Aircraf****t Approach to Landing Fields****.*** These **GPS- based systems** are being deployed and **are** **particularly useful at airports** where good alternatives are not available such as at Aspen, CO and Juneau, AK. There are now more FAA-sanctioned GPS approaches than the older beam-steering type. (Over 2000 GPS approaches). **The value of these systems is enormous but the vulnerability is not universally appreciated: it took over a month to locate the deliberate small Jammer that was periodically driven by Newark airport. This** example **is particularly pertinent because the FAA’s NextGen Air Traffic Control System is critically dependent on GPS. Proliferated Jammers would cripple the new system, which is expected to greatly reduce aircraft delays.**

### NKT - Terror

**It Is Essential That We Act Now**

National PNT Advisory Board-Jamming the Global Positioning System - A National Security Threat: Recent Events and Potential Cures-PDF- 2010

**The interference threats to GPS are very real and promise to get worse. These threats potentially imperil much of the US infrastructure. It will take some time to field a full set of countermeasures and systems. Failure to act will be a serious abdication of our national responsibility**.

### Jamming IL

#### Jamming and Spoofing by Terrorists Can Create Major Havoc

Sean Gallagher Feb 23, 2012- “Computer security officer”

<http://elorantechnologies.com/gps-jammers-and-spoofers-threaten-infrastructure-say-researchers/>

Since **cell phone towers** **and** some **electrical grid systems use GPS signals for time keeping, GPS jamming can throw them off and cause outages**. "We're seeing a large number of low power devices which plug into power sockets in a car," Cockshott told Ars. "**These** **devices take out the GPS tracker in the vehicle, but they also create a 'bubble' of interference**, sometimes out to up to 100 yards. **They're illegal, so their quality control is generally not good." There has also been an emerging threat from more powerful GPS "spoofing" systems**, according to Cockshott, who is also the director of Position, Navigation and Timing technology for the UK's ICT Knowledge Transfer Network. **GPS spoofing attacks** **can provide both inaccurate location and time information**, potentially **creating much larger problems than a dropped call. "There have been incidents where trucks carrying high value goods have been hijacked**," he said, "where GPS and cell phones have been blocked." While such incidents have been rare, Cockshott said, these more **high-powered jamming systems cause the greatest concern. The equipment on the systems have power equivalent to that aboard GPS satellites**, he said, "but they're not 10,000 miles away—they're a mile away." **Use of these sorts of attacks by criminals or terrorists, especially in bad weather, could lead to the grounding of ships in constrained channels like the Strait of Dover, or cause problems with GPS-based air traffic control.**

### Spoofing = 9/11

**Spoofing is another way of hijacking a plane**

**Rashid 7/2** Fahmida Rashid, writer for Security Watch, PCWorld.com, “University Researchers Hijack A Drone With $1,000 Spoofer” July 2nd, 2012, http://securitywatch.pcmag.com/none/299835-university-researchers-hijack-a-drone-with-1-000-spoofer

The Pentagon and drone manufacturers have been lobbying Congress to allow government and commercial use of drones within the United States by 2015. If the idea of the government being able to spy on its citizens from air is not disturbing enough, this experiment raises security issues. **What** **if attackers manage to take control of the unmanned aerial vehicles in our airspace? Spoofing a GPS receiver on a unmanned aerial vehicle (UAV) is "just another way of hijacking a plane,"** Humphreystold Fox News, adding, "**I'm worried about them crashing into other planes…I'm worried about them crashing into buildings**."

**PGS Impacts**

#### PGS prevents erosion of US power projection and credibility

Ochmanek & Schwartz ‘8 - Senior defense analyst & International Policy Analyst @ RAND Corporation [David Ochmanek (Foreign Service of the United States (80 to 85), An officer in the United States Air Force (73 to 78) and Master of Public Affairs degree from Princeton University) & Lowell H. Schwartz (Ph.D. candidate in War Studies @ King's College London and M.A. in international affairs @ Johns Hopkins University), The Challenge of Nuclear-armed Regional Adversaries, 2008]

None of the analysis laid out here suggests that regional adversaries will be spoiling for a fight with their neighbors or with the United States once they acquire a nuclear arsenal. Considering the sort of conflict described in Chapter Four, no one would argue that a rational leader would seek to run the sorts of risks that would be associated with trying to terminate the conflict through threats of escalation. So **the military superiority that the U**nited **S**tates **enjoys in** both **conventional** and nuclear **forces will remain valuable as a deterrent to aggression**. Nevertheless, as long as adversary states pursue goals at odds with important U.S. interests, conflict may arise. **If the U**nited **S**tates **is to avoid suffering an erosion in its influence in key regions, it will wish to find ways to counter its adversaries’ nuclear capabilities effectively**. If the scenario sketched out above is a reasonable depiction of the dynamics of potential conflicts involving the United States and nuclear-armed regional adversaries, it suggests that the potential costs and risks of such conflicts may be exponentially greater than those in which the United States has been involved since the end of the Cold War. Under these new circumstances, the United States and its allies will wish to take steps to reduce the probability that such conflicts might arise through the adversary’s misunderstanding of the situation or miscalculation. In particular, it may be possible to shore up prewar and intrawar deterrence through declaratory measures, such as emphasizing publicly the nation’s commitment and determination to defend certain allies and interests in the adversary’s region. During the Cold War, such statements were deemed to be most credible when a per manent U.S. military presence and a formal alliance structure in the region were in place to back them up. Similar “forward deterrent” postures can be relevant in the future. But **the most important components of such postures will be those that counter directly the enemy’s most threatening capabilities**—its nuclear weapons and delivery means (see below). **Should deterrence fail and conflict occur with a nuclear-armed regional adversary, the U.S. approach to such conflicts must be informed by a careful consideration of the adversary’s perceptions and escalatory options**. In fact, unless the United States and its allies can develop and deploy capabilities that can prevent regional adversaries from employing nuclear weapons (as opposed to trying to deter them from doing so), future power-projection operations will likely revert from the post–Cold War model of “decisive defeat” back toward concepts incorporating elements that were prevalent in military planning during the Cold War: limited war and escalation management. This, in turn, could make it more difficult for the United States to defend and advance its interests in important regions of the world. During the Cold War, the fear of nuclear war compelled both the United States and the Soviet Union to work out “rules of the road” that required each side to recognize and accommodate the other’s core interests in order to avoid confrontations that could potentially have led to a nuclear exchange. This limited both sides’ freedom of action—for example, compelling the United States to acknowledge de facto the Soviet domination of Eastern Europe. Naturally, U**.S. leaders would like to avoid, t**o the extent possible, **adopting a similarly deferential relationship with adversarial regional powers**. Rather, they will seek to retain the freedom to promote regional security in ways that suit U.S. interests. Central to this pursuit is the ability to intervene militarily when necessary. U.S. and allied leaders faced with a serious challenge from a nuclear-armed regional adversary can choose from the following three basic options: Eschew military action and pursue 􀁴􀀁 diplomatic and economic remedies. Conduct limited military operations 􀁴􀀁 in an attempt to coerce the adversary state into changing its behavior. 􀁴􀀁 Undertake a major military operation aimed at unseating the enemy regime, but consider coupling those operations with an offer of safe haven for the enemy leaders. Obviously, one can always avoid war and the risks of escalation by refusing to fight. But **when important interests are threatened, taking military responses off the table is a recipe for the serious erosion of national influence and security.** **It is likelier that U.S. and allied decisionmakers in such cases will seek to devise policy options that incorporate measured military operations tailored to the circumstances in ways that avoid putting the enemy’s leaders in a position in which nuclear use seems to them to be the least bad option available**. For example, if a nuclear-armed Iran were to try to use terrorist attacks or special forces operations to advance its interests in the Persian Gulf region, the United States and its partners would strive to foil those attacks by defending important targets and interdicting enemy forces. Such operations would put a premium on the ability to monitor comprehensively the activities of Iran’s paramilitary forces and of terrorist groups allied with Tehran; to stop and inspect Iranian naval vessels; and to engage and destroy threatening personnel, ships, aircraft, and missiles. **Conventional strikes on selected targets thought to be directly associated with the enemy’s operations might** also **be called for.** Certain other sorts of military operations that have become mainstays of the U.S. military repertoire in the post–Cold War period would likely be judged to be less appropriate in this concept. These include large-scale invasions and intensive air campaigns aimed at crippling the adversary through attacks on strategic targets, such as leadership facilities and national-level command and control communication centers.1 To the extent that the enemy leadership might perceive such attacks as threats to its hold on power, they would have dangerous escalatory potential.

**GPS Key - Heg**

#### GPS guarantees operational superiority in all combat

Medlock ‘8 (“Worldwide Influence of GPS and the Challenges Ahead,” TSgt Theresa A., Lead Specialist Missile Warning Support Element, High Frontier, the Journal for Space & Missile Professionals, May 2008, <http://www.afspc.af.mil/shared/media/document/AFD-080522-087.pdf>, CMR)

The use of **GPS** data **has provided our military with great advantages** since the program’s inception. **Its use in military operations, has virtually guaranteed continuous operational superiority in any sea, land, or air environment**. At sea, **GPS data helps to ensure safe passage of carrier battle groups** through the Persian Gulf. On the battlefield, **its use enhances combatant commander’s capabilities to direct troop movements**. In the air, **it allows pilots to easily locate the enemy and ensure on target munitions delivery**. All of **these applications of GPS have had a great impact on operations that will continue to grow as new tech**nology **advances take hold**.

#### GPS empirically key to all military operation

DeGryse ‘8 (“GPS Modernization and the Path Forward: Bringing New Capabilities to Military and Civil Users Worldwide,” Dr. Donald, Vice President Lockheed Martin, High Frontier, the Journal for Space & Missile Professionals, May 2008, <http://www.afspc.af.mil/shared/media/document/AFD-080522-087.pdf>, CMR)

**America** and much of the world **depend on GPS for accurate position, navigation, and timing** (PNT) **information and this space-based asset has become essential to the military as well as the public at large**. **The US armed forces’ ability to successfully execute global operations with great speed and effectiveness is significantly enhanced by the precision location, guidance and navigation capabilities delivered by GPS**. Most recently, **the system was integral to every military branch in the US-led coalition’s success in Operation Enduring Freedom and Operation Iraqi Freedom**. For example, **special forces mounted on horseback in Afghanistan summoned GPS-guided precision air strikes to engage enemy targets with pinpoint accuracy and then used the system to navigate safely back to base**. Likewise**, in Iraq, GPS demonstrated its value by allowing Air Force pilots to streak through the sky with confidence because they knew exactly where they were and where they needed to go. It would be difficult to fight today’s conflicts without this enabling technology.**

## \*\*\*Economy

### \*\*Competitiveness Add-On

#### GPS key to streamlining operating costs and improving international competitiveness

Habjan ‘09

[Andreja and Costas Andriopoulous, Brunel Business School @ Brunel University (United Kingdom); *European and Mediterranean Conference on Information Systems*; July 13-14; p. 3-4]

Due to the fact that use of IT is unavoidable we can often find its use also in ports as well as in international transportation and logistics services. For example, in the Australian maritime industry,terminal operators and port/transport industry developed a longer-term approach to EC to improve the efficiency of operations, aiming to enhance the competence of their existing operational system (Kia, Shayan and Ghotb, 2000). Furthermore, a properly-designed, computerised container control system increases the operating efficiency of the terminal (Kia, Shayan and Ghotb, 2000). Another example is held **in America** where one of their **transport firms has** put in **place a system to transfer dispatch, fuel purchase and GPS tracking data to IT via the Internet**. The system provides a unique, trip-based process, where GPS points for each trip are matched to the respective dispatch records; an out-of-route analysis tool, in which the "practical" versus "actual" miles are analyzed to identify trips that are out-of-route; reports and mapping tools, **which help the fleet identify and analyze each trip. As a result of this data, the firm is able to produce maps of the worst trips for distribution to driver-managers and to drivers. The process has helped reduce costly out-of-route travel** (Klein, 2004). According to this **we can conclude that GPS has a significant impact in logistics**. Thus, our research interest is to explore of how adoption of GPS changes transport process and which are the main advantages for transport firm. **Moreover, freight carriers in order to optimise urban distribution, redesign their processes in such a way so as to minimize their operational costs** (number of vehicles in use and total distance travelled during delivery execution) (Davenport and Brooks, 2004, Tarn, Razi, Wen and Jr, 2003). They integrate wireless communication systems such as General Packet Radio Services (GPRS) (Giaglis, Kourouthanassis and Tsamakos, 2002) in conjunction with satellite constellations such as Global Positioning System (GPS) (Djuknic and Richton, 2001) with current vehicle routing systems (VRS) (Gayialis and Tatsiopoulos, 2004, Matsatsinis, 2004), and geographic information systems (GIS) (Keenan, 1998) to provide mobile-enabled real-time distribution management services. **These services are designed for collection of real-time information such as position of the vehicles, proof of delivery** (POD), and **field alerts** (for example, temperature violations in frozen cargo); **and re-routing of vehicles** when the execution of delivery cannot follow the pre-assigned plan, due to some unforeseen event (Zeimpekis and Giaglis, 2006). **Consistent with previous findings** we can sum up **that use** of IT in logistics **brings many advantages for the firm**, hence nowadays more and more firms decide to redesign internal processes using IT (Sanders and Premus, 2002). Concentrating mainly on transport firms, **GPS is** the **most preferable** used LIS (Zeimpekis and Giaglis, 2006), which **reduces the cost of communication** (Cantor and Macdonald, 2008), **improve service planning, inventory management, distribution and safety of management decisions** (Sanders, 2007). **Consequently, GPS enables more market-oriented firms** (Cantor and Macdonald, 2008) **and impacts its competitive position on the market** (Sambamurthy, Bharadwaj and Grover, 2003). Based on these factors we are in the following paragraphs describing how transport process changes using GPS and which the main benefits for the transport firm are.

#### Global economic crisis causes war---strong statistical support—also causes great power transitions

**Royal 10 –** Jedediah Royal, Director of Cooperative Threat Reduction at the U.S. Department of Defense, 2010, “Economic Integration, Economic Signaling and the Problem of Economic Crises,” in Economics of War and Peace: Economic, Legal and Political Perspectives, ed. Goldsmith and Brauer, p. 213-214

Less intuitive is how periods of economic decline may increase the likelihood of external conflict. Political science literature has contributed a moderate degree of attention to the impact of economic decline and the security and defence behaviour of interdependent states. Research in this vein has been considered at systemic, dyadic and national levels. Several notable contributions follow. First, on the systemic level, Pollins (2008) advances Modelski and Thompson’s (1996) work on leadership cycle theory, finding that rhythms in the global economy are associated with the rise and fall of pre-eminent power and the often bloody transition from one pre-eminent leader to the next. As such, exogenous shocks such as economic crises could usher in a redistribution of relative power (see also Gilpin, 10981) that leads to uncertainty about power balances, increasing the risk of miscalculation (Fearon, 1995). Alternatively, even a relatively certain redistribution of power could lead to a permissive environment for conflict as a rising power may seek to challenge a declining power (Werner, 1999). Seperately, Polllins (1996) also shows that global economic cycles combined with parallel leadership cycles impact the likelihood of conflict among major, medium, and small powers, although he suggests that the causes and connections between global economic conditions and security conditions remain unknown. Second, on a dyadic level, Copeland’s (1996,2000) theory of trade expectations suggests that ‘future expectation of trade’ is a significant variable in understanding economic conditions and security behavior of states. He argues that interdependent states are likely to gain pacific benefits from trade so long as they have an optimistic view of future trade relations. However, if the expectation of future trade decline, particularly for difficult to replace items such as energy resources, the likelihood for conflict increases , as states will be inclined to use force to gain access to those resources. Crises could potentially be the trigger for decreased trade expectations either on its own or because it triggers protectionist moves by interdependent states. Third, others have considered the link between economic decline and external armed conflict at a national level. Blomberg and Hess (2002) find a strong correlation between internal conflict and external conflict, particularly during periods of economic downturn. They write, The linkages between internal and external conflict and prosperity are strong and mutually reinforcing. Economic conflict tends to spawn internal conflict, which in turn returns the favour. Moreover, the presence of a recession tends to amplify the extent to which international and external conflicts self-reinforce each other. (Blomberg & Hess, 2002, p.89). Economic decline has also been linked with an increase in the likelihood of terrorism (Blomberg, Hess, & Weerapana, 2004), which has the capacity to spill across borders and lead to external tensions. Furthermore, crises generally reduce the popularity of a sitting government. ‘Diversionary theory’ suggests that, when facing unpopularity arising from economic decline, sitting governments have increased incentives to create a ‘rally round the flag’ effect. Wang (1996), DeRouen (1995), and Blomberg, Hess and Thacker (2006) find supporting evidence showing that economic decline and use of force are at least indirectly correlated. Gelpi (1997) Miller (1999) and Kisanganie and Pickering (2009) suggest that the tendency towards diversionary tactics are greater for democratic states than autocratic states, due to the fact that democratic leaders are generally more susceptible to being removed from office due to lack of domestic support. DeRouen (2000) has provided evidence showing that periods of weak economic performance in the United States, and thus weak presidential popularity, are statistically linked to an increase in the use of force..

### Competitiveness Down

#### U.S. competitiveness decreasing in the SQ—multiple factors

**Babu et al** February **2011** Suresh & 10 others, including reps from NASA, GE, and EWI “strengthening manufacturing competitiveness” Online

Alarming Trends **There is an unfortunate gathering of alarming trends in manufacturing that must be recognized and reversed**, including: Decreasing R&D Funding: **U.S. growth in R&D has averaged only about 1% per year** in real terms since 2000.(13) This is of great concern considering that **R&D investment drives innovation, and innovation is thought by many to be the critical strategic imperative to a healthy economy**. Decreasing Manufacturing Output: Manufacturing output as a percentage of U.S. GDP has decreased. **From 1996 to 2007, manufacturing’s share of GDP has fallen from 15.5 to 11.7%.(**12) Furthermore**, manufacturing output since the last recession lags that of earlier economic recoveries ― it has only grown 15%, which is half the pace averaged in recoveries of the past half century**. Declining Employment: **The ultimate metric of manufacturing strength, that of jobs, is the most alarming of the trends. The manufacturing employment base has declined by 4 million jobs in the past 10 years**, as shown in Figure 1, and is suffering severe losses in the current economy.(12) While improved productivity accounts for some job reductions, the major impact is from factory shutdowns and the exporting of manufacturing overseas. As previously noted, manufacturing jobs generally earn higher wages than other sectors. However, job erosion in the manufacturing sector is difficult to recover and permanently scars the standard of living.

### Tipping Point

**The U.S. manufacturing sector is at the tipping point – now’s key to revive the linchpin of the economy**

Arvind Kaushal, Thomas Mayor, and Patricia Riedl Autumn 2011 “Manufacturing’s

Wake-Up Call” All authors are senior executives at booz&co, a leading global consulting firm.

A debate over the future of U.S. manufacturing is intensifying. Optimists point to the relatively cheap dol- lar and the shrinking wage gap between China and the U.S. as reasons **the manufacturing sector could come back to life, boosting U.S. competitiveness and reviving the fortunes of the American middle class**. Whenever production statistics in the U.S. surge, it seems to bol- ster that hope; as New York Times columnist and Nobel laureate Paul Krugman put it in May 2011, “Manufac- turing is one of the bright spots of a generally disap- pointing recovery.” But then when disappointing economic growth in- dicators are released, the **pessimists** weigh in. They **ar- gue that the U.S. has permanently lost its manufactur- ing competitiveness** in many sectors to China and other countries, that the sector is still declining after years of offshoring and neglect, **and that it might never return to its role as the linchpin of the U.S. economy**. **Both the optimists and the pessimists are partially correct. U.S. manufacturing is at a moment of truth**. Currently, U.S. factories competitively produce about 75 percent of the products that the nation consumes. **A series of identifiable smart actions and choices by** busi- ness leaders, educators, and p**olicymakers could lead to a robust, manufacturing-driven economic future and push that figure up** to 95 percent. Alternatively**, if the U.S. manufacturing sector remains neglected, its output could fall by half, meeting less than 40 percent of the nation’s demand, and U.S. manufacturing capa- bilities could then erode past the point of no return**

### Disruption IL

#### GPS disruption can cause a laundry list of impacts from infrastructure to economic, to military

Lyle Brotherton 4/28/2012, Instructs Advanced Navigation worldwide to Special Forces, Mountain Rescue and Search & Rescue, Advises Governments on navigational strategy in Emergency Management Planning, Works with Governments post major disasters, such as the Pakistan Floods of 2010, Developed and delivers the National Satnav (GPS/GNSS) Training Program for Scottish Mountain Rescue. “Satnav Jamming & Spoofing,” <http://micronavigation.com/2063/satnav-jamming-spoofing/>

Why is it such a threat? In addition to the numerous Safety of Life (SoL) applications from commercial aircraft to maritime vessels that use satnav to navigate, spoofing and jamming threaten to create a massive potential destructive impact our infrastructure and economy. The most accurate information any GNSS transmits is its time signal, this is why new satellites can have up to five atomic clocks on board, and it is this component of the satellites transmissions which is most used in our infrastructure. Mobile Telephony All mobile phones rely on GNSS timing signals for the mobile phone masts to synchronize with each other, which enables them to call hand-off. They all use the same codes (CDMA spreading code) to both identify and distinguish themselves from other masts by phasing, in other words using microsecond time offset. Electricity Supply Power Grids also use GNSS time signals to manage the distribution of power across the grid; this is done by shutting down and powering up different generators and is controlled by devices called PMU’s (Phase Monitor Units). These units use time differentials to measure something called phase angles, and if the GNSS time signal is corrupted the results are blackouts and damage to the power grid equipment. Banking Investments across the world are made by computers calculating exactly the right time to buy or sell and to do this all stock markets need to be synchronized in time, otherwise a few milliseconds advantage of information about a market going up or down could have massive impacts for when to buy or sell. The actual satnav component of the system, where a receiver employs all of the data transmitted from the GNSS cover a broad spectrum of use. From our strategic assets (thermonuclear weapons) to shipments of gold bullion and other high-value items, satnav is used to track and monitor their safe movement. Criminal gangs have already used simple jamming technology here in the UK in a heist of a container load of cigarettes and there have been several documented cases elsewhere in the world of similar crimes employing this technology. Road-Routing Car Satnav has become ubiquitous and it is available in nearly all new road going vehicles, even my local supermarket are selling car satnavs, and for what is a very sophisticated piece of technology it is available for under £50. In addition to the safety aspects of not trying to read a map when driving are the very real benefits of traffic flow. Most commercial vehicles and many top spec car satnavs have the ability to reroute traffic past bottlenecks, accidents and other road obstacles thereby increasing the flow of traffic, the commercial benefits of this to haulers is enormous. Government authorities can also use satnav to charge for individual vehicle use of toll-roads and in Germany this is already underway, Weapon systems Like it or not we manufacture weapons to kill people and the more accurately and precisely they can be aimed minimizes collateral damage (a euphemism generally applied to women and children in conflict zones). Less munitions are required, they can be deployed, unmanned, from literally the other side of the world. Crime Prevention & Detection Not only can assets be tracked, suspects can be too by placing small satnav receiver/transmitters on vehicles, planes and boats in addition to using the satnav chipsets in mobile phones to track and monitor peoples movement. Accident Prevention & Management A growing usage of this technology is using trackers with children, where if they leave a defined zone, such as a school, an emergency text is sent. When emergency calls are initiated from a mobile phone many already can report location, by 2015 all mobile phones in North America, under the revised E911 statute, will do so within a couple of meters. These are the main uses of satnav; however there are many more applications with new ones constantly being introduced. Satnav has become an intrinsic component of our lives.

#### Spoofing disrupts stock markets and shipping

Bohn '12

Dieter Bohn, Senior Mobile Editor for The Verge, February 22nd 2012, “Researchers say GPS jamming is on the rise, raise concern that GPS spoofing may be next,” The Verge, http://www.theverge.com/2012/2/22/2815744/gps-jamming-spoofing-uk-study-conference

The concern, now familiar to anybody who has followed the LightSquared saga, is that interfering with GPS can do worse things than allowing a trucker to skip paying toll fees. GPS jamming is cheap and easy, and if taken to an extreme could inadvertently cause a ship to go off course. Beyond simple jamming, another issue researchers' collective radar is GPS spoofing, which is a bit more difficult but has the potential to wreak more havoc. A GPS spoofer could possibly manipulate stock trades, which are timed off the GPS clocks, though luckily no actual cases have been reported.

### Productivity IL

#### GPS offers a huge boost for business productivity & performance

Habjan ‘09

[Andreja and Costas Andriopoulous, Brunel Business School @ Brunel University (United Kingdom); *European and Mediterranean Conference on Information Systems*; July 13-14; p. 7]

**According to the literature use of GPS enables for transport firms to reduce costs of communication, enhance information quality throughout availability to share the information** (Cantor and Macdonald, 2008**). Additionally GPS improve service planning and develop increased productivity because of better safety of management decisions** (Sanders, 2007). **Thus, GPS is** becoming **the most preferable** (Zeimpekis and Giaglis, 2006) and widely used information **system in logistics especially transport industry** (Abbott, Powell, Signal and Redmond, 1999). In compliance with the literature findings we can also conclude **that implementation of GPS has an enormous impact not only on transport process but also on firms’ performance**. Looking closely to the process changes from the firms’ as well as customers perspective of all interviewees we can bring to a close that majority of theoretical grounds are coherent with research findings. Hence, all interview candidates agree that GPS enables constant availability of the information about the location of the vehicle; enhanced communication likewise better tracking and control of transport service (see also Table 3 and Graph 1). Nevertheless, better punctuality of information and better productivity of the vehicle did not reach 90% of level of agreement from interviewees we terminate that GPS also in these two factors has significant effect on transport process. However, we can not support the fact that firms would made less mistakes when giving and instructions (level of agreement 30.76%) and during the transport service realisation (level of agreement 38.46%).

### Transportation IL

#### GPS enables dramatic improvements in transport

Habjan ‘09

[Andreja and Costas Andriopoulous, Brunel Business School @ Brunel University (United Kingdom); *European and Mediterranean Conference on Information Systems*; July 13-14; p. 7]

According to the process flow in the upper table we can conclude that has **implementation of GPS drastically** **changed transport** process: **written documentation** was replaced by electronic data handling **and communication was transformed** from using cell phones and faxes to use of GPS devices. Furthermore transport organisers has up to date information about the location of **the** vehicle, which consequently enabled them to enhance transport planning for further transport to assure increased efficiency and productivity of the vehicle. Shortly we can list the next **advantages of use of GPS: (1) ability for constant tracking the location of the vehicle, (2) recording the working and resting time of the driver, (3) faster and simple communication between the driver and transport organiser as well as among all drivers that are in the system, (4) faster realisation of transport process, (5) simple electronic archiving of the documents and other information, (6) enhanced transparency, punctuality and correctness of the information.** All this findings was also confirmed by data gathered through semi-structured interviews that are illustrated in the following paragraph.

### Jobs IL

**GPS is key to sustaining jobs, profits, and the success of the US and its businesses**

**PR Newswire 12**

[July 2, 2012; June 22nd, <http://www.prnewswire.com/news-releases/study-shows-interference-with-gps-poses-major-threat-to-us-economy-124352063.html>]

**More than 3.3 million U.S. jobs** in agriculture and industries **rely heavily on** Global Positioning System **(GPS) technology and the disruption of interference** with GPS posed **by LightSquared'**s planned deployment of 40,000 **ground stations threatens direct economic costs of up to $96 billion to U.S. commercial GPS users and manufacturers,** according to an economic study released today. The **study by Dr.** Nam D. **Pham of** the Washington, **D.C.-based NDP Consulting Group warns of "serious economic repercussions for the U.S. economy" if LightSquared's plans proceed** and points out that the $96 billion economic figure represents the equivalent of 0.7 percent of the U.S. economy. The $96 billion figure is the total of up to $87.2 billion in costs to commercial GPS users and up to $8.8 billion in costs to commercial GPS manufacturers. **The commercial benefits of GPS are largely enabled by high precision GPS technologies. The study states** **that the** commercial **adoption of GPS continues to grow at a high rate and is expected to annually create $122.4 billion** in benefits **and** grow to **directly affect more than 5.8 million jobs in the** downstream commercial **GPS-intensive industries**. The study makes clear that its analysis is confined to the economic benefits of GPS technology to commercial GPS users and GPS manufacturers, mainly high precision GPS users, and the economic costs of GPS signal degradation to only those sectors. The report therefore does not capture the considerable benefits and costs to consumer users of GPS, other non-commercial users and military users. The analysis shows that GPS equipment revenues in North America in the 2005-2010 time period averaged $33.5 billion per year and that commercial sales accounted for 25 percent of the total, while the consumer and military markets respectively made up 59 percent and 16 percent of the total. The report notes that the U.S. government has already invested $35 billion in taxpayer money in the GPS satellite constellation and continues to invest in GPS at a rate of about $1 billion a year. Referring to LightSquared's plans, the report states, "The commercial stakes are high. **The downstream industries that rely on professional and high precision GPS technology for their own business operations would face serious disruption to their operations should interference occur, and U.S. leadership and innovation would suffer."**

#### GPS is intrinsic to our economy providing everyone with invaluable services and jobs

**Raber ‘11**

Raber; Vice Presidet of Merrick & Company in House Testimony; 2011

Brian; “Federal Geospatial Spending, Duplication and Land Inventory Management"; and H.R.4233, the "Map It Once, Use It Many Times Act;

Lexis-Nexis; 2011

We estimate that **more than 100,000 geospatial-related jobs currently exist in Colorado** . In addition to traditional and new technology commercial mapping firms**, geospatial employment is present in city/county/regional government and entities that use GPS and other** geospatial **technologies, include: defense, aerospace, law enforcement**, public safety, **homeland security,** healthcare, public and private utilities, all types of energy interests like fossil and renewable resources development, IT and software/ hardware development, internet tools, as well as in general business applications such as: banking, insurance, retail and marketing. Federal agencies. Moreover, **Geospatial technologies now have a place in virtually every market sector and industry. According to** **the** federal government's **National Geospatial Advisory Committee, as much as 90 percent of government information has** a **geospatial information** component and up to 80 percent of the information managed by business is connected to a specific location. A study by **the Center for Strategic and International Studies estimated** that **at least $30 billion is jobs are in demand as they are high paying**, high tech, and **high quality job.** These are the type of jobs that **the U.S.** economy **must continue to create a**nd maintain as the information society and **knowledge-based economy evolve generated by geospatial-related companies annually.**

### Economic Predictions IL

**GPS identification of global trends helps to prevent economic and environmental impacts**

**Gibson & McKenzie 8**

(John Gibson, University of Waikato, David McKenzie, Development Research Group, World Bank, July 2nd, Not specified; http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/04/09/000016406\_20070409134246/Rendered/PDF/wps4195.pdf)

**The majority of** empirical **work in** development **economics aims to identify the effect of a** particular **variable** of interest, X, on a particular outcome, Y. For example, **Deininger and Minten.**(2002) wish to **examined whether poverty is associated with** higher or lower levels of **deforestation** in southern Mexico. **A** standard **concern is** that **there are other variables** which are correlated with X and which also affect Y**. Failure to control** for **these variables** then **gives biased results.** One of **the most basic uses of GPS is to allow researchers to better control for** geographic and locational **characteristics** in their regression**s. Such characteristics are increasingly** found to be **relevant to outcomes** ofinterest **for** development **economists and practitioners**. For example, **Deininger and Minten obtain data from** a **GIS on soil quality, rainfall**, elevation, slope **and other** geographic **features, and find** that **higher levels of poverty are** statistically **associated with** greater likelihoods of **deforestation**. Propensity-score matching has become a popular tool for investigating policy impacts (see Ravallion, 2006 for a recent review). **The** basic **idea is to compare individuals subject to a policy to similar individuals** not subject to the policy. Typical variables used for matching are household socioeconomic characteristics, and an often crude set of community-level variables.Brady and Hui(2006)argue that GIS can be used to more explicitly include geography in matching. They present three arguments for doing so: 1) lots of individual data that we would like to match on is unmeasured, and so place can serve as a proxy for unmeasured individual characteristics; 2) near-by places are more likely to share community characteristics, such as culture, trust, and government ability; and 3) geographic matching can be visually persuasive, if you see sudden changes in outcomes across administrative borders when a program is in one community and not its neighbor. Nevertheless, they acknowledge that in some cases places which are most comparable in terms of cultural or socioeconomic characteristics may not be geographically close. Therefore it is important that matching not only be done on geography. Although the U.S. labor literature has emphasized the importance of comparing participants in training programs and non-participants from the same local labor markets (see Heckman et al. 1997), the matching literature to date has generally not explicitly included geographic proximity as a criteria when matching individuals in different communities. As more surveys include GPS coordinates, this will become increasingly possible.

### Downstream Industries IL

**GPS creates a positive spill over and is relied on the USFG and major industries**

**Pham et.al 2011**

Pham et. al; Ph.d in economics, Chief economist for S&P, Economist at the World Bank; 2011

[Nam D, Daniel, Mark, Dylan; The Economic Benefits of Commercial GPS Use in the U.S. and The Costs of Potential Disruption; 2011]

**Industries that rely on** professional and high precision **GPS** technology for **their own** business **operations would face serious disruption to their operations should interference occur, and U.S. leadership and innovation would suffer**. **Although recreational and military applications for GPS** equipment are larger **in** terms of equipment **sales** volume, **commercial applications generate a large share of economic benefits for society**. As shown later in this report, **the direct economic benefits of GPS** technology on commercial GPS users **are** estimated to be **over $67.6 billion per year** in the United States. In addition, **GPS technology creates** direct and indirect **positive spillover effects, such as emission reductions from fuel savings, health and safety gains in the work place, time savings, job creation, higher tax revenues, and improved public safety and national defense.** Today, **there are more than 3.3 million jobs that rely on GPS** technology, including approximately 130,000 jobs in GPS manufacturing industries and 3.2 million in the downstream commercial GPS-intensive industries. The commercial GPS adoption rate is growing and expected to continue growing across industries as high financial returns have been demonstrated. Consequently, **GPS technology will create $122.4 billion benefits per year and will directly affect more than 5.8 million jobs** in the downstream commercial GPS-intensive industries when The commercial stakes are high. The downstream penetration of GPS technology reaches 100 percent in the commercial GPS-intensive industries.

### Regional Economies IL

#### GPS increases regional economic strength through accurate and timely snowplowing

John Chappman, Feb. 3 2012, Rocky mountain Tracking GPS Daily, http://www.rmtracking.com/blog/2012/02/03/gps-helps-make-snow-manageable-in-midwestern-county/

Modern technology has no cure for bad weather. However, GPS technology is helping the county’s salt trucks get Winnebago County’s citizens to work in a more efficient manner. Winnebago has installed GPS tracking devices on all of its salt trucks. The new tools promise to help Wisconsin get back on its feet as the weather takes hold. The GPS trackers do more than just keep tabs on the salt trucks. The county’s highway leaders can also track how much salt is applied to the streets and what kind of salt is used. Winnebago County can then crunch those numbers to map out the most efficient method possible of getting all of its nearly two thousand miles of road cleared. Managing winter weather is absolutely crucial to the economic function of any region—especially the American Midwest. While winter is simply a part of the culture there, and the people of Winnebago have created a culture of integrating the weather into their life pattern, it is impossible to predict function. Weather ebbs and flows; there are still winter storms so horrid that even the experts in Winnebago, Wisconsin may be nonplussed. A county that cannot move food trucks, sell gas, teach its children, and maintain law enforcement due to weather is always at a greater risk. The faster Winnebago gets back on the road, the better. GPS technology promises to make Winnebago’s winter months more manageable, thanks to the improved function of its salt distribution trucks. The method for getting the roads clean hasn’t changed; but the method will become more efficient thanks to what modern GPS technology has brought to the county of Winnebago, Wisconsin.

## \*\*\*Precision Agriculture

### \*\*Small Farms Add-On

#### GPS enhances precision agriculture – reduces pesticide use, increases yield, and allows smaller farms to preserve accurate and productive methods for farming in the face of large scale farm operations

GPS.gov ‘12

(http://www.gps.gov/applications/agriculture/ The National Coordination Office for Space-Based Positioning, Navigation, and Timing maintains the contents of GPS.gov on behalf of the U.S. government. Feb 17, 2012 Accessed: 6-28-12)

Precision agriculture is now changing the way farmers and agribusinesses view the land from which they reap their profits. Precision agriculture is about collecting timely geospatial information on soil-plant-animal requirements and prescribing and applying site-specific treatments to increase agricultural production and protect the environment. Where farmers may have once treated their fields uniformly, they are now seeing benefits from micromanaging their fields. Precision agriculture is gaining in popularity largely due to the introduction of high technology tools into the agricultural community that are more accurate, cost effective, and user friendly. Many of the new innovations rely on the integration of on-board computers, data collection sensors, and GPS time and position reference systems. Many believe that the benefits of precision agriculture can only be realized on large farms with huge capital investments and experience with information technologies. Such is not the case. There are inexpensive and easy-to-use methods and techniques that can be developed for use by all farmers. Through the use of GPS, GIS, and remote sensing, information needed for improving land and water use can be collected. Farmers can achieve additional benefits by combining better utilization of fertilizers and other soil amendments, determining the economic threshold for treating pest and weed infestations, and protecting the natural resources for future use. Farm equipment tending precisely contoured rows of crops GPS equipment manufacturers have developed several tools to help farmers and agribusinesses become more productive and efficient in their precision farming activities. Today, many farmers use GPS-derived products to enhance operations in their farming businesses. Location information is collected by GPS receivers for mapping field boundaries, roads, irrigation systems, and problem areas in crops such as weeds or disease. The accuracy of GPS allows farmers to create farm maps with precise acreage for field areas, road locations and distances between points of interest. GPS allows farmers to accurately navigate to specific locations in the field, year after year, to collect soil samples or monitor crop conditions. Crop advisors use rugged data collection devices with GPS for accurate positioning to map pest, insect, and weed infestations in the field. Pest problem areas in crops can be pinpointed and mapped for future management decisions and input recommendations. The same field data can also be used by aircraft sprayers, enabling accurate swathing of fields without use of human “flaggers” to guide them. Crop dusters equipped with GPS are able to fly accurate swaths over the field, applying chemicals only where needed, minimizing chemical drift, reducing the amount of chemicals needed, thereby benefiting the environment. GPS also allows pilots to provide farmers with accurate maps. Farmers and agriculture service providers can expect even further improvements as GPS continues to modernize. In addition to the current civilian service provided by GPS, the United States is committed to implementing a second and a third civil signal on GPS satellites. The first satellite with the second civilian signal was launched in 2005. The new signals will enhance both the quality and efficiency of agricultural operations in the future.

#### Small farms face significant risks – collapse would result in the US depending on other nations for food

Scholl ‘11

[Jon, President of American Farmland Trust, *Roll Call,* October 27]

**Our nation faces severe economic times. Tens of millions of people are receiving food assistance. Millions of people are out of work**. Many people often ask, "Why do farmers need a farm safety net?"

We agree that our farm policy is in need of reform. Farm support programs are in many ways broken, serving neither farmers nor taxpayers well. However, **to suggest that we don't need a farm safety net would be a true folly.**

Modern agriculture involves more science and precision than most Americans understand, but we still find it difficult to manage major forces beyond our control that affect our ability to survive. Droughts, floods and global political changes can place us on the brink of bankruptcy in an instant.

While we acknowledge that the overall farm economy has recently been a bright spot in the U.S. economy, we remember too well the examples in our history where economic strength was followed by severe and painful economic hardship. **One needs only to look back to the mid-1990s when the Asian financial crisis caused commodity prices to collapse and farm livelihoods to be placed in severe jeopardy.**

**Failure to adequately assist farmers** and ranchers in managing risks they have no other option to protect themselves from **will, at best, invite dramatic consolidation of farms and, at worst, make American citizens dependent upon foreign countries for food just as we depend on others for oil. For nearly a hundred years, American public policy has believed that the health of agriculture is important and affects our national security - especially if we want to feed and clothe ourselves.**

#### Billions die

Julian Cribb, principal of JCA, fellow of the Australian Academy of Technological Sciences and Engineering, 2010, The Coming Famine: The Global Food Crisis and What We Can Do to Avoid It, <http://books.google.com/books?id=Tv0zXxbQ7toC&printsec=frontcover&dq=the+coming+famine&hl=en&sa=X&ei=RR_mT7OYFKeq2gXP5tHZCQ&ved=0CDUQ6AEwAA#v=onepage&q=the%20coming%20famine&f=false>, CMR

The character of human conflict has also changed: since the early 1990S, **more wars have been triggered by disputes over food**, land, and water **than** over **mere** political or ethnic **differences**. This should not surprise US: **people have fought over** the **means of survival** for most of history. But in the abbreviated reports on the nightly media, and even in the rarefied realms of government policy, the focus is almost invariably on the players—the warring national, ethnic, or religious factions—rather than on the play, the deeper subplots building the tensions that ignite conflict. Caught up in these are groups of ordinary, desperate people fearful that there is no longer sufficient food, land, and water to feed their children—and believing that they must fight ‘the others” to secure them. At the same time, the number of refugees in the world doubled, many of them escaping from conflicts and famines precipitated by food and resource shortages. **Governments in troubled regions tottered and fell. The coming famine is planetary because it involves** both **the immediate effects of hunger on directly affected populations** in heavily populated regions of the world in the next forty years—**and** also **the impacts of war**, government failure, refugee crises, shortages, **and food price spikes** **that will affect all human beings**, no matter who they are or where they live. It is an emergency because **unless it is solved, billions will experience great hardship**, and not only in the poorer regions. Mike Murphy, one of the world’s most progressive dairy farmers, with operations in Ireland, New Zealand, and North and South America, succinctly summed it all up: “Global warming gets all the publicity but the real imminent threat to the human race is starvation on a massive scale. Taking a 10—30 year view, I believe that **food shortages**, famine and huge social unrest **are** probably **the greatest threat the human race has ever faced**. I believe future food shortages are a far bigger world threat than global warming.”2° The coming famine is also complex, because it is driven not by one or two, or even a half dozen, factors but rather by the confluence of many large and profoundly intractable causes that tend to amplify one another. This means that it cannot easily be remedied by “silver bullets” in the form of technology, subsidies, or single-country policy changes, because of the synergetic character of the things that power it.

#### Small farms are the lynchpins to ecological diversity.

Griffin ‘6

[Keith B. Griffin, James K. Boyce, Stephen Cullenberg, Prasanta K. Pattanaik. Human Development in the Era of Globalization. 2006. page 95.]

Insofar as agricultural modernization triggers displacement of small farmers, it undermines the social basis for agricultural biodiversity. To be sure, new technologies can lead to genetic erosion on small farms, independently of changes in the agrarian structure, if small farmers themselves decide to replace numerous local varieties with fewer new ones. As noted above however, it is possible for traditional crop varieties and farming practices to coexist with new ones. Indeed one can imagine situation where the introduction of new varieties enhances diversity rather than diminishing it. The impact of ‘modernization’ on agricultural biodiversity hinges, in no small measure, on how it affects the livelihood security of small farmers. As the small farmer goes, so goes diversity.

#### Loss of biodiversity threatens the 6th mass extinction.

Dimas ‘6

[Stavros 1977-2004: Member of the Greek Parliament representing the party of New Democracy 1977: Member of the negotiating committee for the accession of Greece to the EEC 1977-1980: Deputy Minister of Economic Coordination 1980-1981: Minister of Trade 1985-1989: Parliamentary spokesperson for New Democracy 1989-1990: Minister of Agriculture 1990-1991: Minister of Industry, Energy and Technology 1995-2000: Secretary General of New Democracy 2000-2003: Senior Member of the Political Analysis Steering Committee of New Democracy 2000-2004: Head of the New Democracy delegation, Council of Europe March 2004 - October 2004: European Commissioner for Employment and Social Affairs From November 2004: European Commissioner for the Environment. Speech given at the Greek Western Conference, Brussles, May 30, 2006. “Stopping the loss of biodiversity by 2010:

Why nature matters. Why we are losing it. And what we in Europe can do about it”. http://lists.sonic.net/pipermail/pollinator/2006-May/000306.html.]

There can be no doubt that stopping the loss of biodiversity and limiting  climate change are the two most important challenges facing the planet. And  while climate change takes up much of the media attention, in one  fundamental way biodiversity loss is an even more serious threat. This is  because the degradation of ecosystems often reaches a point of no return –  and because extinction is forever.  The reasons for biodiversity loss are well known: destruction of habitats,  pollution, over-exploitation, invasive alien species and, most recently,  climate change. The compound effect of these forces is terrifying. The  global rate of extinction is at least 100 times the natural rate, and an  estimated 34,000 plant and 5,200 animal species face extinction. This means  one in eight of all bird species, one quarter of all mammals and one third  of all amphibians are endangered. Scientists are not exaggerating when they  refer to the 6th great planetary extinction. The last was 65 million years  ago and saw the departure of the dinosaurs.  This situation explains why, in 2001, the European Union’s leaders set the  goal of not only slowing down but actually halting the loss of biodiversity  in the EU by 2010. They also joined 130 other world leaders in 2002 to set  the global goal of significantly reducing the rate of biodiversity loss by  2010.  The Commission’s response to this challenge is the Communication and Action  Plan that we adopted last week. The Communication is a firm and unambiguous  political commitment from the Barroso Commission to prioritise biodiversity  and it is a recognition that existing efforts need to be stepped up. I will  present some of the key elements later – but probably the most important  aspect of the Communication is that it clearly spells out why biodiversity  matters.  There are two fundamental reasons why preserving our natural environment is  essential. Each on its own is a compelling reason for action. Taken together  they mean that protecting biodiversity must be placed at the top of our  political agenda.  The first is that nature has an intrinsic value. Nature is a part of our  culture, our history - and even our religions. We have a moral obligation to  be careful stewards of the planet. And because ecosystem degradation is  often irreversible and species loss is always so, when we destroy nature we  are depriving future generations of options for their survival and  development. This is not only irresponsible behaviour – it is also  unethical.  The second reason is that nature is the foundation for our quality of life.  We must be honest and accept that there is a widely held – and entirely  wrong – perception that nature protection comes at the cost of economic  development. Correcting this myth is the main theme of the Commission’s  Communication. Its key messages are that our prosperity is underpinned by  healthy ecosystems and that ecosystems - both in the EU and worldwide - are  far from healthy. They are, in fact, in dangerous decline.

### \*\*Food Security Mod

#### GPS key to food security worldwide

Gebbers ‘10

[Robin, Department of Agricultural Engineering @ Leibniz Institute for Agricultural Engineering and Viacheslav Adamchuk, Biological Systems Engineering Dept. at University of Nebraska; *Science*, Vol. 327; February 12, p. 828-829]

**To secure food supplies for the future requires adequate quantities and quality of agricultural produce, intensive yet environmentally safe production, and the sustainability of the resources involved**. **In addition, the ability to track food materials from production through processing, storage, and retail provides added capability to respond to changing market conditions, ensure proper food nutrition and safety, and affect national and international policies related to food security**. Precision agriculture, or information-based management of agricultural production systems, emerged in the mid-1980s as a way to apply the right treatment in the right place at the right time (1–3). Increasing awareness of variation in soil and crop conditions, **combined with the advent of technologies such as global navigation satellite systems** (GNSSs), geographic information systems (GISs), and microcomputers, serve as the main drivers (1, 2). Initially, **precision agriculture** was used to adapt fertilizer distribution to varying soil conditions across an agricultural field. Since then, additional **practices have evolved**, such as automatic guidance of agricultural vehicles and implements, autonomous machinery and processes, product traceability, on-farm research, and software for the overall management of agricultural production systems. Apart from field crop production, precision agriculture technologies have been applied successfully **in viticulture and horticulture, including orchards, and in livestock production, as well as pasture and turf management. Applications range from the tea industry in Tanzania and Sri Lanka to the production of sugar cane in Brazil; rice in China, India, and Japan; and cereals and sugar beets in Argentina, Australia, Europe, and the United States** (4). Despite differences in the types of technology and the areas of adoption, the goals of precision agriculture are threefold. First, to optimize the use of available resources to increase the profitability and sustainability of agricultural operations. Second, to reduce negative environmental impact. Third, to improve the quality of the work environment and the social aspects of farming, ranching, and relevant professions (3). Because of the diversity of applications and scenarios, it is difficult to quantify the benefits of precision agriculture in general. In a review of 234 studies published from 1988 to 2005 (5), precision agriculture was found to be profitable in an average of 68% of the cases.

#### Food crises invariably lead to terrorism.

Trudell’5

[Robert, J.D. Candidate, Syracuse University College of Law, “FOOD SECURITY EMERGENCIES AND THE POWER OF EMINENT DOMAIN: A DOMESTIC LEGAL TOOL TO TREAT A GLOBAL PROBLEM”, 33 Syracuse J. Int'l L. & Com. 277, lexis]

Food security deserves its place in any long-term calculation regarding global security. Widespread chronic hunger causes widespread instability and debilitating poverty and decreases all of our safety, for example from the increased threat from global terrorism. 58 Widespread instability is an unmistakable characteristic of life in sub-Saharan Africa. 59 Food insecurity, therefore, causes global insecurity because widespread instability in places like sub-Saharan Africa threatens all of our safety. Food insecurity in the unstable regions of the world must be taken on now lest we find ourselves facing some far worse danger in the days to come.

### \*\*Food Prices Mod

#### GPS key to crop yields – consistency and accuracy

Western Farm Press ‘11 (USA Rice Federation, Western Farm Press, “GPS dependability vital to agriculture”, August 10, 2011, http://westernfarmpress.com/government/gps-dependability-vital-agriculture, CMR)

USA Rice Federation and 12 other **agricultural** and agribusiness **organizations** whose members **are engaged in** global positioning system (**GPS) dependent precision ag**ricultural **practices** or who service the technology wrote to the Federal Communications Commission (FCC) to urge the agency not to permit a corporate wireless network modification until it can be clearly demonstrated that no interference to GPS will occur as a result of the proposed change. "While our members support the development of wireless broadband services in rural America, we are deeply concerned that [the] proposed network will cause unacceptable interference to signals from the Global Positioning System (GPS)," coalition members said. **GPS has been a boon to precision ag**riculture **and the environment. "With the chronically uncertain future of ag**ricultural **production, growers cannot afford to lose dependable, consistent access to GPS tech**nology **and the benefit it provides**," the groups said. **Farmers and ranchers have invested heavily to purchase GPS devices for their equipment**, making it unreasonable to move forward without knowing the effects of the proposed wireless network modifications on agricultural GPS equipment. Developing and proving the effectiveness of a commercially feasible filtering device for the field is needed, although the cost for such a device is unknown.

#### Empirically, rising food prices hurt the poorest in society.

Braun ‘8

(Dr. Joachim von Braun is an economist, with a Doctoral degree in agricultural economics from University of Göttingen, Germany. Former Director of the International Food Policy Research Institute This document was initially prepared for and presented at the Consultative Group on International Agricultural Research (CGIAR) Annual General Meeting held in Maputo, Mozambique, in December 2008 “Food and Financial Crises Implications for Agriculture and the Poor” <http://ageconsearch.umn.edu/bitstream/47663/2/pr20.pdf> December 2008 Accessed:7-2-12)

Even before the world food crisis, the poorest of the poor were being left behind (von Braun and Pandya-Lorch 2007). High and rising food prices further undermined the food security and threatened the livelihoods of the most vulnerable by eroding their already limited purchasing power. Poor people spend 50 to 70 percent of their income on food and have little capacity to adapt as prices rise and wages for unskilled labor fail to adjust accordingly. To cope, households limit their food consumption, shift to even less-balanced diets, and spend less on other goods and services that are essential for their health and welfare, such as clean water, sanitation, education, and health care. It has now become much more expensive to eat nutritious food. For example, in Guatemala, the price of a diet based on corn tortilla, vegetable oil, vegetables, and beans—which supplies key recommended micronutrients—is almost twice as high as the price of a less-nutritious diet based only on tortilla and vegetable oil (Figure 3). In fact, the cost of this balanced diet for just one person is almost three quarters of the total income of a poor household living on one dollar a day. The financial crunch poses additional threats by further lowering the real wages of the poor, and many are now losing their employment altogether. It also limits the funds available for food aid and social protection, which are essential for helping the most vulnerable people avoid malnourishment or even starvation. Compared with previous crises, the current ones are likely to have strong and long-lasting effects on emerging economies and the people most in need. Rising food prices and the credit crunch have reached all corners of the world. At the same time, since many more of the poor in rural and urban areas now depend on wages and are more closely connected to the rest of the economy than in the past, they suffer more from economic shocks. Recent estimates from the Food and Agriculture Organization of the United Nations (FAO) show that the number of undernourished people increased from 848 million to 963 million between 2003–05 and 2008, largely owing to the food price crisis (FAO 2008b). Food price hikes have also exacerbated micronutrient deficiencies,with negative consequences for nutrition and health, such as impaired cognitive development, lower resistance to disease, and increased risks during childbirth for both mothers and children. In Bangladesh, for example, a 50 percent increase in the price of food is estimated to raise the prevalence of iron deficiency among women and children by 25 percent (Bouis 2008). Because good nutrition is crucial both for children’s physical and cognitive development and for their productivity and earnings as adults, the adverse consequences of this price shock will continue even after the shock ends. A 2008 *Lancet* article shows that boys who benefited from a randomized nutrition intervention in their first two years of life earned wages as adults that were 50 percent higher than those of nonparticipants (Hoddinott et al. 2008). Food price shocks have the opposite effect; they negatively impact future economic prospects. Food insecurity can be a key source of conflict, and with food and general living costs on the rise, people have turned to the streets in protest. Social and political unrest has occurred in 61 countries since the beginning of 2007, with some countries experiencing multiple occurrences and a high degree of violence. Although this unrest has occurred mostly in countries with low performance in governance, countries with high governance performance have also been affected (Figure 4).

#### Death toll from poverty outweighs nuclear war impacts.

Abu-Jamal,‘98

(Mumia Abu-Jamal is a prominent social activist “A Quiet and Deadly Violence” Sept 19, 1998 http://www.flashpoints.net/mQuietDeadlyViolence.html)

The deadliest form of violence is poverty. --Ghandi It has often been observed that America is a truly violent nation, as shown by the thousands of cases of social and communal violence that occurs daily in the nation. Every year, some 20,000 people are killed by others, and additional 20,000 folks kill themselves. Add to this the nonlethal violence that Americans daily inflict on each other, and we begin to see the tracings of a nation immersed in a fever of violence. But, as remarkable, and harrowing as this level and degree of violence is, it is, by far, not the most violent features of living in the midst of the American empire. We live, equally immersed, and to a deeper degree, in a nation that condones and ignores wide-ranging "structural' violence, of a kind that destroys human life with a breathtaking ruthlessness. Former Massachusetts prison official and writer, Dr. James Gilligan observes; By "structural violence" I mean the increased rates of death and disability suffered by those who occupy the bottom rungs of society, as contrasted by those who are above them. Those excess deaths (or at least a demonstrably large proportion of them) are a function of the class structure; and that structure is itself a product of society's collective human choices, concerning how to distribute the collective wealth of the society. These are not acts of God. I am contrasting "structural" with "behavioral violence" by which I mean the non-natural deaths and injuries that are caused by specific behavioral actions of individuals against individuals, such as the deaths we attribute to homicide, suicide, soldiers in warfare, capital punishment, and so on. --(Gilligan, J., MD, Violence: Reflections On a National Epidemic (New York: Vintage, 1996), 192.) This form of violence, not covered by any of the majoritarian, corporate, ruling-class protected media, is invisible to us and because of its invisibility, all the more insidious. How dangerous is it--really? Gilligan notes: [E]very fifteen years, on the average, as many people die because of relative poverty as would be killed in a nuclear war that caused 232 million deaths; and every single year, two to three times as many people die from poverty throughout the world as were killed by the Nazi genocide of the Jews over a six-year period. This is, in effect, the equivalent of an ongoing, unending, in fact accelerating, thermonuclear war, or genocide on the weak and poor every year of every decade, throughout the world. [Gilligan, p. 196] Worse still, in a thoroughly capitalist society, much of that violence became internalized, turned back on the Self, because, in a society based on the priority of wealth, those who own nothing are taught to loathe themselves, as if something is inherently wrong with themselves, instead of the social order that promotes this self-loathing. This intense self-hatred was often manifested in familial violence as when the husband beats the wife, the wife smacks the son, and the kids fight each other.

### Productivity IL

#### GPS leads to better precision in agriculture and increases overall farming productivity

Pham 11

Nam, founder and Managing Partner of ndp consulting, Ph.D. in economics from George Washington University with concentrations in international trade andfinance, economic development and applied microeconomics, “The Economic Benefits of Commercial GPS Use in the U.S. and The Costs of Potential Disruption,” June 22, 2011, <http://www.saveourgps.org/pdf/GPS-Report-June-22-2011.pdf>

GPS technology is used extensively in agriculture for what is called precision or site-specific farming. GPS applications are used for farm planning,field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications of seeds, fertilizers, and pesticides, and yield mapping. Before GPS, it was more difficult for farmers to match production techniques or crop yields with land variability. This limited their ability to develop the most effective strategies to increase yields. Today, GPS-guidance equipment enables more precise application of pesticides, herbicides, and fertilizers, and better control of the dispersion of those chemicals, which reduces expenses, increases yields, and creates a more environmentally-friendly farm. For example, ten years ago, a 4,000acre farm might have required eight or nine tractors; today it needs just three or four machines and has the capacity to adopt 24 hour operations during critical planting and harvesting months. In surveys, studies, and other industry literature, GPS adoption rates (use of at least one GPS technology) in crop farming were found to range from 23 percent to 91 percent. Based on a measured consideration of those findings, we estimated an average adoption rate of 60 percent, which factors into our estimation of the current economic impact of GPS on crop farming. Since firms are adopting GPS technology and equipment at an increasing rate, we provide an additional simulation to estimate the economic impact of GPS at the 100 percent adoption rate.

### Input Costs IL

#### Decreases costs on farms and increases economic output

Pham 11

Nam, founder and Managing Partner of ndp consulting, Ph.D. in economics from George Washington University with concentrations in international trade andfinance, economic development and applied microeconomics, “The Economic Benefits of Commercial GPS Use in the U.S. and The Costs of Potential Disruption,” June 22, 2011, <http://www.saveourgps.org/pdf/GPS-Report-June-22-2011.pdf>

The measureable direct economic benefits of GPS to crop farming can be observed in greater output and reduced input costs. Industry studies, surveys, and testimonials from farmers about a variety of crops grown in different regions under different conditions find that the use of GPS equipment is associated with yield gains ranging from 3 percent to 50 percent. On the operation side, GPS technology provides crop farming with cost-savings on labor, capital (machine and equipment), and raw materials (seed, fertilizers, pesticides, other chemicals, fuels and oils, electricity). Estimates of input cost reductions range from 1 percent to 50 percent of total input costs. Based on a considered weighting of thosefindings, we estimate the average GPS-induced yield gain to be 10 percent and the average input savings to be 15 percent. According to data from the U.S. Department of Agriculture, the value of U.S. crop production averaged $169.1 billion per year during the period 2007-2010. The industry spent an average of $108.4 billion per year on affected inputs including seed, fertilizer and lime, fuels and oils, electricity, pesticides, repair and maintenance, and hired and contract labor expenses during the same period. 15 With a GPS adoption rate of 60 percent, we estimate that the use of GPS technology accounted for $10.1 billion of industry output per year ($169 billion production x 0.60 adoption x 0.10 GPS yield gain) and reduced input costs by $9.8 billion per year ($108.4 billion input expense x 0.60 adoption x 0.15 GPS input cost-savings). The aggregate annual benefits of GPS to crop farming, thus, totaled $19.9 billion per year, the equivalent of 11.8 percent of total annual production (Table 2). As GPS technology continues to prove its value, the adoption rate will approach and possibly reach 100 percent, raising the potential benefits of current GPS technology to the industry to $33.2 billion per year, the equivalent of 19.6 percent of the value of current annual U.S. crop production (Table 2)

### Food Security IL

#### Real-time data combined with precision agriculture key to long-term global food security

Gebbers ‘10

[Robin, Department of Agricultural Engineering @ Leibniz Institute for Agricultural Engineering and Viacheslav Adamchuk, Biological Systems Engineering Dept. at University of Nebraska; *Science*, Vol. 327; February 12, p. 830]

Ultimately, using **data feeds regarding production, processing, storage, and retail sale of our foods will** enable us to **optimize production with minimum waste and cost**. Thus, **farm managers will not only detect unnecessary treatments but also discover opportunities for boosting production output. Public agencies can obtain data for yield statistics, the calculation of subsidies, and monitoring of the agroecosystem, while they supply farmers with up-to-date information such as the boundaries of water protection areas or the latest pest warnings. Post-harvest industries and food retailers will be able to use various marketing mechanisms to ensure proper supply and quality standards. Together these** streams of information will **contribute to the main goal of achieving food security in a constantly changing world.**

### Environment IL

#### GPS key to precision farming – slashes costs, fuel use and substantially reduces greenhouse gas emissions

Branson ‘11

[Mark, Clifton Farm (Australia), “Using Conservation Agriculture and Precision Agriculture to Improve a Farming System,” *Rainfed Farming Systems*, p. 898]

**Accurate driving and the matching of machinery operational widths are essential to precision farming, the same GPS equipment being suitable for variable rate applications of fertilisers and herbicides**. Table 34.1 lists some different ways of providing guidance for a controlled traffic system. The farmer has to decide the level of accuracy needed and this may depend on the size and layout of the farm, the degree of accuracy required for various operations (boom spraying needs less accuracy than planting equipment), and cost of putting the system on the machinery. The **benefits include a** 3-10% **reduction in input costs from less overlap, through more accurate driving, easier driving** by using a guidance system, **and** with Autosteer, **less driver fatigue**. **The compacted tramlines also allow for earlier** access for operations such as **planting and spraying in wet conditions, and** allow for **nighttime spraying—important for areas where the days are too windy. CT systems are estimated to reduce fuel use by up to 25%. Fuel and fertiliser savings alone could translate to substantially less greenhouse gas emission for each tonne of increased grain production** (Webb et al. 2004).

#### Precision Agriculture key to environmental and economic sustainability

Branson ‘11

[Mark, Clifton Farm (Australia), “Using Conservation Agriculture and Precision Agriculture to Improve a Farming System,” *Rainfed Farming Systems*, p. 899]

**PA has the potential to achieve profitable**, CA-based rainfed **farming systems with economic and environmental sustainability**. This is achieved **through more efficient use of** scarce or costly inputs (**water, labour, fuel, fertilisers, sprays and other chemicals), with less waste, and less contamination of the environment**. It also provides flexibility for the farm system to respond to changing conditions, through accurate monitoring and decision making on timing and rates of action and inputs. **The major benefit** of PA **to the broader community is the reduction of chemicals released into the environment. European trials have indicated at least one third less nitrogen is leached** using on-the-go nitrogen sensors **over conventional** nitrogen application **methods**. There needs to be more research in this area in the major grain-producing countries. In the future, farmers will have available simple, relatively inexpensive, easy-to-use equipment to enable them to supply the optimal amount of chemicals and nutrients to the crops and to be able to measure and record the results of any application. It is an exciting, but challenging, time to be in agriculture; **if** rainfed **farmers adopt** Conservation Agriculture and **Precision Agriculture techniques, they will improve their whole-farm profits over an extended period, while at the same time preserving the farming environment.**

#### Precision agriculture key to checking environmental contamination & greenhouse gases

Ebel ‘11

[Robert, Dept. of Agriculture Econ. Research Service; David Schimmelpfennig, USDA; “The Information Age and Adoption of Precision Agriculture,” *Amber Waves* (USDA bulletin), December]

**Farmers have traditionally applied fertilizer, for example, at a uniform rate** that matches the highest requirement of a crop in any part of a field. **But if growing conditions vary within the field, some parts of it may receive too much fertilizer, resulting in increased farm and environmental costs. Excessive or poorly timed application can contribute to nutrient runoff from farms into wells, waterways, wetlands, and estuaries. Nitrogen fertilizer, when over-applied and not incorporated into the soil, can oxidize and vaporize into a potent greenhouse gas. By enabling farmers to better match the application of fertilizers and other inputs to crop needs, precision agriculture helps mitigate these effects.** Yield monitors, the most widely used precision equipment, have been available on harvesting combines for decades but are now capable of attaching GPS location coordinates to specific yields in each part of a farmer’s field. Guidance systems and autosteering, which use GPS data to notify farm equipment operators of their exact field position, have become increasingly popular and were used on roughly 35 percent of U.S. wheat acreage in 2009. Variable rate technologies (VRT) allow for the application of fertilizer, pesticide, and seed at different rates as the equipment moves across a field**. Farmers using VRT may maximize the benefits of the technology by also using detailed field maps constructed with GPS data**. These maps are not simple to create, but some farmers are combining geographic information systems with their yield and soil maps to keep track of multiple field and crop characteristics.

#### GPS key to next great evolution in agriculture

Bhatta ‘10

[Basudeb, PhD in Engineering, Senior Systems Engineer @ Jadavpur University; *Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others*, p. 309-10]

Precision farming or **precision agriculture is** an agricultural concept relying on the existence of in-field variability. It is about **doing the right thing, in the right place, in the right way, at the right time**. Precision agriculture has evolved from a concept a half a decade ago into an emerging technology today. **Precision agriculture is often described as the next great evolution in agriculture**. Precision agriculture is considered a concept, management strategy, and even a philosophy. **GNSS provide the agriculturist with a new capability of gathering information for implementing decision-based precision agriculture** (NRC 1997; Srinivasan 2006). GNSS can help us for soil sampling, mapping and preparing a land information system (LIS), and mobile mapping (Shanwad et al. 2002). Mobile mapping is the ability to collect field data, with unique geospatial location, time tags and attributes, for integrating into or updating a GIS or LIS. Mobile mapping provides the freedom to collect data anytime, anywhere, in any manner. Mobile mapping is essentially useless without the GNSS component. The GNSS component not only provides the location for all data collected but also provides the time in which it was collected. GNSS also enables the user to navigate back to any particular location anytime thereafter. **Once the field data has been collected using mobile mapping, the data can be downloaded into a desktop GIS. The GIS then provides the producer the ability to consider all the options for production. The producer can then use the positional data and the decisions that were made with the GIS to carry out the mechanized part of precision agriculture.** GNSS is also very useful for navigating and tracking heavy equipments used in Agriculture. **Agricultural equipment may use GNSS to steer automatically, or as a visual aid displayed on a screen for the driver. This is very useful for controlled traffic and row crop operations when spraying**. Harvesters with yield monitors can also use GNSS to create a yield map of the paddock being harvested. One of the first **GNSS** application fields of high performance single-frequency receivers is agriculture. The main uses consist of having an analysis tool in order to **optimize the spraying of fertilizers and other herbicides and insecticides, and the management of set-aside lands**. The installation is achieved in the best possible conditions: tractors and other agricultural machines move slowly, have enough electric power to supply the receiver, and the typical accuracy needed is 1 m. Specific software allows one to have a graphical representation of the farm work, together with automatic time alerts for cultivation purposes. **With the increased importance of ecological and environmental matters, this approach can** also be used in order to demonstrate and **enhance the changing agricultural practices** in this field. This is certainly a good motivation to develop this market.

#### Autosteer technology streamlines production, curbs emissions & fuel consumption

D’Antoni ‘12

[Jeremy, Department of Agricultural Economics & Agribusiness @ LSU; et al; “Farmers’ Perception of Precision Technology: The Case of Autosteer Adoption by Cotton Farmers,” *Presented at the Southern Agricultural Economics Association Annual Meeting, Feb. 4-7*; p. 3]

Since the early 1990s, GPS-based technology has been widely used in agriculture (Larsen et al., 1994). GPS-based guidance technology can be used for many field operations such as sowing, tilling, planting, cultivating, weeding and harvesting. GPS-based navigation systems are the latest technology that has become commercially available for farm vehicles (Adidine et al., 2002). Cotton farmers primarily use two **GPS navigation technologies**: lightbar and autosteer. Both of these utilize GPS technology to **identify the operator’s location in the field**; the fundamental difference between the two is that lightbar requires the operator to manually adjust steering whereas **autosteer technology allows the operator to focus on monitoring the operation of the implement instead of steering. This innovation has the potential to decrease operator fatigue** **and increase the efficiency of farm input application. It requires minimal setup and service time, is easy to use, and allows greater accuracy when working in limited-visibility conditions. The autosteer system eliminates human error**, such as overlapping and skipping, **which can lead to misapplication of pesticides, fertilizers and** seed. Hence, autosteer technology could be helpful in **reducing fuel consumption and emissions**. Environmental quality is associated with farm input uses, and good environmental outcomes are assumed to be ones in which fewer inputs—like fuel—are used (Mishra et al., 2005; Chang et al., 2011).

#### Agriculture practices are central to environmental concerns

Robbins ‘12

[Jim, freelance journalist formerly with The New York Times; *Yale Environment 360*; <http://e360.yale.edu/feature/can_reforming_the_farm_bill_help_change_us_agriculture/2508/>; March 22]

**Farming may not immediately come to mind as one of America’s biggest environmental issues, but it is**, and that’s the prime interest of Imhoff, who has just published the second edition of his book, [Food Fight: The Citizen’s Guide to the Next Food and Farm Bill](http://www.amazon.com/Food-Fight-Citizens-Guide-Farm/dp/0970950020). **Farming and ranching are the largest single land use in the country — with 20 percent of the land used for crops and 26 percent for pasture and range — and the methods of large-scale agribusiness take a heavy toll**.

#### Excessive fertilization results in water contamination & Greenhouse Gas emissions

Schimmelpfennig ‘11

[David; and Robert Ebel: Economic Research Service (USDA); *Economic Information Bulletin*, No. 80; August; p. 1]

**In addition to higher costs, there are other pitfalls to overuse of fertilizer. Excessive or poorly timed fertilizer application can contribute to nutrient runoff from farms into wells, waterways, wetlands, and estuaries** (Carpenter et al., 1998). And **when rainfall increases**, typically in the spring, **nutrient delivery to the Gulf of Mexico can enlarge the size of the hypoxic “dead zone” at the mouth of the Mississippi River**. In 2009, the delivery of nutrients to the Gulf was 11 percent above the 1979-2009 average and among the highest on record (U.S. Department of the Interior, 2009). A large share of this pollution may come from **agricultural runoff** (Goolsby et al., 2001; Goolsby et al., 1999). Nitrogen, **when overapplied and not incorporated into the soil, can** oxidize (into N2O) and **vaporize into greenhouse gas** (GHG). The Intergovernmental Panel on Climate Change (2007) included reduced N2O emissions through improved agricultural fertilizer application techniques as a key GHG mitigation practice.

### Farm Sustainability

#### Precision Agriculture key to sustaining farms by simplifying operations & allowing for substitute workers

D’Antoni ‘12

[Jeremy, Department of Agricultural Economics & Agribusiness @ LSU; et al; “Farmers’ Perception of Precision Technology: The Case of Autosteer Adoption by Cotton Farmers,” Presented at the Southern Agricultural Economics Association Annual Meeting, Feb. 4-7; p. 5-6]

The development of PA technologies like **autosteer is important in light of several issues faced by farmers. First**, these **innovations benefit** aging **farm operators by reducing** **the physical** **demand** required to continue farming (Feder et al., 1985). **Second**ly, technologies like autosteer **reduce the skill level required to operate farm machinery** (Griffin et al., 2005), **which broadens the potential for greater substitutability of farm labor** (D’Antoni et al., 2011). **With employment in the farming sector decreasing** (United States Department of Labor 2010), **it is important to standardize processes so those without much experience may be quickly and cheaply trained to work on-farm.** Finally, rising fuel costs and heightened attention to environmental conservation accentuate the need for efficiency of input use, which autosteer offers. However, despite this advantage, economic constraints ranked highest among reasons given for rejection of PA technologies, according to the SCPF Survey. The large up-front expenditures required for GPS or margin of inaccuracy (which limits efficiency gains) may cause these concerns.

#### Sustainable agriculture key to reform crucial agriculture policy

ASI ‘12

(Agricultural Sustainability Institute at UC Davis “What is sustainable agriculture?” 2012. <http://asi.ucdavis.edu/sarep/about/def#the-economic-social-political> Accesed: 7-3-12)

In addition to strategies for preserving natural resources and changing production practices, sustainable agriculture requires a commitment to changing public policies, economic institutions, and social values. Strategies for change must take into account the complex, reciprocal and ever-changing relationship between agricultural production and the broader society. The "food system" extends far beyond the farm and involves the interaction of individuals and institutions with contrasting and often competing goals including farmers, researchers, input suppliers, farmworkers, unions, farm advisors, processors, retailers, consumers, and policymakers. Relationships among these actors shift over time as new technologies spawn economic, social and political changes. A wide diversity of strategies and approaches are necessary to create a more sustainable food system. These will range from specific and concentrated efforts to alter specific policies or practices, to the longer-term tasks of reforming key institutions, rethinking economic priorities, and challenging widely-held social values. Areas of concern where change is most needed include the following: Food and agricultural policy. Existing federal, state and local government policies often impede the goals of sustainable agriculture. New policies are needed to simultaneously promote environmental health, economic profitability, and social and economic equity. For example, commodity and price support programs could be restructured to allow farmers to realize the full benefits of the productivity gains made possible through alternative practices. Tax and credit policies could be modified to encourage a diverse and decentralized system of family farms rather than corporate concentration and absentee ownership. Government and land grant university research policies could be modified to emphasize the development of sustainable alternatives. Marketing orders and cosmetic standards could be amended to encourage reduced pesticide use. Coalitions must be created to address these policy concerns at the local, regional, and national level. Land use. Conversion of agricultural land to urban uses is a particular concern in California, as rapid growth and escalating land values threaten farming on prime soils. Existing farmland conversion patterns often discourage farmers from adopting sustainable practices and a long-term perspective on the value of land. At the same time, the close proximity of newly developed residential areas to farms is increasing the public demand for environmentally safe farming practices. Comprehensive new policies to protect prime soils and regulate development are needed, particularly in California's Central Valley. By helping farmers to adopt practices that reduce chemical use and conserve scarce resources, sustainable agriculture research and education can play a key role in building public support for agricultural land preservation. Educating land use planners and decision-makers about sustainable agriculture is an important priority. Labor. In California, the conditions of agricultural labor are generally far below accepted social standards and legal protections in other forms of employment. Policies and programs are needed to address this problem, working toward socially just and safe employment that provides adequate wages, working conditions, health benefits, and chances for economic stability. The needs of migrant labor for year-around employment and adequate housing are a particularly crucial problem needing immediate attention. To be more sustainable over the long-term, labor must be acknowledged and supported by government policies, recognized as important constituents of land grant universities, and carefully considered when assessing the impacts of new technologies and practices. Rural Community Development. Rural communities in California are currently characterized by economic and environmental deterioration. Many are among the poorest locations in the nation. The reasons for the decline are complex, but changes in farm structure have played a significant role. Sustainable agriculture presents an opportunity to rethink the importance of family farms and rural communities. Economic development policies are needed that encourage more diversified agricultural production on family farms as a foundation for healthy economies in rural communities. In combination with other strategies, sustainable agriculture practices and policies can help foster community institutions that meet employment, educational, health, cultural and spiritual needs. Consumers and the Food System. Consumers can play a critical role in creating a sustainable food system. Through their purchases, they send strong messages to producers, retailers and others in the system about what they think is important. Food cost and nutritional quality have always influenced consumer choices. The challenge now is to find strategies that broaden consumer perspectives, so that environmental quality, resource use, and social equity issues are also considered in shopping decisions. At the same time, new policies and institutions must be created to enable producers using sustainable practices to market their goods to a wider public. Coalitions organized around improving the food system are one specific method of creating a dialogue among consumers, retailers, producers and others. These coalitions or other public forums can be important vehicles for clarifying issues, suggesting new policies, increasing mutual trust, and encouraging a long-term view of food production, distribution and consumption.

#### Sustainability key to feed the world

European Commission ‘12

(European Commission on Agriculture and Rural Development “European Innovation Partnership 'Agricultural Productivity and Sustainability'” March 9,2012 <http://ec.europa.eu/agriculture/eip/index_en.htm> Accessed: 7-2-12)

Food security is one of the major challenges worldwide in the years ahead, with global food demand forecast to rise by 70% by 2050 (FAO), accompanied by a steep increase in the demand for feed, fibre, biomass, and biomaterial. However, this challenge is accompanied by a slow down in productivity growth – in good part because of a reduction in investment in agricultural research – and increased pressure on the environment and our natural resources. For example, 45% of European soils face problems of soil quality. Around 40% of agricultural land is vulnerable to nitrate pollution and, over the last 20 years, farmland birds have declined by 20-25%. In short, the key challenge for agriculture in future is not only to produce more, but also to do this in a sustainable manner. These challenges will not be resolved without a major push towards embracing research and innovation – and in particular in bringing researchers, farmers and other players closer together so that we can accelerate the speed of technological transfer from science to farming practice, and provide more systematic feedback about practice needs from farming to science.

#### **Sustainability necessary to meet consumption of growing global population.**

Buffet Foundation ‘12

(Howard G. Buffett Foundation was established in 1999, the Howard G. Buffett Foundation’s (HGBF) primary mission is to improve the standard of living and quality of life for the world’s most impoverished and marginalized populations. “Improving US Agricultural Production” 2012 <http://www.thehowardgbuffettfoundation.org/initiatives/improving-u-s-agricultural-production> Accessed: 7-2-12)

### Small Farms Good

#### Healthy rural economies are key to stable national economies, a bubble-up economy is the most functional route—Japan, Korea and Taiwan prove.

Rosset ‘99

[Peter Executive Director Food First. Food First Policy Brief number 4, “The Multiple Functions and Benefits of Small Farm Agriculture in the Context of Global Trade Negotiations: On the Benefits of Small Farms”. Institute for Food and Development Policy Backgrounder, Winter 1999, Vol. 6, No. 4. http://www.foodfirst.org/en/pubs/policybs/pb4.html.]

A relatively equitable, small farmer-based rural economy provides the basis for strong national economic development. The post-war experiences of Japan, South Korea, and Taiwan demonstrate how equitable land distribution fuels economic development. At the end of the war, circumstances including devastation and foreign occupation, conspired to create the conditions for "radical" land reforms in each country, breaking the economic stranglehold of the landholding class over rural economies. Combined with trade protection to keep farm prices high, and targeted investment in rural areas, small farmers rapidly achieved a high level of purchasing power, which guaranteed domestic markets for fledging industries. The post-war economic "miracles" of these three countries were each fueled at the start by these internal markets centered in rural areas, long before the much heralded "export orientation" policies which much later on pushed those industries to compete in the global economy. This was real triumph for "bubble-up" economics, in which re-distribution of productive assets to the poorest strata of society created the economic basis for rapid development. It stands in stark contrast to the failure of "trickle down" economics to achieve much of anything in the same time period in areas of U.S. dominance, such as much of Latin America, and to the Asian financial crisis, which happened after many of the original policies had been discontinued.

### Fed Key

#### Fed key to programs that increase agricultural productivity

Kahn ‘09

(Dr. Bruce M Kahn PhD Senior Investment analyst DB Climate Change Advisors Deutsche Asset Management “Investing in Agriculture: Far-Reaching Challenge, Significant Opportunity” June 2009 http://www.sage.wisc.edu/pubs/articles/M-Z/Zaks/Investing\_in\_Agriculture\_July\_13\_2009.pdf Accessed: 6-28-2012)

Other policies, such as Renewable Fuel Standards (RFS), which call for increased biofuels in the transportation fuels mix, also impact agricultural demand, although in the US the policy calls for “second generation” solutions from 2015. Exhibit 86 lists several countries that have mandated RFS’s and Exhibit 95 lists the RFS Standards for the US until to 2022. However, in responses to the food price crisis of 2008, the European Union has cut its biofuel mandate to 5% from 10% of transport fuel by 2020. This policy may evolve into a low-carbon fuel standard in the future, as the world continues to debate the carbon intensity of the global economy. Policy initiatives that develop infrastructure, such as transport, ports, telecommunications, energy and irrigation facilities; as well as management skills, labor supply and skills to use modern technology such as GPS, will all help raise productivity. Governmental coordination of agricultural research, public, and private partnerships to develop new technologies such as improved seed and crop varieties and water resources management, while often founds in separate policy instruments, has major implications for agricultural productivity. IFPRI estimates that scaling up investments in agricultural innovation will not only help increase productivity but also strengthen the links between public and private enterprises (Exhibit 88). Regardless of the policy formulation, farm commercialization has a good chance of developing the sector and raising productivity. For example, China’s recent decision to promote the fertilizer use by direct subsidies to farmers will allow different types of investors to enter and support the development of larger fertilizer circulation firms. Also some governments have restricted the use of genetically modified crops, while others encourage its development.

**GPS Key**

#### GPS key to crop yields – consistency and accuracy

Western Farm Press ‘11 (USA Rice Federation, Western Farm Press, “GPS dependability vital to agriculture”, August 10, 2011, http://westernfarmpress.com/government/gps-dependability-vital-agriculture, CMR)

USA Rice Federation and 12 other **agricultural** and agribusiness **organizations** whose members **are engaged in** global positioning system (**GPS) dependent precision ag**ricultural **practices** or who service the technology wrote to the Federal Communications Commission (FCC) to urge the agency not to permit a corporate wireless network modification until it can be clearly demonstrated that no interference to GPS will occur as a result of the proposed change. "While our members support the development of wireless broadband services in rural America, we are deeply concerned that [the] proposed network will cause unacceptable interference to signals from the Global Positioning System (GPS)," coalition members said. **GPS has been a boon to precision ag**riculture **and the environment. "With the chronically uncertain future of ag**ricultural **production, growers cannot afford to lose dependable, consistent access to GPS tech**nology **and the benefit it provides**," the groups said. **Farmers and ranchers have invested heavily to purchase GPS devices for their equipment**, making it unreasonable to move forward without knowing the effects of the proposed wireless network modifications on agricultural GPS equipment. Developing and proving the effectiveness of a commercially feasible filtering device for the field is needed, although the cost for such a device is unknown.

#### GPS essential to farmers

Jon S. Warner, Ph.D. and Roger G. Johnston, Ph.D., ‘3

<http://lewisperdue.com/DieByWire/GPS-Vulnerability-LosAlamos.pdf>

Associate EditorJon S. Warner, Ph.D. Vulnerability Assessment Team Argonne National Laboratory Roger G. Johnston, Vulnerability Assessment Team, Argonne National Laboratory

[GPS Tracking](http://www.rmtracking.com/blog/2012/06/23/using-gps-on-the-farm/) for the farming industry has been around for years now, but what is new is that the [technology](http://www.rmtracking.com/blog/2008/10/13/farmers-use-gps-technology/) is improving so that its benefits are stronger than ever. When it first hit the market, [GPS Tracking](http://www.landairsea.com/) was thought to be a fad by some in the [agriculture](http://www.rmtracking.com/blog/2011/06/20/gps-is-a-powerful-farming-tool/) industry. It took a while for farmers to understand the end goal of such new technology because crop farming had remained unchanged for decades. Sure, advances in seed science were making an impact, but nothing on the technique for planting was available. Soon, farmers began to see the fruits of the labors of using [GPS Tracking](http://www.rmtracking.com/) systems to map out their fields and use the data to increase yields. As the technology continues to advance, the benefits keep on coming. Here are the latest ones and how they will affect your farming operation right now: With the newest [GPS Tracking systems](http://www.rmtracking.com/), the level of accuracy is improving because the systems are able to break down your acreage into smaller bits and pieces thereby giving you the ability to plant and apply fertilizer with more control. And, that equates to better yields. The higher-end systems actually control the steering mechanism on the planting and fertilizing tractors. With everything controlled with such precision, fuel savings are a byproduct of this type of system. You have the control down to the number of times across your fields which means no unnecessary trips. Because you are using your [equipment](http://www.rmtracking.com/blog/2009/04/08/farm-equipment-tracking/) less, maintenance costs will come down as a result. Wear on all mechanical parts is reduced. In farming, every small thing that you can do to reduce the possibility of having to spend money on equipment is a direct increase to profitability. What you are doing is increasing the interval between maintenance stops which cuts down on mechanical failure. The beauty of these GPS Tracking systems is that they allow farming operations to use and reuse the data and information over and over, season after season. Once the data has been captured, it is saved for future use as well. Consistency becomes the byword for the farming operations. Today’s farms are no longer operated by spreadsheet and best guesses as to how to plant and fertilize. The precision and accuracy are build into the GPS Tracking systems. In just five years, gps tracking innovations have resulted in better crop yields and more profit for farmers actively engaged in using this precise technology.

#### GPS is Vital to Agriculture

O’Neal ’06

<http://wichita.agrilife.org/files/2011/05/hi-mom-27-Pecan-winner-at-state-show-7-30-2011.pdf>

Jamie O’Neal is a creative writer for [LandAirSea Systems](http://landairsea.com/), a Woodstock, IL-based manufacturer and distributor of GPS tracking systems, software and accessories accessed July 2, 2012

More than 3.3 million U.S. jobs in agriculture and industries rely heavily on Global Positioning System (GPS) technology and the disruption of interference with GPS posed by LightSquared’s planned deployment of 40,000 ground stations threatens direct economic costs of up to $96 billion to U.S. commercial GPS users and manufacturers, according to an economic study released today. A study by Dr. Nam D. Pham of the Washington, D.C.-based NDP Consulting Group and commissioned by the Coalition to Save Our GPS warns of “serious economic repercussions for the U.S. economy” if LightSquared’s plans proceed and points out that the $96 billion economic figure represents the equivalent of 0.7 percent of the U.S. economy. The $96 billion figure is the total of up to $87.2 billion in costs to commercial GPS users and up to $8.8 billion in costs to commercial GPS manufacturers. The commercial benefits of GPS are largely enabled by high precision GPS technologies. The study states that the commercial adoption of GPS continues to grow and is expected to annually create $122.4 billion in benefits and grow to directly affect more than 5.8 million jobs in the downstream commercial GPS-intensive industries. The analysis shows that GPS equipment revenues in North America in the 2005-2010 time period averaged $33.5 billion per year and that commercial sales accounted for 25 percent of the total, while the consumer and military markets respectively made up 59 percent and 16 percent of the total. The report notes that the U.S. government has already invested $35 billion in taxpayer money in the GPS satellite constellation and continues to invest in GPS at a rate of about $1 billion a year. Referring to LightSquared’s plans, the report states, “The commercial stakes are high. The downstream industries that rely on professional and high precision GPS technology for their own business operations would face serious disruption to their operations should interference occur, and U.S. leadership and innovation would suffer.” Ken Golden, director of global public relations at John Deere: “The use of GPS technology is vital to thousands of people who make their living with agricultural and construction equipment. It is simply not acceptable to allow this new network to interfere with these important industries when all indications are that there is no practical solution to mitigate this interference. In agriculture, the loss of a stable GPS system could have an impact of anywhere from $14 to $30 billion each year. That could significantly erode the strong competitive global position of U.S. farmers in the world agricultural economy. Serious impacts to the productivity of those in the construction business also will be apparent

### Buy Local Movement Ix

#### Small Farms key to the Buy Local movement

Lohr ‘12

[Matthew J., Virginia Commissioner of Agriculture, *Southeast Farm Press*, June 12]

But **in addition to our larger farming operations, we also rely heavily on smaller farms**, too. They provide many tangible benefits not always measured in dollars. **Small farms are at the heart of rural America and small towns scattered across this great nation. They are also behind the successful “Buy Fresh — Buy Local” food movement**. The phenomenon has just exploded in the past several years with amazing results. Farmers’ Markets in Virginia have grown from 88 markets in 2006 to 200 this year. More and more farms are adding pick-your-own elements to their operations. Roadside stands are no longer relegated to back roads and rural areas; they crop up even on busy street corners. And CSAs (Community Supported Agriculture subscriptions) are now so popular that many of them sell out for the year before the official end of winter. Consumers tell us they see several advantage of buying local products. They get the farmer with their food. They can look him or her in the eye, establish a bond, ask questions about his growing practices and sometimes even influence his choice of products. Consumers also appreciate the fact their food doesn’t travel long distances to get to their plates. Often farmers pick it at 6 a.m. and start selling it by 8 a.m. Fresher products not only taste better, but they are more nutritious because they do not lose vitamins or minerals sitting on a side track or traveling across the country.

### A2 Precision Ag Too Costly

#### Even low-cost GPS guidance systems result in more sustainable & environmentally friendly agriculture

Amiama-Ares ‘11

[C., Dept. of Agroforestry Engineering, University of Santiago de Compostela (Spain); *Spanish Journal of Agricultural Research*, Vol. 9, No. 3; p. 711]

Based on **this study** in which we have **tested a commercial GPS guidance system, a low-cost GPS guidance system** developed in this study, **and fertilizer applicator operation without guidance** in ten different fields, **we reached the following conclusions**: — **Using guidance systems** for granular fertilizer distribution **improved uniformity of fertilizer application. Although** the **improvement is** **higher for the PT commercial system, the differences** observed between commercial PT and the software application developed by our research group **were not significant**. — The free SF1 differential correction signal, which is the least accurate signal offered by John Deere, proved sufficient to perform fertilizer application operations. — With regard to the fertilizer rates applied, the best distributions were obtained with the commercial PT system. When no guidance system was used, the areas with fertilizer application rates higher than the intended rate and the areas with rates below the intended rate tended to be equivalent. In contrast, when guidance systems were used, areas with fertilizer rates below the intended rate tended to be larger than areas with excessive fertilizer application. **The use of GPS guidance systems** reduces the area where excess fertilizer is applied, which **contributes to a more sustainable agriculture that is more environmentally friendly**. The greater investment required does not justify the better results obtained with the commercial GPS guidance system compared to the low cost system developed in this study.

### Food Prices IL

#### **Increases in food prices directly harm American consumers.**

Milam ‘10

(Sophie Milam is a senior policy analyst in Bread for the World’s Government Relations department writing for Hunger 2010 “Rising Food Prices and Hunger in the United States” 2010. <http://hungerreport.org/2010/report/chapters/one/green/how-us-firms-can-be-competitive/202-food-prices> Accessed: 7-2-12)

The global food crisis also impacts American consumers. During the last two decades, retail food prices have been quite stable, increasing an average of 2.7 percent per year. But in 2007, grocery prices rose 4.2 percent, the largest annual increase since 1990. Price increases for the first six months of 2008 outpaced the increase in all of 2007. Overall food inflation masks much sharper growth in specific food items, many of them staples for American families. Milk, bread, flour, and eggs have seen double-digit food inflation in the last year. Low-income families spend a greater share of their household budget on food—17.1 percent compared to the U.S. average of 12.6 percent. Most families can shift spending around to make up the difference, but low-income households have less flexibility to absorb higher food costs, particularly in an economy with increasing unemployment, stagnant wages, and sharply higher gasoline and utility costs. Rising food prices and the weak economy have increased the number of people seeking food assistance. Participation in SNAP (formerly the Food Stamp Program) approached record highs as the number of families seeking assistance from the program jumped more than 8 percent. Fortunately, SNAP and the school meals programs have entitlement status, which means they can expand to meet rising demand and serve all who are eligible. Other programs, like the Special Supplemental Nutrition Assistance Program for Women, Infants and Children (WIC), receive annual appropriations from Congress and operate on a fixed budget. For these programs, higher costs due to rising food prices limit the number of people the programs can serve—even at a time of greater need. It is important to remember that higher food prices impact all low-income families, even those who do not qualify for nutrition assistance. Eligibility rules for nutrition programs are largely income-based, so families hit hard by higher food costs do not suddenly become eligible for federal food assistance just because they are spending more on groceries. These families have nowhere to turn but to our nation’s food banks, which have reported a 20 percent increase in requests for help. Unfortunately, food banks suffer the same diminished purchasing power as the families they serve. Rising food and fuel costs make it more expensive for food banks to purchase and transport food. And because of the weak economy, private food donations have declined by almost 10 percent. Food banks are left with reduced capacity to serve just when people need help the most. In the short term, the United States must ensure that nutrition assistance programs have the funding they need to absorb increasing food costs and participation levels, and that benefits keep pace with the price of food. In the long term, we must reevaluate the formula that determines how nutrition assistance programs adjust for food inflation.

### Poverty IL

#### Labor Department reports show food price increases will hurt the poor.

CNN ‘11

*(John Sepulvado writing for CNN “Rising food prices could drive up rates of hunger”*

Opelika, Alabama (CNN) -- At the Community Market food bank, two small alcoves -- each with three chairs and a desk -- are used for interviewing potential clients. At the desk closest to the front door, Michael Davis sits across from an elderly woman with thick glasses. Dottie Battle is a volunteer at the food bank, and she asks for Davis' identification. He reaches into a worn Ziploc bag, pulls out his driver's license and social security card, and hands them to her. Battle asks for his gas, electric and telephone bills, and Davis also pulls them from the same bag. Then Battle asks Davis if he has applied for food stamps, a requisite for this program. He shakes his head "no." "You need the food stamps," Battle says firmly. "You need them badly. And we will need proof that you went and applied for them before you come back. ...You know that, you've shopped here before." Failure to comply with all the requirements could mean denial from the Community Market program -- at a time when Davis says he's been hungry for about two days. "It's not a good feeling," Davis says. "You have to think about it like fasting, like they did in the Bible, and pray for another blessing. That's really the only way to get through it." After about 10 minutes, Davis is approved for 75 pounds of food from the Community Market this visit. He quickly picks up his documents and begins looking for food on the shelves. Rising food prices expected to cause inflation This week, the U.S. Labor Department announced that raw import grain prices rose 1.4% this past February -- that makes an 8.5% increase over the past twelve months. Keystone food commodities like corn, soybeans and wheat have already increased 149% this past decade, according to the New America Foundation's Smart Strategy Initiative Director Patrick Doherty. Doherty recently wrote for CNN that the [U.S. is too vulnerable](http://www.cnn.com/2011/OPINION/03/07/doherty.oil/) to rising food and oil prices, and that strong policy decisions are needed to steer the economy through the prolonged price spikes. "With persistent high unemployment, oil fueling more than 95% of America's transportation system, and transportation costs running 24% of income in suburbia and in exurbia, 35%, America's middle class is extraordinarily exposed," writes Doherty. For families already on the brink, such increases could be devastating. "If prices go up any more, you are going to see more people here and other food banks. People that used to give us food are now asking for it." --Elsie Lott, Community Market director "If prices go up any more, you are going to see more people here and other food banks," says Community Market director Elsie Lott. "You can see it every day. People that used to give us food are now asking for it." Hunger already a 'social fever' Over the past year in Lee County, Alabama, more than 3,000 families accessed the Community Market food bank. Nationwide, the Gallup Organization reports 16%have gone hungry during the year due to finances. "Hunger is like a persistent social fever in our country," says Jim Weill, president of the Food Research and Action Center. "It is like a malignant social ill that leaves the country weaker, and more susceptible to other problems like poorer educational performance and health problems." FRAC advocates for federal funding of food programs as a way of solving hunger. "If you look at other wealthy societies, mostly European, but also some Asian, they have a vastly different hunger problem than we do," Weill says. "Fewer people in those countries go hungry. The sharing of economic growth and the sharing of affluence lifts a lot of people out of poverty and hunger." A recent New York Times [data sheet](http://www.nytimes.com/imagepages/2011/02/19/opinion/19blowcht.html) shows those differences plainly. In Singapore 2% of the population goes hungry. Advanced economic countries of Sweden, Denmark, Germany France, England and Switzerland all have fewer hungry people than the United States. Renewed focus on feeding children To curb this trend, especially among children, many private businesses annually help fill the pantries of the poor. Bank of America, Xerox and Geico help food banks around the country. Small businesses have also helped extensively in underserved communities. In the Tuscaloosa area, for example, the Alabama Credit Union funds a food program called Secret Meals for Hungry Children. Enrollment has swelled has from 18 participants to more than 900 in a little more than two years. "The thing that most surprises me is the numbers," says the program's administrator, Dusti Monk. "I think it was a little naive of me to think that hunger was a third world country issue, when it's right here in our backyards." The program enlists teachers to identify hungry children, and then request meal packets from the credit union. The teachers secretly slip meals into the student's back packs on a Friday, so the kids have food over the weekends. "You can tell the kids are hungry by the way they eat when they get to school on Monday," Monk says. The program costs $120 per student, annually. Monk says the Credit Union recruits sponsors from the community and around the state, and the response has been overwhelmingly positive. President Barack Obama has enlisted the help of private organizations like the Alabama Credit Union to help eliminate childhood hunger by 2015. During his term, "food insecure" households have remained virtually [unchanged](http://www.nytimes.com/imagepages/2011/02/19/opinion/19blowcht.html) according to statistics compiled by the U.S. Department of Agriculture. Four decades ago, [President Richard Nixon urged Congress](http://www.presidency.ucsb.edu/ws/index.php?pid=2038#axzz1GhuFueot) to help eliminate federal hunger spending programs. "That hunger and malnutrition should persist in a land such as ours is embarrassing and intolerable," Nixon wrote in 1969. Back then, less than 5% of the population was estimated to go hungry due to poverty or other economic reasons, according to research by the Citizens' Board of Inquiry into Hunger and Malnutrition. A government 'waiting for you to die' For people, like Wendy Madison of Opelika, rising food prices could be the difference between good health and a bad smile. Madison says she has been poor most of her life, and that she lost her front teeth due to poor nutrition. "It's the worst thing in the world," Madison says. "I don't even want to look at people. I cover up to smile. Emotionally, it hurts just as bad as being hungry." Madison says there was a 10-year period where her family was doing well, before her husband Joseph had a massive heart attack. She says her family's biggest mistake is they failed to plan for such hard times, and didn't save. Now, their family of three depends on a little more than $1,000 dollars in disability pay, along with $294.00 in food stamp benefits per month -- the equivalent of a dollar per meal. Madison says her food stamp benefits have not increased despite rising food prices. An increase in benefits have been denied repeatedly -- leaving the Madisons "begging for food while going hungry." "It makes you feel useless," Madison says, "like your government is waiting for you to die so they don't have to help you anymore."

#### Food prices drive millions into poverty.

World Bank ‘11

(World Bank We are not a bank in the ordinary sense but a unique partnership to reduce poverty and support development. We comprise two institutions managed by 188 member countries: the [International Bank for Reconstruction and Development](http://go.worldbank.org/SDUHVGE5S0) (IBRD) and the [International Development Association](http://www.worldbank.org/ida/) (IDA). The IBRD aims to reduce poverty in middle-income and creditworthy poorer countries, while IDA focuses exclusively on the world’s poorest countries. These institutions are part of a larger body known as the [World Bank Group](http://go.worldbank.org/KRV6R2GW50).”Food Price Hike Drives 44 Million People into Poverty” Feb 15, 2011 http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:22833439~pagePK:64257043~piPK:437376~theSitePK:4607,00.html Accessed: 7-2-2012)

Rising food prices have driven an estimated 44 million people into poverty in developing countries since last June as food costs continue to rise to near 2008 levels, according to new World Bank Group numbers released ahead of the G20 Meeting of Finance Ministers and Central Bank Governors in Paris. “Global food prices are rising to dangerous levels and threaten tens of millions of poor people around the world,” said World Bank Group President Robert B. Zoellick. “The price hike is already pushing millions of people into poverty, and putting stress on the most vulnerable, who spend more than half of their income on food.” According to the latest edition of Food Price Watch, the World Bank’s food price index rose by 15 percent between October 2010 and January 2011, is 29 percent above its level a year earlier, and is only 3 percent below its 2008 peak. Among grains, global wheat prices have risen the most, doubling between June 2010 and January 2011. Maize prices are about 73 percent higher, but crucially for many of the world’s poor, rice prices have increased at a slower rate than other grains. Sugar and edible oils have also gone up sharply. Other food items essential for dietary diversity in many countries have increased, such as vegetables in India and China, and beans in some African countries. According to Food Price Watch, the increase in extreme poverty (under US$1.25 a day) due to the price hike is associated with higher malnutrition, as poorer people eat less and are forced to buy food that is both less expensive and less nutritious.

### Terrorism IL

#### Poverty creates the structural conditions necessary for terrorism to occur.

Rice ‘6

(Susan E. Rice is a senior fellow at the Brookings Institute, The National Interest, “The Threat of Global Poverty,” 2006 Accessed: 7-2-12 l/n)

However, the primary flaw in the conventional argument that poverty is unrelated to terrorism is its failure to capture the range of ways in which poverty can exacerbate the threat of transnational terrorism -- not at the individual level -- but at the state and regional level. Poverty bears indirectly on terrorism by sparking conflict and eroding state capacity, both of which create conditions that can facilitate terrorist activity. Oxford University economist Paul Collier finds that “if a country’s per capita income doubles, its risk of conflict drops by roughly half.”5 A country at $250 GDP per capita has an average 15% risk of internal conflict over five years, while a country at $5,000 per capita has a risk of less than 1%.6 Conflict zones not only cost lives, they can incubate virtually every type of transnational security threat by creating the optimal anarchic environment for external predators. Al Qaeda established training camps in conflict-ridden Sudan and Afghanistan, purchased diamonds from Sierra Leone and Liberia, and now target American soldiers in Iraq. While low per capita income increases the likelihood of civil conflict, conflict zones, in turn, have been exploited by terrorists to lure foot soldiers and train new cadres, as in Bosnia, the Philippines and Central Asia. In extreme cases, conflict results in state failure as in Somalia and Afghanistan. When states collapse, the climate for predatory transnational actors is improved exponentially. Economic privation is an important indicator of state failure. The CIA’s State Failure Task Force found that states in which human suffering is rampant (as measured by high infant mortality) are 2.3 times more likely to fail than others.7 While poor economic conditions are not the only major risk factor for state weakness and failure, they are widely understood to be an important contributor along with partial democratization, corrupt governance, regional instability and ethnic tension. Even absent conflict, poverty at the country level, particularly in states with significant Muslim populations, may enhance the ability of Jihadist terrorists to operate. Poor countries with limited institutional capacity to control their territory, borders and coastlines can provide safe havens, training grounds, and recruiting fields for terrorist networks.8 By some estimates, 25% of the foreign terrorists recruited by Al Qaeda to Iraq have come from North and Sub-Saharan Africa.9 To support their activities, networks like Al Qaeda have exploited the terrain, cash crops, natural resources and financial institutions of low-income states from Mali to Yemen. Militants have taken advantage of lax immigration, security and financial controls to plan, finance and execute operations in Kenya, Tanzania and Indonesia. Al Qaeda is now believed to have extended its reach to approximately 60 countries worldwide. Country-level poverty may also weaken state capacity to provide essential human services and thereby render states more vulnerable to exploitation by terrorist networks. In low-income countries, social and welfare services are often inadequate, creating voids in education and health that may be filled by radical NGOs or madrassas. In Indonesia, the Sahel and Bangladesh, for example, international Islamic charities are closing the welfare gap. In Pakistan and Egypt, radical groups offer social welfare services that governments fail to provide. In the Palestinian territories, Hamas’ stunning electoral victory was due in part to its superior provision of social services. Terrorist networks often use legitimate and illegitimate charities as fronts to garner popular support.

#### Poverty is the root-cause of global warming and loss of bio diversity.

Rice ‘6

(Susan E. Rice is a senior fellow at the Brookings Institute, The National Interest, “The Threat of Global Poverty,” 2006 Accessed: 7-2-12 l/n)

Like disease, environmental degradation is linked significantly to poverty in the developing world and can result in long-term adverse consequences for the United States. Much of the world’s environmental stress can be attributed to population pressure. From 1950 to 1998, the world’s population doubled. It has grown a further 14% in the last ten years to 6.4 billion. By 2050, global population is on track to reach 9 billion. This growth is coming disproportionately from the developing world. Poverty substantially fuels population growth, as families have more children in response to high infant mortality rates and the need to raise income potential. Deforestation is accelerating in the developing world due to increased demand for fuel in the form of firewood and for arable acreage to enable growing populations to survive in marginal areas. The loss of trees exacerbates desertification, which has spread to the extent that 2 billion hectares of soil, or 15% of the planet’s land cover, is already degraded. Logging for trade in exotic African and Asian hardwoods magnifies the problem, contributing to the loss of 2.4% of the world’s forest cover since 1990. One result is reduced biodiversity, which alters delicate ecosystems and depletes the world’s stock of flora and fauna that have produced important medical benefits for mankind. Desertification and deforestation can also accelerate global climate change, though carbon emissions in rich and rapidly growing economies are the main culprit. 2005 was the hottest year on record. Global warming is already rendering coastal areas more vulnerable to flooding. And, as temperatures rise in temperate climates, the transmission vectors for mosquito-borne and other tropical diseases will change. New areas of the world, including our own, will face the possibility of once-tropical diseases becoming prevalent.

### Crop Diversity IL

#### Crop Diversity crucial to food security

COMACO ’10 Community Markets for Conversation.

http://www.itswild.org/food-production

Increasing crop variety is a crucial element of food security. COMACO has introduced rice farming, groundnut production and sweet cassava plantations to area farm groups. As a result, the number of different food crops contributing to member income has increased from 10 to 16 during the 2008-9 season, with very significant increases in percent grown by crop. The increase in crop number this past season is attributed to introduction of three additional legumes: sugar beans, soybeans and cowpeas. Rice and sweet cassava production, crops which are during harsh weather seasons, have increased appreciably since inception. The table below compares total number and percent of member farmers sampled who grew specified grain crops (maize, millet, sorghum, and rice) or sweet cassava in 2000 compared to 2009. The number of rice growers has increased five-fold, which correlates with the increased commodity price by an amount of almost three-fold since the beginning of COMACO. Sweet cassava growers have increased over ten-fold, though many households remain without sweet cassava. There is likelihood that cassava is more commonly grown than presented in the data, as many households do not regard it as an actual crop and tend to understate it. Growth of ground nuts, an important source of protein, has also increased from the baseline year, as shown in the figures below.

#### Crop Diversity key to human survival

AFP,10’

AFP Oct 26, 2010 http://www.seeddaily.com/reports/Lack\_of\_crop\_diversity\_threatens\_food\_security\_UN\_999.html

Accessed 7/3

The genetic diversity of the plants that we grow and eat could be lost forever due to climate change, threatening future food security, the UN's Food and Agricultural Organisation (FAO) said on Tuesday. Experts from the Rome-based organisation warned that the loss of biodiversity will have a major impact on humankind's ability to feed itself in the future as the global population rises to nine billion by 2050. "There are thousands of wild crop relatives that... hold genetic secrets that enable them to resist heat, droughts, salinity, floods and pests," FAO director general Jacques Diouf was quoted in the report as saying. " Increasing the sustainable use of plant diversity could be the main key for addressing risks to genetic resources for agriculture," he said. The report estimated that 75 percent of crop diversity was lost between 1900 and 2000 and called for "special efforts to conserve and use" both cultivated plants and their "wild" relatives, especially in developing countries. Fifty percent of the increase in crop yields in recent years has come from new seed varieties, the report said. FAO experts pointed in particular to the success of New Rice for Africa (NERICA), a cultivator of new types of rice suited to drylands that has transformed local economies in several parts of Africa. The FAO's second report in 12 years on the state of the world's plant genetic resources covers a range of topics from gene bank collections to the effects of climate change. The study predicts that as much as 22 percent of the wild relatives of important food crops of peanut, potato and beans will disappear by 2050 because of the changing climate. The United Nations has named 2010 as the International Year of Biodiversity. particularly important in providing food security

### Anthro Solvency

#### GPS maximizes the humanity of animal feeding and antibiotic operations

Boehlje, Dobbins, & Gray ‘12

(Michael Boehlje, Craig Dobbins, Allan Gray, Department of Agricultural Purdue University May 4th, 2012 http://www.extension.purdue.edu/extmedia/EC/EC-717.pdf Accessed:6-29-2012)

Increased use of monitoring technology will greatly expand the amount of information available regarding what affects plant and animal growth and well-being. This will be made possible by innovations in sensors used in individual monitoring and control systems. In addition, greater understanding of how various growth and environmental factors interact to affect biological performance will be forthcoming. This understanding will then be incorporated into management systems that combine the optimum practices and apply them at a micro or localized level. Precision farming in crop production includes the use of global positioning systems (GPS), yield monitors, and variable rate application technology to more precisely apply crop inputs to enhance growth, lower cost, and reduce environmental degradation. Examples in animal production include medication treatment by animal rather than by the entire group or herd; nutritional feeding to the specific genetics, sex, age, health, and consumer market for the individual animal; and continuous adjustment of the ambient environment, including such factors as temperature, humidity, air movement, and dust and gas levels within buildings, to maximize economic returns and animal comfort.

## \*\*\*Environment

### \*\*Biodiversity Add-On

#### Telemetry (GPS) key to reversing global species loss

Cooke ‘08

[Steven J., Dept. of Biology and Institute of Environmental Science @ Carleton University (Ontario), Endgangered Species Research, Vol. 4, January, p. 182]

**In summary, telemetry** and logging **can provide conservation practitioners with data that is unattainable using other techniques**. However, it is important to only use these technologies when they are determined to be the best means of achieving a specific conservation objective. **Telemetry and** logging, as well as other innovative research, assessment, and **monitoring tools are needed in order to inform decision makers and thus achieve biodiversity targets** (e.g. the Convention of Biological Diversity 2010 targets; see Balmford et al. 2005**) and reverse the apparent global decline of many animal species.**

#### GPS (telemetry) key to saving species and preserving biodiversity

Cooke ‘08

[Steven J., Dept. of Biology and Institute of Environmental Science @ Carleton University (Ontario), Endgangered Species Research, Vol. 4, January, p. 170]

**One of the most desirable characteristics of telemetry** and logging **for the study of endangered species is that one can study free-living animals in their natural environment**. This is particularly relevant to endangered species where removal of the animals to captivity would typically only be done as a conservation measure (e.g. to establish a captive breeding species). **In nature, animals face a suite of site-specific** biotic (e.g. predation) and abiotic (e.g. weather, habitat heterogeneity) **conditions that cannot be adequately replicated in captivity and that need to be characterized and understood in an effort to understand the population ecology of an endangered animal. The monitoring of unrestrained free-ranging animals in their own environment** eliminates laboratory artifacts but **also eliminates the need to remove animals with reproductive potential from an endangered population**. Depending on the technology used, **these tools also provide the opportunity to focus on animal behaviour across a variety of scales**. For example, to identify the seasonal critical habitats and geographic range of a species, telemetry or logging could be used at a spatial (e.g. site, regional, continental) and temporal (e.g. hours, days, years) scale that coincides with the biology of the animal. **Another benefit** of telemetry and logging technology **is** that they can produce **continuous data streams** (through use of arrays, loggers, or satellites) **that eliminate data gaps** during periods when animals are not monitored manually by research team members. **Longterm and continuous records of behaviour facilitate the detection of trends through time** in terms of spatial ecology and phenology. Indeed, data can be collected day and night and in harsh environmental conditions for extended periods without requiring continuous human support. **Such an approach is particularly important for organisms that inhabit large ranges, exhibit rapid movement, or occupy habitats that are difficult to study**. These tools also enable a researcher to characterize the variation among individuals and to recognize the plasticity of the responses. **Individual variation in behaviour is increasingly being recognized as important for the conservation of biodiversity**, as the variation can provide a better idea of the extent to which animals will differ from a ‘mean’ response (e.g. how far will they range from their ‘mean’ home range). **Telemetry is also an ideal tool for** linking individual behaviour with physiology and energy status (Wikelski & Cooke 2006), **information that is fundamental for conservation**. This integration can be achieved through the use of sensors (discussed in ‘Overview’ above) or by obtaining non-lethal biopsies (e.g. blood samples). Energetic analyses are particularly useful in conservation, as energy is the common currency in ecology and is essential for inferring the bioenergetic costs of different behaviours or exposure to different stressors.

**Biodiversity loss outweighs nuclear war, economic collapse and tyranny.**

**Chen 2000** [Jim, Professor of Law at the U of Minnesota, Minnesota Journal of Global Trade Winter 2000, pg. 211]

The value of endangered species and the biodiversity they embody is literally . . . incalculable. What, if anything, should the law do to preserve it? There are those that invoke the story of Noahs Ark as a moral basis for biodiversity preservation. Others regard the Judeo-Christian tradition, especially the biblical stories of Creation and the Flood, as the root of the Wests deplorable environmental record. To avoid getting bogged down in an environmental exegesis of Judeo-Christian myth and legend, we should let Charles Darwin and evolutionary biology determine the imperatives of our moment in natural history. The loss of biological diversity is quite arguably the gravest problem facing humanity. If we cast the question as the contemporary phenomenon that our descendents [will] most regret, the loss of genetic and species diversity by the destruction of natural habitats is worse than even energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. Natural evolution may in due course renew the earth will a diversity of species approximating that of a world unspoiled by Homo sapiens in ten million years, perhaps a hundred million.

### \*\*Oil Spills Mod

**GPS used in tracking and cleaning oil spills**

Christopher **Jablonski** is a freelance technology writer. August 3, 20**08**. “Robot buoy to track oil spills”. ZDnet. http://www.zdnet.com/blog/emergingtech/robot-buoy-to-track-oil-spills/999

Yesterday, *Japan Today* reported about **a prototype of robotic buoy developed at Osaka University to fight sea pollution in the event of an environmental disaster caused by an oil spill. The current prototype**, dubbed SOTAB (short for 'Spilled Oil Tracking Autonomous Buoy') **is a 110-kilogram GPS-equipped robot**. The cylindrical buoy has a length of 2.7 meters and a diameter of 27 centimeters. The lead researcher admits that **these robots will not be really ready before at least three years.** But **he would like to have these buoys installed on all oil tankers to be automatically dropped in the sea in case of an accident.** But read more... You can see on the left a photo of the SOTAB 1 robotic buoy. There are several pictures of this prototype 'floating' on the Web. This one comes from this page at TreeHugger. This robot buoy has been designed by Naomi Kato, professor of submersible robotic engineering at the Department of Naval Architecture at Osaka University, Japan, with the members of his lab. The 'Katolab' "is conducting education and research on underwater robotics, biomechanics on aquatic animals and its application to engineering, computational hydrodynamics of viscous flow fields." You'll find more details about this robotic buoy by looking at this specific research project, Development of Spilled Oil Autonomously Chasing Buoy System. According to *Japan Today*, here is how Kato justifies the usage of such buoys. "**'The development of an oil field in Russia's Sakhalin and Chinese economic expansion will likely lead to increased tanker traffic in Japanese coastal waters.' The buoy is intended to be deposited along the edge of an oil slick in the sea at the time of an accident**. A sensor to analyze the stickiness of liquids detects heavy oil, which is more glutinous than sea water."

**Oil Spills causes loss of Biodiversity, BP proves**

Brian **Merchant** August 10, 20**10** “4,500 Animals Killed in BP Spill ... And Counting”

<http://www.treehugger.com/natural-sciences/4500-animals-killed-in-bp-spill-and-counting.html>

a freelance writer and editor living in Brooklyn, NY. He covers politics for TreeHugger, with a focus on climate and energy issues. Brian has written for Slate, Paste, Salon, GOOD, and the Huffington Post, among many others. He pens the column Getting Samy Out of Burma, and is the editor and founder of the blog the Utopianist.

As BP moves to permanently seal the blown-out well that unleashed 5 million barrels of oil into the Gulf of Mexico, the focus is turning to the toll of the disaster. It should be said that the true and total toll will not be known for some time, until scientists have had a chance to properly investigate the extent of the damage above and below the sea. But there are some things we can start looking at now: Like the **direct number of casualties among the Gulf's wildlife the spill has claimed so far**. **Thousands of animals** -- birds, sea turtles, dolphins, and reptiles **-- have been killed so far.** Birds have fared the worst -- **3,902 have officially been collected dead\*.** These birds include the threatened brown pelican, Louisiana's state bird. The **birds are killed after ingesting oil while attempting to clean it off of their feathers.** **1,869 have been collected alive,** and some 775 of those have been released into the wild **-- though many scientists believe that only a small percentage of those will survive.** **517 sea turtles, all of which are considered endangered, have been killed by the spill.** Another 500 oiled turtles have been collected alive, and their future is uncertain. Many of these turtles belong to a species called Kemp's Ridley, the smallest and most endangered sea turtle in the world. **71 marine mammals, mostly dolphins,** have been killed over the course of the spill thus far. One solitary, unidentified reptile has also perished in the spill

**Impact to loss of ocean life is extinction**

**Craig 8** Robin Kundis, Attorneys' Title Insurance Fund Professor of Law, Florida State University College of Law, Tallahassee, Florida, “ CLIMATE CHANGE, REGULATORY FRAGMENTATION, AND WATER TRIAGE”, Summer, 79 U. Colo. L. Rev. 825, lexis

Marine ecosystems have immense value. Oceans cover more than 70% of our planet, 314 support vast reserves of biodiversity (in all senses), 315 produce at least half of the Earth's atmospheric oxygen, 316 drive the planet's hydrological cycle, 317 sequester carbon dioxide, 318 and play a significant role in the earth's climate and weather. 319 As such, oceans and estuaries are critical providers of ecosystem services - those "myriad of life support functions, the observable manifestations of ecosystem processes that ecosystems provide and without which human civilizations could not thrive**.**" 320 According to a comprehensive study that appeared in Nature in 1997, "about 63% of the estimated value [of the world's ecosystem services] is contributed by marine ecosystems," especially coastal ecosystems. 321 Specifically, "coastal environments, including estuaries, [\*892] coastal wetlands, beds of sea grass and algae, coral reefs, and continental shelves ... cover only 6.3% of the world's surface, but are responsible for 43% of the estimated value of the world's ecosystem services." 322

**\*\*Deforestation Mod**

**Deforestation is at the tipping point**

**Brahic 09**([Catherine Brahic](http://www.newscientist.com/search?rbauthors=Catherine+Brahic), March 2009, “Parts of Amazon close to tipping point” Newscientist, http://www.newscientist.com/article/dn16708-parts-of-amazon-close-to-tipping-point.html)

**The Mato Grosso**, the most scarred **region of the Amazon rainforest, is teetering on a deforestation "tipping point", and may soon be on a one-way route to becoming a dry and relatively barren savannah**. [Mônica Carneiro Alves Senna](http://buscatextual.cnpq.br/buscatextual/visualizacv.jsp?id=K4704425T1) and colleagues at the Federal University of Viçosa, Brazil, used computer models to simulate how the Amazon would recover from various amounts of deforestation. Their **simulations ranged from a complete wipe-out of the entire forest to a situation where just one fifth of the forest would be removed.** Previous studies have shown that cutting trees has a double effect on the forest's recovery. Fewer trees means less rain - because rainclouds are more likely to form above moist forests. It also leads to poorer quality soil, as most of the Amazon's nutrients come from decaying vegetation, explains [Yadvinder Malhi](http://www.geog.ox.ac.uk/%7Eymalhi/) of the University of Oxford. "By removing the forest you remove the nutrients," he says.

**GPS key to tracking and solving deforestation**

Satheesh **Gopi** February 21, 19**96** “Global Positioning System: Principles And Applications” has over 16 years experience as a hydrographer and is currently working as Marine Surveyor in the Hydrographic Survey Wing of the Kerala Port Department. He received his degree in civil engineering from the College of Engineering, Thiruvananthapuram and also holds a masters degree in information technology. He is the author of Global Positioning System – Principles and Applications. He was commissioned to supervise surveys with commercially available Total Stations in the late eighties and with GPS receivers in the early nineties. He has worked with Total Station and GPS ever since. R. Sathikumar is presently Professor (Civil) with the College of Engineering, Thiruvananthapuram. He received his post-graduate degree, in Transportation Engineering, from IIT Kanpur in 1989 and his Ph.D from IIT Roorkee in 1996. N. Madhu is Assistant Professor (Civil) with the College of Engineering, Thiruvananthapuram. He obtained his M.Tech in Traffic and Transportation Engineering from IIT Madras in 1991.

**Modelling Deforestation Researchers in Cameroon have used GPS and Geographic Information Systems (GIS) to create a spatial model of deforestation in southern Cameroon**, around the town of Bertoua. After **producing a GIS database containing information on natural and cultural landscape variables, the researchers were able to create a map of deforestation risk zones on a regional scale** by relating the data base information to how frequently deforestation was happening. Ground observations were geo- referenced using GPS. **The deforestation map will have value in implementing development projects and establishing policies to reduce the detrimental effects of deforestation.**

**Deforestation causes biodiversity loss and human extinction**

**Akhand Jyoti 3** (Akhand Jyoti is the leading magazine in Mathura, India. “The Disaster of Deforestation” March-April 2003. http://www.akhandjyoti.org/?Akhand-Jyoti/2003/Mar-Apr/Deforestation/)

**Imagining Earth without forests is a horrifying picture** to conceive. As its knowledge base has expanded and deepened, mankind has realised that **forests are extremely important to the survival of humans** and other life forms on earth. Yet deforestation continues unabated in different parts of the world. According to the World Resource Institute based at Washington DC (U.S.A.), the rates of rainforest destruction are 2.4 acre per second, 149 acres per minute, 214000 acres per day and 78 million acres per year. Literature survey and research by Stephen Hui reveals that British Columbia has about 40% of its original forests remaining, while Europe has less than half; the United States have approximately 1-2% of their original forest cover; **more than 80% of the planet’s natural forests have already been destroyed**.1 This article examines the importance of forests, the effects of deforestation on health and environment and an effective remedy to replenish the flora already lost. Plants and animals, along with microorganisms, comprise life on Earth. Herbivorous animals sustain their life by consuming plants. Carnivorous animals and birds kill herbivorous animals for food; therefore indirectly they also depend on plants. Sea creatures eat aquatic plants and humans consume crop plants. A large variety of birds feed on seeds. There would rarely be any animal or bird who do not use plants directly or indirectly to satisfy their food requirements. It is thus not surprising that tropical forests are the home to 70% of the world’s plants and animals (more than 13 million distinct species) 30% of all bird species and 90% of invertebrates.**2 Loss of forests has led to the extinction of thousands of species, estimated to be 50000 species annually. Besides being the source for food, plants help us in a number of other ways. Animals, including humans, inhale oxygen and exhale carbon dioxide; plants take up carbon dioxide and in return they release oxygen – this exchange is very important. Forests in particular act as a huge carbon dioxide sink. If there were not enough trees to absorb carbon dioxide, its accumulation would make the environment poisonous.** Over the last 150 years, the amount of carbon dioxide has increased by about 25%.3 Carbon-dioxide also contributes to global warming.

### Spills in SQO

**Magnitude of offshore drilling leads to future spills – its just a question of the cleanup**

Myles **Spicer** 05/07/**10** “Gulf oil drilling has high risk, too little reward” MinnPost.com also known as MinnPost is a non-profit [news](http://en.wikipedia.org/wiki/News) website in Minneapolis, Minnesota, with a focus on Minnesota news

The real dangers and damages To begin with, **there are currently 115 oil rigs operating in the Gulf of Mexico** — and **each provides an opportunity and exposure for another mishap and major crisis**. Many are doing **exactly the kind of extreme deep-water drilling the BP platform was doing** — and extending technology into areas not entirely understood or well managed by the oil industry (as is the BP situation shows). More important, there are about 500 offshore rigs operating worldwide, and they have been far from safe. **Offshore operators continue to spill thousands of barrels of oil, fuel and chemicals into federal waters each year, government records show**. "This is not a zero-risk proposition," said John Rogers Smith, an associate professor of petroleum engineering at Louisiana State University, who monitors such statistics. **Offshore operators have had 40 spills greater than 1,000 barrels since 1964, including 13 in the past 10 years**, according to data from the U.S. Minerals Management Service, which oversees exploration and production in federal waters. Moreover, spills from the rigs and actual drilling, are only part of the story. Drilling offshore has other potential dangers:

**High risk of oil spills**

[Steven **Mufson**](http://www.washingtonpost.com/steven-mufson/2011/03/09/ABX9PoP_page.html), April 19, 20**12** “Two years after BP oil spill, offshore drilling still poses risk” Steven Mufson is a staff writer covering energy and other financial news. He has worked at the Washington Post since 1989 and has been its chief economic policy writer, Beijing correspondent, diplomatic correspondent and deputy editor of the weekly Outlook section. Earlier, he spent six years working for The Wall Street Journal in New York, London and Johannesburg and wrote a book about the 1980s uprisings in South Africa’s black townships.

**Two years after a blowout on BP’s Macondo well killed 11 men and triggered the largest oil spill in U.S. history, oil companies are again plying the waters of the Gulf of Mexico**. **Forty-one deep-water** [**rigs are in the gulf**](http://www.rigzone.com/data/results.asp). The vast majority of them are drilling new holes or working over old ones, while the other behemoths are idle as they await work or repairs. A brand new rig — the South Korean-built [Pacific Santa Ana](http://pacificdrilling.com/Operations/Pacific-Santa-Ana/default.aspx), capable of drilling to a depth of 7.5 miles — is on its way to a Chevron well. But three recent incidents in other parts of the world show just how risky and sensitive offshore drilling remains. **In the North Sea, French oil giant** [**Total is still battling**](http://www.elgin.total.com/elgin/) **to regain control of a natural gas well that has been leaking for nearly four weeks.** Meanwhile, **Brazil has confiscated the passports of 11 Chevron employees and five employees of drilling contractor Transocean** as they await trial **on criminal charges related to an offshore oil spill there**. And **in December, about 40,000 barrels of crude** [**oil leaked out of a five-year-old loading line**](http://www.shell.com.ng/home/content/nga/aboutshell/media_centre/news_and_media_releases/bonga/) **between a floating storage vessel and an oil tanker in a Royal Dutch Shell field off the coast of Nigeria**. **Many experts say that even with tougher regulations here in the United States, such incidents are inevitable**. “I’m not saying we shouldn’t do it [offshore drilling], but we ought to go at it with our eyes open,” said Roger Rufe, a retired Coast Guard vice admiral. “We can’t do it with a human-designed system and not expect that there will be occasional problems with it.” Shell is one company particularly anxious to avoid the slightest whiff of trouble. It is on the verge of getting the final two permits needed to drill this summer in the Chukchi Sea, off Alaska’s Arctic Coast, a plan that has aroused opposition from a broad array of environmental groups. So on April 10 when federal regulators told Shell that they had spotted a 1-by-10-mile oil sheen in the eight miles of water between two Shell production platforms in the Gulf of Mexico, executives acted quickly. They promptly mobilized an oil cleanup vessel and sent two remotely operated underwater vehicles to scour the sea floor. It turned out that the oil — only six barrels — came from a natural seep common in the gulf. “Post-Macondo, there’s no such thing as a small spill,” said an executive from another big oil company, who asked for anonymity because he was not authorized to comment. With the anniversary of the BP spill, many experts are reassessing U.S. progress since the accident. And environmentalists are assessing damages. [A National Wildlife Federation report](http://www.nwf.org/News-and-Magazines/Media-Center/News-by-Topic/Wildlife/2012/%7E/media/PDFs/Wildlife/NWF_WildlifeWetlandsStatusReport_4-18-12_final.ashx) said, for example, that the shrimp catch increased last year but that since the spill 523 dolphins have been stranded onshore, four times the historic average; 95 percent of them were dead. A team of scientists led by Peter Roopnarine of the California Academy of Sciences said oysters collected post-spill contain higher concentrations of heavy metals in their shells, gills and muscle tissue than those collected before the spill.

**Push for oil risks catastrophic spills**

**The PEW Environmental group, 2010**. Oceans North U.S. http://oceansnorth.org/oil-spill-risks

The search for oil is pushing into ever more remote corners of the world – including the U.S. Arctic Ocean. Diminishing sea ice is increasing access to Arctic waters, potentially enabling industrial activities such as shipping and oil and gas development. But industrial development in U.S. Arctic waters brings a new set of challenges and a larger set of risks than in other oceans. In the Arctic, people and machinery will be working in some of the most remote and harshest conditions on the planet. The track record of the oil and gas industry shows that despite safeguards, equipment fails, mistakes are made and accidents happen. British Petroleum’s Deepwater Horizon blowout in the Gulf of Mexico provides a vivid illustration of the risks of offshore oil and gas activity. The rig exploded on April 20, 2010, killing 11 workers. Two days later, the rig sank, causing a disastrous spill that eventually spewed 205,000,000 barrels of oil into the Gulf before BP was able to plug the well three months later. If anything goes wrong in the Arctic, oil will spill into a highly sensitive marine environment. The combination of oil and ice could be disastrous to the ecosystem and nearly impossible to clean up.

### Deforestation IL

**Deforestation causes biodiversity loss and extinction**

**Abiola 97** (Jayeola Omotola Abiola is an Undergraduate, Department of Forestry and Wildlife Management, College of Environmental Resources Management, University of Agriculture, P.M.B. 2240, AbeoLuta, Ogun State, Nigeria. “FORESTRY FOR SUSTAINABLE DEVELOPMENT: TOWARD THE 21st CENTURY” http://www.fao.org/forestry/docrep/wfcxi/publi/V8/Ee/V8E\_E1.HTM)

**Forest degradation as a result of deforestation ignites a lot of problems for human existence and** the problem if unchecked **can cause further ecological problems leading to human extinction. Forest clearing** due to logging, land degradation resulting from shifting cultivation social and economic development, range10 depletion as a result of overgrazing, project execution without environmental impact assessment (EIA) **leads to climatic changes, global warming, loss of biological diversity pollution and desertification. The tropical forest ecosystem** which **has been described as home to more than half the earth's species** (Spore 59 1995) has been disappearing at the rate of tens of thousands of square kilometers per year. Over this period, tropical deforestation rate increased by more than 50 percent and the world lost 10% of its tropical forest**. Loss of biological diversity is another major area of` concern** in forestry for sustainable development. **Countless plants and animals have been driven into extinction through deforestation, thus contributing to the build up of green house gases.** Biodiversity is a comprehensive word for the degree of nature variety including both the number and frequency of ecosystems, species and genes in a given assemblage (Mc Neely 1988). **Biological diversity is a word which embraces both species richness and genetic diversity of an ecosystem, both of which are threatened. Throughout the world, species extinction and a reduction in genetic variability is taking place at rates never before witnessed, especially in the tropical forests which are often thought of as being the richest area.** These losses can be attributed to various factors including pollution, physical disturbance of the forest, exploitation for food and other uses, deliberate extirpation, habitat loss and fragmentation.

**Deforestation causes biodiversity loss and extinction**

**Rochen and Stock 98** (Andy Rochen and Jocelyn Stock are undergraduate researchers at the University of Michigan. “Deforestation and Society” http://www.umich.edu/~gs265/society/deforestation.htm)

**To understand why deforestation is such a pressing and urgent issue, forests must first be given credit for what they bring to global ecosystems and the quality of life** that all species maintain. **Tropical Rainforests presently give a place to call home for 50% - 90% of all organisms, 90% of our relatives**, the primates, **and 50 million creatures that can live no place but** the rich **rainforests** (World Rainforest Movement 16). **Not only are other species at risk, but the human race also** benefits from what the trees give. **From** something as minor as the spices that indulge food to **life giving medicines, the rainforests** amplify and **save lives**. According to the World Rainforest Movement, **25% of medicines come from the forests** (28). **This is a number that does not do justice to all the cures that have yet to be discovered or that have been destroyed. The forests give life, not only to other species, but they help to prolong the human race**. The forests have global implications not just on life but on the quality of it. Trees improve the quality of the air that species breath by trapping carbon and other particles produced by pollution. Trees determine rainfall and replenish the atmosphere. As more water gets put back in the atmosphere, clouds form and provide another way to block out the sun’s heat. Trees are what cool and regulates the earth’s climate in conjunction with other such valuable services as preventing erosion, landslides, and making the most infertile soil rich with life. Mother earth has given much responsibility to trees.

### Climate Change IL

#### Deforestation drives climate change

National Geographic, 2011, “Deforestation” National Geographic Society, http://environment.nationalgeographic.com/environment/global-warming/deforestation-overview/

**Deforestation is clearing Earth's forests on a massive scale**, often resulting in damage to the quality of the land. **Forests still cover about 30 percent of the world’s land area, but swaths the size of Panama are lost each and every year**. **The world’s rain forests could completely vanish in a hundred years at the current rate of deforestation**. Forests are cut down for many reasons, but most of them are related to money or to people’s need to provide for their families. **The biggest driver of deforestation is agriculture. Farmers cut forests to provide more room for planting crops or grazing livestock**. Often many small farmers will each clear a few acres to feed their families by cutting down trees and burning them in a process known as “slash and burn” agriculture. Logging operations, which provide the world’s wood and paper products, also cut countless trees each year. Loggers, some of them acting illegally, also build roads to access more and more remote forests—which leads to further deforestation. Forests are also cut as a result of growing urban sprawl. Not all deforestation is intentional. Some is caused by a combination of human and natural factors like wildfires and subsequent overgrazing, which may prevent the growth of young trees. **Deforestation has many negative effects on the environment. The most dramatic impact is a loss of habitat for millions of species.** Seventy percent of Earth’s land animals and plants live in forests, and many cannot survive the deforestation that destroys their homes. **Deforestation also drives climate change. Forest soils are moist, but without protection from sun-blocking tree cover they quickly dry out. Trees also help perpetuate the water cycle by returning water vapor back into the atmosphere. Without trees to fill these roles, many former forest lands can quickly become barren deserts.**

### Bio D IL

**Oil Spills kill thousands of animals causing loss of biodiversity**

Larry **West** finalist for the Pulitzer Prize and received the Meeman Award for national environmental reporting from the Scripps Howard Foundation served as press secretary and deputy chief of staff for a U.S. Representative, and was communications director for a U.S. Senator. He also managed public affairs for a leading global technology company, the Federal Aviation Administration, and one of the largest ports in the United States. 20**10**. “How do Oil Spills Damage The Environment?” http://environment.about.com/od/petroleum/a/oil\_spills\_and\_environment.htm

Oil Spills Kill BirdsOil-covered birds are practically a universal symbol of the environmental damage wreaked by oil spills. Any oil spill in the ocean is a death sentence for sea birds. Some species of shore birds may escape by relocating if they sense the danger in time, but sea birds that swim and dive for their food are sure to be covered in oil. Oil spills also damage nesting grounds, which can have serious long-term effects on entire species. The 2010 BP Deepwater Horizon offshore oil spill in the Gulf of Mexico, for example, occurred during prime mating and nesting season for many bird and marine species, and the long-term environmental consequences of that spill won't be known for many years. Oil spills can even disrupt migratory patterns by contaminating areas where migrating birds normally stop. Even a small amount of oil can be deadly to a bird. By coating the feathers, oil not only makes it impossible for birds to fly but also destroys their natural waterproofing and insulation, leaving them vulnerable to hypothermia or overheating. As the birds frantically try to preen their feathers to restore their natural protections they often swallow some of the oil, which can severely damage their internal organs and lead to death. The Exxon Valdez oil spill killed somewhere between 250,000 and 500,000 seabirds, plus a number of shore birds and bald eagles. Oil Spills Kill Marine Mammals Oil spills frequently kill marine mammals such as whales, dolphins, seals and sea otters. The deadly damage can take several forms. The oil sometimes clogs the blow holes of whales and dolphins, making it impossible for the animals to breathe properly and disrupting their ability to communicate. Oil coats the fur of otters and seals, leaving them vulnerable to hypothermia. Even when marine mammals escape the immediate effects, an oil spill can cause damage by contaminating their food supply. Marine mammals that eat fish or other food that has been exposed to an oil spill may be poisoned by the oil and die or can experience other problems. The Exxon Valdez oil spill killed thousands of sea otters, hundreds of harbor seals, roughly two dozen killer whales and a dozen or more river otters. Even more troubling in some ways, in the years after the Exxon Valdez oil spill scientists noted higher death rates among sea otters and some other species affected by the oil spill, and stunted growth or other damage among other species. Oil Spills Kill Fish Oil spills often take a deadly toll on fish, shellfish and other marine life, particularly if large numbers of fish eggs or larvae are exposed to the oil. The shrimp and oyster fisheries along the Louisiana coast were among the first casualties of the 2010 BP Deepwater Horizon offshore oil spill. Similarly, the Exxon Valdez oil spill destroyed billions of salmon and herring eggs. Those fisheries still have not recovered. Oil Spills Destroy Wildlife Habitat and Breeding Grounds The long-term damage to various species, and to the habitat and nesting or breeding grounds those species depend upon for their survival, is one of the most far-reaching environmental effects caused by oil spills. Even many species that spend most of their lives at sea—such as various species of sea turtles—must come ashore to nest. Sea turtles can be harmed by oil they encounter in the water or on the beach where they lay their eggs, the eggs can be damaged by the oil and fail to develop properly, and newly hatched young turtles may be oiled as they scurry toward the ocean across an oily beach. Ultimately, the severity of environmental damages caused by a particular oil spill depends on many factors, including the amount of the oil spilled, the type and weight of the oil, the location of the spill, the species of wildlife in the area, the timing or breeding cycles and seasonal migrations, and even the weather at sea during and immediately after the oil spill. But one thing never varies: oil spills are always bad news for the environment.

### GPS Key to BioD

#### Telemetry (GPS) is key to preserving endangered species populations

Cooke ‘08

[Steven J., Dept. of Biology and Institute of Environmental Science @ Carleton University (Ontario), Endgangered Species Research, Vol. 4, January, p. 176]

**Knowledge of the reproductive biology of animals is critical to understanding population dynamics, particularly in the case of endangered species. For many endangered species, there is a rudimentary understanding of basic natural history information related to reproduction**, including the reproductive timing and output, **which is critical to the understanding of endangerment risk and status. One of the unique characteristics of telemetry and technology is that it enables the same individuals to be monitored throughout multiple periods of their life cycle.**

When an animal engages in reproduction, additional information can be obtained with respect to differential reproductive success, age at maturation, and reproductive output. For example, Litzgus & Mousseau (2006) used radio telemetry to study the reproductive biology of spotted turtle Clemmys guttata in South Carolina, USA. They documented the timing of courtship, the proportion of females that were gravid in each year, the timing duration of the nesting period, nesting times (nocturnal) and habitats, and clutch size. Palomares et al. (2005) used radio tracking over a 9 yr period to study the reproductive biology of the Iberian lynx Lynx pardinus, the most endangered felid in the world, in a population in southwestern Spain. The authors found that the potential breeding subpopulation was usually composed of 3 adult females (which were tracked for almost their complete reproductive life) with a lifetime reproductive output of between 11 and 19 cubs. However, mortality rates for young (predispersal) cubs were sufficiently high that the authors proposed the extraction of cubs from a mother with a low survival probability. In some cases, **telemetry can be used to locate reproductive sites, enabling researchers to collect data on reproductive potential**. For example, Fox et al. (2000) used both acoustic and radio telemetry to monitor the movements of endangered adult Gulf sturgeon Acipenser oxyrinchus desotoi as they moved between Choctawhatchee Bay **and** the Choctawhatchee River system. Telemetry results coupled with egg sampling were used to identify Gulf sturgeon spawning sites, the timing of reproduction, and sex-specific behaviour. Results from histology and their telemetry data supported the hypothesis that male Gulf sturgeon may spawn annually, whereas females require more than 1 yr between spawning events. By combining telemetry with other approaches (e.g. histology, in the above example) **conservation scientists can elucidate the subtle mechanisms of reproductive biology to improve conservation efforts**.

#### GPS essential to track oil spills, help preserve endangered species, increase the effectiveness of conservation programs, anticipate earthquakes – accuracy and consistency of the data is key to solve

The National Coordination Office for Space-Based PNT, 12

Positioning, Navigation, and Timing, February 17, 2012, ”Environment,” GPS.Gov, http://www.gps.gov/applications/environment/

To sustain the Earth's environment while balancing human needs requires better decision making with more up-to-date information. Gathering accurate and timely information has been one of the greatest challenges facing both government and private organizations that must make these decisions. The Global Positioning System (GPS) helps to address that need. Data collection systems provide decision makers with descriptive information and accurate positional data about items that are spread across many kilometers of terrain. By connecting position information with other types of data, it is possible to analyze many environmental problems from a new perspective. Position data collected through GPS can be imported into geographic information system (GIS) software, allowing spatial aspects to be analyzed with other information to create a far more complete understanding of a particular situation than might be possible through conventional means. Aerial studies of some of the world's most impenetrable wilderness are conducted with the aid of GPS technology to evaluate an area’s wildlife, terrain, and human infrastructure. By tagging imagery with GPS coordinates it is possible to evaluate conservation efforts and assist in strategy planning. Some nations collect and use mapping information to manage their regulatory programs such as the control of royalties from mining operations, delineation of borders, and the management of logging in their forests. GPS technology supports efforts to understand and forecast changes in the environment. By integrating GPS measurements into operational methods used by meteorologists, the atmosphere’s water content can be determined, improving the accuracy of weather forecasts. In addition, the proliferation of GPS tidal tracking sites, and improvement in estimating the vertical component of a site’s position from GPS measurements, present a unique opportunity to directly observe the effects of ocean tides. GPS receivers mounted on buoys track the movement and spread of oil spills. Helicopters use GPS to map the perimeter of forest fires and allow efficient use of fire fighting resources. The migratory patterns of endangered species, such as the mountain gorillas of Rwanda, are tracked and mapped using GPS, helping to preserve and enhance declining populations. In earthquake prone areas such as the Pacific Rim, GPS is playing an increasingly prominent role in helping scientists to anticipate earthquakes. Using the precise position information provided by GPS, scientists can study how strain builds up slowly over time in an attempt to characterize, and in the future perhaps anticipate, earthquakes. Another benefit to using GPS is timeliness with which critical products can be generated. Because GPS data are in a digital form available at all times and in all parts of the world, they can be captured and analyzed very quickly. This means that it is possible for analysis to be completed in hours or days rather than weeks or months, thus ensuring that the final product is timelier. With the rapid pace of change in the world today, these savings in time can be critical. The modernization of GPS will further enhance the support of GPS technology to the study and management of the world’s environment. The United States is committed to implementing two additional civilian signals that will provide ecological and conservation applications with increased accuracy, availability, and reliability. Tropical rain forest ecology, for example, will benefit from the increased availability of GPS within heavy foliage areas and the reduction of spatial error in fine-scale vegetation mapping.

#### GPS key to species protection

Bhatta ‘10

[Basudeb, PhD in Engineering, Senior Systems Engineer @ Jadavpur University; *Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others*, p. 306-7]

**Positioning systems could enable animal management in different types of applications. At first sight, it could help in defining migration movements of wild animals.** **This** has already been achieved through the installation of miniaturized GNSS receivers coupled to transmitting devices; which **allows animals to be followed continuously in real-time. It is also helpful in the case of protected species.** By permanent monitoring, any harm done to the animal can be precisely dated and located, allowing optimized pursuits. This can also help human populations located near dangerous wild animals, in detecting their presence and coping with sharing the same environment. This locating feature can be used to study very specific wild behavior such as the sense of orientation developed by travelling pigeons. Equipped with miniaturized recording receivers, it has been possible to know the route followed by pigeons. Of course, even with this information the mystery has not yet been solved, but this is an appreciable tool to study. GNSS is also being used for tracking domestic animals and pets (Fig. 10.15).

#### GPS-based wildlife tracking offers substantial improvements over existing technologies – allows for more in-depth studies, better information – Signal Interruption prevents widespread adoption

Frair ‘10

[Jacqueline L., SUNY College of Envt’l Science and Forestry, et al; “Resolving Issues of Imprecise and Habitat-Biased Locations in Ecological Analyses Using GPS Telemetry Data,” Philosophical Transactis of the Royal Society; No. 365; p. 2187]

**Radio-collars and other platforms equipped with** global positioning systems (**GPS) document animal activity under cloak of darkness and inclement weather conditions, providing a continuous record of animal locations that remains unobtainable using traditional technologies** such as very high-frequency (VHF) devices (White & Garrott 1990; Beyer & Haufler 1994; Rogers et al. 1996; Tomkiewicz et al. 2010). **The systematic and frequent recording of animal locations by on-board GPS units facilitates greater resolution in the study of habitat selection** (Johnson et al. 2002b; Boyce et al. 2003), **deeper insight into animal movements** (Morales et al. 2004; Frair et al. 2005; Fryxell et al. 2008), **and** novel investigations into **animal behaviour** (e.g. Anderson & Lindzey 2003; Merrill et al. 2010). **Although GPS applications have transformed contemporary wildlife studies** (Hebblewhite & Haydon 2010), **the technology** **comes with** its problems. High up-front unit costs, **rare but catastrophic equipment failures** (i.e. computer glitches or failed breakaway devices), and trade-offs between GPS location collection intervals and unit longevity lead generally to fewer monitored individuals and shorter study durations compared with VHFbased studies (Johnson et al. 2002a; Gau et al. 2004; Hebblewhite et al. 2007). Moreover, decreasing the interval between recorded locations increases the level of autocorrelation in the resulting data. As a result, analysts of GPS telemetry data face even greater challenges for deriving population-level inferences (Lindberg & Walker 2007; Fieberg et al. 2010).

#### Advancements in GPS technology allow tracking through canopied forests

Wing ‘08

[Michael, Professor of Forest Engineering @ Oregon State University; *Journal of Forestry,* September; *p*. 337]

With an additional fully operational satellite system predicted within the next several years and expected improvements to the current NAVSTAR constellation. **GPS receiver operators in forested environments and steep terrain will likely enjoy greater accuracies and efficiencies in collecting measurements**. It is also likely that GPS hardware and software will become more affordable and versatile as satellite presence increases. GPS technology has found its way into mainstream society today with availability in cell phones and other compact forms. **As GPS continues to mature, the value and potential applications of GPS technology in forested settings will also increase**.

#### GPS key to preventing biodiversity loss

Greg **Bratlet**, administrator of rmtracking.com. February 26, 20**11**. Rocky Mountain tracking Daily GPS News. http://www.rmtracking.com/blog/2011/02/26/gps-tracking-devices-help-endangered-species/

Researchers have found GPS tracking devices useful in gathering information on many species of wildlife, from Kenyan lions to Bengal tigers. Conservationist programs all over the world have discovered the value of these tiny information gatherers. These amazing devices are satellite powered, and are unique because they function in almost any location in the world. Although they are used in many areas of life, the realm of science has found GPS tracking units particularly useful. Scientists often use GPS technology to follow an animal in its natural habitat. Usually an animal is caught and fitted with a GPS tracking device such as a collar, and then set free to resume its normal habits. Researchers can then track the animal’s location from the signals they receive from the GPS device. Scientists have used GPS technology to learn more about an animal’s migration pathway, feeding habits, and even disease that may be threatening a population. Conservationists in Nepal are currently experimenting with GPS tracking on Royal Bengal tigers. These beautiful animals are found mostly in Nepal, Bhutan, and India. As an endangered species, Bengal tigers are prime candidates for GPS tracking studies. The World Wildlife Fund (WWF) recently equipped a Royal Bengal tiger with a GPS tracking system. The purpose of the study is to find out more about Bengal tigers’ habitat, especially breeding grounds. The number of Bengal tigers has dramatically dropped since 1900, mostly because of poachers. War in Nepal was also a contributing factor, since the conflict drove some tigers from their natural habitat. The WWF researchers hope to gain enough information from this study to preserve the tigers’ habitat in order to facilitate breeding. World Wildlife Fund also plans to develop a strategy to protect the endangered tigers from poachers. Conservationists in Kenya and Tanzania are using GPS tracking devices for a different purpose. These activists are fitting lions with GPS collars not to protect the lions, but to protect the lion’s prey. In some areas of Africa, many livestock are lost due to frequent lion attacks. The local conservationist organization in Kenya, Living with the Lions Trust, plans to further test the GPS tracking system this summer. Initial tests have proven successful, and the conservationists involved hope the satellite tracking system will provide a solution to the lion attacks. Many scientists in the past have used GPS tracking to assist various animal populations. These conservationists in Africa and the Himalayas are also discovering how useful GPS technology can be

#### GPS essential to biodiversity

TSD, 14 June, 20**11**. “Monitoring Animals For Preservation” Tracking System Direct. http://www.tracking-system.com/news/3-tracking-system-information/931-gps-tracking-endangered-species.html

First of all, it is important to note that this article is in no way suggesting a GPS tracker be equipped to significant portions of an animal species that is classified as endangered, but rather suggesting those species categorized as "endangered" undergo more meticulous observation. GPS tracking makes logical sense for wildlife tracking applications because the devices can: 1. Document how long a target species stays in a particular location. 2. Account for movements during mating and/or hibernation seasons. 3. Provide analysis on potential harmful interactions between the endangered species and humans or predators. 4. Transmit alerts if an animal equipped with a tracker enters or exits a pre-set region. All of this information is critical to helping scientists understand the likely cause for the decline in population among a particular species, and result in the creation of new hypothesis' on what measures can be made to ensure the continued survival of that species. Currently, scientists all across the globe use real-time GPS systems to monitor everything from the impact of poaching among tiger and elephant populations, to mating patterns of baby turtles off the coastal regions of Hawaii.

**GPS crucial to improving biodiversity**

Brian **Klinkenberg,** Department of Geography, University of British Columbia, 2010. “THE USE OF GEOSPATIAL TECHNOLOGIES AND SPATIAL ANALYSIS IN BIODIVERSITY STUDIES” Biodiversity of British Columbia. http://www.geog.ubc.ca/biodiversity/gisbiodiversity.html

The advent of geospatial technologies has dramatically changed the way we study the natural world.  Spatial analyists now use advanced remote sensing techniques to assess climate change and air pollution transport, GPS and remote sensing to study migration of elephants and wildebeasts, and GIS mapping software to map and analyze species distributions. In this section, we explore spatial analysis and the role of  geospatial technologies in exploring and understanding biodiversity.  The evolution and widespread use of these geospatial technologies has opened new windows on how we view biodiversity and associated complexities.  Additionally, the availability of these technologies at the public level has brought in new avenues of data gathering, with VGI (Volunteer Geographic Information) and citizen science playing prominent roles in some areas of study.

#### First step toward species protection depends on accurate data to map population dynamics and geographic range

Cooke ‘08

[Steven J., Dept. of Biology and Institute of Environmental Science @ Carleton University (Ontario), *Endgangered Species Research*, Vol. 4, January, p. 166]

**The first step to initiating conservation actions for endangered organisms is to identify the populations or species that are in decline** (deterministic processes) **or are faced with risk of extinction** because they are small (stochastic processes; Caughley 1994, Brook et al. 2006). **Key to this process is the use of objective, quantifiable, and consistent criteria to assess the status of a species**. Included in this analysis is the identification of threats which are used to inform conservation actions if required. **Globally, the Species Survival Commission** (SSC) of the IUCN World Conservation Union (IUCN; www.iucn.org) produces the IUCN Red List of threatened species (i.e. the Red List). The Red List classifies globally endangered plant and animal taxa and is regarded as the most comprehensive and authoritative list of its kind (Lamoreux et al. 2003, Rodrigues et al. 2006). IUCN has developed a clear and standardized framework for the assessment of species status which **increasingly relies on rigorous scientific input** (rather than subjective expert opinion) **and has become more recognized by the scientific community as a valuable and necessary tool in biodiversity conservation and research** (Rodrigues et al. 2006). Nonetheless, decisions are often made in the face of uncertainty because for many species we do not have a complete understanding of their natural history, let alone their demography (Akçakaya et al. 2000).

A candidate species (or group of species) is evaluated relative to a number of criteria which are then used by the IUCN and their expert panels to assess the need for designation within formal categories, including threatened, endangered, critically endangered, and extinct (Mace 1994). **Formal thresholds based on population size, population dynamics, geographic range, connectivity, etc. are used for categorization**. Once an animal has been classified as ‘endangered’, recovery plans can be developed and conservation actions implemented (Mace 1995, Collar 1996). For instances in which there is insufficient information to assess the status, the phrase ‘data deficient’ is used. Similar assessments also occur at a local, regional, and national scale, although many rely at least in part on the IUCN criteria (Gardenfors et al. 2001, Miller et al. 2007). In recent years, the Red List is increasingly being used not only as a system for assigning endangerment status, but also as a means of aiding conservation science, although the utility of this for some groups is limited (Hayward et al. 2007a). Indeed, Butchart et al. (2005) suggested that Red List indices could be used to evaluate progress towards meeting biodiversity targets. For the Red List and other related assessments **to be useful in conservation, data used to evaluate and assign endangerment status must be rooted in sound, robust science**. Scientific data that form the basis of threat identification and endangerment assessments typically come from field studies of natural history and population biology. The study of animal ecology and demographics is challenging, as many species tend to avoid human observers and travel great distances, often in environments that present numerous challenges to humans. As a result, population estimates generated for wildlife populations are notoriously fraught with bias and error, which brings uncertainty to threat assessments and the management (see Williams et al. 2002). However, **improvements in statistical techniques and, more critically, innovations in technology, have enabled scientists to generate robust population estimates and to understand the extent to which different populations interact (which is linked to the declining population paradigm**). In particular, **methods** **such as biotelemetry** and biologging (defined below; herein biotelemetry is simply called ‘telemetry’ and biologging ‘logging’) are increasingly being applied to the study of animal ecology in the wild because they **can provide detailed information on the fundamental biology of animals, including assessments of behaviour, survivorship, spatial ecology (i.e. the distribution of animals in space and time), energetics, and physiology that is often unattainable using other techniques** (Cooke et al. 2004, Block 2005, Ropert-Coudert & Wilson 2005, Hooker et al. 2007). Telemetry and logging are also being used to address more applied questions associated with wildlife medicine (Karesh 1999) and wildlife management (Millspaugh & Marzluff 2001). However, only in the last decade or so have these tools been regarded as having utility in studies specifically related to animal conservation.

### GPS Solves Oil Spills

**GPS used in tracking and cleaning oil spills**

Christopher **Jablonski** is a freelance technology writer. August 3, 20**08**. “Robot buoy to track oil spills”. ZDnet. http://www.zdnet.com/blog/emergingtech/robot-buoy-to-track-oil-spills/999

Yesterday, *Japan Today* reported about a prototype of robotic buoy developed at Osaka University to fight sea pollution in the event of an environmental disaster caused by an oil spill. The current prototype, dubbed SOTAB (short for 'Spilled Oil Tracking Autonomous Buoy') is a 110-kilogram GPS-equipped robot. The cylindrical buoy has a length of 2.7 meters and a diameter of 27 centimeters. The lead researcher admits that these robots will not be really ready before at least three years. But he would like to have these buoys installed on all oil tankers to be automatically dropped in the sea in case of an accident. But read more... You can see on the left a photo of the SOTAB 1 robotic buoy. There are several pictures of this prototype 'floating' on the Web. This one comes from this page at TreeHugger. This robot buoy has been designed by Naomi Kato, professor of submersible robotic engineering at the Department of Naval Architecture at Osaka University, Japan, with the members of his lab. The 'Katolab' "is conducting education and research on underwater robotics, biomechanics on aquatic animals and its application to engineering, computational hydrodynamics of viscous flow fields." You'll find more details about this robotic buoy by looking at this specific research project, Development of Spilled Oil Autonomously Chasing Buoy System. According to *Japan Today*, here is how Kato justifies the usage of such buoys. "'The development of an oil field in Russia's Sakhalin and Chinese economic expansion will likely lead to increased tanker traffic in Japanese coastal waters.' The buoy is intended to be deposited along the edge of an oil slick in the sea at the time of an accident. A sensor to analyze the stickiness of liquids detects heavy oil, which is more glutinous than sea water."

**GPS tracking key to cleaning oil spills**

Mark **Francis** 20 december, 20**10. “**Methods for observing and recording”Oil Spill Solutions. http://www.oilspillsolutions.org/evaluation.htm

Precise observation will be done using available nautical charts and maps of the region. It is also necessary to have basic information, such as the location of the spill, the pertinent coastal characteristics and the type of oil spilled, in order to know the rate of spreading. During the flight, careful annotation should be made of all of the locations where contamination could possibly occur.  Pertinent characteristics should be recorded in order to make possible the preparation with confidence of an informative flight report. In particular, the efforts of response are concentrated on the most significant areas of the spill. It is important to record the denser concentrations of oil.  The GPS equipment of the aircraft also permits the definition of the location of oil slicks. Photography, especially digital, is also a useful tool for recording information and allows others to see the situation at the location of the accident.  Dedicated remote sensing aircraft frequently have built-in photographic equipment linked to a GPS in order to accurately determine geographic coordinates.

### GPS Key to Climate Modeling

#### GPS will play an increasingly important role in monitoring and tracking climate change

ScienceDaily (June 30, 2007) http://www.sciencedaily.com/releases/2007/06/070630060807.htm

"We are actually able to measure the amount of bending in the GPS beam as it passes through the atmosphere. We can then use that knowledge to more accurately measure atmospheric temperatures and use this to improve temperature fields and calibrate other satellite readings. This extra information, in the data-sparse southern hemisphere, is now making our forecasts more accurate."Professor Le Marshall said that "since the research was completed and began being used in forecasts this year, we estimate the Bureau is now delivering forecasts of the same accuracy 10 hours earlier."He predicts that, as techniques improve, GPS data will also play a bigger role in climate monitoring and severe weather warnings.Professor Kefei Zhang, Director of the RMIT SPACE Research Centre, said that GPS as a revolutionary technology for Positioning, Navigation and Timing (PNT), provided a low-cost, powerful means of precise measurement of the earth environment.

### GPS S Defo

**GPS essential to track deforestation**

**The National Coordination Office for Space-Based Positioning, Navigation, and Timing,** February 17, 20**12**, ”Environment,” GPS.Gov, http://www.gps.gov/applications/environment/

To sustain the Earth's environment while balancing human needs requires better decision making with more up-to-date information. Gathering accurate and timely information has been one of the greatest challenges facing both government and private organizations that must make these decisions. The Global Positioning System (GPS) helps to address that need. Data collection systems provide decision makers with descriptive information and accurate positional data about items that are spread across many kilometers of terrain. **By connecting position information with other types of data, it is possible to analyze many environmental problems from a new perspective**. Position data collected through GPS can be imported into geographic information system (GIS) software, allowing spatial aspects to be analyzed with other information to create a far more complete understanding of a particular situation than might be possible through conventional means. Aerial **studies** of some **of the world's** most impenetrable **wilderness are conducted with** the aid **of GPS technology to evaluate an area’s wildlife, terrain, and human infrastructure.** By tagging imagery with GPS coordinates **it is possible to evaluate conservation efforts and assist in strategy planning.** Some nations collect and use mapping information to manage their regulatory programs such as the control of royalties from mining operations, delineation of borders, and the management of logging in their forests. GPS technology supports efforts to understand and forecast changes in the environment. **By integrating GPS measurements into operational methods used by meteorologists, the atmosphere’s water content can be determined, improving the accuracy of weather forecasts**. In addition, the proliferation of GPS tidal tracking sites, and improvement in estimating the vertical component of a site’s position from GPS measurements, present a unique opportunity to directly observe the effects of ocean tides. **GPS receivers mounted on buoys track the movement and spread of oil spills. Helicopters use GPS to map the perimeter of forest fires and allow efficient use of fire fighting resources. The migratory patterns of endangered species, such as the mountain gorillas of Rwanda, are tracked and mapped using GPS, helping to preserve and enhance declining populations. In earthquake prone areas such as the Pacific Rim, GPS is playing an increasingly prominent role in helping scientists to anticipate earthquakes. Using** the precise position information provided by **GPS, scientists can study how strain builds up slowly over time in an attempt to characterize, and in the future perhaps anticipate, earthquakes.** Another benefit to using GPS is timeliness with which critical products can be generated. Because GPS data are in a digital form available at all times and in all parts of the world, they can be captured and analyzed very quickly. This means that it is possible for analysis to be completed in hours or days rather than weeks or months, thus ensuring that the final product is timelier. With the rapid pace of change in the world today, these savings in time can be critical. **The modernization of GPS will further enhance the support of GPS technology to the study and management of the world’s environment.** The United States is committed to implementing two additional civilian signals that will provide ecological and conservation applications with increased accuracy, availability, and reliability**. Tropical rain forest ecology, for example, will benefit from the increased availability of GPS within heavy foliage areas and the reduction of spatial error in fine-scale vegetation mapping.**

### NKT - BioD

#### Biodiversity loss on the brink- Now is key

Adrain Bishop, Journalist and editor for over 25 years, and owner of Yellow Online Media. May 2, 2012. “Biodiversity loss from species extinctions may rival pollution and climate change impacts” Earth Times. http://www.earthtimes.org/nature/biodiversity-loss-species-extinction-top-driver-global-change/1960/

Species extinction and loss of biodiversity could be as devastating for the earth as climate change and air pollution. That's the finding of a new study by a group of scientists from nine countries. The research aims for the first time to comprehensively compare the consequences of biodiversity loss with other possible environmental issues caused by humans. Ecologist and University of Michigan assistant professor, Bradley Cardinale, who helped write the study, says, "Loss of biological diversity due to species extinctions is going to have major impacts on our planet, and we better prepare ourselves to deal with them. These extinctions may well rank as one of the top five drivers of global change." The study, which suggests that more moves must be made to strengthen biodiversity at all levels, has just been published online in the *Nature* journal. Research conducted over the last 20 years has showed that production increases in ecosystems with the widest biodiversity. This raised worries that today's high extinction rates from harvesting increases, habitat reduction and other environmental issues, could affect vital issues such as food production, pure water and a stable climate. But until this study, it had been difficult to separate the effects due to the loss of biodiversity against problems caused by human activity. Lead author of the research, David Hooper, a Western Washington University biologist, says it had been believed that the effects of biodiversity were minor, but the findings of the new study suggests that future species loss has as big an effect on reducing plant production as global warming and pollution. The international team took data from 192 published studies and experimental to compare how different worldwide environmental factors affected the growth of plants **and how fungi and bacteria attacked dead plants**. They found that in places were species loss was low, affecting up to 20% of local plant species, there was a negligible impact on plant growth in the ecosystem and in species diversity. In areas with 21-40% extinction, plant growth was expected to fall by between 5-10%, which is equivalent to the likely impact of global warming and rising ultraviolet radiation caused by major ozone reduction. In the highest levels of species loss, from 41-60%, the impact would be similar to major factors of environmental change, including pollution of the ozone, acid decay of forests and pollution of nutrients

#### Biodiversity loss High now- Risk of extinction

Juliette Jowit, political correspondent at the Guardian News. March 2010. “Humans driving Extinction Faster Than Species Can Evolve, Say Experts” The Guardian. http://www.guardian.co.uk/environment/2010/mar/07/extinction-species-evolve

For the first time since the dinosaurs disappeared, humans are driving animals and plants to extinction faster than new species can evolve, one of the world's experts on biodiversity has warned. Conservation experts have already signalled that the world is in the grip of the "sixth great extinction" of species, driven by the destruction of natural habitats, hunting, the spread of alien predators and disease, and climate change. However until recently it has been hoped that the rate at which new species were evolving could keep pace with the loss of diversity of life. Speaking in advance of two reports next week on the state of wildlife in Britain and Europe, Simon Stuart, chair of the Species Survival Commission for the International Union for the Conservation of Nature – the body which officially declares species threatened and extinct – said that point had now "almost certainly" been crossed. "Measuring the rate at which new species evolve is difficult, but there's no question that the current extinction rates are faster than that; I think it's inevitable," said Stuart. The IUCN created shock waves with its major assessment of the world's biodiversity in 2004, which calculated that the rate of extinction had reached 100-1,000 times that suggested by the fossil records before humans. No formal calculations have been published since, but conservationists agree the rate of loss has increased since then, and Stuart said it was possible that the dramatic predictions of experts like the renowned Harvard biologist E O Wilson, that the rate of loss could reach 10,000 times the background rate in two decades, could be correct. "All the evidence is he's right," said Stuart. "Some people claim it already is that ... things can only have deteriorated because of the drivers of the losses, such as habitat loss and climate change, all getting worse. But we haven't measured extinction rates again since 2004 and because our current estimates contain a tenfold range there has to be a very big deterioration or improvement to pick up a change."

#### Biodiversity loss is at a high risk now

**NPG**, 26 August, 20**11.** Nature Publishing Group. http://www.nature.com/npg\_/index\_npg.html

Predicting the scale of biodiversity loss this century from climate change is a formidable challenge. At present we recognize about 2 million species, but estimates of the total number of species on Earth range from about 5.5 million to tens of millions. Despite our incomplete knowledge, we do know however that the promise of world leaders to significantly reduce the rate of global biodiversity loss by 2100 has failed. In 2002, Parties to the Convention on Biological Diversity committed to a significant reduction of the current rate of biodiversity loss at a global, regional and national level. Yet, at current rates species extinctions could very well outpace new discoveries. The decline in global biodiversity — which has been 30% since 1970 — continues unabated. In the oceans, overfishing has eroded blue-fin tuna numbers to 18% of their number just 40 years ago, and on land, deforestation removes millions of hectares of pristine forest habitat each year. A study last year that looked at a host of biodiversity impacts — from extinctions to shifts in distribution and habitat loss for terrestrial, fresh water and marine ecosystems worldwide — predicted that for a range of possible scenarios, biodiversity will continue to decline over the twenty-first century ([Science 330, 1496–1501; 2010](http://dx.doi.org/10.1126/science.1196624)). But how much of the ongoing and anticipated loss is attributable to climate change? Recent evidence suggests that one in every species could face extinction by 2100 from climate change alone ([Proc. Natl Acad. Sci. USA 108, 12337–12342; 2011](http://www.pnas.org/content/108/30/12337.abstract)). Yet, this startling figure may well be conservative. Although it has been possible to point to anthropogenic climate change as a driver of global biological changes, assessing the extent to which regional changes in biodiversity are caused by greenhouse-gas warming has proven particularly intractable, not least because of the need to disentangle the effects of climate change from those of other drivers such as pollution or overexploitation

#### Coastal populations increasing worldwide, heightening the risk of species loss & need for improved conservation through GPS

Schofield ‘07

[Gail, Department of Environmental and Natural Resources Management, University of Ioannina (Greece); et al; Journal of Experimental Marine Biology and Ecology, Vol. 347, p. 65]

**Increasing development and settlement of human populations in coastal locations has become an important issue worldwide, threatening the sustainability of many marine and coastal resources** (Arianoutsou, 1988; Argardy, 1994; Parra et al., 2006). **To facilitate wildlife conservation** and sustainable use of marine areas, **it is essential to understand the relationship between populations and their habitats** (Castilla, 2000; Canadas et al., 2005), **with knowledge about the impacts of environmental and anthropogenic parameters providing additional benefit** (Thompson et al., 2000; Tisdell and Wilson, 2002; Douglas-Hamilton et al., 2005; Preisler et al., 2006). However, quantification of such parameters is often difficult hence the ‘precautionary approach’ to protect wildlife is applied in many areas, whereby measures are introduced, such as the regulation of boating activity, to minimise disturbance across general regions (Thompson et al., 2000; Wilson et al., 2004; Lusseau, 2006; Sorice et al., 2006). In the case of sea turtles, nesting beach locations and relative nesting densities have been used to delineate the degree of protection offered by adjacent marine protection zones (Arapis and Margaritoulis, 1994). While this approach has shown relatively good success in general, core protection areas may not reflect actual areas of wildlife habitat use, as we have demonstrated in our study at the largest sea turtle rookery in the Mediterranean.

The **fine-scale detail of movement patterns obtained using** the **GPS** loggers during this study, **could not have been replicated using conventional telemetry** (Hays et al., 2001; Hulbert and French, 2001; Tremblay et al., 2006; Bradshaw et al., 2007). This has been made possible because the TrackTag™ GPS system calculates the position during post-processing rather than in real time (http://www.navsys.com). We have shown here how TrackTag™ **GPS loggers can now obtain large numbers of locations for marine species**. **The volume of data and degree of accuracy** obtained using the TrackTag™system **are greatly improved** in comparison to that obtained in previous GPS studies of marine wildlife (Sisak, 1998; Arai and Ono, 2002; Jay and Garner, 2002; Yasuda and Arai, 2005; Petersen et al., 2006), **facilitating fine-scale analysis and application to protected area management.**

**Environment at the tipping point**

**AP 12**(Associated Press, June 6 2012)http://www.ap.org/

RIO DE JANEIRO (AP) **– The earth's environmental systems "are being pushed towards their biophysical limits**," beyond which loom sudden, irreversible and potentially catastrophic changes, the [**United Nations**](http://content.usatoday.com/topics/topic/Organizations/Government+Bodies/United+Nations) **Environment Program warned** Wednesday. Bottom of Form In a 525-page report on the health of the planet, the agency paints a grim picture: **The melting of the polar ice caps, desertification in Africa, deforestation of tropical jungles, spiraling use of chemicals and the emptying out of the world's seas** **are just some of myriad environmental catastrophes posing a threat to life as we know it.** "As human pressures on the earth … accelerate**, several critical global, regional and local thresholds are close or have been exceeded**," the report says. "**Once these have been passed, abrupt and possibly irreversible changes to the life-support functions of the planet are likely to occur**, with significant adverse implications for human well-being." Such adverse implications include rising sea levels, increased frequency and severity of floods and droughts, and the collapse of fisheries, **said the report, which compiles the work of the past three years by a team of 300 researchers**. The bad news doesn't end there. **The report says about 20 percent of vertebrate species are under threat of extinction, coral reefs have declined by 38 percent since 1980, greenhouse gas emissions could double over the next 50 years, and 90 percent of water and fish samples** from aquatic environments **are contaminated by pesticides**. It adds that **of the 90 most crucial environmental goals**, **little or no progress has been made over the past five years on nearly a third of them, including global warming**. Significant progress has been made on just four of the objectives, the report says. "This is an indictment," UNEP executive director [Achim Steiner](http://content.usatoday.com/topics/topic/People/Politicians,+Government+Officials,+Strategists/World+Leaders/Achim+Steiner) said at a news conference in Rio De Janeiro, which is to host later this month a [U.N.](http://content.usatoday.com/topics/topic/U.N) conference on development that protects the environment. "We live in an age of irresponsibility that is also testified and documented in this report. "In 1992 (when the first of the agency's five reports was released) we talked about the future that was likely to occur. This report 20 years later speaks to the fact that a number of the things that we talked about in the future tense in 1992 have arrived," Steiner said. "Once the tipping point occurs, you don't wake up the next morning and say, 'This is terrible, can we change it?' That is the whole essence of these thresholds. We are condemning people to not having the choice anymore." Steiner called for immediate action to prevent continued environmental degradation, with its ever-worsening consequences. "Change is possible," he said, adding that the report includes an analysis of a host of environmental preservation projects that have worked. "Given what we know, we can move in another direction." The United Nations' upcoming Rio+20 conference on sustainable development would be the ideal forum to spearhead the kind of global action that's needed if the worst is to be avoided, Steiner said. However, the run-up to June 20-21 conference has been plagued with problems, as developing and developed countries continue to bicker over what the objectives of the event should be. Speaking in New York on Wednesday, U.N. Secretary-General Ban Ki-moon acknowledged that negotiations on a final document for the conference have been "quite difficult" but he said he was "cautiously optimistic" that the 193 U.N. member states will reach agreement. "**We live in a world of economic uncertainty, growing inequality and environmental decline**," Ban told a news conference at U.N. headquarters. "This (conference) is a once in a generation opportunity. … We need leaders to have political commitment and political courage and vision. Short-term measures will not be the answers. You need to have mid- and longer-term visions for sustainable development." UNEP spokesman [Nick Nuttall](http://content.usatoday.com/topics/topic/Nick+Nuttall) said the agency deliberately scheduled the release of its report to coincide with the run-up to the conference. "It tells, we hope in a polite way, but in a scientifically honest way, world leaders who are coming in a few weeks' time why they are coming and why they need to define an impressive outcome for everybody in the world," Nuttall said at the Rio news conference

### Bio D Terminal

#### Biodiversity loss leads to extinction

Coyne and hoekstra ‘7 - jerry coyne is a professor in the department of ecology and evolution at the university of chicago. Hopi e. Hoekstra is john l. Loeb associate professor in the department of organismic and evolutionary biology at harvard university and curator of mammals at harvard's museum of comparative zoology. ,“diversity lost as we head towards a lonely planet“, weekend australian, november 10, lexis  
**Extinction exacerbates global warming**: by burning rainforests, we're not only polluting the atmosphere with carbon dioxide (a greenhouse gas) but destroying the plants that can remove this gas from the air. Conversely, **global warming increases extinction,** directly (killing corals) and indirectly (destroying the habitats of Arctic and Antarctic animals). **As extinction increases, then, so does global warming**, **which in turn causes more extinction and so on, into a downward spiral of destruction.** Why, exactly, should we care**? Let's start with the most celebrated case: rainforests. Their loss will worsen global warming, raising temperatures, melting icecaps and flooding coastal cities**. And, as the forest habitat shrinks, so begins the inevitable contact between organisms that have not evolved together, a scenario played out many times and one that is never good. **Dreadful diseases have successfully jumped species boundaries, with humans as prime recipients**. We have got AIDS from apes, severe acute respiratory syndrome from civets and Ebola from fruit bats. **Additional worldwide plagues from unknown microbes are a real possibility**. But it isn't just the destruction of the rainforests that should trouble us. Healthy ecosystems the world over provide hidden services such as waste disposal, nutrient cycling, soil formation, water purification and oxygen production. Such services are best rendered by ecosystems that are diverse. Yet, **through intention and accident, humans have introduced exotic species that turn biodiversity into monoculture**. Fast-growing zebra mussels, for example, have outcompeted more than 15 species of native mussels in North America's Great Lakes and have damaged harbours and water-treatment plants. Native prairies are becoming dominated by single species (often genetically homogenous) of corn or wheat. **Thanks to these developments, soils will erode and become unproductive which, along with temperature change, will diminish agricultural yields**. Meanwhile, **with increased pollution and run-off, as well as reduced forest cover, ecosystems will no longer be able to purify water, and a shortage of clean water spells disaster.** In many ways, oceans are the most vulnerable areas of all. As overfishing eliminates important predators, while polluted and warming waters kill off phytoplankton, the intricate aquatic food web could collapse from both sides. Fish, on which so many humans depend, will be a fond memory. As phytoplankton vanish, so does the ability of the oceans to absorb carbon dioxide and produce oxygen. (Half of the oxygen we breathe is made by phytoplankton, with the rest coming from land plants.) Species extinction is also imperilling coral reefs, a big problem since these reefs have more than recreational value: they provide tremendous amounts of food for human populations and buffer coastlines against erosion. Indeed, the global value of hidden services provided by ecosystems -- those services, such as waste disposal, that aren't bought and sold in the marketplace -- has been estimated to be as much as $US50thousand billion ($53.8 thousand billion) a year, roughly equal to the gross domestic product of all countries combined. And that doesn't include tangible goods such as fish and timber. **Life as we know it would be impossible if ecosystems collapsed.** Yet **that is where we're heading if species extinction continues at its present pace**. **Extinction also has a huge impact on medicine**. Who really cares if, say, a worm in the remote swamps of French Guiana becomes extinct? Well, those who suffer from cardiovascular disease. The recent discovery of a **rare South American leech has led to the isolation of a powerful enzyme that**, unlike other anticoagulants, **not only prevents blood from clotting but also dissolves existing clots**. And it's not just this species of worm: its wriggly relatives have evolved other biomedically valuable proteins, including antistatin (a potential anti-cancer agent), decorsin and ornatin (platelet aggregation inhibitors) and hirudin (another anticoagulant). Plants, too, are pharmaceutical goldmines. The bark of trees, for example, has given us quinine (the first cure for malaria), taxol (a drug that is highly effective against ovarian and breast cancer) and aspirin. **More than one-quarter of the medicines on our pharmacy shelves were originally derived from plants**. The sap of the Madagascar periwinkle contains more than 70 useful alkaloids, including vincristine, a powerful anti-cancer drug that saved the life of one of our friends. Of **the roughly 250,000 plant species on Earth, fewer than 5 per cent have been screened for pharmaceutical properties.** **Who knows what life-saving drugs remain to be discovered**? Given present extinction rates, it's estimated that we're losing one valuable drug every two years. Our arguments so far have tacitly assumed that species are worth saving only in proportion to their economic value and their effects on our quality of life, an attitude that is strongly ingrained, especially in Americans. That is why conservationists always base their case on an economic calculus. But we biologists know in our hearts that there are deeper and equally compelling reasons to worry about the loss of biodiversity: namely, morality and intellectual values that transcend pecuniary interests. What, for example, gives us the right to destroy other creatures? And what could be more thrilling than looking around us, seeing that we are surrounded by our evolutionary cousins and realising that we all got here by the same simple process of natural selection? To biologists, and potentially everyone else, apprehending the genetic kinship and common origin of all species is a spiritual experience, not necessarily religious but spiritual nonetheless, for it stirs the soul. But whether or not one is moved by such concerns, it is certain that our future is bleak if we do nothing to stem this sixth extinction**. We are creating a world in which exotic diseases flourish but natural medicinal cures are lost; a world in which carbon waste accumulates while food sources dwindle; a world of sweltering heat, failing crops and impure water. In the end, we must accept the possibility that we are not immune to extinction.** Or, if we survive, perhaps only a few of us will remain, scratching out a grubby existence on a devastated planet. Global warming will seem like a secondary problem when humanity finally faces the consequences of what we have done to nature; not just another Great Dying, but perhaps the greatest dying of them all.

#### And, loss of biodiversity causes extinction.

**Diner, 1994** [David, Ph.D., Planetary Science and Geology, *"The Army and the Endangered Species Act: Who's Endangering Whom?,"* Military Law Review, 143 Mil. L. Rev. 161]

To accept that the snail darter, harelip sucker, or Dismal  Swamp southeastern shrew 74 could save [hu]mankind may be difficult for some. Many, if not most, species are useless to[hu]man[s] 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. 75 Moreover, as the number of species decline, the effect of each new extinction on the remaining species increases dramatically. 4. Biological Diversity. -- The main premise of species preservation is that diversity is better than simplicity. 77 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. 78 [\*173] 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." 79 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, 80 [hu]mankind may be edging closer to the abyss.

### Impact Comparisons

**Biodiversity loss comparatively outweighs nuclear war, economic collapse and tyranny.**

**Chen 2000** [Jim, Professor of Law at the U of Minnesota, Minnesota Journal of Global Trade Winter 2000, pg. 211]

The value of endangered species and the biodiversity they embody is literally . . . incalculable. What, if anything, should the law do to preserve it? There are those that invoke the story of Noahs Ark as a moral basis for biodiversity preservation. Others regard the Judeo-Christian tradition, especially the biblical stories of Creation and the Flood, as the root of the Wests deplorable environmental record. To avoid getting bogged down in an environmental exegesis of Judeo-Christian myth and legend, we should let Charles Darwin and evolutionary biology determine the imperatives of our moment in natural history. The loss of biological diversity is quite arguably the gravest problem facing humanity. If we cast the question as the contemporary phenomenon that our descendents [will] most regret, the loss of genetic and species diversity by the destruction of natural habitats is worse than even energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. Natural evolution may in due course renew the earth will a diversity of species approximating that of a world unspoiled by Homo sapiens in ten million years, perhaps a hundred million.

#### Biodiversity loss itself outweighs human extinction. We have a moral imperative to protect the other species on Earth.

Elliott`97

[Herschel, University of Florida Emeritus Philosophy, 1997 “A General Statement of the Tragedy of the Commons,” February 26, <http://www.dieoff.org/page121.htm>]

Third, all systems of ethical beliefs are hypotheses about how human beings can live on Earth. As such, they make factual claims. And like all factual claims, their truth or falsity depends on empirical evidence. For this reason, the sequence of biological events which the general statement of the tragedy of the commons describes is of decisive importance for ethical theory. It shows (1) that moral behavior must be grounded in a knowledge of biology and ecology, (2) that moral obligations must be empirically tested to attain necessary biological goals, (3) that any system of moral practices is self-inconsistent when the behavior, which it either allows or makes morally obligatory, actually subverts the goal it seeks. Thus empirical criteria give a necessary (though not a sufficient) condition for acceptable moral behavior. Regardless of the human proclivity to rationalize, any system of ethical beliefs is mistaken if its practice would cause the breakdown of the ecosystem which sustains the people who live by it. Indeed, biological necessity has a veto over moral behavior. Facts can refute moral beliefs Fourth, ecosystems are in dynamic equilibrium. In addition, technology and human institutions are constantly evolving in novel and unpredictable ways. Furthermore, living things must compete with each other for space and resources; yet each organism also depends symbiotically on the well-being of the whole for its own survival and well-being. Indeed the welfare of all organisms -- including human beings -- is causally dependent on the health and stability of the ecosystems which sustain them. As a consequence, the stability and well-being of the Earth's biosystem has moral priority over the welfare of any of its parts -- including the needs and interests of human societies and individuals.

## \*China

### \*Taiwan Add-On

#### China developing ability to counteract US primacy in PNT

WSJ, 11

Jeremy Page, Wall Street Journal Staff writer, The Wall Street Journal, “China Threat: Beijing Launches Its Own GPS Rival,” December 28, 2011 <http://online.wsj.com/article/SB10001424052970203479104577123600791556284.html> beijing launches its own gps rival Acc: 6/27/2012.waru:AY

China has begun operating a homegrown satellite-navigation service that is designed to provide an alternative to the U.S. Global Positioning System and, according to defense experts, could help the Chinese military identify, track and strike U.S. ships in the region in the event of armed conflict. The Beidou Navigation Satellite System started providing initial positioning, navigation and timing services to China and its "surrounding areas" on Tuesday, Ran Chengqi, a spokesman for the system, told a news conference. Visitors looked at a model of the Beidou satellite-navigation system in Shanghai in May. The system started providing positioning services Tuesday. WSJ's Jeremy Page has details of a new GPS system launched by China this week. The new system, featuring 10 satellites as guidance, is expected to aid in military tracking. AP Photo/Xinhua, Qian Xian'an He said China had so far launched 10 satellites for the Beidou system, including one this month, and planned to put six more in orbit in 2012 to enhance the system's accuracy and expand its service to cover most of the Asian-Pacific region. China began building an experimental precursor to Beidou in 2000 with the goal of creating its own global system—called Compass—with 35 satellites, by 2020. The only other operational global system apart from GPS is Russia's Glonass, although the European Union's Galileo system is set to be completed by 2020. Beidou, like GPS, will provide free civilian services—for both Chinese and foreign users—that can be used in conjunction with commercially developed applications to help navigate private cars, monitor commercial trucks and ships and assist during natural disasters. It has the added advantage of supporting SMS messages. The system is designed partly to give Chinese companies a larger share of the satellite-navigation-system market in China, which is currently dominated by GPS and which the state-run Xinhua news agency said was valued at 50 billion yuan ($7.9 billion) by May 2011, compared with four billion yuan in 2003. Mr. Ran didn't mention potential military applications at the news conference, according to a transcript on the website of the information office of China's State Council, or cabinet. But the system will also give the Chinese military an alternative to GPS, which was developed by the Pentagon and is still controlled by the U.S. government. The U.S. could, in theory, disable or deny access to the system by others in the event of a conflict, although it says it never has done so in the past. GPS is thought to be widely used by the Chinese military, according to defense experts. Beidou isn't believed to be as accurate as the U.S. GPS. Nonetheless, it could be used in conjunction with Yaogan remote-sensing satellites and older imaging satellites to support tactical military operations, according to a paper by Eric Hagt and Matthew Durnin published in the Journal of Strategic Studies in October. "Although China still has a long way to go before it has continuous real-time tactical coverage, even of a regional maritime environment, it now has frequent and dependable coverage of stationary targets and at least a basic ability to identify, track and target vessels at sea," they wrote. "Based purely on capabilities, with a space-based reconnaissance system as the backbone, China is clearly acquiring greater ability not only to defend against intruding aircraft carriers but to project force as well."

**US-China Relations on the brink: Taiwan commitment risks conflict and tension spikes in East Asia**

Carpenter 11’

Ted Galen Carpenter (senior fellow for defense and foreign policy studies at the Cato Institute.) and as vice president for defense and foreign policy studies from 1995 to 2011. He is the author of eight and the editor of 10 books on international affairs, and is the author of more than 400 articles and policy studies.. Carpenter received his Ph.D. in U.S. diplomatic history from the University of Texas. October 11. 2011 <http://nationalinterest.org/blog/the-skeptics/especially-delicate-phase-us-china-relations-5999> Acc://7/2.12 WaruAHY

**The Taiwan issue also is resurfacing as a source of irritation in the bilateral relationship.** Although the Obama administration’s retreat on the F-16 issue soothed Beijing to some extent, it did not resolve the overall matter of arms sales to the island. Indeed**, another request from Taipei is still pending**. That request includes sophisticated radars, lasers and GPS-guided bombs. Cui and other officials have made it clear that any sale of those weapon systems would seriously impact relations between Washington and Beijing. As with the warnings about China’s response to passage of the currency legislation, the warning about arms sales is probably not a bluff. Beijing reacted to a modest arms sale package in early 2010 by [severing nearly all military-to-military contacts](http://www.csmonitor.com/World/2010/0202/US-arms-sales-to-Taiwan-stifle-US-China-military-engagement) with the United States for an extended period. Given the number of security issues in East Asia—and beyond—that require close cooperation between the United States and China, that was not a minor development, and a[repetition](http://www.google.com/hostednews/ap/article/ALeqM5hLtiRs_CXII8SCQ0whQI_BgbyH_A?docId=acf227e42b0d44b199575f42c2b77ffa) would be most unwelcome. More broadly, President **Hu Jintao**’s [speech](http://www.google.com/hostednews/ap/article/ALeqM5gEAdjMjoOvpzDr8EOQqSxt3yYTAQ?docId=968eab1a2f044728ad4da7dc8e641845) over the weekend **made it clear that Beijing remains** firmly **committed to securing Taiwan’s political reunification with the mainland.** Although there were elements of that speech that suggested a reasonably conciliatory attitude toward Ma Ying-Jeou and the governing Kuomintang Party in Taiwan, the ultimate objective was clear. And **that** [**has to worry Washington**](http://nationalinterest.org/blog/the-skeptics/the-ticking-taiwan-time-bomb-5201)**, since the United States** **has a** vague, but still very real, [**commitment**](http://nationalinterest.org/blog/the-skeptics/taiwan-other-security-clients-are-not-valuable-allies-5700) **to Taiwan’s defense under the provisions of the 1979 Taiwan Relations Act. What happens if the Taiwanese continue to refuse to consider reunification?** And there is no more sentiment than before for merging with the mainland while it is governed by a one-party dictatorship—even if Ma’s administration is less bombastic and confrontational than its predecessor toward Beijing. **Washington is being gradually boxed in regarding relations with China**. There are growing domestic political constituencies that favor a more hard-line policy toward Beijing—especially on currency valuation and other economic issues, but to some extent on the arms sale question and other security issues as well. Yet, **adopting policies on those matters to placate domestic critics of China risks a major disruption in the bilateral relationship and a spike of overall tensions in East Asia.** The Obama administration, like previous administrations, has been able to finesse matters thus far, but the latitude for such maneuvers is clearly narrowing.

#### US-China conflict over Taiwan escalates to nuclear war

Glaser 11

pol sci prof aid dir. Institute for Secunty ard Conflict Studies, George Wash PhD, Harvard. (Charles, Will China's Rise Lead to War? Why Realism Does Not Mean Pessimism, Foreign Affairs 902, Proquest)

The prospects for avoiding interne military competition and war nay be good, but growth in China's power may nevertheless require some changes in U S. foreign policy that Washing ton will find disagreeable- particularly regarding Taiwan Although it lost control of Taiwan during the Chinese Civil War more than six decade; ago, China still considers Taiwan to be part of its homeland, and unification retains a key political goal for Beijing. China has made clear that it will use force if Taiwan declares independence, and much of China's conventional military buildup has heat dedicated to increasing its ability to coerce Taiwan and reducing the United States' ability to intervene. Because China places such high value on Taiwan and because the United States and China-whatever they might formally agree to-have such different attitudes regarding the legitimacy of the status quo, the issue poses special dangers and challenges for the US .-Chinese relationship. placing it in a different category than Japan or South Korea. A Crisis over Taiwan could fairly easily escalate to nuclear war, because each step along the way might well seem rational to the actors involved. Current US. policy is designed to reduce the probability that Taiwan will declare independence and to make clear that the United States will not cone to Taiwan's aid if it does. Nevertheless, the United States would find itself under pressure to protect Taiwan against any Sort Of attack, no matter how it Originated. Given the different interests and perceptions of the various parties and the limited control Washington ha? over Taipei's behavior, a crisis could unfold in which the United States found itself following events rather than leading them. Such dangers have been around for decades, but ongoing improvements in China's military cap abilities may make Baling more willing to escalate a Taiwan crisis, in addition to its unproved conventional capabilities, China is modernizing its nuclear forces to increase their ability to survive and retaliate following a large-scale U.S. attack. Standard deterrence theory holds that Washington's current ability to destroy most or all of China's nuclear force enhances its bargaining position. China's nuclear modernization might remove that check on Chines e action, leading Beijing to behave more boldly in future crises than it has in pas t ores. A U .S. attempt to preserve its ability to defend Taiwan, meanwhile, could fiiel a conventional and nuclear arms race. Enhancements to U.S. offensive targeting capabilities and strategic ballistic missile defenses might be interpreted by China as a signal of malign U.S. motives, leading to further Chinese military efforts and a general poisoning of U.S.-Chinese relations. Given such risks, the United States should consider backing away from its commitment to Taiwan. This would remove the most obvious and contentious flashpoint between the United States and China and smooth the way for better rel~~a~~ti~~o~~ns between them in the decades to come. Critics of such a move argue that it would result in not only direct costs for the United States and Taiwan but indirect costs as well: Beijing would not be satisfied by such appeasement; instead, it would find its appetite w hefted and nuke even greater demands afterward-spumed b y Washington's lost credibility as a defender of its allies .The critics are wrong, however, because territorial concessions are not always bound to tail.Notall adversaries are Hitler, and when they are not, accommodation can be an effective policy tool. When an adversary has limited territorial goat, granting them can read rot to firrlher demands but rather to satisftaction with the new stalls quo and a reduction of tension.

### Taiwan IL

**New GPS systems allow China to deny US intervention capabilities in a conflict over the Taiwan straight**

Smith, 7

Mr. Smith's life sounds like a character in a Tom Clancy novel. He received a U.S. government "Top Secret" clearance as a top-level computer engineer for EDS. There he was assigned to work with the U.S. Army on logistic projects during the Cold War. (Charles R. Smith) November 23, 2007, China Takes Aim At U.S. GPS, http://www.geopoliticalmonitor.com/china-takes-aim-at-us-gps-054/

**China has deployed special vans equipped with sophisticated electronics designed to jam U.S. GPS (**global positioning satellite) **satellite navigation signals**. The fear inside the Pentagon is that China will deploy large numbers of these vans to jam GPS signals over large sections of its territory. Intelligence officials are watching the vans carefully to assess their capabilities and to see whether China moves to export the technology to other nations like Iran**. The U.S. intelligence agencies have photos of the vans, taken from space and on the ground, but are not sure how capable they are in jamming GPS-guided weapons in the American arsena**l. Iraq deployed similar technology during the Gulf war but was unable to exploit its capabilities because the U.S. quickly modified GPS bombs to home in on the jammers. Pentagon officials are concerned that U.S. bombs and missiles may not have that same capability against the Chinese GPS systems. **Defense analysts noted that the recent Chinese anti-satellite missile test demonstrated a capability to destroy GPS and low orbit reconnaissance satellites. The weapons demonstrated by Beijing are aimed at destroying or degrading the U.S. GPS system. These weapons include the jamming vans, anti-satellite missiles, and cyber-warfare attacks against computers and communications systems**. Beijing obtained detailed information on the U.S. GPS system through the Clinton administration during the 1990s. Chinese military officers were given detailed briefings on construction, design, coding, and manufacturing GPS systems through President Clinton. For example, in 1997, Chinese army officers were given a demonstration in Sunnyvale, Calif., by Ashtech, a maker of GPS receivers. The briefing for the PLAAF and Chinese Navy officers states, “Ashtech produces a receiver that uses both the U.S. GPS signals and the Russian GLONASS signals resulting in significantly greater availability and integrity.” In 1999, the Clinton administration offered the PLAAF the latest in advanced “mobile radars,” command and control systems, GPS navigation, and “surveillance avionics” such as “air to air,” “air to ground,” and “surface area movement” surveillance radars. **The FAA documents forced from the Clinton administration by the Freedom of Information Act also show extensive briefings on GPS technology given to the PLAAF officers. One such document describes in English and Chinese the workings of the GPS “space segment” and the system’s “ground control segment” including the central control location in Colorado**. The document also details how GPS works using “triangulation from satellites” to “measure distances using the travel time of a radio signal” and “very accurate clocks.” **The Clinton gift of GPS technology to Beijing also gave the People’s Liberation Army a new offensive punch. It is known that Chinese air force aircraft are often equipped with U.S. GPS receivers for navigation and more accurate bombing**. In addition, many of the aircraft and missiles sold by China to Iran and Sudan are equipped with GPS systems. One such example is the YJ-62 anti-ship missile being offered to Chinese military customers for export under the designation of C602. The turbojet-powered missile has a range of 174 miles and flies a low level mission, skimming the sea surface at 98 feet. During the attack phase the missile dives under 30 feet to avoid defense detection**.** The C602 resembles the U.S. Navy Tomahawk in that it has a conventional mid-body wing, which deploy after launch. The engine inlet is mounted slightly forward of a cruciform tail configuration. The YJ-62 will arm Chinese navy guided-missile destroyers. Two of the new 052C destroyers under construction are fitted with four-canister launchers. Chinese officials claimed that the C602 export version of the cruise missile uses a “strap-down laser ring gyro system coupled with GPS and agile frequency radar” for better attack targeting. China is also deploying its DH-10 long-range cruise missile. The subsonic missile appears to be in the final stages of development. It is to be deployed on a three-launcher road mobile platform. The DH-10 has a 930-mile range. Its guidance system is reportedly based on U.S. technology obtained by the Chinese during the Clinton administration, again using GPS navigation this time combined with electro-optical digital scene mapping for the final attack mode**. The Pentagon reported in 2003 that China had improved its ballistic missile force with U.S GPS technology. The improvements enable Chinese missiles to now accurately strike the U.S. base at Okinawa with “satellite-aided guidance” navigation technology obtained from America during the Clinton administration.** The Clinton administration was warned that the unbridled transfer of space technology would improve the Chinese offensive missile force. The Clinton GPS transfer and its military impact were documented in a 1997 Rand Corp. report forced from the U.S. Commerce Dept. by a federal lawsuit. “**The most troubling potential transfer to China is Rockwell’s proposed joint venture deal with the Shanghai Broadcast Equipment Factory and the Shanghai Avionics Corporation, the latter of which is a key enterprise of the Aviation Industries of China,” states the 1997 Rand report. “Rockwell Collins Navigation and Communications Equipment Company, Ltd. will design, develop, and build** Global Positioning System **(GPS) navigation receivers systems for the Chinese market**. T**hese components have serious dual-use applications, since the acquisition of reliable GPS data can enhance, to varying degrees, the capacity of militaries to field highly accurate cruise and ballistic missiles, such as those used to intimidate Taiwan during March 1996.”** According to the 1997 Rand Corp. report on the Chinese Defense Industry, **“More accurate GPS systems would enhance the PLA’s ability to carry out attacks against Taiwan’s military and industrial facilities, potentially reducing the ability of the Taiwanese military to defend itself against PRC coercive diplomacy. "The use of GPS to enhance the accuracy of long-range Chinese cruise missiles**, coupled with long-range sensors, **would raise serious concerns for the U.S. Seventh Fleet in the Pacific**, **and possibly circumscribe their ability to provide an effective deterrent in a crisis over Taiwan**.”

### China GPS = Taiwan Strategy

**Chinas new GPS system large threat to Taiwan**

J. Michael Cole, 12/29/2011, Taipei Times, Beidou satellites raise fears of threat to Taiwan, http://taipeitimes.com/News/front/archives/2011/12/29/2003521879

**Defense specialists are warning that China’s Beidou (北斗) satellite-based navigation system, which began providing services on Tuesday, could pose a long-term threat to Taiwan’s security and they** are calling for countermeasures. Xinhua news agency announced on Tuesday that the Beidou (“Compass”) Navigation Satellite System had begun providing initial positioning**, navigation and timing services for China and the surrounding areas**. **Hoping to diminish its reliance on the US’ global positioning systems (GPS**), China began work on the Beidou system in 2000. Ten satellites which form the Beidou “constellation” have been launched since 2007, with six more launches scheduled for next year to provide extended coverage for the Asia-Pacific region. By 2020, the Beidou constellation will comprise 35 satellites. At present, only the US and Russia, with its Glonass constellation of 24 satellites, have fully operational satellite-based navigation services, with the EU’s Galileo expected to enter full service in 2013. According to an October 2008 article by Jane’s Defence Weekly, China’s involvement in the Galileo project might have benefited the development of the Beidou constellation, especially dual-use technology used by the EU consortium. Although China claims **Beidou will provide commercial services, such as mapping, fishery, transport, meteorology and telecommunications, the system could also be of great assistance to the People’s Liberation Army (PLA).** The US military relies primarily on GPS satellite navigation data for military vehicles and precision-guided munitions and the US Air Force operates the more than 30 satellites on which the GPS is based. **Once it becomes fully operational, Beidou will provide tracking and imaging at a resolution to within 10m, greatly enhancing the PLA’s ability to launch “surgical” missile attacks using precision-guided munitions. It could also provide guidance for unmanned vehicles, or “drones.” China Satellite Navigation Office director Ran Chengqi (冉承其) said the system is also intended for military use, adding that it would enhance the tracking abilities of the PLA by 100 to 1,000 times and reduce military spending.** Arthur Ding (丁樹範), a professor of international relations at National Chengchi University, said as the **Chinese system represents a long-term threat to Taiwan, the latter should develop counterattack technology that can disrupt the Beidou system’s “ears and eyes.” Taiwan does not need to destroy China’s weapons-guidance satellites**, Ting said, adding that **disruptive technology could be developed at relatively low cost. Other measures adopted over the years are multi-layered air defense architecture through the acquisition and development of early-warning systems, radar and missile interceptors**, such as the US-made Patriot and the Tien Kung I and II “Sky Bow.” **Taiwan has also been upgrading its “Skyguard” short-range air defense system by switching to Advanced Hit Efficiency And Destruction munitions, which are ideal to shoot down precision-guided munitions and unmanned aerial vehicles.** At a regular press conference in Beijing yesterday, Taiwan Affairs Office spokesman Yang Yi (楊毅) sought to assuage fears in Taiwan of potential military uses for the Beidou system, saying those were “unnecessary” and “misplaced,” adding that the navigation system “**would only enhance the well-being of compatriots on both sides” of the Taiwan Strait.**

## \*Early Warning

### NKT - EWS

#### Now is the key time for early warning systems – natural disasters increasing in strength & frequency

Doong ‘12

[DJ, National Taiwan Ocean University; et al; “Development of an Operational Coastal Flooding Early Warning System” National Hazards and Earth System Sciences, February, p. 389]

**The frequency of natural disasters may be increasing because of growing global change. The magnitude of a disaster depends on the intensity of a natural hazard, in addition to the effectiveness of prevention mitigation actions. Natural hazard events cannot be prevented from occurring, but their impacts on people and property can be reduced if accurate information can be provided to people in a timely manner. An early warning system is therefore essential.** Taiwan, located at the major site of typhoons in the NW Pacific, is frequently threatened by typhoons. A large amount of coastal defense has failed, life and property has been lost in the past thirty years in Taiwan. **Global climate change is increasing the frequency and strength of typhoons**. **The threat from** typhoons and **disasters is increasing.** In this study, we have developed the warning system CoFEWs to mitigate coastal flooding in Taiwan. First, the users of the system must be defined clearly. The warning system functions according to the background of a user and to the purpose of using the system. Because users of the CoFEWs are administrators without professional academic backgrounds, a userfriendly interface with a single page of information, without requiring numerous clicks and video and movie presentations for measurements and model results has been designed. Second, the functionality of the system must be clearly defined. CoFEWs monitor sea conditions and forecast overtopping possibilities on sea dykes. To achieve this objective, a real-time coastal watch network and numerical modeling are the basis of the system. We constructed the CoFEWs by integrating an operational East Asian scale NWWIII model and the regional SWAN model for coastal wave forecasting, in addition to the POM model for storm surge prediction. Accurate forecasting was verified in the wave growth stage, but poor results were obtained for the wave subsiding period in a typhoon. The maximal significant wave heights during typhoons are occasionally not forecasted properly. We improved this problem by applying data assimilation technology in CoFEWs. The operational model should not only pursue the accuracy of the simulation, but balance it with computational efficiency. Decision makers cannot wait for 5% simulation improvements, but require reasonable model results immediately. **Real-time data are very necessary to import into the system for assimilation purposes**, except for their direct function of monitoring the coastal sea conditions. The web-based warning system presented contains the main nationwide information page and a regional subsystem. Applying the system during Typhoon Haitang in 2005 and for numerous other typhoons thereafter has verified its accuracy and applicability.

### SQO Inadequate

#### Early warning response systems are lacking in SQ

Grasso ‘11

[Veronica F; Ashbindu Singh; “Early Warning Systems: State-of-Art Analysis and Future Directions,” *United Nations Environment Programme*, November 21, p. 6]

**Effective early warning systems embrace all aspects of emergency**

**management**, such as: risk assessment analysis, which is one of early warning system’s design requirements; monitoring and predicting location and intensity of the natural disaster waiting to happen; communicating alerts to authorities and to potentially affected; and responding to the disaster. All aspects have to be addressed by the early warning system. **Commonly, early warning systems lack of one or more elements. In fact, the review of existing early warning systems shows that in most cases communication systems and adequate response plans are lacking**.

### Funding at Risk

#### Funding for tsunami early warning is on the chopping block – risk of catastrophic impacts

McClatchey ‘12

[McClatchey Newspapers syndicated editorial column, February 29]

**Almost one year ago, the catastrophic earthquake off Japan sent a tsunami barreling across that country's coast, taking nearly 20,000 lives and setting off a potential nuclear disaster**. That same earthquake sent a surge across the Pacific Ocean, leading to a tsunami that hit the California coast, devastating the Santa Cruz harbor. At the time, **the tsunami warning system** -- strengthened after the 2004 Indian Ocean tsunami that killed at least 230,000 people -- **was hailed for how it alerted local authorities to the potential disaster** heading our way. **In what seems to be** an **incredibly shortsighted** proposal, however, the debt-struggling **Obama** administration **has proposed sharply reducing** the **federal funding** for the public outreach part of the program. **It's shortsighted not just because the savings** -- $4.6 million -- **are infinitesimal in the overall federal budget, and not because a tsunami warning system protects only a small number of Americans in the Pacific islands and living right on the West Coast. It's just that** unlike earthquakes, where warning systems are ineffective, **tsunamis**, once generated, **can be predictable**. Take what happened on March 11, 2011. The warning system began delivering information minutes after the quake occurred off Japan, a nation that has its own tsunami warning system. **Every minute matters when a tsunami is created, since they can move at speeds up to 600 mph across the ocean**. The quake-triggered tsunami was detected by a series of floating buoys and monitoring stations in the Pacific Ocean, which relayed information about the size of the surge to scientists. The $400,000 buoys -- the number was increased to 39 from six after the 2004 disaster -- are tethered to the ocean floor. **The federal government**, which created the buoy warning system in 1996, **funds two tsunami warning centers** -- one in Hawaii and one in Alaska -- **to get the information out to areas where a tsunami might hit. Once alerted, local emergency management officials activate their own emergency communications systems** and start evacuating low-lying areas. Overall, the combined tsunami-warning systems seemed to work pretty well last year. Three minutes after the 9.0-magnitude quake hit, a major tsunami warning was issued for the Japanese coast and within 9 minutes of the quake, warnings or watches had been issued for Hawaii and other Pacific islands. The Alaska-based tsunami warning center then coordinated and issued warnings for mainland United States and Canada, predicting when waves would hit and how big they would be when they came ashore. Santa Cruz officials got their alert about 8 hours before the tsunami hit. Although the warning couldn't prevent $17 million in damages to the harbor and boats, it came with plenty of time to alert and evacuate residents. **Tragically, in Japan, the warnings, quick as they were, were not fast enough, since the waves hit just 10 minutes after the quake, so quickly that many people were unable to flee in time and were swept to their deaths.** But it doesn't take long to forget, it seems. Republicans proposed a similar cut in a budget plan passed by the House in February 2011. But the plan went nowhere after the Japanese tsunamis. Funding for the buoys is due to run out Oct. 1, with no new legislation yet proposed to renew it. Without sufficient funding, maintenance will suffer -- currently, 10 buoys are inoperable. The Obama administration proposal would cut money for things like computer research tsunami risk maps, emergency drills and warning signs -- all vital toward preparing for the next tsunami. This cut should be rescinded immediately. People's memories are short. Apparently, so is the government's.

### Tsunami MPX

#### U.S. is prone to a catastrophic tsunami – mass devastation would ensue

Morrissey ‘08

[Wayne A., Information Research Specialist, Knowledge Services Group – CRS Report for Congress; May 28; p. ]

On December 26, **2004, a powerful submarine earthquake struck near** Sumatra, **Indonesia, and** an ensuing tsunami devastated communities around the northern rim of the Indian Ocean. The National Oceanic and Atmospheric Administration (NOAA) reported that **an estimated 250,000 people lost their lives**.1 After the dual disaster, some Members of Congress were soon on record as supporting an international effort to build a regional tsunami detection and warning network for the Indian Ocean where no such system existed prior to the disaster**. Some lawmakers called for** establishing an **expanded tsunami detection and warning network to monitor the U.S. Atlantic coast, the Gulf of Mexico, and the Caribbean** Sea.2 They noted that although the risks may be small, the consequences of a tsunami for the U.S. Atlantic Coast justified such expenditures.3 To apprise Congress of the probabilities and potential risk for a tsunami striking the east coast of the United States, the House Congressional Coastal Caucus and the House Oceans Caucus sponsored a briefing in January 2005 on Capitol Hill.4 At the briefing, **scientists from the NOAA** at the Department of Commerce and the U.S. Geological Survey (USGS) at the Department of the Interior **discussed the risk factors. Speakers alluded to the Puerto Rican Trench, the deepest point in the western Atlantic Ocean, where massive submarine landslides have historically occurred along the face of the North American continental shelf**.5 Also, they noted that **strong earthquakes have occurred on the ocean floor off the coast of Puerto Rico, and that some of them generated tsunamis that caused major loss of life and property damages in both the Atlantic and Caribbean Basins**.6 **Another geographic area of concern** for the United States that was discussed **is the Pacific Northwest** Cascadia [seismic] Zone. **Based on historical seismic activity, many geologists are convinced that there is a potential for a large earthquake that could generate tsunamis and devastate the** U.S. **Pacific Coast and other settlements around and in the greater Pacific** Ocean Basin.7 This admonition was **based on empirical evidence of a large tsunami that was generated in the area** around 1700 **and affected lands as far away as Japan**.8

#### GPS can detect and help to study earthquake patterns

[Jamie Condliffe](http://www.gizmodo.com.au/author/jamie-condliffe/) April 26, 2012, <http://www.gizmodo.com.au/2012/04/nasa-begins-testing-gps-based-earthquake-detection-system/>

NASA has a new trick up its sleeve: a GPS system that is designed to locate the exact positon of [serious earthquakes](http://www.gizmodo.com.au/2012/03/what-is-an-earthquake). Known as the Real-time Earthquake Analysis for Disaster (READI) Mitigation Network, it’s being tested in the western US — and it’s hoped it will save lives in the process. The system gathers GPS data from over 500 locations across Washington, Oregon and California, so that once a major earthquake is detected it can determine the exact location of the quake, along with its magnitude and details about its fault ruptures. While the system has been in development in collaboration with universities since 2004, this marks the first time it will be used in a real-life setting. Currently, it’s actually extremely difficult to rapidly pinpoint the exact location of an earthquake — and it’s hoped READI can change that. The same system can also be used to detect tsunamis. Once testing comes to a close, it’s hoped READI will be used by natural disaster detection agencies across the US, including the USGS and the National Oceanic and Atmospheric Administration.

#### GPS can become a tsunami detection device

[Marcie N. W. Grabowski,](mailto:mworkman@hawaii.edu?subject=GPS%20on%20commercial%20ships%20could%20improve%20tsunami%20warnings) Outreach Coordinator, School of Ocean and Earth Science and Technology, University of Hawaiʻi at Mānoa**,** May. 7, 20**12**,http://www.hawaii.edu/news/article.php?aId=5084

**James Foster, lead author and Assistant Researcher at the UH Manoa School of Ocean and Earth Science and Technology (SOEST), and colleagues were able to detect and measure the properties of the tsunami generated by the magnitude 8.8 earthquake in Maule, Chile** (February 2010), even though, out in the open ocean, the wave was only about 4 inches (9.4 cm) high. **The UH Manoa research vessel Kilo Moana was on its way from Hawaii to Guam at the time of the tsunami, and was equipped with geodetic GPS system recording data as the tsunami passed by**. Careful analysis of this data showed that the researchers were able to detect changes in the sea-surface height very similar to the Pacific Tsunami Warning Center predictions.  **This finding came as a surprise because tsunamis have such small amplitudes in the deep water, in contrast to their size when they reach the coastline, that it seemed unlikely that the tsunami would be detected using GPS unless the ship was very close to the source and the tsunami was very big.  “Our discovery indicates that the vast fleet of commercial ships traveling the ocean each day could become a network of accurate tsunami sensors,” Foster said.**

#### GPS Tracking System Earthquake Early Warning Devices – saves lives

Greg Bartlett, 2009, Rocky Mountain Tracking GPS daily, http://www.rmtracking.com/blog/2009/02/21/gps-tracking-system-earthquake-early-warning-devices/

Can a satellite tracking device be used to track the actual Earth itself? Well, the way GPS actually works lends itself quite easily to this. Satellites in orbit around the planet have equipment which routinely sends signals down to receivers below. These satellites are positioned at equidistant locations around the Earth, but send signals at exactly the same time, every five seconds. Something receiving these signals would receive them at different times. By extrapolating this data it is possible to construct an algorithm which can allow the receiving system to discover its exact position on Earth with pin-point accuracy. At these earthquake fault lines, GPS receivers are embedded into the shifting geological plates. They are actually firmly positioned into the bedrock itself. The plate shift is not so important as how quickly the plates are shifting away from each other. Scientists can measure the exact distance moved by working out the end position of each receiving station in relation to the original position. Now scientists are able to measure this shift to within a millimeter. Several of these measurements taken over time can allow the pattern of seismic shift to be determined which eventually leads to an earthquake. It has been found that the distance moved is related to the magnitude of the earthquake itself. This research is in its early stages still, but it has the potential to save hundreds of lives and hundreds of thousands of dollars worth of damage.

**Disaster – MPX**

#### Extinction

Sid-Ahmed, ‘5 **– Yeah, it’s the same guy**

[Mohamed. “The post-earthquake world.” Al-Ahram Weekly Online. Jan 6-12, 2005. <http://weekly.ahram.org.eg/2005/724/op3.htm>]

The human species has never been exposed to a natural upheaval of this magnitude within living memory. What happened in South Asia is the ecological equivalent of 9/11. Ecological problems like global warming and **climatic disturbances in general threaten to make our natural habitat unfit for human life. The** extinction of the species has become a very real possibility, whether by our own hand or as a result of natural disasters of a much greater magnitude than the Indian Ocean earthquake and the killer waves it spawned. Human civilisation has developed in the hope that Man will be able to reach welfare and prosperity on earth for everybody. But now things seem to be moving in the opposite direction, exposing planet Earth to the end of its role as a nurturing place for human life. Today, human conflicts have become less of a threat than the confrontation between Man and Nature. At least they are less likely to bring about the end of the human species. **The reactions of Nature** as a result of its exposure to the onslaughts of human societies **have become more important in determining the fate of the human species** than any harm it can inflict on itself. **Until recently, the threat Nature represented was perceived as likely to arise only in the long run**, related for instance to how global warming would affect life on our planet. Such a threat could take decades, even centuries, to reach a critical level. **This perception has changed following the devastating earthquake and tsunamis** that hit the coastal regions of South Asia and, less violently, of East Africa, on 26 December. This cataclysmic event has underscored the vulnerability of our world before the wrath of Nature and shaken the sanguine belief that the end of the world is a long way away. **Gone are the days when we could comfort ourselves with the notion that the extinction of the human race will not occur before a long-term future** that will only materialise after millions of years and not affect us directly in any way. We are now forced to live with the possibility of an imminent demise of humankind.[sic]

### GPS Key – Disaster Response

#### GPS key to effective disaster response coordination

Christensen ‘08

[Ian A., International Space University (France) et al; “Socio-Economic Benefits of Using Space Technologies to Monitor and Respond to Earthquakes,” *Space Technology*, Vol. 28, No. 1; p. 12]

**One of the most important tasks in the coordination process is the GNSS-based vehicle tracking subsystem**. The existence of multiple uncoordinated tracking systems for each of the response organisations (e.g. Red Cross and Red Crescent, non-governmental organisations [NGOs], military, police) can sometimes lead to inefficient management of resources and delays in the reaction time. The TREMOR proposal provides **an integrated system based on GPS tracking to monitor all existing vehicles from the response teams** that enter an affected area. The use of such a system from the deployable unit centre **can provide a more efficient and coordinated response. The system will provide vehicle tracking, safe routing information, coordination amongst teams, intercommunication and interoperability. This will result in reduced delays in the treatment of medical emergencies and faster search and rescue operations. The information gathered from all vehicles by the control centre has the additional benefit of real-time mapping of drivable roads and areas accessible by vehicle and could be processed to generate useful maps of the area or improve existing ones.** The vehicle terminals normally consist of a GNSS receiver, a microprocessor and a transceiver or transmitter to send the information to the command centre. A simple user interface is required to present processed information, messages and maps of the area. GNSS receivers and transmitters compatible with existing GNSS systems should be used. This may require establishing guidelines and recommendations in the design of GNSS receivers and data exchange protocols to allow for the possibility of a universal transmitter. Several examples of systems using vehicle tracking for disaster management exist. For example, ESA’s Real-time Emergency Management via Satellite (REMSAT I and II) has been used in cooperation with several Canadian universities and agencies to target forest fire hazards in British Columbia, Canada [35].

#### GPS-enabled early warning systems saves lives & is key to damage mitigation

Doong ‘12

[DJ, National Taiwan Ocean University; et al; “Development of an Operational Coastal Flooding Early Warning System” *National Hazards and Earth System Sciences*, February, p. 379-80]

**In the past, warnings for natural disasters** were first reported by people who witnessed signs of impending danger, such as the sea surface rising at the coast. This mode of detection **provided little opportunity for people to seek shelter and avoid injury or death. The number of avoidable and unnecessary deaths and property damage could be reduced dramatically with an effective early warning system.** Over the last several decades, scientists have progressed considerably in understanding the causative effects of natural disasters that have a great impact on lives. Although they cannot yet predict disasters fully, countries now possess the technical ability to detect and track them with impressive accuracy. Warning systems for river flooding are numerous (Parker and Fordham, 1996; Wang and Du, 2003; Plessis, 2002; Kaya et al., 2005; Basha and Rus, 2007). For coastal areas, substantial efforts have been invested into the different management systems (Solomon and Forbes, 1999; Doornkamp, 1998; Thumerer et al., 2000). In the aftermath of the 2004 Indian Ocean tsunami, the warning system was developed (Nayak and Kumar, 2008; Taubenb¨ock et al., 2009). Most of the presented warning have a rigid theoretical base, but some of them lack an operational interface**. A correct, direct, and simple warning system is useful for the decision marker to receive valuable information. Currently, such a system can be implemented by applying latest computer technologies**. Holz et al. (2006) presented an application of information and communication technology to provide improved flood detection capabilities for citizens. Katuk et al. (2009) presented the development of a web-based support system for flood response operations in Malaysia to provide prompt and effective response to victims. Wang and Du (2003) developed a flood warning system with an internet-based interface by integrating Internet technology, a Geographic Information System (GIS), and a hydrologic model. Taramelli et al. (2010) modeled the risk hurricane elements in potentially affected areas by a GIS system. **Accurate estimation on the potential flooding area in a typhoon is critical for damage or loss mitigation**. Basher (2006) and Twigg (2003) suggested that insufficient communication and lack of preparedness are always the cause of warning system failure. They both emphasized that an early warning system should be people-centered.

#### And, GPS key to disaster relief

Wussler ‘8 (“Global Positioning Systems: Space-Based PNT for Today and Tomorrow,” Col. Donald E., Vice Commander Global Positioning Systems Wing, Los Angeles AFB, High Frontier, the Journal for Space & Missile Professionals, May 2008, <http://www.afspc.af.mil/shared/media/document/AFD-080522-087.pdf>, CMR)

In addition to automobile and handheld consumer devices, **GPS has become the commercial mainstay of transportation systems worldwide, providing navigation for aviation, ground, and maritime operations**. Farmers use precision navigation through GPS and an augmentation system to plow, cultivate, and harvest their fields. Surprisingly to many people, auto-pilot assisted/controlled vehicles will probably be realized in the near future. Civil aviation is continuously increasing its reliance on satellite-based navigation in preparation for the expected increase in air traffic. Aircraft can actually fly user-specified routes from point-to-point with reduced dependency on ground infrastructure, resulting in enhanced landing approaches. The potential savings from these improvements to civil aviation stem from increased efficiency of the air traffic control infrastructure. **Life-saving missions, including disaster relief and emergency services currently depend on GPS for locating victims and deploying resources**. **The potential savings in human life and resources worldwide are astounding**. Even everyday, commonplace activities such as banking, mobile phone operations, and control of power grids are facilitated by the accurate timing provided by GPS.

### GPS Key – Tsunami EWS

#### GPS key to early warning for tsunamis

Falck ‘10

[C., GFZ German Research Centre for Geosciences; et al; *Natural Hazards and Earth System Sciences*; Vol. 10; p. 181]

**GPS** (Global Positioning System) technology is widely used for positioning applications. Many of them **have high requirements with respect to precision**, reliability or fast product delivery, but usually not all at the same time as it is the case for early warning applications. The tasks for the **GPS-based components** within the GITEWS project (German Indonesian Tsunami Early Warning System, Rudloff et al., 2009) are to **support the determination of sea levels** (measured onshore and offshore) and to detect co-seismic land mass displacements with the lowest possible latency (design goal: first reliable results after 5 min). The completed system was designed to fulfil these tasks **in near realtime**, rather than for scientific research requirements. The obtained data products (movements of GPS antennas) are supporting the warning process in different ways. **The measurements from GPS instruments on buoys allow the earliest possible detection or confirmation of tsunami waves on the ocean**. Onshore GPS measurements are made collocated with tide gauges or seismological stations and give information about co-seismic land mass movements as recorded, e.g., during the great Sumatra-Andaman earthquake of 2004 (Subarya et al., 2006). **This information is** important to separate tsunami-caused sea height movements from apparent sea height changes at tide gauge locations (sensor station movement) and also as additional information about earthquakes’ mechanisms, as this is an **essential** information **to predict a tsunami** (Sobolev et al., 2007).

#### GPS offers most reliable early warning for tsunamis

Falck ‘10

[C., GFZ German Research Centre for Geosciences; et al; *Natural Hazards and Earth System Sciences*; Vol. 10; p. 188]

**A GPS-based tsunami early warning** component, developed by GFZ within the GITEWS project, was installed in Indonesia. The system provides measurements of land mass movements due to earthquakes and coordinates of GPS sensors on buoys, corresponding to sea levels. It **supports the prediction of a tsunami** using GPS data from land and the detection and confirmation of a tsunami with offshore-measured data **at the earliest possible time**. **In addition**, the **data can be used to improve the reliability of tide gauge data** by confirming that a tide gauge location has not moved during an earthquake. The provision of all this information is expected **to significantly increase the reliability of tsunami early warnings**. Test installations of single frequency receivers close to 2 frequency receiver locations are planned as well as the installation of more BGAN modems (less tight antenna pointing requirements than for VSAT). This will further increase the system reliability, which is most important for early warning applications. A function for a tsunami pre-alert, released due to automatically detected displacements measured by GPS, may be added at a later time.

#### GPS offer key tool in tsunami early warning

UPI ‘12

[United Press International, April 25]

**GPS systems near an earthquake could determine magnitude and location in just over 3 minutes, allowing early tsunami warnings**, German researchers say. For submarine earthquakes that can generate tsunamis, the warning time for coastal areas is very short, said scientists at the German Research Center for Geosciences, GFZ, who analyzed GPS data from the Fukushima earthquake of March 11, 2011, in Japan. "On the occasion of the Fukushima earthquake, we analyzed data from more than 500 GPS stations and showed that a correct estimate of the magnitude of M=9.0 and of the generated tsunami could have been possible in just 3 to 4 minutes after the earthquake," Andrey Babeyko told a meeting of the European Geosciences Union in Vienna. **The GPS shield concept was initially developed for a tsunami early warning system** developed by GFZ on behalf of the German Federal Government for Indonesia, he said. **Such a system could have given a timely warning in Fukushima**, he said. "The application on the data sets of the catastrophic earthquake of March 11, 2011, shows again what potential a GPS shield has in tsunami early warning systems," Babeyko said. "**A GPS shield could be a useful tool for all regions with earthquake/tsunami risks**."

#### GPS-enabled buoys key to tsunami projection

Doong ‘12

[DJ, National Taiwan Ocean University; et al; “Development of an Operational Coastal Flooding Early Warning System” National Hazards and Earth System Sciences, February, p. 382]

**Data buoys are the most commonly used instrument for marine measurements in coastal oceans and at sea**. They are developed and manufactured locally in Taiwan (Kao et al., 1999). Discus-shaped buoys with 2.5m diameter were designed. Two anemometers are mounted on the mast of the buoy at approximately 3m above the sea surface, equipped with sea and air temperature sensors and a barometer. The buoy payloads and light are typically powered by secondary batteries with solar charging and primary battery backup. For wave monitoring by data buoys, both inertia gyros and GPS systems are integrated to provide six degrees of freedom for acceleration, velocity, and inclination on three axes. **GPS is used as a wave measurement auxiliary device** (Doong et al., 2011). **The recorded buoy movements of ocean surface waves are used to yield a wave directional spectrum** using cross-spectrum analysis, detailing the characteristics of wave energy distribution on frequency **and** the direction of propagation. The directional spectra **provide superior precision for building a wave forecast model and for application of data assimilation technology**.

#### GPS enables more accurate assessment of large earthquakes & tsunamis

Blewitt ‘08

[Geoffrey, Nevada Bureau of Mines and Geology, University of Nevada (Reno); *Journal of Geodesy*; Vol. 83, No. 3-4; p. 341]

Recommendation 1 So that early warning can be better informed by prediction, real-time GPS infrastructure development and deployment should be designed to play a dual role both for early warning (real-time, higher rate data) and prediction (lower rate data with latency, with a strong tie to ITRF as part of GGOS). As we have already discussed, **GPS infrastructure could enable more accurate and timely assessment of the magnitude and mechanism of large earthquakes, as well as the magnitude and direction of resulting tsunamis. Real-time GPS could add significant value to existing data types** (1) **to improve tsunami warnings** by centers including NOAA’s Pacific TsunamiWarning Center (PTWC), **and** (2) to **enhance post-earthquake damage assessment for emergency response** produced operationally (for example in the United States, USGS ShakeMap). Potential contributions to this effort include the research and development required to make real-time GPS operational with sufficient accuracy, precision, reliability, and low latency. To realize the full potential of these contributions requires coordination between national agencies and with international programs including Group on Earth Observation (GEO), Global Earth Observation System of Systems (GEOSS), and of course, GGOS and IGS.

### GPS Key – Earthquake EWS

#### Better remote sensing technology key to search & rescue in earthquakes

Hochstein ‘08

[Jason, Int’l Space University; et al; “Improved Earthquake Response via Stimulation and Integrated Space- and Ground-based Technologies: the TREMOR Proposal,” *International Astronautical Federation* Paper IAC-08.D3.2.4; p. 4]

**The response to a natural disaster must occur immediately and efficiently in order to save as many lives as possible**. **The first hours and days** after an earthquake **are critical for search-and rescue** (SAR) teams to help trapped, stranded, or injured people. Communications systems routinely fail, however, and the coordination of rescue teams can be challenging. At present, numerous ground- and space-based technologies are used during the response phase of disaster management, such as telecommunications, remote sensing (RS), and **global navigation satellite systems** (GNSS). These technologies **offer services over wide coverage areas and are not impacted by the earthquake itself, giving them a significant advantage over terrestrial counterparts in disaster situations.** These technologies are not efficiently integrated, however, to ensure human safety and the rapid delivery of aid (Abolghasemi et al., 2005; Simmons et al., 2004; Garshnek & Burkle, 1999). The purpose of the Earthquake Response Prototype proposed in the TREMOR project is to significantly improve the effectiveness of response efforts following earthquakes via the integration of space-based technologies and terrestrial resources at the global and local levels.

#### GPS technology key to improving earthquake prediction

Bhatta ‘10

[Basudeb, PhD in Engineering, Senior Systems Engineer @ Jadavpur University; *Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass and Others*, p. 305-6]

**The analysis of earthquakes and more generally seismology, means dating the various observations in order to allow correlations. Precision dating is possible with GNSS due to the fine time management required for these systems. Thus it helps in determining whether two distant phenomena are linked to each other or not**, using an underground wave propagation model to estimate the time bias that would have occurred in the case of related events. **Earthquakes can be predicted using GNSS technology. Continuous observation using GNSS can provide information of crustal deformation and rate of tectonic plate movements. This information can help in earthquake prediction** (Aydan 2006; Kato et al. 1998; Jiang et al. 2007). The ionosphere observation can also provide prediction of earthquake and post-disaster terrestrial events. **It has been shown that earthquakes or tsunamis** (before and after) **induce changes in the constitution of the ionosphere that can be observed through GNSS readings** (Samama 2008). **Therefore, studying the ionosphere can also help in earthquake prediction.** The augmentation of the number of available satellites with the combination of GPS and Galileo constellation should increase observation capabilities.

### GPS Key – Natural Disasters

#### Effective early warning key to contain air pollution, wildfires, deforestation

Grasso ‘11

[Veronica F; Ashbindu Singh; “Early Warning Systems: State-of-Art Analysis and Future Directions,” *United Nations Environment Programme*, November 21, p. 9]

In addition**, remote sensing satellites** now provide a continuous stream of data. They **are capable of rapid and effective detection of hazards such as transboundary air pollutants, wildfires, deforestation, changes in water levels, and natural hazards**. With rapid advances in data collection, analysis, visualization and dissemination, including technologies such as remote sensing, Geographical Information Systems (GIS), web mapping, sensor webs, telecommunications and ever growing Internet connectivity, **it is now feasible to deliver relevant information on a regular basis to a worldwide audience relatively inexpensively**. In recent years, commercial companies such as Google, Yahoo, and Microsoft have started incorporating maps and satellite imagery into their products and services, delivering compelling visualization and providing easy tools that everyone can use to add to their geographic knowledge.

#### GPS key to enhance early warning systems for earthquakes, landslides & tsunamis

Grasso ‘11

[Veronica F; Ashbindu Singh; “Early Warning Systems: State-of-Art Analysis and Future Directions,” *United Nations Environment Programme*, November 21, p. 14]

**For earthquakes, information on location and magnitude of the event is the first information that needs to be conveyed to responsible authorities. This information is used** by seismic early warning systems **to activate security measures within seconds after the earthquake origin and before the strong shaking occurs at the site**. Shakemap generated within 5 minutes provides essential information to assess the intensity of ground shaking and the damaged areas. The combination of **data from seismic networks and GPS may help to increase reliability and timeliness of this information**. Earthquake frequency and probability shakemaps- based on historical seismicity and base maps (geological, soil type, active faults, hydrological, DEMs)- assist in the earthquake mitigation phase and need to be included in the building code design process for improved land use and building practices. For response additional data are needed such as seismicity, intensity, strain, DEMs, soil type, moisture conditions, infrastructure and population to produce post-event damage maps. Thermal information from low/medium resolution IR imagery from polar and geostationary satellites for thermal background characterization (Advanced Very High Resolution Radiometer (AVHRR), ATSR, MODIS and GOES) together with deformation from EDM and/or GPS network; borehole strainmeters; SAR interferometry needs to continuously monitored. **Useful information for landslides and ground instability is: hazard zonation maps** (landslides, debris flows, rockfalls, subsidence and ground instability scenarios) during the mitigation phase, associated with landlside inventory, DEM, deformation (GPS network; SAR interferometry; other surveys as leveling, laser scanning, aerial etc), hydrology, geology, soil, geophysical, geotechnical, climatic, seismic zonation maps, land cover, land use, historical archives. **Forecasting location and extent of ground instability or landslide is quite challenging.** While mechanism of subsidence are well understood, for landslides this still remains a challenge for scientists. Landslides can be preceded by cracks, accelerating movement, rock fall activity. **Real-time monitoring of key parameters then becomes essential. The observed acceleration, deformation or displacement, exceeding a theoretical pre-fixed threshold is the trigger for issuing an alert signal**. An alternative approach is based on hydrologic forecasting. It should be said that for large areas site-specific monitoring is not feasible. In this case hazard mapping associated with monitoring of high risk zones remains the best option for warning. Local rapid mapping of affected areas, updated scenarios and real-time monitoring (deformation, seismic data and weather forecasts) assist during the response phase. A tsunami is a series of ocean waves generated by sudden displacements in the sea floor, landslides, or volcanic activity. **Although a tsunami cannot be prevented, the impact of a tsunami can be mitigated through community preparedness, timely warnings, and effective response. Observations of seismic activity**, sea floor bathymetry, **topography**, sea level data (Tide Gauge observations of sea height; Realtime Tsunami Warning Buoy Data; (Deep Ocean Assessment and Reporting of Tsunamis (DART) buoys) **and sea-level variations** from the TOPEX/Poseidon and Jason, the European Space Agency's Envisat and the U.S. Navy's Geosat Follow-On, **are used in combination with tsunami models to create inundation and evacuation maps and to issue tsunami watches and warnings.**

### GPS Key – Weather

#### GPS technology improves weather forecasting,

June 14th 2010, RMIT university's John Le Marshal, 10

**Researchers at RMIT University's SPACE Research Centre and the Bureau of Meteorology are using GPS and** [**low earth orbit**](http://phys.org/tags/low+earth+orbit/) **satellites to provide an additional type of temperature profile observation for use in weather forecasting computer models. The computer models draw on about a hundred thousand million current weather observations**, including data from 30 to 40 complementary satellite instruments, to generate the information used by meteorologists to prepare [weather forecasts](http://phys.org/tags/weather+forecasts/) **RMIT Adjunct Professor John Le Marshall,** Research Program leader at the Bureau of Meteorology and former Inaugural Director of the Joint Center for Satellite Data Assimilation, a joint NOAA, NASA and DOD research initiative in Washington, said: **"What we've found through our work with RMIT's SPACE research team is that the GPS data improves the real-time temperature field and the cross-calibration of the data from a number of satellite instruments. This in turn significantly increases the usable quality of the satellite observations.** "We are actually able to measure the amount of bending in the GPS beam as it passes through the atmosphere. We can then use that **knowledge to more accurately measure atmospheric temperatures and use this to improve temperature fields and calibrate other satellite readings. This extra information, in the data-sparse southern hemisphere, is now making our forecasts more accurate."** Professor Le Marshall said that "since the research was completed and began being used in forecasts this year, **we estimate the Bureau is now delivering forecasts of the same accuracy 10 hours earlier".** He predicts that, as techniques improve,[**GPS data**](http://phys.org/tags/gps+data/) **will also play a bigger role in climate monitoring and severe weather warnings. Professor Kefei Zhang,** Director of the RMIT SPACE Research Centre, **said that GPS as a revolutionary technology** for Positioning, Navigation and Timing (PNT), **provided a low-cost, powerful means of precise measurement of the earth environment.** "Weather forecasting is dependent on accurate observations of the atmosphere surrounding the whole planet, but there is a significant lack of ground-based meteorological observation stations. That and the shortage of accurate surface level data from over the world's oceans and polar regions limits the reliability of climate and[weather](http://phys.org/tags/weather/) predictions. "This is particularly true for Australia, where people live along long coastlines but forecasters can only draw on very limited measurements from the middle of the continent and surrounding oceans. **"GPS can fill that gap. It's revolutionary technology. It's the missing link," Professor Zhang said.** The RMIT SPACE Research Centre is a multi-disciplinary and international collaboration supported through the Federal Government's Australian Space Research Program

### GPS key - Wildfires

#### Early warning system key to improving wildfire response times

Grasso ‘11

[Veronica F; Ashbindu Singh; “Early Warning Systems: State-of-Art Analysis and Future Directions,” *United Nations Environment Programme*, November 21, p. 14]

**Wildland fires pose a threat to lives and properties and are often connected to secondary effects such as landslides, erosion, and changes in water quality**. Wildland fires may be natural processes, human induced for agriculture purposes, or just the result of human negligence. **Early warning methodologies for wildland fires are based on the prediction of precursors, such as fuel loads and lightning danger. These parameters are relevant for fire triggering prediction, but once the fire has begun, fire behavior and pattern modeling are fundamental for estimating fire propagation patterns**. Most industrial countries have EW capabilities in place, while most developing countries have neither fire early warning nor monitoring systems in place (Goldammer et al., 2003). Wildland fire information is available worldwide through the Global Fire Monitoring Center (GFMC), a global portal for wildland fire data products, information, and monitoring. This information is accessible to the public through the GFMC web site but is not actively disseminated. The GFMC provides global wildland fire products through a worldwide network of cooperating institutions. GFMC fire products include: fire danger maps, which provide assessment of fire onset risk; near realtime fire events information; an archive of global fire information; and assistance and support in the case of a fire emergency. Global fire weather forecasts are provided by Experimental Climate Prediction Center (ECPC), which also provides national and regional scale forecasts. NOAA provides experimental potential fire products based on estimated intensity and duration of vegetation stress, which can be used as a proxy for assessment of potential fire danger. The Webfire Mapper, collaboration between the University of Maryland and NASA, provides near real-time information on active fires worldwide, detected by MODIS rapid response system. The Webfire Mapper integrates satellite data with GIS technologies for active fire information. This information is available to the public through the website and email alerts. Local and regional scale fire monitoring systems are available for Canada, South America, Mexico and South Africa. An interactive mapping service based on Google maps and EO imagery from INPE the Brazilian Space Research Institute, is available since September 2008. Individuals can contribute with information from the ground, in only 3 months the service has received 41 million reports on forest fires and illegal logging, making it one of the most successful web sites in Brazil, and obtaining real impact through follow up legal initiatives and Parliamentary enquiries. Although global scale fire monitoring systems exist, an internationally standardized approach is required to create a globally comprehensive fire early warning system. Integration of existing fire monitoring systems could significantly improve fire monitoring and early warning capabilities. **An information network must be developed to disseminate early warnings about wildland fire danger at both the global and local levels, to quickly detect and report fires, and to enhance rapid fire detection and classification capabilities at national and regional levels.** The Global Early Warning System for Wildland Fire, which is under development as part of the Global Earth Observation System of Systems (GEOSS) effort, will address these issues.

### Natural Disasters MPX

#### Natural Disasters Causes Major Fatalities

Matthew E. Kahn, September 2003**,** Tufts University and Stanford University,THE DEATH TOLL FROM NATURAL DISASTERS: THE ROLE OF INCOME, GEOGRAPHY, AND INSTITUTIONS, <http://elsa.berkeley.edu/users/webfac/quigley/e231_f03/kahn.pdf>

Natural disasters can affect several different aspects of an economy, ranging from long-run growth rates to naturalresource prices (Skidmore & Toya, 2002; Prestemon & Holmes, 2002). **Such disasters as earthquakes, floods, windstorms, extreme temperature events, and landslides can also impose significant death counts. Between 1990 and 2002, 4,300 natural disasters took place, killing 815,077 people**.16 This paper has used cross-national data for 73 nations to test hypotheses concerning the role of income, geography, and institutions in mitigating death counts from natural disasters

#### Volcanic Activity has the Potential to Take Out Populations

Corey S. Powell, [October 2000](http://discovermagazine.com/2000/oct) , Discover Magazine, <http://discovermagazine.com/2000/oct/featworld/>

In **1783, the Laki volcano in Iceland erupted, spitting out three cubic miles of lava. Floods, ash, and fumes wiped out 9,000 people and 80 percent of the livestock.** **The ensuing starvation killed a quarter of Iceland's population.** Atmospheric dust caused winter temperatures to plunge by 9 degrees in the newly independent United States. **And that was just a baby's burp compared with what the Earth can do. Sixty-five million years ago, a plume of hot rock from the mantle burst through the crust in what is now India**. Eruptions raged century after century, ultimately unleashing a quarter-million cubic miles of lava—the Laki eruption 100,000 times over. **Some scientists still blame the Indian outburst, not an asteroid, for the death of the dinosaurs**. An earlier, even larger event in Siberia occurred just about the time of the Permian-Triassic extinction, the most thorough extermination known to paleontology. At that time 95 percent of all species were wiped out. Sulfurous volcanic gases produce acid rains. Chlorine-bearing compounds present yet another threat to the fragile ozone layer—a noxious brew all around. While they are causing short-term destruction, volcanoes also release carbon dioxide that yields long-term greenhouse-effect warming .**The last big pulse of flood-basalt volcanism built the Columbia River plateau about 17 million years ago. We're ripe for another.**

**Natural Disasters Killed 250,000 People in 2010 Alone**

MSNBC 2010

Julie Reed Bell, Seth Borenstein 12/19/2010, <http://www.msnbc.msn.com/id/40739667/ns/us_news-2010_year_in_review/t/s-world-gone-wild-quakes-floods-blizzards/#.T_H4ofWuB5E>

**Earthquakes, heat waves, floods, volcanoes, super typhoons, blizzards, landslides and droughts killed at least a quarter million people in 2010** — the deadliest year in more than a generation**. More people were killed worldwide by natural disasters this year than have been killed in terrorism attacks in the past 40 years combined.** "It just seemed like it was back-to-back and it came in waves," said Craig Fugate, who heads the U.S. Federal Emergency Management Agency. It handled a record number of disasters in 2010. "The term '100-year event' really lost its meaning this year." And we have ourselves to blame most of the time, scientists and disaster experts say. **Even though many catastrophes have the ring of random chance, the hand of man made this a particularly deadly, costly, extreme and weird year for everything from wild weather to earthquakes. Poor construction and development practices conspire to make earthquakes more deadly than they need be. More people live in poverty in vulnerable buildings in crowded cities. That means that when the ground shakes, the river breaches, or the tropical cyclone hits, more people die.**

## \*Noko

### Tensions High

#### NoKo tensions high in the SQO

JEAN H. LEE,06/23/12, North Korea-U.S. Relations: In Pyongyang, Learning To Hate America Starts Early, Huffington Post, http://www.huffingtonpost.com/2012/06/23/north-korea-us-relations\_n\_1621067.html

**A framed poster on the wall of a kindergarten classroom shows bright-eyed children brandishing rifles and bayonets as they attack a hapless American soldier, his face bandaged and blood spurting from his mouth. "We love playing military games knocking down the American bastards," reads the slogan printed across the top.** **Another poster depicts an American with a noose around his neck. "Let's wipe out the U.S. imperialists," it instructs. For North Koreans, the systematic indoctrination of anti-Americanism starts as early as kindergarten** and is as much a part of the curriculum as learning to count. Toy pistols, rifles and tanks sit lined up in neat rows on shelves. The school principal pulls out a dummy of an American soldier with a beaked nose and straw-colored hair and explains that the students beat him with batons or pelt him with stones – a favorite schoolyard game, she says. For a moment, she is sheepish as she takes three journalists from The Associated Press, including an American, past the anti-U.S. posters. But Yun Song Sil is not shy about the message. "**Our children learn from an early age about the American bastards," she** **says, tossing off a phrase so common here that it is considered an acceptable way to refer to Americans.** **North Korean students learn that their country has had two main enemies: the Japanese, who colonized Korea from 1910 to 1945, and the U.S.,** which fought against North Korea during the 1950-53 Korean War. They are told that North Korea's defense against outside forces – particularly the U.S., which has more than 28,000 soldiers stationed in South Korea – remains the backbone of the country's foreign policy. And they are bred to seek revenge, even as their government professes to want peace with the United States. "They tell their people there can be no reconciliation with the United States," says American scholar Brian Myers, who dissected North Korean propaganda in his 2010 book "The Cleanest Race: How North Koreans See Themselves and Why It Matters." "**They make it very clear to the masses that this hate will last forever."** In recent years, state propaganda has shifted away from the virulent anti-American slogans of the past and has instead emphasized building up the economy. On the streets of Pyongyang, anti-American posters have largely given way to images of soldiers in helmets and workers in factories. But the posters and curricula at kindergartens across North Korea remain unchanged. One glimpse inside a school, and it's clear that despite U.S.-North Korean diplomacy behind closed doors, **4-year-olds are still being taught that the "Yankee imperialists" are North Korea's worst enem**y. **At the Kaeson Kindergarten in central Pyongyang, one of several schools visited by the AP, U.S. soldiers are depicted as cruel, ghoulish barbarians with big noses and fiendish eyes. Teeth bared, they brand prisoners with hot irons, set wild dogs on women and wrench out a girl's teeth with pliers.** One drawing shows an American soldier crushing a girl with his boot, blood pouring from her mouth, her eyes wild with fear and pain. "The American imperialists and Japanese militarism are the sworn enemies of the North Korean people," reads a quote from late leader Kim Jong Il affixed to the top of one wall in a large room devoted to anti-U.S. education. "The main theme of anti-American propaganda is not `We must be ready for an attack' but `We must be ready for revenge,'" Myers says. "People are being whipped up to hate the United States on the basis of past actions." The Americans also are portrayed with nuclear symbols on their helmets and uniforms, a reference to the North Korean insistence that the U.S. poses an atomic threat to the region. An undated poster in French is dotted with places in South Korea where missiles and fighter jets purportedly were kept. **The U.S. denies having nuclear weapons in Korea. The North cites the presence of U.S. soldiers in South Korea, as well as the alleged nuclear threat, as key reasons behind its drive to build atomic weapons in defiance of U.N. Security Council resolutions designed to hobble its nuclear and ballistic missile programs. As disarmament discussions continue in fits and starts, the message in classrooms across the country remains the same: North Korea needs its rockets, bombs and missiles and is proud of its atomic arsenal**. Kaeson Kindergarten is a model school. In the mornings, the children line up for calisthenics and to sing patriotic songs, and at lunchtime they are fed rice, fish and tofu, according to the principal. They learn to sing, dance and ride unicycles, and at 4 p.m. they get a snack and soy milk. History lessons include tales about Kim Jong Il's childhood, life under Japanese occupation and the Korean War. "First, we start by teaching that the American imperialists started the war," said soft-spoken schoolteacher Jon Chun Yong, citing the North Korean version of how the war began. "From that time on, the tragedy emerged by which our nation was divided in two," said Jon, who has taught at the kindergarten for 15 years. "Since then, our people had to endure the pain of living divided for a long half-century." Outside North Korea, history books tell a different story. Western textbooks say that two years after North and South Korea declared themselves separate republics, North Korean troops marched into South Korean capital, Seoul, on the morning of June 25, 1950. U.S.-led United Nations and South Korean forces fought communist North Korean troops backed by Chinese soldiers in a three-year battle for control of the peninsula. The U.S. and North Korea finally called a truce in 1953, and Korea remains divided to this day. At the Kaeson Kindergarten, children sit hunched over sheets of drawing paper clutching pastel crayons. One girl has drawn a school of bright blue fish; the boy next to her has covered his paper with tanks. Another boy depicts a whole battlefield: a North Korean plane dropping bombs on dead, bloodied American soldiers, as well as grenades and tanks. In a final flourish, he adds the name of the South Korean president to the tableau, muttering the name under his breath as he labors over the letters. The North Korean hate campaign generally does not include South Koreans, who are portrayed as puppets of the U.S. However, in recent months, it has come to encompass South Korean President Lee Myung-bak, whose tough policies toward the North have enraged its leaders as well as the South's conservative media. The best of the children's work is pinned up on a board: One kindergartner used color pencils to draw a boy in a blue cap attacking a midget American soldier with a studded club. Another drawing depicts North Korean fighter jets dropping bombs on American soldiers trapped in flames. In a third, a man wearing a helmet marked "U.S." in English is on his knees begging for mercy as he is pummeled on the head with a stick. The children run around beating up mock American soldiers and planes, Jon said. The worst schoolyard taunt is to call someone "miguk nom" – "American bastard." The games culminate every year on International Children's Day on June 1. Across the nation, students convene en masse, dressed in military uniforms and armed with toy rifles and bayonets. At one such celebration in Pyongyang this month, students took turns charging dummies of U.S. soldiers with their weapons. Still, like children everywhere, the littlest North Koreans show more fascination than fear when they encounter the rare American in Pyongyang, invariably waving and calling out "Hello!" in English. And spotted among the mourners following Kim Jong Il's death in December was a boy who clearly had no problem with a Yankee of a different kind. Perched on his head was a blue knit cap with the New York Yankees logo from a distinctly American sport: baseball.

### Jamming Now

#### North Korea’s Jamming capabilities threaten GPS systems – attacks are becoming more common

Brewin, 12’

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North Korean jamming of GPS signals on the Korean peninsula has affected the navigation of 667 aircraft in South Korean airspace since April 28, the Seoul-based Chosun Ilbo newspaper [reported](http://english.chosun.com/site/data/html_dir/2012/05/10/2012051000917.html) today. Aircraft zapped by the high-powered jammer include 618 Korean passenger planes, 48 foreign passenger planes, including 17 U.S., 10 Japanese and six Chinese, and one U.S. military aircraft, the paper reported. Over 122 ships also experienced malfunctions with their GPS-based navigation systems, the South Korean Yonhap News Agency [reported](http://english.yonhapnews.co.kr/national/2012/05/04/50/0302000000AEN20120504005000315F.HTML), including eight patrol boats belonging to the coast guard and a passenger liner carrying 387 people. Incidents like this are to be expected, according to this warning from the Cambridge, Mass.-based Volpe Transportation Systems Center, a research arm of the Transportation Department: “In recent years, the potential for intentional, malicious disruption of GPS has been recognized. These disruptions can range from limited denial of GPS service caused by a low power, localized jammer to more catastrophic incidents could result in the denial of GPS service over large geographic areas and for extended periods of time.” Volpe, in its [report](https://www.transportationresearch.gov/dotrc/pnt/Documents%20of%20Interest/Volpe%20GPS%20Vulnerability%20Study.pdf) on the vulnerabilities of transportation systems that rely on GPS, recommended development of back-up systems. A really good idea -- except for one salient fact: that report was released on Sept. 10, 2001. Almost eleven years later there is still no GPS backup.

#### NoKo launching GPS attacks in the SQO -

UPI 11

North Korea jams South's guided missiles." UPI. (March 8, 2011 Tuesday 5:00 PM EST ): 432 words. LexisNexis Academic. Web. Date Accessed: 2012/06/30.

Seoul has accused North Korea of using sophisticated jamming systems to block South Korean military signals and disrupt its guided missiles. South Korea's Yonhap news agency said the strong jamming signals have been transmitting from the northern border city of Keasong since last week. The purported purpose of the jamming was to disrupt navigational devices using Global Positioning Systems as a major joint military exercise is under way northwest of Seoul. The jamming is believed to have prevented some U.S and South Korean bombs from hitting their targets during a military drill. The Korea Communications Commission said they caused minor inconvenience last week. "Intermittent GPS disruptions are still continuing, although signals are weak," the commission said in a statement, adding that it was working with government agencies and security authorities to shield against the jamming. The defense ministry also confirmed the jamming but refused to afford details citing security reasons. It is believed that Pyongyang has modified Russian equipment to make its own jammers, which can interfere with GPS up to 50 miles away. The U.S.-South Korean annual Key Resolve drill kicked off Feb. 28. More than 12,000 U.S. troops are taking part in the drill, alongside 200,000 South Korean soldiers. The exercise, including live drills and computer simulated war games, is expected to run for 11 days. South Korea and the United States stage regular exercises with their combined forces. The recent drill, though, comes amid heightened tension with North Korea. Both Seoul and Washington have invited media to cover several of the drills scheduled for the coming weeks, including when railroads are used to move weapons and the air landing of troop reinforcements from other countries. Relations between North and South have soured since North Korea's suspected sinking of a South Korean war ship last March and Pyongyang's artillery shelling of a South Korean island in November. GPS jammers work by sending a signal that interferes with the communication between a satellite and GPS receiver. South Korea is also purported to use French made equipment to disrupt or monitor the North's military communications systems. Military officials said the jamming coincided with cyberattacks on the Web sites of about 30 key government agencies and financial institutions in South Korea. The origins of those attacks have yet to be determined. The Korea Communications Commission said that more than 77,200 "zombie" computers were mobilized for the latest attack. The viruses destroyed the hard disks of 114 of them.

### Capable

#### North Korea jamming capabilities are improving – recent incident proves

Rawnsley ’11 (Adam, “North Korean Jammer Forces Down U.S. Spy Plane”, Sept 12, <http://www.wired.com/dangerroom/2011/09/north-korean-jammer-forces-down-u-s-spy-plane/>, CMR)

North Korea, East Asia’s most annoying Stalinist dictatorship, tends to get a little cranky when its neighbor to the South drills with the American military. Usually, that means Pyongyang using its GPS jammers to try and throw a wrench in the exercise. Now, South Korea’s military says the North’s electronic interference has done more than just bug folks trying to get satellite-guided directions to their favorite bibimbap spot. **North Korea’s jamming pushed an American military aircraft out of the skies**. South Korea’s Chosun Ilbo reported Friday that North Korea’s GPS jamming forced an American spy plane to make an emergency landing during joint U.S.-South Korean exercise in March. The incident took place during the Key Resolve-Foal Eagle exercise, and was revealed by a South Korean Defense Ministry report. “If the report is accurate, **the [North Koreans] may have acquired a more powerful GPS jammer, capable of affecting navigation systems over a wider area, (potentially) impacting a host of activities, from intelligence collection to precision weapons applications**,” one former U.S. Air Force intelligence officer notes.

**Noko has Jamming ability**

**BBC 5/2** BBC, “'North Korea jamming' hits South Korea flights”

**Jamming signals thought to be from North Korea have affected GPS navigation on at least 250 flights**, South Korean officials say. Nine South Korean and nine foreign airlines have been affected since Saturday, the Transport Ministry said. The flights had to rely on alternative navigation systems but were in no danger, the ministry added. The South has accused the North - with which it remains technically at war - of similar incidents in the past. "We've confirmed the **GPS** [global positioning system**] jamming signals have been stemming from the North**," Lee Kyung-woo, deputy director at Seoul's Korea Communications Commission, was quoted by Agence-France Presse news agency as saying. The transport ministry has not set out who was to blame. But director Kim Choon-oh told the agency the **GPS disruption was noticeable at Incheon international airport**. He said there was "no serious threat to the safety of flights because planes are using other navigation devices". **South Korea has accused Pyongyang of jamming before, in August 2010 and March 2011.**

### US Intervention

#### US will defend south Korea in the event of a GPS attack by the DPRK

AP 6/14

"Clinton warns NKorea to reform or face backlash." Associated Press Online. (June 14, 2012 Thursday 8:56 PM GMT ): 437 words. LexisNexis Academic. Web. Date Accessed: 2012/06/28.

North Korea's new young leader must transform his impoverished country for the better or face a backlash from its oppressed people, Secretary of State Hillary Rodham Clinton warned Thursday. Clinton issued a direct appeal to Kim Jong Un: "Rather than invest in implements of war, feed your people." She spoke to reporters after top diplomats and defense chiefs of the U.S. and South Korea resolved to respond decisively to military provocations from North Korea. Clinton said Kim, the 20-something young man who rose to power after his father's death in December, could go down in history as a transformative leader if he brought North Korea "into the 21st century." She said if he continued the model of the past, "Eventually North Korea will change because at some point people cannot live under such oppressive conditions: starving to death, being put into gulags and having their basic human rights denied." "We are hoping he will chart a different course," Clinton said. Kim is the third leader in a hereditary dynasty that has sustained six decades of autocratic rule in North Korea but is unable to feed its own people. Despite the chronic food shortages, North Korea has invested its scant resources in maintaining one of the world's largest standing armies and developing nuclear weapons that it claims are needed to deter a U.S. invasion. The United Nations reported this week that millions of North Korean children don't get the food, medicine or health care they need to develop physically or mentally. It said nearly a third of children under 5 show signs of stunting. As for South Korea's security, Clinton said the U.S., which maintains 28,000 troops there, would stand "shoulder-to-shoulder" with its ally. Her South Korean counterpart, Foreign Minister Kim Sung-hwan, said Thursday's meeting should send a clear message to North Korea about the strength of the alliance. Animosity between the rival Koreas is high following a North Korean rocket launch in April that violated a U.N. ban, and more recently threats to attack several South Korean media outlets. In a joint statement issued after Thursday's talks, the U.S. reaffirmed it would defend South Korea through "the full range of U.S. military capabilities, both conventional and nuclear." The allies also agreed to strengthen their combined defenses against missiles and coordinate against cyber attacks and GPS jamming. The statement said North Korea still could rejoin the international community "if it refrains from provocations and complies with its international obligations and commitments, which include taking concrete actions toward denuclearization."

#### US and South Korea cooperation in the SQO over GPS attacks by North Korea

RTT News, 6/15

"US, S. Korea To 'Strongly And Consistently' Respond To North's Threats." RTT News (United States). (June 15, 2012 Friday ): 478 words. LexisNexis Academic. Web. Date Accessed: 2012/06/28.

The U.S.-South Korea Foreign and Defense Ministerial Consultation meeting has made it clear that the alliance will "strongly and consistently respond to any North Korean provocation, in particular regarding North Korean nuclear and missile threat." Addressing the media after the so-called 2+2 meeting in Washington on Thursday, South Korean Defense Minister Kim Kwan-Jin said through the meeting, the two countries confirmed once again that the South Korea-U.S. alliance is more solid than ever. The 2+2 ministerial meeting was held at a strategically critical moment amid continuing provocative threats from North Korea and volatile security environment in that country, a time which calls for a proactive alliance response. Both sides agreed to strengthen policy coordination to reaffirm the strong U.S. commitment to provide extended deterrents and to develop extended deterrent policies in an effective and substantial way. They also agreed to strengthen alliance capability against North Korea's increasing asymmetric threats such as cyber threats like the DDoS attack and GPS jammings. Further, the two countries confirmed that the 2015 transition of operational control and the building of a new combined defense system are progressing as planned. It has also been confirmed that the South Korean military will acquire the critical capabilities needed to lead the combined defense, and the U.S. military will provide bridging and engineering capabilities. The two nations also confirmed that U.S. Forces Korea bases relocation projects such as YRP and LPP are well underway and agreed to work to ensure that these projects are completed on time. "We assess that combined exercises in the West Sea and Northwest Islands deter North Korean provocation and greatly contribute to the peace and stability of the Korean Peninsula. We agreed to continue these exercises under close bilateral coordination," Kim told reporters. Next year marks the 60th anniversary of the South Korea-U.S. alliance which was born in 1953 with the signing of the ROK-U.S. Mutual Defense Treaty. In the past six decades, the two countries worked to ensure a perfect security of the peninsula and have developed the alliance into the most successful alliance in history. In the future, the two countries will expand and deepen the scope and level of defense cooperation from the Korean Peninsula, and to the regional and global security issues, will continue evolving the alliance into the best alliance in the world for the peace and stability of the Korean Peninsula, and of the world, Kim said. U.S. Secretary of State Hillary Rodham Clinton and Defense Secretary Leon Panetta hosted their respective South Korean counterparts Kim Sung-Hwan and Kim Kwan-Jin at the 2+2 meeting.

## \*Disease

### Bird Flu IL

#### The Study of Migration Patterns is Key To Tracking Disease Spread

[Rocky Mountain Tracking,](http://www.rmtracking.com/blog/) Daily GPS News, May 6th 2011, <http://www.rmtracking.com/blog/2011/05/06/combating-bird-flu-with-gps-tracking/>

**Scientists have used** [**GPS tracking**](http://www.rmtracking.com/blog/2009/08/17/bird-observation-via-gps-tracking/) **for years to study the migratory patterns of birds and other animals.** The devices provide hands on information about the summer and winter movements of animals that could not otherwise be viewed closely enough by humans to gain any significant data. **Now, using that same** [**technology**](http://www.rmtracking.com/blog/2009/02/28/gps-wildlife-tracking/)**, researchers are learning more about the deadly strain of influenza known as H5N1, or** [**bird flu**](http://www.rmtracking.com/blog/2011/06/16/h5n1-mystery-solved-with-the-help-of-gps/)**. Bird flu has caused the deaths of hundreds of humans and millions of wild and domestic birds throughout Europe, Asia, and Africa since the year 2003.** Until recently, little was known about the origin of the disease or how to track and contain the animals transmitting it**. But** **using the information obtained from** [**GPS tracking**](http://www.rmtracking.com/) **devices attached to wild geese along with data regarding outbreak areas, scientists now have a** greater base of knowledge with which to form **a strategy for combating the deadly virus. Wild geese in China were tagged with transmitters that relayed their location and movements to researchers who followed their migration** from Qinghai Lake to Lhasa, Tibet. **Using the geographical knowledge they already had of outbreaks in these areas, scientists were able to trace the movement of the disease from known outbreaks in China and Tibet to other parts of the world, carried by the migrating geese.** While much research remains to be done on the bird flu outbreaks in order to contain and eventually eliminate it as a threat to humans and domestic fowl, the information gained from tracking technology **remains a key component in the overall strategy for pinpointing outbreaks and tracing carriers. The devices worn by wild geese in these studies can relay vital information to researchers by transmitting the location of individual birds to a central computer, enabling scientists to trace not only the individual movements of specific animals,** but also their movements relative to the migration of the entire group. The technology has been used not only in this study, but also to monitor movements of endangered species, predatory animals, and invasive species in order to aid scientists in their attempts to understand animal behavior. **Without GPS tracking, advances in knowledge regarding bird flu and other diseases could take decades to emerge; with the technology, however, scientists hope to create effective strategies for dealing with H5N1 in order to save both human lives and those of the animals with whom we share the planet.** Article Written by Lynetta Bowen; rocky mountain tracking inc.

### Pandemics IL

**Japan explores using cell phones to stop pandemics**

[June 7, 2009](http://phys.org/archive/07-06-2009/), JAY Alabaster 9, <http://phys.org/news163600177.html>

**A few months from now, a highly contagious disease will spread through a Japanese elementary school. The epidemic will start with several unwitting children, who will infect others as they attend classes and wander the halls**. If nothing is done, it will quickly gain momentum and rip through the student body, then jump to parents and others in the community. But **officials will attempt to stymie the disease and save the school - using mobile phones. The sickness will be a virtual one, in an experiment funded by the Japanese government.** A subsidiary of Softbank Corp., a major **Japanese Internet and cellular provider, has proposed a system that uses phones to limit pandemics.** The exact details have yet to be fixed, but **Softbank hopes to pick an elementary school with about 1,000 students and give them phones equipped with GPS. The locations of the children will be recorded every minute of the day and stored on a central server. A few students will be chosen to be considered "infected," and their movements over the previous few days will be compared with those of everyone else. The stored GPS data can then be used to determine which children have crossed paths with the infected students and are at risk of having contracted the disease. The families of exposed students will be notified by messages to their mobile phones, instructing them to get checked out by doctors. In a real** [**outbreak**](http://phys.org/tags/outbreak/)**, that could limit the rate of new infections. "**The number of people infected by such a disease quickly doubles, triples and quadruples as it spreads. If this rate is decreased by even a small amount, it has a big effect in keeping the overall outbreak in check," said Masato Takahashi, who works on infrastructure strategy at Softbank. He demonstrates with a calculation: If an infected person makes about three more people sick per day, and each newly infected person then makes another three people sick, on the 10th day about 60,000 people would catch the disease. If each sick person instead infected two people a day, on the 10th day about 1,500 people would get sick.

### AIDS IL

**GPS helps control observable characteristics and isolate HIV/AIDS**

**Gibson & McKenzie 8**

(July 2nd, Not specified; http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2007/04/09/000016406\_20070409134246/Rendered/PDF/wps4195.pdf)

The above two examples highlight the ability of **GPS** to **helps researchers to better control for (**potentially**) observable characteristics**. Several **recent papers are** also **using GPS to create instruments for use in instrumental** variables **estimation.**7 The most standard application is to use distance as an instrument**. For example, Oster** (2006) wishes to **examined the response of sexual behavior to HIV prevalence rates in Africa.** The concern is that HIV prevalence is endogenous, as places where people have a lot of risky sex are likely to have high rates of HIV prevalence. **Her solution is to use the GPS information contained in the Demographic and Health Surveys** (DHS**) to calculate the distance of each cluster** to the Democratic Republic of Congo (DRC), **where the HIV virus is thought to have originated.** She argues that the spread of the virus should be related to the distance from the DRC, but that after controlling for region, latitude, longitude, and country-level measures of development, distance from the DRC should not otherwise affect sexual behavior. As a further check, she uses data on pre-marital sex to show that distance from the DRC was not correlated with sexual behavior before the spread of HIV occurred.

### GPS Solves – Diseases

**Disease origins can be tracked with GPS**

**Mulder ‘11** (Elise Mulder, writer for Earthzine, Tracking Typhoid: How DNA and GPS Partner to Prevent Disease, http://www.earthzine.org/2011/11/11/tracking-typhoid-how-dna-and-gps-partner-to-prevent-disease/)

**Typhoid is** believed to be **a water-borne bacteria**, but within that category there are many ways the disease may be spread: Person-to-person contact, unclean food in the home, unclean food vendors, or unfiltered water in public places such as schools. **The results of this** particular **study reveal that the bacteria may cluster around public water spouts.** A similar course of discovery took place nearly two centuries ago in the 1840s, when John Snow used interviews, deductive reasoning, and a hand-drawn map to suggest that public pumps might be a key source of spreading cholera in London. Much has changed since Dr. Snow used mapping to investigate cholera hot spots. Today’s researchers share Snow’s goal of disease prevention, but an array of new tools and constantly developing theories of infection aid them in their work. **For the study on typhoid in Kathmandu, researchers took blood from 700 Kathmandu patients infected with typhoid. They used DNA sequencing to determine the strain’s genotype for each patient and mapped the patients’ home locations using GPS (Global Positioning System). Mapping shows that outbreaks tend to cluster around water spouts,** as reported by SciDev.Net. DNA data helps researchers to determine whether separate typhoid outbreaks are related to one another, which in turn allows for speculation as to how the disease may be spreading. **A stronger understanding of sources of disease allows health officials to take more effective action toward the prevention of disease.** For example, the Kathmandu study suggests that environmental rather than person-to-person causes may be most responsible for the spread of typhus in Nepal.

## Iran

### Can Spoof

#### Iran has used GPS spoofing to capture a US drone

Ragan '11 Steve Ragan, Reporter for Security Week, December 18th, 2011,<http://www.securityweek.com/reports-say-us-drone-was-hijacked-iran-through-gps-spoofing>

Iran has captured an RQ-170 drone used by the CIA, and according to unconfirmed reports from the Christian Science Monitor (CSM), the Iranians were able to pull off such a feat by targeting the drone’s GPS systems. The CSM interviewed an Iranian engineer who is said to be working as part of a team assigned to study the remotely piloted aircraft (RPA). He explained that the process of capturing the drone centered on spoofing the communications signal used to manage GPS. “By putting noise [jamming] on the communications, you force the bird into autopilot. This is where the bird loses its brain...,” the engineer told CSM. Once the autopilot was activated, Iran was able to force the drone to “land on its own where we wanted it to, without having to crack the remote-control signals and communications...” The CSM report also quoted the engineer as explaining that the technique was a known vulnerability.

**Iran has ability to spoof – Captured drone.**

**Schwartz 11** Matthew Schwartz, Columnist Information Week, “Iran Hacked GPS Signals To Capture U.S. Drone” Information week

**Iran** recently **captured a CIA** batwing stealth **drone** **by spoofing the GPS signals** it received, fooling the drone into thinking it was landing at its home base. The Christian Science Monitor, broke that news Thursday, after interviewing an Iranian engineer who's been reviewing the systems of the captured RQ-170 Sentinel drone, which was downed by Iranian forces on December 4 near Kashmar, which is about 140 miles inside northeast Iran. "**The GPS navigation is the weakest point**," the engineer told the Monitor. Indeed, numerous researchers have warned that **GPS signals are relatively easy to spoof**, given that the related signal broadcast by satellites is relatively weak. Accordingly, **the Iranians focused on spoofing the GPS data being received by the drone.**

## Shipping

### Maritime GPS Vulnerable

#### GPS prone to maritime jamming

Grant 09

[Alan; Paul Williams; Nick Ward; Sally Basker, General Lighthouse Authorities of the United Kingdom and Ireland, Journal of Navigation, Vol. 62, No. 2, p. 173-187]

The US Global Positioning System **(GPS) is currently the primary source of** Position, Navigation and Timing (PNT) **information in maritime applications**, whether stand-alone or augmented with additional systems. **This situation will continue in the future** with GPS, possibly together with other Global Navigation Satellite Systems (GNSS) e.g. Galileo, being the core PNT technology for e-Navigation – the future digital maritime architecture. **GPS signals**, measured at the surface of the earth, **are very weak**. As such, **the system is vulnerable to unintentional interference and jamming, resulting in possible denial of service over large geographical areas. The result of such interference could be the complete failure of the mariner’s GPS receiver or**, possibly worse, the presentation to the mariner of **hazardously misleading information** (HMI) **for navigation and situational awareness**, depending on how the GPS receiver reacts to the jamming incident.

#### GPS prone to jamming – multiple impacts on maritime navigation

Grant ‘09

[Alan, et al. General Lighthouse Authorities of the United Kingdom & Ireland (gov’t agency responsible for maritime safety); “GPS Jamming and the Impact on Maritime Navigation,” *Journal of Navigation*, Vol. 62; p. 185-6]

6. CONCLUSIONS. **GPS is vulnerable and** this trial has investigated GPS service denial by intentional interference using low-power jammers. It should be clear that the results can be extended to GPS service denial by unintentional interference. Unintentional sources of interference include spurious harmonics from active TV antennas, damaged GPS antenna cables and ionospheric effects. The latter are correlated with an eleven-year sun-spot cycle and are particularly prevalent at high latitudes. This will bring challenges when arctic shipping routes become available. The main conclusion from this trial is that GPS **service denial has a significant impact on maritime safety**: · On shore – the marine picture presented to Vessel Traffic Services/Management (VTS) will be confused as AIS information with erroneous positions and high-velocities conflicts with the radar information. Further study is needed to determine how VTS operators will respond. · AtoNs – DGPS reference stations can be jammed and the impact may result in the absence of DGPS corrections and integrity information broadcast to users over a very large geographical area; AIS used as an AtoN may broadcast incorrect information; and synchronised lights may not be synchronised, thus having an adverse impact on visual conspicuity. · **On ships – navigation, situational awareness, chart stabilisation and DSC emergency communications will be lost if they are based on GPS**. Some vessels have integrated bridge systems, which enable automatic execution of a passage plan on autopilot. If this system is operating at a time when jamming occurs then, **depending on the system design, the vessel’s course and heading may change without informing the watch-keeper, potentially leading to extremely hazardous consequences**. At this point, continuation of navigational safety is dependent on mariners’ abilities to recognise that GPS service is being denied and to operate effectively using alternative techniques (e.g. radar parallel-indexing). Increased use of ECDIS will increase the attendant risks. · On people – People are conditioned to expect excellent GPS performance. As a result, **when ships’ crews or shore staff fail to recognise that the GPS service is being interfered with and/or there is a loss of familiarity with alternative methods of navigation or situational awareness, GPS service denial may make a significant impact on safety and security**. In this trial, despite the fact that the Pole Star’s crew was forewarned, problems were experienced with the ECDIS. Moreover, the number of alarms that can sound on the bridge can be distracting. Moving to other navigation techniques can cause an increase in bridge workload. eLoran was unaffected by GPS jamming and demonstrated an accuracy of 8.1m (95%) which is comparable to stand-alone, single-frequency GPS. Consequently, eLoran can be used to detect erroneous positions and high velocities that may be experienced during GPS service denial. Moreover, when GPS is unavailable, eLoran can provide a PNT input to all maritime systems. Finally, in the future e-Navigation environment, the combination of GPS, Galileo and eLoran will provide robust and resilient PNT in order to reduce the impact of human error and to improve the safety, security and protection of the marine environment.

## Japan

### Cooperation Now

#### Japan and the US cooperating now – interoperability key to US and Japanese systems and cooperation on GPS key to stability in Asia

"Press Releases: Joint Announcement on United States-Japan GPS Cooperation." State Department Documents and Publications. (January 14, 2011 ): 703 words. LexisNexis Academic. Web. Date Accessed: 2012/06/30.

The Governments of the United States of America and Japan convened a plenary meeting in Tokyo, Japan on January 13, 2011, to review and discuss cooperation in the civil use of the Global Positioning System (GPS) and GPS augmentations, including Japan's Multi-functional Transport Satellite (MTSAT) Satellite-based Augmentation System (MSAS) and Quasi-Zenith Satellite Systems (QZSS). The GPS consultations are held regularly pursuant to the "Joint Statement on Cooperation in the Use of the Global Positioning System" signed by the heads of the two Governments on September 22, 1998. During the meeting, U.S. representatives described the status of Wide Area Augmentation System (WAAS) and GPS modernization and the United States' international GPS cooperation with third parties. Representatives of the Government of Japan reported on the status of the Multi-functional Transport Satellite Satellite-based Augmentation System and Quasi-Zenith Satellite Systems programs and on Japan's international Global Navigation Satellite System (GNSS) - related cooperation activities. Both Governments reaffirmed the importance of providing open access to basic space-based positioning, navigation and timing (PNT) services for peaceful purposes, free of direct user fees. Both Governments reiterated that GPS and its augmentations have become indispensable for modern life in the U.S., Japan and the world, providing essential services and increased efficiencies in a broad range of applications, such as aviation and maritime safety-of-life, geodetic surveying, car and personal navigation, mobile telephone timing, international financial transactions and electric power transmission. Representatives of both Governments reviewed the ongoing work of the Global Positioning System/Quasi-Zenith Satellite System Technical Working Group, which was established to foster close cooperation during the development of Quasi-Zenith Satellite System. The Technical Working Group reaffirmed that both systems are designed to be compatible and highly interoperable. Both Governments noted with satisfaction that the Japan Aerospace Exploration Agency and the U.S. National Oceanic and Atmospheric Administration (NOAA) have commenced operations of a Quasi-Zenith Satellite System Monitoring Station on NOAA property in Guam. A similar effort between the Japan Aerospace Exploration Agency and the U.S. National Aeronautics and Space Administration (NASA) to establish both a Quasi-Zenith Satellite System monitoring station and a Two-Way Satellite Time and Frequency Transfer station at a NASA facility in Hawaii, in support of Japan's National Institute of Information and Communications Technology and the U.S. Naval Observatory, is expected to be completed shortly. Both Governments intend to continue cooperation in protecting spectrum used for GNSS and also reaffirmed the importance of pursuing the interoperability and compatibility of all current and planned global navigation satellite systems with Global Positioning and Quasi-Zenith Satellite Systems. This 8th Plenary meeting strengthened cooperative relations between the United States and Japan. Both Governments acknowledged the important future contribution of Quasi-Zenith Satellite System to the space-based positioning, navigation and timing services of Japan. They affirmed that continued close cooperation in the area of navigation satellite system will contribute to the peaceful development of the Asia-Pacific region and promote global economic growth. In that regard, both Governments welcomed the 6th meeting of the International Committee on Global Navigation Satellite Systems to be held in Tokyo, September 5-9, 2011, and the 3rd Asia Oceania Regional Workshop on Global Navigation Satellite Systems to be held in Japan's fiscal year 2011.

## Poverty

### GPS key - Poverty

#### GPS essential to poverty reduction techniques

Chowdhury ‘01

(Nuimuddin Chowdhury Consultant International Food Policy Research Institute. Nuimuddin Chowdhury runs Grameen Software Limited, a company chaired by Professor Muhammad Yunus, the founder of the Grameen Bank in Bangladesh. He wrote the two case studies published on The Globalist while a consultant for The Century Foundation in New York. Mr. Chowdhury was trained in Economics at Punjab University in Lahore, Pakistan — and at the University of Cambridge, England. He worked in various capacities for the Bangladesh Institute of Development Studies (BIDS), the World Bank and the International Food Policy Research Institute (IFPRI). September 18, 2001 http://www.ifpri.org/sites/default/files/pubs/divs/cd/dp/ictdp01.pdf Accessed: 6-29-2012 )

Against a background of rapid changes in markets and in the pipeline of technologies, the demand for real-time information and up-to-date knowledge to help make effective policy has become greater. Agricultural growth of a kind that assuredly lowers secular poverty has three essential ingredients: diffusion of modern farm technology; integration of markets, which enables cost gains to be shared throughout the market chain; and a diversified productive capacity in rural areas. The flow of information and knowledge is an integral part in all three. Also, the increasingly ascendant imperatives of natural resource management at watershed, landscape, and community levels point up the need for a sharp spatial focus in both research and policy. Dealing with malnutrition at policy and institutional levels also requires a keen locational or geographical differentiation. This again points up the relevance of geographical information systems (GIS), global positioning systems (GPS), and other informational techniques. ICTs are relevant to each of the following imperatives: (1) give policymakers access to real-time information and best-practice knowledge distilled from the Web (by “servlets” and “Enterprise Javabeans” that combine to respond to “hot-button indents” from policymakers); (2) reduce private and public search and transactions costs; (3) respond to environmental modifiers at watershed, landscape and community levels; (4) foster diversification of the rural economy; (5) implement spatially sensitive informational strategies, which render food security and nutritional programs more effective and less costly; (6) harness the capability to mount early-warning information systems, with peoples’ participation. ICTs would likely pay off by increasing the effectiveness of the tried-and-tested recipes, but they also add some bite of their own.

## Energy

### GPS key – Thermostats

#### GPS-enabled thermostats offer potential for massive reductions in US energy consumption

Gupta ‘09

[Manu, Massachusetts Institute of Technology; et al; *Proceedings of the 7th International Conference on Pervasive Computing;* May, p.1-4]

With only 5% of the world's population, the U.S. uses 25% of the world's energy [1]. The

**U.S residential sector is responsible for 21% of the total U.S energy consumption, and heating and cooling accounts for 46% of the total energy consumed** in U.S residential buildings. Overall, 9% of total U.S energy consumption is expended on residential heating and cooling [2, 3]. Forty-nine percent of homes in the U.S are unoccupied during the day, and it is estimated that **in 53% of U.S homes the temperature (T) is not lowered during the daytime when no one is at home** in winters (conversely, in 46% the T is not raised in summers) [4]. Even in the 30% of the U.S homes that have programmable thermostats (PTherms), as many as 44% may not use daytime setbacks to save energy [4]. As Table 1 shows, **as many as 55 million U.S. households** – some with manual thermostats (MTherms) and some with P-Therms **– may not change their T settings when no one is home**. Although per capita consumption of energy is much lower in other countries [1], a significant amount of energy is likely being wasted heating and cooling unoccupied environments in many industrialized countries because common thermostats do not adapt to variable occupancy schedules and because people have difficulty setting and optimizing P-Therms [5]. The challenge, therefore, is to create a system to augment existing thermostats so that regardless of what the home occupants do, the thermostat (1) saves energy, (2) requires non-burdensome user input and no reliance on memory, and (3) doesn’t sacrifice comfort, where we define comfort as ensuring that the home is always at a desirable temperature upon return. Additionally, a thermostat needs to be inexpensive to use and install. We describe a concept for augmenting existing thermostats with a just-in-time heating and cooling mode that is controlled using travel-to-home time computed from locationaware mobile phones. Although existing P-Therms can save substantial amounts of energy when used effectively [6], we show, via a set of simulations using real travel data and home heating and cooling characteristics, that the proposed just-in-time system augmentation might provide energy savings for the substantial number of people who do not use M-Therms or P-Therms optimally. The system that we propose does not require users to program occupancy schedules. In fact, no change in behavior on the part of the home occupants from what they currently do is necessary. We focus on standalone housing and commuting patterns common in the northern U.S. and leave the question of how these results might generalize to other climates, housing types, and lifestyles for future work. 2 Prior Work Pervasive computing systems that can infer context clearly offer potential for energy saving. Harris et al. [7], for example, argue that context-aware power management (CAPM) could use multi-modal sensor data to optimally control the standby states of home devices to optimize energy use, reducing so-called vampire power consumption [8]. They conclude that to optimally save energy, in addition to predicting what someone is currently doing, a system should predict what someone is about to do. Reliable detection of intentionality to control appliance energy use indoors is a difficult problem that is the subject of ongoing research [9]. Nonetheless, Harle and Hopper [10] showed that even without such prediction, in one office building using location of occupants would have permitted energy expended on lighting and “fast-response” electrical systems to be reduced by 50%. Although inefficient use of electrical devices can be a substantial source of energy waste in a home or office, others have instead focused on improving home thermostats to lower heating, ventilation and air condition (HVAC) costs. A thermostat balances two competing factors: energy savings and air temperature/humidity comfort levels. There are three common types [11]. Manual thermostats (M-Therms) can be the most energy efficient option. People who set the T very low in winter when they leave the house and then turn up the T when they return achieve maximal energy savings but with significant discomfort upon return to the home. Avoiding that discomfort may be one reason that over 65% of people with MTherms do not use setbacks when they are away from their homes in winter [4]. Programmable thermostats (P-Therms) automatically regulate the T according to a prescheduled program. P-Therms do not adapt to variable occupancy schedules – if schedules change, the user must remember to re-program the system in advance, and reprogramming is often tricky with current interface designs. The lack of responsiveness and difficulty of programming may be one reason that over 43% of people with P-Therms do not use daily setbacks when away in winter [4]. So-called intelligent thermostats have “adaptive recovery control,” so that rather than starting and stopping based on timers, they set the T when away to ensure that given typical heating/cooling patterns, the home will reach the comfort T at the right time. These thermostats may also learn the T preferences of the user for different contexts [12] and use occupancy sensors to infer occupancy patterns [13, 14]. Others use light levels to change the T settings in the house [15] or control the air velocity and direction [16]. Some even have persuasive elements, such as informing users about the minimum T settings that can produce the desired comfort level [12, 17]. When these systems imperfectly infer behavior patterns, however, they optimize savings at the expense of comfort, and they typically require complex sensor installations to be retrofit into the home. Unfortunately, all of these thermostats are often misused. **An estimated 25-50% of U.S. households operate the thermostat as an on/off switch rather than a T controller** [18]. A common misconception is that the more one changes the T dial, the faster the thermostat will make T change [19, 20]. Also, it has been shown that P-Therms do not save as much energy as predicted [5, 21, 22], most likely because they are difficult to use [5, 23]. Clearly, it is important that the thermostat interface be made as simple as possible. 3 Opportunity **The key idea advocated here is to augment current thermostats with the ability to control heating and cooling using travel time, as determined automatically via GPS-enabled mobile phones** that will become commonplace.1 When the thermostat is not being used regularly in setback mode, the thermostat should switch to this “just-in-time” travel-tohometime mode. In this mode, the thermostat system communicates with the GPS-enabled mobile phones of the residents. Based on the location of the residents as determined by each resident’s mobile phone and free geo-location mapping services, travel-to-home time is continuously estimated. The thermostat uses travel time of the home occupants, inside and outside T, and heating/cooling characteristics of the home to dynamically control the thermostat so that energy savings are maximized without sacrificing comfort. By setting T as a function of the fastest possible return time of the closest resident (and the other factors mentioned above), the system ensures that the home will always be comfortable on return.

## Special Needs

### We s ableism

#### GPS key to streamlining mass transit for passengers with special needs

Barbeau ‘08

[Sean J., et al – Center for Urban Transportation Research & Dept. of Computer Science & Engineering – University of South Florida; “The Travel Assistant Device: Utilizing GPS-Enabled Mobile Phones to Aid Transit Riders with Special Needs,” Presented at the 15th World Congress on Intelligent Transportation Systems (NYC): November 16-20; p. 10-11]

CONCLUSION **The design, implementation, and field testing of** TAD, a software application for commercially available **GPS-enabled mobile phones that announces a transit rider’s upcoming bus stop, has been successful**. **The rider’s real-time location can be viewed on a website, which is also used to create new trip itineraries. Alerts can be automatically issued in case the rider has deviated from his or her planned route**. TAD has been field- tested in the Tampa, Florida area on the HART transit bus routes for over one year, including an evaluation with special needs transit riders from USF’s STAGES program. These tests successfully demonstrated the proof-of-concept of TAD and inspired areas of future TAD research. The accuracy of bus stop inventories provided by transit agencies is a critical requirement for TAD to work properly on a transit system. Future work will focus on improving the bus detection algorithm to increase the general system reliability and adding new services through the integration of TAD with live bus location data. **The capability to receive** the “Get ready…” and “Pull the cord now!” **prompts through a** Bluetooth™ **wireless headset will reduce the risk of the auditory alert being lost in a noisy transit environment, and will protect the user’s privacy**. Future research is also needed in integrating TAD into travel training curriculums. **While the TAD was designed to aid transit riders with special needs to increase their level of independence, any new transit rider can benefit from its service.**

## Prolif

### GPS key - Testing

#### GPS can be used to track illicit nuclear testing

Dan Nosowitz, 08.29.2011, GPS Data Could Help Track and Monitor Secret Nuclear Tests From Rogue Nations

**The** [**Bulletin of Atomic Scientists**](http://www.thebulletin.org/web-edition/op-eds/new-way-to-detect-secret-nuclear-tests-gps) **may have found a new way to track secret nuclear tests from those rogue nations (cough cough North Korea cough cough) who are trying to keep those tests under wraps**. **Surprisingly enough, that new solution may be possible with analysis of regular old GPS data, along with some clever mathematics. In May 2009, North Korea detonated a clandestine nuclear test, a kilometer underground. That's worrisome for obvious reasons, and more worrisome because performing the test underground severely limits our ability to measure the size and specifics of the blast--**no radioactive gas or dust was let into the air, as it usually would. But that doesn't mean there are no signs of radioactive explosions. **When a nuclear blast that large goes off underground, it sends a shockwave of disturbed air into the ionosphere. That shockwave is typically hard to measure, but these scientists may have found a way, using regular GPS**. GPS, see, relies on timing more than anything else to determine location: it measures the time the signal takes to rebound from a device to the satellite, and vice versa. But disturbances in the air can change those measurements, so GPS units have sophisticated algorithms to sense and adjust to that kind of disturbance--so why not the nuclear shockwave? The scientists performed some tests after the 2009 blast, **and found that they were able to nail down the location and timing of the blast using eleven different satellites. They're optimistic that this tech could be used to supplement other ways of confirming that an illicit blast took place**. They even hope that this technology might compel the U.S. to reconsider its refusal to sign the Nuclear Test Ban Treaty, which I personally am skeptical about but would certainly be great if it was true

# A2’s

## A2: T

#### DoT has the authority to operate, upgrade, and manage all GPS systems

National Executive Committee for Space-Based PNT, 2004

U.S. Space-Based Positioning, Navigation, and Timing Policy, December 15, 2004, <http://www.pnt.gov/policy/2004-policy.shtml>

The Secretary of Transportation shall: Have lead responsibility for the development of requirements for civil applications from all United States Government civil Departments and Agencies; Ensure, in cooperation with the Secretary of Defense and the Secretary of Homeland Security, the performance monitoring of U.S. civil space-based positioning, navigation, and timing services; Consistent with the guidance in Section V of this policy, and in coordination with the Secretary of Commerce and the Secretary of State, facilitate: (1) foreign development of civil positioning, navigation, and timing services and systems based on the Global Positioning System; and (2) international participation in the development of civil applications for U.S. space-based positioning, navigation, and timing services; Ensure, in coordination with the Secretary of Defense, that space-based positioning, navigation, and timing public safety services meet or exceed international performance standards, including but not limited to those used for these services in aviation and/or maritime applications; In cooperation with other Departments and Agencies, promote the use of U.S. civil space-based positioning, navigation, and timing services and capabilities for transportation safety; Represent the civil Departments and Agencies in the development, acquisition, management, and operations of the Global Positioning System; Develop, acquire, operate, and maintain Global Positioning System space or terrestrial augmentations for civil transportation applications; Ensure the earliest operational availability for modernized civil signals and services on the Global Positioning System and its augmentations,

#### DoT has primary authority over managing and developing civil GPS technologies in the United States

NSC, 96

National Security Council, Office of Science and Technology Policy, March 29, 1996 FACT SHEET U.S. GLOBAL POSITIONING SYSTEM POLICY, <http://clinton2.nara.gov/WH/EOP/OSTP/html/gps-factsheet.html>

Agency Roles and Responsibilities

The Department of Defense will: Continue to acquire, operate, and maintain the basic GPS. Maintain a Standard Positioning Service (as defined in the Federal Radionavigation Plan and the GPS Standard Positioning Service Signal Specification) that will be available on a continuous, worldwide basis. Maintain a Precise Positioning Service for use by the U.S. military and other authorized users. Cooperate with the Director of Central Intelligence, the Department of State and other appropriate departments and agencies to assess the national security implications of the use of GPS, its augmentations, and alternative satellite-based positioning and navigation systems. Develop measures to prevent the hostile use of GPS and its augmentations to ensure that the United States retains a military advantage without unduly disrupting or degrading civilian uses. The Department of Transportation will: Serve as the lead agency within the U.S. Government for all Federal civil GPS matters. Develop and implement U.S. Government augmentations to the basic GPS for transportation applications. In cooperation with the Departments of Commerce, Defense and State, take the lead in promoting commercial applications of GPS technologies and the acceptance of GPS and U.S. Government augmentations as standards in domestic and international transportation systems. In cooperation with other departments and agencies, coordinate U.S. Government-provided GPS civil augmentation systems to minimize cost and duplication of effort. The Department of State will: In cooperation with appropriate departments and agencies, consult with foreign governments and other international organizations to assess the feasibility of developing bilateral or multilateral guidelines on the provision and use of GPS services. Coordinate the interagency review of instructions to U.S. delegations to bilateral consultations and multilateral conferences related to the planning, operation, management, and use of GPS and related augmentation systems. Coordinate the interagency review of international agreements with foreign governments and international organizations concerning international use of GPS and related augmentation systems.

**GPS is transportation infrastructure**

**Adams 2k1** (Bill, “U.S. COAST GUARD NAVIGATION CENTER”, U.S. Department of Transportation, Sept 1, <http://www.navcen.uscg.gov/?pageName=pressRelease>, CMR)

The U.S. Department of Transportation (DOT) today released the results of a study assessing the vulnerability of the national **transportation infrastructure** that **relies on** the Global Positioning System (**GPS**) (Adobe Acrobat). The study notes that GPS is susceptible to unintentional disruption from such causes as atmospheric effects, signal blockage from buildings, and interference from communications equipment, as well as to potential deliberate disruption. It contains a number of recommendations to address the possibility of disruption and ensure the safety of the national transportation infrastructure. The report was mandated by a Presidential Decision Directive and prepared by the DOT Volpe National Transportation Systems Center. “This report provides a roadmap for addressing possible vulnerabilities in GPS so that we can continue maintaining the highest standards of transportation safety,” **said U.S. Transportation Secretary** Norman Y. **Mineta**. “The Department of Transportation takes this report’s findings very seriously, and **we will be working to ensure that GPS will fulfill its potential as a key element of the nation’s transportation infrastructure**.” Secretary Mineta charged the administrators of each DOT operating administration to thoroughly review this report and consider the adequacy of backup systems for each area of operation in which GPS is being used for critical transportation applications. The administrators are to report their findings back to the Secretary within 60 days. DOT, in consultation with the Department of Defense (DOD), sponsored the study to assure the continued safe operation of the U.S. transportation system. **All modes of transportation are increasingly reliant on GPS** and, according to the study, GPS is susceptible to various forms of interference. This study identified transportation operations that employ GPS, methods for GPS disruption, possible impacts to transportation safety, and approaches to ensure service reliability.

**GPS is a vital component of transportation infrastructure**

**GSN ‘2** (Global Security Newswire, “Transportation pledges to secure Global Positioning System”, March8, <http://www.govexec.com/defense/2002/03/transportation-pledges-to-secure-global-positioning-system/11207/>, CMR)

The Transportation Department will implement an action plan to secure the **G**lobal **P**ositioning **S**ystem, Transportation Secretary Norman Mineta announced Thursday. Emergency teams responding to an attack with weapons of mass destruction would use the system, which **supports U.S. transportation infrastructure.** The department's decision followed a September report by the Volpe National Transportation System Center that determined GPS is vulnerable to unintentional and intentional disruptions. The report offered several recommendations, and the department has concurred with all of them, according to a Transportation press release. "The action plan we are announcing today will ensure that the vulnerabilities identified in the report do not affect the safety and security of our transportation system as we work to ensure that **GPS fulfills** its potential as **a key element of the nation's transportation infrastructure**," Mineta said.

## A2: Solar Flares

#### GPS satellites can resist interference from solar flares – they are built to withstand the Van Allen radiation belts

Satnews Daily 12

, March 15, 2012, “GPS.GOV... A Softer, Solar Storm... Thank Heavens!” Satnews. <http://www.satnews.com/cgi-bin/story.cgi?number=2114395267>

The solar storm that occurred in early March 2012 disrupted satellite communications and forced airlines to reroute some flights. However, so far, no major GPS problems have been reported as a result of the event. The U.S. network of Continuously Operating Reference Stations (CORS), which monitors GPS daily from more than 1,800 locations, observed only slight changes to GPS reception in some parts of Alaska on March 7 and 9. Solar activity can distort the GPS signals as they pass through the Earth's ionosphere, causing accuracy errors. In addition, intense radio bursts from the Sun can overwhelm or jam GPS devices. This occurred after a solar flare in December 2006, causing widespread outages of GPS equipment. Solar events may also impact GPS satellite operations, although that did not occur this time. All 31 operational satellites in the GPS constellation remained fully functional throughout the solar storm. GPS spacecraft are built to withstand high levels of radiation, since they fly in a fairly intense region of the Earth's Van Allen radiation belts. More solar storms are likely to occur through 2013-2014 as the Sun reaches its "solar max" period. GPS users should keep this in mind and always have a secondary means of navigation or timing. As reported in GPS.GOV, the official U.S. government information site regarding GPS and related topics.

## A2: SQO Solves Spoofing

#### Your evidence based on overweening optimism about the threat of spoofing

Humphreys ’09 (Todd E. Humphreys, Ph.D. in Orbital Mechanics and Assistant Professor at the University of Texas at Austin, Assessing the Spoofing Threat, http://www.gpsworld.com/defense/security-surveillance/assessing-spoofing-threat-3171?page\_id=1)

The Homeland Security Institute, a research arm of the U.S. Department of Homeland Security, has also considered the threat of civil GPS spoofing. On its website it has posted a report listing seven spoofing countermeasures. The proposed countermeasures include the first three techniques from the list here. Some of the remaining four countermeasures would be trivial to spoof. None of the seven would adequately defend against a sophisticated attack. Nonetheless, the posting claims that its proposed techniques "should allow suspicious GPS signal activity to be detected." We worry that such optimistic language in such a prominent posting will mislead many readers into believing that the spoofing threat has been adequately addressed.

## A2: Telemetry unethical

#### Processes are reviewed by external organizations to ensure benefits to the larger population are significant enough to warrant action

Cooke ‘08

[Steven J., Dept. of Biology and Institute of Environmental Science @ Carleton University (Ontario), Endgangered Species Research, Vol. 4, January, p. 170]

**The ethical considerations of tagging endangered animals is a complex issue, as one of the assumptions** **of telemetry is that the tagging and presence of the device do not deleteriously affect the individual** (Wilson & McMahon 2006). **However, sample sizes are relatively low (relative to other methods) and animals can be studied in their natural environment**. Several explanations have been proposed to account for a perceived lack of public ethical discourse among field scientists (reviewed in Farnsworth & Rosovsky 1993). Of particular relevance to telemetry studies is the assumption that **the relative benefits of the research technique outweigh potential short-term costs to the study organism or population** (i.e. increased knowledge may inform and promote its long-term conservation; Farnsworth & Rosovsky 1993). **Institutional animal care committees usually require researchers to consider the impacts of their tagging activities on populations**, and this is coupled with the development and testing of tagging techniques. **There has been an explosion of studies that compare and contrast different tagging techniques with the purpose of trying to identify techniques that minimize the impact on the animal. Indeed, data derived** from telemetry and logging studies **would not be useful if the observations generated were not genuine**. A number of authors have proposed that ethical considerations must be considered when conducting research on all animal species (particularly those that are endangered) and when developing conservation measures (Farnsworth & Rosovsky 1993, Putman 1995, Wilson & McMahon 2006). In many cases, the burden still lies on the telemetry practitioner (Minteer & Collins 2005), as not all countries (or institutions) regulate or require ethical approval to conduct research on wild animals (Peck & Simmonds 1995). In such cases, it would be worthwhile to obtain external peer review from experts in the field (including a veterinarian) prior to embarking on research on endangered species. Typically, if animal care approvals are needed by a researcher’s home country/jurisdiction, the permit must be obtained there, even if the research is to be conducted elsewhere. In some cases, this means obtaining approvals from 2 jurisdictions (home institution and study site).

## A2: High Consumer Cost/No Adoption

#### Advancements in GPS technology will include the introduction of low-cost instruments for consumers

Jin ‘11

[Shuanggen; Shanghai Astronomical Observatory, Chinese Academy of Sciences, et al; “Remote Sensing Using GNSS Signals: Current Status and Future Directions,” Advances in Space Research, Vol. 47, p. 1652]

With more and more space-borne **GPS** reflectometry and refractometry **missions in the near future** (e.g., follow-on FORMOSAT-7/COSMIC-2 mission, CICERO and TechDemoSat-1), these missions **will monitor more detailed Earth’s surface characteristics and atmospheric and ionospheric information with high temporal-spatial resolutions**. Furthermore, some advanced GNSS receivers are being developed with improved algorithms for the various possible applications and quasi real-time data processing capabilities to satisfy the future space-based high-performance missions (e.g., next generation TriG (Tri-GNSS) receiver with the ability to generate multi-GNSS refraction and reflection). **It is also possible in the next few years a low cost instrument will be made public capable of operating on limited resource satellites, such as those being developed by Universities. New remote sensing applications** using GNSS signals **are expected to continue expanding over a global scale in the coming years**.

### A2: Russia

**Empirics prove, U.S. Russia Relations fail**

Oberg, 05’

James Oberg, July 18, 2005 “The real lessons of international cooperation in space”

http://www.thespacereview.com/article/413/1James Oberg spent 22 years as a space engineer at the Johnson Space Center in Houston, TX where he specialized in NASA space shuttle operations for orbital rendezvous. In honor of his pioneering work, on developing and documenting these space shuttle rendezvous techniques, he was named by the NASA-Area "Association of Technical Societies" as their 1984 "Technical Person of the Year". In 1997 he received the "Sustained Superior Performance" award for designing the complex first Space Station assembly mission. In support of NASA's spaceflight operations he has written books on Rendezvous Flight Procedures, on Mission Control Center console operations, and on the history of orbital rendezvous. He provides expert assessment and forecasts of Russian space industrial and technological elements for corporate and government clients.SmwDI/WaruAHY

**It was the very heights of the Cold War**,” Stafford recalled, “**with thousands of nuclear weapons aimed at each country**.” **Then from outer space** a streak of **sanity appeared**: “Yet **both superpowers had great accomplishments in space, so we decided to work together**.” On the dais, his opposite number on the Soviet side, Leonov, nodded amiably. **However, history paints a far different picture**, and Leonov, especially, knew it. **The Soviet space program was in shambles, its drive to land men on the Moon literally in ruins and rubble** (Leonov was to have been the commander of that mission**). Its backup plan to regain the lead in the “Space Race” was to build a small orbiting space station, but linkups failed and one space crew died** (Leonov was supposed to have gone on that flight but a medical problem led to the dispatch of his backup crew). **Two subsequent space stations were launched but crashed to Earth**, and Leonov had trained to command them both. His subsequent assignment to the space linkup was a consolation prize. Only with the Soviet program at a standstill did Moscow agree to fly a joint orbital mission. **Its fallback position was that if it couldn’t be Number One in space, it could at least pose as the equal partner of the new Number One, the United States.** It was better than letting on how far behind its space program had fallen.But for the biggest promises often touted for the “grand alliance” of the US and Russia, the scorecard is much less clear-cut. **Having the Russians along was supposed to make the project cheaper, but it cost more to build the proper international interfaces. Launching all components into a northerly orbit accessible from Russia increased the space transportation cost by billions** of dollars.As far as “not speaking about politics”, that may be an acceptable rule in the narrow theater of spacecraft operations, but it is not a technique that can be generalized to apply to international partnerships as a whole. There, national policy requires a relationship with moral law as well as amoral “realpolitik”. **There are plenty of regimes that the US simply would not partner with in the 1980s and 1990s, and for similar reasons, will not partner with today.**

### A2: China Cooperation

**China has recently become more realist and less interested in cooperating.**

Shambaugh, 11**’**David Shambaugh, Director, China Policy Program, GWU, Winter, 2011

[Washington Quarterly, volume 34. number 1, Winter 2011 p. 24]Waru:ahy/Smw:di

**What the world has seen from China since 2009 is an increasingly realist**, narrowly **self-interested nation, seeking to maximize its own comprehensive power.** **China’s** rapid **recovery from the global financial crisis**, growing **energy consumption needs**, rising **nationalism**, a **looming leadership transition, and distrust of** the **Obama** administration **following** President Obama’s 2010 **decisions to receive the Dalai Lama in the White House and to sell a $6 billion arms package to Taiwan** **have** all **fueled this tendency. This external behavior is mirrored in the country’s domestic discourse.**

**Cooperation with China could undermine US tech leadership**

Cheng, 09’

Dean Cheng, research fellow Asian Studies Center, Heritage Foundation, 10.30.09 [http://www.heritage.org/Research/Reports/2009/10/US-China-SpaceCooperation-More-Costs-Than-Benefits]Waru:AHY/Smw:DI

Beyond the technical issues, however, **there are more fundamental political concerns that must be addressed**. **The U.S. military depends on space as a strategic high ground**. **Space tech**nology **is** also **dual-use in nature: Almost any technology or information that is exchanged in a cooperative venture is likely to have military utility. Sharing such information with China, therefore, would undercut American tactical and technological military advantages.**

## A2: Spending

#### Augmentation Is Cost Effective & Spoof-Free

Assimilating GNSS Signals to Improve Accuracy, Robustness, and Resistance to Signal Interference -**Todd E. Humphreys “**Professor of Orbital Mechanics University of Texas Austin” **3/24/11** http://www.faqs.org/patents/app/20110068973#b

**The Assimilator is a cost-effective alternative to replacing existing user equipment for users who want a PVT solution that is robust against GNSS signal obstruction, jamming, and spoofing, or who want access to the benefits of GNSS modernization. Thus, the GNSS Assimilator provides for augmenting instead of replacing legacy equipment. The augmentation need not require hardware or software modification to the existing equipment-**-the Assimilator can simply attach to a GNSS receiver's radio frequency (RF) input port and inject a consistent set of synthesized GNSS signals **defining a PVT solution that is robust, accurate, and spoof-free.**

#### Augmenting is the Most Cost-Effective Option

Assimilating GNSS Signals to Improve Accuracy, Robustness, and Resistance to Signal Interference -**Todd E. Humphreys “**Professor of Orbital Mechanics University of Texas Austin” **3/24/11** http://www.faqs.org/patents/app/20110068973#b

**Augmentation with the Assimilator is particularly cost-effective** where **the Assimilator itself is less expensive than replacing existing** user **equipment with a new model as capable as the Assimilator-receiver pair.** The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

#### Augmentation Cheaper & Simplifies Modernization

Assimilating GNSS Signals to Improve Accuracy, Robustness, and Resistance to Signal Interference -**Todd E. Humphreys “**Professor of Orbital Mechanics University of Texas Austin” **3/24/11** http://www.faqs.org/patents/app/20110068973#b

**The Assimilator advantageously delivers the benefits of GNSS modernization through augmentation, rather than replacement, of both commercial and military existing user equipment**. **This augmentation need not require hardware or software changes to the existing equipment, and is particularly cost-effective** where **the Assimilator can be less expensive than replacing existing user equipment with a new model as capable as the Assimilator-receiver pair.**

## A2: Ptx

#### GPS has bipartisan support – empirics prove.

Russo ‘11

*(Testimony of Mr. Anthony J. Russo Director National Coordination Office Space-Based Positioning, Navigation and Timing Hearing on "Sustaining GPS for National Security" Subcommittee on Strategic Forces U.S. House of Representatives September 15, 2011* [*http://www.gps.gov/congress/hearings/2011-09-HASC/russo/*](http://www.gps.gov/congress/hearings/2011-09-HASC/russo/) *Accessed: 7-3-12)*

Since 1983, the United States has had a multi-use policy in place for GPS. This policy has had strong bipartisan support and each successive administration has strengthened the interagency participation in the program. In 2004, President Bush issued a National Space-Based Positioning, Navigation and Timing (PNT) Policy establishing a Deputy Secretary level Executive Committee to advise and coordinate on policies, programs, requirements, schedules, architectures and budgets to sustain and modernize GPS, systems that augment or enhance GPS, and any backup capabilities. Last year, President Obama signed a comprehensive National Space Policy which left the PNT policy in place, but added emphasis and additional guidance in four key areas related to GPS. The policy outlines six primary goals, all of which are threatened by the proposed LightSquared deployment.

#### Push by military for Congress to take action concerning the drone spoofing

States News Service 6-26-12

(States News Service June 26, 2012 Tuesday “Domestic drones turned into terrorist missiles?” L-N Accessed: 7-3-12)

Now, Todd Humphreys, a professor at the University of Texas at Austin, is showing how tech savvy terrorists can, and very likely will, exploit a "gaping hole" in the government's flight security structure. Last Tuesday, in the barren desert of the White Sands Missile Range in New Mexico, officials from the FAA and Department of Homeland Security watched as Humphrey's team repeatedly took control of a drone from a remote hilltop. The results were every bit as dramatic as the test at the UT stadium a few days earlier. DHS is attempting to identify and mitigate GPS interference through its new "Patriot Watch" and "Patriot Shield" programs, but the effort is poorly funded, still in its infancy, and is mostly geared toward finding people using jammers, not spoofers. According to Humphreys, "Spoofing [a drone's GPS receiver] is just another way of hijacking a plane." For about $1,000 and with a little bit of technical training a terrorist could take control of any civilian-operated drone and wreak havoc. Without a human pilot at the controls, the drone's onboard computer will simply follow whatever commands it is given, regardless of where they originate. And while some terrorists may be interested in taking over surveillance drones for intelligence gathering purposes, the real danger is if a drone as large as a cargo plane - which FedEx plans to use when domestic drones are approved - is overtaken and flown into planes carrying people or into crowded buildings. As Humphreys says, "In 5 or 10 years you have 30,000 drones in the airspace. Each one of these would be a potential missile used against us." So not only would a terrorist hacker not need to buy a drone in order to fly one, he wouldn't even need to go through an invasive TSA screening to reenact the 9/11 tragedy. Because of pressure from the military and drone manufacturers, Congress is requiring the Federal Aviation Administration to fast-track regulations as part of the FAA's reauthorization act. Significant rules that will impact every American are to be conceived, written, and finalized within weeks of each other, and an entire regulatory scheme is mandated to be implemented in less than a year. If you think that kind of statutory mandate translates into greater bureaucratic efficiency, think again. The time-crunch - and the deliberate lack of oversight from Congress by pushing the rule writing onto an agency - means that everyday Americans will not be privy to the decision making process that will dramatically impact their safety in the air and on the ground. Congress needs to rein itself and this process in. With arguably illegal waivers being given to certain groups to avoid provisions of ObamaCare and No Child Left Behind, we've seen how arbitrary and capricious federal regulators can be when it comes to expedited rulemaking. There's no reason to expect a more coherent approach from an FAA trying to balance competing interests like privacy, profit, and public safety on an irrational deadline. We need open debate and deliberation from our elected officials about the costs and benefits of domestic drones. If Congress won't engage the issue because it's too politically painful, then the American people shouldn't suffer a lapse in safety and privacy because their representatives would rather pass the buck than take responsibility.

## A2: States – USFG key

**GPS is a matter of national security**

**PNT ‘4/17(National Executive Committee for Space-Based Positioning, Navigation, and Timing (PNT) is a U.S. Government organization established by Presidential directive to advise and coordinate federal departments and agencies on matters concerning the Global Positioning System (GPS) and related systems, Federal Agencies,** **http://www.gps.gov/policy/agencies/)**

**The U.S. government manages GPS as a national asset** **that is integral to U.S. national security, economic growth, transportation safety, international leadership, and homeland security**. While the Department of Defense is responsible for operating the system, **the GPS program receives national-level attention and guidance** through the National Executive Committee for Space-Based Positioning, Navigation, and Timing (PNT) -- a joint civil/military body established by presidential directive. **Coordinating GPS-related matters across multiple federal agencies ensures the system addresses national priorities as well as military requirements.** The National Executive Committee is chaired jointly by the Deputy Secretaries of Defense and Transportation. Its membership includes top leaders from the Departments of State, the Interior, Agriculture, Commerce, and Homeland Security, the Joint Chiefs of Staff, and NASA.

**The U.S government is effective**

**Chaplain ’09 (Cristina T. Chaplain, Director Acquisition and Sourcing Management, GLOBAL POSITIONING SYSTEM Significant Challenges in Sustaining and Upgrading Widely Used Capabilities, www.nsgic.org/public.../GAO\_GPS\_Challenges\_d09670t.pdf)**

**The U.S. government provides GPS service free of charge** and plans to invest more than $5.8 billion over the next 5 years in the GPS satellites and ground control segments. **The Department of Defense (DOD) develops and operates GPS**, and an interdepartmental committee—co-chaired by **DOD and the Department of Transportation—manages the U.S. space-based positioning, navigation, and timing infrastructure**, which includes GPS. DOD also provides most of the funding for GPS. The Air Force is responsible for GPS acquisition and is in the process of modernizing GPS to enhance its performance, accuracy, and integrity. The modernization effort includes GPS IIF and IIIA, two satellite acquisition programs that are to provide new space-based capabilities and replenish the satellite constellation; the ground control segment hardware and software; and user equipment for processing modernized GPS capabilities. Other countries are also developing their own independent global navigation satellite systems that could offer capabilities that are comparable, if not superior, to GPS.

**GPS costs billions states can’t afford**

**Barr Group ‘12**

DoD U.S. Air Force Budget FY2013-FY2017 http://www.bga-aeroweb.com/Defense/DoD-Budget/GPS-III-DoD-Budget-USAF-Space.html accessed 7/3 2012

**The Global Positioning System (GPS) fills** validated **Joint Service requirements for worldwide, accurate, common grid three-dimensional positioning/navigation for military aircraft, ships and ground personnel. The consistent accuracy,** unaffected by location or weather and available in real time**, significantly improves effectiveness of reconnaissance, weapons delivery, mine countermeasures and rapid deployment for all services**. **The system is composed of three segments**: user equipment (funded under PE 0305164F), **satellites and a control network** (funded under PE 0603423F and PE 0305165F). RDT&E,AF funding for GPS III, including development and acquisition of Space Vehicles (SV) 1 & 2, is in PE 0305265F, GPS III Space Segment. **The funding cost is $1.462 billion.**

**Federal Government Guarantees GPS Success**

**National Coordination Office for Space-Based Positioning, Navigation, and Timing**, April 12**, 2012** <http://www.gps.gov/policy/>

**Since the 1980s, multiple U.S. presidents have issued consistent policies encouraging the worldwide use of GPS for peaceful purposes**. Congress has enacted elements of these policies as permanent law. **The stability and transparency of U.S. policy, combined with a long track record of dependable GPS service, have laid a solid foundation for investment and innovation in GPS technology.** As a result, the commercial use of GPS technology has flourished, transforming the way we live and work today.

## A2: Private CP

**National Focus Is Key**

**National PNT Advisory Board**, November 4**, 2010**, Jamming the Global Positioning System -

A National Security Threat: Recent Events and Potential Cures

**GPS is absolutely critical US National Infrastructure**. This has not been formally recognized. **GPS should be formally declared critical infrastructure by Executive Branch** and managed as such by DHS. **This is necessary to elevate the importance of GPS to our critical infrastructure and bring the needed attention to the interference problem.** The various existing national interference programs must be coordinated and gaps must be filled with additional funded efforts (see later recommendations**). Senior leadership must recognize the vulnerabilities of the current critical infrastructure and give high priority to budgets and solutions.**

## A2: Privacy K

#### Plan only works within existing frameworks: Patriot Act gave the green light for electronic surveillance

**Karim ‘04**

[Wassim, Attorney, former associate editor of Washington University Journal of Law and Policy; *Washington University Journal of Law and Policy*, Vol. 14; p. 505]

**Legislation pertaining to electronic surveillance has been modified repeatedly over the years**,133 **the most recent development of which has been the** Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act, or the USA **PATRIOT Act**.134 Generally**, this legislation broadens federal law enforcement’s authority to use surveillance and eliminates barriers in retrieving intelligence information**.135 In particular, **by lowering the standard of proof and reducing judicial oversight**, the Act broadens the FBI’s ability to obtain the information that a business maintains about an individual when the FBI is conducting an intelligence investigation.136 Furthermore, **the Act broadens the government’s ability to conduct searches in secret**.137