

Space Forensics

Measurement and Signatures Intelligence find 'fingerprints' on Earth

During a recent 'town hall' meeting on Peterson Air Force Base, Colo., to inform SMDC/ARSTRAT Soldiers, civilians and contractors on the state of the command, Chief G-2 Plans and Operations Division, LTC Michael Childers gave a briefing that was both entertaining and prophetic. The briefing compared the current and future activities and capabilities of the Spectral Operations Resource Center (SORC) to the abilities of the investigators on the television show CSI: Miami. This planted the idea of CSI: Space.

"I came up with that comparison for Crime Scene Investigation on my way up to the stage to do the briefing," Childers said. "I thought it was a good analogy."

The CSI team's expertise at taking a unique look at evidence, using all the technologies available to them, makes them extremely effective — on television. Childers opined that the SORC is the real life CSI: Miami for the warfighter, noting that CSI Miami is a television show detailing the newest, highest level of technology available to solve crimes and provide evidence to be used to convict a guilty person. The CSI technology is real. The show is fiction.

Childers said that CSI: Space, or geospatial intelligence and, in particular, Measurement and Signatures Intelligence, or MASINT are real world, ever growing and expanding capabilities that allow our forces to see the battlespace in a whole new way. He feels that these capabilities offer commanders a new paradigm and more possibilities than ever before.

"Combined with the entire field of geospatial capabilities, MASINT offers a powerful tool for planners and commanders," he added. And what we are capable of today is just the beginning.

Our interest was piqued and we sent one of ASJ's own, Ed White, to get the rest of the story.

The simplest ideas are usually the best and they come from simple, basic questions. For instance, Einstein's $E=MC^2$ came from the question the nine-year-old boy genius asked himself:

"What would happen if I could ride on a beam of light?"

The result? Nuclear energy.

The next greatest and simply brilliant idea is that everything has some kind of signature that can be measured. A new discipline called Measurement and Signatures Intelligence (MASINT) is evolving as a result.

"The use of MASINT starts with a problem-solving approach to the question, 'what is the unique signature that will provide me the answer to an operational need?'" said COL Toni Smart, U.S. Army Space and Missile Defense Command/U.S. Army Forces Strategic Command (SMDC/ARSTRAT) G-2.

"The thrust of MASINT is to detect and characterize intelligence and operations information based on identifying and 'fingerprinting' specific signatures of suspect activity." This type of analysis brings MASINT in to the "CSI era." "MASINT is performed across the electromagnetic spectrum," she added.

Contractor, Brian Collins, of the SMDC/ARSTRAT G-2 explained that, "the vast majority of things, living things and inanimate things, have signatures. These may be in the

spectral range in the way they reflect or absorb sunlight. They may be odors, such as CS gas used as a riot agent, or they can be the reliable decay rates of nuclear material being detected on a Geiger counter."

From this basic concept, a loosely knit science is developing.

"Today, scientists from a wide range of disciplines are coming together and defining the parameters for MASINT. This effort will continue until a library of measurable signatures for things are identified, mapped and made readily available to those government, scientific, educational and business interests that can use them. The field is constantly growing and evolving and revealing new types of information and new approaches to using it," Collins concluded.

Smart added, "MASINT has applications ranging from detecting disturbances in desert soil based on changes in the manner in which infrared light is emitted to detecting traces of explosive materials at airports based on chemical and gas analysis.

"The value of this application of technology is that MASINT collectors can positively detect certain materials rather than circumstantial evidence of their presence, such as identifying the signature of an asphalt road rather than what looks like an asphalt road on a black and white image."

The development of this arcane branch of knowledge is not a new effort.

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The National Geospatial-Intelligence Agency (NGA) Web site states that the first U.S. geospatial effort began in 1803 when President Thomas Jefferson sent the Army's Lewis and Clark expedition to explore and map the recently acquired Louisiana territory. The state of the art in this arena remained static until World War I when aerial photography became a major contributor to battlefield intelligence.

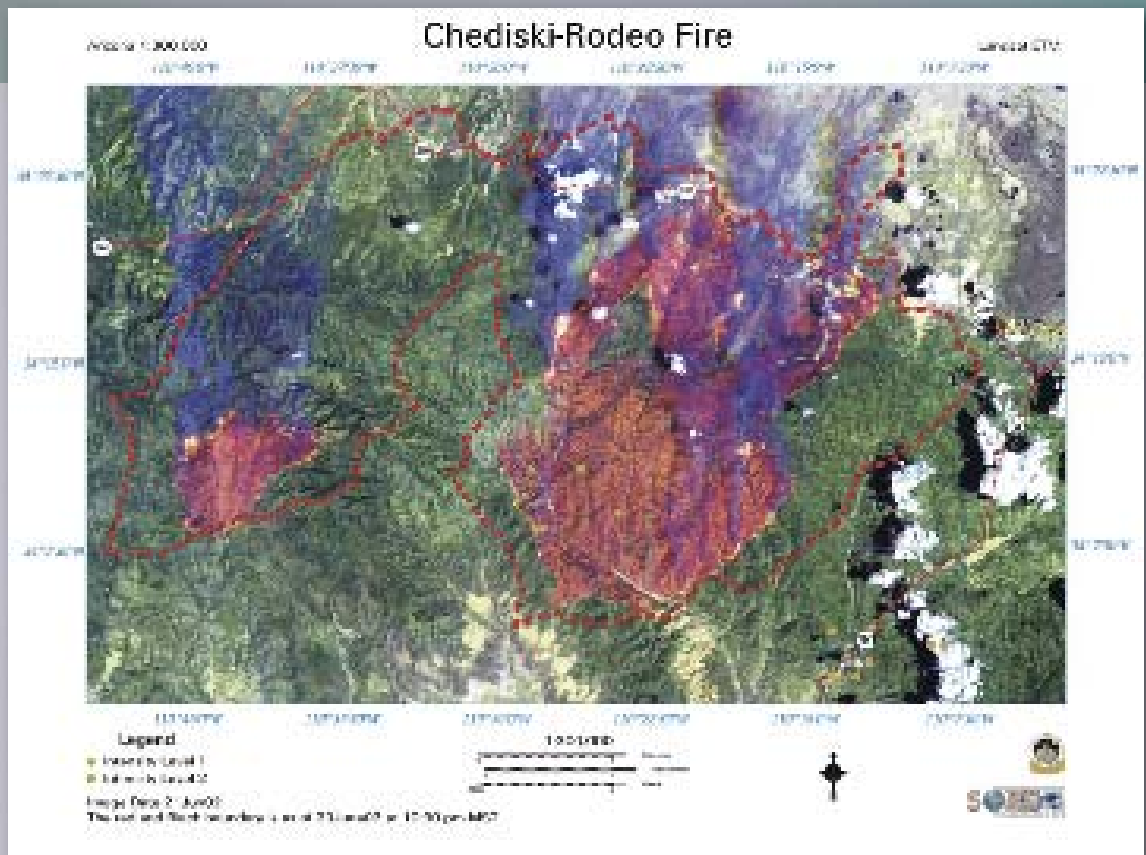
According to Robert "Bo" Dunaway, of the SMDC/ARSTRAT Spectral Operations Resource Center (SORC), "This idea really cropped up during World War II when the Eastman Kodak Company began to develop film that would make images into the infrared range."

Through this type of photography, American forces were able to discern German camouflage nets. A simple ability with a far reaching effect. "From the visible, that is, to the human eye and normal film, those nets looked green, just like the foliage around them. However, in the infrared they had distinctly different characteristics. That difference was the reflection of the living foliage, filled with chlorophyll versus the reflection of the netting material that was inanimate. This gave our forces a huge tactical advantage," Dunaway said.

Carry this further. It is now 60 years later and our science and technology has grown by leaps and bounds. In the spectral arena, we have the ability to look from both airborne platforms and Space and acquire huge amounts of highly diverse information. Because it is in digital form, it can be manipulated in a number of ways. This information is called geospatial intelligence and MASINT is a large and important piece of this puzzle.

For instance, during the recent efforts by the U.S. Pacific Command to help the victims of the tsunami, spectral imagery was able to assist the recovery efforts in several ways. The images of the post-tsunami areas of Banda Aceh province showed the relief providers what the situation on the ground actually was. This is the geospatial intelligence piece. However, using pre-tsunami images provided a whole other dimension of information.

LTC Richard Lewis is the Space Operations Officer (FA40) on the Eighth U.S. Army staff in Korea. Eighth Army was the tip of the



This image of the Chediski-Rodeo Fire in Arizona was taken from a LANSAT 7 Satellite on June 21, 2002. The red region was the burned area as of June 21. The red dotted line showed the additional land the fire had consumed as of June 27. U.S. Army Space and Missile Defense Command/U.S. Army Forces Strategic Command's Spectral Operations Resource Center along with the Colorado Springs element of the 1st Space Company, 1st Space Battalion, helped firefighters battle the Western wildfires with satellite imagery that depicted hot spots in the fire. The imagery was provided on the ground to firefighters through the Internet.

spear in providing direct Space support to the operation.

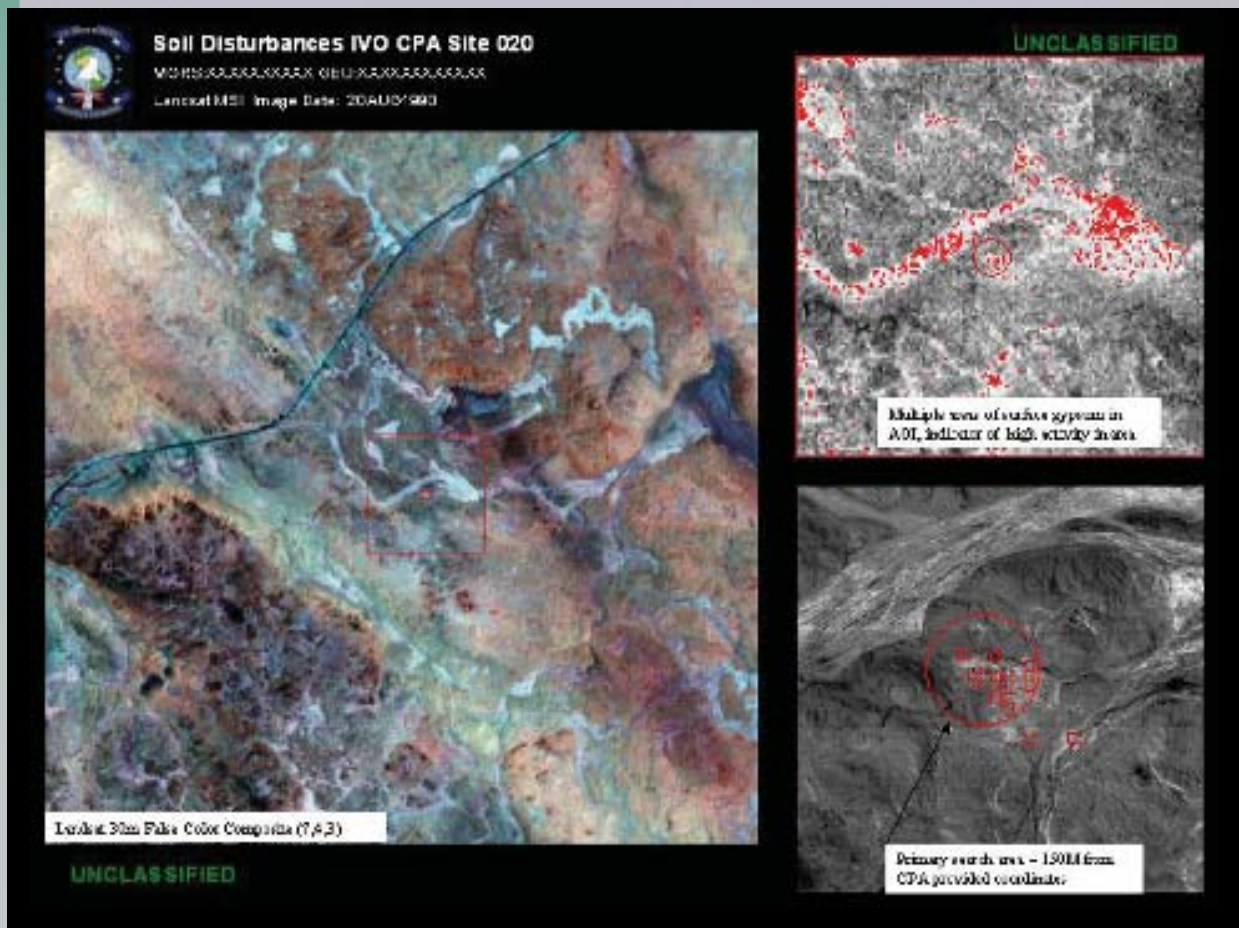
"I was contacted shortly after the tsunami by the deputy G-2 of Eighth U.S. Army to see if there was anything that we could provide to assist in planning efforts in support of the emerging relief effort," Lewis said. "The capabilities of the SORC immediately came to mind.

"Through a series of very timely e-mails and phone calls, even after-hours in the States, I was able to explain the areas that we were planning for and the type of information we needed. The SORC quickly jumped onto the project and provided products in a very timely manner. The information was very helpful to our geospatial Soldiers in putting together the planning tools necessary for the units identified to deploy," Lewis added.

Dunaway detailed the SORC efforts Lewis described.

"For tsunami relief we did a lot of change detection work, primarily assisting the relief agencies in capturing what impacts the tsunami had on select areas," he said.

Change detection involves taking a pre-tsunami image and overlaying a post-tsunami image on it and noting the differences. This kind of detective work allowed the relief providers to identify areas where roads were open or closed by tsunami damage, and to identify where villages had been but were now destroyed or damaged in some way. This information allowed the Eighth U.S. Army to focus their efforts,



Unclassified imagery from commercial sources was used to locate mass graves in Iraq.

plan movements and decide what could be done and what couldn't.

Detective work like this takes the geospatial information available and combines it to read the key signatures related to tsunami damage so the relief forces were able to effectively and accurately focus their efforts to rescue and relieve survivors.

Dunaway has been a key player in the spectral imagery field at SMDC/ARSTRAT for about six years. In that time he has helped support a number of international and national efforts with the unique capabilities spectral analysis and MASINT can provide.

"The SORC has provided a lot of support to the National Interagency Fire Center (NIFC), the U.S. Forest Service and others who fight fires," he said. "We get the requests for efforts within the U.S. through U.S. Northern Command and pass them out through that same agency."

"We have provided fire imagery on several large fires in the past few years. Primarily, we used the imagery to show where the fire had already traveled in the burned over areas. We were also looking for hot spots that the firefighters could then address to ensure there would not be any restarts in those areas."

"We also provided some predictive models of what the fire might do based on weather, however fires are hard to predict because they make their own weather when they get large enough," Dunaway concluded.

Other efforts have included the location of mass graves in the Balkans and Iraq based on the change detection model to discern patterns of disturbed earth. The SORC is also capable of providing the information for the construction of digital fly throughs which can help our forces rehearse missions well before they depart their U.S. bases. These fly throughs give a commander the ability to have an extremely accurate picture of what the terrain he will be operating over actually looks like. Additionally, he can also take a look at the way a foe will see his unit by reversing the direction of movement on the fly through. This kind of detective work can save time in rehearsal for short notice missions and can save lives during a mission.

The SORC will soon be undergoing some upgrades to its current capabilities.

LTC Michael Childers, Chief, G-2 Plans and Operations Division, SMDC/ARSTRAT said, "The SORC will be getting some new capabilities to complement the geospatial efforts they now provide. These upgrades will help to more accurately refine warfighter requirements. The better the tools that we bring to the MASINT node, the better we can support the warfighter."

SMDC/ARSTRAT involvement in the Geospatial Intelligence and MASINT arenas goes back 15 years to the days in 1990 when the command, then known as the Army Space Command, ran the Army Space Exploitation and Demonstration Program (ASEDP).

WMD's MASINT

"Measurements and signatures can offer important intelligence about nuclear, biological, and chemical weapons. But the tools we use to collect these measurements and signatures--tools collectively referred to within the intelligence community as "MASINT"--do not obviously constitute a single discipline. In a world of specialized collection agencies, there is reason to suspect that these orphaned technologies may have been under-funded and under-utilized. We recommend that the DNI take responsibility for developing and coordinating new intelligence technologies, including those that now go under the title MASINT. This could be done by a special coordinator, or as part of the Director of National Intelligence's (DNI) Office of Science and Technology. The DNI's office does not need to directly control MASINT collection. Rather, we recommend that individual collection agencies assume responsibility for aspects of MASINT that fall naturally into their bailiwicks. At the same time, the DNI's designated representative would promote and monitor the status of new technical intelligence programs throughout the Intelligence Community to ensure that they are fully implemented and given the necessary attention."

— Presidential Commission on WMD's MASINT

The ASEDP staff demonstrated the advantages of the Portable, Lightweight, GPS Receiver (PLGR) to the Army prior to OPERATION DESERT SHIELD/DESERT STORM and then acquired thousands of the units and trained the U.S. forces on its use when the call came from Saudi Arabia. One result of the use of the Global Positioning System (GPS) was that a battle, the battle of 32 Easting, was named, not for a hill or a town, but for GPS coordinates.

The command also provided the U.S. forces with satellite imagery maps of the area of responsibility. This was the first time that commercial satellite imagery played a key role in a real world operation.

"MASINT is now considered one of the most important intelligence sources for the future force," Smart said. "By removing uncertainty and enabling positive identification of materials and the effects of human actions, MASINT's true value will be in countering our adversaries' attempts to hide their true actions and intentions."

When asked how this new intelligence capability is affecting the way we fight, Smart answered, "MASINT is changing the way we view information. In the past we relied heavily on sources of information that we understand based on our current (physical) senses, imagery for example. Unfortunately, we and our adversaries understand the limitations of our senses, and exploit these to conceal intentions and activities. As MASINT continues to provide more insight into what is actually occurring physically in the operational environment, Army forces are now making decisions based on the technical value of these sensors vice what they see. As a result, we are reducing ambiguity in the decision cycle across the spectrum of operations."

Even the presidential commission on Weapons of Mass Destruction

weighed in on the MASINT issue. They recommended the government should "reconsider MASINT." The commission believes that MASINT has been under-funded and under-utilized in the government. Their recommendations include setting up a special office to investigate, develop and link these disparate technologies for future use.

Finally, while most examples of the military applications of Space are classified, Childers described some really good detective work done by former Air Force Master Sgt. Rich Burch. Now a civilian employed with the SORC, Burch's story illustrates the relationship between geospatial intelligence and MASINT.

During his tour in Iraq, Burch used a known mass gravesite to gather spectral data that he could use to compare to about 240 other possible grave sites throughout the desert portion of the country.

Burch located at least one site based on the presence of gypsum. Gypsum is a sub-soil in the dry, desert regions of Iraq. When mass graves are dug, the gypsum is turned over and winds up on top of the earth, thereby leaving a signature.

One mass grave Burch located was a mere 20 feet by 50 feet, about the size of a home garden. This garden yielded 300 corpses.

The worst one for me was a little five or six-year-old girl's body we found near Somalia," Burch said. "Her hands were bound and she had been shot.

"I have a daughter," he added quietly.

His real life work provided closure to the families of those people.

"This is CSI: Space," Childers said.