Multi-Temporal Remote Sensing

WORKSHOP EMPHASIZES IMPORTANCE OF EARTH MONITORING

EARTH SCOPE

The world took notice this past July on the 40th anniversary of the first moon walkers, Neil Armstrong and Buzz Aldrin. This was truly the biggest step ever recorded for human history. A milestone of this magnitude certainly deserved the media sunshine. Another major milestone for humanity this past July did not receive media attention and clearly deserves to be pushed to the forefront of our civilized minds. Landsat, as a program of continuity for monitoring the whole Earth, is 37 years old and more important than ever.

Change on this planet is happening faster than governments can track and in ways hardly imagined 40 years ago. Human consumerism, consumption, and resource extraction are contributing to accelerating climate change, resulting in profound changes in the ability of nature to provide life-supporting ecological goods and in our ability to provide services.

It was therefore a welcomed respite from the summer heat to attend The Fifth International Workshop on the Analysis of Multi-Temporal Remote Sensing Images (MultiTemp 2009) in Groton, Connecticut on July 28-30. The University of Connecticut, under the guidance of Professor Dan Civco, was the host organization, along with NASA, EPA, USGS, IEEE, and CLEAR (http://clear.uconn.edu/multitemp09/). This gathering of international scientists from over a dozen nations targeted the advances and capacity of our technology to conduct change detection and monitoring.

MultiTemp began in September of 2001 at the University of Trento, Italy under the leadership of Professor Lorenzo Bruzonne. At the time, the organizers recognized that the development of effective methodologies for the analysis of multi-temporal data represented one of the most important and challenging issues that the remote sensing community would face at the beginning of the 21st Century. It was surmised by the organizers that relevance and timeliness for upgrading our community's understanding of this issue were directly related to the ever-increasing quantity of multi-temporal data provided by the numerous remote sensing satellites that orbit our planet. They proposed that it would require the synergistic use of multi-temporal remote sensing data and advanced analysis methodologies to address and solve complex problems regarding monitoring of the Earth's surface and atmosphere. MultiTemp has been meeting every two years since, with the sixth in the series, MultiTemp 2011, to be held in the city of its inception, Trento, Italy.

It was fitting that NASA's Darryl Williams kicked off the workshop by looking at the cornucopia of imagery available to today's Earth scientists and by challenging the community to take stock of where we are and where we are going with this surfeit of data. NASA, along with the USGS, has had the longest track record with remote sensing change detection, as used for a plethora of classic examples demonstrating fantastic changes on the Earth's surface. Williams presented examples ranging from the depletion and fragmentation of tropic forest to the desiccation of Lake Chad (***Figure 1a,b,c***), noting that the advent of the Landsat remote sensing data series has been instrumental in chronicling our dynamic Earth.

A litany of high-resolution and high-temporal data sets were presented over the three-day workshop, from GeoEye-1 and IKONOS to WorldView-1, that fully demonstrated the power of multi-temporal data analysis for defining key changes in our landscape and environs. Land use and land cover change detection led the program, while vegetation dynamics opened new horizons for

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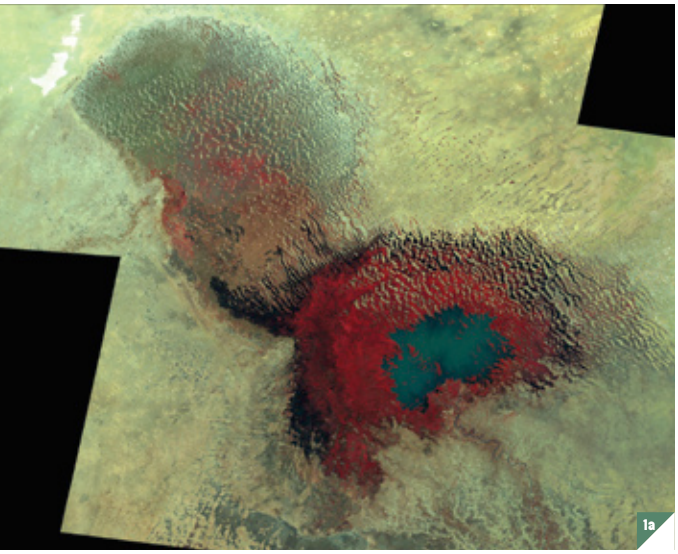
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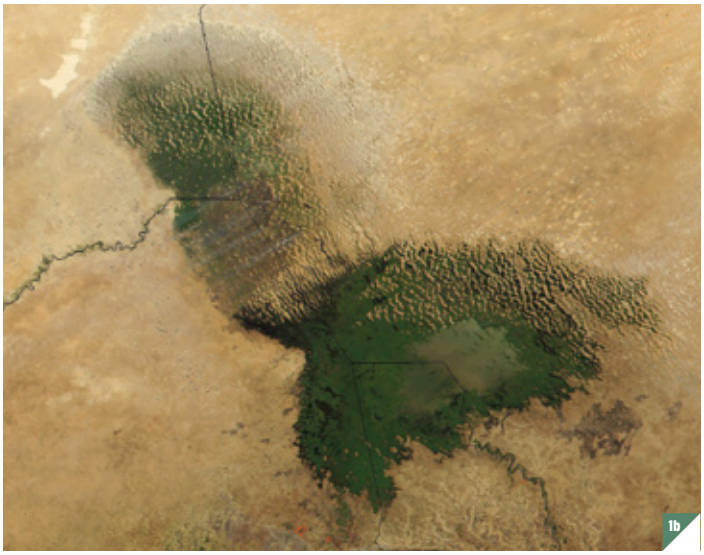
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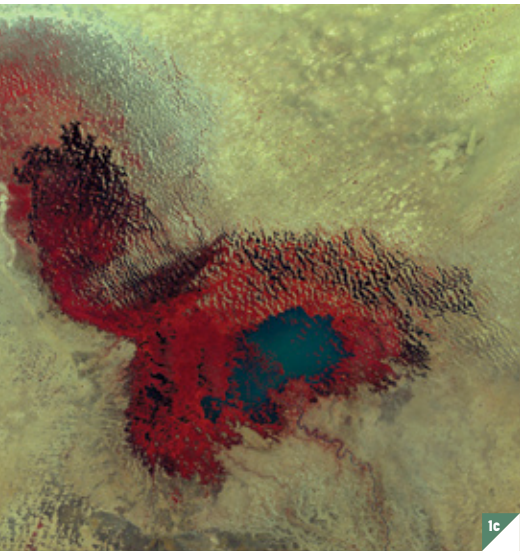
forest chemistry and other biomass indicators critical to our understanding of carbon.

Radar, especially SAR data, is being used more actively for multi-temporal analysis with the advent of multiple platforms for providing data. Scientific applications include monitoring of the cryosphere to help quantify glacier melting around the globe. Significant results include land deformation and subsidence, which are practical problems for major cities depleting their aquifers for an ever thirsty and growing populace. Danish scientists are applying multi-temporal radar for land use classification (***Figure 2***). Most of the major environmental and climatic challenges were addressed in part by the examples provided during the workshop.

However elated I was with the cutting-edge prowess and creativity of these international scientists, I remain concerned regarding the impact of our community's work. What, if any, international treaties are being invoked? How are governments and industry using these data, and communicating to the public and media? How is our 37 years of experience in Earth monitoring changing our K-12 educational settings to address several problems quickly? What exposure to the technology and research findings are university students getting as part of their basic education? I am concerned that we are remote sensing savants with our heads in the clouds and not in the halls of the decision makers or the public venues for the citizens who elect the decision makers.

I sometimes wonder if our situation is akin to looking into the mirror and discerning the telltale signs of aging. As we watch the Earth with our increasing sophistication of innovative analytical approaches, we see Gaia aging and senescing in so many directions. We see evidence of crow's feet creeping along areas of previously verdant, untouched biodiversity now exacerbated by transportation networks fragmenting the landscape, while weather patterns transition to a new climate regime.

We have no cosmetic palliatives to reverse these declines and no international or local consensus has been raised on when we should address this aging phenomena. Aging is, after all, a natural process. But the Earth is an ever-rejuvenating system that is rapidly shifting to a new climate regime, the Anthropocene, a man-made epoch. The application of remote sensing technology and techniques to monitor our affairs and potentially change our governance and commerce patterns presents a very robust and rewarding calling to new and old scientists on our dynamic Earth.



◀ **FIGURE 1A**
1987 Landsat 5 MSS mosaic of Lake Chad, in west-central Africa, courtesy of USGS.

◀ **FIGURE 1B**
2001 MODIS mosaic of Lake Chad, courtesy of NASA.

◀ **FIGURE 1C**
2007 Landsat 7 ETM of Lake Chad, courtesy of USGS.

▶ **FIGURE 2**
Images illustrate the virtues of multi-date C- and L-band SAR data in agricultural land cover classification, courtesy of Dr. Henning Skriver, Technical University of Denmark.