NASA Land-Cover/Land-Use Change Program Science Team Meeting Summary

Kelley O'Neal, University of Maryland College Park, kelleyo@umd.edu
Garik Gutman, NASA Headquarters, garik.gutman@nasa.gov
Chris Justice, University of Maryland College Park, justice@hermes.geog.umd.edu

The NASA Land-Cover and Land-Use Change (LCLUC) Program Science Team Meeting was held May 1–2, 2008, at the University of Maryland Inn and Conference Center located in Adelphi, MD. The meeting was held in conjunction with the NASA Carbon Cycle and Ecosystems (CCE) Joint Science Workshop April 28–May 2, 2008. Over 630 participants joined the greater meeting, with over 60 participating in the LCLUC Science Team Meeting. The focus of the LCLUC Science Team Meeting was on research in the Arctic within the context of the International Polar Year (IPY). There were 18 science and programmatic presentations given at the LCLUC Science Team Meeting and 35 LCLUC-related posters presented at the CCE Joint Science Workshop. Information about the CCE Joint Science Workshop can be found at: *cce.nasa.gov/meeting_2008/.* The agenda for the LCLUC Science Team Meeting, as well as presentations and posters, can be found on the LCLUC website at: *lcluc.hq.nasa.gov.*

Science Issues

The focus of the LCLUC Science Team Meeting was on research in the Arctic, with emphasis on projects located in northern Eurasia having strong linkages to the Northern Eurasian Earth Science Partnership Initiative (NEESPI). The meeting agenda focused on human-ecosystems-climate interactions and placed particular importance on understanding human dimensions of land-use in the region. Science issues concerning climate change, hydrology, disturbance and changes in land cover and productivity, carbon cycling, resource management, and alteration of indigenous lifestyles were common themes to the research presentations. In addition, the discussion highlighted new data products being developed to support LCLUC research in the Arctic.

Opening Remarks

Garik Gutman [NASA Headquarters—*LCLUC Program Manager*] kicked off the meeting with a status update of the LCLUC program, including Science Team activities, projects, and data issues. He highlighted the role of LCLUC research in the framework of the NEESPI and Monsoon Asia Integrated Regional Study (MAIRS) regional initiatives. He also announced a new data sharing initiative within the LCLUC program. **Kelley O'Neal** [University of Maryland, College Park] presented the new data access capabilities on the LCLUC website. Gutman concluded with a list of near-term priorities for the program, including improved land-use models, an enhanced social science component, continued participation in the Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) program, coupling of LCLUC processes in climate and dynamic vegetation models, and development of land-cover and change products from the Global Land Survey (GLS) products.

Chris Justice [University of Maryland, College Park—*LCLUC Program Scientist*] presented some emerging themes relevant to LCLUC research that he noted from presentations and breakout sessions at the NASA CCE Joint Science Workshop:

- Increasing attention to human managed/modified ecosystems;
- modeling multiple stressors on managed systems and related challenges;
- examining "end-to-end" impacts of LCLUC; and
- projecting land-use adaptations to climate and socioeconomic changes.

Group photograph of the LCLUC meeting attendees.

Justice also discussed:

- Opportunities for tighter connection between Earth science and applications;
- importance of securing long-term observations; and
- opportunities from the decadal survey's proposed new systems for improved land-cover characterization and land-use science.

Scientific Presentations

A total of 11 scientific presentations were given during the Science Team Meeting.

Scott Goetz [Woods Hole Research Center] presented research on recent productivity and disturbance changes associated with high-latitude climate change. He focused on changes in fire regimes related to warming in high latitudes along with resultant changes in vegetation composition.

Matt Hansen [South Dakota State University] presented work toward mapping forest cover and forest-cover loss in the Boreal zone from 2000 to 2005. The process assesses change on an annual basis using MODIS data, mapping presence or absence of tree cover regardless of land use, and stratifying the Boreal biome into high, medium, and low areas of change.

Skip Walker [University of Alaska, Fairbanks] presented information regarding the cumulative effects of resource development, reindeer herding, and climate change on the Yamal Peninsula in Russia. He focused on current and future gas and oil production in the region, the effects on the nomadic herding society from loss of land, and the effects on land cover from overgrazing remaining land. He also noted only a modest warming trend in the region.

Nancy Maynard [NASA Goddard Space Flight Center] presented information on human dimensions in the Arctic tundra under changing climate conditions. She discussed the importance of understanding indigenous traditions in reindeer pastoralism and the utility of reindeer mapping in assessing the vulnerability of coupled human-ecological systems in the Arctic to global warming and climate change.

Svein Mathiesen [Saami University College, Norway] presented an overview of climate adaptation related to reindeer herding from the Ealat Network study. He noted the original high resilience of the Arctic tundra human-ecological system to climate variability and change. Mathiesen followed on to the previous presentation with emphasis on the importance of understanding indigenous knowledge and external pressures from development and industry in order to assess the future resilience of this system.

Richard Lammers [University of New Hampshire] presented research on hydrological change within the NEESPI region. He assessed the net impact of the combined effects of natural and anthropogenic sources of change in the patterns or hydrological variability and identified and ranked the sources of change.

Kyle McDonald [NASA/Jet Propulsion Laboratory] presented on LCLUC interactions between Arctic land cover and hydrology, and links to the carbon cycle. He focused on carbon sources from permafrost lakes and methane emissions, river discharge, frozen soils, and peatlands.

Olga Krankina [Oregon State University] presented an overview of land cover and carbon cycling at high latitudes. She highlighted results from her land-cover mapping project in northern Eurasia and emphasized the importance of input map selection in determining the accuracy of final results.

Vladimir Romanovsky [University of Alaska, Fairbanks] presented an overview of changes in permafrost in the northern hemisphere and linkages to the carbon cycle. He focused on permafrost dynamics during the last glacial cycle, the present state of permafrost and possible future changes, and consequences of these changes.

Irina Sokolik [Georgia Institute of Technology] presented an overview of radiation and Arctic aerosol interactions with LCLUC. She differentiated between natural and anthropogenic sources of aerosols, focused on long-term aerosols trends in the North American and Eurasian Arctic, and related aerosols to accelerated rates of warming.

Robert Chen [Center for International Earth Science Information Network (CIESIN)] presented an overview of social science data for high latitudes and highlighted the importance of including socioeconomic data in LCLUC research. He showcased socioeconomic data relevant to Arctic research available through CIESIN.

Programmatic Presentations

A total of five programmatic presentations were given during the Science Team Meeting.

Curtis Woodcock [Boston University] presented an overview of the Global Observations of Forest Cover-Global Observations of Land Cover Dynamics (GOFC-GOLD) program and discussed the new Reducing Emissions from Deforestation and Degradation (REDD) sourcebook. He also noted details and key activities for the Group on Earth Observations (GEO) task of land-cover characterization.

Thomas Loveland [U.S. Geological Survey (USGS)] presented a status update on the current Landsats and the Landsat Data Continuity Mission (LDCM). He reviewed LDCM instrument specifications and noted a planned launch date for July 2011. He also provided an overview of the current Landsat archive, a status update for Landsat 5 and Landsat 7, and noted the recent USGS policy changes for Landsat cost and availability.

Jeff Masek [NASA Goddard Space Flight Center] presented an overview of the GLS 2005 product, including processing and land-cover product development. He reviewed processing specifications, including scene selection criteria and sensor preference, and noted the current reprocessing of older Geocover datasets from 1975, 1990, and 2000 to GLS standards. Masek also noted the GLS 2005 effort is focusing on both data products and land-cover analysis through support from several LCLUC-funded projects. He introduced the planned GLS 2010 initiative.

Eric Vermote [University of Maryland, College Park] provided an overview of the Land Long-Term Data Record (LTDR) project providing a continuous data record from the Advanced Very High Resolution Radiometer (AVHRR) to MODIS. He presented details on AVHRR geolocation accuracy, calibration within the AVHRR series, and calibration between AVHRR and MODIS.

Tres Montano [University of Maryland, College Park] presented a demonstration of the new Land Measurements Portal designed to provide information on the land products from NASA and the international community, and the associated validation and coordination initiatives on land observations.

Arctic LCLUC Book for IPY

Garik Gutman discussed the plans and chapter content for *Arctic Land Cover and Land Use in a Changing Climate*, the LCLUC contribution to IPY. Topics covered include changes in vegetation cover and productivity, forest-cover loss, carbon balance, hydrology, reindeer pastoralism, resource development, aerosols, pollution, and an overview of scientific challenges for LCLUC research in the Arctic. The book is authored by LCLUC and NEESPI principal investigators and focuses on northern Eurasia. The book will be submitted by October 2008 and published at the conclusion of IPY.

Closing Remarks

Garik Gutman wrapped up the meeting with encouragement to the LCLUC community to organize topical science workshops in order to facilitate better coordination and collaboration. He emphasized the importance of data availability from the international assets and suggested a workshop on the GLS program. He encouraged LCLUC researchers to be involved with the emerging new NASA instruments planned for launch, and to give attention to the future national and international systems. He noted the need for increased research on the role of societal feedbacks, effects on ecosystems, and integration of LCLUC processes in climate models in order to assess vulnerability, resilience, and adaptation. He concluded the meeting with a reminder of the success of the LCLUC program in improving understanding of human-ecosystems-climate interactions.

Future Meetings

The next LCLUC Science Team Meeting is planned for January 2009 in Chiang Rai, Thailand to be held jointly with the MAIRS program. Its focus will be on tropical land-cover and land-use change. More information concerning this meeting, along with presentations from the Spring Science Team Meeting, can be found on the LCLUC website at: *lcluc.hq.nasa.gov.* ■

LASP Returns Nearly $3 M to NASA in Cost Savings on SORCE Mission

On June 17, the University of Colorado (CU) at Boulder's Laboratory for Atmospheric and Space Physics (LASP) took the rather unusual step of returning nearly $3 M in cost savings on the Solar Radiation and Climate Experiment (SORCE) to NASA. NASA launched SORCE as part of EOS in 2003 and the mission is controlled from the LASP Space Technology Building at the CU Research Park. During an event held at CU on June 17, LASP officials presented a $2,997,000 check for the cost savings from SORCE development and operations to Ed Chang, [NASA Goddard Space Flight Center—SORCE Manager]

This surplus is money that was not spent during the SORCE Prime Mission development and operations (first five years). The cost savings is a result of an efficient management team, effective pre-launch testing, an extraordinary science team, and the sharing of LASP Mission Operations Center personnel. In an era of tight budgets and ever rising costs this is quite an accomplishment. Congratulations to SORCE PI Tom Woods and everyone else involved in the mission on a job well done.

NASA Scientists Hope to See the Data Through the Haze

Denise M. Stefula, NASA Langley Research Center, Denise.M.Stefula@nasa.gov

Strange things are happening at the top of the world.

As early as the 1940s, weather reconnaissance pilots flying the Canadian high Arctic reported seeing smog bands of unknown origin, and the term *Arctic Haze* was soon born.

Since then, scientists have discovered that the atmospheric particles, or aerosols, found in *Arctic Haze* are composed of a variety of species associated with urban pollution: soot, sulfate, nitrate, ammonia, and organic acids. The thick layers of aerosols contribute to regional and global climate modifications.

Studying these aerosols may help researchers better understand what's going on inside the Arctic Circle—a "fragile" first alert system of global climate change.

How can such a seemingly pristine environment, relatively desolate and certainly remote as regions go, be so plagued by pollutants attributed to the far more populated, industrialized portions of the world?

The reason is found in the wind. Strong pressure gradients during winter months cause episodes that push the air northward. With this push, aerosols are transported into the Arctic from mid-latitude sources in North America and Eurasia.

Once reaching the Arctic, aerosols disperse into the atmosphere, and that's when things get strange.

Over the dark winter months, the Arctic atmosphere becomes stable. The lack of sunlight and low precipitation allow aerosols longer "residence" times, and the haze settles in the troposphere.

The awakening Arctic spring brings sunlight once again and photochemical processing first causes the formation of ozone, then essentially starts to clean aerosols from the troposphere in what scientists characterize as a fast, highly reactive process.

"During the spring when the sun reappears over the Arctic," says **Jennifer Olson**, a research scientist at NASA's Langley Research Center, "the sunlight interacts with the aerosols and photochemical reactions quickly begin to take place."

Through their participation in NASA's Arctic Research of the Composition of the Troposphere from Aircraft and Satellites (ARCTAS), Langley researchers are part of an international group of scientists brought together by the International Polar Year to collect data in the Arctic region. Their aim is to better understand human influences and changes in Arctic atmospheric conditions relating to pollution and climate. The first deployment took place in April to investigate the Arctic Haze phenomenon. Read firsthand accounts of the experience on page 4 of this issue.

ARCTAS scientists have used multiple approaches—lidar, *in situ* measurements, and satellite observations—to collect data. The Langley *King Air B-200* aircraft was used for lidar and *in situ* measurements. At no other time has this kind of extensive sampling of the Arctic been used on a scale as broad in such close proximity to the North Pole, and NASA Langley projects have played an important role.

"You don't have just one instrument measuring aerosols," says **Eddie Winstead**, a Langley Aerosol Research Group Experiment (LARGE) team scientist with Langley's Science Directorate. "Our rack (a frame for housing equipment) alone can sometimes have anywhere from 13 – 15 instruments and they all measure different parameters."

LARGE, headed up by Principal Investigator **Bruce Anderson**, measures aerosol particle sizes and concentrations and studies the impact of the amount of sunlight absorbed or reflected (radiative forcing) by Earth's system. Absorption warms, reflection cools.

"With Arctic Haze it's important to read the composition, size, and number of particles present, as well as the amount of light being scattered," Winstead explains. "This gives scientists insight into the energy balance and global climate effects."

The LARGE instruments include particle counters and sizers, photometers, spectrometers, cloud imaging probes, and nephelometers. These instruments not only provide data on the Arctic region's atmospheric conditions, they also benefit in validating operational success.

Operational success is measured in part through critical studies comparing results to ensure techniques and platforms are complementary. Flight planners also work to ensure that the aircraft collect observations in locations where Earth-observing satellites associated with NASA's A-Train are passing overhead. Putting instrumented aircraft in the path of a satellite allows scientists to gather comprehensive data for comparison and validation of satellite observations.

Eddie Winstead (far right) with some of the Langley Aerosol Research Group Experiment team members in Fairbanks, Alaska. From left: Andreas Beyersdorf, Gao Chen, Principal Investigator Bruce Anderson, and Terry Lathem. Credit: NASA.

"Aircraft in the field provide what scientists call *truth* data. One aircraft is sampling the air as another above takes *remote* measurements," says **Chris Hostetler**, one of Langley's platform scientists for the *B-200*. "The data are then integrated to provide a two dimensional vertical context to investigate new and existing remote techniques."

During the spring ARCTAS campaign, several aircraft underflights of the Langley-developed Cloud-Aerosol Lidar Pathfinder Satellite Observations (CALIPSO) satellite were performed. Data from campaigns like ARCTAS improve the utility of satellite measurements and aid in the formulation of future field activities.

"The data from different instruments overlap," explains Winstead. "This is state-of-the-art equipment, and we check the data carefully to see if the results agree."

Back in the lab, researchers like Winstead use the combined observational techniques to identify pollution sources and transport pathways, and study the radiative properties of aerosols in the Arctic. The results offer opportunities for a better understanding of the strange, rapid atmospheric changes occurring each spring at the top of our world, and how those changes apply to global climate concerns. ■

ESIP Federation Elects Four New Partners

The Federation of Earth Science Information Partners ("ESIP Federation") has elected four new partners for full membership. The following group illustrates the continuing strength of applicants for ESIP Federation partnership:

- The Comprehensive Large Array-data Stewardship System (CLASS), **Robert Rank**, NOAA/ NESDIS Office of Systems Development, Suitland, MD.
- CyberForSPACE: Cyberinfrastructure For Sustainable Programs And Community Empowerment, **James Wilson**, James Madison University Geographic Science Program, Harrisonburg, VA.
- Massachusetts Maritime Academy, **Tom Pham**, Buzzards Bay, MA.
- Marine Metadata Interoperability Initiative, **John Graybeal**, Monterey Bay Aquarium Research Institute, Moss Landing, CA.

"The ESIP Federation's growth continues to surpass all expectations," says **Charles Hutchinson**, ESIP Federation President. "We are drawing in new partners from a variety of sources, representing all the ESIP Types and the experts who innovate in the field of Earth science data and information technology management. The ESIP Federation's reputation as a collaborative community-driven forum for Earth science data and information technology experts is growing."

Celebrating its 10th anniversary, the ESIP Federation now comprises 110 partners representing a wide range of Earth science data interests. ESIP Federation partners include Earth science data centers, environmental research groups, practitioners in the application of environmental data, educators and technologists. Across these diverse interests, public, private and non-profit organizations are represented.

The ESIP Federation is a broad-based community drawn from agencies and individuals who collectively provide end-to-end handling for Earth science data and information. The ESIP Federation promotes increased accessibility, interoperability and usability for Earth science data and derivative products. Initiated by NASA in 1997, the ESIP Federation provides data, products and services to decision makers and researchers in public and private settings. The Foundation for Earth Science provides administrative and staff support to the Federation of Earth Science Information Partners.