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The Earth Observer

Editor's Corner

Michael King
EOS Senior Project Scientist

I'm pleased to report that the Earth Observing System (EOS) Program was selected to receive the American Institute of Aeronautics and Astronautics (AIAA) Space Systems Award for 2006. The award is given "for developing the Earth Observing System, consisting of a series of earth-observing satellites, an advanced data system, and teams of scientists that represent the first global environmental monitoring system." I had the honor of receiving this award on behalf of EOS at the AIAA's *Space 2006* Conference and Exhibition in San Jose, CA, on September 20. The speaker for the awards ceremony was Bill Vass, President and Chief Operating Officer, Sun Microsystems Federal, Inc. For more details on this award please see the *Kudos* on page 4 of this issue. I extend my congratulations to everyone whose hard work has made this award possible.

In other news, the two newest Earth observing satellite missions continue to perform well. The CloudSat Cloud Profiling Radar (CPR) and spacecraft continue to operate nominally, collecting profiles of clouds

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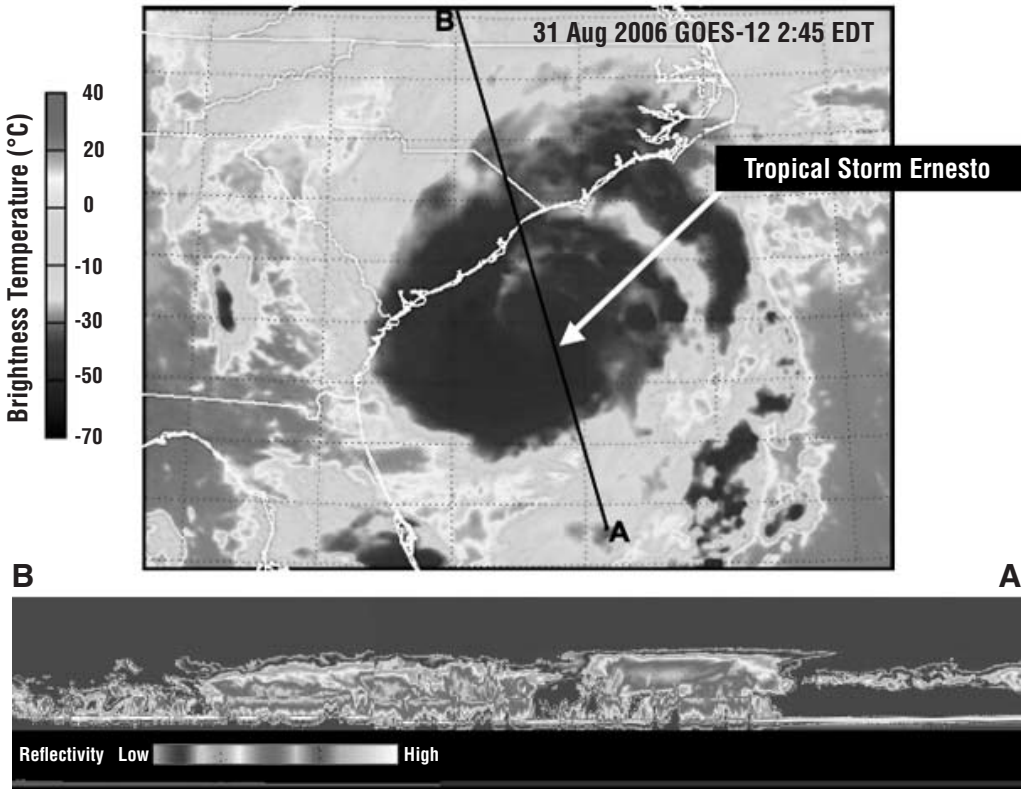
At approximately 2:45 p.m. EDT, August 31, 2006, the NOAA Geostationary Operational Environmental Satellite (GOES-12) Imager captured the image of Tropical Storm Ernesto shown in the top panel. Brightness temperature is a measure of the apparent temperature of the top of the clouds when viewed from space. Thicker clouds (darker shades of grey in the center of the storm) extend higher in the atmosphere where temperatures are colder. At about the same time, NASA's CloudSat satellite with its Cloud Profiling Radar passed over the same area following the track from A to B as shown on the GOES image, capturing the data shown in the bottom panel. The shades of grey indicate differing amounts of water and ice in the clouds. The bright line at the bottom of the panel is the ground return from the radar indicating it penetrated to the ground most of the time, even through heavy rainfall. The bottom panel shows an area approximately 800 km (497 mi) wide; from top to bottom is approximately 30 km (18.6 mi.). The CloudSat data provide analysts and forecasters with a three-dimensional view of hurricanes never before available.



In This Issue

and precipitation. Many hurricane overpasses have occurred, including two directly over the hurricane eye (Typhoon Prapiroon and Hurricane Ileana in the Pacific). CloudSat quick-look images can be viewed at *www.cloudsat.cira.colostate.edu/dpcstatusQL.php* within a few hours of the observation. The CloudSat Science Team is working to validate Level 1 and Level 2 products, and plans to begin releasing products to the community this fall. Shown on the cover of this issue is an image of Tropical Storm Ernesto as it approached the Carolina coast. The top panel shows data from the Geostationary Operational Environmental Satellite (GOES-12) Imager and the bottom data come from CloudSat's Cloud Profiling Radar as it moved across the track superimposed on the GOES-12 image. Notice how the CPR data literally add a new dimension to our ability to observe clouds, and thus enhance our ability to study clouds in detail and characterize the role they play in regulating Earth's climate.

Meanwhile, the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission continues to operate nominally, and CALIPSO's innovative lidar system has collected hundreds of unprecedented two-dimensional views of clouds and aerosols. As of September 1, 2006, the CALIPSO laser has collected over 150 million shots on-orbit. CALIPSO has seen a number of fascinating atmospheric features. In late July, the lidar observed polar stratospheric clouds over Antarctica extending to heights above 28 km—about 17.4 miles. CALIPSO was able to use its unique depolarization capabilities to discern what part of the cloud contained solid ice and/or nitric acid trihydrate (NAT) particles, which is important for understanding the complex process of polar ozone loss. The team has collected extensive correlative measurements with the NASA African Monsoon Multidisciplinary Analyses (NAMMA) campaign conducted in late August, as well as with our French colleagues in a field campaign in Africa. In addition, the team obtained measurements to coincide with the Texas Air Quality Study/Gulf of Mexico Atmospheric Composition and Climate Study (TexAQS/GoMACCS) that took place during August and September in the Houston area.

A major validation experiment for both CALIPSO and CloudSat, called the CALIPSO & CloudSat Validation Experiment (CC-VEx) took place at Warner Robins AFB, GA between July 26 and August 14. The experiment was designed to acquire coincident cloud and aerosol measurements to verify lidar and radar calibration, stability and sensitivity, and the accuracy of CALIPSO/CloudSat data products. Three aircraft were deployed to fly under the satellite overpasses: the NASA ER-2 equipped with the Cloud Physics Lidar (CPL), Cloud Radar System (CRS), and Moderate Resolution Imaging Spectroradiometer (MODIS) Airborne Simulator (MAS); the NASA King Air equipped with the High Spectral Resolution Lidar (HSRL) instrument; and the Weather Modifications Inc. Learjet with *in situ* particle instruments. Researchers conducted eight daytime and four nighttime deployments and successfully achieved all pre-mission flight objectives. The results of CC-VEx, as well as data taken in other validation activities, will be examined by the CALIPSO Science Team at their next meeting scheduled for October 3-5, and by the CloudSat Science Team at their next meeting scheduled for October 16-20.

Also, at the request of **Lou Schuster** from NASA Headquarters, there was an Aqua briefing at Headquarters on August 7. This went very well, with Aqua Project Scientist **Claire Parkinson** systematically listing and providing a status on each of the ten Aqua mission success criteria, then **Tom Pagano, Elena Lobl**, myself, and **Bruce Wielicki** in turn discussing the status of the Atmospheric Infrared Sounder (AIRS)/Advanced Microwave Sounding Unit (AMSU), Advanced Microwave Sounding Unit–EOS (AMSR-E), MODIS, and CERES science efforts, respectively. We were followed by **Bill Guit** discussing the status of Mission Operations and the fact that the Aqua mission is well-positioned, from a technological point of view, to continue well beyond its nominal six-year lifetime. The briefing included exciting new results from each of the science teams, and there were numerous fruitful exchanges with the Headquarters' attendees. All of the presentations are posted at *aqua.nasa.gov/reference/presentations.php*.

Likewise, on August 16 Aura Project Scientist **Mark Schoeberl** gave a presentation to Schuster and other senior management at Headquarters on the status of the Aura spacecraft and its instruments, progress towards *mission success*, and important scientific discoveries resulting from Aura. The spacecraft and instruments are in good shape two years after launch, and the Aura team is on track to meet and exceed mission success criteria, making new scientific discoveries along the way. The "Top Ten" scientific discoveries from Aura are described on the Aura web site—*aura.gsfc.nasa.gov*. The article on page 5 of this issue goes into more detail on this briefing. Schoeberl's full presentation can be found at—*ftp://hyperion.gsfc.nasa.gov/pub/aura/Aura_Review.ppt.* ■

On May 31, 2006, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite captured this image of Guadalupe Island off the coast of Mexico's Baja Peninsula. Turbulence, caused by the wind passing over the island, can produce pronounced eddies that swirl the clouds into a pattern called a *vortex 'street'*. The swirls extend south from the island, which is visible through the break in the clouds. Image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC.

Kudos

Following are excerpts from a letter dated July 31, 2006, written by **G. P. "Bud" Peterson**, Honors and Awards Chairman, American Institute of Aeronautics and Astronautics (AIAA) to Michael King, EOS Senior Project Scientist:

Dear Dr. King:

It is my pleasure to formally inform you that the Earth Observing System (EOS) Program has been selected to receive the American Institute of Aeronautics and Astronautics Space Systems Award for 2006. This award is presented to recognize outstanding achievements in the architecture, analysis, design, and implementation of space systems. Mark Webster, Program Manager, Ball Aerospace & Technology Corporation, submitted the nomination.

The citation for the award reads: "For developing the Earth Observing System, consisting of a series of earth-observing satellites, an advanced data system, and teams of scientists that represent the first global environmental monitoring system." The award consists of an engraved medal, a certificate of citation, and a rosette pin.

As the EOS Senior Project Scientist, you are cordially invited to receive the award on behalf of the team on Wednesday, 20 September 2006, at the Awards Luncheon held in conjunction with the AIAA Space Conference and Exhibit, San Jose Convention Center, San Jose, California. Additional details about this conference can be found at www.aiaa.org.

The team will be shown as follows in our award brochures, in Aerospace America and all other promotional outreach. If this is not correct, please advise!

Earth Observing System (EOS) Team
NASA Earth Science Enterprise
Greenbelt, Maryland

Congratulations on this well-deserved honor!

Honors and Awards Chairman

CC: Mark Webster, Nominator
Ferdinand Grosveld, Region 1 Deputy Director-Honors and Awards
Tom Milnes, AIAA Baltimore Section Honors & Awards

The *Earth Observer* staff and the entire scientific community wish to congratulate every past and current member of the EOS Team for this outstanding accomplishment.

Editors Note: King has instructed the Awards Committee to list it as a NASA Award (without a Center or address, since it represents HQ, GSFC, JPL, and LaRC), and also eliminate 'Earth Science Enterprise' as this organization no longer exists.

An Update on the Status of the Aura Mission

Anne Douglas, NASA Goddard Space Flight Center, Anne.R.Douglass@nasa.gov
Mark Schoeberl, NASA Goddard Space Flight Center, Mark.R.Schoeberl@nasa.gov

Introduction

Aura is the third of the large EOS platforms, and was launched July 15, 2004, into a sun-synchronous orbit with a 1:45 p.m. equator crossing time. Aura is the trailing satellite in the "A-Train," which is the nickname often used to describe the Afternoon Satellite Constellation. The other members of the "A-Train" include the NASA missions Aqua, CloudSat, and Cloud-Aerosol Lidar Infrared Pathfinder Satellite Observations (CALIPSO), as well as a French Centre National d'Etudes Spatiales mission called Polarization and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar (PAROSOL).

On August 16, 2006, **Mark Schoeberl** [Goddard Space Flight Center—*Aura Project Scientist*] gave a presentation at NASA Headquarters on the status of the Aura spacecraft and its instruments, progress towards *mission success*, and important scientific discoveries resulting from Aura. The following report draws from that presentation and presents a summary of the status of the Aura mission. The full presentation can be found and downloaded from *ftp://hyperion.gsfc.nasa.gov/pub/aura/Aura_Review.ppt.*

Spacecraft Status

The Aura spacecraft is in good condition; the status of all subsystems is nominal. Early in the mission a small piece of the solar array disconnected, most likely due to an isolated workmanship problem. This loss does not impact present operations or Aura life expectancy. Aura has sufficient propellant reserves to last until 2015, while retaining fuel to lower the orbit and meet end-of-mission requirements according to Earth Science Mission Operations (ESMO) Flight Dynamics analysis. More than 99% of data have been captured over the mission life.

Status of Instruments

The High Resolution Dynamic Limb Sounder (HIRDLS) experienced a problem at launch. A piece of plastic closeout material, *Kapton®*, came loose and now blocks a large part of the front aperture. The HIRDLS team has learned how to work around the reduced aperture, correct for the radiometric interference of the *Kapton®*, and obtain high vertical resolution retrievals of temperature, ozone, and water vapor. Apart from the blockage, HIRDLS is operating flawlessly with excellent signal to noise characteristics.

The Microwave Limb Sounder (MLS) is functioning well, and has gathered data 94% of the time since activation a few weeks after launch. There have been signs of aging in one band used to retrieve hydrochloric acid (HCl), most likely due to failure of a heterojunction bipolar transistor (HBT). Measurements of HCl are still obtained using a less optimal band, and the primary band will be turned on about once per month to compare the retrievals from both bands.

The Ozone Monitoring Instrument (OMI) is also doing well, and shows no significant radiometric degradation two years after launch. An anomaly with the Folding Mirror Mechanism occurred in February 2006, and was resolved after careful analysis.

The Tropospheric Emission Spectrometer (TES) is currently operating mostly in the nadir mode. After about a year of global survey observations that included both limb and nadir measurements, the instrument showed signs of translator bearing wear. To increase the lifetime of the instrument, TES adopted a new global survey mode with only nadir measurements. TES was designed to make measurements of temperature, ozone (O_3), carbon monoxide (CO), and other tropospheric constituents. In an effort to improve the accuracy of CO retrievals, engineers revised TES' optical bench temperature by 5 K to try and improve the signal-to-noise ratio. Limb measurements are scheduled occasionally as part of special observations.

Calibration

Capture and processing of data are presently routine. Data have been calibrated to the extent required. In-flight calibration of the OMI data is on-going. Pitch-up maneuvers have been made for HIRDLS calibration, and an additional maneuver is scheduled—these are required because the *Kapton®* blocks the internal calibration source.

Validation

The Aura Science Team worked with NASA HQ to develop a comprehensive platform-wide validation plan. This approach followed the recommendation that the community articulated at the 1997 Snowmass meeting. To date, five major aircraft validation missions have been completed as listed in **Table 1**.

There have also been stratospheric balloon launches and several intensive sonde campaigns. Aura investigators

TABLE 1: Major Aircraft Validation Campaigns for Aura.

Campaign	Date	Aircraft Used
Houston Aura Validation Experiment (AVE I)	October 2004	University of Colorado
Polar Aura Validation Experiment (PAVE)	January 2005	DC-8
Second Houston Aura Validation Experiment (AVE II)	June 2005	WB-57
Costa Rica Aura Validation Experiment (CRAVE)	January-February 2006	WB-57
Intercontinental Chemical Transport Experiment (INTEX-B)	April-May 2006	DC-8

have taken advantage of several other campaigns such as the Texas Air Quality Study and the INTEX-B Ozonesonde Network Study (IONS) 2006. The Aura Validation Data Center was developed to provide easy access to campaign data and conventional data, e.g., sonde data, and to provide data from other satellites including the Atmospheric Chemistry Experiment (ACE) on the Canadian SCI-SAT and the SCanning Imaging Absorption spectroMeter for Atmospheric ChartograpHY (SCHIAMACHY), and Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) on the European Environmental Satellite (ENVISAT). A second validation workshop is planned for September 11-15, 2006, in conjunction with the Aura Science Team meeting in Boulder, CO, and a special validation issue of the *Journal of Geophysical Research* is planned for 2007.

Following successful validation efforts, data from MLS, OMI, and HIRDLS have been transferred to the Goddard Earth Sciences (GES) Data and Information Services Center (DISC) [formerly the Goddard Distributed Active Archive Center (DAAC)] for public release. Data from TES are available from the Langley DAAC.

Important Scientific Discoveries on the Road to Mission Success

The Aura team is well on its way to achieving *mission success* and is advancing our knowledge of atmospheric chemistry along the way. Mission success criteria are centered around analyses of environmentally important trace gases and aerosols that the Aura instruments could measure. The mission success criteria include:

- Producing 3-D global atmospheric surveys of environmentally important trace gases and aerosols;
- determining the linkage between climate change and changes in atmospheric constituents;
- determining how localized tropospheric pollution sources contribute to regional and global pollution; and
- determining natural and anthropogenic influences on the global oxidizing power of the troposphere.

Measurements from MLS contribute to efforts to quantify the change in stratospheric ozone in response to decreases in chlorofluorocarbons (CFCs) and increases in greenhouse gases. Once validated, HIRDLS measurements will also contribute to this problem. OMI column measurements are being used to extend the record of column measurements begun in the late 1970's by the Total Ozone Monitoring Spectrometer (TOMS) instrument on NIMBUS 7.

Measurements from OMI, HIRDLS, and MLS contribute to determination of climate-change gases in the stratosphere and troposphere, as well as mapping aerosols and clouds in the upper troposphere. The upward tropical fluxes are inferred from MLS measurements of CO and H_2O. Downward fluxes leading to zone enhancements at mid-latitudes can be seen at fold events by combining MLS and OMI data. OMI measures aerosol optical thickness and single scattering albedo over bright surfaces and clouds.

Information about tropospheric sources and sinks of pollutants such as nitric oxide (NO_2) from OMI, and CO and O_3 from TES is needed to determine how localized tropospheric pollution sources contribute to regional and global pollution. OMI is developing a formaldehyde (CH_2O) product, a good representative of volatile organic compound (VOC). OMI and MLS

can estimate the tropospheric ozone residual by subtracting the MLS stratospheric column ozone from the OMI column ozone. High residual regions show global impacts of long-range transport—see **Figure 1**.

Aura observations are focused on the troposphere, the upper troposphere, and lower stratosphere, a part of the atmosphere that has not been thoroughly observed by previous instruments on other satellites. The *"Top Ten"* scientific discoveries from Aura are described on the Aura web site—*aura.gsfc.nasa.gov/*.

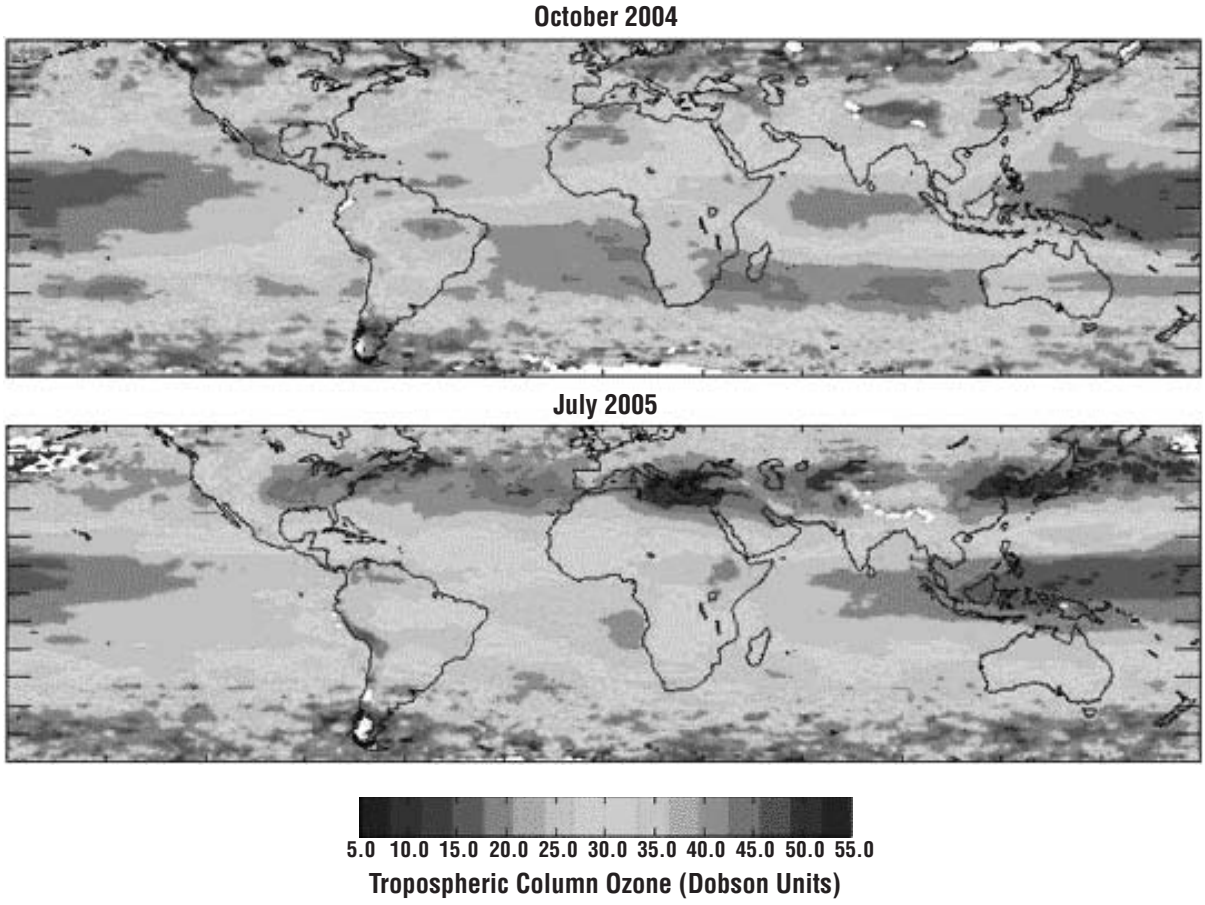
Education and Public Outreach

The Aura web site is one of many activities that Aura Education and Public Outreach supported. A fruitful collaboration with the American Chemical Society led to four Aura-related issues of *ChemMatters*, a publication sent to high school chemistry teachers. These issues have a broad scope, with articles on science issues, spacecraft issues, air quality, elements of environmental policy, and the people who stand behind Aura and similar satellite programs. Aura also contributes to a Smithsonian Exhibit called *Atmosphere: Change is in the air.* The exhibit addresses three main questions: What is the atmosphere? How is the atmosphere important to our lives? How do we study the atmosphere? In addition, an *ozone garden*—a collection of ozone sensitive plants—was planted this summer at the Goddard Visitor Center to illuminate the connection between tropospheric ozone and plant life.

Conclusion

Aura is unique among the EOS observatories in that its complementary instruments function as an integrated observatory of atmospheric composition. The spacecraft and instruments are in good shape two years after launch, and the Aura team is on track to meet and exceed mission success criteria, making new scientific discoveries along the way. The Aura mission continues and even more scientific accomplishments will likely be added to the web site following the September 2006 Science Team Meeting. ■

Figure 1. Monthly mean maps of the tropospheric ozone column show pollution from biomass burning in the equatorial zone during October 2004 and pollution from the U.S., Europe, and China during July 2005. (from Ziemke *et al.* Journal of Geophysial Research, 2006)



The Quest For The Elusive Corncrake: A Story of a Chance Meeting and a Milestone Discovery

Terry Arvidson, NASA Goddard Space Flight Center, terry.arvidson@gsfc.nasa.gov

When I entered the London hotel meeting room the welcome party was well underway. I am Terry Arvidson, senior engineer on the Landsat 7 program, and my friend Sue and I were on an expedition with the World Wildlife Fund (WWF) to explore Wild and Ancient Britain. This party afforded us our first look at our fellow passengers. For the next two weeks, the two of us (and 100 of our soon-to-be friends) would be cruising on the *Clipper Adventurer*, visiting the remote island groups of the U.K., and learning about the ancient Pict, Celt, and Viking sites as well as the abundant wildlife of the region. Not many Brits ever visit the Scillys, the Saltees, and the Outer Hebrides, to name a few of our destinations—we would soon join the only 200-some people to set foot on the Flannans this year. As we stood sipping our wine and looking around at everyone, imagine my surprise when I spotted someone I recognized—Anne Kahle, former U.S. ASTER Team Leader. I re-introduced myself to Anne and we chatted a bit before drifting off to meet others, never suspecting at that time what excitement lay ahead on our voyage.

One of the aspects that Sue and I like the most about this type of trip is the experts that accompany the tour, willingly imparting their knowledge and enthusiasm as we explore—there were 15 on this trip. I am an amateur birder and was happy that there were no fewer than 3 expert ornithologists traveling with our group, including Peter Harrison, a foremost expert on seabirds, and author of *Seabirds, An Identification Guide,* which I had brought on the cruise—yes, I asked him to autograph it. Peter has become a good friend of Anne's over the years as she has traveled with him on many birding trips. During one of his lectures, Peter informed us that Anne was seeking to achieve her 5,000th bird sighting on this trip. She'd made the previous milestone sightings of

The object of our quest—the Corncrake. **Photo Credit:** Bird Watch Ireland.

Iona Village. **Photo Credit:** Sue Mickel.

1000, 2000, etc. in Peter's company and he was anxious to help Anne achieve number 5000. The bird they had in mind for this honor was the corncrake (*Crex crex*), a very secretive, partridge-like bird—see photo below. Its population has declined, becoming very rare and local in Britain and Ireland, and threatened globally with extinction. Peter was hoping to find one on the island of Iona, where they are frequently heard but rarely seen.

The big day finally arrived, day eight of our voyage. Today we were to explore the islands of Iona and Staffa. It was grey and misty on Iona that day, occasionally breaking into Scottish sunshine—also known as rain showers. There were 18 of us birders following Peter and Rob McCall, another of the ornithologists. Rob had his laptop, on which he had a recording of the corncrake's call—the bird's Latin name, *crex crex*, is derived from the sound of its call. We'd walk to a likely location, get out the laptop, play the call several times, listen for a reply, train our binoculars on where we thought the reply came from, then play the call over and over again. We were looking at the edges of fields, where there was taller vegetation including lovely iris plants. Eventually, Rob got tired of juggling the laptop and binoculars, not to mention getting everything wet in the rain, so we resorted to a cell phone on which an MP3 file of the call had been recorded. We could hear the wily little critters, but we never spotted one.

Of course, it was far from a waste of time for Iona is a gorgeous setting. We were wandering about a picturesque little harbor village with green hills rising behind, nunnery ruins, stone crosses 10-12 feet high scattered about, and the mostly restored abbey sitting proudly above the beach. And we saw our share of birds as well including pied wagtail, crow, song thrush, greenfinch,

blackbird, fledged jackdaws, lapwing, herring gull, twite, and arctic tern. Underfoot were hundreds of grey snails dragging their shells along—think escargot—and large black slugs—think ugh!

Eventually, we found ourselves at the bottom of a field with large clumps of tall iris to the left, shorter wildflowers and grasses on the right, and a clipped lawn separating us from the field. This lawn belonged to one of the village houses so we were respectfully standing alongside the building, crowded into an alleyway, peering over their fence. We were hoping to lure the corncrake to the clipped lawn with our cell phone recording, and when we played the recording and got an immediate answer, our hopes rose. Those up against the fence trained their binoculars on the field and searched for the bird. After a while, someone ceded me a place against the fence, and I assumed the stance—binoculars up, ears wide open. After 5-10 minutes, I started scanning the wildflower part of the field, partly to look at the flowers, and partly out of frustration. Knowing that the bird we sought was brown, I started investigating all the brown bits in the field. Imagine my surprise when I saw a pair of eyes looking back at me. I alerted the others, pointing to where I'd spied the bird and trying to describe the location within the field—hard to do when the only landmarks are clumps of plants. Peter immediately made room for Anne at the fence and showed her where to look with the binoculars. Fortunately the corncrake was on the move and easier to spot, trotting from the wildflowers into the taller iris. We continued to try to follow it in the tall growth with our binoculars. Alerted by our excitement, the owner of the house came out and gave us permission to stand inside the fence, at the edge of the lawn. We spotted the bird two more times, in between clumps of iris, but it couldn't rival the thrill of that first sighting.

Well, we'd done it! At the start of the day, all of us were aware of how rare sightings could be of this bird and we wanted to add it to our lists. I just never expected to be the one who helped connect Anne with her 5000th bird. What are the odds that two of us involved in remote sensing of the Earth would meet in the remote islands of the U.K. and share such a triumph? It is indeed a small, small world. ■

The restored Abbey at Iona, Hebrides. **Photo Credit:** Terry Arvidson.

Feedback Sought on Land Earth Science Data Records (ESDRs)

NASA has established a preliminary Land Measurements Team to start to address the observation needs of its land-oriented Science Focus Areas. One of the responsibilities of this team will be to define the requirements and provide stewardship for a number of science-quality, time-series data records, to be called Earth Science Data Records (ESDR). These ESDRs will be designed to meet the needs of both NASA research and applied science and the broader global-change-research community. As a first step in the process of developing the ESDRs, a number of individuals were tasked with leading the development of *white papers* on candidate products in consultation with other members of the community. To date, this initiative has been advanced predominantly by data producers, however, as the Team develops, a balance will be sought between producers and data users. The *white papers* can be found at:

lcluc.umd.edu/products/Land_ESDR/index.asp

The *white papers* provided follow a common template and focus on systematic moderate resolution products. **They are meant as short summaries to initiate discussion.** A message-board feedback forum is provided to facilitate community feedback on the candidate ESDRs. You are invited to comment in general and on specific products.

Transition of MODIS Services at the GES DISC (DAAC) to MODAPS Ongoing

Michael Teague, NASA Goddard Space Flight Center, opsman@saicmodis.com

Data products for the Moderate Resolution Imaging Spectroradiometer (MODIS) are in the process of transitioning from the Goddard Earth Sciences (GES) Data and Information Services Center (DISC) [formerly the Distributed Active Archive Center (DAAC)] to the MODIS Adaptive Processing System (MODAPS) at the NASA Goddard Space Flight Center (GSFC) in Greenbelt, MD. Effective **August 9, 2006**, MODAPS became the source for MODIS *Collection 5* Aqua Level 1 (L1) and atmospheres data products. All *Collection 5* Aqua L1 products previously available from the GES DISC are now available through MODAPS, and the GES DISC stopped distribution services for all MODIS Aqua *Collection 5* products on **August 16, 2006**.

The user services provided by the GES DISC for MODIS *Collection 4* L1 and atmospheres data products, and *Collection 5* L1 data products are comprehensive and extensive and the transition to MODAPS began in March 2006. By September 2006, all GES DISC services for MODIS data products will be transitioned to MODAPS. The transition is a complicated process and both GES DISC and MODAPS staff apologize for any inconvenience to our users this may cause. In an effort to minimize user difficulty, both organizations maintain web sites that identify the status of the services presently available for MODIS data products.

- MODAPS: *modaps.nascom.nasa.gov/services* provides a summary of MODAPS production activities. Archive and distribution services both at the present time and at the end of the transition are given at *modaps.nascom.nasa.gov/services/about*. This site provides schedule information for all transition activities.

- GES DISC (DAAC): *daac.gsfc.nasa.gov/* summarizes the activities at GES DISC including a discussion of the transition to MODAPS.

Only the MODIS *Collection 5* Aqua L1 and atmospheres data products are being released through MODAPS at this time; some other services continue through the GES DISC (see the web sites given above). MODAPS will use the L1 and Atmospheres Archive and Distribution System (LAADS) for providing user access to these Aqua products. LAADS can be found at *ladsweb.nascom.nasa.gov.* This system maintains some Level 1B (L1B) and all Level 2 and higher (L2+) atmospheres products on disk (the remaining L1B products are available through processing-on-demand) and provides access through search/order and ftp.

The Earth Science Data and Information System (ESDIS) project has conducted independent load tests on LAADS, and the system has performed very successfully. Basic questions or comments/suggestions concerning MODIS product orders and how to use LAADS should be addressed to user services at *modapsuso@saicmodis.com.* User services can also be reached at the following toll-free number: (866) 506-6347.

The GES DISC will continue to use the Web-based Hierarchical Ordering Mechanism (WHOM) and the EOS Data Gateway (EDG) systems for the distribution of other data products, including Terra *Collection 5* L1 and Terra and Aqua *Collection 4* atmospheres data products. WHOM and EDG can be found respectively at *daac.gsfc.nasa.gov/MODIS/data_access.shtml* and *eos.nasa.gov/imswelcome.*

MODAPS is sending metadata and browse products for MODIS Aqua L1 and atmospheres data to the Earth Observing System Clearinghouse (ECHO)—*www.echo.eos.nasa.gov/index.html*. These data will not be visible through the EDG and WHOM systems but can be seen using the Warehouse Inventory Search Tool (WIST), an ECHO client, which can be found at *delenn.gsfc.nasa.gov/~wist/wist/imswelcome/*. WIST users may acquire the online MODAPS data products using the Online Access URL associated with the data product. MODAPS will support cross-DAAC product search/ordering through WIST and ECHO later this year.

Table 1 and **Table 2** summarize where to order products for MODIS *Collection 4* and MODIS *Collection 5*.

Table 1: Ordering Collection 4 MODIS Products

Product	Order Interface
Collection 4 Level 1B	**WHOM (GES DAAC)** Mirador (GES DAAC) EDG (GES DAAC) WIST (ECHO)
Collection 4 Level 2 Atmosphere Products	**WHOM (GES DAAC)** Mirador (GES DAAC) EDG (GES DAAC) WIST (ECHO)
Collection 4 Level 3 Atmosphere Products	**WHOM (GES DAAC)** Mirador (GES DAAC) EDG (GES DAAC) WIST (ECHO) LAADS

Table 2: Ordering Collection 5 MODIS Products

Product	Order Interface
Collection 5 Level 1B	**LAADS** WHOM (GES DAAC) Mirador (GES DAAC) EDG (GES DAAC) WIST (ECHO)
Collection 5 Level 2 Atmosphere Products	**LAADS** WIST (ECHO)
Collection 5 Level 3 Atmosphere Products	**LAADS** WIST (ECHO)

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Michael Teague, MODAPS (301 385-8398) or *opsman@saicmodis.com*

Get Involved with NASA Science at the Fall AGU!

December 11-15, 2006
San Francisco, CA

Join us at NASA's booth Tuesday, December 12 through Thursday, December 14, for an opportunity to hear live presentations from, and network with, scientists from across the agency.

The presentations will cover a wide range of topics including how to access NASA data, scientific visualization techniques, and highlights of the latest science results.

On Friday, December 15, **students get involved**! The AGU's Student EXPloration of Research in the Earth and Space Sciences (EXPRESS) program brings together approximately 600 students from local middle schools for a tour of the AGU exhibit hall to learn more about research and careers in Earth and Space science. NASA will partner with the National Science Foundation (NSF), National Oceanic and Atmospheric Administration (NOAA), and Incorporated Research Institutions for Seismology (IRIS) to facilitate educational activities for students including a scavenger hunt and interactive presentations on both Earth and space science.

For more details on these activities, including a schedule for each day, check out the Earth Observing System Project Web Page—*eospso.gsfc.nasa.gov/*

Ocean Vector Wind Science Team Meeting Summary

W. Timothy Liu, Jet Propulsion Laboratory, California Institute of Technology, liu@pacific.jpl.nasa.gov

The newly selected NASA Ocean Vector Wind Science Team held its first meeting in Salt Lake City, July 5-7, 2006.

Eric Lindstrom [NASA Headquarters] started the meeting with an overview of NASA imperatives, interagency pressures, and international activities. **Rob Gaston** [Jet Propulsion Laboratory (JPL)] reviewed the QuikSCAT spacecraft, instrument, and flight operation status. Gaston also gave an overview of Project activities. **Stan Wilson** [National Oceanic and Atmospheric Administration (NOAA)] provided NOAA's operational perspective of and forecast requirements for ocean vector winds. **Paul Chang** [NOAA] described the near-real-time distribution and operational application of ocean vector winds at NOAA. **Eric Betternhausen** [Naval Research Laboratory] reviewed wind retrieval using WindSAT at the Naval Research Laboratory. **Heruhisa Shimoda** [Japan Aerospace Exploration Agency (JAXA)] gave an overview of the activities at JAXA. **Naoto Ebuchi** [Hokkaido University] reviewed research and operation applications of scatterometer data in Japan, including validation, air-sea interaction and flux data, typhoon and tropical research, numerical models, and weather forecasts. **Hans Bonekamp** [European Organization for Exploration of Meteorological Satellites (EUMETSAT)] presented the commissioning plan for the Advanced Scatterometer (ASCAT), and **Marcos Portabella** [Royal Netherlands Meteorological Institute (KNMI)] described the plan for ASCAT Level 2 data. **Rob Gaston** ended the first day of the meeting by calling for the formation of four working groups: Geophysical Science, Product Improvement/Validation, Measurement Requirement, and Senior Review.

The second day started with a session on Data Reprocessing of Ocean Vector Winds, which included a presentation of an improved retrieval algorithm with a better rain-flag and higher resolution (12.5 km), and a product evaluation by the Beta Release Validation Working Group. Coincident data from the scatterometers on QuikSCAT and ADEOS-2 in 2003 will be produced first, and data production will then be conducted forward and backward from June 2006.

Twenty-Four principal investigators of NASA funded investigations related to ocean vector winds presented their scientific results and plans in three sessions chaired by **Kathie Kelly** [University of Washington], **Mike Freilich** [Oregon State University], and **James Carton** [University of Maryland, College Park]. Each session included a period of discussion on direction and synergism. The presenters are listed in **Table 1**.

TABLE 1: Names and Affiliation of NASA-Funded PIs Presenting on Day Two of the OVWST Meeting.

Presenter	Affiliation
Weiquan Han	University of Colorado
Tong Lee	Jet Propulsion Laboratory
Claire Perigaud	Jet Propulsion Laboratory
James Carton	University of Maryland, College Park
Mark Bourassa	Florida State University
Simon Yueh	Jet Propulsion Laboratory
Linwood Jones	University of Central Florida
Frank Wentz	Remote Sensing Systems
David Long	Brigham Young University
David Weissman	Hofstra University
Robert Contreras	University of Washington
Mike Caruso	Woods Hole Oceanographic Institute
Fabrice Bonjean	Earth and Space Research
Kathie Kelley	University of Washington
Richard Small	University of Hawaii
Mike Freilich	Oregon State University
Lisan Yu	Woods Hole Oceanographic Institute
Rong Fu	Georgia Institute of Technology
Dudley Chelton	Oregon State University
Ralph Foster	University of Washington
Shuyi Chen	University of Miami
Robert Atlas	NOAA's Atlantic, Oceanographic, and Meteorological Library
Ralph Milliff	Colorado Research Associates
Timothy Liu	Jet Propulsion Laboratory

The impact of scatterometer data in oceanography, meteorology, ocean-atmosphere interaction, ecology, and climate were articulated. The discussion underscored the uniqueness of QuikSCAT in providing high-resolution ocean-surface wind stress (air-sea momentum exchanges), and the opportunity provided by the long time series of data being accumulated in understanding climate changes.

The meeting adjourned after a discussion session on the charters of the four working groups mentioned above. ■

SORCE Sponsors Solar Spectral Irradiance and Climate Modeling Workshop

Peter Pilewskie, Laboratory for Atmospheric and Space Physics, University of Colorado, pilewskie@lasp.colorado.edu
Tom Woods, Laboratory for Atmospheric and Space Physics, University of Colorado, woods@lasp.colorado.edu
Judith Lean, Naval Research Laboratory, Washington, DC, jlean@ssd5.nrl.navy.mil

The Laboratory for Atmospheric and Space Physics (LASP) Solar Radiation and Climate Experiment (SORCE) Science Team hosted a one-day workshop in Boulder, CO, on Solar Spectral Irradiance (SSI) and Climate Modeling on August 9, 2006. Approximately 40 people attended, primarily from the University of Colorado, National Center for Atmospheric Research, and National Oceanic and Atmospheric Administration, but also represented were Naval Research Laboratory (NRL), Jet Propulsion Laboratory (JPL), and Atmospheric and Environmental Research, Inc. (AER).

The solar Spectral Irradiance Monitor (SIM) on SORCE is currently providing the very first continuous observations of the Sun's ultraviolet, visible, and near-infrared spectrum with sufficient precision to characterize true solar variations. The measurements enable detailed quantification of the solar radiation that produces the variations in total solar irradiance, monitored from space since 1978. This characterization, not possible before the launch of SORCE, is the basis for new understanding of the solar-spectrum variability needed for input to a variety of climate and atmospheric models, and for reconstructing solar-spectral irradiance variations prior to the SORCE mission.

A workshop's primary goal was promotion of the SORCE measurements of SSI and its variability for use by scientists in the climate, chemistry, and radiative-transfer communities. It is well known that the greatest *relative* variability in the solar spectrum occurs in the ultraviolet spectrum but that the largest energy changes occur at longer wavelengths. Thus a high priority for the workshop was assessing the variability of the full radiation spectrum (0.2 - 2 μm), together with the climate processes and mechanisms of climate response to these variations. By fostering new interactions between the climate and atmospheric modeling communities and the SORCE Science Team, we ultimately aim to improve understanding of physical processes that generate a multitude of reported empirical Sun-Climate connections. From a practical standpoint, user communities gain a better understanding of the available SORCE SSI data, their format, cadence, sampling, and spectral resolution, precision, and accuracy. Conversely, the SORCE team gains a better understanding of current and future user-community needs and applications.

Tom Woods [LASP, University of Colorado (CU)—*SORCE Mission Principal Investigator*] opened the workshop with a SORCE status report. The SORCE spacecraft was launched on January 25, 2003, and the mission is currently funded until January 2008. Following next year's Senior Review, SORCE could be extended an additional 4 years. However, Woods emphasized that there is still a risk of potential gaps in SSI (beyond SORCE) and Total Solar Irradiance (TSI) (beyond Glory), even if the SORCE mission extends to 2012.

Jerry Harder [LASP, CU—*SORCE LASP Program Scientist* and *SORCE SIM Instrument Scientist*] presented an overview of SORCE SSI measurements. Harder stressed the need for a highly accurate absolute solar spectrum and discussed the links between solar variability and the Earth's climate. He presented examples of SORCE 27-day (solar rotation) variability, from Solar Stellar Irradiance Comparison Experiment (SOLSTICE) and SIM, longer-term variability (mean variance in spectral irradiance over a 60-day period), and simulations of differential instantaneous spectral heating rates between active and quiet solar conditions.

Alexander Ruzmaikin [JPL], a regular contributor to SORCE's annual Science Team Meetings, illustrated the utility of Empirical Mode Decomposition (EMD) for potentially linking modes of solar variability with those of climatically significant variables such as ozone concentration and temperature. Advantages of EMD over other methods include better handling of non-stationarity and nonlinearity and no *leakage* between modes.

Judith Lean [NRL], a member of the SORCE Science Team, provided an overview of models of total and spectral solar variability, and gave several examples of applications in climate and atmospheric chemistry. As an example, the solar spectra in 203 bands from 0.121 - 0.859 μm are needed daily by *AutoChem*, a model developed by David Lary—**Figure 1** shows a screenshot from *www.autochem.info/*. In describing the broad user community of SSI, Lean set the stage for subsequent talks and stimulated discussions of user requirements, and also discussed improvements in her new spectral irradiance model and comparisons with SOLSTICE and SIM observations—shown in **Figure 2**.

Dan Marsh [NCAR], **Hauke Schmidt** [Max Planck Institute] and **Judith Lean** [NRL]—presenting for David

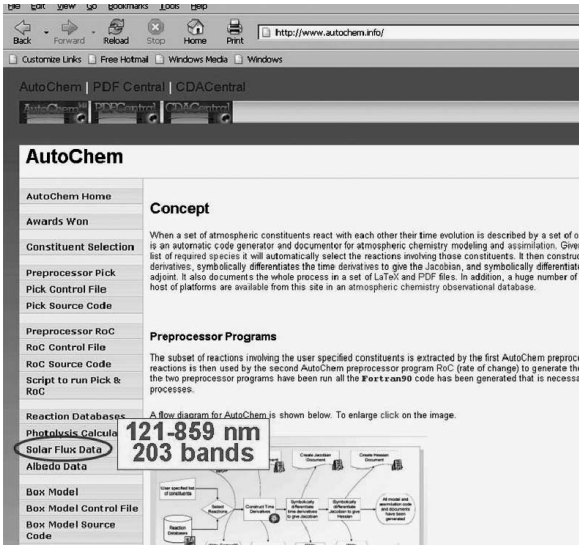


Figure 1: *AutoChem* is an example of an application of solar spectral irradiance daily data—*www.autochem.info/*.

Rind [Goddard Institute for Space Studies]—gave the next three talks. Each speaker addressed a specific coupled climate model. Marsh focused on the the Whole Atmosphere Community Climate Model (WACCM), Schmidt on the Hamburg Model of the Neutral and Ionized Atmosphere (HAMMONIA), and Lean on the Goddard Institute for Space Studies (GISS) Model. Each speaker provided model details, including spectral range and resolution for the radiation modules and how solar irradiance is input into the models. For example, GISS has a suite of atmospheric and ocean general circulation models that require as input the solar spectral irradiance in 190 wavelength bands between 0.115 and 100 µm. Solar spectra needed for input to WACCM include 11-year and 27-day spectrum variability in the ultraviolet, visible, and infrared; extended (100 year) SSI; high temporal resolution for flare studies; and spectral irradiance for historic periods such as the Maunder minimum.

Schmidt indicated that for HAMMONIA, high-resolution spectra are needed between 120 and 700 nm. At shorter wavelengths the *F10.7* proxy will be used. Currently, Lean supplies 1-nm spectral resolution and 1-day temporal resolution for the solar irradiance, which appears to be sufficient for most current applications. For long-term simulations of the recent past, data for several solar cycles will be required. Currently, simulations rely on models. Of interest are data with high temporal resolution (~10 min.) to characterize terrestrial responses to solar eruptions of flares and solar proton events.

Jennifer Delamere [AER, Inc.] described high spectral resolution, shortwave radiative transfer in the Earth's atmosphere. AER builds radiative-transfer models suitable for Earth's atmosphere and validates them using high-resolution *in situ* radiance and irradiance measurements. High-resolution solar spectral irradiance over the complete spectral range from UV through far infrared is one of the key model inputs. AER seeks guidance from the solar irradiance community to provide a high-accuracy reference spectrum that will ultimately be transferred into global climate and numerical weather prediction models.

Juan Fontenla [LASP, CU] described his Solar Radiation Physical Model (SRPM). Fontenla has produced a very high-dynamic resolution quiet-Sun spectrum to be used by AER in their models and a similar set of spectra to be incorporated in MODTRAN at variable native MODTRAN resolution bins. SRPM includes seven different solar models and 10 quadrature angles to synthesize the solar spectrum based on Precision Solar Photometric Telescope (PSPT) imagery. SIM-measured irradiance is used to refine the model and set the absolute irradiance scale.

Marty Snow [LASP, CU—*PI of the LASP Interactive Solar IRradiance Datacenter (LISIRD)*] gave a brief review of LISIRD and the various products it serves. Snow provided an online demonstration and solicited the attendees to provide him with recommendations for data formats and composite (time/wavelength) products.

In summary, this initial SSI-Climate workshop established a forum to communicate to the climate and atmospheric-science communities the available SORCE spectral irradiance data, and to educate the SORCE Science Team on the variety of applications and future user needs. It is well recognized that deciphering the underlying mechanisms of climate response to solar variability will require better representation of the atmosphere's dynamical, chemical, and radiative processes in models, part of which includes full spectral representation of solar variability. Progress toward this end will be achieved through coordinated efforts between the SORCE instrument Science Team and users of these data. ■

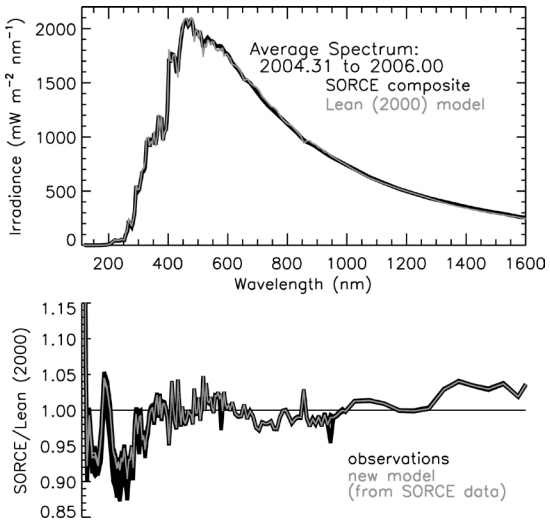


Figure 2: Models of solar spectral irradiance variations currently used as input for some climate and atmospheric studies are being validated and improved using the SORCE SIM observations.

HIRDLS Science Team Meeting

John Gille, University of Colorado and National Center for Atmospheric Research, gille@ucar.edu

The second High Resolution Dynamics Limb Sounder (HIRDLS) Science Team Meeting took place June 12-14 at the National Center for Atmospheric Research (NCAR) in Boulder, CO, at the new Foothills Lab 0 building, which houses the University of Colorado (CU) and NCAR staffs for HIRDLS with the Atmospheric Chemistry Division.

Day One

The first day of the Science Team meeting focused on discussion and feedback on the present status of the correction schemes to compensate for the scan mirror blockage.

John Gille, [University of Colorado (CU) and National Center for Atmospheric Research (NCAR)–*HIRDLS Principal Investigator, U.S.*] welcomed the United Kingdom (U.K.) and U.S. members of the High Resolution Dynamics Limb Sounder (HIRDLS) Science Team. Gille went on to review the history of the HIRDLS instrument to date. During the launch of the Aura satellite, a sheet of plastic lining inside HIRDLS came loose, probably due to rapid depressurization and acceleration, and came to rest across the scan mirror. This obstruction covered all but a small fraction of the optical beam, and severely limited the views to the atmosphere and space. The HIRDLS team spent six months working to understand what had happened, and tried to shake the plastic sheet loose with a series of increasingly violent motions of the scan mirror. Each of these efforts proved unsuccessful. At that point, Gille and **John Barnett** [Oxford University–*HIRDLS Principal Investigator, U.K.*] presented evidence to show that there was still sufficient signal through the small aperture to allow useful scientific results to be achieved. They proposed correcting the signals to produce radiances as close as possible to the originally expected radiances, thus minimizing changes to the retrieval Level 1-Level 2 (L1-L2) code. NASA HQ accepted the proposal in February 2005, and the team has been working since then to demonstrate this quantitatively, and to produce increasingly improved results. Gille noted the status at the time of the first Science Team Meeting in Oxford, U.K., in November 2005, and showed a small sample of the new results to indicate the progress that had been made since then.

In his opening remarks, **Mark Schoeberl** [Goddard Space Flight Center–*Aura Project Scientist*] announced that the HIRDLS team would receive a NASA Achievement Award for their work to resolve the post-launch anomaly and achieve science results from the compromised instrument. Schoeberl went on to outline the plans to re-compete the science activities next year. In closing, he congratulated the team for having two of the Aura *Top 10* Science Results—see *aura.gsfc.nasa.gov*.

John Barnett outlined the instrument operations since November. HIRDLS has been collecting science data almost the entire time. Major exceptions have been when the spacecraft pitched down for a few orbits, to allow HIRDLS to look above the atmosphere in order to characterize the signals received from the plastic sheet. These pitch maneuvers took place in November 2005, and in February, May, and July 2006. In addition, the scan pattern was varied to excite the smallest, most regular oscillations of the plastic, which shows up as a small oscillation on top of the main signal.

Jim Craft [CU–*Flight Ops Manager*] pointed out that HIRDLS has operated continuously since launch, and has not experienced any faults that have taken it out of science mode. HIRDLS is the only instrument on Aura that can make that statement. The trend data Craft presented showed the instrument was operating extremely well by every measure. In particular, Craft showed that the refrigerators had maintained the focal-plane-detector temperature at 61.615 K, with a stability of 1 milliKelvin (0.001K).

John Gille introduced the discussion of the corrections to compensate for the scan-mirror blockage. To ensure everyone was using the same terms, Gille outlined the three major corrections that are necessary. The corrections are to remove the oscillations from the signal, correct for the reduced viewing area, and remove the infrared signal from the plastic itself.

Hyunah Lee [NCAR] and **Chris Halvorson** [NCAR] described the development of the algorithm to remove the effects of the oscillations, which turned out to be quite regular in frequency and phase, although differing between up and down scans. The method involves determining sets of seven empirical orthogonal functions (EOFs) to describe the oscillations in one channel, and scaling the results to the other channels. So far EOFs have only been developed for the most recent of the scan patterns; but there are plans to develop them for the other three patterns. **Tom Eden** [NCAR] showed that it was possible to model the variation of the radiometric signals from the plastic during the night side of the orbit as a function of instrument temperatures. By doing this for vertical scans at different azimuth angles, it is possible to estimate the open area fraction (OAF) through which the different channels view the atmosphere. To correct for the signal reflected and emitted from the plastic, **Gene Francis** [NCAR] described how the *pitch-up* signal can be expressed very precisely by a mean and three EOFs. However, Eden's modeling indicates that there is a difference between pitched and normal orientation signals, so further development is

needed. **Rashid Khosravi's** [NCAR] overview of the Level 2 (L2) retrieval algorithm emphasized its features and the L2 output, which is in the *HIRDLS2* file.

The wrap-up session reviewed the day's presentations and noted future work that was needed. The oscillation correction needs to be extended to include all four scan tables, and improved to remove residual oscillations, as well as to show that it works equally effectively at all times of year. The input parameters for the model to determine the OAF need to be optimized, and the azimuthal variations of a space-reflective term need to be included. Finally, the correction for the plastic signal around the orbit needs to be refined, preferably using a more-physical model to allow for orbit-orbit variations during daytime, and annual variations in the angle between the orbital plane and the direction to the sun (the solar β angle).

Day Two

The goal of the second day was a product-by-product review to understand the characteristics of the results obtained for May 2006, using the most recent algorithms, in order to obtain feedback for improvements.

Hyunah Lee, **Cora Randall** [CU], and **Jolyon Reburn** [Rutherford Appleton Laboratory, U.K.] showed results of comparing HIRDLS temperature retrievals to those from the Goddard Modeling and Assimilation Office (GMAO), Microwave Limb Sounder (MLS), Atmospheric Chemistry Experiment (ACE), and European Centre for Medium-Range Weather Forecasts (ECMWF), respectively. The HIRDLS temperatures have a high bias at low altitudes, e.g. 200 hPa, show agreement in the middle stratosphere, and exhibit a low bias at the stratopause. Cloud contamination can contribute to higher temperatures at the lower altitudes. The temperature precision is better than in previous versions, and the standard deviation (σ) of the temperature difference from ACE showed good agreement. The horizontal structure seen in the HIRDLS temperature fields agrees well with that given by ECMWF data, and the mean profiles are typically within 1K of each other in the stratosphere.

Bruno Nardi [NCAR], **Cora Randall** and **Jolyon Reburn** reported on comparisons of HIRDLS ozone with MLS and lidar, ACE, and ECMWF, respectively. The profiles are improved in low latitudes, and extend lower toward the tropopause than earlier versions. They show a low bias in the lower stratosphere, good agreement in mid stratosphere, and a high bias near the stratopause. (This may be due to the opposite bias in temperature described above.) The lidar comparisons show that the small-scale features seen are geophysical. The σ of the differences have also decreased. The latitudinal structure agrees with ECMWF results, although the peak HIRDLS altitude may be higher than that for ECMWF. HIRDLS is more sensitive to shorter vertical wavelengths (λ_z < 8 km) than most previous observations. The horizontal spacing is also very regular. **Joan Alexander** [Colorado Research Associates] exploited these capabilities, and used temperature channel radiances to detect mountain waves over the Andes, with λ_z ~ 5-6 km. Analyses of the shorter wavelength waves displayed the expected equatorial peak and winter/summer asymmetry. She indicated waves with λ_z ~ ≥ 4 km were observable.

Doug Kinnison [NCAR] discussed nitric acid (HNO_3) retrieval comparisons with MLS, and demonstrated that results were improved over last November's results. The tropical regions showed better agreement with MLS, and the high-latitude maximum was at the correct altitude. However, while HIRDLS is closer to ACE, it is still lower. HIRDLS is also lower than MLS, which appears to be biased high at present.

John Gille, **Cora Randall,** and **Jolyon Reburn** presented comparisons of water vapor with MLS, ACE, and ECMWF respectively. Some banding is still present, but the HIRDLS data have greatly improved since November. They follow the general tropopause shape, with lower mixing ratios in the lower stratosphere. HIRDLS fields show similar latitudinal structure to that from ECMWF, but are clearly noisier. There are also problems at high latitudes in the Southern Hemisphere. The radiance in the water-vapor channels is smaller than that in the previous, longer wavelength channels, so the corrections need to be better.

Steve Massie [NCAR] reported on the cloud and aerosol data. HIRDLS is unique on Aura for its ability to observe sub-visible cirrus, Polar Statospheric Clouds (PSCs), and stratospheric aerosols. Researchers are working on algorithms to determine aerosol properies. Such algorithims have to make use of more than one aerosol channel. Algorithms to determine these are in development. The code to determine cloud-top pressure is presently used to set the lower limit of the retrieval. Massie noted that the present code misses clouds about 10% of the time, leading to some of the retrieval problems noted above.

Michael Coffey [NCAR] discussed HIRDLS retrievals of chlorofluorocarbons (CFCs) 11 and 12, and noted that the HIRDLS data had the same morphology as Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) data. Coffey was much encouraged by the improvement since November.

Cora Randall, compared nitrous oxide (N_2O), nitrogen dioxide (NO_2) and methane (CH_4) with ACE data. The signals from these gases are small, and again corrections must be made for them to be retrieved well. HIRDLS

appears to be successfully retrieving N_2O above 40 hPa, and the σ are close. However CH_4, which should be similar, does not compare well with ACE, and does not have the same structure. HIRDLS retrievals of NO_2, show a lot of variability compared with ACE. This comparison has the usual problem of comparing an occultation measurement of a diurnally varying species with an emission measurement. In general, however, the results are encouraging.

Gene Francis [NCAR] showed that HIRDLS chlorine nitrate ($ClONO_2$) and nitric pentoxide (N_2O_5) retrievals were smoother than ACE. Francis also pointed out that most of the radiance in these channels comes from overlapping species N_2O and CH_4, exacerbating the difficulties in obtaining good retrievals after the corrections.

The team discussed the data quality, and made the decision to deliver temperature, ozone, nitric acid, and cloud-top pressure to the Aura Validation Data Center (AVDC) for validation, and to the Distributed Active Archive Center (DAAC) for evaluation. The time span included May 4-31, 2006, when *scan table 23* was running, and for which oscillation-removal software existed. These were the data processed for the meeting. The team also announced that it would deliver a quality document for these products that would be available at the DAAC. The data documents can be found at—*disc.gsfc.nasa.gov/Aura/documentation/*

The near-term plan is to extend the oscillation-correction capability to handle the other three scan tables, for the full range of solar β angles, and to fix the cloud-top flag to eliminate the problem of not identifying all clouds. For the longer range, a list of improvements was made, including refining the line-of-sight pointing for all channels, improving the OAF and correction for the signal from the plastic, and incorporating additional extensions to the cloud-detection algorithm.

At the end of day two, the group adjourned to a delicious and delightful team dinner.

Day Three

On the third day **Charles Cavanaugh** [NCAR], **Joe McInerney** [CU], and **Cheryl Craig** [NCAR] presented overviews of the operational software and the Q/A tools. To close out the formal part of the meeting, **Vince Dean** [CU], presented a review of the HIRDLS Science Investigator-led Processing System (SIPS) status and capabilities.

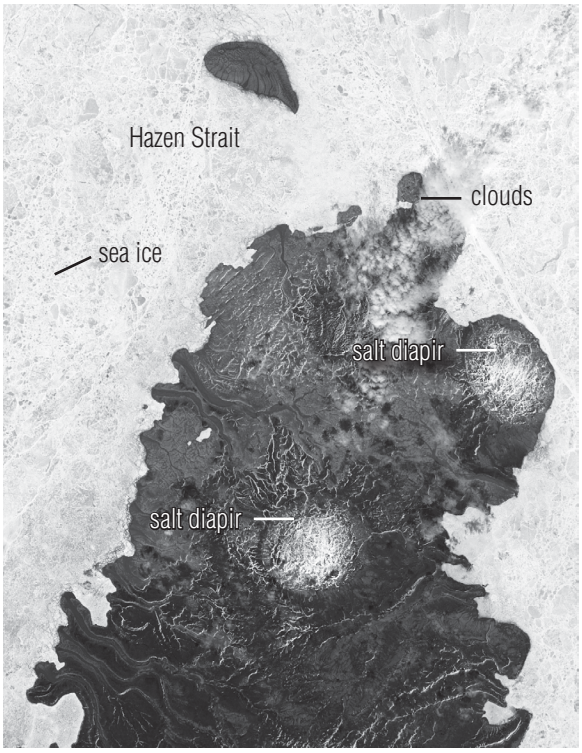
The consensus coming out of the closing discussions was that the team was pleased with the progress and improvements to this point, and confident that additional improvements now in development would lead to data that would be very important for scientific studies. The next meeting will be held in Boulder September 7 and 8, just before the Aura Science Team meeting.

Because of the frequent changes and provisional nature of the data, scientists wishing to work with the HIRDLS data should contact one of the PIs: **John Barnett** *j.barnett1@physics.ox.ac.uk* or **John Gille** *gille@ucar.edu.* ■

They may look like meteor craters, but the circular depressions in the surface of northern Canada's Melville Island actually formed from geologic processes deep underground. The crater-like features on the island's Sabine Peninsula are salt domes, or *diapirs*. When ancient seas evaporate, they leave behind salt deposits. The salt layers are buried by sediment, which eventually turns into rock. Because the salt deposit is less dense than the overlying rock, it's buoyant. The buoyant mass of salt balloons upward and intrudes into the overlying rocks through weak spots. The intruding "salt bubble" is called a *salt diapir*. In most environments, salt diapirs that reach the surface erode rapidly, leaving behind craters such as the ones shown here.

This image from the Landsat 7 satellite shows two salt diapirs on Melville Island. The island's rocky surface appears to be dusted with snow in places, even though summer had officially begun. Sea ice surrounds the island like a carefully crafted stained-glass window. A few puffy clouds stretch across the northern tip of the island where it juts into the Hazen Strait. Hazen Strait is one of the interconnected pathways that weave through the northern Canadian islands that stretch between Baffin Bay to the southeast and the Arctic Ocean to the northwest.

NASA image created by Jesse Allen, Earth Observatory, using data obtained from the University of Maryland's Global Land Cover Facility.



NASA Assists Search for Woodpecker Thought to be Extinct

Gretchen Cook Anderson, NASA Goddard Space Flight Center, gretchen.cookanderson@rsis.com

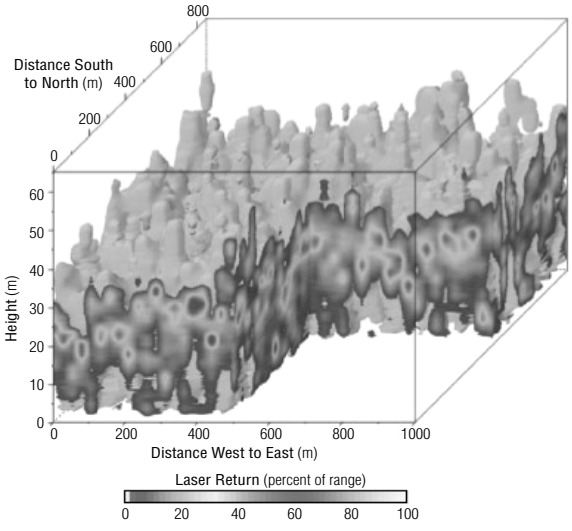
Unlike its more famous cartoon cousin Woody the Woodpecker, the ivory-billed woodpecker is thought to be extinct, or so most experts have believed for over half a century.

But last month scientists from NASA and the University of Maryland, College Park, MD, launched a project to identify possible areas where the woodpecker might be living. Finding these habitat areas will guide future searches for the bird and help determine if it is really extinct or has survived an elusive existence.

The question of whether the species still exists started when a kayaker reported spotting the woodpecker along Arkansas' Cache River in 2004. That sighting spawned an intensive search for the species by wildlife conservationists, bird watchers, field biologists, and others.

In June, a research aircraft flew over delta regions of the lower Mississippi River to track possible areas of habitat suitable for the ivory-billed woodpecker, one of the largest and most regal members of the woodpecker family. The project is supported by the U.S. Fish and Wildlife Service and the U.S. Geological Survey.

Scientists from NASA's Goddard Space Flight Center, and the University of Maryland used NASA's Laser Vegetation Imaging Sensor (LVIS) onboard the aircraft. The instrument uses lasers that send pulses of energy to the Earth's surface. Photons from the lasers bounce off leaves, branches, and the ground and reflect back



An image produced from the airborne LVIS instrument shows a three-dimensional view of tree tops and vegetation in the tropical forest of La Selva, Costa Rica. The shades of gray indicate the amount of laser energy reflected from trees and leaves back to a sensor onboard the aircraft. **Credit:** John Weishampel, University of Central Florida.

An artist's image of what an ivory-billed woodpecker looks like. **Credit:** George M. Sutton/Cornell Lab of Ornithology.

to the instrument. By analyzing these returned signals, scientists receive a direct measurement of the height of the forest's leaf-covered tree tops, the ground level below, and everything in between.

"LVIS is aiding this search effort far beyond what aircraft photos or satellite images can provide in the way of just a two-dimensional rendering of what's below," said **Woody Turner**, Program Scientist at NASA Headquarters, Washington, D.C. "The laser technology gives us the third dimension, enabling us to better assess the complex vegetation structure the plane flies over." The flights are the latest step in an effort spanning over two years to find absolute evidence that a bird once thought extinct continues to survive.

"We're trying to understand the environment where these birds live or used to live, using LVIS-plotted features like thickness of the ground vegetation and tree-leaf density, in combination with other factors like closeness to water and age of the forest, to determine where we might find them," said Turner.

"Through numerous studies, we have shown the effectiveness of the data generated by this sensor for many scientific uses, including carbon removal, fire prediction, and habitat identification," said LVIS project researcher **Ralph Dubayah**, a professor in the University of Maryland's Department of Geography. "Lidar technology like LVIS measures the vertical structure of the trees and ground, setting it apart from other remote-sensing systems that provide detailed horizontal information that tells us little about whether a green patch of forest is short or tall, for example. When identifying habitats,

continued on page 21

Greenland's Ice Loss Accelerating Rapidly, Gravity-Measuring Satellites Reveal

Becky Rische, University of Texas, brische@mail.utexas.edu

A new analysis of data from twin satellites has revealed that the melting of Greenland's ice sheet has increased dramatically in the past few years, with much of the loss occurring primarily along one shoreline, and potentially affecting the weather in Western Europe.

The loss of ice has been occurring about five times faster from Greenland's southeastern region in the past two years than in the previous year and a half. The dramatic changes were documented during a University of Texas at Austin study of Greenland's mass between 2002 and 2005.

The study was published August 10, 2006, in the journal *Science*. Related results on the significant loss of ice from Antarctica were published in *Science* in March by other researchers participating in the Gravity Recovery and Climate Experiment (GRACE) mission. The GRACE mission is funded by NASA and the German Aerospace Center.

"Our latest GRACE findings are the most complete measurement of ice mass loss for Greenland," said **Byron Tapley**, Principal Investigator for GRACE, and Director of the University of Texas Center for Space Research (CSR). "The sobering thing to see is that the whole process of glacial melting is stepping up much more rapidly than before."

Antarctica is considered the largest, and Greenland the second largest, reservoir of fresh water on Earth, with the latter containing about 10% of the world's fresh water. Melting of ice from these two regions is expected to impact sea level and ocean circulation, and potentially the future of global climate.

The Greenland study, for example, suggests that the amount of fresh water contributed from the melting of its ice sheet could add 0.56 mm annually to a global increase in sea levels, higher than all previously published measurements.

"These findings are consistent with the most recent independent measurements of Greenland's mass done by other techniques like satellite radar interferometry, but in this case they provide a direct measure of ice-mass changes," said **Clark Wilson**, Chair of the Department of Geological Sciences at the University of Texas and co-author on the latest *Science* article. Within the subpolar zone that includes Greenland, the rapid rise in meltwater along its eastern coast could add to other warming-related factors believed to be weakening the counterclockwise flow of the North Atlantic Current. For instance, the increased meltwater could change how more buoyant fresh water mixes with salt water in a branch of this flow called the Norwegian Current. This change could lower the temperatures of water, and thus wind, that travels past the west coast of Ireland and Great Britain.

That ocean-temperature change would occur because the current might not move northward past Norway before returning to more southerly latitudes. Warmer, southerly waters would be stalled from moving northward if that happened, resulting in chillier winters in parts of Western Europe.

"If enough fresh water enters the Norwegian Current," Tapley said, "and you interrupt return flow, then there could be climate effects in Europe."

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Shown here is Byron Tapley, Director of the Unversity of Texas Center for Space Research, and PI of GRACE. In front of Tapley is a model of the twin satellites that are sensitive enough to the gravitational pull of masses on Earth to detect changes in mass. The gravitational impact causes minute changes in the distance between the paired satellites. **Photo:** Patrick Cummings.

Washington Got a Summertime Air Quality Exam

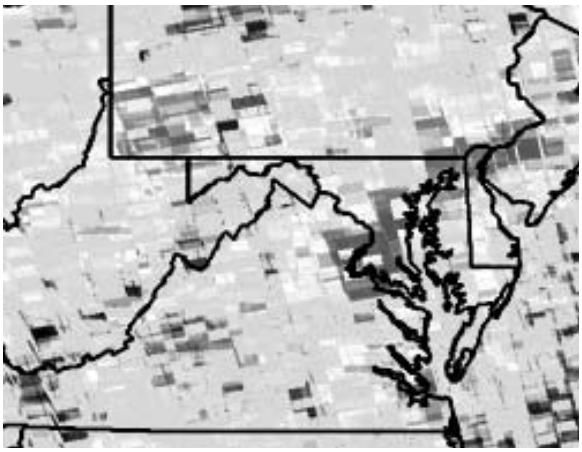
Stephen Cole, NASA Goddard Space Flight Center, scole@pop600.gsfc.nasa.gov

Summer in the city can often mean sweltering "bad air days" that threaten the health of the elderly, children and those with respiratory problems. This summer the Nation's Capital has been no stranger to such severe air-quality alerts.

But since early July, Washington area skies have been put under a unique microscope as scientists from NASA and around the country assembled a powerful array of scientific instruments—in space and on the ground—to dissect the region's atmosphere. The result will be not only a better understanding of intense urban air pollution episodes, but also a better toolkit to track and probe air pollution worldwide from space.

Two years ago NASA launched the third of its major Earth Observing System satellites—Aura—carrying a group of instruments designed to take global measurements of air pollution on a daily basis. Sensors on Aura can detect five of the six air pollutants regulated by the U.S. Environmental Protection Agency. But to make these 400-mile-high readings as accurate as possible, data from the sophisticated Aura instruments need to be compared to data from tried-and-true sensors on Earth.

NASA sponsored just such a "ground-truth" experiment this summer. Howard University Research Campus, Beltsville, Md., hosted visiting scientists, graduate students, and instruments for a six-week-long series of intensive observations. The experiment also evaluated the next generation of instruments used in daily weather forecasting, as well as tracked one of the strongest greenhouse gases involved in climate change: water vapor, which at increased levels we feel as humidity.



NASA's Aura spacecraft captured high summertime levels of the air pollutant nitrogen dioxide in the Washington metropolitan area. This image (which zooms into the Washington area) combines several Aura views from July 13-20, 2006. Nitrogen dioxide plays a key role in the formation of ground-level ozone pollution. Color images can be viewed at *www.nasa.gov/centers/goddard/news/topstory/2006/washington_air.html* **Credit:** NASA.

The Beltsville research facility grew out of collaborations between NASA, the National Oceanic and Atmospheric Administration (NOAA), and Howard University in Washington.

The site is dotted with instruments from the National Weather Service, the Maryland Department of the Environment, and a local television station. For this summer's experiment, additional sensors were brought in from NASA's Goddard Space Flight Center, Greenbelt, MD; NASA's Wallops Flight Facility, Wallops Island, VA; Pennsylvania State University, University Park; University of Colorado, Boulder; and Trinity University, Washington, DC. Students from many of these institutions, as well as the University of Wisconsin, Madison, and Smith College, Northampton, MA, were involved in the day-to-day operations.

"With a large collaboration like this you can really investigate a lot of interesting aspects of air quality," says **David Whiteman**, who led Goddard's research team from the nearby NASA center. "You can look straight down through the atmosphere to the ground from the satellite and at the same time you see in great detail the whole chemical soup of pollutants near the surface from the state's air quality monitoring site located here. Multi-instrument observations like this make the Howard site a real gem."

The experiment also focused on a key measurement for both global climate change and local weather forecasting: water vapor. "Measuring water vapor is a tricky business, because it varies greatly in quantity around the globe," says Whiteman. But if our Earth is indeed warming, we need to understand how water vapor responds to that. Water vapor is a stronger greenhouse gas than carbon dioxide and could have a major impact on future climate."

Water vapor measurements from NASA's Aura satellite and its companion Aqua, launched in 2002, were compared with readings at the site from several laser-based instruments called lidars that can continuously observe water vapor levels in great detail directly overhead. In addition, balloon-borne instruments called radiosondes, a standard instrument used daily around the world, were flown to compare their accuracy with the more sophisticated research tools.

"The moisture information we get every day from radiosondes is becoming more important in numerical weather prediction and climate monitoring," says **Joe Facundo**, chief of the National Weather Service's Observing Systems Branch, who participated in the

Beltsville experiment. "This type of instrument-comparison project lets us test improved moisture sensors." Better water vapor data from radiosondes flown around the world can lead to more-accurate weather forecasts and long-term climate predictions.

New knowledge also emerged from the experiment about the daily rise and fall of ozone pollution, which involves a complex interplay between the "chemical soup" of pollutants, sunlight, and meteorology. "We have already observed examples of the influence of a narrow stream of strong winds during the night on surface-level ozone formation," says Howard's **Everette Joseph**, who led the university's team of scientists and students. "Better understanding of this process could lead to better air-quality forecast methods and aid local governments in developing strategies to combat ozone pollution." ■

Search for Woodpecker

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the vertical structure of the vegetation is of paramount importance to many species, including a bird like the ivory-bill."

The reported sighting of the ivory-billed woodpecker inspired a year-long search by more than 50 experts working together as part of the Big Woods Conservation Partnership, led by the Cornell University's Cornell Laboratory of Ornithology and the Nature Conservancy. Researchers have followed reported sightings across a huge swath of the southeastern United States, including the Gulf Coast, Alabama, and Florida.

In April 2005, that team published a report in the journal *Science* that at least one male ivory-bill still survived. However, some scientists have challenged whether it really was the ivory-billed woodpecker that was spotted. The NASA-University of Maryland project is designed to provide detailed habitat information that search teams will use beginning this fall for expanded efforts to find new evidence about the possible survival of the bird.

The project also has a broader application, according to NASA Goddard's **Bryan Blair**, principal investigator for the project. "This field campaign is part of an effort to develop approaches that bring together many types of remote-sensing data for monitoring wildlife habitat."

The research team previously used NASA's LVIS to study wildlife habitats in old-growth forests in the western United States and rain forests abroad. ■

Greenland's Ice Loss

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The twin GRACE satellites provide the most comprehensive monthly estimates of Greenland's ice-mass balance. The satellites are sensitive to the gravitational pull of mass changes on Earth, which produce micrometer-scale variations in the distance (137 mi or 220 km) that separates the two satellites as they fly in formation over Earth.

Lead author **Jianli Chen**, a CSR research scientist, developed a method to improve the effective spatial resolution of mass-change estimates. The method used the known locations of major glaciers as information in estimating the sources of mass change.

"By using this special filtering procedure," Chen said, "we teased out additional details of mass changes in Greenland along its southeastern and northeastern shores separately."

The estimates showed that 69% of the ice-mass loss in recent years came from eastern Greenland. Of the 57 mi^3 (239 km^3) of water mass lost on average each year, 39 mi^3 (164 km^3) were from the eastern shoreline. More than half of that eastern loss involved ice from the glacier complex in southeast Greenland.

"This melting process may be approaching a point where it won't be centuries before Greenland's ice melts, but a much shorter time-frame," Tapley said, noting that it isn't possible to tell how much sooner this will be.

GRACE is managed for NASA by the Jet Propulsion Laboratory, and is in its fifth year. The University of Texas Center for Space Research in the College of Engineering has overall mission responsibility, and GeoForschungsZentrum Potsdam (GFZ) in Potsdam, Germany, handles German mission elements. Science data processing, distribution, archiving, and product verification are managed jointly by JPL, The University of Texas at Austin, and GFZ. ■

There's a Change in Rain Around Desert Cities

Rob Gutro, NASA Goddard Space Flight Center, robert.j.gutro@nasa.gov

A study using NASA satellite data and weather records shows the urban-heat-island effect, pollution, irrigation, and population changes alter rainfall in desert cities.

Urban areas with high concentrations of buildings, roads, and other artificial surfaces soak up heat, lead to warmer surrounding temperatures, and create *urban heat islands*. This increased heat may promote rising air and alter the weather around cities. Human activities such as land use, additional aerosols, and irrigation in these arid urban environments also affect the entire water cycle as well.

Although the urban heat island effect has been known to affect large cities such as Atlanta and Houston, effects on arid cities such as Phoenix, AZ and Riyadh, Saudi Arabia were relatively unknown. These cities both experienced explosive population growth.

A study by **J. Marshall Shepherd**, a climatologist at the University of Georgia, Atlanta, used a unique 108-year-old data record and data from NASA's Tropical Rainfall Measuring Mission (TRMM) satellite, to examine arid cities' rainfall patterns.

Shepherd found a 12-14% increase in rainfall in the northeast suburbs of Phoenix from the *pre-urban* (1895-1949) to *post-urban* (1950-2003) periods. This increase in rainfall is likely related to changes in the city and the lands within the city, such as more roadways and buildings in place of open natural area. The increase may also be related to changes in irrigation. However, the role of irrigation in changing the weather of cities in arid areas requires more study, Shepherd said.

"We think that human activities, such as changing the landscape, can affect the flow of the winds associated with the U.S. southwest's monsoon and rising air and building storms on the east side of mountains," said Shepherd. The weather in Phoenix, in fact, is affected by both, and that can change where the rains fall.

The city of Riyadh has also grown quickly in the past few decades, and its weather has been affected by the urban heat-island effect, although the causes are less clear than they are in Phoenix. Weather stations on the ground have confirmed a recent significant increase in rainfall around the city of Riyadh.

Phoenix, the capital of Arizona, is located on the upper edge of the Sonoran Desert. It is in the south-central portion of the state at the intersection of Interstates 17 & 10. Phoenix is an agricultural, industrial, and service center. It is surrounded by 22 other cities in the Valley of the Sun. **Credit:** USGS.

This image shows a model of an urban area with high concentrations of buildings, roads and other artificial surfaces. Such surfaces retain heat and lead to warmer surrounding temperatures, and create a phenomenon known as an urban *heat island*. **Credit:** Susan Gonnelli Byrne, NASA GSFC.

Shepherd used satellite images from the Landsat satellite and the Advanced Spaceborne Thermal Emission and Reflection Radiometer instrument aboard NASA's Terra satellite to determine expansion characteristics. He used the TRMM satellite's rainfall data to pinpoint precipitation areas. This study shows the importance of satellite data in regions like the Middle East, where traditional measurements are sparse or inaccessible.

"Many of the fastest-growing urban areas are in arid regimes," said Shepherd, author of the report just published in the online edition of the *Journal of Arid Environments*; "Because their total rainfall is low, these areas have been largely ignored in studies on how human activities affect the water cycle. But these cities are particularly sensitive to such changes, since the water supply is so critical."

Cities in arid areas or desert cities have shown great growth only in the last 30-50 years because of new methods of irrigation and ways to obtain water for daily use. Shepherd had access to a unique 108-year-old data record for Phoenix, and for the first time confirmed a significant change in rainfall took place in certain areas of the city from the late 1890s to the present.

Understanding rainfall changes in arid cities is very important. One United Nations estimate projects that between 60-70% of all people will live in cities by 2025, and many of the fastest-growing areas for city growth are in arid areas.

"The results showed us just how sensitive the water cycle can be to human-induced changes, even under arid or drought conditions," Shepherd said. These findings have real implications for water resource management, agricultural efficiency, and urban planning. ■

This image shows warm air rising in an urban area model, and subsequent cloud formation. Cities tend to be one to 10° F (0.56 to 5.6° C) warmer than surrounding suburbs and rural areas, and the added heat can destabilize the atmosphere and change the way air circulates around cities. Added heat creates wind circulations and rising air that can produce or enhance existing clouds. Under the right conditions, these clouds can evolve into rain-producers or storms. It is suspected that converging air due to city surfaces of varying heights, like buildings, also promotes rising air needed to produce clouds and rainfall. Winds can carry these clouds to the east of the cities. **Credit:** Susan Gonnelli Byrne, NASA GSFC.

1972 MSS **1990 TM** **2000 ASTER**

These images show a desert city's urban expansion captured by satellite. Riyadh, the national capital of Saudi Arabia, is shown in 1972, 1990, and 2000. Its population grew in these years from about a half-million to more than two million. The city grew through immigration from rural areas, and from decreases in the death rate while birthrates remained high. The 1972 image is a Landsat satellite image; the 1990 image is a Landsat Thematic Mapper scene; and the 2000 image is from NASA's ASTER instrument. **Credit:** NASA/GSFC/METI/ERSDAC/JAROS, U.S./Japan ASTER Team.

EOS Scientists in the News

Stephen Cole, scole@pop600.gsfc.nasa.gov, NASA Earth Science News Team
Mike Bettwy, mbettwy@sesda2.com, NASA Earth Science News Team

NASA Looks to Uncover Complexities of Clouds, August 8; *Richmond Times-Dispatch (Va.), Macon Telegraph (Ga.), Decatur Daily (Ga.).* Atmospheric scientist **Chip Trepte** (NASA LaRC) discusses the intimate connection between aerosols and water droplets in an update on the CALIPSO mission including the CALIPSO-CloudSat validation exercise at Warner Robins Air Force Base near Macon, Georgia.

Washington Getting a Summertime Air Quality Exam, August 3; *Reuters, United Press International, WUSA-TV (Washington). Scientists including* **David Whiteman** (NASA GSFC) gathered outside the Nation's Capital for an Aura validation field campaign to better understand intense urban air pollution episodes and how they can be tracked by satellites.*

NASA Assists Search for Woodpecker Thought to be Extinct, August 3; *Reuters, CNN, MSNBC, Houston Chronicle, Baltimore Sun (August 11).* There's new evidence that a woodpecker long-thought to be extinct may be alive, and scientists from NASA including **Woody Turner** (NASA HQ) and from the University of Maryland have launched a project to identify areas where it may be living.*

Small-Scale Logging Leads to Clear-Cutting in Brazilian Amazon, August 1; *Economist.com, National Geographic News.* A team of scientists, including **Greg Asner** (Carnegie Institution), **Michael Keller** (U.S. Forest Service), and **Daniel Nepstad** (Woods Hole Research Center) have quantified the relationship between selective logging, where loggers extract individual trees from the rain forest, and complete deforestation.

Sky Graffiti Warming Up Earth, July 29; *CBS Evening News, Earth & Sky Radio*. **Patrick Minnis** (NASA LARC) discusses the effects of aviation contrails on climate.

An Active Florida Hurricane Season Adds to Red Tide, July 27; *Scripps Howard News, ESPN.com, KSHB-TV (Kansas City).* NASA-funded scientists **Chuanmin Hu** (University of South Florida), **Frank Muller-Karger** (University of South Florida), and **Peter Swarzenski** (USGS), report that Florida's active 2004 hurricane season may have played an important part in the development of extensive and long-lasting red tide conditions in 2005.

NASA Africa Mission Investigates Origin, Development of Hurricanes, July 26; *United Press International, New Scientist, Newsday.com, Washington Post (August 6).* Scientists from NASA, other federal agencies, and universities, including **Edward Zipser** (University of Utah), **William Lau** (NASA GSFC), and **Liguang Wu** (NASA GSFC) are involved in an intensive field campaign to study how winds and dust from Africa influence the birth of hurricanes in the Atlantic Ocean.

NASA Coral Reef Images Key to New Global Survey, July 26; *United Press International, LiveScience.com, The Register (UK).* A team of researchers led by **Camilo Mora** (Dalhousie University) has compiled an updated inventory of all "marine protected areas" containing coral reefs and compared it with the most detailed and comprehensive inventory of coral reefs based on NASA satellite images.

There's a Change in Rain around Desert Cities, July 25; *Albuquerque Tribune, National Geographic Online, PhysOrg.com.* Research by **Marshall Shepherd** (University of Georgia) using NASA satellite data and weather records shows the urban heat-island effect, pollution, irrigation, and population changes alter rainfall in desert cities.*

CALIPSO's First Images Offer New Dimension to Air Quality and Climate Research, July 24; *United Press International, Christian Science Monitor, New Scientist, The Orlando Sentinel.* CALIPSO is returning never-before-seen images of clouds and aerosols, tiny particles suspended in the air, say NASA scientists including Principal Investigator **David Winker** (NASA LaRC).

Deadly Heat Continues in California, July 24; KCRW-FM (Los Angeles Public Radio), *Washington Post.* A heat wave has plagued much of California for weeks, and **Bill Paztert** (NASA JPL) is interviewed to explain its causes and provide forecasts of when it may wane.

Forests in Flames: Scientists See Warming Ties, July 21; *Associated Press, MSNBC, Fox News, Forbes.* **Amber**

** See full article in this issue.*

Soja (NASA LaRC) reports that warming in high latitudes is expected to generate more lightning that may help ignite forest fires.

Rains Bring Little Relief from Heat, July 18; *Scripps Howard News, Los Angeles Times, San Francisco Chronicle.* Electricity use in California hits record highs and **Bill Patzert** (NASA JPL) is interviewed to explain the causes of the heat wave.

NASA Explains Puzzling Impacts of Polluted Skies on Climate, July 13; *United Press International, USA Today, Connecticut Public Radio, Christian Science Monitor.* Researchers **Lorraine Remer** (NASA GSFC), the late **Yoram Kaufman** (NASA GSFC), and **Ilan Koren** (Weizmann Institute) discover why some aerosols contribute to cloud growth while others prevent clouds from forming.

Rainy Days Driven by Traffic Patterns, July 13; *National Geographic News.* Summer rainfall in the southeast U.S. appears to mimic the highs and lows of air pollution from weekday commuters, finds researcher **Thomas Bell** (NASA GSFC).

Fuel for the Fires, July 7; *KABC-TV (Los Angeles), KPCC-FM (Los Angeles Public Radio).* **Bill Patzert** (NASA JPL) is interviewed for a story about how the West is warming and the many resulting impacts, especially earlier, longer, and more frequent wildfires.

NASA Satellites Find Balance in South America's Water Cycle, July 5; *Science Daily, PhysOrg.com*. NASA scientists including **Timothy Liu** (NASA JPL) are the first to use data solely from satellites to monitor and measure the complete cycle of water movement across South America.

Scientists Find Antarctic Ozone Hole to Recover Later than Expected, June 29; *Discovery.com, LiveScience.com, Science Daily, Terra Daily.* Scientists from NASA including **Paul Newman** (NASA GSFC) find that the ozone hole over the Antarctic will recover around 2068, nearly 20 years later than previously believed.

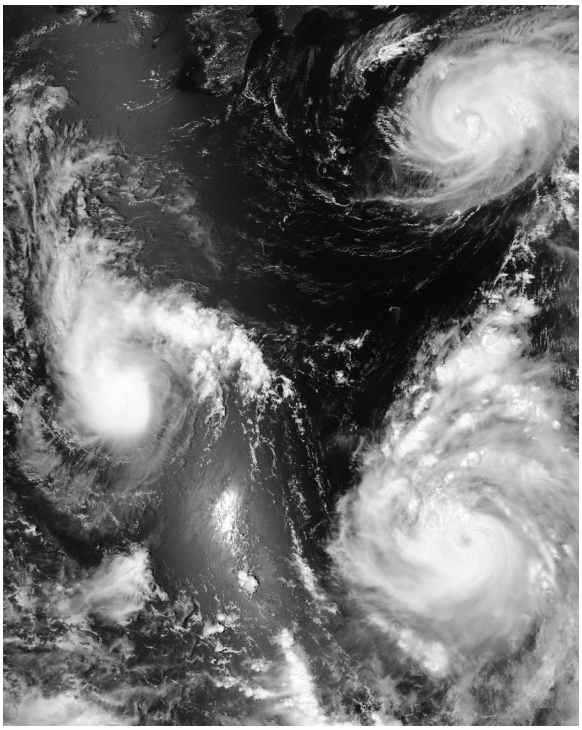
NASA Satellite Positioning Software May Aid in Tsunami Warnings, June 28; *United Press International, LiveScience.com, Washington Times, PhysOrg.com.* NASA-funded scientists **Geoffrey Blewitt** (University of Nevada-Reno) and **Seth Stein** (Northwestern University) find that GPS can determine, within minutes, whether an earthquake is big enough to generate an ocean-wide tsunami.

NASA Finds Intense Lightning Activity around a Hurricane's Eye, June 23; *Science Daily, Space Daily, India Daily.* **Richard Blakeslee** (NASA MSFC) says scientists were surprised to find an extensive amount of lightning in the core of a hurricane, where it was long-thought to be relatively rare.

Ocean Temperatures Warm, but Not as Extreme as 2005, June 21; *Gannett News Service.* As the 2006 hurricane season gets underway, NASA satellite data show warmer-than-normal waters in the Atlantic, but not as extreme as last year, says **David Adamec** (NASA GSFC).

Reading the Poles: Earth's Ice in Jeopardy, June 20; *National Public Radio.* Scientists **Ted Scambos** (NCAR) and **Mark Serreze** (NCAR) say the disappearance of Antarctica's Larsen B ice shelf and warming Arctic winters are sure signs of global warming that have worked to raise public awareness of the problem.

Interested in getting your research out to the general public, educators, and the scientific community? Please contact Steve Cole on NASA's Earth Science News Team at scole@pop600.gsfc.nasa.gov and let him know of your upcoming journal articles, new satellite images, or conference presentations that you think the average person would be interested in learning about. ■



Three different typhoons were spinning over the western Pacific Ocean on August 7, 2006, when the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite acquired this image. The strongest of the three, Typhoon *Saomai* (lower right), formed in the western Pacific on August 4, 2006, as a tropical depression. Within a day, it had become organized enough to be classified as a tropical storm. While *Saomai* was strengthening into a storm, another tropical depression formed a few hundred kilometers to the north, and by August 6, it became tropical storm *Maria* (upper right). Typhoon *Bopha* (left) formed just as *Maria* reached storm status and became a storm itself on August 7. Image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC.

NASA Science Mission Directorate – Science Education Update

Ming-Ying Wei, mwei@hq.nasa.gov, NASA Headquarters
Theresa Schwerin, theresa_schwerin@strategies.org, IGES

NASA RELEASES EDUCATION STRATEGIC COORDINATION FRAMEWORK: A PORTFOLIO APPROACH

NASA's Education Office has released a new framework to work with the academic community to prepare the next generation of explorers and innovators. The Education Strategic Coordination Framework identifies three priorities for NASA to work with academia, industry, and informal educators to foster increased studies in science, technology, engineering, and mathematics. NASA's education priorities include strengthening the nation's workforce, attracting and retaining students, and engaging America in NASA's missions. Information may be found at *education.nasa.gov/about/strategy/index.html.*

NASA EARTH EXPLORERS AND SPACE SCIENCE EXPLORERS SERIES

In an effort to show that a science career is a worthy and attainable goal, these series profile real-life scientists, young and old, with a variety of backgrounds and interests. Most articles are presented in three different versions according to reading level—grades 9-12 and up, grades 5-8, and grades K-4. Earth Explorers: *science.hq.nasa.gov/education/earth_explorers.* Space Science Explorers: *science.hq.nasa.gov/education/space_explorers.*

INDEX AVAILABLE OF NASA EARTH & SPACE SCIENCE PORTAL STORIES

The Institute for Global Environmental Strategies (IGES) develops articles on NASA-sponsored education products and programs in Earth and Space Science. All products featured have passed the NASA Earth or Space Science Education Product Review. Archived indexes are available. Earth Science at *www.strategies.org/education/index.aspx?sub=education&sub2=eartharticles.* Space Science at *www.strategies.org/education/index.aspx?sub=education&sub2=spacearticles.* Teachers are encouraged to browse these lists for information on resources that may be incorporated into their curriculum. Also included are educational stories explaining the science behind NASA missions.

PROJECT LEARNING TREE PREMIERES SECONDARY CURRICULUM

Project Learning Tree® (PLT), the environmental education program of the American Forest Foundation, has developed new supplementary education materials for grades 9-12 to develop their sense of place and critical thinking skills. *Exploring Environmental Issues: Places We Live* gets students exploring their own neighborhoods and involved in local community action projects. It is an interdisciplinary, supplemental curriculum designed for grades 9-12, but can be easily adapted for adult or middle school audiences. For more information visit *www.plt.org/cms/pages/31_41_39.html.*

RESEARCHCHANNEL CALL FOR PROPOSALS TO DEVELOP VIDEO PROGRAMMING

ResearchChannel is a nonprofit media and technology organization founded in 1996 by research and academic institutions to share the work of their researchers with the public. Accredited universities and nonprofit research institutions are invited to submit proposals to develop programming that furthers *ResearchChannel's* goals. The matching fund award will reimburse winning entrants for one-half the cost of video production, e.g., interview, panel, documentary, or performance, up to $6,000. The purpose of these awards is to provide a showcase for the outstanding work being done by world-class researchers at leading research and academic institutions and make that content available to the public. Complete details are available on the *ResearchChannel* website, *www.researchchannel.org/news/news.asp.*

DLESE RESOURCE OF INTEREST: WINDOWS INTO WONDERLAND

The Digital Library for Earth System Education (*dlese.org*) recently featured: *Windows Into Wonderland*, from the National Park Service, which takes visitors on a series of electronic field trips (eTrips) into Yellowstone National Park—*Yellowstone Exposed: Mysteries in the Living Laboratory*. Each eTrip is equipped with curricular materials for teachers and an *Ask an Expert* area that provides an archive of questions and answers. eTrips are available with and without audio and video to accommodate most internet connections. Designed for middle school students, it is appropriate for general audiences. More information is available at *www.windowsintowonderland.org/*

EOS Science Calendar

October 3-5
CALIPSO Science Meeting, Annapolis, MD. Contact: Pat Jones, *P.A.Jones@larc.nasa.gov*

October 16-20
CloudSat Science Team Meeting, Big Island, HI. Contact: Deborah Vane, *Deborah.G.Vane@jpl.nasa.gov*

October 23-27
CERES Science Team Meeting, Hadley Centre, U.K. Meteorological Office, Exeter, UK. Contact: Shashi Gupta, *S.K.Gupta@larc.nasa.gov*

November 28-30
HDF & HDF-EOS Workshop X, Landover, MD. URL: *hdf.ncsa.uiuc.edu/*

Global Change Calendar

October 13-15
American Association for Artificial Intelligence Fall Symposium, Arlington, VA. URL: *www.aaai.org/Symposia/Fall/fss06symposia.php*

October 30-November 2
6th Africa Association of Remote Sensing of the Environment (AARSE) International Conference of Earth Observation and Geoinformation Sciences in Support of Africa's Development, Cairo, Egypt. URL: *www.narss.sci.eg/aarse2006/index.htm*

November 2-4
Pan Oceanic Remote Sensing Conference, Busan, Korea. URLs: *porsec.nwra.com* and *www.isrs2006 porsec.com*

November 7-8
2nd International Young Scientists' Global Change Conference, Beijing, China. URL: *www.start.org/links/announce_oppo/YSC_2006_Announce7.pdf*

November 9-12
Global Environmental Change: Regional Challenges–An Earth System Science Partnership, Global Environmental Change Open Science Conference, (IGBP, WCRP, IHDP, Diversitas), Beijing, China. URL: *www.essp.org/essp/ESSP2006/*

November 13-17
SPIE's 5th Asia-Pacific Remote Sensing Symposium, Panaji, Goa, India. URL: *spie.org/conferences/calls/06/ae*

December 4-14
International Joint Conferences on Computer, Information, and Systems Sciences, University of Bridgeport, CT. URL: *www.cisse2006online.org/*

December 11-15
American Geophysical Union (AGU) Fall Meeting, San Francisco, CA. URL: *www.agu.org/meetings/fm06/*

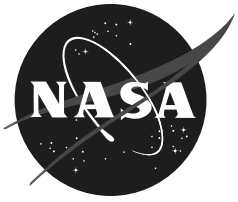
January 14-18, 2007
2007 American Meteorological Society (AMS) Annual Meeting, San Antonio, TX. URL: *www.ametsoc.org/meet/annual/index.html*

February 12-15, 2007
International Symposium on Signal Processing and its Applications (ISSPA), Sharjah, United Arab Emirates. URL: *www.isspa07.org/*

March 3-10, 2007
IEEE/AIAA Aerospace Conference: Global Earth Observation System of Systems (GEOSS), Big Sky, Montana. Call for Papers. Contact: Kathy Fontaine, *Kathy.Fontaine@nasa.gov.* URL: *www.aeroconf.org*

April 17-20, 2007
IEEE Radar Conference 2007, Boston, MA. URL: *www.radar2007.org/*

June 25-29, 2007
32nd International Symposium on the Remote Sensing of the Environment (ISRSE), San Jose, Costa Rica. URL: *www.cenat.ac.cr/simposio/welcome.htm*



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The Earth Observer

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