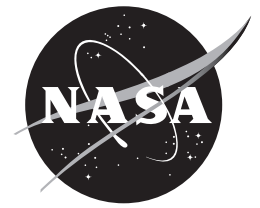


The Earth Observer



... advancing knowledge of Earth through exploration

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Editor's Corner

Michael King
EOS Project Scientist

I'm pleased to report that the CloudSat and Cloud-Aerosol Lidar Infrared Pathfinder Satellite Observations (CALIPSO) missions are preparing to be launched together on-board a Delta II rocket from Vandenberg AFB in California. The launch readiness date is September 10, 2005. Both missions are in the final stages of preparation for shipment to Vandenberg Air Force Base. CloudSat will be shipped from Ball Aerospace in Boulder, Colorado and CALIPSO from the Alcatel satellite facility in Cannes, France sometime in May.

These two missions are set to join Aqua, Aura, and CNES's Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar (PARASOL) mission already in orbit, and eventually will be joined by the Orbiting Carbon Observatory (OCO), to form the Afternoon Satellite Constellation or "A-Train." All of these missions fly in close proximity to each other—all within about 15 minutes. In fact, CloudSat and CALIPSO will pass over the same area within 15 seconds of one another, requiring frequent precise maneuvering of CloudSat to maintain the tight formation needed to accomplish this. Each individual mission in the A-Train has its own independent objectives, but the carefully planned formation also allows for synergy between the missions so that more information about Earth's climate is obtained by the combined observations from all the missions than would result from the sum of the observations taken independently (i.e., if they were not flying together in the A-Train). The new results should improve our understanding of many aspects of Earth's climate including clouds, aerosols, atmospheric chemistry, and energy balance.

I would also like to congratulate the GRACE mission on the third anniversary of their launch on March 17. GRACE continues to observe changes in the Earth's gravity field with a level of detail that has previously not been possible, providing new insight into complex climate processes. The monthly Earth gravity fields produced by GRACE enable us to track the changing water content in hydrologic basins and time variability of the Antarctic Circumpolar Current. They are also opening an entirely new window into studies on the movement of water between the oceans, the cryosphere and the continents.

In addition, thanks to GRACE, models of the Earth gravity field are now accurate enough for oceanographers to derive (i) absolute surface ocean geostrophic currents, when combined with altimetry; (ii) depth profiles of absolute geostrophic currents, when combined with altimetry and *in situ* data on temperature and salinity; and (iii) transports of heat and chemicals.

As time goes on, scientists expect further improvements in spatial resolution by up to 50% at the shortest oceanographic wavelengths, which should allow for studies of narrow currents such as the Gulf Stream and Kuroshio Currents, and should also reveal previously unknown details of the circulation and sea ice properties in the nearly inaccessible Arctic ocean.

I reported in the last issue of The Earth Observer that Terra would celebrate five years on orbit in February. Unfortunately the fifth anniversary celebration that was planned at Goddard for February 25 was postponed due to snow. Those events have been rescheduled for May 19. Now entering its sixth year of operation, the instruments on Terra continue to perform well and it brings us new science data every day. Likewise, the instruments on Aqua (save HSB) continue to function normally and bring back new science data as the mission nears three years in orbit—May 4. Congratulations to all who have worked hard on both missions to make them such a success.

Lastly, I wish to commend the hard work the HIRDLS team has done to prove that they can still retrieve new science data despite the piece of kapton material blocking the instrument's field of view and preventing it from obtaining data at seven different positions across the spacecraft track as originally planned, and limiting it to vertical scans at a single fixed azimuth position. Although the horizontal scanning capability is lost, they should still get the vertical resolution they hoped for from the start.



Announcements

New MISR "Clim-Likely" Dataset Available

The Atmospheric Science Data Center (ASDC) at NASA Langley Research Center in collaboration with the MISR Science Team announces the public release of a new Model-Derived Global Aerosol

Climatology for MISR Analysis Data Set ("Clim-Likely").

The "Clim-Likely" data set was derived from 'typical-year' aerosol transport model results, and was developed as an initial step in identifying a range of components and mixtures for the MISR Standard Aerosol Retrieval Algorithm climatology, and as one standard against which to compare MISR aerosol air mass type retrieval results.

Six component aerosols included in the model were medium and coarse mode mineral dust, sulfate, sea salt, black carbon, and carbonaceous aerosols. Values reported are percent of total column mid-visible aerosol optical depth (AOT) for each component, total column mid-visible AOT, and the Mixing Group.

Five aerosol air mass "Mixing Groups," and thirteen sub-groups, were identified from a cluster analysis of the entire database. Each Mixing Group contains the four most abundant component particles in the column for climatologically common aerosol air masses, and each sub-group identifies the dominant particles within the Mixing Group.

The MISR "Clim-Likely" data are available as individual monthly 1-degree by 1-degree boxes or as global monthly files and are available from a dedicated ASDC web page: eosweb.larc.nasa.gov/cgi-bin/misr_tools/clim_likely.cgi and are also accessible under "Special Products" on the ASDC MISR Data table: eosweb.larc.nasa.gov/PRODOCS/misr/table_misr.html

An interactive tool allows access to monthly individual 1-degree by 1-degree boxes, and an interface option allows download of global

monthly files or the entire database in ASCII format. If you are a new user to our Langley Web Ordering Tool, a short registration form will need to be completed. This information is necessary for statistical purposes.

New CERES Datasets Available

The Atmospheric Sciences Data Center (ASDC) at NASA Langley Research Center in collaboration with the CERES Science Team announces the release of the following Terra and Aqua data sets:

Single Scanner Footprint TOA/Surface Fluxes and Cloud Parameters (SSF):

One hour of instantaneous CERES data for a single scanner instrument.

- CER_SSF_Aqua-FM3-MO-DIS_Edition1B
- CER_SSF_Aqua-FM4-MO-DIS_Edition1B

Monthly Gridded TOA/Surface Fluxes and Clouds (SFC):

Hourly single satellite flux and cloud parameters averaged over 1.0-degree regions.

- CER_SFC_Aqua-FM3-MO-DIS_Edition1B
- CER_SFC_Aqua-FM4-MO-DIS_Edition1B
- CER_SFC_Terra-FM1-MO-DIS_Edition2C
- CER_SFC_Terra-FM2-MO-DIS_Edition2C

Information about the CERES products, including products available, documentation, relevant links, sample software, tools for working with the data, etc., can be found on the CERES data table at the ASDC web site: eosweb.larc.nasa.gov/PRODOCS/ceres/table_ceres.html



Report on U.S./Japan ASTER Science Team Meeting

— Michael Abrams, mike@lithos.jpl.nasa.gov, Jet Propulsion Lab/California Institute of Technology, Pasadena, CA

The 26th Joint Japan/U.S. Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Science Team Meeting was held at Caesar's Palace, Las Vegas, Nevada from December 6 to December 10, 2004. The meeting was attended by about 60 people, including science team members from Japan and the U.S. and NASA Headquarters, as well as participants from other affiliated organizations.

At the opening plenary session, **M. Abrams** (Jet Propulsion Laboratory, JPL) and **H. Tsu** (Earth Remote Sensing Data Analysis Center, ERSDAC), the U.S. and Japan ASTER Science Team Leaders, opened the meeting with greetings on behalf of the U.S. and Japan. **E. Abbott** (JPL) described the schedule of the ASTER Science Team Meeting and other meeting logistics.

W. Turner (NASA Headquarters) talked about the EOS project status. He said rumors indicated the possibility of a 10-20% budget cut for Fiscal Year 2005 after the Office of Management and Budget (OMB) passback in the next few weeks.

F. Sakuma (National Institute of Advanced Industrial Science and Technology, NMIJ/AIST) reported on the instrument status. ASTER is operating normally. Shortwave infrared (SWIR) temperatures increased 1K this summer and then became stabilized. Flight Operations Team (FOT) and Japan Resources Observation System (JAROS) studied the problem, and concluded normal operations would continue. A new offset in data values is seen and compensated in the processing. Radiometric calibration coefficients for the visible and near infrared (VNIR) and thermal infrared (TIR) will be modeled using an exponential function.

B. Bailey (U.S. Geological Survey Land Processes Distributed Active Archive Center [USGS LPDAAC]) described the ASTER emergency scheduling interface and control system for use by several pre-approved users. He reported on the Terra ASTER metadata inventory web site, available in January, where the Level-1 metadata would be ftp-pulled by authorized users. LPDAAC and Ground Data System (GDS) are completing preparations for use of the Asia-Pacific Advanced Network (APAN) network to replace airplane shipping of data to and from Japan and the U.S. Both sides are changing over to a Linux processing environment by June 2005. Granule-distribution statistics indicate that foreign and educational users make up 60%, followed by commercial users at 20%. The LPDAAC has produced over 5400 digital elevation models (DEMs) so far, but the backlog of orders is 2600 scenes (some large individual orders).

Y. Kannari (Earth Remote Sensing Data Analysis Center, ERSDAC) talked about the status of GDS in Japan. The extension of the NASA/Japan Ministry of Economy, Trade and Industry (METI) Memorandum of Understanding (MOU) was signed on October 22, 2004 through an Exchange of Notes; it extended the MOU until 2012. He described the General Programming Request progress, and noted that the system would be operational last month. APAN and Linux conversions were discussed again from the Japan perspective.

B. Eng (JPL) described the status of the Level 2 software. The next version is being tested at the LPDAAC, and includes TIR recalibration option; SWIR crosstalk correction option; support for optional input hierarchy; and bug fixes.

K. Okada (Earth Remote Sensing Data Analysis Center, ERSDAC) gave the

Science Scheduling group report. Over 880,000 ASTER scenes have been observed. He described the Operations and Mission Planning Working Group *ad hoc* meeting in September (details are found in the working group report). The Science Team Acquisition Request (STAR) review is almost completed, and necessary edits are being made to remove requests no longer active nor needed. VNIR pointing issues will be discussed in the OPM working group.

Y. Yamaguchi (Nagoya University) described a committee of Japanese aerospace companies formed to discuss post-ASTER projects. A final report is due in early 2005. The Japan Aerospace Exploration Agency (JAXA) also has a similar committee, with a final report due in spring 2005.

A. Gillespie (U. Washington) and **M. Abrams** presented the status of the *Remote Sensing of Environment* special issue, and articles submitted to *Transactions on Geoscience and Remote Sensing* (TGARS). In both cases, articles are in review, and publication is anticipated in 6-12 months.

V. Realmuto (JPL) presented an overview of ASTER and MODIS/ASTER (MASTER) airborne simulator work on Mount St. Helens (MSH) by many ASTER team members. ASTER obtained several useful overpasses, despite clouds. The MASTER instrument coincidentally was stationed in Oregon, and was tasked to stay in the area for 3 weeks to overfly the mountain as the volcanic crisis intensified. Several spectacular data sets were obtained, in conjunction with 1-m lidar data for elevation models (EMs).

K. Thome (U. Arizona) laid out the logistics for Wednesday's field trip to Ivanpah Playa, coinciding with an AS-

TER overpass and calibration/validation experiment.

M. Abrams and **Y. Yamaguchi** charged the group with issues to be discussed during the working group meetings, and reported at the closing plenary.

Working Group Reports

Radiometric Calibration Working Group

The radiometric calibration working group and ASTER Calibration Team meeting was held on Tuesday, December 7, 2004. The meeting was co-chaired by **S. Biggar** (University of Arizona) and **K. Arai** (Saga University).

F. Sakuma discussed Radiometric Calibration Coefficient (RCC) determination for ASTER, including the use of fitting to allow for smooth variation of the coefficients with possible extrapolation in the VNIR. Historically, step changes were made in the RCC when the calibration had changed by more than the uncertainty in the absolute calibration. Sufficient data have been acquired to show that the change in the VNIR subsystem according to On-Board Calibration (OBC) data follows an exponential function after a bit less than 2 years in orbit. SWIR is basically stable. The prediction of the TIR RCC was also discussed.

H. Tonooka (Ibaraki University) presented the RCC for the TIR subsystem. The TIR system changes are reflected in the RCC and are updated frequently. Further refinements can be made by accessing the recalibration web site.

The next series of talks focused on results of recent vicarious calibrations.

K. Arai presented vicarious data showing that ASTER is following the trends found earlier. **Tsuchida-san** (AIST) also presented work on the VNIR and SWIR.

Q. Sanford (University of Arizona) presented new work using a cross-calibration with the Moderate-Resolution

Imaging Spectroradiometer (MODIS) over Railroad Valley (RRV) and African desert areas. This work indicates that an exponential function predicts the performance of the VNIR subsystem of ASTER when compared to MODIS.

K. Thome presented vicarious results for the VNIR collected since the last calibration meeting. There is an unexplained upward trend in some recent data that will be studied.

H. Tonooka presented recent TIR vicarious results.

R. Alley (JPL) showed additional TIR vicarious results. The vicarious results fit with the trend in TIR response.

S. Hook (JPL) presented recent TIR results from Lake Tahoe and some information about updates to the JPL thermal radiometers used for vicarious calibration. The ASTER TIR subsystem compares well with MODIS over Lake Tahoe, especially when the ASTER data are recalibrated.

B. Eng (JPL) reported the U.S. side is testing production software to make a correction for SWIR crosstalk in bands 5 and 9. This product corrects Level 1A data before it is used in the production of Level 2 and higher products. The crosstalk correction will be an optional step in processing. **A. Iwasaki** (AIST) presented a newly developed correction for the SWIR filter and also for some stray light effects other than crosstalk. This software may be made available at a later date after further testing. **T. Tachikawa** (ERSDAC) gave a short presentation about changes to the science web site. Of note are the links to the recalibration data.

Atmospheric Correction Working Group

The Atmospheric Correction Working Group met Wednesday afternoon co-chaired by **S. Tsuchida** and **K. Thome**. The meeting began with a discussion of past action items during which Thome

showed that the look-up table resolution is not the cause of artifacts seen in the Band 2 surface reflectance product.

B. Eng (JPL) gave an update of the current status of the processing software and a description of planned improvements for including MODIS-based aerosols and water vapor, a SWIR crosstalk correction, and the improved water vapor scaling method for the TIR correction.

K. Thome described work to develop a new VNIR/SWIR correction look-up table based on MODIS-derived aerosols as well as comparisons of the AST-07 surface reflectance product to ground-based measurements of surface reflectance. The results of this work show that the Band 1 calibration may be an issue as well as Band 9 crosstalk or water vapor.

H. Tonooka (Ibaraki University) then gave two talks related to the atmospheric correction of the TIR. Comparisons of retrieved emissivities from the atmospheric correction from known surface types to laboratory spectra showed similar results for inputs from both MODIS-based results and from National Centers for Environmental Prediction (NCEP) analysis. Errors in the correction also show larger errors at larger water vapor amounts. The error, as shown by Tonooka in the next talk, decreases dramatically when the water-vapor scaling approach is used.

L. Mars (USGS) gave the final talk for this working group, and showed the results of comparisons of ground spectra to atmospherically-corrected ASTER and Airborne Visible/Infrared Imaging Spectroradiometer (AVIRIS) data. Mars used AST-07 surface reflectance products for the comparison as well as results with and without crosstalk correction and those including column water vapor from MODIS-based retrievals. The overall conclusion was that there is a possible Band 5 calibration issue and that water vapor effects appear to dominate the crosstalk effects in Band 9. In addition, Mars found that the NCEP water vapor

product produced results that were not as good as the MODIS products.

Geology Working Group

D. Pieri (JPL) reviewed the action items from the June team meeting. **M. Bishop** (Indiana University) has been investigating regional mass balance for Himalaya glaciers. He found a negative mass balance, and a warming trend expressed in the geomorphology.

Jeff Kargel (USGS) showed examples from Peru where ASTER data were effective in mapping features of environmental and natural hazards.

A. Gillespie described investigations of geomorphology in Mongolia that demonstrated that ASTER can provide key clues to the understanding of the impact of paleo-climate events on Asia as compared to the impact on North America and Europe.

D. Pieri showed how ASTER data are documenting degradation of permafrost along the Alaskan coast. There is a combination of diminished sea ice and permafrost melting spelling catastrophe for native subsistence villages. Pieri gave two talks on using ASTER for planetary analogs for Mars, and using TIR data to determine spectral signatures applied to spectroscopy of Earth-like extra-solar planets.

L. Trunk (University Washington) is investigating the thermo/spectral signatures of volcanic lakes to develop basic research and hazards methodologies. **R. Dominguez** (NASA Ames Research Center, ARC) introduced a new function that attaches location and elevation to each MASTER pixel. **G. Vaughan** (JPL), **M. Ramsey** (University Pittsburgh) and **S. Hook** (JPL) showed how MASTER data well-documented the evolution of the latest volcanic crisis at MSH, including thermal characteristics and composition. Lessons learned from MSH point to the need for advanced planning for the next eruption in the U.S.

S. Hook presented problems anticipated when we release the ASTER/MASTER data to the public. **M. Ramsey** presented ASTER/Forward-Looking Infrared (FLIR) observation results at MSH and Bezymianny Volcano. **M. Urai** (NMIT/AIST) presented observations at Satsuma-Iwojima demonstrating the ability to monitor and detect high-temperature fumarolic emissions. **D. Pieri** described the Volcano Data System that will permit rapid web access to ASTER volcano data observation histories.

F. Kruse (HGI Imaging) showed comparisons of Hyperion data and ASTER for geologic mapping of hydrothermally altered rocks. ASTER data can be used to separate out many of the important mineral classes, but does not work as well as the hyperspectral data. **D. Sabol** (University Washington) used ASTER data to calculate/discriminate playa thermal inertias, and related that to soil moisture content.

Ecosystems/Oceans Working Group

The Working Group was co-chaired by **A. French** (U.S. Department of Agriculture, USDA), and **Y. Yamaguchi** (Nagoya University).

M. Ramsey (U. Pittsburgh) discussed the current and future mapping and analysis of desert aeolian deposits in the Kelso Dunes, Gran Desierto east of the mouth of the Colorado River in Mexico and desert dunes by Lake Chad. These studies utilize ASTER multispectral, thermal, and high resolution aspects to better understand the relationships between sediment source regions and the dunes.

M. Abrams discussed work he has been doing with Gary Geller on development of the Protected Area Archive Tool, an easy-to-use software tool incorporating a GIS interface to allow conservation resource managers to view ASTER and Landsat data over their lands of interest. The tool was presented at the World Conservation Congress Meeting in

Bangkok in November where it attracted very high interest.

W. Stefanov (NASA Johnson Space Center, JSC) presented urban heat island analysis studies over two large and rapidly growing cities: Houston and Phoenix. ASTER, MASTER and Thematic Mapper (TM) observations reveal relationships between social income and environment. Future work will focus on incorporation of the MM5 model (MM5 is a mesoscale model developed jointly by Pennsylvania State University and the National Center for Atmospheric Research) with ASTER observations and astronaut photography.

A. French presented results from surface-energy-flux model intercomparisons over an Iowa site and showed the importance of ASTER thermal bands and their higher spatial resolutions.

H. Tonooka presented again his surface emissivity ratio approach for snow/ice monitoring a second time (to allow those not present earlier in the week to learn of his work).

T. Tachikawa gave an overview of ERSDAC Ecosystem research projects on Ecosystem for 2003, which encompasses seven diverse subject areas including coastal zone monitoring, carbon storage in woodlands and urban heat island analysis. Work for 2004 is similarly diverse and will be presented in full at the next ASTER Science Team meeting.

STAR Committee Working Group

K. Okada discussed the problems with the Science Team Acquisition Request (STAR) tool network at GDS. He offered to change the IP address outside GDS to get it working again. **L. Maldonado** (JPL) committed to send current STARS to reviewers by email until the web tool problem is resolved. **K. Duda** (LPDAAC) described the Emergency scheduler web tool. It will be used by several pre-approved users. Japan GDS was interested in the tool, and Duda

will investigate sharing the software with GDS.

Level 1/DEM/Geometric Working Group

M. Abrams reviewed the action items from the previous meeting, and declared them closed. **H. Fujisada** (Sensor Information Laboratory Corp.) reported that there were no changes to the Level 1 processing software. Level 1 geometric performance for inter-telescope and intra-telescope registrations continues to be well within specifications. A longitude error in the geolocation accuracy was discovered recently. It first appeared in July 2003, and has increased to about 180 m. Fujisada tracked it down to uncompensated terms in the nutation of the Earth's rotation. Numerical modeling almost perfectly models the error. A fix will be made in the next Level 1 software delivery, and the correction will be included in the JPL web site lat/long correction program.

B. Bailey reported that errors were increasing in both the relative and absolute DEMs produced at the LPDAAC. Tests have ruled out operator error. It was decided that 2 commercial off-the-shelf (COTS) packages would be evaluated as possible replacements for the current DEM software.

M. Abrams described a project that produced superresolution DEMs by averaging 4-5 ASTER DEMs, and combining them with Shuttle Radar Topography Mission (SRTM) DEMs. The final product was created as a 10 m DEM, and mostly meets the specification for the Level 3 DTED.

*Science Scheduling Support Group/
Operations and Mission Planning Working Group*

L. Maldonado reviewed the action items coming from the September *ad hoc* meeting in Tokyo. Twelve items were closed, three were continued. **K. Okada** reported on the instrument sup-

port terminal. The hardware has been successfully upgraded and the network established. Work is continuing on the final software installation.

N. Cole (JPL) reported on the Mission Analysis Tool for generating metrics and analysis for mission acquisitions. It is almost operational, and is undergoing final testing. **L. Maldonado** talked about the ASTER Mission Simulator rebuild at JPL. The tool will help future acquisition planning for ASTER. It is almost operational and will be available in a few weeks.

K. Okada led the discussion on the status of the STAR acquisition request reviews. Only two STARs were still out for review. Okada next presented several reports on behalf of speakers who could not be present. He gave a report on behalf of **H. Muraoka** (Geotechnos Co. Ltd.) on the Global Mapping 2nd round. It started August 2003, and 18,000 scenes have been collected with <20% cloud cover. Australia acquisitions have been very successful. Additional STARs will be submitted to fill 162 gaps in Global Map 1. By next team meeting we must have a plan for 2006-08 acquisitions. He also presented a report on behalf of **H. Sekine** (Mitsubishi Research Institute, Inc.) on the status of the Nighttime TIR acquisition project. Areas of interest (AOIs) were finalized, and the requests submitted. The STAR will run for one year, then be re-evaluated. Okada next presented a report on behalf of **A. Miura** (ERSDAC) on the General Programming Request project. The system became operational in November. Finally, Okada presented a report on behalf of **S. Huzikawa** (Geotechnos Co. Ltd.) concerning VNIR pointing. A study revealed the problem with the scheduler during the Spring 2004 test to limit pointings. Future recommendations are to disallow arbitrary pointings and maintain the seven fixed pointings; minimize wide-angle VNIR pointings; and make sure it works properly for the remaining observations.

Temperature/Emissivity Separation (TES) Working Group

A. Gillespie reviewed the action items coming from the Joint Science Team Meeting in June 2004 in Tokyo. No items were closed, three were continued.

H. Tonooka reported on the status of TIR nighttime global mapping. The nighttime STAR is having a big impact but over a limited area. STAR parameter files of all of the AOI are ready now—observations will start soon. After first-year results are evaluated, maybe second and third years will be acquired as indicated.

W. Gustafson (U. of Washington) reported on the status of the atmospheric correction study that has been on-going at U.W. At the June 2004 meeting a problem with the lookup table (LUT) index in atmosphere correction code was suspected. Now it has been proven and B. Eng has fixed it. Maximum radiance error is typically 1-10%, mean is 0.5-4.0%. This includes Tonooka's recalibration. There will continue to be problems under rapidly changing atmospheric conditions. With the correction of this problem, the Temperature and Emissivity Separation (TES) parameters can be restored to their planned values (as opposed to the "detuned" values required by the sub-par performance of the ASTER data and correction algorithms, now corrected).

H. Tonooka talked about snow/ice monitoring using surface emissivity ratios. The emissivity changes with conditions in a well-known way, and ASTER Band 14 is the most sensitive channel. This has been tested with the CIMEL sun photometer. Tonooka proposes a Surface Emissivity Ratio (SER) for 10.4/12 μm : at 10.4 μm , all snow/ice has the same emissivity. The SER increases from frost to ice, but the change is small. However, the Surface Radiance Ratio (SRR) is a function of tem-

perature, unlike SER. Use of SRR may require a new, tuned regression based on predicting minimum emissivity from spectral contrast. ASTER 13/14 is noisy. MODIS may give better results, but the resolution is much worse.

D. Sabol (U. of Washington) gave an update on the continuing TES validation program at the existing sites: Hawaii (28 scenes), Railroad Valley (60 scenes), Salton Sea, and Lake Tahoe. Day/night image results will be compared at playas in the Mojave Desert. Collaboration at the Barrax (Spain) test site was undertaken in June 2004.

H. Tonooka discussed resolution enhancement of shortwave infrared (SWIR) and TIR images (lossless sharpening). Higher resolution SWIR data were used to predict TIR values, controlled by the lower-resolution TIR as possible.

A. Gillespie made further comments on the validation program, which will be expanded by collaboration with Jose Sobrino to include classification with ASTER VNIR data to improve temperature recovery for spectrally flat surfaces, and an adaptation of in-scene relative atmospheric corrections such as In-scene Atmospheric Correction (ISAC) for ASTER. MODIS atmospheric profiles will be used and compared to NCEP data, and an effort will be made to use Multiangle Imaging Spectroradiometer (MISR) and other aerosol products to improve atmospheric correction. ASTER and Multispectral Thermal Imager (MTI) results will be compared in collaboration with Lee Balick at Los Alamos National Laboratory (LANL). Remaining concerns include cirrus.

A. French reported on ASTER TES used for mapping surface temperatures by Frederick Jacob in Toulouse, with test sites there and in Avignon.

A. Gillespie led discussion and assignment of new action items. A new action item was assigned to the night-

time Working Group, to specify new targets for acquisition, to be reported at the Tokyo meeting in June 2005. The atmospheric correction code fix should be documented and team members notified. The TES parameter adjustment may not have been implemented similarly in all versions of the code, and this must be verified.

Field Trip to Ivanpah Playa

An ASTER acquisition was scheduled for Ivanpah Playa near the California/Nevada border on Wednesday, December 8, 2004. A number of groups doing vicarious calibration took equipment to Ivanpah. Another group of ASTER Science Team members traveled from the Las Vegas meeting location to the playa to observe a vicarious calibration experiment. The observer group left the hotel at about 8 A.M. meeting at the Las Vegas Fashion Mall in Primm.

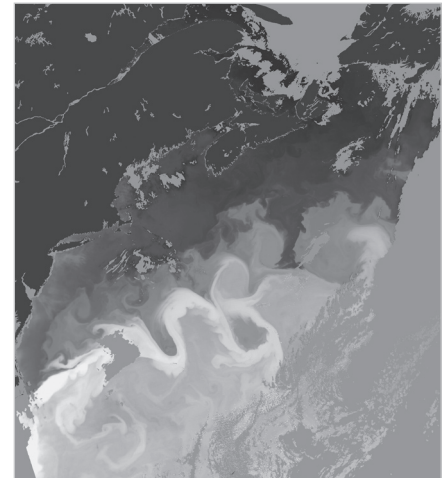
Groups of investigators from both the Japanese and U.S. ASTER Science Teams set up equipment on the playa during the morning before the scheduled ASTER acquisition (18:32 GMT). Solar radiometers were deployed as were radiometers to measure the spectral reflectance of the playa surface. Thermal radiometers were also set up to measure surface temperature and a radiosonde was launched to measure atmospheric temperature and water vapor profiles. However, there were clouds at various levels during the ASTER overpass so the data collected will be of marginal value for vicarious calibration.

Visiting ASTER Team Members were able to view the equipment and watch the various data collection procedures. Simon Hook tried carrying an ASD radiometer used to measure the reflectance in the VNIR and SWIR wavelength region after watching the University of Arizona group make a collection. In total, about 40 people were involved in the field trip.

Closing Plenary Session

The closing plenary session featured short summations by each of the Working Group chairs, reviewing discussions, presentations and action items. **Jon Ranson** (NASA Goddard) the Terra Project Scientist, described science highlights of the Terra mission, discussed the status of the Terra mission, and presented information on the upcoming NASA Headquarters Senior Review for Terra.

M. Abrams and **H. Tsu** closed the meeting with a promise to meet again in May or June, 2005 in Japan.



The Gulf Stream Current is one of the strongest ocean currents on Earth. This river of water that ferries heat from the tropics far into the North Atlantic pulls away from the coast of the U.S. Southeast around Cape Hatteras, North Carolina. There the current widens and heads northeastward. In this region, the current begins to meander more, forming curves and loops with swirling eddies on both the colder, northwestern side of the stream and the warmer, southeastern side.

This image shows the sea surface temperature of the Gulf Stream on April 18, 2005. The warm waters (light shades) of the Gulf Stream snake from bottom left to top right, showing several deep bends in the path. In fact, the northernmost of the two deep bends actually loops back on itself, creating a closed-off eddy. On the northern side of the current, cold waters (dark shades) dip southward into the Gulf Stream's warmth.

NASA image courtesy Norman Kuring, MODIS Ocean Team

Aura Science Team Meeting

— Anne Douglass, anne.r.douglass@nasa.gov, Goddard Space Flight Center

The first post-launch Aura Science Team meeting was held February 28 – March 3, 2005 at the Pasadena Convention Center, Pasadena California. More than 200 people attended some part of this information-packed meeting. Summaries of the working group meetings that were held the first two days are given below, followed by summaries of the plenary sessions on Wednesday and Thursday.

E. Hilsenrath (chair) reviewed the latest Aura Education and Public Outreach (EPO) activities with the Working Group members. The American Chemical Society is producing the third and last of the series of *ChemMatters* magazine dedicated to Aura. This issue will deal with Aura results and validation. The Smithsonian's National Museum of Natural History exhibit on atmospheric chemistry called "*Change is in the Air*" is scheduled to open this summer on the Mall. Aura EPO has been heavily involved in developing content and media for the exhibit. Interaction with Global Learning and Observation to Benefit the Environment (GLOBE) continued with a workshop in Fort Collins, CO, that brought teachers from all over to learn to use Aura-sponsored GLOBE measurements including the aerosol photometer, Ultraviolet-A (UVA) meter, and the local ozone measurement. In addition to discussing Aura EPO activities, the workshop also touched on activities related to the upcoming Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission.

The Aura Algorithm Working Group (**Nathaniel Livesey**, chair) met as part of the spring Aura Science Team meeting. Most of the meeting was a summary report from the individual instrument algorithm teams. A report was given that summarized the impres-

sive amount of work undertaken by the High Resolution Dynamics Limb Sounder (HIRDLS) team to retrieve atmospheric data after subtracting the signature of the 'blockage.' The Troposphere Emission Spectrometer (TES) team also showed impressive results of their retrievals in the presence of clouds. Following these reports, the group discussed its future direction now that we are post-launch. They decided to reformulate the group as the 'Aura Algorithm and Data Assimilation Working Group.' The structure of this new group remains to be decided.

The Meteorological Products Working Group (MPWG) (**Gloria Manney**, chair) began its meeting with a report from **Craig Long** of NOAA, who provided updates on the National Centers for Environmental Prediction (NCEP) datasets provided for Aura. **Steven Pawson** from NASA/GSFC Global Modeling and Assimilation Office (GMAO) next reported on the GMAO datasets provided for Aura—Goddard Earth Observing System (GEOS) version 4 and version 5 (under development). Both Long's and Pawson's reports focused on the effect of trouble with Advanced Microwave Sounding Unit (AMSU) instruments on NOAA operational satellites on the analyses. In addition, Craig gave an update on NCEP plans for a "unified analysis system" to span regional-to-global models, increases in forecast resolution, and examples of NCEP analyses from this unusual Arctic winter. Steven's report also included an update on GEOS-5 development status, and development of evaluation metrics focused on "system performance," e.g., validating against *in situ* and other data, for GEOS-4 and GEOS-5. After these reports, each instrument team gave a brief update on their use of the meteorological data sets.

HIRDLS plans to use GEOS-4 Temperature (T), Ozone (O₃) and Water (H₂O) to derive cross-track line-of-sight gradient information to help make up for loss of cross-track coverage; they are also getting many late-look GEOS-4 products for Chemistry and Transport Model (CTM) comparisons. The Ozone Monitoring Instrument (OMI) is not currently using meteorological data provided by the Distributed Active Archive Center (DAAC).

TES uses GEOS-4 T, H₂O, skin temperature and surface pressure in their retrievals, and is using T and H₂O for initial analysis/validation efforts. The Microwave Limb Sounder (MLS) uses GEOS-4 T in retrievals, and GEOS-4 and NCEP/Climate Prediction Center (CPC) products in routine data inspection, validation and initial scientific analyses. They presented several examples of how they use these.

The Aerosol Working Group (MOWG, **Steven Massie**, chair) presented early aerosol and cloud validation results. The group discussed validation of OMI cloud pressure heights, MLS cloud frequency of occurrence, TES cloud optical depths and heights, and HIRDLS observations of tropical cirrus. The ice-water content observations by MLS in the upper troposphere will be very useful for validation of global circulation models.

The Mission Operations Working Group (**Angie Kelly**, chair) met on March 1, 2005. The five Instrument Operations Teams (IOTs) presented their current status, including current performance trends and the progress of the science data processing. GSFC Mission Operations personnel presented the spacecraft status. They also gave a short presentation on the Afternoon Constellation. The IOTs noted getting together as a group

meeting is worthwhile and suggested that the MOWG meet twice a year.

The Aura Data System Working Group (DSWG) (**Scott Lewicki**, chair) is chartered to address issues in common to all of the Aura Instrument Teams in the areas of data product formats, science system interfaces and testing, quality assessment, tools, and end-user interests. In previous meetings the DSWG has developed Aura File Format Guidelines for all Aura Level 2 products. At this meeting the team looked at promoting these Guidelines to a NASA Standard for use by any similar future project. It also looked at extending these Guidelines to Aura Level 3 products. Other discussions included XML formatted metadata, status of Interface Documentation, status of HDF-EOS and related applications, and development of tools for analyzing Aura data at the Goddard Earth Science (GES) DAAC.

The Validation Working Group (**Lucien Froidevaux** and **Anne Douglass**, co-chairs) met on Tuesday. The agenda included more than 40 short, focused presentations. Aura products discussed included temperature, ozone profiles, ozone columns, water vapor, carbon monoxide, nitrous oxide, hydrogen chloride, hydroxyl, and the nitrogen dioxide column. Aura data were compared to data from other satellites, models and climatology. They were also compared to the following other sources: ground-based measurements, including ozone sondes and water-vapor sondes; balloon profiles from the Fall 2004 flights in Fort Sumner; observations from the first Aura Validation Experiment (AVE), a mission using the WB-57 flown from Houston in October 2004 (cloud1.arc.nasa.gov/ave-houston/); observations from the Polar Aura Validation Experiment (PAVE) (<http://cloud1.arc.nasa.gov/ave-polar/>), a mission using the DC-8 flown from Portsmouth, NH in January/February 2005.

Attendees left this meeting with a sense of the present state of the data from TES,

MLS, and OMI. A more comprehensive Validation Workshop is planned for the week of September 19, 2005.

Working group chairs gave reports on their sub-meetings to the plenary session; the validation report included brief summaries by sub-group leaders of all the information provided for temperature and various constituents.

The plenary session opened on Tuesday with a welcome from the Project Scientist **Mark Schoeberl**. James Gleason represented NASA headquarters as Phil DeCola, the Aura Program Scientist, was unable to attend this meeting due to illness. **Bill Guit** provided a brief report on the status of the Aura spacecraft. Aura operations have been smooth partly because the flight operations personnel have experience with Aqua, Aura's twin spacecraft.

The principal investigators of the four Aura instruments reported on the operational status of their instruments and on the retrieved data that is currently being validated.

Reinhard Beer reported that TES is working well, and tropospheric ozone is being retrieved from nadir soundings made along with limb soundings in the Global Survey model and used in the special "step and stare" mode (a sequence of only nadir views). The optical bench is being warmed to improve the instrument alignment and improve the carbon monoxide (CO) measurements. TES Level 2 nadir products will be generally available this summer.

Pieter Levelt reported that all products from the OMI are being retrieved except the ozone profile, which needs algorithm work, and chlorine dioxide (OCIO) (partly due to its seasonal dependence). In-flight calibration of OMI, necessary because pre-launch calibration was inadequate, is underway. The total ozone product retrieved from OMI data using a Total Ozone Mapping Spectrometer (TOMS) algorithm differs

by only a few percent from that retrieved using the Differential Optical Absorption Spectrum (DOAS) method of data processing. Differences correlate with clouds because they are accounted for differently by the two retrievals. OMI products from the Total Ozone Mapping Spectrometer (TOMS) ozone algorithm and for aerosols are expected within a month.

Joe Waters reported that MLS data are becoming available from the GSFC DAAC, and stressed that the MLS data quality document is required reading for anyone working with this partially validated data set. The instrument is performing well: noise is low, and signatures of molecules such as upper tropospheric CO are present and clear even though there are nearby lines due to O₃.

John Barnett said the HIRDLS scan mirror has been blocked by kapton since launch. Attempts to move this obstruction have failed, but there is one azimuth angle for which HIRDLS partially views the Earth's atmosphere. Since the instrument is operating with extremely low noise and the obstruction itself is stable, it should be possible to characterize the effect of the obstruction on the measured radiance, remove the effect of the blockage, and then retrieve high-resolution profiles from the remaining atmospheric radiance. HIRDLS has been in its single azimuth observing mode since late January. They anticipate HIRDLS data for validation before the September Validation Workshop.

The remainder of the plenary session was devoted to science presentations, some giving early results from Aura data and some using other data sources but relevant to Aura science. The poster session Wednesday afternoon included more than 40 posters covering a wide range of topics and was a highlight of the meeting. Titles and abstracts can be obtained from the Aura website. Oral presentations are mentioned briefly below.

Peter Bernath described the Sci-Sat platform that consists of the Atmospheric Chemistry Experiment (ACE) and Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation (MAESTRO). ACE data will be important to validation of Aura profiles and will be accessible to Aura investigators through the Aura Validation Data Center (AVDC).

Because total ozone responds to changes in solar flux, volcanic aerosols, and changes in atmospheric composition, and because the overhead column varies significantly with latitude and season, it is not a simple task to obtain evidence of ozone recovery following cessation of the production of chlorofluorocarbons. **Betsy Weatherhead** detailed statistical approaches, noting that present models more or less reproduce the “observed” decline but do not capture the recent changes in column ozone (while stratospheric chlorine is declining slowly).

Ross Salawitch showed that bromine monoxide (BrO) is underestimated by models used in assessments of past ozone trends and prediction of future ozone behavior. Such simulations have prescribed boundary conditions that neglect any influence of short-lived halocarbons.

Curtis Rinsland showed that solar flares in October/November 2003 affect concentrations of nitrogen species and ozone in the upper stratosphere. Comparisons of ACE profiles with Atmospheric Trace Molecules Observed by Spectroscopy (ATMOS) data from the early 1990's suggests that chlorofluorocarbon (CFC)-11 and CFC-12 have leveled off in the stratosphere while sulfur hexafluoride (SF-6) and CFC-22 continue to increase.

Mike Newchurch addressed issues concerning recovery of stratospheric ozone. He presented convincing evidence from Stratospheric Aerosol and Gas Experiment (SAGE) observations that there has been a cessation of decline of upper stratospheric ozone (partly because chlorine gases no longer increase) and cooling

due to CO₂. Recovery of the ozone column and lower stratospheric ozone is much more complicated.

Pepijn Veefkind presented first results for the OMI Nitrogen Dioxide (NO₂) product. A mobile lidar is being used to provide information concerning the tropospheric NO₂ profile shape. The OMI retrieval is sensitive to the shape of the NO₂ profile and the height of the NO₂ peak.

Simon Carn showed results of the OMI Sulfur Dioxide (SO₂) retrieval. The retrieval procedure uses total ozone residuals at 4 wavelengths that are sensitive to SO₂. Differences among wavelength pairs are a signature of SO₂. OMI horizontal resolution leads to impressive results: OMI can actually observe emissions associated with individual copper smelters.

Dong Wu presented early analysis of MLS data aimed at separating dense cirrus from deep convective clouds. Analysis relies on measurements in several MLS channels.

P. K. Bhartia showed that clouds are both a nuisance and an opportunity. Deep convective clouds absorb primarily with the cloud volume, allowing determination of the in-cloud ozone mixing ratio by using the “effective cloud pressure” which can be estimated using rotational Raman Scattering (the ring effect). The key assumption is that the ozone mixing ratio is independent of pressure inside the cloud.

Andrew Dessler showed an analysis of the effects of convection on the composition of the lowermost stratosphere. His argument, consistent with data from MLS, is that even rare convective events can impact the distribution of lower stratospheric water, because the mid-latitude lower stratospheric mixing ratio of water is much lower than the saturation mixing ratio. In contrast, rare convective events will have little or no impact on lower stratospheric ozone.

Leonhard Pfister coupled a microphysical model with a trajectory model to investigate the effect of convection on clouds and water in the tropical tropopause layer. He stressed that information from MLS, HIRDLS and TES along with information on clouds from the A-train partner CALIPSO (when launched) should resolve issues in this region.

David Fahey presented an update on the October 2004 component of the Aura Validation Experiment (AVE), a WB-57 mission flown from Houston Texas. He showed observations from a November 3, 2004 flight though a tropopause fold—the effects of the fold can be seen in the ozone profile—and contrasted the TOMS view of the effects of the fold on total ozone with that seen by OMI's much better horizontal resolution. He stressed that Aura instrument teams work with the AVE experimenters and project scientists to guarantee that appropriate and useful validation measurements are obtained.

Mark Schoeberl, Project Scientist for Aura and co-mission scientist for the Polar Aura Validation Experiment (PAVE), a DC-8 mission flown from Pease, NH, presented early results from PAVE. A comparison of lidar observations of ozone made along the satellite track with MLS profiles showed that MLS obtained evidence of a filamentary structure in ozone that was seen by the lidar.

James Elkins explained plans for a NOAA mission using Unmanned Aerospace Vehicles (UAVs). The mission, with logistics provided by NASA and with flight hours paid for by NOAA, will demonstrate some capabilities of UAV's to provide atmospheric observations that could be useful for validation.

Gloria Manney showed MLS observations of the break-up of the 2004 Antarctic vortex. Remnants of vortex air can be tracked through November. The global observations of hydrochloric acid (HCl) can be used to infer the relative importance of mixing and chemical transfor-

mation as the Southern Hemisphere recovers from this annual event.

Ivanka Stajner presented preliminary results for assimilation of OMI total ozone and MLS profiles compared with assimilation of lower vertical resolution profiles from the Solar Backscatter Ultra Violet (SBUV). The assimilation system using MLS produces profiles that compare better with Polar Ozone and Aerosol Measurement and SAGE than the profiles produced by a system using OMI and SBUV.

Hanwant Singh related experience from the A phase of the Intercontinental Chemical Transport Experiment (INTEX) (Summer, 2004) and plans for INTEX B (Spring 2006). Since the Aura launch was delayed there was no opportunity for validation of Aura measurements during INTEX A, but other coincident profiles were obtained allowing for validation of Measurements of Pollution in the Troposphere (MOPITT), Multiangle Imaging SpectroRadiometer (MISR), Atmospheric Infrared Sounder (AIRS) and Scanning Imaging Absorption Spectrometer for Atmospheric Chartography (SCIAMACHY).

Jasma Pittman interpreted transport pathways in the subtropical lowermost stratosphere using data from the Cirrus Regional Study of Tropical Anvils and Cirrus Layers—Florida Area Cirrus Experiment (CRYSTAL FACE) campaign in July 2002.

Susan Kulawik explained how the TES instrument can obtain useful information about tropospheric composition in the presence of clouds, as long as the cloud optical depth is less than one. The effects of clouds are parameterized and included in the forward model, and retrieved simultaneously with constituents. Validation includes comparisons with observations from Moderate Resolution Imaging Spectroradiometer (MODIS) on Aqua.

Richard Stimpfle presented observations of chlorine monoxide (ClO), chlorine

nitrate (ClONO₂) and HCl from the SAGE III Ozone Loss and Validation Experiment (SOLVE) campaign. There are inconsistencies among these measurements as the reservoirs ClONO₂ and HCl are reformed during Spring. Formation of HCl via ClO + Hydroxyl free radical (OH) is substantial compared with formation via Cl + Methane (CH₄); ClO + Hydroperoxy free radical (HO₂) could also play a role if a reaction channel as small as 3% exists.

Elliott Weinstock compared water vapor measured by the Halogen Occultation Experiment (HALOE) and measured by frost point with the Harvard water vapor during Pre-AVE, and also compared HALOE measurements with Harvard water vapor during the Stratospheric Tracers of Atmospheric Transport (STRAT) and Photochemistry of Ozone Loss in the Arctic Region in Summer (POLARIS) missions. It is important to understand differences among measurement techniques to be able to differentiate the mechanisms which control stratospheric water.

Qinbin Li used a simulation using the GEOS Chemistry and Transport Model (GEOS CHEM) to show that a broad maximum in CO observed by MLS at 147 hPa over the Tibetan plateau is consistent with trapping of deep convective pollution by upper level anticyclones.

Kelly Chance discussed prospects for retrieval of BrO, formaldehyde (HCHO) and OClO from OMI. The biggest problem for retrieving these weak absorbers is the calibration of OMI's Level 1B product.

Daniel Jacob showed that column HCHO is simply related to its sources in the absence of wind. In the real atmosphere dispersion quickly reduces the column below the detection limit. Global Ozone Monitoring Experiment (GOME) data compares pretty well with *in situ* flux measurements, but the large GOME footprint makes such comparisons problematic.

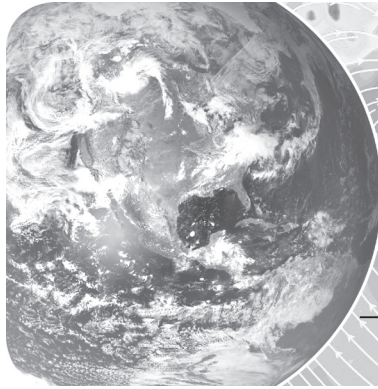
James Anderson presented his ideas for developing an observing system that can answer questions of important societal significance during the coming decades.

Karen Rosenlof reviewed results of previous intercomparisons of water vapor, and stressed the importance of obtaining seasonal measurements in the northern hemisphere middle latitudes. Previous measurements suggest a broad minimum over a large altitude region at equinox, strong minima in January and February, and highly variable maxima during summer (indicating the need for stringent coincidence criteria for validation measurements). Complete validation of Aura's water vapor measurements requires that the validation measurements test the dynamic range of the satellite instruments.

Elizabeth Moyer discussed intercomparison of water vapor isotopes, and also the information that can be obtained concerning mechanisms controlling water vapor from these detailed isotopic measurements. This overview talk set the stage for the final two talks of the meeting. **Thomas Hanisco** talked about the HOXITOP instrument that uses a combination of photolysis and laser induced fluorescence to detect deuterium (HDO) and H₂O from the WB-57. **Frank Keutsch** discussed the design of the Harvard Integrated Cavity Output Spectroscopy (ICOS) Isotope instrument, a new *in situ* instrument which offers significant improvement in sensitivity over traditional *in situ* mid-infrared spectroscopic instruments. He presented measurements of several isotopes of water (HDO, H₂¹⁸O and H₂O) in the near-tropopause region that were made during the first flights of the instrument.

The next Aura science team meeting is planned for November and will be hosted by the OMI team in the Netherlands.





EOS Scientists In The News

— Robert Gutro, rgutro@pop900.gsfc.nasa.gov,
NASA Earth Science News Team

Near Record Rainfall in Los Angeles, April 29; *Los Angeles Daily News*, *LA Times*. **Bill Patzert** (NASA JPL) interviewed with Josh Kleinbaum of the *Daily News* and with Claudia Zequeira and Wendy Thermos of the *LA Times*, respectively for articles on recent rains. Los Angeles' rainfall inched closer to an all time record after getting 1.02 inches early Thursday. The city was only 1.12 inches shy of the all-time high.

Scientists Confirm Earth's Energy Is Out Of Balance, April 29; *Associated Press*, *ABC News*, *Al Jazeera*, *BBC News*, *CNN*, *ENS*, more than 50 U.S. TV stations, *USA Today*, the *Weather Channel* and many more. Scientists have concluded more energy is being absorbed from the sun than is emitted back to space, throwing the Earth's energy "out of balance" and warming the globe. Scientists from NASA, Columbia University, New York, and Lawrence Berkeley National Laboratory, Berkeley, Calif. used satellites, data from buoys and computer models to study the Earth's oceans. **Jim Hansen** of NASA's Goddard Institute for Space Studies, New York confirmed the energy imbalance by using precise measurements of increasing ocean heat content over the past 10 years. Other GISS scientists interviewed include: **Gavin Schmidt**, **Anthony Del Genio** and **Dorothy Koch**. Original story: www.nasa.gov/vision/earth/environment/earth_energy.html

The Climate of Man, April 25; *New Yorker* magazine. This article is about current climate change references disap-

pearing islands, thawing permafrost, and melting polar ice. It highlights how the Earth is changing and mentions research by **James Hansen** (NASA GISS) and **Jay Zwally** (NASA Goddard).

Drought in the American West, April 27; *KFWB News radio* (980 am), Los Angeles. **Bill Patzert** (NASA JPL) interviewed with Jack Popejoy, news anchor person with KFWB News radio (980 am), about the continuing drought in the American West and possibility of a record breaking rain year in Los Angeles.

Science Takes Hands-Off Approach, April 21; *Antelope Valley Press* (Lancaster, CA) Story of a NASA and NOAA partnership for a series of spring research flights to gather scientific data and test the concept of using an unmanned aircraft to carry out such missions. **Cheryl Yuhas**, NASA (Dryden) Suborbital Sciences Manager, commented that the mission's long-endurance flight will employ sensors to validate data collected by NASA satellites.

Climate Change: Serious Risk or Environmental Hoax?, April 21; *WRVA-AM*, news and talk radio, Richmond, VA. **Bruce Wielicki**, NASA Langley senior Earth scientist climate change specialist, was featured on WRVA-AM. Wielicki summarized the science behind the concerns and challenges associated with global climate change, promoting his lecture on climate change that he presented at the Virginia Air and Space Center in Hampton, Va. on April 21 in celebration of Earth Day.

Earth Day, April 21; *Pasadena Weekly News*. Climatologist **Bill Patzert** (NASA JPL) was quoted extensively in this article about Earth Day. Patzert said "At NASA, every day is Earth Day."

Eurasian Snow Melt Causes Large Ocean Plant Blooms, April 21; Appeared in many websites around the world, including: *BBS News*, *Biology News*, *Ocean Conserve*, *ScienceDaily*, *SpaceRef*, *Spacewire*, *Water Conservation*. The story was carried in the U.S., the U.K., China, Canada and Germany. The study finds a decline in winter and spring snow cover over Southwest Asia and the Himalayan mountain range is creating the right conditions for more widespread blooms of ocean plants in the Arabian Sea. Joaquim Goes, a senior researcher at the Bigelow Laboratory for Ocean Sciences in Maine was quoted. Original story: www.nasa.gov/vision/earth/lookingatearth/eurasian_melt.html

Climate Change: Serious Risk or Environmental Hoax?, April 19; Radio program "*HearSay with Cathy Lewis*" on 89.5 *WHRV-FM*, eastern Virginia. **Bruce Wielicki** (NASA Langley) was featured on this radio program. This feature examined the legacy and future of the environmental movement. Wielicki summarized the science behind the concerns and challenges associated with global climate change, and fielded calls from listeners across Hampton Roads of Virginia [from Richmond, Virginia to the Outer Banks of North Carolina]. During the interview, Lewis promoted a climate change lecture that Wielicki presented at the Virginia Air and Space Center in Hampton, Va. on April 21 in celebration of Earth Day.

Explosions in Space May Have Initiated Ancient Extinction on Earth, April 11; *Astrobiology*, *Kashar News* (Pakistan), *Kerala Next* (India), *New Zealand Herald*, *red Nova*, *Science Blog*, *SpaceDaily*, *Spaceflight now*, *Space Times*, *Space Today*, *Washington Times*, and many more. Scientists at NASA and the University of Kansas using atmospheric modeling say

that a mass extinction on Earth hundreds of millions of years ago could have been triggered by a star explosion called a gamma-ray burst. Mentioned in different versions of the news were Adrian Melott (University of Kansas, Lawrence); Brian Thomas (University of Kansas), **Charles Jackman** (NASA's Goddard Space Flight Center) and Bruce Lieberman (University of Kansas). Original story: www.nasa.gov/vision/universe/starsgalaxies/gammaray_extinction.html

Southern California's Unusual Winter, April 7; *KNBC TV*, Channel 4, Los Angeles, CA. Patrick Healy, reporter with KNBC TV interviewed **Bill Patzert** (NASA JPL), for an 11 pm Evening News segment about the very unusual, wet winter in Southern California and the continuing drought in the U.S. West.

Scientists Find Earth's Auroras Aren't Mirror Images, April 5; Many websites, science web blogs and coverage in Africa, Canada, China, Finland, India, the U.K. and USA including *Scientific American Magazine*. Earth's northern and southern auroras are not mirror images of each other, as was once thought. From spacecraft observations made in October, 2002, **Tim Stubbs**, **Richard R. Vondrak**, and **John B. Sigwarth**, (all of NASA Goddard), Nikolai Østgaard (University of Bergen, Norway) and Louis A. Frank (University of Iowa) found that these circular bands of aurora shift in opposite directions to each other depending on the orientation of the sun's magnetic field, which travels toward the Earth with the solar wind flow. Original story: www.nasa.gov/vision/earth/lookingatearth/dueling_auroras.html

Jet Set Heats up the Skies: Contrails May Contribute to Global Warming, April 2005; *National Geographic Magazine*. **Patrick Minnis**' (NASA Langley) research was featured in this one-page "Geographica" piece which used satellite cloud products to show that contrails are having a significant impact on Earth's radiation balance and in global climate change. Minnis and his colleagues estimate that contrails and their resulting cir-

rus clouds may increase surface and lower atmospheric temperatures by 0.36 to 0.54 degrees Fahrenheit per decade.

Melting Point: Tracking the Global Warming Threat, March 27; *CNN Presents*. Miles O'Brien, reporter and producer for CNN, for a Sunday evening CNN Presents program, "Melting Point: Tracking the Global Warming Threat," interviewed **Bill Patzert** (NASA JPL). CNN correspondent Miles O'Brien traveled from the Arctic Circle to the South Pacific to examine the debate about whether global warming is taking place, whether humans are making it worse, what the effects might be and what should be done about it.

California Rain Storm Makes History, March 22, 23 & 26; *Los Angeles Times*, *Los Angeles Daily News*, *Redlands Daily Facts*, and *Pasadena Star News*. NASA JPL's **Bill Patzert** appeared in articles about the recent California rains that made history. The season's rain was only surpassed in 1883-84.

NASA Scientists Find Black Soot May be Changing the Arctic Environment, March 23; *Bloomberg News*, *Express Newsline* (India), *Houston Chronicle*, *The Independent* (U.K.), *India Times*, *Innovations Report* (Germany); *L.A. Times*, *Miami Herald*, *MSNBC News*, *SpaceFlightNow*, *TalkRadio702* (South Africa), *United Press International*, *Washington Times*, *Yahoo News!*, and many more around the world. New findings show soot may be contributing to changes happening near the North Pole, such as accelerating melting of sea ice and snow and changing atmospheric temperatures. **Dorothy Koch** of Columbia University, New York, and NASA's Goddard Institute for Space Studies (GISS), New York, and **James Hansen** of NASA GISS are co-authors of the study. Original story: www.nasa.gov/home/hqnews/2005/mar/HQ_05084_arctic_soot.html and www.nasa.gov/vision/earth/environment/arctic_soot.html

Continuing Drought in the West, March 22; *KFWB News Radio AM*, Los

Angeles. Jack Popejoy, news anchor person with *KFWB News radio* (980 am) interviewed **Bill Patzert** (NASA JPL) about the continuing drought in the American West and possibility of a record breaking rain year in Los Angeles.

NASA Announces Sun-Earth Day Activities, March 16; *Contra Costa Times* (CA), *Denver Post* (CO), *Gis User.Com*, *I-NewsWire.Com*, *Mysan.De* (Germany), *Science Blog*, *Spaceref*. This year's Sun-Earth Day on March 20 focused on "Ancient Observatories: Timeless Knowledge" and fell on the vernal equinox. NASA and the Exploratorium in San Francisco focused on ancient peoples and their fascination with the Sun, which played a major role in most Native American religious practices and social events. Original story: www.nasa.gov/vision/universe/solarsystem/sun_earthday.html

NASA Finds Lightning Clears Safe Zone in Earth's Radiation Belt, March 8; *Florida Today*, *Live Science*, *MSNBC*, *New Scientist*, *SpaceFlight Now*, *Yahoo News*, and others. Lightning in clouds, only a few miles above the ground, clears a safe zone in the radiation belts thousands of miles above the Earth, according to NASA-funded researchers such as **James Green** (NASA Goddard). The unexpected result resolves a forty-year-old debate as to how the safe zone is formed, and it illuminates how the region is cleared after it is filled with radiation during magnetic storms. Green's colleagues included **Scott Boardson**, **Leonard Garcia**, **William Taylor**, and **Shing Fung** (NASA Goddard) and Bodo Reinisch (University of Massachusetts, Lowell). Original story: www.nasa.gov/home/hqnews/2005/mar/HQ_05070_radiation_belt.html

Canada's Shrinking Ice Caps, March 6; *Blackvault* (Largest online military and government research center), *ClimateChange.com*, *Innovations Report* (Germany), *Keralanext* (India), *RedNova*, *ScienceDaily*, *Zinken/Worldwide Archeology*, and more. **Waleed Abdalati** (NASA Goddard) published research recently in

the *Journal of Geophysical Research* showing that Canada's Arctic ice is one of the more significant and immediate sources of world-wide changes in sea levels.

Original story: www.nasa.gov/vision/earth/lookingatearth/Canada_Ice.html

Satellites See Ocean Plants Increase, Coasts Greening, March 2; *The Australian*, *China View* (China), *Discovery.com*, *Hindustan Times* (India), *Indo-Asian News Service*, *Innovations Report* (Germany), *Navhind Times* (India), *Net India* (India), *New Kerala* (India), *Niburu* (Netherlands), Roland Piquepaille's *Technology Trends* (France), *Vista Verda* (Germany), *Terradaily*, and more. A few years ago, **Watson Gregg** (NASA Goddard) published a study showing that tiny free-floating ocean plants called phytoplankton had declined in abundance globally by 6% between the 1980s and 1990s. A new study by Gregg and his co-authors suggests that trend may not be continuing, and new patterns are taking place. Original story: www.nasa.gov/centers/goddard/news/topstory/chlorophyll.html

NASA Research Aids UNESCO Global Conservation Efforts, March 1, 2005; *The Economist*, *Energy for the Environment*, *Federation Of Earth Science Information Partners*, *Hindustan Times* (India), *Press Trust* (India), *SpaceWire*, *United Nations*, *U.S. Policy*, and more. NASA signed a Memorandum of Agreement (MOA) on March 1, 2005 with the United Nations Educational, Scientific and Cultural Organization (UNESCO) to foster improved global conservation through increased use of NASA Earth science research and remote sensing data. NASA's Acting Administrator **Fred Gregory** (Headquarters) was quoted. Original story; www.nasa.gov/home/hqnews/2005/mar/HQ_05061_unesco-global.html

Bill Patzert Discusses California Weather on Many Outlets, March 2005; *San Diego Union Tribune*, *News Talk KRLA* (870 am), *National Public Radio Santa Barbara* (102.3 fm), *Ventura Counties* (88.3 fm), *Talk Radio KTIE* (590 am), and *KABC Radio* (790 am);

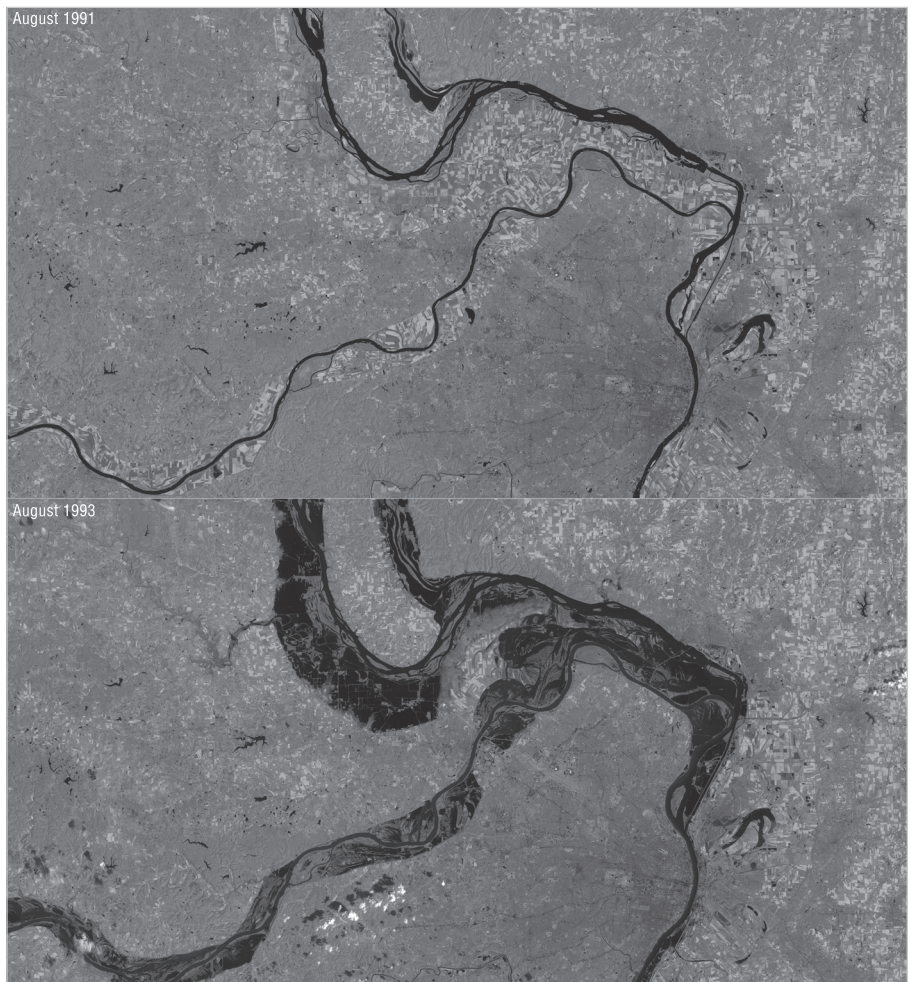
Bill Patzert (NASA JPL) was quoted about southern California's wet weather in the March 2 article "Weather Watch" in the *San Diego Union Tribune*, and hit the radio in an interview on March 4 with Lance Orozco of KCLU, National Public Radio in Santa Barbara (102.3 fm) and Ventura Counties (88.3 fm). He was also interviewed on March 7 with Larry Marino of News Talk KRLA radio (870 am) and News Talk radio KTIE (590 am). On March 21, Steve Gonzalez, reporter from Metro Networks News KABC radio (790 am in LA) interviewed Patzert about the rainy season, continuing drought in the West, and the high potential for a busy summer/fall fire season.

During the first half of 1993, the U.S. Midwest experienced unusually heavy rains. Much of the United States in the upper reaches of the Mississippi River drainage basin received more than 1.5 times their average rainfall in the first six months of the year. Floods overwhelmed the elaborate system of dykes and other water control structures in the Mississippi River basin, leading to the greatest flood ever recorded on the Upper Mississippi. In St. Louis, the Mississippi remained above flood stage for 144 days between April 1 and September 30, 1993.

This image pair shows the area around St. Louis, Missouri, in August 1991 and 1993. The 1993 image was captured slightly after the peak water levels in this part of the Mississippi River. Flood waters had started to recede, but remained well above normal. This image was created by combining infrared, near infrared, and green wavelengths of light observed by the Thematic Mapper (TM) instrument onboard the Landsat 5 satellite (TM bands 5, 4, and 2 respectively).



NASA images created by Jesse Allen, Earth Observatory, using data provided courtesy of the Landsat Project Science Office.



EOS Science Calendar

September 14-16

SORCE Science Team Meeting, Durango, CO. URL: lasp.colorado.edu/sorcel2005ScienceMeeting/

September 19

Aura Validation Workshop, Greenbelt, MD. Contact: Anne Douglass: anne.r.douglass@nasa.gov.

October 3-7

International EOS/NPP Direct Broadcast Meeting, Benevento, Italy. Contact: dbmeeting@backserv.gsfc.nasa.gov

Global Change Calendar

June 20 - 24

5th International Scientific Conference on the Global Energy & Water Cycle, Orange County, CA. URL www.gewex.org/5thconf.html

June 20 - 24

31st International Symposium on Remote Sensing of Environment, "Global Monitoring for Sustainability and Security," Saint Petersburg, Russia. Call for papers. URL: www.niesrc.spb.ru/isrse/call_for_papers.shtml

June 20 - 24

5th International Scientific Conference on the Global Energy and Water Cycle, Costa Mesa, CA. URL: www.gewex.org/5thconf.htm

June 28 - 30

Earth-Sun System Technology Conference 2005 (ESTC2005), College Park, MD. URL: esto.nasa.gov/conferences/estc2005/

July 24 - July 29

Gordon Research Conference on Radiation and Climate. Colby College, Waterville, Maine. URL: www.grc.uri.edu/

July 31 - August 4

SPIE's Earth Observing Systems X Conference. San Diego, California. URL: spie.org/conferences/calls/05/am/

August 29 - September 1

Eighth International Symposium on Signal Processing and its Applications, Sydney, Australia. Call for papers. URL: www.elec.uow.edu/isspa2005/
Paper Submission: isspa05.suvisoft.com/corg/submission/

September 19 - 22

Sensors, Systems, and Next-Generation Satellites XI (RS03), Bruges, Belgium. Call for papers. URL: spie.org/conferences/calls/05/ers/



Announcement

International EOS/NPP Direct Readout Meeting 2005 - Call for Abstracts

We are five months away from our next International EOS/NPP Direct Readout Meeting 2005 to be held at the Mediterranean Agency for Remote Sensing in Benevento, Italy, October 3-6.

This 2nd announcement serves as an invitation for you to submit your presentation or poster abstract.

This year our meeting will focus on three primary areas: Direct Readout Application Algorithms, Systems, and Upcoming Continuity Missions. The meeting will first address the status of the existing EOS satellite missions along with individual instrument status. We will then focus on developments in

the direct readout application algorithms along with EOS instrument calibration and algorithm issues that have arisen this year. Vendor direct readout system presentations are also very much encouraged; it is recognized that along with the university community, the commercial sector has been setting the pace for acquisition and science processing systems and have indirectly determined how much EOS data gets used by the global community. We would also like to invite presentations on impacts real-time direct readout systems and algorithms have had in your community.

New continuity missions will also be discussed such as the NPOESS Preparatory Project (NPP) as a follow-on to EOS and as a precursor to NPOESS; as well as presentations and discussions on continuity science algorithms, availability and timelines.

This meeting is intended to foster discussions on science algorithm development and help academia and remote sensing agencies focus algorithm development priorities.

You may submit your abstract via email to: dbmeeting@backserv.gsfc.nasa.gov

Abstracts are due July 31.

The meeting website can be found at: dbmeeting.gsfc.nasa.gov

Please register at this site. You will also find information on travel assistance, hotel, transportation and sponsored tours that you may wish to sign-up for.





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To explore the universe and search for life,
To inspire the next generation of explorers
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The Earth Observer

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Notice

The Earth Observer will no longer be printed after the May-June 2005 issue. We will continue to produce new issues bi-monthly, but they will only be available on-line in PDF format at eospsa.gsc.nasa.gov/earth_observer.php.



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