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Michael King

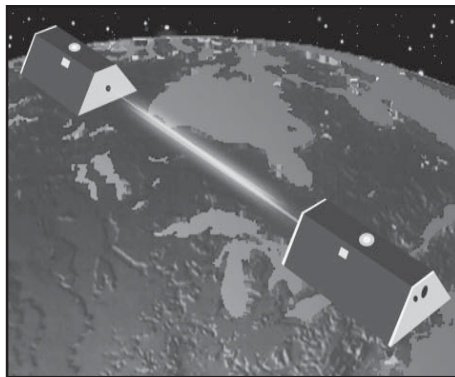
EOS Senior Project Scientist

Following up on my previous announcement that the Meteor 3M Stratospheric Aerosol and Gas Experiment (SAGE III) instrument was successfully launched on December 10, I'm pleased to report that SAGE III has completed all post-launch calibration exercises, and is now routinely acquiring both sunrise and sunset occultation data. Preliminary analysis of Lunar Level 2 data products (NO₂, NO₃, and O₃) indicates good agreement with profiles from LaRC's 2-dimensional atmospheric chemistry model. Overall, the instrument is performing as expected, albeit with high signal-to-noise ratio measurements. Additional refinement of the data is necessary due to the lack of GPS navigation data onboard the Meteor 3M Spacecraft. However, the SAGE III team is seeking support from the International Laser Ranging Service to provide satellite positioning information with sufficient accuracy to meet the instrument's retrieval processing requirements. SAGE III will extend important observations of aerosols, ozone, water vapor, and other important trace gases in the upper troposphere and stratosphere made by SAGE and SAGE II.

Similarly, the joint U.S./French Jason-1 mission that was successfully launched on December 7 has completed four cycles of mission operations and data collection, and is now producing its first operational science data products. Team managers from the French Space Agency's Satellite Control Center in Toulouse, France, and NASA's Jet Propulsion Laboratory, Pasadena, CA, have declared Jason's satellite, payload and ground segment are all functioning properly. Jason Project Scientist Lee-Lueng Fu reports a surprising level of accuracy in the initial science data, exceeding that of Jason's predecessor TOPEX/Poseidon. Like TOPEX/Poseidon, Jason will make observations of ocean surface topography for monitoring ocean circulation, studying the interactions between the oceans and atmosphere, improving climate predictions, and observing events like El Niño.

(Continued on page 2)

More recently, the Gravity Recovery And Climate Experiment (GRACE) mission was launched on March 17 from Plesetsk, Russia. The ROCKOT launch vehicle placed the satellites very accurately into their 89° inclination orbit and separated them from the upper stage exactly as planned. The commissioning phase is now underway and the instrumentation appears functional. Says Dr. Byron Tapley, Principal Investigator for GRACE, "We have a mission!" GRACE employs an extremely precise satellite-to-satellite microwave tracking system between two spacecraft 170 to 270 km apart to measure the Earth's gravitational field and its variations from solar maximum to solar minimum.



GRACE was successfully launched March 17. The drawing above depicts the GRACE satellites in orbit above the Earth separated by about 210 km. GRACE will measure the Earth's gravity with a precision that is 100 to 1000 times more than has ever been obtained to date and is expected to lead to new advances in the fields of hydrology, oceanography and geology.

Finally, I would like to congratulate the Ozone Monitoring Instrument Science Team for a successful OMI Algorithm Theoretical Basis Document (ATBD) review held February 8 near Goddard Space Flight Center. The Dutch-based team was very responsive and thorough in their ATBD preparation and presentations, and made every effort to address previously submitted written evaluations of each of the four OMI ATBD volumes. The initial OMI ATBD panel report was very favorable, and is a strong indication of scientific validity and accuracy of data products to be produced by OMI when the Aura satellite is launched in January 2004.



KUDOS:

Each year, the American Geophysical Union selects a small number of individuals as Fellows. The number of Fellows selected annually is limited to no more than 0.1% of the AGU membership. The Earth Observer staff wishes to congratulate the following EOS colleagues who have been named as AGU fellows for 2002:

Robert A. Bindshadler, NASA Goddard Space Flight Center

Dennis L. Hartmann, University of Washington

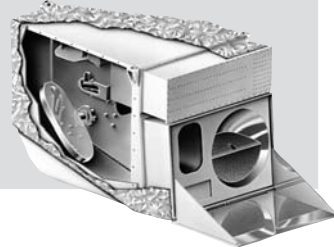
Judith L. Lean, Naval Research Laboratory

David A. Randall, Colorado State University

Steven W. Running, University of Montana

Minutes from the MODIS Science Team Meeting

— *Rebecca Lindsey (rlindsey@pop900.gsfc.nasa.gov), SSAI*
 — *Vincent Salomonson (Vincent.V.Salomonson.1@gsfc.nasa.gov), MODIS Team Leader, NASA Goddard Space Flight Center*



INTRODUCTION

The MODIS Science Team Meeting was held December 17-19, 2001, in Baltimore, MD. The meeting began with a welcome from **Vincent Salomonson**, the MODIS Team Leader, who indicated that he felt a lot of good progress was being made thanks to the aggregated, dedicated efforts of the MODIS Science Team, Technical Team, and all others associated with the MODIS effort. The MODIS efforts must continue to develop the data products for use by the science and applications community. From that perspective, the primary focus of the meeting was to address MODIS product quality status with respect to the Terra data maturity definitions - beta, provisional, and validated.

Some really intense efforts have been put forth in recent months to process MODIS data, but there remains a need to evaluate and respond to the needs and perceptions of the user community. Toward that end, Salomonson reported that he had initiated an end-to-end review of the MODIS data processing system by an external review team. The team was chaired by Moshe Pniel from JPL and met December 11-13, 2001. This MODIS Data Processing Review Team (MDPRT) provided five essential recommendations on how MODIS processing could make the best use of its

resources to get validated products out to the user community. Because MODIS is truly an instrument that can support global, interdisciplinary studies, one of the MDPRT recommendations included developing a reduced-resolution set of global data products that would be both useful to the scientific community and perhaps would allow for rapid reprocessing. The full MDPRT report is available on the MODIS web site.

DISCIPLINE TEAM AND PRODUCT REPORTS

OCEANS SESSION

The meeting was organized into sessions by discipline, with the first session devoted to Oceans Group products. **Wayne Esaias**, Oceans Group Leader, expressed enthusiasm for the good results coming out of the team. They have found, in general, some calibration bias corrections that had not been accounted for in the ocean color data processed to this point, but once those corrections are introduced this spring and the data are reprocessed, nearly all ocean products should be able to be considered validated.

Sea Surface Temperature (SST)

Bob Evans reported that global SST maps demonstrate outstanding coverage and excellent continuity. Based on validation

from a variety of sources, it appears that the SST standard deviation is better than 0.25°C. Peter Minnett presented results of comparisons of M-AERI cruise ship data versus MODIS SST, indicating standard deviations of around 0.2 K, which is excellent agreement. Similar MOBY-MODIS, best-pixel comparisons have standard deviations around 0.5 W/m². There may be a warm bias regionally, but Minnett concluded that the MODIS 11-12 μm SST could be considered validated from November 2000 to the present.

Ocean Color

Despite the calibration biases discovered this year, the MODIS Ocean Color products look quite good for unaffected time periods, and a few products can already be considered validated for those specific periods (i.e., December 2000). The full time series will likely be validated after the next ocean reprocessing, expected in the summer of 2002.

A discussion of some results followed. **Howard Gordon** presented data showing that MODIS normalized water-leaving radiance values (nLws) are in excellent agreement with SeaWiFS—nearly 1 to 1—when optical depth is less than 0.2, with the nLws at 412 nm exhibiting better orbit-to-orbit continuity than the 551 nm nLws.

Barney Balch showed that for a simulated coccolithophore bloom in the Gulf of Maine, MODIS Calcite agreed well with ship measurements to values of ~2 μg/L—a factor of five better than expected. He said the Calcite product could be considered validated using east-side swath data. Full validation will come after reprocessing removes the east-west swath bias in the data. **Frank Hoge** reported that results from Fluorescence Line Height and Chlorophyll agreed close enough with aircraft sensor measurements to be considered validated based on

several case studies. **Ricardo Letelier** added that ultimately the team cannot validate Fluorescence Line Height until nLw is validated; and that they can validate Chlorophyll Fluorescence Efficiency only after IPAR and Absorbed Radiation by Phytoplankton products are validated. According to Hoge, Phycobilipigments and Dissolved Organic Matter products are more affected by calibration biases, and validation of these and the Phycoerythrin product would have to wait until the reprocessing.

Wayne Esaias concluded the Oceans session with results from analysis of the Primary Productivity product from December 2001. Both models (P1 and P2) look quite reasonable globally, and agree within a few percent with calculations based on SeaWiFS chlorophyll for the month of December 2000. Validation of this product will likely come about one month after the Chlorophyll product is validated.

LAND SESSION

Surface Radiation Products

Eric Vermote reported that comparisons of the Land Surface Reflectance product to high-resolution surface reflectance data from Landsat ETM+ aggregated to MODIS resolution showed that values were well within the pre-launch specified error bars. In the long term, they would like to move into fine calibration (below error bars), and would like to correct for mirror side differences and polarization.

Crystal Schaaf reported that a number of field campaigns have been undertaken for validation of the Bi-directional Reflectance Distribution Function (BRDF) products, including some in the U.S., Africa, and China. Results from the Beltsville Agricultural

Research Center in Maryland showed errors of less than 5% using scaled-up ground and tower imagery. They expect validated products by the first half of 2002.

Zhengming Wan presented results from four field campaigns in 2000 and four in 2001 designed to assess the Land Surface Temperature (LST) and Emissivity products. For cases over lake sites, the differences in MODIS 1 km versus in situ measurements ranged from 0.2 K to 0.9 K. Over grassland and rice fields, differences were less than 1 K. Over a playa in Railroad Valley, Nevada, after a correction with 5-km LSTs, the MODIS LSTs also agreed with in situ LSTs within 1 K. In general, from -10 to almost 50° C, with column water vapor between 0.4 and 3.0 cm, measurements agree very well with in situ measurements. Validated products will be available with the next reprocessing, probably in July 2002.

Cryosphere Products

Dorothy Hall announced that in addition to the Snow Cover product at 500 m and Climate Modeling Grid (CMG) resolution, a beta-version Snow Albedo product would become available in the spring. The CMG products are available via their own web page as flat binary and hdf files. MODIS maps compare well with operational NOAA maps, and MODIS' more frequent coverage allows it to map more snow than others like ETM+. Sea Ice Surface Temperature (IST) results appear reasonable; however, the existence of thin clouds over sea ice can preclude accurate IST determination, so this remains a problem. Hall felt that once they are able to compare the MODIS snow maps with operational maps and ground measurements from this winter, they will be able to declare that the snow maps are validated.

Vegetation Variables

Alfredo Huete reported that the MODIS vegetation index algorithms, the Enhanced Vegetation Index (EVI) and the Normalized Difference Vegetation Index (NDVI), are provisionally validated, and that uncertainties continue to be reduced. Preliminary validation from core sites throughout the U.S. representing various ecosystems shows that expected seasonal trends are evident in both the EVI and NDVI. Multi-temporal comparison with ETM and MQUALS and ground measurements looks good. While they are getting good matches with ground measurements, he indicated that current validation is limited to clear sky conditions.

Juri Knyazikhin reported that the Leaf Area Index (LAI) and Fraction of absorbed Photosynthetically Active Radiation (FPAR) products could be considered provisionally validated according to the following criteria: the algorithm doesn't produce LAI/FPAR when uncertainties in input data exceed 15%; retrievals obey known relationships, such as the relationship of LAI and NDVI; the algorithm identifies situations when single angle data convey little information about canopy structure and reports their occurrences by assigning a special value to the QA; and the MODIS LAI/FPAR fields are comparable with those derived from other instruments, e.g., MISR, AVHRR and SeaWiFS. To move to validated status, they will be testing the LAI/FPAR retrievals using field data collected at various sites representative of major biome types. Initial validation results at a highly heterogeneous site indicate that the presence of water in the 1-km MODIS land pixel may result in an increased uncertainty in LAI/FPAR retrievals. Compared to SAFARI 2000 (wet season) data, the MODIS LAI is within the expected

uncertainties. Users should pay careful attention to the QA fields associated with the LAI product.

The culmination of the vegetation products is the MODIS annual Net Primary Productivity (NPP) product, and **Steve Running** reminded those present that NPP is inherently a time series measurement. Until they have a continuous first year of data, they can't start serious science or validation activity. Since photosynthesis and annual NPP change across the biosphere as a function of temperature and moisture, they can be regionally, but not globally, validated. Time series measurements from both the Pacific Northwest and Asia showed encouraging results. For example, PNN lags NDVI in the spring/summer, and fades more quickly in the fall, both of which are expected trends. Regionally, then, the MODIS products are behaving seasonally as expected, and Running expects more good results once they have a complete year of data, which should be available at the end of January.

Land Cover Products

Crystal Schaaf presented the status of the 1-km Land Cover product, which includes IGBP classification, secondary classes, confidence measures, the University of Maryland sub-pixel classification, and LAI/FPAR classification. Initial evaluation of the first and second most likely classes shows high accuracy, with discrepancies usually between two closely related categories, e.g., cropland and cropland mosaic. MODIS has more structure than EDC DISCover. BIGFOOT comparisons look very good in most situations, but may overestimate needle leaf forest. Once they have a full year of data representing the phenological cycle, they should be able to validate the products, probably by the first quarter of 2002.

John Townshend presented on the 250-m resolution Land Cover products: the Vegetation Cover Conversion (VCC) product and the Vegetation Continuous Fields (VCF). Townshend indicated they are very pleased with the initial results. Tree cover compared between Ikonos, ETM+, and MODIS is quite reasonable. They are comparing their VCF estimates to U.S. Forest Service data, and while MODIS seems to be underestimating for a few western states, that may be because the thresholds for definition of forest cover are different. They expect to have their first full version of the product (i.e., an annual cycle) by February 2002. He feels that even in its current state, the product is better than what is currently available from other sources.

For VCC, they are working on compositing issues caused by clouds and aerosols. They used the VCC product to analyze the impact of roads on burn severity in the Montana/Idaho border region in 2000, and their results show that burned area density increased in managed areas. The area burned by lightning-caused fires was roughly equal in managed versus roadless areas, but managed areas suffered more losses due to human-caused fires. Continental-scale results for the U.S. are promising, but still have issues such as false detection from snow melt or clouds over water. They plan to develop a simplified version of the product that will run in the Rapid Response System in 2002.

The Fire products from MODIS will make an important contribution to global change research by providing fire location, timing, and burned area estimation. **Chris Justice**, Land Group and Fire Team Leader, gave examples of the Fire products and described how fire validation activities are engaging the broad user community under the Global Observation of

Forest Cover/Global Observation of Landcover Dynamics (GOFC/GOLD) project. Preliminary results from active fire validation efforts in Africa, based on seven concomitant ASTER/MODIS scenes, show that errors of commission are rare and that agreement is good for the larger ASTER fires. MODIS-GOES comparisons show some differences that need further investigation. The global active fire product is planned to be validated by the middle of 2003. Burned area comparisons using Landsat data show a good match between the prototype MODIS burned area product and Landsat over several sites in Africa. Preliminary results were presented using burned area information to model regional emissions for southern Africa, associated with the SAFARI 2000 experiment.

The land session wrapped up with a presentation by **Jacques Desclotres** on the MODIS Land Rapid Response System. The system's standard product is an RGB image with active fire overlay; the products are used by the U.S. Forest Service (USFS), for imagery for the Earth Observatory, and for use by the Goddard Public Affairs and MODIS web sites for public relations purposes. They get their input feed from the NOAA "bent-pipe," and reuse IMAPP software from the University of Wisconsin-Madison. The system is 100% automated, producing products within 2-5 hours of acquisition. They are not keeping a long-term archive of data, but they do keep the imagery. They plan to transition this system into NOAA's operational service and provide algorithms to the Direct Broadcast community, using a code-sharing approach. A partnership has been developed between NASA and the USFS to enhance the utility of the rapid response system. Data are being provided to a number of fire management agencies around the world through the GOFC/GOLD pro-

gram. Data are also being provided to the Air Force Weather Agency. New developments are underway in the areas of agricultural monitoring, food security and flooding with the U.S. Department of Agriculture's Foreign Agricultural Service.

ATMOSPHERE SESSION

Cloud Products

Steve Ackerman described the challenge of global cloud detection: tests that work well in some places don't work well in others. He cautioned against evaluating the Cloud Mask on an individual granule basis because correcting single granules can produce undesirable effects elsewhere. For global cloud detection, the MODIS Cloud Mask has 48 bits representing the results of a variety of tests. He believes that the Cloud Mask could be considered validated at this point. Among the most significant improvements to the Cloud Mask is elimination of much striping in Band 26, which allows them to lower the threshold for cirrus detection from 0.035 to 0.01 reflectance. Ackerman said that the Cloud Mask code would be offered to Direct Broadcast users soon.

Michael King, Atmospheres Group Leader, reported that among the significant improvements to the Cloud Optical and Microphysical Properties product are revisions to the ecosystem model that allows them to use band-specific, MODIS white-sky albedo (1 km) rather than broadband albedo. Cloud validation is significantly different than aerosol, for which there is a large network of validation sites, but they have conducted preliminary comparisons using data from SAFARI 2000. MODIS retrievals are slightly larger for particle radius than in situ aircraft measurements suggest. Optical thickness is good compared to an integration of cloud liquid water content obtained during in situ profiles through

the cloud—values of about 5 for in situ observations and 3 ± 1 for MODIS. While King wouldn't feel comfortable calling the product globally validated, it is definitely scientifically useful at the granule and regional level.

Atmospheric Profiles

Paul Menzel gave the status of the Atmospheric Profiles: moisture, ozone, and cloud temperature and motion. He felt that most products could be considered validated. In case studies, tropospheric temperatures compared to AMSU with rms of better than 1°C , and to within 2°C of radiosonde observations. Dewpoint temperatures are within $2\text{--}3^\circ\text{C}$ rms of radiosonde values. The IR total precipitable water vapor is within 3 mm rms of GOES, and MODIS ozone agrees with GOES ozone to an rms of about 10 Dobson units over North America. Cloud top pressures compare well with GOES, and aircraft validation is better than 50 hPa. Menzel was enthusiastic about MODIS' success tracking polar winds, saying that MODIS observations had shown coherent atmospheric motion, and were within 7–10 m/s of the few observations available for validation in polar regions.

Water Vapor and Cirrus Detection

Bo-Cai Gao reported on the status of the Near-IR Water Vapor and thin Cirrus Detection algorithms. With respect to cirrus, the product is picking up great detail, including many contrails, and is tracking global seasonal trends well. Comparisons of MODIS near-IR vapor and microwave radiometer (MWR) vapor from March-June 2001 showed the near-IR vapor values to be about 10% higher than the MWR vapor values. However, from December 2000 to February 2001, differences were much smaller. There may be a drift in the radiometric calibration of the MWR, and they plan to conduct addi-

tional validation of MODIS Near-IR Water Vapor products based on MWR measurements and radiosonde measurements from a few DOE ARM sites.

Aerosol

Lorraine Remer gave the final atmosphere presentation on behalf of Yoram Kaufman and the rest of the Aerosol product group. They have compared MODIS aerosol (over ocean) retrievals to AERONET for 64 measurements during a 2-month period at 11 stations. Their results show correlations of $r = 0.94$ for 660 nm and $r = 0.95$ for 870 nm. They think that effective radius is validated to within $0.1 \mu\text{m}$ in the 0.2 to $0.8 \mu\text{m}$ size range. The group is confident that 1σ (66%) of individual retrievals are accurate to within $\pm 0.03 \pm 0.05\tau$ over ocean, to within $\pm 0.05 \pm 0.20\tau$ over land, or to within $0.10 \mu\text{m}$ for effective radius. In addition, there is no systematic bias, so that ensemble means and climatic averages will fall within the above stated uncertainties. Thus, most of the Aerosol Optical Thickness products could be considered validated from September 2000 onward. They hope that all aerosol optical thickness and size parameters will be validated by Spring 2002.

LEVEL 1 PRODUCTS

Jack Xiong summarized the status of the MODIS L1B product, including instrument issues that impacted the product. In 2001, MODIS had two anomalies: a temporary solid-state recorder failure, and the Power-Supply 2 shutdown anomaly in late June. After the July 2 turn-on, things have been operating smoothly on A-side electronics. Xiong said that signal to noise ratio (SNR) values in the reflective solar bands are within specification. Thermal bands are good except for Band 36, which has been out of spec since before launch. With respect to changes in the L1B this year, there has been one change for

misregistration during aggregation in the high resolution bands, delivery of a consistent year dataset that used piece-wise Look Up Tables (LUTs), and finally, a change to turn off the 250 and 500 m bands while in night mode. With respect to Aqua, we can expect less optical and thermal leaks, and less cross-talk and sub-frame differences; however, Bands 5 (1.24 μm) and 6 (1.64 μm) have a significant number of dead or noisy detectors.

Kurt Thome presented results of validation of the L1B product using a ground reference calibration site in Nevada. The comparisons of MODIS reflective bands to ground measurements are generally within $\pm 5\%$. Cross comparisons for thermal bands show a little more scatter than for reflectance, but again both look pretty good. In most cases agreement is better than 2% on average, except for the 905 nm band. Thome thought that L1B could be considered validated.

Robert Wolfe presented on the Geolocation product. Since the Collection 3 data set production began, the along-scan error decreased from 58 to 56 m; however, in the along-track direction, the error increased from 57 m to 74 m, which is well within specification (150 m), but above their goal (50 m). They plan an update in January, after a consistent year is done, that introduces correction for tilt versus pitch bias (40 m in track direction at large scan angles). They can also remove ± 10 m, mirror-side difference in scan direction. They also plan to review the use of FDF-processed attitude data since the along-track errors seem to be correlated with the spacecraft pitch. In some regions, the inland water bodies in the land-sea mask may not be as good as the team would like. The geolocation group uses the EOS Digital Elevation Model SWG, which is the best available. Wolfe cautioned people about using this

for fine resolution work, and showed an example of rivers being displaced 2-3 km in South America. With the land team, they are investigating the possibility of using MODIS data to update the land-water mask.

DATA PROCESSING STATUS

Steve Kempfer, Goddard Earth Science (GES) DAAC Manager, gave a status report from the three DAACs that archive and distribute MODIS data. The highlights are that GES DAAC processing and reprocessing are going well. As of January 2002, the DAAC has more than a full year of reprocessed data. They have been processing at a rate of 3X, with bursts of 4X. They have gotten past problems with a problematic software drop in the summer of 2001, and have been developing many tools, such as parameter and spatial subsetting. They are sending out data via subscriptions to other DAACs for their use and secondary distribution.

Ed Masuoka, Science Data Support Team Leader, reported that processing in the MODIS Adaptive Processing System (MODAPS: for Level 2 and higher data products) has been allowed by ESDIS to rise above the 96 baseline, which the team appreciates. At the end of January, the system will have processed 15 months of data in 7 months. This is about 2X, or 2.4 TB/day. In 2002, they plan to add 128 Linux dual-processors to the system, and increase disk space by 60 TB. Per the recommendation of the MDPRT, they are talking with ESDIS about the possibility of getting a machine-to-machine gateway between the GES DAAC and MODAPS to streamline processing.

PROGRAMMATIC PERSPECTIVES

Diane Wickland, MODIS Program Scientist, presented some of the Earth Science Enterprise performance metrics,

especially as they relate to MODIS:


- Quantify year to year variation in marine and terrestrial primary production (PP) in five years
- Describe ten-year (decadal) variation in PP and more detailed relationships
- Provide global fire inventory in five years
- Discriminate phytoplankton from detritus and other matter in coastal waters
- Provide first comprehensive data set for aerosol sources and sinks
- Characterize role of land cover change associated with natural fires
- Extend ISCCP data set
- Describe radiative forcing due to aerosols.

Specific metrics include merging MODIS and SeaWiFS ocean color data to increase coverage 25%, testing ability to discriminate phytoplankton using fluorescence, validating results from SAFARI, and making AVHRR-MODIS correlations. Wickland explained that Headquarters must conduct a self-analysis based on the metrics that can be audited by OMB. Salomonson and the Discipline Group leaders indicated their desire to continue to be involved in the development of the metrics and their assessment.

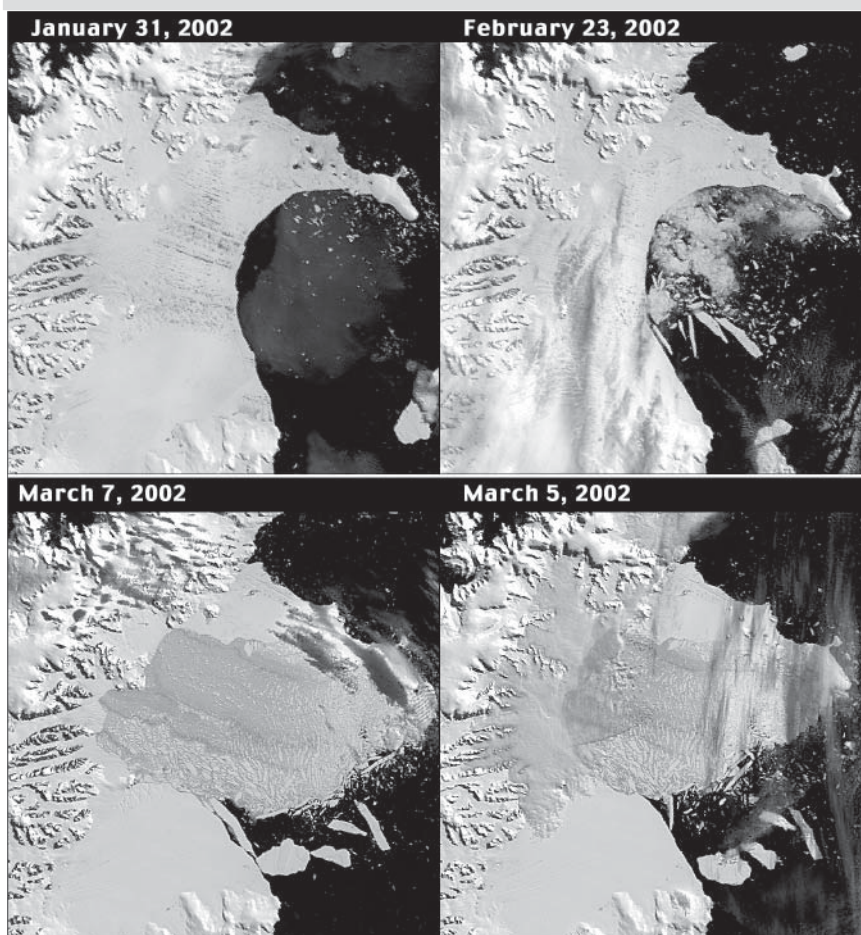
CONCLUSIONS

Salomonson thanked everyone for attending and observed that MODIS is making considerable progress in getting results that are useful to the science and applications community. He observed that "MODIS success" will continue to be the sum of: (a) science-quality products being developed and validated; (b) the MODIS data products being produced, reprocessed as necessary, and delivered to the archives; and (c) the access to the MODIS products being such that users can get

what they want without undue difficulty or burden. It was Salomonson's opinion that (a) is going fine, but considerable challenges lie ahead for (b) and (c). Of the two, (c) is probably the largest, near-term challenge, and he and the Science Team need to work with the ESDIS, et al. to do whatever can be done to make the data access "user-friendly" as quickly as possible. The data processing, (b) above, will continue to be a challenge, involving the utilization of known or expected resources for processing and reprocessing in as efficient and strategic a manner as possible. The Team also needs to do whatever can be done in terms of outreach and interaction with the community to inform and assist them regarding the status and use of MODIS data and products. This means planning workshops, attending and presenting at scientific meetings, etc.

The next Science Team Meeting should occur 6-7 months from this one. In the meantime everyone will be kept informed via Technical Team minutes and, possibly, telecons as issues requiring such occur. This article is a summary of the minutes of the two-day plenary session. For full meeting minutes, as well as additional minutes and attachments from breakout meetings, please visit the "Science Team" section of the MODIS web site - modis.gsfc.nasa.gov. 

Larsen B Ice Shelf Collapses



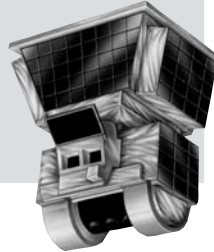
Recent Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery analyzed at the University of Colorado's National Snow and Ice Data Center revealed that the northern section of the Larsen B ice shelf has collapsed. The section that collapsed was approximately the size of the state of Rhode Island. Larsen B is a large floating ice mass on the eastern side of the Antarctic Peninsula. The series of images above show a progression of the breakup over time - starting in the top left image and progressing clockwise to the bottom left. The shattered ice formed a plume of thousands of icebergs adrift in the Weddell Sea. A total of about 3,250 square kilometers of shelf area disintegrated in a 35-day period beginning on January 31, 2002. Over the last five years, the shelf has lost a total of 5,700 square kilometers and is now about 40 percent the size of its previous minimum stable extent.

Ice shelves are thick plates of ice, fed by glaciers, that float on the ocean around much of Antarctica. The Larsen B shelf was about 220 meters thick. Based on studies of ice flow and sediment thickness beneath the ice shelf, scientists believe that it existed for at least 400 years prior to this event and likely existed since the end of the last major glaciation 12,000 years ago.

This is the largest single event in a series of retreats by ice shelves along the peninsula over the last 30 years. The retreats are attributed to a strong climate warming in the region. The rate of warming is approximately 0.5°C per decade, and the trend has been present since at least the late 1940s. Overall in the peninsula, the extent of seven ice shelves has declined by a total of about 13,500 square kilometers since 1974. This value excludes areas that would be expected to calve under stable conditions.

Minutes from the CERES Science Team Meeting

— *Shashi K. Gupta (s.k.gupta@larc.nasa.gov) and Jennifer M. Hubble (j.m.hubble@larc.nasa.gov) NASA Langley Research Center*



The 25th Clouds and the Earth's Radiant Energy System (CERES) Science Team meeting was hosted by **Steven Dewitte** of the Royal Meteorological Institute of Belgium (RMIB) in Brussels, Belgium, on January 21-23, 2002. The meeting focused on the status of new Tropical Rainfall Measuring Mission (TRMM) and Terra data products in development and validation, Terra long-term calibration stability, and Science Team results. The CERES meeting was coordinated with a Geostationary Earth Radiation Budget (GERB) meeting at the same venue to encourage interaction between the two teams.

Bruce Wielicki (LaRC), CERES Principal Investigator, gave an Earth Observing System (EOS)/CERES status report. EOS Team recompetitions are expected by June. Proposal inputs for CERES-heritage instruments on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) are currently being developed. The next CERES Science Team Meeting is scheduled for May 14-16, 2002, in Williamsburg, VA.

Instrument Status

Bruce Wielicki reported that the Terra instruments continue to operate without problems, and the Aqua instruments are

being readied for launch in April 2002. For Terra Flight Model (FM)-1, all channel gains in orbit were initially within 0.5% of ground values and there has been no detectable gain change in any channel. For Terra FM-2, initial Total and shortwave (SW) channel gains were within 0.2% of ground values, but the window (WN) channel was higher by 1.3%. There was no detectable gain change in the SW or WN channels, but the Total channel gain changed by 0.4%/yr. The Mirror Attenuator Mosaic (MAM) has experienced degradation. MAM performance for FM-1 is marginal (1% changes) and poor for FM-2 (3-6% changes).

Data Production

Wielicki next showed the progress on TRMM and Terra science data products. CERES is meeting science community expectations and needs, but all of the Terra data products are behind the original goals established in the early 1990s. Last fall, CERES delivered the first of a new generation of validated radiation data products that go well beyond the Earth Radiation Budget Experiment (ERBE) capability for climate analysis and accuracy. The remainder of the full suite of validated CERES TRMM products will appear by fall 2002. The ERBE-like versions of CERES data, however, have

been validated and in the archive since eight months after launch, and the global record of CERES Terra top-of-atmosphere (TOA) radiative fluxes is available from March 2000 through November 2001.

Clouds: TRMM and Terra

Patrick Minnis (LaRC) of the Cloud Working Group presented the status of cloud property retrievals from the Visible InfraRed Scanner (VIRS) and Moderate Resolution Imaging Spectroradiometer (MODIS). Beta versions of CERES MODIS cloud properties have been archived. Papers describing VIRS imager calibration have been accepted for publication and a paper describing cloud property comparisons with surface data has been submitted. A comparison of VIRS and MODIS imager calibration showed good agreement for most channels. A preliminary comparison of cloud properties derived by the CERES and MODIS groups using MODIS data showed overall consistency between the retrievals, but several scene-dependent anomalies were identified.

TRMM Angular Modeling and TOA Fluxes

Norman Loeb (Hampton University [HU]) reported on the status of TRMM Single Satellite Footprint (SSF) Edition 2 Angular Distribution Models (ADMs) and TOA flux validation. An area of concern for the TRMM SSF product is the need to adjust the ADMs and TOA fluxes to a more appropriate reference level. Loeb showed that in order to ensure that all Earth radiation contributions are accounted for when constructing ADMs, the field-of-view reference level where the viewing geometry is defined must be well above the Earth's surface. Loeb showed that the optimal reference level for defining TOA fluxes in Earth radiation budget studies is about 20 km.

TRMM SSF Edition 2 Surface Fluxes

Shashi Gupta (Analytical Services & Materials, Inc. [AS&M]) presented results of the validation studies of surface-only fluxes. For cases involving shortwave (SW) clear-sky fluxes, the study indicated good agreement between 1-minute surface measurements and the Langley Parameterized Shortwave Algorithm results. In contrast, the study also indicated a 30 W/m² bias, attributable to aerosol forcings, between surface measurements and the Li-Leighton formulation. Large all-sky rms errors were significantly reduced by using 60-minute averaged surface data. For longwave (LW) clear-sky fluxes, there is good agreement between the surface fluxes and the Inamdar and Ramanathan model. The Langley Parameterized Longwave Algorithm was in good agreement with surface fluxes for both clear- and all-sky conditions.

SARB Retrievals

Thomas Charlock (LaRC) and **Fred Rose** (AS&M) gave a status report on the retrieval of the vertical profiles of fluxes - the Surface and Atmospheric Radiation Budget (SARB). This component of CERES uses a radiative transfer code to simulate the fluxes observed at TOA. Inputs to the code include imager-based cloud and aerosol properties, as well as European Center for Medium Range Weather Forecasts (ECMWF) temperature and humidity profiles. The SARB algorithm constrains (tunes) key inputs (i.e., cloud optical depth) and observables (i.e., outgoing LW radiation, OLR) to achieve a least squares fit based on *a priori* uncertainties for the key inputs and observables.

Rose covered recent changes to the CERES algorithms to retrieve the SARB profiles. Improvements to the radiative transfer code included adding a water vapor

continuum, modifications to the spectral shape of land surfaces in the near IR, and parameterization of ocean surface spectral albedo according to wind speed, sun angle, and aerosol/cloud optical depth. Constraint (tuning) now uses new *a priori* uncertainty values for TOA fluxes, consistent with the more accurate CERES observations. Charlock chronicled the improvement in the performance of the SARB algorithm through the current (Beta 3) version. He demonstrated that constraint (tuning) reduces bias and rms errors by roughly one half. A disappointing comparison with Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) data at the surface was attributed to questionable surface observations, rather than to CERES retrievals.

Geostationary Data Enhanced Averaging

David Young presented the status of the temporal interpolation of CERES products using data from imagers aboard geostationary satellites. The first Level 3 results based on Edition 2 CERES TRMM data were shown. A comparison of monthly mean SW and LW fluxes derived with and without geostationary data revealed large corrections in regions of poor temporal sampling near the upper latitude limit of the TRMM orbit. Histograms of monthly mean flux revealed no significant shifts due to the inclusion of the geostationary data. Processing of the geostationary imager data is on schedule. Cloud properties derived from the geostationary data were shown to be consistent with VIRS-derived properties.

Surface and Atmospheric Radiation Budget Working Group

The SARB meeting was chaired by **Tom Charlock**. The goal of the meeting was to get recommendations of the Working Group (WG) on several outstanding issues

facing the SARB team. The Beta 2 version of SARB/CRS data has a problem in the ice-cloud tuning part of the code which results in larger errors for the ice-cloud overcast footprints. The WG recommended that the SARB team not release the Beta 2 version and release the corrected (Beta 3) version when ready.

Charlock presented a revised table of *a priori* uncertainties (tuning sigmas) used in the constraint process in SARB processing. He noted that the sigma of the natural logarithm of aerosol optical depth for land areas was smaller than that of ocean areas. The WG recommended that this tuning parameter for land areas should be equal to or greater than for ocean areas. Constraint in the LW region is currently performed on the fluxes; however, since constraining radiances in some instances provided better results, the WG discussed the constraint options, but did not make specific recommendations. Charlock pointed out that the bulk of the error in SARB products is in the SW fluxes. The WG recommended that the SARB team conduct extensive objective tests to establish the benefits of 4-stream processing.

Cloud Working Group

The CERES Cloud Working Group, led by **Patrick Minnis**, held a discussion on recent developments from intercomparisons of VIRS and MODIS imager calibrations. The VIRS 3.7 μm channel calibration used by CERES/TRMM has a 0.5 K bias for some scenes. This will be corrected in future editions. **Jim Coakley** (Oregon State University [OSU]) presented a calibration comparison of VIRS and MODIS 1.6 μm channels based on sunglint scenes and presented results of a simulated surface/satellite cloud property comparison. **Alessandro**

Ipe (RMIB) investigated the normalization of cloud property retrievals from two different imagers. The results will be used to apply CERES-derived angular distribution models based on VIRS cloud property retrievals to GERB data using cloud properties from the Spinning Enhanced Visible and Infrared Imager (SEVIRI).

ADM and TOA Flux Working Group

Norman Loeb led the ADM working group meeting and presented a general overview of critical ADM/inversion research issues. **David Doelling** (AS&M) presented results from several instruments to examine the dependence of daytime LW and WN radiances on relative azimuth angle. Radiances tended to be larger in the backscattering direction and smaller in the forward scattering direction due to differences in surface temperature. The relative azimuth dependence was related to time of day and surface roughness.

Seiji Kato (HU) conducted a sensitivity study to determine the uncertainty in TOA flux caused by using the MODTRAN radiative transfer model to approximate the flux contribution of radiances emerging from above the Earth's tangent point.

Nicolas Clerbaux (RMIB) described the methodology used in GERB to convert measured radiances to LW fluxes. The method uses the correlation between the angular and spectral dependence of LW radiation to derive a theoretical regression function that converts SEVIRI spectral radiances to LW fluxes. GERB broadband radiances are used to adjust the SEVIRI-based fluxes. **Norman Loeb (presenting for Konstantin Loukachine)** showed results from a validation study of TOA CERES TRMM LW and WN fluxes. Compared to TOA flux estimates from the ERBE-like product, the new CERES SSF ADMs show a reduction in bias with viewing geometry by up to a factor of 5.

Nitchie Manalo-Smith (AS&M) presented an overview of current plans for development of Terra LW and WN ADMs.

Improvements can be made in scene identification, geometry, angular resolution, a theoretical model for estimating radiances in under-sampled angular bins, and implementing LW and WN models over snow surfaces.

TISA Working Group

The Temporal Interpolation and Spatial Averaging (TISA) Group, **led by David Young**, discussed recent progress in the development of monthly mean CERES products. New models of diurnal albedo variability are being developed from eight months of Edition 2 fluxes. Initial comparisons show general consistency between these empirical models with theory. Testing is underway to compare interpolations using these new models to the previously used models based on ERBE data. A discussion was held on the validation strategy for calibration of the narrowband geostationary imager data. Comparisons with VIRS and possibly ISCCP data are planned. Deep convective cloud albedos will be used to monitor imager gain consistency.

Invited Presentations

John Harries (Imperial College, London) presented an overview of the activities of the GERB project, a joint project between the United Kingdom, Belgium, and Italy. GERB was designed for measuring the broadband SW and LW radiation budget of the Earth from a geostationary platform. The GERB instrument will be flown onboard the first METEOSAT Second Generation (MSG-1) spacecraft, currently scheduled for launch in July 2002. Harries presented results from the characterization of the gains of SW and total channels, filter transmission, spectral response, and point-spread function. The GERB process-

ing system will use a number of models and methods developed for CERES processing.

Anthony Slingo (Hadley Center [UK]) presented an overview of the climate research at the Hadley Center. He described the model currently in use for climate studies, namely, the HadCM3. This model has a varying horizontal resolution over land and ocean areas, 19 vertical levels, and uses the Edwards and Slingo radiation code. Slingo showed a time-series of the observed surface temperature for 1860 to 2000 and stated that HadCM3 is being used to determine whether the observed temperature changes were caused by natural or anthropogenic factors. Model simulations showed precipitation decreasing in the absence of a CO₂ sink, and a positive feedback. Comparisons of LW and SW cloud forcing (LWCF and SWCF) were presented between the 40-year ECMWF Reanalysis (ERA40) which uses HadCM3 and ERBE observations. Good agreement was found for LWCF but not for SWCF. It was suggested that cloud forcing was strongly affected by highly interactive dynamical processes.

Investigator Presentation Highlights

Tom Charlock (LaRC) discussed early results from the Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) flights and summarized the new measurement capabilities at the CERES Ocean Validation Experiment (COVE) site. At COVE, the long-term Baseline Surface Radiation Network (BSRN), Aerosol Robotic Network (AERONET), and Multi-Filter Rotating Shadowband Radiometer (MFRSR) measurements continued. Wind speed/direction and temperature/humidity measurements at 10 m will start in February/March. Wenying Su (HU) is initiating a study of ocean foam using data

from a second spectral photometer. Given the high accuracy of CERES at TOA, surface albedo is now regarded as the primary uncertainty to assessments of TOA aerosol radiative forcing (ARF) in clear conditions.

James Coakley (OSU) presented estimates of direct ARF derived from CERES TOA radiances and aerosol optical depth (AOD) data from AERONET stations. Derived ARF values were generally independent of the aerosol model used but varied greatly from site to site. Low sensitivity was associated with sites with highly absorbing aerosols. Sites with non-absorbing aerosols showed high sensitivity.

Xiquan Dong (University of Utah) presented comparisons of CERES/MODIS retrievals of cloud properties with those measured at the ARM/SGP site. Satellite retrievals were performed by the CERES team using MODIS data for November 2000 to June 2001. Surface data taken with the mm-wave cloud radar provided reflectivity profiles. For thin clouds, cloud height and temperature showed good agreement during the day, but not at night. Results for thick clouds showed better agreement. He also compared effective droplet radius for daytime stratus clouds and concluded that MODIS retrievals overestimate cloud height during the night and underestimate effective droplet radius during both day and night. Liquid water path retrievals showed better agreement.

Leo Donner (Geophysical Fluid Dynamics Laboratory) presented results from a study of convective mass fluxes and tracer transport in a new parameterization of cumulus convection. Most existing cumulus parameterizations model only the deep convective aspects of the systems. In the new parameterization,

mesoscale circulation is also accounted for and the resulting tracer transport was much lower. This result is very significant with regard to atmospheric chemical composition when chemistry is included in the General Circulation Models (GCMs).

Steven Dewitte (RMIB) presented results of blending GERB-like fluxes derived from METEOSAT-7 data and corresponding CERES fluxes. A factor developed to correct for viewing zenith angle effects was found to be dependent on surface scene type. A corresponding effort for SW fluxes is more difficult because of the complex angular models and surface classifications.

Alexander Ignatov (NOAA) presented comparisons of aerosol optical depth (AOD) retrieved from TRMM/VIRS and Advanced Very High Resolution Radiometer (AVHRR) data. Because of the persistent problem with VIRS channel 2, Ignatov recommended that the team use only the AOD retrievals from VIRS channel 1.

Seiji Kato (HU) estimated the absorption by atmosphere and tropical ocean from CERES and ARM data taken at Manus Island. The results indicated that clouds over Manus Island present between January and August 1998 had a cooling effect to the column and a warming effect to the atmosphere compared to clear-sky conditions.

Robert B. Lee (LaRC) briefed the team on the long-term precision of ERBE nonscanner data. For 1984 to 1999, the ERBE nonscanner active cavity radiometer (ACR) measurements of SW and LW irradiances were stable at precision levels approaching 1 W/m^2 . A special spacecraft maneuver is being planned to observe deep space and the sun to provide the

calibrations required to determine the final ACR gains and zero-irradiance offsets, and to process the October 1999 through 2002 measurements.

Bing Lin (LaRC) reported on using CERES data to test the Iris hypothesis proposed by Lindzen et al. Lin used CERES ERBE-like and SSF data to detect high clouds and to estimate the radiative properties of tropical dry, clear- moist, and cloudy-moist regions. The net radiative forcing between cloudy-moist and clear-moist regions was generally an order of magnitude smaller than that of Lindzen et al. Using the CERES observed radiative properties, the climate feedback calculated from Lin's model was about a factor of 5-10 smaller than the Iris hypothesis.

Sergei Matrosov (University of Colorado) presented multi-year datasets of the properties of Arctic clouds collected at the ARM/North Slope of Alaska site and during the Surface Heat Budget of the Arctic (SHEBA) experiment. These properties were derived from measurements made by cloud radars, microwave radiometers, depolarization lidars, and Atmospheric Emitted Radiance Interferometer (AERI) instruments. These datasets are available to the science community and can be used for validation of CERES and MODIS cloud retrieval algorithms.

V. Ramanathan (Scripps Institution of Oceanography [SIO]) presented results of a validation of spatio-temporal properties of tropical convective clouds simulated in the GCMs using geostationary satellite images from METEOSAT-5. A Lagrangian analysis scheme was used to identify biases in cloud sizes and precipitation rates. The winter monsoon cloud systems are dominated by very large clouds, and the probability of cloud precipitation increased with increasing cloud size. He stated that most GCMs do not simulate

tropical convective clouds well.

David Randall (Colorado State University) presented results from a modeling study of mesoscale convective systems. The shapes, orientation, and propagation speed of these systems are their most important observed features, yet they are not well simulated in the large-scale models. The study was motivated by the fact that mesoscale convective systems or thunderstorms have widespread effects on human activities. In this study, latent heating was included as a forcing factor and linearized 3-dimensional equations of momentum, continuity, and thermodynamics were solved for the system. Model simulation comparisons with observations generally showed good agreement.

G. Louis Smith (Virginia Tech) described the annual cycle of surface radiation budget in terms of empirical orthogonal functions. He also examined temporal variations with periods between 10 days and a year, using the first year of CERES/Terra data. The data show variations that have a lifetime beyond the usual 10-day limit of predictability. The equatorial eastern Indian Ocean has especially strong variations in the 20 to 60 day range, which could be due to Madden-Julian oscillations.

Petra Udelhofen (State University of New York at Stony Brook) presented results from a study exploring relationships between cloud amount variability and variables like the galactic cosmic ray flux or the sunspot number over the U.S. Both galactic cosmic ray flux and sunspot number showed negative correlation with cloud amount.

Francisco Valero (SIO) presented an update on the Triana mission. This spacecraft will be located at the first Lagrangian point between the Sun and the

Earth. From this location, it will provide a synoptic view of the entire sunlit side of the Earth. A 10-channel imaging instrument will be used to monitor radiation budget, ozone, aerosols, cloud phase, and ultraviolet radiation at the surface. The expected lifetime of this spacecraft is about 10 years.

Michel Viollier (Laboratoire de Meteorologie Dynamique, France) presented correlations between narrowband (NB) fluxes from METEOSAT and broadband (BB) fluxes from Scanner for Radiation Budget (ScaRaB). LW correlation worked well for the entire region. SW correlation worked well except for some regions affected by sunglint. These NB-BB correlations can be used to derive broadband SW and LW fluxes using METEOSAT NB measurements. Another ScaRaB launch is scheduled for 2007.


Betsy Weatherhead (University of Colorado) presented results from a trend detection study on regionally averaged ERBE data. From a trend detection point of view, cloud and radiation data sets are not very well behaved and do not provide unambiguous results. Overall, regional trends in ERBE data were not strong.

Bruce Wielicki (LaRC) summarized his recent *Science* paper on the tropical decadal variability seen in 22 years of overlapping broadband radiation data, and what appears to be a shift of 3 W/m^2 in the tropical mean SW and LW fluxes from the late-1980s (85-89 baseline) to the mid-1990s (94-97 period between Pinatubo and the strong 97/98 El Niño). The decadal variations also show a shift in the seasonal variations in tropical albedo in spring and fall seasons. Comparisons were made to the major current climate models forced with observed sea surface temperatures, but the models failed to reproduce

the radiation field variations, including the large 1998 El Niño tropical mean anomalies. Wielicki also discussed a companion paper by Chen et al. Which shows a new method to compare upper tropospheric humidity, vertical velocities, and cloud fraction to the radiative anomalies shown in Wielicki et al.

Shi-Keng Yang (NOAA/National Centers for Environmental Prediction) presented results from validation of the Medium Range Forecast (MRF) model using CERES data. He described many improvements made to the MRF recently, especially those to the radiation scheme. A comparison between CERES OLR and AVHRR-derived OLR from NOAA showed good agreement only in the middle of the range.

Outreach

David Young (LaRC) presented an update on the CERES Students' Cloud Observations On-Line (S'COOL) educational outreach program. During the past six months, S'COOL signed up its 1000th participant and logged its 10,000th observation. S'COOL now has over 1000 schools in all 50 states and in 57 other countries. 

Minutes from the Meeting of the Federation of Earth Science Information Partners

— John K. Soldner, *jsoldner@hq.nasa.gov*, SAIC - ESIP Federation Front Office, Washington, DC



The Federation of Earth Science Information Partners (ESIPs) held its eighth semi-annual meeting in Anchorage, AK, from January 23-25, 2002. The first day was dedicated to small group meetings of Committees, Working Groups and Clusters. Much of the focus was on the overarching theme of developing end-to-end value chains for Federation activities. Below is a summary of the plenary sessions from Thursday and Friday and the Business Meeting.

THURSDAY JANUARY 24

General Announcements

Pat Reiff brought to the Assembly's attention the World Space Congress meeting in Houston, October 10-20, 2002, which is an opportunity for the Federation and individual ESIPs to get major visibility. The Standing Committee for Community Engagement, along with Reiff's Museum Teaching Planet Earth ESIP, will be displaying at the meeting and are offering to share the display space (and cost) with any other Federation members.

George Seielstad made the Assembly aware of a one-day symposium on Agricultural Technology for Rural Development to be held at the University

of North Dakota (UND) in Grand Forks on February 21, 2002. The UMAC consortium will follow this meeting with its annual two-day planning meeting February 22 and 23, also at UND. All ESIPs are welcome to attend both meetings.

Remarks from the Federation President

Federation President **Bruce Caron** presented several issues facing the Federation on the dynamics of membership, communication and voting, as the Federation grows and moves forward. The underlying theme was the necessity for the Federation to be "vital" to its members. One specific area Bruce addressed was the need for changes in the Federation voting procedures to ensure a quorum. The Constitution and Bylaws currently require a quorum of 2/3 of the entire Federation to conduct a business meeting. As the membership continues to grow, attendance at meetings becomes more vital in order to conduct business. Yet, for many members of the Federation, attendance at the Assembly business meetings (and voting on Federation issues) is not their number one priority for becoming Federation members. Several possible changes were proposed:

- Reduce the quorum requirement to something less than 2/3, for example 1/2.
- Impose a nominal dues structure to reduce membership rolls to those willing to pay a nominal fee.
- Have any ESIP missing two meetings in a row declared inactive, and non-voting.
- Solicit members to voluntarily opt for inactive status.

After discussion from the floor, the Constitution and Bylaws Committee was tasked with bringing forth recommendations on this subject to the Assembly at the May meeting.

Summary of Wednesday January 23 Discussions

Don Collins presented an overview of the end-to-end value chain discussions held on Wednesday in the smaller group meetings. A number of important topics arose during one or more of these discussion that the Assembly should consider.

Role Between Clusters and the Federation. One issue that was discussed was the role between Clusters and the Federations. At issue was whether or not the Federation should develop rules for endorsing a proposal submitted by a Cluster. There was also discussion as to whether there was value in a Federation "endorsement" for a proposal from a single ESIP? In developing such procedures, is the Federation becoming a "Funding Business"? In wrestling with these issues the previous day, it was felt that the recently created Foundation should bare primary responsibility for pursuing new funding sources, and consistent with that, the Federation itself should keep a "light touch" in regard to the current NASA funding.

Adding Raytheon as a New Partner. The question was raised whether Raytheon should be invited to join the Federation, vis-à-vis the Synergy program? While there was no definitive answer to this question, after much discussion it was decided that the Federation should engage Raytheon in discussions on this topic.

The Need for a Federation Review. In concluding the Thursday morning discussion regarding the Federation's future planning, **George Seielstad** proposed asking for a review of the Federation from the National Academy. Since the NRC spawned the Federation several years ago, it is appropriate now to ask for a report card on the Federation experiment. Seielstad also offered his opinion that the Federation should be the organization tapped by NASA to implement NewDISS/Strategic Evolution of ESE Data Systems (SEEDS). Further, he proposed the Standing Committee for Community Engagement (SCCE) should be tasked with targeting new Type IV's in its outreach efforts.

Breakout Session on Metrics

Frank Lindsay concluded the morning session by moderating a breakout session on Federation metrics. His report back to the Assembly was presented during the Friday morning session.

FRIDAY JANUARY 25, 2002

The Friday morning session consisted of the reports from the Federation's Standing Committees, plus two special presentations by NASA HQ Earth Science Applications management. Copies of the slides presented can be found on the Federation web site - www.esipfed.org. A listing of the talks that were presented and the speaker's name follows.

- Standing Committee for Community Engagement - David Etter

- Standing Committee for Earth Science Products and Services - Annette Schloss
- Metrics - Frank Lindsay
- Guest Speaker - Ron Birk, NASA HQ
- Guest Speaker - Ed Sheffner, NASA HQ Applications Division
- Standing Committee for Interoperability - Rob Raskin
- Standing Committee for Commercial Development - Doug Kliman
- Federation 2002 Budget - Doug Kliman

Business Meeting

Bruce Caron, Federation President, called the formal voting session to order promptly at 2:00 PM. It was noted that a maximum of 43 votes are possible, making the required number for a quorum 29. A role call was conducted by the Executive Secretary to determine the voting members, or approved proxy voters, present. A total of 23 Assembly Representatives were not present for the voting session; however, 14 designated a proxy voter, resulting in nine "no votes."

The following are the major accomplishments of the meeting:

- A decision by the Assembly to create a fifth Standing Committee, a Standing Committee for Education. The sponsors of the Resolution argued that it was important to elevate Education activities to full Committee status. Critics argued that another committee would further dilute already sparse Federation funds. The vote was closely contested but the resolution was passed.
- Rejection by the Assembly of a Resolution that would have placed more explicit language in the Federation Bylaws that would clearly define the expectations of each Federation

partner. The Constitution and Bylaws Committee will create a Working Group to consider the issue of how to get partners to more actively participate in Federation-wide activities—attending meetings for example.

- Unanimous approval by the Assembly of a Resolution by President Bruce Caron to create rules by which the Foundation (non-profit entity set up by the Federation) may go about seeking out new sources of funding for the Federation. These rules are to be voted on by the full Assembly at its next meeting.

Final Notes

Paul Hemenway read a statement to the Federation that the Distributed Oceanographic Data System (DODS) is migrating DAP to a non-profit organization called OpenDAP, thereby adding another organization to the Federation family.

It was agreed that the next meeting of the Federation Assembly would be in the Washington, DC-area the week of May 13-17.

The meeting was adjourned at 3:45 PM.



Earth Science Enterprise at the Olympics

— Fritz Hasler, hasler@agnes.gsfc.nasa.gov, Goddard Space Flight Center

The Earth Science Enterprise (ESE) was clearly visible in many different ways at the Winter Olympics in Salt Lake City recently, thanks to a team of Goddard Space Flight Center employees headed by **Fritz Hasler**, Code 912, NASA GSFC. A few of ESE's activities are discussed below.

A total of 22,000 visitors at The Children's Museum of Utah (TCMU) Olympic Walk On The World exhibit saw the 16-ft Blue Marble Terra/MODIS Globe, 30-ft floor mounted Earth, the NASA/NOAA Earth Science Electronic Theater, and the large U.S., Utah, Salt Lake City, and Park City murals using Landsat, ASTER and Space Imaging/IKONOS data. Since the internally illuminated globe was clearly visible outside the Museum, it is estimated that several hundred thousand saw as they passed by. Also, the globe was used as a backdrop for numerous broadcasts by NBC News Affiliates.

A total of 150,000 attendees at the rehearsal for the Opening Ceremonies on February 6, Opening Ceremonies on February 8, and Closing Ceremonies on February 24 saw the NASA MODIS/Landsat/Space Imaging IKONOS/Goddard/SVS Zoom from space to Rice Eccles Olympic Stadium that opened the production on each occasion. The audience included George W. Bush, President of the United States, John Glenn and

numerous other dignitaries. The NASA/Space Imaging/Goddard SVS visualization brought the audience zooming towards Earth. Soon a buzz went through the crowd, and as the view approached Utah, the buzz turned into a roar which continued as the spectacular ceremonies began.


Approximately 1,000,000 viewers of KSL-TV/NBC-5 in Salt Lake City saw repeated broadcasts of the zooms by Chief Meteorologist Mark Eubank in his reports on the Olympics and promotion of the TCMU exhibit. KSL-TV also ran a very nice special report on the exhibit during the games.

Approximately 20,000,000 viewers of the NBC Network Olympic Broadcast, Access

Hollywood, NBC Headline News, and numerous NBC local affiliates saw the zooms at various times throughout the games.

An estimated two billion viewers around the world saw broadcasts of the zooms that were distributed by International Sports Broadcasting (ISB) Inc.

Similar globes were installed at three other locations throughout the Olympic area. The globe at the Olympic Village will remain through the Paralympics that end on March 17. The globe at TCMU will remain indefinitely and is intended to act as the beacon for the TCMU when it opens permanently at the Gateway Center in 2003. The globes were provided by the Earth Science Enterprise/Earth Science Technology Office and the World Quest Foundation in partnership with TCMU.

The NASA/NOAA Earth Science Electronic Theater ran continuously from 3 PM to 8 PM during the Olympics. An E-theater presentation was given at Barratt Elementary School in American Fork, Utah, to approximately 800 students on February 22. The final E-theater presentation was given at Brigham Young University. 



NASA Study Links El Niño and Southern Ocean Changes

— Robert Gutro (rgutro@pop900.gsfc.nasa.gov), NASA Goddard Space Flight Center, SSAI
— Carolina Martinez (carolina.martinez@jpl.nasa.gov)
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— Stephanie Kenitzer, American Meteorological Society

NASA researchers have found strong relationships between El Niño episodes and changes in climate and sea ice cover around Antarctica. Identifying these relationships is important because it provides new insights into the changing characteristics of the Antarctic region and their role in Earth's climate system.

The findings, published in the March 1 issue of the American Meteorological Society's *Journal of Climate*, show that although the total ice coverage of the southern ocean has not changed significantly over the last 20 years, the El Niño and its related Southern Oscillation appear to affect regional ice distributions. The oscillation is a recurring warming and cooling of the surface ocean in the central and eastern Pacific. El Niño refers to the warm phase of the oscillation.

"Understanding the connection between the Southern Oscillation and southern ocean climate and the sea ice cover will substantially improve our understanding of global climate," said Ron Kwok, a senior research scientist at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "Our study concludes that the southern ocean's climate and ice cover is somehow connected to climate in the tropical latitudes. While we don't know yet the cause-and-effect relationship between the two, we do know the changes in sea ice

cover cannot be explained by local climate variations alone and are instead linked to larger scale climate phenomena."

The study was conducted by scientists at JPL and NASA's Goddard Space Flight Center, Greenbelt, Md. It is based on data from 1982 to 1999. The NASA scientists also noted changes in sea ice cover in regions not normally associated with El Niño, such as the Weddell Sea east of the Antarctic peninsula.

The strongest links were observed to be in the Amundsen, Bellingshausen and Weddell Seas of the west Antarctic, where the connections are localized and well defined. Within these sectors, higher sea level pressure, warmer air temperature and warmer sea surface temperature are generally associated with the El Niño phase.

A number of observations in the scientific literature can be explained by this El Niño/Southern Oscillation connection. Examples include a record decrease in sea ice coverage in the Bellingshausen Sea from mid-1982 through early 1999; the reduced sea ice concentration in the Ross Sea; and the shortening of the ice season in the eastern Ross, Amundsen and far western Weddell Seas. Four El Niño episodes over the 17 year period occurred at the same time as ice cover retreated in

the Bellingshausen and Amundsen seas, showing unique associations between the Southern Oscillation and this region of the Antarctic.

"The study shows that the impact of El Niño is global and that processes as remote as those in the polar regions are affected," said co-author Joey Comiso, senior research scientist from NASA's Goddard Space Flight Center. "The effect can be profound since these El Niño episodes affect the Weddell and Ross Seas. These areas are regarded as key sources of cold and dense bottom water that have an influence on global ocean circulation. Also, the ice cover in the Bellingshausen Sea is the habitat for a wide variety of marine life and is crucial to their survival."

Data for the study were acquired from several sources, including satellite data from the National Oceanic and Atmospheric Administration, Washington, D.C.; climate data from the joint data set of the National Centers for Environmental Prediction, also in Washington, and the National Center for Atmospheric Research, Boulder, Colo.; sea ice data from the National Snow and Ice Data Center in Boulder; and sea ice motion data from JPL's Remote Sensing Group.

The complete paper, "Southern Ocean Climate and Sea Ice Anomalies Associated with the Southern Oscillation," is available to journalists from Alan Buis at JPL. The American Meteorological Society is the nation's leading professional society for scientists in the atmospheric and related sciences. The study was funded by the Cryospheric Sciences Program within NASA's Earth Science Enterprise, a long-term research effort dedicated to understanding how human-induced and natural changes affect our global environment.



Satellites vs. Mosquitoes: Tracking West Nile Virus in the United States

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— Cynthia O'Carroll, cynthia.m.ocarroll.1@gsfc.nasa.gov, NASA Goddard Space Flight Center

A NASA-funded study uses temperature and vegetation data from satellites to help track and predict where West Nile Virus is spreading in North America. Scientists and public health officials hope one day to use near real-time maps to focus resources and stave off the disease more efficiently.

The disease, first reported in the U.S. in 1999, causes flu-like symptoms that can lead to fatal encephalitis in people with compromised immune systems, like the elderly. Though not yet proven, scientists believe the West Nile Virus may be spread across the country by infected birds traveling along their migration routes. Mosquitoes that act as a vector carry the virus, and pass it on when feeding on hosts like birds, livestock, other animals and people.

The satellite maps show nation-wide temperatures, distributions of vegetation, bird migration routes and areas pinpointing reported cases. The combined data help scientists predict disease outbreaks by showing where conditions are right for the insects to thrive and where the disease appears to be spreading.

David Rogers, lead author of the study, says, "The images are derived from satellite data that capture a number of

variables that are crucial for detecting whether a habitat is suitable for a vector, like a mosquito that carries West Nile Virus." He adds that, "It's not a single variable that tends to determine whether a disease will occur, but rather a combination of variables." Satellite sensors, like the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer (AVHRR), provide information on vegetation and peak and average annual temperatures.

Mosquito populations are constrained by different factors in different places. In the North, colder temperatures hold mosquito populations back. In the south, where temperatures are higher, the insects are more dependent on the availability of moisture for survival. Lush vegetation provides a good indicator of areas with increased levels of moisture. Mosquitoes tend to thrive in warmer, wetter areas. Satellites let researchers see which areas have these conditions, allowing for better prediction of disease transmission.

Similarly, satellites also help plot patterns like the timing of when temperatures peak during a year. Mosquito populations appear to increase during the first half of the year but only reach sufficient levels to transmit the disease during the second

half of each year.

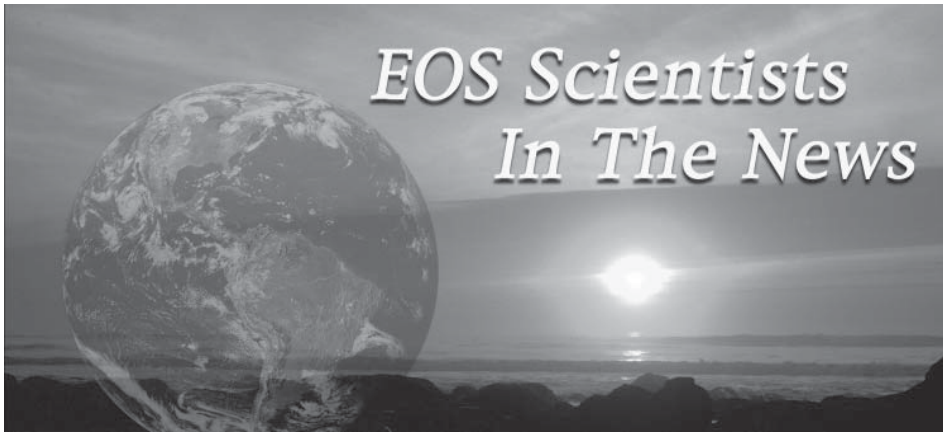
"The timing of a seasonal peak of temperatures determines the increase of vector populations in that place," said Rogers. "An early rise in spring temperature is likely to get the mosquito off to a flying start."

The idea is to let the satellite capture where the disease is spreading from year to year and make some predictions about where the disease is going. Computer models can determine areas that have temperatures and moisture levels most suitable for mosquitoes and transmission of West Nile Virus. Then, efforts and resources can target those high-risk areas.

The study suggests that a mild winter in 1998 to 1999 may have provided favorable conditions for mosquitoes to survive the winter, leading to a greater number of carriers in 1999. In that first year reported cases were found in three states. The number grew to 12 states in 2000, and more than 20 in 2001, despite the fact that the winters preceding these years were either average or slightly below average. "Once a disease like West Nile Virus establishes a foothold and spreads, it will be very difficult to eradicate," said Rogers. The methods used in this research may be modified and applied to study a variety of other diseases like malaria, dengue fever, Lyme disease, influenza and even asthma.

For more information, see:
www.gsfc.nasa.gov/topstory/20020204westnile.html





— Robert Gutro (rgutro@pop900.gsfc.nasa.gov). NASA earth Science News Team, SSAI

Earth's Magnetic Field Controls Damaging Radiation, February/March 2002 — (American Geophysical Union's EOS newspaper). James Heirtzler (NASA/GSFC) was featured in an article that concerns how the Earth's magnetic field controls damaging radiation in low earth orbits and how this has caused damage to a number of spacecraft (and injury to humans, including Shuttle astronauts). The changing geomagnetic field is expected to cause even more damage.

Snow Science, Not Sport, in the Rockies, February 26 — (Denver Rocky Mountain News, Science Daily). This month, dozens of scientists on the ground, in the air and using satellite observations will begin a multi-year experiment to study winter snow packs on the Colorado side of the Rocky Mountains. Scientists came from: NASA, NOAA, the USDA Forest Service and the U.S. Army Corps of Engineers, and from several universities. NASA's Jet Propulsion Laboratory (NASA/JPL), Goddard Space Flight Center (NASA/GSFC), Dryden Flight Research Center, and NASA Headquarters were all involved in this project.

Satellites Track Mosquitoes, February 25 — (United Press International). David

Rogers (Oxford Univ.) is using temperature and vegetation data from satellites to track and predict the course of West Nile Virus in North America.

NASA's Aqua Satellite Shipped to Launch Site, February 25 — (UPI, Spaceflight Now, Santa Maria Times). NASA's Aqua spacecraft is ready to be shipped to Vandenburg Air Force Base in California to begin launch preparations, according to Phil Sabelhaus (NASA/GSFC) Aqua Project Manager.

The Growing Season Is Growing as Warming Trend Persists, February 25 — (Philadelphia Inquirer). Compton Tucker (NASA/GSFC) was featured in this article discussing an increase in the density of vegetation throughout Pennsylvania and much of the Northern Hemisphere as a result of warming and increased carbon dioxide.

Polar Warming Continues With Ice Mass Losses, February 20 — (Spacedaily.com, Christian Science Monitor, Nature News). A study of the Arctic during the summer of 2000 noted that temperatures in the Arctic were the warmest in 400 years, and that there has been an 18-year downturn in ice cover over the Atlantic Ocean. Ted

Scambos and Mark Serreze (both Univ. of Colorado Boulder), were quoted in this article.

Pollution Drying Up Rainfall, February 19 — (United Press International, Nature News). At the American Association for the Advancement of Sciences meeting, Daniel Rosenfeld (Hebrew Univ., Israel), used satellite data to explain how tiny airborne particles are changing rainfall patterns around the world, and making it more difficult for clouds to precipitate.

Terra Takes Sea Surface Temperature With Precision, February 15 — (Spaceflightnow.com). Otis Brown and Peter Minnett (both of Univ. of Miami) were featured in this article about NASA's Terra satellite. Terra is collecting the most detailed measurement of sea surface temperatures ever made, enabling scientists to advance their studies on ocean-atmosphere interactions that help define the Earth's climate.

Satellites Blow the Surprises Of World's Wild Weather, February 12 — (Boston Globe). 23 speakers made presentations on NASA Earth Science topics at the Annual Meeting of the American Association for the Advancement of Sciences. Included were: Yoram Kaufman (NASA/GSFC), Harold Annegarn (Univ. of Witwatersrand, South Africa), Paulo Artaxo (Universidade de Sao Paulo, Brazil), V. Ramanathan (Scripps Institution of Oceanography), Daniel Rosenfeld (Hebrew Univ., Israel), James Hansen (NASA/GISS), Azita Valinia (NASA Headquarters), Mark Abbott (Oregon State Univ.), David Skole (Michigan State Univ.), Richard Reynolds (National Environmental Satellite Data and Information Service), Mark Meier (Univ. of Colorado), Claire Parkinson (NASA/GSFC), Bob Bindshadler (NASA/GSFC), Ted Scambos (National Snow and Ice Data

Center), Mark Serreze (National Snow and Ice Data Center), Shripad Deo (NOAA/National Weather Service), Tim Liu (NASA/JPL), Bob Adler (NASA/GSFC), Steven Goodman (NASA/MSFC), Marshall Shepherd (NASA/GSFC), and Edward Gutro (EA Kelley Insurance).

Satellites Help Track Disease Epidemics, February 7 — (Space.com, Cosmiverse.com, Environment News Service). Satellite images of droughts, floods and heatwaves are now helping scientists track and predict the conditions that are favorable for transmissions of diseases such as West Nile Virus in the U.S., and Rift Valley Fever and Ebola in Africa. This article discussed recent papers by Compton Tucker and Assaf Anyamba (both of NASA/GSFC).

The Blue Marble, February 7 — (ABC news, BBC news, CBS news, NBC news). The most detailed true-color image of the entire Earth was created by scientists and visualizers (NASA/GSFC) from a collection of satellite based observations, and aired around the world during the Olympic games. To see the image: www.earthobservatory.nasa.gov/Newsroom/BlueMarble/

Climate Studies Point to More Floods in This Century, January 30 - (NationalGeographic.com). EOS-funded researcher P. Christopher Milly (U.S. Geological Survey) reviewed data on 100-year floods that occurred in the last century to look for flooding trends. Milly and his colleagues concluded that much of central and northern Europe will be five times more likely to suffer very wet winters this century.

Ecology Dramatically Altered by Fertilizers, Acid Rain, January 25 — (Spaceflight Now, ScienceDaily.com, Spacedaily.com). Steve Perakis (U.S. Geological Survey) and

Lars Hedin (Princeton Univ.) found that high levels of inorganic nitrogen in the United States are really the result of acid rain and agricultural fertilizers.

Study Links El Niño to Deadly South American Disease, January 22 — (Baltimore Sun newspaper, Science News, Spacedaily.com). William K. Lau (NASA/GSFC) and U.S. military health specialists may have discovered a way to predict outbreaks of Bartonellosis by observing sea surface temperatures in the tropical eastern Pacific.

Climate Change May Bring More Winter Floods in California, January 22 — (Spacedaily.com, ScienceDaily.com). Over the next century, climate change will likely bring more wintertime flooding, and summertime drought to California, according to a study by EOS researcher Norman Miller (Lawrence Berkeley National Labs), and his colleagues at the National Weather Service.


A Chilling Effect on the Great Global Melt, January 18 - (New York Times, Associated Press). Ian Joughlin (NASA/JPL), Slawek Tulaczyk (Univ. of California, Santa Cruz), and Richard Alley (Pennsylvania State Univ.) were all quoted in this article that discussed how ice in parts of western Antarctica is getting thicker.

Growth of Greenhouse Gases Slowing, January 17 - (Christian Science Monitor, CNN, LA Times, UPI). James Hansen (NASA/GISS) published a paper in the Proceedings of the National Academy of Sciences that explained the current growth of greenhouse gases has slowed since 1980 because of the phase-out of chlorofluorocarbons.

Seawinds Satellite Provides Faster Cyclone Warnings, January 16 - (Cosmiverse.com, ScienceDaily). Ryan

Sharp (Florida State Univ.) used Seawinds data to see rotating winds and identify cyclones earlier than the present system. In 2001, out of the 17 tropical cyclones that developed in the Atlantic Ocean, eight were detected an average of 43 hours before they were classified by the National Hurricane Center.

New Technique Greatly Improves U.S. Seasonal Forecasts, January 16 - (United Press International, Cosmiverse.com) William Lau (NASA/GSFC) presented a paper at the annual AMS meeting demonstrating a technique to increase predictability of precipitation during all seasons by examining changes in sea surface temperatures in various ocean basins and their individual impacts on regional climate.

Scientists Unsure of Absorption, December 13, 2001 - (Associated Press). Scientists are uncertain how much of the carbon dioxide emitted naturally each year within the North American ecosystem is reabsorbed by that system, complicating calculations of the net effect of human activities on emissions of the greenhouse gas. Christopher Potter (NASA/Ames) and Jing Chen (Univ. of Toronto) were both featured in this article. 

Earth Science Education Program Update

— *Blanche Meeson* (bmeeson@see.gsfc.nasa.gov), NASA Goddard Space Flight Center
 — *Theresa Schwerin* (Theresa_schwerin@strategies.org), IGES

SPACE SCIENCE INSTITUTE'S 4-DAY EDUCATION WORKSHOP FOR SCIENTISTS, ENGINEERS, AND EPO MANAGERS

21-24 April 2002, Boulder, Colorado

Sponsored by NASA and NSF, this workshop offers scientists, engineers, and education managers the knowledge necessary to design and implement effective Education and Public Outreach (EPO) programs for scientific programs associated with universities, NASA centers and flight projects, research institutions, and government agencies. It is targeted towards those who work in any sphere of Space or Earth Science, including scientists or engineers interested in K-14 EPO, EPO managers who are tasked with EPO program design and with providing meaningful ways for scientists and engineers to contribute to EPO efforts, and educators interested in gaining perspective about working with scientists and engineers in EPO. For more information, application, and registration visit www.space-science.org, or contact Christy Edwards at edwardcl@colorado.edu.

WANTED: EDUCATORS FOR EARTH SYSTEM SCIENCE ACADEMY FOR TEACHERS

21-22 June 2002

The Earth System Science Academy offers

K-12 educators the opportunity to learn about the health of local waterways and the Great Dismal Swamp in North Carolina. The Academy will include a tour of the Great Dismal Swamp Boardwalk; hands-on water quality labs; and workshops on Earth System Science. Internet workshops will focus on NASA educational resources on Earth System Science. The Academy will challenge educators to develop new skills through the experience of working with university and NASA researchers. There is a \$99 registration fee and seating is limited. Call (252) 335-3696 to reserve a place or see nia.ecsu.edu/nrts/workshops/essa2002/essa2002.html for more information.

WILDLIFE BIOLOGISTS WANTED FOR ONLINE PROGRAM

The NASA-funded "Signals of Spring" ([www.signalsofspring.com/](http://www.signalsofpring.com/)) along with newest program sponsor *National Geographic*, is seeking a diverse team of Earth scientists and wildlife biologists to interact with students online in their interactive analysis journals for the Spring 2002 investigation. In the classroom program, student teams use Earth imagery and GIS to explain the migratory movement of animals tracked by satellite, including bald eagles, whales, sandhill crane and other species. Scientists receive a stipend of \$250 for interacting with electronic

journals during April and May. Student teams will study phytoplankton, weather, sea surface temperature, bathymetry, geography, and wildlife species. The time involved is 5-15 total hours. Participating scientists will be featured online and receive a Signals of Spring Certificate of Participation. For more information, email: scientist@signalsofpring.net and include your name, affiliation, and contact information.

EDUCATION RESOURCES

oea.larc.nasa.gov/PAIS/AtmSciCareer.html

Fact sheet on Atmospheric Science Careers developed by NASA Langley Research Center.

NEW ON THE NASA EARTH OBSERVATORY

earthobservatory.nasa.gov/

The following are new references and feature articles included in NASA's Earth Observatory. In addition to these resources, visit the Earth Observatory to see the latest images and summaries of Earth science stories from radio, newspaper, and television.

Hantavirus Risk Maps (DAAC Study)

earthobservatory.nasa.gov/Study/Hanta/

Satellite and ground truth data help scientists predict the risk of hantavirus pulmonary syndrome.

Tracking a Volcano: Satellite Observations of Piton de la Fournaise

earthobservatory.nasa.gov/Study/ReunionIsland/

NASA satellite data from Terra and Landsat provide a unique perspective on the current eruption of the Piton de la Fournaise volcano.

SCIENCE NEWS


For the latest NASA Earth science news, visit the NASA Earth Observatory - earthobservatory.nasa.gov - or Science@NASA - science.nasa.gov/.

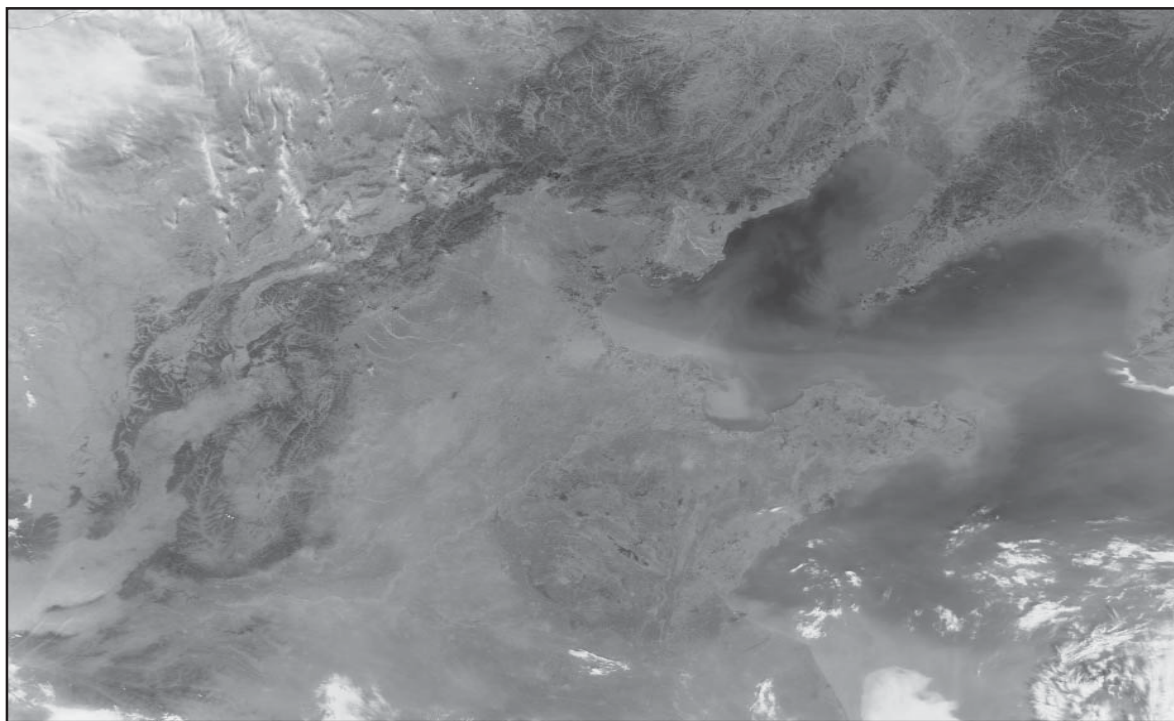
NASA GLOBAL CHANGE MASTER DIRECTORY AVAILABLE

NASA's Global Change Master On-line Directory (GCMD) 2002 provides descriptions of Earth science data sets and services relevant to global change research. The Global Change Master Directory now holds more than 10,600 descriptions of Earth and environmental science data, with information on how to obtain the data and/or direct links to data sources. The individual data set descrip-

tions were contributed by more than 1,300 data centers, government agencies, universities, research institutions and private researchers around the world. The directory is organized by topics: Agriculture, Atmosphere, Biosphere, Human Dimensions, Hydrosphere, Land Surface, Oceans, Paleoclimate, Radiance/Imagery, Solid Earth, Snow and Ice and Sun-Earth Interactions.

Access to the directory is available through globalchange.nasa.gov or gcmd.nasa.gov. Selected portions of the directory can be placed on a CD for users without Internet connections. New data set descriptions are added daily, and others are updated on an ongoing basis. Their interactive analysis journals for

the Spring 2002 investigation. In the classroom program, student teams use Earth imagery and GIS to explain the migratory movement of animals tracked by satellite, including bald eagles, whales, sandhill crane and other species. Scientists receive a stipend of \$250 for interacting with electronic journals during April and May. Student teams will study phytoplankton, weather, sea surface temperature, bathymetry, geography, and wildlife species. The time involved is 5-15 total hours. Participating scientists will be featured online and receive a Signals of Spring Certificate of Participation. For more information, email: scientist@signalsofspring.net and include your name, affiliation, and contact information. 



On March 12, 2002, the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra satellite obtained this stunning image of haze over China. The haze has turned the sky an opaque grey over much of eastern China. Beijing, China's capital city, is situated roughly 150 km (93 miles) west of Bo Hai Bay, just north of what appears to be the densest portion of the aerosol pollution in this scene. The heavy aerosol concentrations can be seen blowing eastward across the Bo Hai Bay and Yellow Sea.

EOS Science Calendar

June 17-21 (Tentative)

Second Public Workshop on the Strategic Evolution of ESE Data Systems (SEEDS), location TBD. The focus of this workshop will be on developing community-based processes to guide the development and validation of SEEDS protocols and standards, cost models, interfaces, technology and accountability.

July 22-26

The International Tropical Rainfall Measurement Mission (TRMM) Science Conference, Honolulu, Hawaii. Contact: Robert Adler, e-mail: robert.adler@gssc.nasa.gov.

July 15-19

Community Outreach Workshop on MODIS Vegetation Variables (VI/LAI/FPAR/NPP), University of Montana, Missoula, MT. Contact: Steven Running, swr@ntsg.umt.edu. See URL: www.forestry.umt.edu/ntsg/MODISMTG

Global Change Calendar

April 22-26

2002 American Society of Photogrammetry and Remote Sensing Annual Conference, Washington, DC. URL: www.fig2002.com/.

May 13-17 (Tentative)

Ninth Meeting of the Federation of ESIPs, Washington, DC. URL: www.esipfed.org/.

May 28-June 1

American Geophysical Union (AGU) 2002 Spring Meeting, Washington DC. URL: www.agu.org/.

May 20-22

Seventh International Conference on Remote Sensing for Marine and Coastal

Environments, Miami. Contact Nancy Wallman. e-mail: nancy.wallman@veridian.com; URL: www.erim-int.com/CONF/marine/MARINE.html.

June 5-7

59th Eastern Snow Conference, Stowe, VT. Contact Ken Rancourt, email: K.rancourt@mountwashington.org

June 11-13

Third International Symposium on "Remote Sensing of Urban Areas," Istanbul, Turkey. Call for Papers. Contact Filiz Sunar Erbek, e-mail: fsunar@srv.ins.itu.edu.tr, URL: www.ins.itu.edu.tr/rsurban3.

July 7-10

Second Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) Science Conference, Manaus, Brazil. Contact Flavio Luizao of the National Institute for Space Research (INPE), Manaus, Brazil, e-mail: luziao@cptec.inpe.br.

July 9-12

2002 Joint International Symposium on GeoSpatial Theory, Processing and Applications, Ottawa, Canada. Call for Papers. For details, tel. +1 613 224-9577; e-mail: exdircig@netrover.com; URL: www.geomatics2002.org.

September 2-6

ISPRS Commission V Symposium, Thessaloniki, Greece. Call for Papers. Contact Prof. Alexandra Koussoulakou, e-mail: kusulaku@eng.auth.gr.

September 3-6

Pan Ocean Remote Sensing Conference (PORSEC) 2002, Bali, Indonesia. Contact Bonar Pasaribu, e-mail: bonarpp@indosat.net.id, URL: www.porsec2001.com.

September 9-13

ISPRS Commission III Symposium 2002, Graz, Austria. Contact Institute for

Computer Graphics and Vision, tel. +43 316 873-5011, email: office@icg.tugraz.ac.at, URL: www.icg.tu-graz.ac.at/isprs

September 18-25

Joint CACGP/IGAC 002 International Symposium, "Chemistry Within the Earth System: From Regional Pollution to Global Change," Crete, Greece. Contact Maria Kanakidou, email: mariak@chemistry.uoc.gr, URL: atlas.chemistry.uoc.gr/IGAC2002

September 23-27

Conference on Sensors, Systems, and Next Generation Satellites VIII (RS03), an SPIE Symposium on Remote Sensing, Crete, Greece. Contact Steve Neeck, email steve.neeck@gssc.nasa.gov, or SPIE, email spie@spie.org

October 14-19

COSPAR Scientific Commission A, Houston, TX. Contact Robert Ellingson, email: bobe@metosrv2.umd.edu, tel. 301-405-5386.

October 26-28

3rd International Symposium on Sustainable Agro-environmental Systems: New Technologies and Applications, Cairo, Egypt. Contact Derya Maktav, e-mail: dmaktav@ins.itu.edu.tr.

December 3-6

International Symposium on Resource and Environmental Monitoring, Hyderabad, India. Contact R. Nagaraja, e-mail: nagaraja_r@nrnsa.gov.in, tel. 91-40-388-4239

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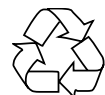
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