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Editor's Corner

The Tropical Rainfall Measuring Mission (TRMM) spacecraft arrived safely at the Tanegashima Space Center (TnSC), Japan, on August 23. In addition to the Precipitation Radar (PR), TRMM Microwave Imager (TMI), and Visible and Infrared Scanner (VIRS), TRMM carries the first two sensors developed as part of the EOS program: CERES (Clouds and the Earth's Radiant Energy System) and LIS (Lightning Imaging Sensor). TRMM is scheduled for launch in mid-November, and will fly in a mid-inclination (35°) precessing orbit at an altitude of 350 km.

The Office of Mission to Planet Earth has now finalized the selection of proposals arising from the NASA Research Announcement (NRA) for supplementary activities to support the validation of measurements by EOS satellite sensors in the AM-1 and SAGE III time frame, released March 13. This NRA also solicited proposals for investigations as part of NASA's Global Data Integration and Validation Program, an MTPE Research and Analysis Program.

NASA received 270 proposals in response to this announcement, 64 of which were accepted. Details of the selection can be found on pp.12-13 in this issue of *The Earth Observer*. The final selection results can be summarized in Table 1.

An Investigators Working Group (IWG) meeting is now scheduled for November 4-6 in Atlanta, Georgia. As in the past couple of years, the primary focus of this meeting is to (i) learn of recent progress and exciting accomplishments obtained thus far by various EOS

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investigations, with special sessions on seasonal-to-interannual climate, atmospheric chemistry, and land cover/land use change, (ii) assess progress and expectations for EOSDIS in the next couple of years, (iii) discuss objectives and status of Earth System Science Pathfinders (ESSP) that were recently selected for launch at the beginning of the next decade, and (iv) discuss integrated assessments on climate variability and change, as reflected in regional workshops recently conducted in 6 regions of the U.S.

Finally, I am happy to report that MOPITT (Measurements of Pollution in the Troposphere) was delivered to Lockheed Martin Missiles and Space, King of Prussia, Pennsylvania, on August 25 for integration on the EOS AM-1 spacecraft. This instrument joins ASTER (Advanced Spaceborne Thermal Emission and Reflection radiometer), CERES, MODIS (Moderate Resolution Imaging Spectroradiometer), and MISR (Multi-angle Imaging Spectroradiometer), bringing together all five instruments that will fly on AM-1. The next critical step for the spacecraft is to complete systems tests that will validate the ability of the integrated spacecraft to withstand the harsh environment of space and to work with its ground system. The spacecraft will be delivered to Vandenberg Air Force Base, CA, for launch processing, and is scheduled for launch in June 1998.

—Michael King
EOS Senior Project Scientist

Table 1.

EOS Validation			
Ocean surface	4	Atmospheric chemistry	10
Land surface	11	Atmosphere	9
Surface radiation budget	5	Calibration and characterization	4
Global Data Integration and Validation Program			
CERES relevant — outgoing longwave radiation, Earth radiation budget	4	MODIS relevant — polar products, aerosols from VIRS, SST, calibration over ice, impact of cloud information	6
SAGE relevant — analysis methods	1	PM-1 relevant — land hydrology, water budget, snow melt, ice cover	4
LIS relevant — lightning and cloud properties	1	Miscellaneous — Radarsat, GPS, interferometic delay	4
SeaWinds relevant	1		

ANNOUNCEMENT! ASTER EARLY MISSION DATA

—Anne Kahle, ASTER U.S. Science Team Leader, anne@lithos.jpl.nasa.gov

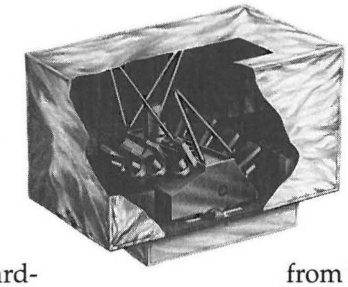
ALL EOS INVESTIGATORS!

November 27 is the deadline for requesting ANY ASTER data to be acquired during the first 105 days of the EOS AM-1 mission. This includes any cal/val data, any PR data and any early science data. Remember, ASTER data is only collected upon request, and in the early mission phase (the first 105 days), the scheduling will be done manually.

SO, if you need any data acquired during the early mission, you must have your requests in before November 27. Contact Robert Molloy (bmolloy@haleakala. jpl.nasa.gov) for further information.

Multi-Angle Imaging Spectro-Radiometer (MISR) Science Team Meeting

— **Stuart McMuldroch** (stuart@jord.jpl.nasa.gov), MISR Science Coordinator, Jet Propulsion Laboratory



The MISR Science Team met on June 4-6, 1997 at the Jet Propulsion Laboratory in Pasadena, CA. The MISR meeting was an opportunity for all members of the team to obtain the latest information regarding the recently completed MISR instrument. Given the proximity to the scheduled launch of the AM-1 platform, emphasis this year was placed on final algorithm refinements, status of science production code, science verification and validation, and initial concepts for early mission science. The following text briefly describes the focus of the meeting and highlights the most important aspects of the proceedings.

Introduction

The Principal Investigator, Dave Diner, opened the session, bidding welcome to the team and summarizing resolved issues from the previous science team meeting. He then went on to give a brief overview of the meeting's objectives: 1) to update the team on instrument hardware and flight software status, 2) to update the team on ground data processing software status, 3) to develop test data requirements to verify the scientific veracity of the MISR production code, 4) to review MISR's validation strategy, and 5) to hone the MISR science emphasis especially during the early mission phase.

Instrument Status, Software Development Status, and In-flight Calibration

Terrence Reilly gave the instrument and project status report. The instrument, having successfully passed thermal-vacuum testing, was delivered for spacecraft integration at the Lockheed-Martin facility at Valley Forge, PA, on May 26. Several problems that had surfaced during previous thermal-vacuum testing had been solved. Reilly emphasized that the project focus has shifted to science data processing activities and the completion of AirMISR—the airborne version of MISR.

Dave Diner continued describing the instrument performance by detailing the results of several instrument science tests. Preliminary analysis of test images from the Collimator Array Tool (CAT) suggests that the alignment of the cameras on the optical bench is within specifications. Alignment measurements made pre- and post-shake testing are comparable, suggesting that the MISR optical system can tolerate vibration. Additional tests, performed by imaging a target suspended above the instrument, successfully yielded the first true two-dimensional image. Progress on the in-flight radiometric calibration and characterization was reported by the instrument scientist, Carol Bruegge. As reported previously, all thermal, dynamical, radiometric, and spectral testing of the cameras has been successfully completed. Bruegge showed results demonstrating how unacceptable out-of-band errors can be corrected to within reasonable limits.

The science data system status was presented by Graham Bothwell. Activity in the last year has been intense, with staffing reaching maximum levels as we approach launch. Version 1 of the production code is in the process of being delivered to the Langley DAAC. Version 2 of the code, which contains the complete system suitable for launch, is expected to be delivered near the beginning of 1998. Every AM-1 instrument team has drafted backup plans to ensure minimum processing ability immediately after launch. The MISR back-up plan includes the processing of 1 or 2 swaths of data plus several local-mode sites per week at the MISR SCF. Additional functionality, including distribution and archiving, will be achieved by working with the Langley DAAC. The MISR home page on the Web at http://www-misr.jpl.nasa.gov continues to expand, providing increased levels of information to the community.

Science Verification and Test Data

The MISR test team is building datasets to check both the operability and scientific veracity of the production code. Operability tests range from unit tests which verify the functionality of individual executable components to full system-wide tests. Robert Ando described efforts to build a simulated MISR multi-angle dataset covering a portion of an orbit swath from Minnesota to Mexico. This dataset will soon contain a simulated atmosphere and clouds generated from a Monte Carlo scheme. Bob Vargo led the effort to form science verification teams comprising scientists and software engineers to enhance the effectiveness of the testing efforts. Each team will test a particular MISR product to guarantee product structure and scientific veracity. In addition to simulated data, the test teams plan to use observations from AirMISR, as these will be the closest data to MISR imagery in the pre-launch timeframe.

Validation and AirMISR Status

AirMISR collects multi-angle MISR-like data utilizing a spare MISR camera mounted on a gimbal system aboard an ER-2 aircraft at an altitude of 20 km. AirMISR research objectives include supporting development and validation of MISR algorithms, retrieval algorithms, and products, providing an additional radiometric calibration path to assist in-flight calibration, and enabling scientific research utilizing multi-angle imaging data. Currently, construction of AirMISR has finished, and the instrument is undergoing flight-readiness tests.

Jim Conel gave an overview of the validation strategy and lessons learned from field campaigns during the past year. Pre-launch validation efforts concentrate on algorithm validation and technique development while post-launch efforts focus on MISR product validation and vicarious calibration. The validation team has now perfected their techniques for collecting and analyzing data with subsequent intercomparisons with other teams. Conel continued by discussing planned field campaign agendas and the potential of AirMISR. Peter Muller presented studies comparing varying spatial resolution Bidirectional Reflectance Distribution Function (BRDF) model retrieval data with multi-angle Advanced Solid-State Array Spectroradiometer (ASAS) data. Results suggest a good agreement confirming MISR's retrieval approach.

Roger Marchand described the MISR cloud validation plan. Pre-launch activities include comparisons of cloud products derived from AirMISR data with those derived from ground instrumentation and other airborne detectors such as MODIS Airborne Simulator (MAS). Post-launch validation efforts will use AirMISR-derived values, ground station climatologies, and comparison with MODIS cloud products.

MISR Algorithm Development and Associated Science

This section of the meeting focussed on refining the MISR algorithms in preparation for launch and strengthening the link between MISR's standard products and early mission science.

Top of Atmosphere/Cloud

MISR's cloud detection ability relies on both stereoscopic and radiometric techniques. Roger Davies started the session by reviewing MISR's hierarchy of stereo matchers. Simple tests suggest that the combined set of matchers is reliable and robust. Tests using the simulated dataset described above, combined with accurate truth fields, will provide better reliability estimates. Radiometric techniques, developed by Larry Di Girolamo, utilize a dynamic thresholding method to detect clouds. Eugene Clothiaux described his research on cloud detection using texture techniques as an example of possible future algorithms.

Local albedos are calculated from MISR data using a combination of solid angle weighting, deterministic, and stochastic methods. Local albedos are then used to determine coarse resolution restrictive and expansive values. Tests on simulated scenes confirm the validity of these techniques.

Aerosol

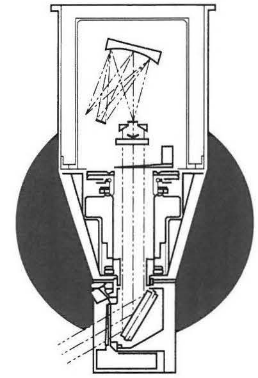
MISR aerosol retrieval techniques are dependent on the background surface, i.e., whether the aerosol retrieval is performed over dark water, dense dark vegetation, or heterogeneous land. Ralph Kahn described the on-going work investigating the MISR instrument's sensitivity to aerosols over dark water. This study examines sensitivity to particle shape, optical depth, characteristic radius, and indices of refraction for pure particle types. Future work will examine sensitivity to mixtures of particles and changes in natural conditions. Results from the sensitivity study of aerosol retrievals over land were presented by John Martonchik. Retrievals over dense dark vegetation are well characterized with accuracies which depend on aerosol amount and solar zenith angle. The team agreed to adopt the empirical orthogonal function approach suggested by Martonchik as a superior method for aerosol retrieval over heterogeneous land.

Dave Crisp provided an alternative explanation to the cloud absorption anomaly where GCMs underestimate the atmospheric absorption of sunlight. He suggested that the anomaly arises from incorrect assumptions regarding global annual-average gas and aerosol distributions and illumination conditions, combined with underestimates of water, ozone, and tropospheric aerosol absorption. Calculations performed since the Science Team Meeting show that MISR should be able to determine whether aerosols are distributed just above the clouds as Crisp suggests. Tom Ackerman continued the session by describing differences between models and clear sky diffuse radiation data from the Atmospheric Radiation Measurement (ARM) site in Oklahoma. These differences can be resolved by the inclusion of an additional unidentified absorber at blue wavelengths. Spectral flux observations with 1-2% accuracy are needed to resolve this problem.

Surface

Michel Verstraete turned the focus of the meeting to multi-angular measurements of land surfaces. He quickly reviewed the panoply of tools and techniques available for the quantitative interpretation of remote sensing data. The multi-angular data available from MISR will permit the evaluation of existing parametric BRF model assumptions about the anisotropy of the radiance fields and allow for the development of new more-accurate models. Possible future algorithms were presented by Yuri Knyazikhin and Bernard Pinty. Knyazikhin described an empirically based Fraction of Photosynthetically Active Radiation/Leaf Area Index (FPAR/LAI) algorithm. Pinty presented a semi-discrete model for the characterization of land surfaces, which includes soil albedo, leaf characteristics, and canopy structure. This session on land surface studies was concluded by Anne Nolin, who described possible uses of MISR's multi-angle data for accurately determining albedo and grain size over snow-covered areas.

SAGE III Science Team Meeting



— **Sandra Smalley**
(sesmalley@larc.nasa.gov),
NASA Langley Research Center

On June 11 & 12, a Science Team Meeting for the Stratospheric Aerosol and Gas Experiment (SAGE) III was conducted at Hampton University. The meeting was hosted by the project Principal Investigator (PI), M. Patrick McCormick. The meeting primarily focused on validation planning for SAGE III. Status briefings were also given for the program, project, instrument, mission operations, and software development.

Jack Kaye, NASA Headquarters (HQ) Program Scientist, gave an overview, including broader issues relating to Mission to Planet Earth (MTPE) and the Earth Observing System (EOS). A major focus of his talk was a focused review of MTPE's atmospheric chemistry program that was established as one of two areas of emphasis (along with EOSDIS) for a broader biennial review of MTPE's programs.

The Atmospheric Chemistry Review Panel was chaired by Michael Prather of the University of California at Irvine. SAGE-related panel members included Lamont Poole, head of the Aerosol Research Branch at the NASA Langley Research Center (LaRC), Steven Wofsy of Harvard University, who is a member of the SAGE II and SAGE III Science Teams, and O. Brian Toon of the University of Colorado, who is a member of the SAGE II Science Team. Wofsy also served as a member of the panel for the larger biennial review, in addition to his service as Chair of MTPE's Earth System Science and Applications Advisory Committee. The two questions that the chemistry review panel was asked to address most closely were the current instrument complement and planned architecture for the EOS CHEM satellite mission, and the balance of resources between space-based measurements (and associated ground systems) and research and analysis (R&A) activities.

Among the conclusions of the Atmospheric Chemistry Review Panel of most interest to SAGE were a strong endorsement of the current EOS CHEM instruments and plans for their flight on a single spacecraft; concerns that the funding decline for R&A science be halted and funds preferentially restored to allow for increased scientific activities in the area of atmospheric chemistry; and improved coordination between the EOS project and R&A, especially in the area of calibration/validation for EOS sensors. They also expressed extreme concern about the current manifest plans for SAGE, noting that the next inclined orbit for SAGE was planned for the International Space Station (ISS) in 2002, and that ISS has limitations as a platform due to lost viewing opportunities during Shuttle visits, etc. The panel strongly endorsed exploring the possibility of MTPE's finding an early inclined orbit for the third SAGE III instrument, for which no flight opportunity has yet been identified.

Kaye noted that some 270 proposals had been received at NASA HQ in response to the NASA Research Announcement (NRA) soliciting proposals for EOS calibration and validation. Approximately 40 of these were in the areas of atmospheric chemistry (covering MOPITT and/or SAGE). A panel review for all the proposals was to be held in July. The NRA for Kaye's Atmospheric Chemistry Modeling and Analysis Program (ACMAP) was open, with proposals due August 15; the NRA may be found on the World Wide Web.

Kaye also reported on his activities associated with the Integrated Global Observing Strategy (IGOS) being organized in part under the auspices of the Committee on Earth Observing Satellites (CEOS). Kaye was asked to co-lead an activity on "Long-term continuity of ozone measurements" in conjunction with Chris Readings of the European Space Agency (ESA). A two-page activity description had been prepared this spring, and the group's activity will be kicked off this summer as part of a CEOS Analysis Group meeting in Tokyo, Japan.

The status of the EOS program was briefly summarized by Kaye. He considers it likely that there will be a major change in the EOS program away from the original concept of multiple copies of each instrument to provide 15 years of continuous data. The new paradigm for implementing the second series of EOS missions is to treat the required observations in two groups: Process Understanding Observations and Long-Term Systematic Observations. The intent is to solicit and select the Process Understanding Observations through a mechanism such as that used for the Earth System Science Pathfinder (ESSP) program. NASA intends also to obtain the Long-Term Systematic Observations through open solicitation, but with an emphasis on domestic and international partnerships. In both cases, the emphasis will be on small missions requiring short development cycles of no more than 3 years from the time of selection of each mission.

Shahid Habib, the SAGE III Program Integration Manager (PIM), followed Kaye's discussion with a status report on MTPE. He reiterated that the program is going through a Biennial Review where the focus is placed on a new way of doing business. In other words, future missions will rely on smaller instruments, a faster development process, smaller spacecraft, and a more-efficient project life cycle. The paradigm shift is driven by a more-lean budget, and a need to infuse state-of-the-art technologies. The results of the Biennial Review will establish a new baseline for future missions slated for flight after the year 2000. Another area being evaluated is NASA's involvement in future missions in terms of project management. For example, the ESSP mission may provide some insight as to how effectively a PI-mode program will run with minimal involvement from NASA. In spite of these changes, MTPE as a whole is very healthy and doing well. Habib also provided an overview of the Flight of Opportunity (FOO) status resulting from a series of meetings with the Russian Space Agency (RSA). Three possibilities for the flight of the FOO were identified: 1) a mid-inclination orbit in 1999, 2) a joint SAGE/TOMS/Meteor in Aug 2000 in a 1030 sun-synchronous orbit, and 3) a TBD sun-synchronous orbit after 2000. Habib is also discussing possible flight opportunities with countries other than Russia, including Brazil. In addition to SAGE, Habib is responsible for the TOMS, Chemistry, and New Millennium Earth Orbiting-1 missions.

L. Edward Mauldin, SAGE III Project Manager, presented the SAGE III project status. The tenth Technical Interchange Meeting (TIM) was held in Moscow May 19-23. The Russians are still preparing for an August

1998 launch. The next TIM is scheduled for September and will be critical to ensure convergence of the various elements as the launch date approaches. Mauldin expressed concern with the Ukrainian rocket failure on May 20. Investigations were in progress during the science team meeting and preliminary analysis pointed to a software problem. The contingency plan includes utilization of a military Zenit rocket. Contamination control had been a project concern, but the three facilities in the Ukraine were found to be very clean. Successful execution of a tight spacecraft and instrument development schedule is critical to meet launch in August 1998. Mauldin stated that the project was well within budget but the schedule is tight. As of June, RSA had not signed a Zenit rocket fabrication contract, but money had been appropriated. Mauldin also provided an overview of instrument changes on the Meteor spacecraft.

With respect to the ISS instrument, launch has been delayed to January 2002. An ISS payload TIM was held at Kennedy Space Center (KSC) in May. During this TIM, informal agreements were reached on all major ISS issues except providing power to the Shuttle bay. Mauldin also mentioned that the NASA/ESA Early Utilization Agreement has been signed and the Hexapod is now in phase C/D with a Preliminary Design Review (PDR) planned later this year. The Interface Design Specifications (IDS), which identify all requirements to Ball Aerospace, ISS, and ESA were published. This was critical because Ball will be delivering the instrument prior to baseline of the ISS Interface Control Documents (ICD).

Regarding the FOO mission, Mauldin stated that NASA HQ rejected the SPOT 5 proposal with the French because it ran counter to a no-exchange-of-funds policy between the U.S. and other countries. The fact that the FOO mission had not been identified is a major concern from two aspects: (1) HQ funding issues, and (2) Ball's contract expiration prior to identification of FOO mission requirements.

SAGE is also sponsoring two outreach programs (education and business), which support the outreach goals identified during the latest Gore-Chernomyrdin Commission agreement. Mauldin asked the science team to recommend SAGE III-related experiments for potential use in the educational outreach program with a current target student age of 10-12 years. The SAGE business outreach program links the Hampton Roads business community with the Russian manufacturing community in Istra.

Obie Bradley, SAGE III Instrument Manager, provided the status of the instrument and test schedule. Specifically, Bradley discussed the instrument electronics, pointing system, spectrometer telescope, flight software, and detectors. Many subsystems have been completed and are in testing. Several problems have been identified, including difficulty bonding to the thermal electric coolers and detector problems. The Charge Coupled Device (CCD) detector problems including serial leakage from the parallel registers and from bulk silicon at the segment breaks, and red leakage were identified during testing with the test model spectrometer/telescope. Also, there have been 3 failures due to electrostatic discharge (ESD) to date. Handling methods have been modified to avoid ESD-related damage. Several options are being considered to reduce the leakage effects.

Joe Zawodny, LaRC co-investigator, continued the detector failure discussion with a presentation on science impact. As designed, the CCD cannot meet the 0.02 % out-of-band rejection specification. Ball Aerospace provided data on the serial and parallel leakage. Zawodny compared scattered light to desirable light (wing to core) and found the ratio of "bad" to "good" data to be 1.4% at 850 nm or 50 times specification. At 950 nm the ratio was close to 6%. It was found that you would have to go 100 pixels from line center at 850 nm to reach specifications. At 950 nm it was found to be over 150 pixels. The detector was deemed unacceptable, based on Zawodny's evaluation. A significant amount of light comes from pixels as far away as 150 nm in the 900- to -1000-nm spectral region. Measurements of aerosol at 1020 nm and water vapor are, therefore, interdependent and both must be considered simultaneously in the retrieval. There is also the possibility that species which SAGE III does not measure (such as CO_2 and CH_4) may also need to be modeled in the data reduction. In response to the question inquiring why this problem cannot be corrected via the algorithm, it was stated that monitoring of the effective spectral band passes could be accomplished on the ground but not in flight. Therefore, the calibration could not be maintained in the long term.

Advanced Camera has also experienced and investigated similar leakage problems since their CCDs were produced on the same wafer as the SAGE III CCDs.

Advanced Camera moved the gold layer from the bottom of the substrate to between the glass and silicon. Their performance improved significantly except at 1 micrometer (where the gold layer may not be thick enough to prevent tunneling). The transparency of silicon in the infrared and the "soda-like" glass on which the detector was mounted were found to be the problem. When the gold was removed from the back of the SAGE detector and re-coated with black, a factor of ten improvement (as determined by Ball Aerospace) was observed, which still did not meet specifications. An additional factor of ten was anticipated from the detector slotting option. Etaloning effects remain a concern. Zawodny speculated that the etaloning effects could be used for cloud detection. The response was that these effects need to be carefully characterized and understood. The impact on lunar occultation was not considered to be at risk because neither the red leak nor the etaloning occurred at wavelengths less than 700 nm. Questions were asked about the impact on solar occultation ozone measurements.

Zawodny developed a revised specification table with extra science channels to measure ozone using differential absorption. The Project Office has been working on a contract incentive to demonstrate/implement the revised table. The red leakage problem is exacerbated if the modified table is not implemented. The possibility of masking all pixels that aren't being used was evaluated but is in conflict with the calibration specification, which is dependent on using Fraunhofer lines. With regard to the GSFC alternate detector solution, dark current may be a potential problem. Detector contingency plans continue to be worked, and the scientific impact will continue to be evaluated as data become available.

Herb Mott, a SAGE Mission Operations Specialist, provided an update on the status of the SAGE III mission operations. The Joint Mission Operations Plan was reviewed during TIM #10, with anticipated signing during the upcoming TIM in September. An extensive review of the detailed command exchange protocol was performed. The Russian GLONASS definitive solution matches the U.S. GPS definitive solution, using simulated data. The U.S. and GLONASS solutions will be compared regularly during the mission for validation. Nominal data exchange occurs between NASA LaRC, Central Aerological Observatory (CAO)/Dolgoprudny, and MCC-M. CAO/Dolgoprudny will now manage the link of the science and raw data exchanges between LaRC/CAO/NPO. The command station memory storage and transmission rates are still open issues.

Mary Osborn gave an overview presentation on the SAGE III science software development, development resources, processing strategy, and data archiving activities. The objective of Phase A was to design and write the software that will produce the SAGE III Level 1B data products (transmission profiles). Phase A software was ready for integration and testing at the Distributed Active Archive Center (DAAC) in late June. During Phase B, retrieval software for producing Level 2 solar and lunar products will be designed and written, and supporting databases (spectroscopy, meteorological, etc.) used in the data processing will be developed. During post-launch activities, instrument calibration (CCD wavelength registration and mirror calibration) will be performed, and the Level 1B and 2 data products will be distributed to the science team via the world wide web. The transmission algorithm, retrieval algorithm, and data production procedures were outlined, and the software development schedule was provided.

The SAGE III Algorithm Theoretical Basis Document (ATBD) panel review was held on March 12-13. McCormick provided a summary of this review process. Chu, the SAGE III associate PI, discussed the critiques. A formal response to the panel critique is being prepared. In general, the SAGE III oral review was a resounding success!

Chip Trepte led a discussion on Meteor/SAGE III validation requirements and correlative measurement plans. The discussion began with a listing of the major validation needs and sampling constraints. Besides acquiring correlative measurements for each science product near the location of SAGE III occultation, the science team identified a need to verify the altitude registration of transmission profiles to <100 m. Further discussion ensued on the need to acquire correlative measurements of known accuracy and precision, sampling representativeness, and completeness for validation. It was recognized that for many of the SAGE products (e.g., aerosol extinction) such an approach was difficult without standard procedures. For these products validation would, instead, be more of an intercomparison activity.

A correlative measurement strategy was outlined that consisted of three components: (1) leveraging upon measurements from on-going ground-based observational activities; (2) intercomparisons with concurrent satellite programs; and (3) use of supplemental airborne measurement campaigns to satisfy additional measurement needs. The first part of the strategy has low risk and takes advantage of operational and international measurement programs, such as the World Meteorological Organization (WMO) and the Network for Detection of Stratospheric Change (NDSC), by coordinating satellite occultation events with these sites. Both the Lauder, NZ, and the arctic NDSC stations were identified as being anchor sites for early validation activities. A number of remote sensing measurements from these locations would provide early feedback on the retrieval products. Mohnen and Trepte will oversee coordination of the WMO ozonesonde network with SAGE activities. Brogniez will help coordinate valuable European balloon activities during the Third European Stratospheric Experiment on Ozone (THESO) campaign (1999) with SAGE III overpasses.

A listing of concurrent satellite missions was also presented that showed more than 5 missions that may be available for intercomparisons. Most of the meeting, however, centered around prioritizing measurement activities and discussing the airborne correlative measurement campaign in the fall of 1998. Because correlative measurements are needed within 90 days of the operation of SAGE III, a *strawman* airborne mission based from Fairbanks, Alaska, was presented to meet this requirement. For this mission, emphasis is placed on acquiring measurements of stratospheric ozone and aerosol.

Trepte announced that a meeting was scheduled in August for coordinating SAGE III validation with NASA's Upper Atmospheric Research Program. This program manages stratospheric chemistry research with the ER-2 and DC-8. The Program Manager, M. Kurylo, was interested in working together with SAGE and merging measurement objectives into a unified airborne campaign.

Andreas Herber, from the Alfred Wegener Institute (AWI) presented an overview of the validation sites at Svalbard. This site performs NDSC measurements targeting vertical profile and columnar measurements in an effort to gain a better understanding of stratospheric and tropospheric processes. Herber also presented details on a lidar instrument and their high-latitude stratospheric and tropospheric measurement facilities which have been used to measure two different types of polar stratospheric clouds (PSCs) within the past year. AWI has also been successful in intercomparing lidar results with backscatter sondes. Herber described the AWI microwave radiometer instrument developed by the University of Bremen. The microwave radiometer is used for ozone profiles, ClO, and other measurements. Good coincidence was observed in a comparison of microwave measurements to ozone profile measurements in February/March 97 as well as in the February/March comparison between the University of Wyoming and AWI ozonesondes. Details were also provided of the AWI sun photometer. They have been very successful with this instrument due to the extremely stable conditions in Svalbard, which simplifies the calibration process. Herber discussed the AWI star photometer and how it could be used in conjunction with lidar for a better vertical profile as another validation option.

Collette Brogniez, Laboratoire d'OptiqueAtmospherique (LOA), France, presented a European Validation proposal. The Europeans are planning a balloon campaign in late summer 1998 from Sweden to support Improved Limb Atmospheric Spectrometer (ILAS), Polar Ozone and Aerosol Measurement III (POAM III), SAGE III, and one in January–March, 1999 from THESEO. The balloons will cover altitudes from 12-30 km.

Nicolai Elansky, co-investigator, Russian Institute of Atmospheric Physics (IAP), presented the Russian validation activities of both the Central Aerological Observatory (CAO) and IAP. Elansky presented a slide of current WMO-Global Atmosphere Watch (GAW) validation stations as well as proposed future sites.

Sites at Zhigansk and Yakutsk were used to measure total ozone and NO_2. These were the only sites where regular ozonesondes were carried out in the winter and spring. Both sites registered the severe ozone depression above Siberia for March-April 1997. The total content of ozone decreased here up to 40% of the mean values. Measurements of total ozone and vertical profiles of O_3 and NO_2 are carried out at the Tomsk and Obninsk sites, using the Brewer spectrophotometer and lidars. Vertical profiles of ozone were made using microwave techniques in Nijniy Novgorod and Zvenigorod near Moscow. IAP was specifically responsible for the NO_2 network that includes Kislovodsk, Murmansk, Tomsk, Zvenigorod, and Issyk-Kul sites. In September 1997 the NO_2 instrument intercomparisons will take place at the Zvenigorod observatory. All Russian instruments will be compared with the reference spectrophotometer from the Lauder observatory. Elansky also presented the carriage-laboratory for atmospheric minor species measurements along the Trans Siberia Railway. Three Russian-German expeditions for gases and aerosol concentration measurements have been made in 1995-1997 between Moscow and Vladivostok. Some important features of O_3, NO_2, CH_4, CO, and other compound distributions over the continent have been obtained. In spring 1997, the first vertical profiles of O_3 and NO_2 were measured from the carriage-laboratory in the ozone depression area above Siberia. These data show that a carriage-laboratory could be used effectively for SAGE III data validation. IAP is hosting an international conference to intercompare validation instruments in mid September

Volker Mohnen, co-investigator, SUNY Albany, gave a presentation intercomparing SAGE II vs. ozonesondes using the Eulerian intercomparison techniques and found the delta of 20-30 km to be well within specification. The most significant discrepancy occurred below 15 km. The following reasons were cited: (1) air masses associated with the two measurements were not correlated; and (2) ozonesondes are not as effective at these levels. For SAGE III the focus will be on the 8-16 - km range. Mohnen suggested ozone intercomparisons for SAGE III plus Lagrangian intercomparisons in the future for potential vorticity field measurements to enhance coincidence and reduce the meteorological variability. A comparison of SAGE with HALOE has been published in the July issue of JGR.

Mohnen suggested using the WMO-GAW/International Global Atmospheric Chemistry (IGAC)- Global Tropospheric Ozone Network (GLONET) validation approach, stating that the GAW measurements are of known quality. A permanent GAW facility for ozonesonde intercomparison and calibration is being established at Julich, Germany. Lidar is also used for ozonesonde intercomparisons. Discrepancies above 8 km may be corrected with Lagrangian techniques. Globally coordinated quality assurance for ozonesondes in support of SAGE III ozone validation could be based on WMO-GAW and IGAC-GLONET procedures, but would require funding.

Sasano, of the National Institute of Environmental Studies (NIES) Data Handling Facility (DHF) Earth Observing Center (EOC), introduced the planned ILAS activities and stated that data should be available to the public after May 1998. The instrument consists of two spectrometers (one visible and one infrared) and a sun-edge sensor. The instrument is on the ADEOS satellite in a sun-synchronous high-latitude polar orbit and is designed to measure ozone, ozone chemistry-related gases, aerosols, PSCs, and meteorological parameters, including temperature and pressure. The channels range between 6.2 and 11.8 micrometers. Unfortunately, the ADEOS spacecraft ceased operation in early June this year, after successful operation for eight months. The data processing algorithms used a transmission comparison, but plans were underway for a utilization of the tangent-height determination technique. Line-by-line calculations of the absorption spectrum were performed, the onion peeling method was used for vertical profiling, and a non-linear least square method was used for spectrum fitting. In the future, the ILAS II instrument will add a mid-infrared spectrometer for aerosol/PSCs and a narrow band spectrometer for OClO and NO_2. ILAS II is scheduled for a 1999 launch with a 5-year life expectancy.

Patrick Hamill, Professor of Physics at San Jose State University, presented a proposal for a cooperative SAGE III/Global Ozone Monitoring Experiment (GOME) mission to capitalize on the synergies between these instruments if operated on the same satellite in a near-equatorial orbit. Hamill has been working with Giorgio Fiocco at the Universita di Roma. Hamill gave an overview of the GOME capabilities, the scientific rationale, the synergisms between the instruments, and other considerations. He explained that GOME is a nadar-viewing instrument that measures light scattered from the atmosphere between 240 and 790 nm, using a differential optical absorption spectrometer to determine total column ozone, trace gases, and aerosols. It is a scaled-down version of the Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) instrument. Profiles are determined by using the temperature dependence of the Huggins band. The sun and moon are used for radiometric calibration. GOME is scheduled to fly on the ERS-2 satellite and operate in three different modes to measure the following species: 0_3, NO, NO_2, BrO, H_2O, O_2-O_4, and aerosols. Hamill cited interest in the equatorial region and SAGE/GOME synergisms as the scientific justification for a two-instrument/two-satellite mission. Coverage would be limited to the tropics but that coverage would be very detailed. The tropical region is of interest because of such phenomena as volcanoes, which are a source of stratospheric sulfate particles, and because it is a reservoir for tropical aerosols, has interesting dynamics and cloud cover, has biomass burning, and has cloud absorption anomalies.

Vin Saxena, North Carolina State University co-investigator, and John Anderson, also from North Carolina State University, presented proposed SAGE III investigations to: (1) retrieve aerosol microphysical characteristics down to 6 km from a shape-constraint-free algorithm for use as a correlative measurement during validation; (2) determine the aerosol optical depths and associated UV-B transmission at southern and northern latitudes during the validation/correlative phase in cooperation with John DeLuisi; and (3) delineate the presence and transport of lower tropospheric aerosols such as arctic haze. Anderson also provided an outline of the RMST (Randomized Minimization Search Technique) along with preliminary results of retrievals with synthetic test data.

Colette Brogniez presented the Laboratoire d'Optique Atmospherique activities concerning SAGE III measurements with a focus on water vapor inversion and aerosol characteristic retrieval. She presented the methodology used for the inversion process. Three cases were presented: one mono-modal and two bi-modal with two inversion methods (a least squares fit method and the King method).

Didier Rault, NASA LaRC, reviewed the Forward Simulation methodology presented during the January Science Team Meeting and provided a status of the simulation. Rault has studied the effects of inhomogeneity of atmospheric density and temperature. He conducted a detailed comparison of the Forward Simulation with SAGE II measurements and ran simulated SAGE III scans. A systematic error from 5-15% between the SAGE II inversion code and the Forward Simulator was attributed to the Earth oblateness, Rayleigh scatterings, atmospheric refraction, and edge times. Rault has prepared the simulator for SAGE III operating conditions, which requires additional channels, a higher spectral resolution, and SAGE III instrument characteristics.

Eleonor Tchayanova, Russian Central Aerological Observatory (CAO), presented the status of the Russian NO_2 algorithm development in the spectral region 430-450 nm. The algorithm calculated optical depths for the chosen atmospheric model followed by retrieval of NO_2, ozone, and aerosol extinction profiles. Inverted profiles were then compared with the forward calculations of NO_2, O_3, and aerosol extinction profiles.

Chu provided an overview of the limb scattering discussions. The current modeling status will depend on the data to be obtained from a GSFC limb scattering instrument to be flown on the Shuttle this November. GSFC, LaRC, and the University of Arizona have been collaborating on the limb scattering methodology. GSFC and the University of Arizona are currently in the process of modeling inhomogeneous clouds. Determination of the optimum limb scattering geometry which results in the best sensitivity for the various species requires identification of the spectral region and operating modes. The Department of Defense (DOD) instrument Midcourse Space Experiment (MSX) will be taking limb scattering data in August this year for the GSFC scientists to analyze. GSFC will provide LaRC with modeling information based on the MSX data to support reprogramming SAGE III for limb scattering measurements. A follow-on meeting is scheduled in September.

The next SAGE III Science Team meeting will be scheduled in conjunction with the flight instrument pre-ship test and review scheduled during the second quarter of FY 98.

Winning Proposals from NRA-97-MTPE-03

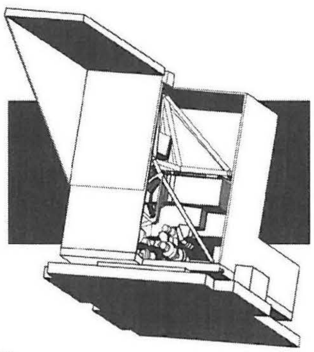
Note: Type 1=Global Data Integration and Validation Program; Type 2=EOS Validation

Proposer	Type	Title	Institution	E-Mail address
Armstrong, Richard L	1	Passive Microwave Snow Cover Algorithm Intercomparison and Validation	University of Colorado Boulder	rlax@kryos.colorado.edu
Arrigo, Kevin R	2	Satellite Remote Sensing Measurement Accuracy, Variability and Validation Studies	Goddard Space Flight Center	kevin@shark.gsfc.nasa.gov
Augustine, John A	2	Surface Radiation Budget and Cloud Measurements for NASA's EOS/ CERES Programs	NOAA	augustin@srrb.noaa.gov
Baldocchi, Dennis	2	FLUXNET: Unifying a Global Array of Tower Flux Networks for Validating EOS Terrestrial Carbon, Water and Energy Budgets	NOAA/ARL	ich@stc10.ctd.ornl.gov
Boccippio, Dennis J	2	Cross-Sensor Validation of the Lightning Imaging Sensor	Marshall Space Flight Center	Dennis.Boccippio@msfc.nasa.gov
Brogniez, Colette	2	European Coordinated Programme for SAGE IIIValidation	University of Science and Technology	
Brown, Linda R	2	Calibration of the Oxygen A-Band for SAGE III	Jet Propulsion Laboratory	lrb@caesar.jpl.nasa.gov
Collins, William D	2	Validation of the CERES Surface Radiation Budget Using Long-Term Observations from the Indian Ocean Experiment	University of California San Diego	wcollins@ucar.edu
Di, Liping	1	Validation and Algorithm Inter-Comparison of Global NDVI Time Series Products Derived from NOAA AVHRR	Hughes STX Corporation	lpd@ulabsgi.gsfc.nasa.gov
Dutton, Ellsworth G	2	EOS/CERES Surface Radiation Validation at NOAA Climate Monitoring and Diagnostics Laboratory Field Sites	NOAA	edutton@cmdl.noaa.gov
Ellingson, Robert G	1	Evaluation of Operational Longwave Radiation Budget Parameters Using the GOES Sounders	University of Maryland College Park	bobe@atmos.umd.edu
Emery, William J	1	Improving the Accuracy of Satellite Sea Surface Temperature Measurements by Explicitly Accounting for the Bulk-Skin Temperature Difference	University of Colorado Boulder	emery@orbit.colorado.edu
Ferrare, Richard A	2	EOS Validation of Aerosol and Water Vapor Profiles by Raman Lidar	Goddard Space Flight Center	ferrare@agnes.gsfc.nasa.gov
Fowler, Charles	1	AVHRR-Based Polar Pathfinder Products-Evaluation, Enhancement and Transition to MODIS	University of Colorado Boulder	cfowler@frodo.colorado.edu
Freilich, Michael H	1	Comprehensive Validation of Satellite Ocean Winds: Advanced Techniques and Multi-Instrument Analysis	Oregon State University	mhf@oce.orst.edu
Goldstein, Richard	1	Interferometric Propagation Delays	JPL	goldstein@kahuna.jpl.nasa.gov
Goodman, Steven J	1	Interpretation of Lightning Observations for Understanding the Meterological Properties of Clouds	Marshall Space Flight Center	steven.goodman@msfc.nasa.gov
Gower, Stith T	2	Validation of ASTER and MODIS Surface-Temperature and Vegetation Products with Surface-Flux Applications	University of Wisconsin Madison	stgower@facstaff.wisc.edu
Henry, Patrice	2	Cross-Calibration Between EOS AM-1 and CNES Sensors	CNES	patrice.penry@cst.cnes.fr
Heymsfield, A.	2	In-Situ and Remote Sensing Measurements in Support of the EOS/MODIS Retrieval Algorithm Validation Program	National Center for Atmospheric Res.	heyms1@ncar.ucar.edu
Hook, Simon J	2	Validation of Thermal Infrared Data and Products from MODIS and ASTER over Land	Jet Propulsion Laboratory	simon.j.hook@lithos.jpl.nasa.gov
Hooker, Stanford B	2	Marine Optical & Biological Measurements from the Atlantic Meridional Transect for MODIS Calibration and Validation	Goddard Space Flight Center	stan@ardbeg.gsfc.nasa.gov
Ignatov, Aleksandr	1	Validation and Adjustments of Aerosol Retrievals from TRMM/VIRS	NOAA/NESDIS	aignatov@nesdis.noaa.gov
Jaross, Glen	1	Reflectance-Based Sensor Validation over Ice Surfaces	Hughes STX Corporation	jaross@qhearts.gsfc.nasa.gov
Jessup, Andrew T	2	Broadband Infrared Thermometer Measurements for MODIS Validation	University of Washington	jessup@apl.washington.edu
Jezek, Kenneth C	1	The Spatial and Temporal Characteristics of High Latitude Seasonal Snow Melt as Detected by Passive and Active Microwave Sensors	Ohio State University	jezek@iceberg.mps.ohio-state.edu
Krider, E Philip	2	LIS Validation Studies Using Lightning at the KSC-ER	University of Arizona	krider@air.atmo.arizona.edu
Kursinski, E Robert	1	Assessing and Improving the Accuracy of Passive Operational Sounders Using GPS	Jet Propulsion Laboratory	erk@mercu1.caltech.edu
Lacis, Andrew A	1	Intercomparison of SCARAB, ERBE, and ISCCP Seasonal Flux Variability	Goddard Institute for Space Studies	ccaal@nasagiss.bitnet
Li, Shusun	2	Validation of MODIS Snow and Sea Ice Products in the Southern Ocean	University of Alaska Fairbanks	sli@sparc1k..images.alaska.edu
Liang, Shunlin	2	Validating MODIS/MISR Land Surface Reflectance and Albedo Products	University of Maryland College Park	sliang@geog.umd.edu
Lindsay, Ronald W	1	Validation of Radarsat Geophysical Processing System Products	U. of Washington	lindsay@apl.washington.edu

Mace, Gerald G	2	Cloud Property and Surface Radiation Observations and Diagnostics in Support of EOS, CERES, MODIS, and MISR Validation Efforts	University of Utah	mace@atmos.met.utah.edu
Marshak, Alexander	2	Validation of Cloud Optical Depths Retrieved From EOS/MODIS Data	Goddard Space Flight Center	marshak@climate.gsfc.nasa.gov
McMillan, William	2	Validation of MOPITT Column and Profile CO from Spaceborne, Airborne, and Ground-based Interferometers	University of Maryland Baltimore Cnty	mcmillan@umbc.edu
Meyer, David J	2	Validating MODIS Surface Reflectance, fAPAR and LAI Products Over the North American Grasslands	USGS/EROS Data Center	meyer@dg1.cr.usgs.gov
Minnett, Peter J	1	High Accuracy Infrared Interferometric Validation of Satellite Surface Temperature Retrievals	University of Miami	pminnett@rsmas.miami.edu
Morris, Gary Allen	1	Validation of H_2O and O_3 Meas. from SAGE III Using Trajectory Mapping and Constituent Recons.	Goddard Space Flight Center	morris@zephyr.gsfc.nasa.gov
Murcray, Frank J	2	Near IR Balloon-Borne Measurements in Support of SAGE III and MOPITT	University of Denver	murcray@ram.phys.du.edu
Myers, Daryl R	2	Application of Saudi Arabian Surface Radiation Flux Measurements for Validation of Satellite Remote Sensing Systems	National Renewable Energy Lab.	myersd@tcplink.nrel.gov
Nolin, Anne W	2	Validation Studies and Sensitivity Analyses for Retrievals of Snow Albedo and Snow Covered Area from EOS AM-1 Instruments (Programs Area: EOS Validation)	University of Colorado Boulder	nolin@spectra.colorado.edu
Novelli, Paul C	2	Vertical Profiles of Carbon Monoxide and Other Gases in the Troposphere	NOAA	pnovelli@cmdl.noaa.gov
Olson, Richard J	2	A Global Flux Data and Information System to Support EOS Product Validation	Oak Ridge National Laboratory	rjo@ornl.gov
Pinker, Rachel T	1	Evaluation of Accuracies in Geophysical Parameters Derived from PATHFINDER Data	University of Maryland College Park	pinker@atmos.umd.edu
Pinker, Rachel T	2	EOS Validation Activity in a Desert Encroachment Zone of Sub-Sahel Africa	University of Maryland College Park	pinker@atmos.umd.edu
Platnick, Steven	2	A Study of Uncertainties for MODIS Cloud Retrievals of Optical Thickness and Effective Radius	University of Maryland Baltimore City	platnick@climate.gsfc.nasa.gov
Porter, John N	2	Aircraft Radiation and Aerosol Measurements near Hawaii: Satellite Validation at the Moby and the Hot Sites	University of Hawaii, Manoa	porter@soest.hawaii.edu
Pougatchev, N. S.	2	Validation of Measurements of Pollution in the Troposphere (MOPITT) Experiment by Ground-based Infrared Solar Spectroscopic Measurements of Carbon Monoxide (CO) and Methane (CH4)	Christopher Newport University	n.s.pougatchev@larc.nasa.gov
Privette, Jeffrey L	2	Southern Africa Validation of EOS (SAVE): Coordinated Augmentation of Existing Networks	Goddard Space Flight Center	privette@gsfc.nasa.gov
Robertson, F.R.	1	Intercal. and Val. of Top-of-Atmosphere Longwave Clear-Sky Fluxes and Surface Skin Temps for Climate Diagnostic and Feedback Studies	Marshall Space Flight Center	pete.robertson@msfc.nasa.gov
Sander, Stanley P	2	Validation of SAGE III Measurements of NO3: Ground-Based Vertical Profile Measurements	Jet Propulsion Laboratory	ssander@ftuvs.jpl.nasa.gov
Schmidlin, Francis J	2	Balloon-Borne Ozone Measurements in Collaboration with SAGE III	GSFC/Wallops Flight Facility	fjs@osb1.wff.nasa.gov
Schowengerdt, R A	2	Validation and Correction for the MODIS Spatial Response	University of Arizona	schowengerdt@ece.arizona.edu
Shi, Jiancheng	2	Investigation of Snow Properties Using MODIS and ASTER Data	University of California Santa Barbara	shi@icess.ucsb.edu
Smith, Eric A	1	Comb. SSM/I,/T,/T2 and GOES Meas. for a Sat.-based Atmos. Water Budget of the Gulf of Mexico	Florida State University	esmith@metsat.met.fsu.edu
Stephens, Graeme	1	Assessing the Impact of Remote Sensing Data on the Cloudiness Prediction in Short-Term Forecasts	Colorado State University	stephens@langley.atmos.colostate.edu
Stramski, Dariusz	2	Optical and Ancillary Measurements at High Latitudes in Support of the MODIS Ocean Validation Program	Scripps Institution of Oceanography	stramski@usc.edu
Teillet, Philippe M	2	Quality Assurance and Stability Reference (QUASAR) Monitoring	Canada Centre for Remote Sensing	teillet@ccrs.nrcan.gc.ca
Thome, Kurtis J	2	Absolute Radiometric Calibration of EOS Multispectral Imaging Sensors	University of Arizona	kurt@titan.opt-sci.arizona.edu
Uttal, Taneil	2	Validation of CERES Cloud Retrievals Over the Arctic with Surface-Based Millimeter-Wave Radar	NOAA	tuttal@etl.noaa.gov
Ward, Darold E	2	Biomass Burning and Emissions of Trace Gases and Aerosols: Validation of EOS Biomass Burning Products	US Department of Agriculture	ward@selway.umt.edu
Webster, Chris. R	2	In situ Measurements of NO2 and CH4 by the Aircraft Laser Infrared Absorption Spectrometer (ALIAS) for SAGE III Validation Studies	Jet Propulsion Laboratory	cwebster@alpha1.jpl.nasa.gov
Wood, Eric F	1	Remote Sensing for Land Surface Hydrology: Accuracy and Uncertainty Analyses	Princeton University	efwood@soil.princeton.edu
Yurganov, Leonid	2	Validation of MOPITT Carbon Monoxide and Methane Measurements Using Remote Sensing by IR Solar Spectroscopy of Moderate Resolution Combined with In-situ Measurements	University of Toronto	leonid@atmosp.physics.utoronto.ca

14th Tropospheric Emission Spectrometer/Airborne Emission Spectrometer (TES/AES) Science Team Meeting June 11-13, 1997

— **Reinhard Beer** (beer@caesar.jpl.nasa.gov), Jet Propulsion Labratory



After a general welcome from our Harvard colleagues (Daniel Jacob and Jennifer Logan), Reinhard Beer (PI) gave a brief outline of what we hoped to accomplish during the course of the meeting, the primary emphasis being (as always) on the algorithm and Algorithm Theoretical Basis Document (ATBD) developments.

The new CHEM Platform Scientist, P.K. Bhartia, then outlined the events of the past several months with particular attention to the "ESSP Mode" studies, and the CHEM platform science and overall program balance review by M. Prather's board. The general finding of the first set of studies showed that the baseline CHEM mission (4 instruments on 1 spacecraft) was, by a large margin, the cheapest approach. The Prather board endorsed this finding, in particular as a means of freeing up funds for the R & A program which has seen significant declines in recent years. Other issues raised by P.K. were the paucity of funding for cal/val and the fact that the activities that are ongoing need better coordination. He also announced that a CHEM platform experimenters group is being formed and will meet for the first time in Boulder in early August.

The JPL Project Manager, Tom Glavich, then provided an update on the TES instrument development, which is proceeding well. The next major milestone is the Preliminary Design Review (PDR) early next year. This discussion led naturally into the ATBD and algorithm schedule. While the Level 2 algorithm is undoubtedly the largest task, Level 1 has the highest priority because it is needed for Engineering Model testing beginning in June 1998.

Helen Worden provided a progress report on the Level 1B algorithm, where it was recently demonstrated that correction for self-apodization of off-axis pixels is feasible and successful. This is essential because the Science Team has requested that all spectra be put onto a common frequency and spectral resolution grid both for purposes of inter-comparison and to reduce the computational burden at Level 2. She was followed by Kevin Bowman, who has been investigating wavelet decomposition as an alternative approach to determining phase functions.

After lunch, a special briefing on TES was given to representatives of AER, Boston University, and local educators. Our first efforts at an outreach program are being made in the Boston area, and the team was very impressed by the enthusiasm shown for programs in atmospheric science in which students can participate. These programs currently target secondary school students but will soon apply to lower grades as well.

Tony Clough then reported on his January meeting with Clive Rodgers and Reinhard Beer (held under trying circumstances of high winds and consequent power outages) in which a detailed outline of the Level 2 algorithm was generated. This has proven to be a most valuable tool for setting up tasks and priorities. Following this, he discussed updates to a general strategy document that was generated about a year ago. A number of action items arose from this discussion.

The following morning discussion was begun by Ming Luo, describing the progress being made on the prototype Level 2 algorithm. The forward (radiative transfer) model is nearly complete, and work is beginning on the actual "retrieval" segment. We expect to have a functional version of the entire algorithm ready for testing by October of this year. Rob Toaz then discussed the actual C language implementation of the algorithm, with particular emphasis on the approaches used for temperature interpolation of the precomputed absorption coefficient (one set for each preselected pressure). It is clear that there is a strong trade-off between memory requirements and accuracy (e.g., 3-point Lagrangian interpolation is much better than 2-point linear but requires 50% more memory).

Pat Brown and Tony Clough then presented their on-going studies on limb pointing retrieval (using LBLRTM). They are investigating the errors associated with the spatial convolution of the radiance profile with a pixel model as a function of the number of rays (each requiring a forward model calculation) and the interpolation scheme.

The decision to use C and C++ for deliverable code was confirmed by the team, although FORTRAN inputs to the SCF at JPL will continue to be accepted.

Steve Larson discussed the logistics of storing and accessing the absorption coefficient tables (a non-trivial problem). He was followed by Jennifer Logan and Daniel Jacob, who provided the team with an updated list of trace species of atmospheric interest, whose feasibility for retrieval as Special Products should be investigated.

In a break from tradition, the meeting adjourned for the afternoon to permit R. Beer to give a special seminar to the Harvard faculty and students: "Air-borne Emission Spectrometer (AES) results from the Southern Oxidants Study," a field campaign that took place in the summer of 1995. This was the first opportunity for many individuals (including some TES team members) to see the outcome of real retrievals on real remotely-sensed data, including some preliminary comparisons with *in situ* and sonde data.

The last morning began with a paper by Curt Rinsland, describing his retrieval of information from ATMOS tropospheric spectra—a data set which has scarcely been examined. He has successfully extracted profiles of a number of new species (including HCN) but, particularly, has seen strong features attributable to cirrus clouds. Many of these characteristics should be readily seen in TES data.

Helen Worden and David Rider went into much greater depth on AES/Southern Oxidant Study (SOS) retrieval accuracy and error analyses than was possible in the previous day's seminar. While the temporal and spatial overlap between our results and those of other participants is quite small, where comparisons can be made they seem generally satisfactory, although some puzzling discrepancies remain among all the techniques employed (not just AES). The investigation of these differences continues.

The final two scientific presentations were made by X. Liu who is attempting to employ Singular Value Decomposition both as a means of noise reduction (by eliminating the higher order principal components) for smoothing black body calibration data and also as an interpolation scheme for absorption coefficient tables. The first is not obviously applicable to TES and the second may be quite risky and, in any case, offers no savings in computation time over direct interpolation (although it may offer mass storage savings).

The meeting closed with a brief overview of the highlights of the 7th Atmospheric Science from Space using Fourier Transform Spectrometry (ASSFTS) Workshop, held this year in Oberpfaffenhofen (near Munich) in May. As always, this is our best opportunity to learn of the progress of our international colleagues and to exchange views on many topics. This year's theme was "Calibration and Characterization," and one of the outcomes was a proposal to request the International Radiation Commission to sponsor a working group to arrive at a generally-agreeable algorithm for determining Noise Equivalent Spectral Radiance (NESR). Some existing methods give results that can differ by factors of 2-4, yet it is a critical performance parameter for any remote sensor (not just infrared FTS systems). The next workshop will probably be held in the south of France in October 1998, although some logistical issues remain to be worked out.

It was agreed that the next Science Team meeting would be held in Boulder (at NCAR if possible), probably October 7-9.

Grassland Prototype Validation Exercise (PROVE) at Jornada Experimental Range

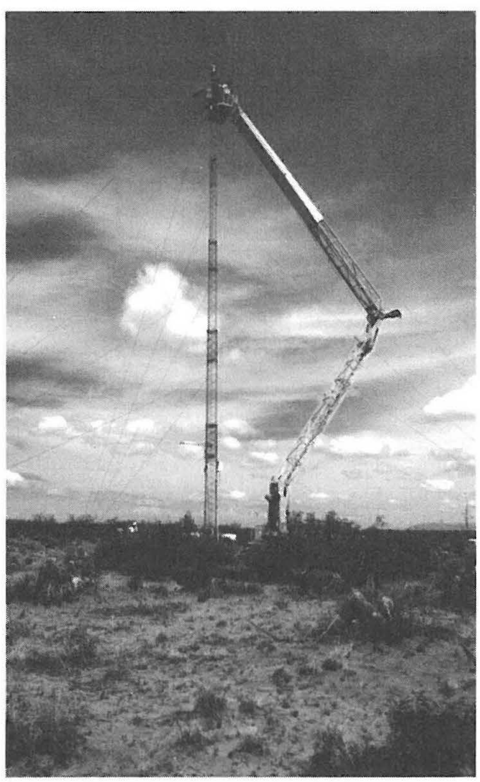
— **Bob Kannenberg** (rkannenb@pop900.gsfc.nasa.gov), Science Systems & Applications, Inc.

Introduction

A diverse group of researchers from both within and without the EOS community gathered in late May at the Jornada Experimental Range near Las Cruces, New Mexico, for the Grassland Prototype Validation Exercise (PROVE). Grassland represents the first PROVE campaign (a Forest PROVE was held in August), and was the result of a joint agreement by MODIS, MISR, and ASTER, and also included participants from the USDA-Agricultural Research Service (ARS), Jornada Long Term Ecological Research Project (LTER), Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC), Boston University, and the Universities of Arizona, Colorado, Montana, Nebraska, and Oklahoma. GSFC physical scientist Jeff Privette, who helped coordinate the activity, stated, "The PROVE campaigns focus on how quickly and accurately we can measure the relevant parameters for the validation of MODIS and other AM instrument products over a range of surface conditions. During the PROVE campaigns we are prototyping remote sensing algorithms, as well as methods for collecting field data commensurate with satellite spatial resolutions, and asking how we can measure the relevant parameters on the ground to validate the planned remote sensing products."

Background

The Jornada Range contains a large (roughly 50x100 miles) and extremely flat valley which is slowly undergoing a land-cover change from grassland to shrubland (predominantly mesquite). Because of this land-cover change, three distinct areas exist: grassland, shrubland (mesquite), and transitional (mixed grass and shrub). The area is semi-arid, so grass and shrub cover is sparse (the average leaf area index [LAI] is roughly 0.5). There are very few manmade structures in the whole Jornada area, with the exception of a few unpaved roads, a data tower, and some fences, meaning that contributions from non-target components to the remote sensing data are very small.



Grassland PROVE researchers check instruments mounted on the tower at the transitional site.

Data Collection Strategy

PROVE researchers utilized USDA-established data collection sites in each of the three land-cover areas, although high dunes surrounding the mesquite bushes in the shrubland area were problematic. Privette explained that the effects of the surrounding dunes on the measurements are still not well-understood. Researchers focused their efforts on the grassland and transitional sites and employed airborne, tower- and ground-based instruments and data collection techniques. First, PROVE set out to collect airborne remote sensing data over different spectral, angular, and spatial ranges with AirMISR, the MODIS Airborne Simulator (MAS), the Advanced Visible and Infrared Imaging Spectrometer (AVIRIS), and an Exotech radiometer. These data sets could be collected over most of the Jornada area and should adequately address issues of scaling. Second, a CIMEL sunphotometer was mounted on a cherry-picker at the grassland site, and later moved and remounted near the top of a 100-foot tower at the transitional site. Third-generation Portable Apparatus for Rapid Acquisition of Bidirectional Observation of Land and Atmosphere (PARABOLA) instruments were collocated using the cherrypicker at both the grassland and transitional sites. Third, ground crews collected LAI, fractions of absorbed photosynthetically active radiation (fAPAR), and surface temperature data along transects at the grassland and transitional sites. Digital photographs were taken along the transects, and many other variables were also measured.

Airborne data collection was hampered by the last-minute unavailability of MAS and AirMISR. However, PROVE did acquire high-spectral-resolution data from AVIRIS, and angular data that would have been supplied by AirMISR were obtained through a combination of Polarization and Directionality of Reflectances (POLDER), Geostationary Operational Environmental Satellite (GOES), Advanced Very High Resolution Radiometer (AVHRR), and airborne Exotech data. Privette felt confident that, despite the loss of AirMISR and MAS data, researchers were able to substitute other data sets and still accomplish their remote sensing data collection goals. He noted that they were very fortunate to receive POLDER data before the ADEOS satellite became inoperative in late June. He added that PROVE prototyped a method to quickly obtain just the Jornada subscenes of GOES data. A commercial GOES supplier sent the data to the ORNL DAAC within a few hours of acquisition. Researchers in the field could then use a laptop computer to access images from Oak Ridge and, for instance, obtain aggregate values for albedo or surface temperature. Allowing for spectral differences, these data could be compared to data collected with ground- and tower-based instruments, and researchers could at least plot data and compare curves. PROVE researchers did not access the GOES data from the field, but Privette expects that future campaigns will utilize this capability.

A CIMEL sunphotometer mounted on a cherrypicker (grassland and transitional sites) and a tower (transitional site) was used to gather both surface and atmospheric data that allow calculation of parameters such as Bidirectional Reflectance Distribution Function (BRDF) and aerosol optical depth. CIMEL data were transmitted in near-real time, via GOES and the Aerosol Robotic Operational Network (AERONET), to Wallops Island and archived. AERONET then made the images available online. Privette pointed out that Brent Holben of Goddard's Code 923 was instrumental to this effort. PARABOLA III data were downloaded to a laptop computer in the field by JPL investigators. These data will be cleaned up and eventually archived at ORNL. Privette noted that the PARABOLA III has 8 separate bands, whereas the original model had only 3 bands. The PARABOLA III was prototyped on the Boreal Ecosystem-Atmosphere Study (BOREAS) campaign, and will be validated by PROVE. MODIS researchers at GSFC and MISR researchers at JPL are eager to compare the CIMEL and PARABOLA III data, especially with regard to determining BRDF.

Ground data were collected with a variety of instruments, giving a first look at consistency of results between the different BRDF instruments and, later, to compare ground data to satellite data. The University of Arizona (UA) team made ground Exotech, quantum sensor, ceptometer, infrared thermal (IRT) and Modular Multiband Radiometer (MMR) measurements. The UA team took digital and GPS photographs, and also measured fractional vegetation cover and obtained soil samples. The Boston University team took multiple albedo measurements at all the sites, under various solar conditions, in an attempt to show how albedo varies during a day. The University of Colorado team made LAI measurements with a Licor LAI-2000, and fAPAR measurements with a Licor line quantum sensor. This team also measured leaf optical properties and leaf angles. GSFC, ORNL, USDA-ARS, and University of Oklahoma researchers made destructive measurements of LAI for selected mesquite, yucca, and Mormon tea data points. (These three plants account for virtually all of the vegetation cover at the Jornada Range.)

Accomplishments

When asked to discuss PROVE's successes, Privette cited three primary accomplishments. First, the MODIS Land team joined with other AM-1 instrument teams, interdisciplinary science investigators, and university and government agency scientists to develop strategies envisioned for field measurements at EOS validation sites. Second, participants prototyped sampling schemes and instrumentation envisioned for MODIS land product validation. Third, participants gathered simultaneous, coherent data for all major parameters (land and atmosphere) affecting remote sensing signals. Privette explained that modelers had identified the parameters that they wanted to measure, but did not always know the best instrument or method to collect the necessary data. With PROVE, cooperation between the modeling and measurement communities should help to ensure that the most useful data collection methods were used. Dick Olson from the ORNL DAAC participated in ground data collection in order to provide feedback from an EOS validation data archiving and management perspective. New instruments used by PROVE included the third-generation PARABOLA III, and Exotechs mounted off-nadir on light aircraft. New digital photography methods were also employed. While CIMEL sunphotometers have been used successfully by past field campaigns, PROVE represents the first time that CIMEL data were used to measure surface directional reflectance. Privette indicated that so far use of the new instruments appears to have been successful, although further data analysis is necessary before a real assessment can be made. Finally, the use of multiple instruments taking similar measurements of the same parameters should ensure a coherent data set. Preliminary comparison between instruments indicates that measurements agree. Privette added that a significant amount of satellite data was collected during this period (including 137 AVHRR scenes provided by the University of Colorado), and these will be compared to the various instrument data.

In a broader sense, Privette felt that PROVE was a success in that it brought together, in one place and time, researchers from both within and without the EOS community in the context of EOS product validation. The various research teams each had different strengths and emphases, and future campaigns will hopefully be able to play to these strengths. PROVE also allowed EOS and non-EOS researchers to share and compare data collection methods, as well as establish contacts in preparation for similar mini-campaigns after the launch of the AM-1 platform.

Continuing PROVE Activities

Analysis of the vast amount of data collected is ongoing. Some EOS researchers will likely rejoin USDA researchers to collect supplemental data from Jornada in September, when the grassland region will be green following the August monsoons. A Forest PROVE campaign was held in the beginning of August at the Walker Branch Watershed in Oak Ridge, Tennessee, and results from the Grassland and Forest exercises will be compared. Additional PROVE activities are being discussed for the first half of 1998.

KUDOS

The following members of the MTPE/EOS science community were chosen as 1997 Fellows by the American Geophysical Union:

David Halpern, Jet Propulsion Laboratory

James W. Head, III, Brown University

E. Philip Krider, University of Arizona

Michael Prather, University of California, Irvine

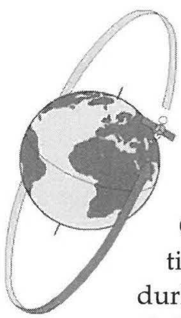
A. R. Ravishankara, NOAA/OAR

W. James Shuttleworth, University of Arizona

We would like to congratulate these colleagues on their outstanding achievements in the world of science.

EDUCATION HIGHLIGHTS

From NASA Mission to Planet Earth Education Program Update
— **Nahid Khazenie** (khazenie@istbsun.gsfc.nasa.gov), Managing Editor



1997 Discover Earth Workshop
Cool water, hot volcanoes, and insolation were some of the themes explored during the second Discover Earth summer workshop, July 14-25, at the University of Maryland at College Park. Fifteen elementary, middle, and high school teachers from eight states were joined by two NASA Aerospace Education Specialists from the east and west coasts to spend two weeks studying key issues of global climate change.

Discover Earth is sponsored by NASA's Office of Mission to Planet Earth, and conducted by the Institute for Global Environmental Strategies in collaboration with Eric Barron, Director of the Earth System Science Center at the Pennsylvania State University, and Robert Hudson, Chairman of the Department of Meteorology at the University of Maryland at College Park (UMD-CP). Additional instructors for this summer's session were Satya Kalluri, UMD-CP-ecosystems; Alan Robock, UMD-CP-volcanoes and climate change; and Soroosh Sorooshian, University of Arizona-hydrology.

The participating teachers represented an exceptional and diverse range of experiences including from one-to-thirty-three years of classroom teaching. Highlights of their awards and honors include a Presidential Honoree for Excellence in Secondary Science Teaching, two teachers who have been honored as the outstanding high school science teacher for their states, one NASA Teacher-In-Space finalist, and the Outstanding Earth Science Teacher for the Eastern Section of the National Association of GeoScience Teachers. Their expertise includes everything from astronomy to zygotes. As a result of their workshop study of the Earth as a system, volcanoes and climate change, and ecosystems and surface hydrology, they have developed five groups of classroom materials that bring key issues of global climate change into the classroom or can serve as the basis for student research projects.

The new materials will be available by the beginning of October, either in hard copy or on-line at: http://www.strategies.org. Classroom materials developed by teachers during the 1996 workshop (clouds, radiation, greenhouse gases, and ozone) are already available via mail or at that Internet site. To request project information or hard copies of the classroom materials, contact the Discover Earth Project Manager, Colleen Steele, at the Institute for Global Environmental Strategies, 2111 Wilson Blvd, Suite 700, Arlington, VA 22201, Phone: (703) 875-8634; FAX: (703) 875-8635; e-mail: colleen_steele@strategies.org.

NASA Educational Workshop (NEW)
NASA sponsored a pilot program this summer at Goddard Space Flight Center (GSFC), called the NASA Educational Workshop (NEW). Teams consisting of five teachers each were invited through the NASA Urban Initiative. The participating teams represented Baltimore, Maryland; Washington, DC; and New Jersey. The three teams spent six full days working on the theme "Earth Systems," using the Global Learning and Observations to Benefit the Environment (GLOBE) program measurements and learning activities as a tool to understand and develop the theme. The project began with the topic "Soils," illustrating the system within a pond, forest, and field. Through research programs such as NASA's Solar and Heliospheric Observatory (SOHO), the teachers also examined the Sun's influence on the Earth's system. GSFC will support these urban teams throughout the school year with additional training and MTPE materials; partici-

pants will reinforce connections by continuing to report GLOBE measurements and learning about other space science topics that show the impact of the Sun on the Earth's systems. For more information, contact: Elaine Lewis, Education Specialist, GSFC Education Office, e-mail: elewis@pop100.gsfc.nasa.gov.

S'COOL Project

Classroom teachers can sign up now to participate in the third phase of the development of the Students' Cloud Observations On-Line (S'COOL) Project. S'COOL is a component of the Clouds and the Earth's Radiant Energy System (CERES) research program within MTPE. Selected classes will make basic weather and cloud observations for a week during October and report them to the NASA Langley Distributed Active Archive Center (DAAC). After the launch of the first CERES instrument this fall, the project will be open to all interested teachers. Students' observations will be used to validate the CERES algorithms and will be available via the Internet, along with selected satellite data, for use in the classroom. There is no fee to participate, and additional information is available at http://asd-www.larc.nasa.gov/SCOOL/ or by sending an e-mail to: scool@larc.nasa.gov

Student Scientists Participate in NASA Ames Research Center Experiment

An unusual educational activity is taking place in the San Francisco Bay. Each week, students and educators at the Marine Science Institute (MSI) collect samples of the Bay water, and high school students analyze the samples for UV-absorbing pigments in Lynn Rothschild's lab at NASA's Ames Research Center (ARC). The purpose of this collaboration is to assess natural annual variability in UV radiation and its effect on the phytoplankton in this important mid-latitude estuary. The students learn about global change issues while participating in an on-going scientific experiment. This summer Judy McCurdy, a middle school biology teacher in San Ramon, California, started developing both on-ship and classroom exercises associated with this project, which will extend the excitement and educational value of this work for both the participating students and any student world-wide with access to the Web. This work was presented by Karen Grimmer, of MSI, and Rothschild, NASA ARC, at the California and the World Oceans '97 Convention in San Diego, April 1997. For more information, please contact: Lynn J. Rothschild, e-mail: lrothschild@mail.arc.nasa.gov. The URL for MSI is http://www.sfbaymsi.org/

RESOURCES ON THE INTERNET

AGU Report on Undergraduate Earth Science Education http://www.agu.org

The report of the American Geophysical Union/Keck Geology Consortium Workshop on undergraduate Earth science education is available in hard copy and on the AGU web site. The report "Shaping the Future of Undergraduate Earth Science Education: Innovation and Change Using an Earth System Approach" is from a workshop held at AGU last November. It is available at http://www.agu.org, under the Science and Society section of the Web site.

El Niño Watch from Space

http://airsea-www.jpl.nasa.gov/ENSO/welcome.html

This JPL home page provides updated information on NASA's contribution in monitoring the evolution of El-Niño and its climatic consequences. Sections include: A Brief Explanation [of El Niño]; Current Analysis; El Niño Movies; and related links.

Digital Versions of "Geomorphology from Space" Now Available

The Jet Propulsion Laboratory's Data Distribution Lab (Mike Martin and Cyndi Hall-Atkinson) and the GSFC DAAC (Linda McNeely), and Nick Short, Sr. have produced digital versions of the NASA Special Publication SP-486, "Geomorphology from Space: A Global Overview of Regional Landforms." This publication has been widely used in college geology classes, but is now out of print and difficult to obtain. To make the publication available, JPL has produced a CD-ROM version of the document, using Adobe Acrobat PDF format, and the GSFC DAAC is preparing a WWW version.

"Geomorphology from Space: A Global Overview of Regional Landforms," published in 1986, discusses various Earth and planetary landforms and landscapes, including their description, classification, origin, and development, illustrated with a rich collection of space images. The book contains 237 plates, each treating some geographic region where a particular landform is exemplified. The CD targets high school and college Earth science education audiences.

The WWW version is available at: http://daac.gsfc.nasa.gov. From there, click on the "Education" icon and then proceed to the "Geomorphology from Space" Web link. As of August 1997, half of the book is available at this WWW site; the complete document is planned to be ready by December 1997.

To place an order for the free CD click the "multimedia" button on the following page and proceed to the "Geomorphology from Space" announcement: http://stargate.jpl.gsfc.nasa.gov:1087/. This CD is compatible with all computers that can read Adobe Acrobat Portable Document Format (PDF) files. Currently 500 copies are available; 5000 copies will be available by early winter.

More Than 700,000 Aerial Photos Available Through Internet

U.S. Geological Survey News Release, contact: **Bill Tolar**, Phone: (703) 648-7759, Fax: (703) 648-4466

The public can now search and order images from the world's largest inventory of recent aerial photographs covering the United State through a U.S. Geological Survey (USGS) site on the World Wide Web.

The USGS coordinates the interagency National Aerial Photography Program, mainly for mapping purposes, and has made NAPP products available to the public for years. Now, the entire NAPP inventory can be searched, and its products ordered, through the Internet at http://edcwww.cr.usgs.gov/Webglis/glisbin/search.pl?NAPP

Professionals such as civil engineers and land use planners make frequent use of the photographs. Many customers order aerial photos for the unusual vertical perspective on their own land or neighborhoods. In addition, their popularity is growing among recreational users, such as hunters, hikers and anglers who value a bird's eye view of the outdoors.

The photographs are shot over the lower 48 states from 20,000 feet. Each square photograph, covering an area of about 25 square miles, is sufficiently detailed to show buildings, land cover, drainage patterns and other features that may not be visible on maps. Although most of the photos are black and white, some are shot on infrared film and rendered in tones of red.

For assistance in ordering aerial photographs for price information, contact USGS EROS Data Center Customer Services, Sioux Falls, SD 57198, telephone (605) 594-6151, fax (605) 594-6589 or e-mail: custserv@edcmail.cr.usgs.gov

For additional information about USGS products and services contact any Earth Science Information Center (ESIC), telephone 1-800-USA-MAPS, fax (703) 648-5548 or e-mail: esicmail@usgs.gov

The USGS is the federal government's largest natural resources science and civilian mapping agency. Each year the USGS sells and distributes more than three million copies of more than 80,000 different maps to a wide range of users. The USGS is dedicated to providing the nation with reliable, impartial information to describe and understand the Earth. This information is used to minimize the loss of life and property from natural disasters; maintain water, biological, energy and mineral resources; enhance and protect the quality of life, and contribute to wise economic and physical development.

ECS Successfully Demonstrates Launch Ready Capabilities

—**Joe Senftle** (jsenftle@eos.hitc.com), Hughes Information Technology Systems, Landover, MD

On August 28, 1997, the EOSDIS Core System (ECS) Team demonstrated the data capture and processing functions critical for timely support of the upcoming EOS AM-1 and Landsat-7 missions using ASTER, MODIS, and Landsat-7 Instrument Team-provided data and Product Generation Executables (PGEs). Requirements were translated into 42 critical functions, all of which were successfully demonstrated to NASA and the science community. Highlighting the results of 3 months of focused integration effort following the successful ECS May Demo, the demo scenarios tested system functionality including data ingest and conversion, product generation, on-demand data acquisition, user registration, product subscription, and product order. The scenarios also emphasized instrument data handling as well as data system archive, search, and retrieval capabilities.

The ASTER scenario presented by Lynne Case (Interoperability and Data Management Subsystem lead) tested support from the Data Acquisition Request Tool (DART). This tool was developed to provide on-demand data acquisition as well as expedited requests for data access. A PGE automatically triggered processing of additional PGEs to produce the requested granules. The system also allows for backward chaining so that users may request end products without having to specify the intermediate products required to create the needed end product. Additionally, the ASTER data were used to demonstrate the ability to update Quality Assurance (QA) metadata at the DAAC using the QA graphic user interface.

Evelyn Nakamura (Science Data Server lead) demonstrated the scenario which showed the exercise of the MODIS instrument launch-critical automatic scheduling and archiving capabilities. These capabilities began with a production chain starting with a synthetic MODIS MOD_PGE 01. PGE 01 staged and destaged 1.7 Gbytes of data and upon completion automatically triggered two instances of MODIS Level 1B PGE 02, which subsequently destaged 2.0 Gbytes of data. When PGE 02 completed execution, the resulting output file served as input for PGE 08 for the generation of a MODIS Level 2 Sea Ice Product. The B0 Search and Order Tool (B0SOT) was used to search and display inventory metadata to verify that the products were properly inserted into the archive. Additionally, outputs from a failed PGE were pushed via ftp to a simulated Science Computing Facility (SCF) where the data could then be examined to determine the cause of the failure.

One of the most exciting events of the day occurred during the MODIS scenario. A MODIS ancillary product was requested, but due to an unexpected operational condition, the system could not see the file. The first request was, therefore, rejected. The system is configured automatically to retry on a pre-planned delayed basis. A second retrieval request was automatically initiated and proved successful.

Jan Dreisbach (Science Data Server lead) discussed the Landsat-7 support scenario. This scenario tested the interface protocols for the Level 0 Processing System and Image Assessment System (IAS) and ingest of both types of data. B0SOT performed directory and inventory searches of Landsat-7 data, which were archived and distributed via ftp and 8 mm tape, thus demonstrating concurrent ordering from two workstations. User login and registration, operator-assisted order status tracking, data subsetting service, and browsing orders with the EOSView data visualization tool were exercised.

The B.0 development lead, Mary Armstrong, discussed work that was done prior to the August Demonstration. ECS effectively ingested and archived MODIS Level 0 data and timed the activity to ensure that the system achieved the throughput rate required at launch. The system also supported the EDOS protocol interface, ingesting and archiving ASTER L1A and L1B granules from D3 tape. Using the Data Preparation (DPREP) PGE, ECS converted EOS AM-1 ancillary data into orbit and attitude data.

Randy Miller presented a plan for achieving required ECS throughput performance followed by a presentation on the ingest thread performance by Nick Singer. Mike Daily discussed the continuing work on the JAVA Earth Science Tool (JEST), which will provide users with World Wide Web access to search for, browse, and order data from various participating archive centers.

The August Demonstration marks a significant milestone in the validation of ECS for data insertion, production, and retrieval. This effort emphasizes the ECS team's commitment to success in providing a high-performance, extensible information system infrastructure in support of NASA's Mission to Planet Earth Program.

EOS Science Calendar

October 20-21	Workshop on Atmospheric Validation in EOS-1 and SAGE III (WAVES), NASA/Langley Contacts: Tom Charlock (t.p.charlock@larc.nasa.gov) and Dave Woods (d.c.woods@larc.nasa.gov)
October 21 - 23	Landsat Science Team Meeting, Goddard Space Flight Center, Bldg. 26, Rm. 205, and/or University of Maryland. Contact: Sam Goward (sg21@umail.umd.edu) or Darrel Williams (darrel@ltpmail.gsfc.nasa.gov).
October 21-23	AIRS Science Team Meeting, Lexington, Mass. Contact: George Aumann, (hha@williwaw.jpl.nasa.gov)
October 22-24	MODIS Science Team Meeting , Location TBD. Contact: Mary Floyd (mfloyd@pop200.gsfc.nasa.gov), tel. (301) 220-1701.
October 28	AMSR-E Science Team Meeting, Tokyo, Japan. Contact: Elena Lobl (elena.lobl@msfc.nasa.gov), tel. (205) 922-5912.
November 4-6	EOS-IWG, Renaissance Atlanta Hotel-Downtown, Atlanta, GA. Contact: Mary Floyd (mfloyd@pop200.gsfc.nasa.gov), tel. (301) 220-1701.
December 9-12	14th ASTER Science Team Meeting, International Forum, Chiyoda-ku, Tokyo, Japan. Contact: H. Tsu, (tsu@gsj.go.jp), Anne Kahle, (anne@aster.jpl.nasa.gov).
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January 12-16	7th Annual JPL Airborne Earth Science Workshop. Contact Catherine Hormann (cat@gomez.jpl.nasa.gov), tel. (818) 354-0963.
February 17-18	TES PDR, NASA/Goddard Space Flight Center. Contact: Rudy Larson, (Rudolph.K.Larsen.1@gsfc.nasa.gov).
February 23-25	AIRS Science Team Meeting, Santa Barbara, CA. Contact: George Aumann, (hha@williwaw.jpl.nasa.gov).

Global Change Calendar

November 16-19	International GCTE-BAHC-LUCC Workshop under auspices of IGBP and IHOP: Prospects for Coordinated Activities in Core Projects, Wageningen, The Netherlands. Call for Papers. Contact Irene Gosselink, tel. +31 317 475700 or 475731, Fax +31 317 423110, e-mail IGBP97@ab.dlo.nl, URL: http://www.wau.nl/CCB/.
December 1-4	Fourth Asia-Pacific Conference on Multilateral Cooperation in Space Technology and Application. Contact Waheeb Essa Alnaser, tel. +973 688381/683310, Fax +973 683278/688396, e-mail: waheeb@sci.uob.bh. Internet: http://www.uob.bh/.
December 3-5	Land Satellite Information in the Next Decade II: Sources and Applications Conference, Washington, DC. Contact: ASPRS, 5410 Grosvenor Lane, Suite 210, Bethesda, MD 20814-2160. Tel: (301) 493-0290; Fax: (301) 493-0208; e-mail: asprs@asprs.org.
December 8-12	American Geophysical Union, San Francisco, CA. Contact Karol Snyder, tel. (202) 939-3205, Fax: (202) 328-0566, e-mail: exhibits@kosmos.agu.org.
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January 11-16	American Meteorological Society, Phoenix, AZ. Contact AMS Office, tel. (202) 682-9006, Fax: (202) 682-9298, e-mail: ams@dc.ametsoc.org.
January 25-29	Space Technology & Applications International Forum, Albuquerque, NM. Contact Carolyn Marcum, tel. (505) 277-2813, Fax (505) 277-2814, e-mail: cmarcum@unm.edu.
March 25-29	Association of American Geographers, Boston, MA. Contact AAG, tel. (202) 234-1450, Fax (202) 234-2744, e-mail: gaia@aag.org, URL at http://www.aag.org.
March 30-April 4	ASPRS-RTI Annual Convention, Tampa, FL. Contact Dan French, tel. (301) 493-0290, Fax: (301) 493-0208, e-mail: dfrench@asprs.org.
June 8-12	27th International Symposium on Remote Sensing of Environment. Tromso, Norway. Contact 27th International Symposium on Remote Sensing of Environment, Norwegian Space Centre, P.O. Box 113 Skoyen, N-0212 Oslo, Norway. Fax: +47 22 51 18 01, e-mail: isrse@spacecentre.no. Internet: http://www.spacecentre.no/.

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The Earth Observer Staff: