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Editor's Corner

In the last few months, the Project Science Office has held elections for chairs of various panels of the EOS Investigators Working Group (IWG). Prof. Eric Wood of Princeton University has been elected chair of the Physical Climate and Hydrology Panel, replacing Prof. Soroosh Sorooshian who has served his maximum two terms of four years as chair. Prof. Daniel Jacob of Harvard University has been elected chair of the Atmospheres Panel, replacing Dr. Rich Zurek who has served in this capacity for the past two and one half years. Finally, Dr. G. David Emmitt, Simpson Weather Associates, Inc., has been elected chair of the EOS Data and Information System (EOSDIS) Panel, replacing Dr. David Glover who has served for the past four years. This panel has continued to play a vital role in assessing the progress and status of EOSDIS developments in support of the scientific research community, both in past and current developments with the EOSDIS Core System and in developing plans for federation and PI processing for the future.

The Netherlands Agency for Aerospace Programs (NIVR) has approved an immediate new start for the Ozone Monitoring Instrument (OMI), to be built by two Dutch space companies, Fokker Space and TNO-TPD. This sensor will fly as part of the EOS Chemistry-1 mission in December 2002. The primary purpose of this instrument is to continue the long-term data record of total column ozone and surface UVB radiation started by the Total Ozone Mapping Spectrometer (TOMS) in November 1978. (The fifth and final instrument in the TOMS series will be launched on a Russian Meteor spacecraft in 2000.) OMI is a wide field-of-view (~100°) imaging spectrometer that

provides superior spectral coverage to TOMS without sacrificing its daily global mapping capability. OMI complements measurements to be obtained by the other instruments on CHEM (HIRDLS and MLS) that provide vertical distributions of ozone in the stratosphere. The addition of OMI to CHEM satisfies the concern raised by a NASA Chemistry Review Panel about a gap in the total ozone record when the anticipated recovery of the ozone layer is expected to occur in the early part of the new millennium.

The Naval Research Laboratory, Washington, DC, and the University of Colorado's Laboratory for Atmospheric and Space Physics in Boulder have been selected by NASA's Office of Earth Science to conduct parallel six-month definition studies of a new small satellite to monitor variations in the amount of radiant solar energy that reaches the Earth. Known as the Total Solar Irradiance Mission (TSIM), this mission will follow and complement observations of the Sun's total solar irradiance to be obtained from the Active Cavity Radiometer Irradiance Monitor (ACRIM), scheduled for launch in October 1999. The TSIM mission is part of a joint small Science Satellite (SciSat) program with the Canadian Space Agency, and is scheduled for launch from a NASA-funded launch vehicle in December 2001. Dr. Judith Lean is the Principal Investigator of the NRL proposal, and Dr. Gary Rottman is the PI of the University of Colorado proposal (see page 19 for further details).

There have been many changes to the make-up of the EOS science community over the last several years. The following table provides the status on the number and types of EOS investigations that are currently components of the EOS program:

Instrument Science Teams	19
Interdisciplinary Science Investigations	71
EOS Validation Investigations	44
New Investigator Program Investigations	21
Total number of EOS investigators	811

Mr. William F. Townsend, Deputy Associate Administrator of NASA's Office of Earth Science (formerly Mission to Planet Earth), has been selected to be the Deputy Director of Goddard Space Flight Center. I would like to congratulate him on his new appointment, and welcome the opportunity to continue to work with him in NASA's Earth Science Program.

Dr. Robert D. Price passed away suddenly on March 13 at his home in Harwood, Maryland. An enthusiastic supporter of Earth Science programs and global change initiatives, he will be sorely missed by everyone who knew him. He served as my EOSDIS Project Scientist from 1992-1993, at which time he was appointed Director of the Mission to Planet Earth Program Office. He was appointed Associate Director of Goddard for Earth Science in 1995, and served in both capacities until his untimely death. His interpersonal relations with colleagues and friends and his impeccable integrity are among his most lasting memories.

—Michael King
EOS Senior Project Scientist

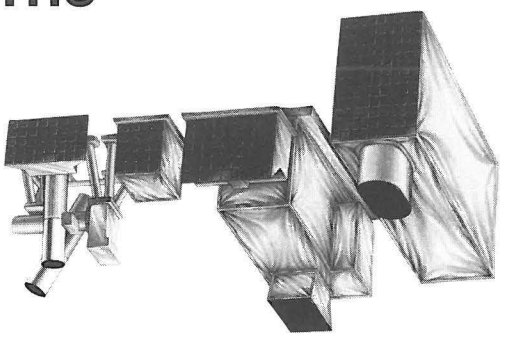
Dr. Robert Price, Director of the Earth Science Systems Program Office at NASA's Goddard Space Flight Center, died March 13 at his home in Harwood, MD.

Dr. Price began his NASA career in 1967 at Goddard's Laboratory for High Energy Astrophysics. He held a variety of assignments at Goddard and NASA Headquarters until he was appointed Deputy Director of Goddard's Earth Sciences Directorate in 1990. In that position, he assisted in a broad range of oversight activities including work on the Earth Observing System Data and Information System. He was named Director of the Earth Science Systems Program Office (formerly Mission to Planet Earth Program Office) at Goddard in 1993 and served in that capacity until his death.

Dr. xPrice received the NASA Exceptional Service Medal in 1990 for his assistance in integrating data system and science activities, and again in 1996 for his leadership in redesigning the NASA Earth Science Program in response to budget cuts.

On behalf of the Earth Science community, *The Earth Observer* staff would like to express condolences to his colleagues, friends, and family. His expertise, talents, friendly smile, and quiet manner will be sorely missed by those of us who knew him to be the outstanding leader and fine gentleman that he was.

The 14th Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Science Team Meeting



— Toru Kawakami (kawakami@ersdac.or.jp), ERSDAC (Earth Remote Sensing Data Analysis Center)

The 14th ASTER Science Team Meeting was held December 9-12, 1997, at the Tokyo International Forum in Yurakucho, Tokyo, Japan. There were approximately 100 participants representing the ASTER Science Team, Jet Propulsion Laboratory (JPL) ASTER Science Project, Goddard Space Flight Center (GSFC), Earth Remote Sensing Data Analysis Center (ERSDAC), Japan Resources Observation Systems Organization (JAROS), the ASTER Ground Data System (GDS) Project, the instrument vendors, and the Japanese algorithm development contractors. The four-day meeting was composed of two plenary sessions and several individual Working Group meetings.

Plenary I, Tuesday Morning, December 9

H. Tsu (Geological Survey of Japan, GSJ), the ASTER Science Team Leader, welcomed the participants and opened the Plenary Session.

Y. Yamaguchi (Nagoya University) reported on recent Science Team activities and status.

M. Kudoh (JAROS) reported on the ASTER and Spacecraft Integration and Test (I&T) status. He said that the bus subsystems and integration of all instruments were completed in early November. The ASTER Initial Comprehensive Performance Test and ASTER Special Test were performed in mid-October 1997. The thermal vacuum test is planned for January 1998 and will take approximately one month. Following the Bench Acceptance Test (BAT), the ASTER instrument itself has been performing well at Lockheed Martin Missiles and Space (LMMS).

M. Pniel (JPL ASTER Science Project) summarized the EOSDIS Status. He said that:

- The EOSDIS connections to the National Center for Atmospheric Research and Toronto for MOPITT are scheduled to be operational in January.
- Polar ground station development activities are on schedule for contingency support of AM-1 launch and operations.
- Flight Operation Segment delivered Release B in September and Release B patch December 17 to correct performance problems and add missing functions.
- Mini-EDOS (EOS Data and Operations System) at Valley Forge is routing science data produced during spacecraft I&T to all instrument teams except ASTER.

H. Watanabe (ERSDAC) presented the current status of the ASTER GDS. He presented the major milestones of the U.S.-Japan meetings especially focused on the GDS-EOSDIS I/F meetings up to that point, and talked about the schedules of prelaunch activities, interface documents, and hardware procurement.

Activity Report

F. Palluconi (JPL) summarized the November 1997 EOS Investigators Working Group (IWG) Meeting discussions. He said that:

- EOSDIS will support processing to Level 2 for 25% of AM-1 data in year one, 50% in year two, 75% in year three, and 100% in year four.

- EOS may make requests to ASTER for coverage of specific sites on a fast-response basis.

- The EOS Project would like to increase EOS visibility through the release of new and interesting science results as soon after launch as practical and then on a regular and continuing basis.

- For the AM-1 platform, all the major system tests remain to be completed, but a 1998 launch is still possible although there is no schedule margin. The schedule will be clearer once the system thermal vacuum test is successfully completed.

A. Kahle (JPL), the U.S. ASTER Science Team Leader, summarized the discussions at the SWAMP Meeting in November 1997, including:

- The results of the thermal vacuum test will be issued in January 1998.

- The EOS AM-1 Project is still on schedule (but a tight schedule) for launch on June 30, 1998.

- MODIS was delivered to Valley Forge and is now on the spacecraft.

- JGR Special Issue on AM-1 is in press.

- EOS Validation Plan concerns.

Y. Yamaguchi (Nagoya University) summarized the Operations and Mission Planning Working Group (OMPWG) ad hoc meeting that was held September 17-19, 1997, at ERSDAC in Tokyo. The main topics of the meeting included:

- All-Data-Acquisition-Requests (xAR) resource allocation and tracking
  - ◊ Data Acquisition Request (DAR) allocation plans for various user categories were agreed to. They were 40,000 km^2 per one proposal by an Announcement of Opportunity (AO) user, and 160,000 km^2 for an ASTER Science team member.

- ASTER AO status
  - ◊ More than 100 letters of interest had been received by September 16, 1997, in response to the Japanese pre-announcements.
  - ◊ Formal Japanese AO materials will be distributed in February 1998.
  - ◊ In the U.S., the ASTER user authorization site on WWW is finished.

- ASTER Long Term Instrument Plan (LTIP)
  - ◊ Already signed by H. Tsu (ASTER Science Team Leader), A. Kahle (U.S. ASTER Science Team Leader), M. King (EOS Senior Project Scientist, GSFC) and Y. Kaufman (EOS AM-1 Project Scientist).

- Scheduler and Instrument Support Terminal ((IST) development status.
  - ◊ The scheduler was delivered to GDS at the end of November 1997.
  - ◊ The IST schedule and status were reported.

M. Pniel reported on the action items of the OMPWG ad hoc meeting.

H. Sekine (Mitsubishi Research Institute) reviewed the Science Team Acquisition Request (STAR) collection status. He said that collection of STARs for the Initial Check Out (ICO) Phase will be completed by February 1, 1998.

B. Molloy (JPL) presented the U.S. STAR Collection status. He said that:

- 226 observation requests have been received from more than 90 researchers from 20 countries.

- STAR Committee evaluation is underway.
  - ◊ Final assessment due mid-January 1998.
  - ◊ All approved early mission STARs to be entered via Web tool by January 15 for final transfer to GDS by February 1, 1998.

- The Announcement of Opportunity for submission of requests for Early Mission STARs was made in mid-October.

S. Tsuchida (GSJ) and H. Tonooka (Ibaraki University) described the plan for the EOS Field Campaign that was held December 13-14, 1997 at the Tsukuba area and on Kasumigaura Lake, Ibaraki, Japan.

A. Kahle discussed the Institute of Electrical and Electronic Engineers (IEEE) *Transactions on Geoscience and Remote Sensing* (TGARS) EOS AM-1 Special Issue (ASTER papers).

T. Kawakami (ASTER Science Project Manager, ERSDAC) presented the URL address of the Japanese ASTER Science Server at ERSDAC that includes the ASTER User's Guide, AO, ASTER News, and so forth.

Y. Yamaguchi asked each working group to discuss the following issues:

- Algorithm Validation Plan and Initial Check-Out (ICO) Phase.
- After-launch Algorithm Update Plan.
- STAR collection.

I. Sato (GSJ) asked all Science team members to give him their comments on the User's Guide.

The first plenary session was followed by a short tour to observe the ASTER GDS Facility at ERSDAC.

Plenary II, Friday Afternoon, December 12

Y. Yamaguchi summarized the discussion of the STAR committee. The topics of the discussion included:

- STARs during Initial Checkout Phase (ICO).
  - ◊ Data acquisition for global mapping will be started in the ICO Phase.
  - ◊ All the parameters have been fixed and will be transferred to GDS soon.
- STAR proposals during normal operations phase.
- xAR Collection Schedule.
  - ◊ Collection schedule was changed to require proposals by January 25, 1998 and xAR parameters by March 1, 1998.
  - ◊ STARs will be accepted anytime before and throughout the mission period.
  - ◊ DARs will be input through IMS after July 1998.
  - ◊ DARs will be scheduled only in the normal operation phase.

H. Kayanne (Tokyo University) presented the agenda and a summary of the Ecosystem Working Group meeting. The presentation included:

- Algorithm development for ecosystem mapping and surface heat fluxes.
- Ecosystems WG STARs.

M. Abrams (JPL) presented the agenda and a summary of the Oceanography Working Group meeting. The presentation included:

- Discussion about collaboration with the MODIS Ocean Team for sea-surface temperature.
- Status of Oceanography WG STAR.
- Future Oceanography meetings.
- Algorithm for a special product.
- Preliminary report of 1997 Lake Shinji Airborne/Field Campaign.
- Turbidity analysis in Tokyo Bay by Landsat/TM after atmospheric correction.

M. Urai (GSJ) presented the agenda and a summary of the Geology Working Group meeting. The presentation included:

- Volcanoes for monitoring, including an IDS team request.
- Definition of Global Mapping acquisition time for non-desert areas.
- Volcano Map Products.
- STAR status.

S. Hook (JPL) presented the agenda and a summary of the Airborne Working Group meeting.

S. Hook also reported on the agenda and summary of the Spectral Library Committee meeting. The presentation included:

- An update on the U.S. ASTER spectral library.
- An update on the Japanese ASTER spectral measurements, which will be available via the WWW in the near future.
- Recent spectral measurements of vegetation, rocks, and minerals.

H. Fujisada (Science University of Tokyo) summarized discussions about the Level-1 Algorithm Development Status, the Geometric Validation Plan, and the Ground Control Point (GCP) Library in the Geometric/Level-1 Working Group meeting. His presentation included:

- Level-1 Algorithm/Software Development Status.
  - ◊ Header Information Update: New version (Ver. 2.3) of L1 Data Product Specification was released and distributed.
- Browse Header Information Update.
- Parallax Correction Algorithm Update.

- ◊ Evaluation results using the 1-km coarse Digital Elevation Model (DEM): The accuracy is about 0.3 pixels (3 sigma).

- Intertelescope Registration Algorithm Update.
- Geometric Validation Plan Update - Japanese Plan.
- Geometric Validation Plan Update - U.S. Plan.
- Observation Plan for Geometric Validation.
- GCP Library Preparation Plan Update - U.S. Plan.
  - ◊ Report of SWAMP GCP Working Group that will fund preparation of control.
- GCP Library Preparation Plan Update - Japanese Plan.

S. Rokugawa (Tokyo University) presented the agenda and a summary of the Temperature-Emissivity Separation (TES) Working Group meeting. The topics included:

- TES algorithm.
  - ◊ Comparison between Japanese and U.S. TES code results based on the various materials shows very small differences.
  - ◊ Japanese science TES was transferred to GDS and is now under implementation.
  - ◊ EOSDIS TES code updated to conform with the latest Algorithm Theoretical Basis Document (ATBD) version 2.3 and Quality Assurance (QA) code is now in place.
  - ◊ U.S. side adopted emissivity-ratio rather than radiance-ratio in TES Code.
- QA status.
  - ◊ Japanese side proposed to exchange the User's Guide information relevant to QA items.
- Field campaign short report.
- Milestone and Initial Check Out program.
  - ◊ TES parameter tuning, if necessary, will be done from 40 days to 105 days after launch and will be updated after 18 months.
  - ◊ TES algorithm validation includes TES parameter tuning, parameter transfer to GDS, if necessary, and some field tests synchronized with satellite.
  - ◊ Long-term TES parameter update scenario.

Y. Yamaguchi reported on the discussions at the OMPWG meeting. His presentation included:

- xAR cancellation procedure and Not-OK to OK flag change.
- User Categories Issues, User ID Update.
- Japan AO and U.S. User Authorization Status.
  - ◊ Formal AO announcement (Japan) will be made in January 1998.
- xAR Collection Status.
- Cloud Prediction Data Issues.
- Mission Guideline Status.
- Mission Procedure Outline.
- Mission Analysis Tool (MAT) Status
  - ◊ Ver. 0 (query generation and result display only) will be completed in March 1998.
- Scheduler Status.
- Operation Simulator Status.
- IST Status.

M. Pniel reported on the OMPWG Action Item status.

F. Palluconi (JPL) presented the agenda and a summary of the Atmospheric Correction Working Group meeting. The topics covered included:

- Status of Level 2 software.
  - ◊ Ver. 2 has been delivered to U.S. scientists and will be delivered to the Earth Resources Observation System (EROS) Data Center (EDC) in February.
  - ◊ Algorithm changes (as long as they are small) are due February 1, 1998.
- VNIR/SWIR Results from 1997 Lunar Lake Campaign.
  - ◊ The summary of June field campaign results for the VNIR/SWIR.
  - ◊ Surface reflectance retrievals agreed to better than 0.01 in reflectance at both low (0.08) and high (0.5) reflectance.
- TIR Results from 1997 Railroad Valley Campaign.
  - ◊ TIR found up to 4 K difference between the radiometric and bulk temperatures at Lockes Ponds.

K. Arai (Saga University) reported on the agenda and a summary of the Radiometric Calibration Working Group (CAL WG) meeting. The presentation of the WG included:

- Calibration Plans for each subsystem in the initial checkout period and Prelaunch Calibration Coefficients.
- Destriping issue & Proto Flight Model (PFM) Test.
- Subsystem Level of Proto Flight Test (PFT) data and Prelaunch Calibration Coefficient.
  - ◊ The results of the VNIR test showed that the photodetector output had overstepped the caution limitation. The Instrument Team is investigating the causes of this result.
  - ◊ Some detector anomalies of the SWIR Band 6 were detected in the Lamp-A calibration data. The Instrument Team is investigating the causes of this result.
- Preflight Cross Calibration Activities.
- Lunar Calibration & Results from PFM Test Data Analysis.
  - ◊ Candidate observation dates of September 4 or October 2, 1998, were proposed for Lunar Calibration.
- Status of Radiometric Calibration Coefficient Generation Method.
- Detailed Report on the previous Joint Field Campaign.
- Field Campaign Plan in Tsukuba, December 13-14, 1997.
- Activities and Operation Plan in Initial Checkout including calibration test sites.
- ATBD revision.
- STAR status.
- User's Guide.
- Status of Radiometric Validation Plan Document.
- Status of IEEE Special Issue.
- New Action Special Validation of stray light effect on Cross Calibration Method.

H. Murakami (Geographical Survey Institute) presented a summary of the Digital Elevation Model Working Group (DEMWG) meeting. The presentation included:

- ATBD progress report.
- Early mission phase target for DEM validation sites.
- Status of U.S. DEM software/hardware Request for Proposal (RFP) and production plans.
- DEMWG validation site presentations.
- DEM processing time of Japanese algorithm.

I. Sato (GSJ) reported on the agenda and a summary of the Higher Level Data Product Working Group (HLDPWG) meeting. His presentation included:

- ASTER User's Guide.
  - ◊ Will be available to AST Science Team members for evaluation after the Science Server is available (January, 1998).
  - ◊ U.S. will begin development in the March time frame, available to public in the October 1998 time frame.
- Validation Data Base update.
  - ◊ Reported on the current status and development in FY 1997.
- General Discussion.
  - ◊ The flow of Expedited Data for HLDP validation. Need to know the nature of Expedited Data and how it is different from L1A and L1B data.
  - ◊ Usage of L1 product with Ver. 0.4 and Ver. 1.0 parameter files. Ver. 0.4 is principally for Precipitation Radar (PR) product generation. Ver. 1.0 is formal for HLDP algorithm validation.

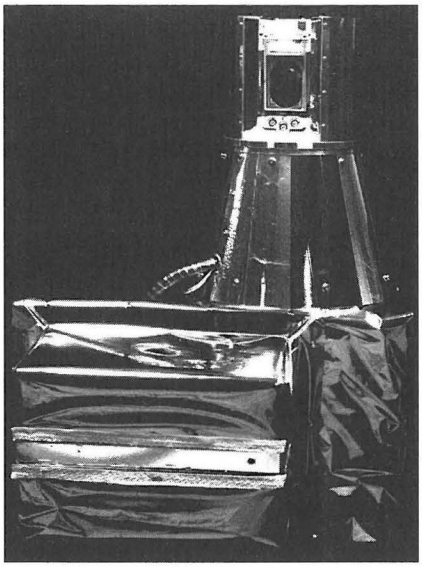
M. Pniel invited the attendees to the next ASTER Science Team meeting, which will be held in the U.S. in conjunction with the launch of AM-1.

S. Machida (ERSDAC) explained the logistics for the Field Campaign in the Tsukuba area.

The meeting was closed by A. Kahle, who called this a significant and productive meeting in which many issues were resolved both in the scheduled sessions and in off-line splinter meetings.

Summary of SAGE II Science Team Meeting

— Jack A. Kaye (jkaye@hq.nasa.gov), Manager, Atmospheric Chemistry Modeling and Analysis Program, Office of Earth Science, NASA Headquarters



The Science Team Meeting for the Stratospheric Aerosol and Gas Experiment (SAGE II) instrument was held at Hampton University in Hampton, VA, on February 12-13. SAGE II, which has been flying for over 13 years aboard the Earth Radiation Budget Satellite (ERBS), measures many of the same parameters that will be measured by the SAGE III instrument that forms part of the Earth Observing System. Measurements of vertical profiles of ozone, aerosols, water vapor, and nitrogen dioxide, as well as cloud presence, are made by SAGE II using the technique of extinction of solar radiation at occultation. The first SAGE III instrument, which will also allow for the measurement of additional species, will have lunar occultation capability. It will be launched aboard a Russian Meteor-3M satellite in the summer of 1999. A summary of the meeting is given below.

The meeting began with an introduction and greetings by the SAGE II Principal Investigator, **M. Patrick McCormick**, of the Center for Atmospheric Sciences at Hampton University (HU). He summarized current activity in the Physics Department at HU, especially several new hires in the area of atmospheric chemistry and physics. A summary of recent activities related to NASA's newly renamed Office of Earth Science and planned research announcements likely to be of interest to the SAGE investigator community was presented by the SAGE II Program Scientist, **Jack Kaye**, of NASA Headquarters, including the planned recompetition for the SAGE II Science Team in an announcement expected to be released this spring with proposals due in early summer.

Science presentations began with a detailed discussion by **Joseph Zawodny** of the NASA/Langley Research Center (LaRC) of the status of the SAGE II instrument and reprocessing activities. The instrument continues to operate normally. Data are currently available through the LaRC Distributed Active Archive Center (DAAC) for the period from launch through January, 1998, using the current version of the algorithm (version 5.931). A new version of the algorithm (5.96) has been developed for only the ozone and aerosol products; it has been used to prepare revised data sets for the ozone trends activity carried out for the Stratospheric Processes and their Role in Climate (SPARC) subgroup of the World Climate Research Programme. A newer version of the algorithm, ultimately designed for providing new data sets for all SAGE products (6.0), is currently under development, with the new data sets to be released to the science community late this summer. The main new aspect of V5.96 is the use of a new model for estimating the 600-nm aerosol extinction that is needed if one is to determine ozone extinction from the total extinction at 600 nm; use of this model has significantly improved the retrieved properties, especially during the times of high aerosol loading following the Mt. Pinatubo eruption. The V5.96 ozone and aerosol data sets do have some unexplained diurnal variations, however, at high altitudes. Some problems in nitrogen dioxide vertical profiles found with the earlier version of the SAGE algorithm have been resolved (especially through correction of time-dependent properties of one of the two channels used in the NO_2 detection), but at present the NO_2 data set is not recommended for use in

scientific studies. The version 6.0 algorithm will include several improvements, including the incorporation of multi-wavelength refraction, addition of an oblate Earth model to the representation of refraction, and corrections to the "edge times" observed as the SAGE II instrument scans across the solar disk. The first end-to-end test of the new algorithm was completed in January, 1998. Additional work to be done includes an increase of vertical resolution from 1 km to 0.5 km, improvements of the ozone retrieval above 40 km, incorporation of new NO_2 spectroscopy, and improved representation of spectral interference between ozone and water vapor. When the new algorithm is fully implemented and a data set prepared, users will be needed to carry out validation activities.

SAGE Aerosol Observations

Philip Russell of the NASA Ames Research Center reviewed work by his team to develop an integrated picture of the evolution of the pre- and post-Pinatubo stratospheric aerosol. The recent work has focused on combining SAGE II extinction measurements with those from the Cryogenic Limb Array Etalon Spectrometer (CLAES) instrument on the Upper Atmosphere Research Satellite (UARS). Previous work had shown how particle sizes increased for about a year after the eruption and decreased very slowly thereafter. However, those results also showed that when effective radius values exceed ~ 0.4 μm, an upper bound on particle size cannot be retrieved from optical depth spectra unless the spectra extend to wavelengths greater than 1 μm. Therefore, a technique for deriving effective radius values from extinction in the SAGE II wavelength range was extended to include UARS/CLAES-measured extinction at 7.955 μm. The technique takes into account the error bars on measured extinction at each wavelength and reflects them as error bars on retrieved values of effective radius, surface area S, and volume V. Interesting features in the results include: (i) increases in S and V (but not effective radius) after the Ruiz and Kelut injections, (ii) increases in the S, V, and effective radius after Pinatubo, (iii) post-Pinatubo increases in S, V, and effective radius that are more rapid in the tropics than elsewhere, (iv) midlatitude post-Pinatubo increases in effective radius that lag increases in S and V, and (v) S and V returning to pre-Pinatubo values sooner than effective radius does. This task also contributed to publications on the life cycle of stratospheric aerosols, stratospheric aerosol effects in General Circulation Model (GCM) studies of climate change, and simplified approaches to estimating radiative effects of aerosols. Future work will include examining longitudinal dependencies and determining and correcting for effects of assumption of a unimodal, lognormal size distribution.

Geoffrey Kent of Science and Technology Corp. summarized work he has done determining tropospheric aerosol distributions from SAGE observations. This work, which relies on a method for separating aerosol and cloud extinction, has been applied to the 13 years of SAGE data except for an approximately 2-year period following the Mt. Pinatubo eruption (1991-1993). SAGE I data have also been studied in this way although they have less information because of the non-availability of aerosol extinction data at 0.5 μm. Besides extending the previous work to now cover the post-Pinatubo period, the most recent work includes a relaxation of the assumption that there is an exponential decay for the volcanic component of the aerosol; now the volcanic component of the upper tropospheric optical depth is assumed to be linearly dependent on the stratospheric aerosol overburden within the same season and latitude band. Latitudinal distributions of upper tropospheric aerosols were obtained, showing an order of magnitude increase between 70° S and N. Long-term trends in upper tropospheric aerosol have been studied using the SAGE I and SAGE II data. It is unlikely that any change greater than 1% per year has occured in the upper tropospheric aerosol optical depth of either hemisphere.

Pi-Huan Wang, also of Science and Technology Corp., briefly described work he has done on the derivation of information on tropospheric meridional circulation using SAGE aerosol and cloud data. This work has been described in a paper which has been accepted for publication in *J. Geophys. Res.* The circulation that is derived in this work differs from that coming from meteorological models. Wang also noted his SAGE-related work in other areas, including studies of eddy isentropic transport of ozone in the "middleworld" and studies of the climatology of global cloud occurrence as seen in SAGE.

The geographical distribution of upper tropospheric aerosols as observed by SAGE II was reviewed by

Chip Trepte of the NASA Langley Research Center. Maps of aerosols were produced when there was sufficient sampling in a given latitude/longitude region. One particularly interesting result to come from this analysis was an apparent "plume" of mid-tropospheric aerosols (6.5 km altitude) produced from biomass burning in South America that nearly circled the globe in southern midlatitudes. Comparisons of SAGE-observed aerosols with data obtained during the Lidar in Space Technology Experiment (LITE) Space Shuttle mission in 1994 were also carried out.

Comparisons of aerosol observations made from SAGE and from *in situ* instruments aboard the ER-2 and DC-8 aircraft were presented by **Darrell Baumgardner** of the National Center for Atmospheric Research. Data from several different airborne campaigns were reviewed, including the Antarctic Southern Hemisphere Ozone Expedition (ASHOE), the Photochemistry of Ozone Loss in Arctic Region in Summer (POLARIS), and the Tropical Ozone Transport Experiment/Vortex Ozone Transport Experiment (TOTE/VOTE). During the ASHOE mission, there were several nice matchups between the *in situ* and SAGE measurements, and similar values for the effective radius of stratospheric aerosol particles were found. The *in situ* instruments have shown evidence for asphericity in some of the aerosol particles; the origins of this is not well understood.

Additional *in situ* - SAGE comparisons were reviewed by **Chuck Wilson** of the University of Denver, who has been focusing on non-volcanic aerosols in his comparisons. A major difficulty in making such comparisons is the effects of having only approximate matchups between the *in situ* and SAGE measurements, as it can be difficult to interpret the significance of differences for near-matchups. In some cases, the differences between the two measurements are larger than would be expected for coincidences based on the properties of the measurements. Work on the relationship between aerosol distributions and those of their precursors was also presented; results suggest that the rate at which sulfate appears (based on comparison with the age of air) is consistent with that at which carbonyl sulfide, a key precursor, disappears. The *in situ* results show that in "older" air, the concentration of large particles (~ 1 μm diameter) is much smaller than in younger air. These results suggest that SAGE may be able to provide additional insight on aerosol size distribution. Remaining work centers on increasing understanding of stratospheric sulfate mixing ratios and the role of large particles in the stratosphere.

Simulation of stratospheric aerosols using a combined two-dimensional atmospheric chemistry model with a detailed microphysical model was presented by **Michael Mills** of the University of Colorado. This model includes a fairly detailed representation of aerosol microphysics (condensation/evaporation, coagulation, transport, sedimentation, homogeneous nucleation) and carries 45 size bins for aerosols. Aerosol-related chemical species include carbonyl sulfide, sulfur dioxide, and sulfuric acid. Through comparison with SAGE observations of stratospheric aerosol abundance, it appears that carbonyl sulfide cannot provide for enough aerosol mass in the stratosphere, especially in the lower stratosphere. It therefore appears that tropospheric aerosol and sulfur dioxide account for a sizable fraction of aerosol mass in the lower stratosphere. These results were independent of assumptions made about the long-wavelength absorption of carbonyl sulfide (longward of 295 nm) where laboratory data are not available.

Simulations of the Mt. Pinatubo aerosol cloud using a three-dimensional model were presented by **Howard Houben** of the Bay Area Environmental Research Institute. The simulations suggest that the self heating of the aerosol cloud is very important to how it spreads; if assumed to be non-interacting, the clouds would have less impact. Model-measurement comparison is improved if slightly larger particles are used than had been previously assumed. The model results and existing observations also suggest that following the Mt. Pinatubo eruption there was not a significant increase in the total number density of stratospheric particles—that most of the condensation was onto existing particles, which became larger. In some cases, sedimentation of these larger particles may actually lead to a "cleaning" of the stratosphere, which is a somewhat unexpected result. The ability to test models during the period most closely following the eruption is limited by the scarcity of data during this time period.

Two-dimensional aerosol simulations were also presented by **Debra Weisenstein** of Atmospheric and Environmental Research, Inc. Her model included a fairly complete representation of atmospheric gas phase sulfur chemistry (including carbonyl disulfide,

dimethyl sulfide, carbonyl sulfide, methane sulfonic acid, sulfur dioxide, sulfur trioxide, and sulfuric acid), aerosol microphysics, and size distributions (40 size bins from 0.39 nm - 3.3 μm). A particular question addressed was whether or not tropospheric deep convection would impact stratospheric aerosol loading. Results suggested that this was the case, as carbonyl sulfide yielded aerosol loading approximately a factor of two lower than observations. By imposing elevated sulfur dioxide (40 pptv) in the tropics and subtropics (equatorward of 24°) in the middle and upper troposphere (4-12 km), much better agreement between calculated and observed stratospheric aerosol extinction was obtained. A calculation for the post-Mt. Pinatubo period was also carried out, in which 20 Mton of sulfur dioxide were put uniformly between 5° S and 14° N and 16-29 km. The calculated e-folding removal rate for sulfur dioxide (39 days) was fairly close to the observed value (33-35 days), and the calculated peak aerosol loading amount (32.7 Mton) and time (4 mo.) were fairly close to that observed. Comparisons of calculated aerosol amounts with those determined from SAGE for 2 km above the tropopause showed that the model-calculated aerosols were removed somewhat more rapidly than those in the atmosphere. This model is also being used to study the potential effects of a projected fleet of high speed supersonic civilian transport aircraft.

SAGE Water Vapor Observations

Comparisons of SAGE II and Halogen Occultation Experiment (HALOE) water vapor observations with those made from *in situ* platforms, notably balloons and the NASA ER-2, were summarized by **Adrian Tuck** of the NOAA Aeronomy Laboratory. Some work, already published, showed that the Southern Hemisphere lower stratosphere is significantly drier than that of the Northern Hemisphere for three major reasons —the relationship between the annual cycle in tropical tropopause temperature and that of the Brewer-Dobson circulation, desiccation in the Antarctic in winter, and differences in high-latitude wintertime descent between the two hemispheres. Work currently underway will extend this analysis to look at longitudinal variability in water vapor concentrations, especially the greater desiccation observed at high southern latitudes near the Greenwich meridian relative to the international date line; this is true both inside and outside the vortex. Studies of long-term trends in stratospheric water vapor made using all the available long-term data sources (SAGE II, HALOE, balloon-borne instruments, ER-2-borne instruments) suggest that there are problems with most if not all of these measuring systems. Not only are the observed trends obtained with different instruments different, but there are significant differences in absolute abundance. These differences are not simply related to measurement type. The possibility of obtaining some very focused coincident measurements between *in situ* instruments aboard the WB-57 aircraft and those from SAGE II in the next few months was noted.

Both observational and modeling studies related to two questions on stratospheric water vapor were presented by **Marvin Geller** of the State University of New York at Stony Brook. These questions were the relationship between the annual variation of the hygropause and the cold-point tropopause temperature, and the factors giving rise to interannual variation in stratospheric water vapor. For the former, cold-point tropopause temperatures were obtained from spline fitting to daily European Center for Medium Range Weather Forecasting analyses and compared to temperature profiles from the U.S. National Centers for Environmental Prediction and also to radiosonde information from Kapingamarangi. Results show these cold points are predominantly located in the region of the atmosphere between 90° and 180° East and 20° S and N. The saturation mixing ratios associated with these cold-point tropopause temperatures were then calculated with the Clausius-Clapeyron equation, and shown to be significantly below those calculated using mean temperatures as has normally been done. The resulting water vapor mixing ratios are much closer to the minimum water vapor mixing ratios seen by SAGE, especially near their seasonal minimum. The results demonstrate clearly that tropical tropospheric air enters the stratosphere continuously through the locations with the coldest tropical cold-point tropopause temperature, which, given their spatial distribution, means that the tropical western Pacific is the main part of the "stratospheric fountain" throughout the year. Studies of the interannual variation in SAGE II water vapor observations were also carried out. Clear evidence was seen for a QBO effect, with increased upward motion during the easterly phase of the QBO. Examination of the difference between water vapor distributions in El Niño and La Niña periods gave a much-less-clear result. The relatively brief period of

data analyzed and the complexity of overlapping El Niño and QBO effects made it difficult to conclusively demonstrate what the El Niño effects were. There was some evidence for a small negative trend in SAGE II water vapor concentrations in the lower stratosphere. This could be spurious, and should be analyzed further.

Several aspects of upper tropospheric and stratospheric water vapor were reviewed by **Er-Woon Chiou** of SAIC, Inc., including intercomparisons of water vapor data obtained from SAGE II, HALOE, and MLS, the seasonal variability of water vapor at northern midlatitudes, and the dryness of the tropical upper troposphere. The intercomparisons suggest a fairly complicated relationship between the three different water vapor data sets (relative agreement appears to vary with height and latitude), although these are complicated by the fact that the SAGE water vapor distributions were from the pre-Pinatubo period in which the water vapor distributions are usable, while the UARS (HALOE, MLS) observations were for the post-Pinatubo period. Seasonal variation studies showed that the dominant variation in lower stratospheric (26, 46 mb) water vapor in the tropical northern hemisphere was the annual cycle, while in the upper stratosphere (5, 10 mb) semi-annual variation dominated (in the tropical Southern Hemisphere upper stratosphere, the annual variation appeared to dominate as well). Empirical fits were developed to represent the water vapor composition of the upper troposphere; empirical scale heights of 1.2 - 1.6 km were obtained. Relative humidity values were calculated for the upper troposphere. Some relative humidity values as low as 5-10% were found; these are consistent with those obtained with recent reanalysis of other satellite instruments.

Factors controlling the distribution of upper tropospheric water vapor under clear-sky conditions were summarized by **Minghua Zhang** of SUNY Stony Brook. Several processes are important—subsidence, advection of cirrus clouds, evaporation of precipitation, intermittent convection, large-scale eddies, and diffusion. In clear-sky regions there should be no internal moisture sources or sinks, however, so the moisture content should be dominated by horizontal and vertical advection, as interpreted through the slopes of air parcel trajectories. To help understand the origin of these slopes, a two-dimensional model was developed to simulate atmospheric motions in a clear-sky region given lateral boundary conditions. The results show that subsidence does not necessarily mean dry conditions—it is the slopes of the trajectories that determine dryness, and these are determined by the lateral boundary conditions. The relationship between convection and moisture varies with closeness to convection—closer to the convection, more convection increases moisture (a positive feedback), while farther away, the opposite is true. Whether or not the net feedback is positive or negative will depend on the spatial extent of the clear-sky region.

Water vapor climatologies derived from SAGE II data were reviewed by SAGE II Principal Investigator **Pat McCormick** of Hampton University. The first SAGE II water vapor climatologies covered three years, and have recently been extended to cover the full 5.3 years of pre-Pinatubo SAGE data. Key results to come from the climatologies include the observation that the lowest water vapor mixing ratios observed in the lower stratosphere occur in both hemispheres in the same season, suggesting a single source. Some seasonal differences do exist—for example, in Northern Hemisphere winter, the hygropause is much better defined than in summer. There are significant differences in the water vapor distributions in the eastern and western hemisphere when 500-100 mb columnar water vapor is considered. Future work will involve separation of the 100-300 and 300-500 mb regions so that the effects of stratospheric air in the upper part of these regions at middle and higher latitudes can be examined.

Ozone, Chemistry, and Climate

Studies of long-term ozone trends calculated using SAGE II data and the comparison of those calculated with other measurements systems were presented by **Derek Cunnold** of the Georgia Institute of Technology. Most of this work was carried out as part of the ozone trends assessment organized by the Stratospheric Processes and their Role in Climate (SPARC) activity of the World Climate Research Programme and by the World Meteorological Organization. The version 5.96 SAGE II data described earlier were used in these studies; the differences between this and the 5.93 data set were largest below 15 km, although for the early post-Pinatubo period, when aerosol levels were exceedingly high, significant differences existed up to 20 km. In most of the long-term trend studies, the

period of data following the Pinatubo eruption was removed in the lower and middle stratosphere; above 27 km the data were usable all the time. Trends were calculated on the altitude scale native to SAGE rather than on pressure levels to minimize possible complications from temperature trends. Relatively good agreement was obtained between trends calculated with SAGE and with Nimbus-7 SBUV data—differences in trends were 0.2±0.2 %/year. Comparisons of more-recent data (1989-present) using SBUV/2 data had larger differences, and there is a possible anomaly in the latter data set (apparent increase in the tropics). Comparisons of SAGE trends with those from MLS and HALOE for the UARS period show some systematic differences, but they are small and not statistically significant. The SAGE ozone trends in the upper stratosphere have largest decreases of 0.8%/year at 40-45 km and are roughly hemispherically symmetric, in contrast to some previous observations of asymmetry. In the lower stratosphere (near 20 km) the decreases in the Northern Hemisphere midlatitudes are 1%/year, but there are unexplained differences in trends between the SAGE sunrise and sunset observations. Comparisons with ozonesondes suggest that there may be continuing problems with the SAGE data below 20 km, possibly associated with altitude registration or subtraction of Rayleigh scattering. Comparisons with HALOE show that SAGE II observations below 46 mb are usually higher than those from HALOE, and that, SAGE-HALOE differences are larger in the Northern Hemisphere than the Southern Hemisphere.

Michael Newchurch of the University of Alabama in Huntsville discussed comparisons of SAGE ozone observations with those from Dobson Umkehr measurements using 8 Umkehr stations (6 in the Northern Hemisphere, 2 in the Southern Hemisphere). The Boulder station provided an example of the average results. By using coincident measurements to eliminate most geophysical variability, the difference between the Umkehr and the SAGE ozone trends in the upper stratosphere is approximately 0.05%/year for Boulder, but averaged over the larger number of Northern Hemisphere sites the difference is 0.2-0.3%/year. Differences for the Southern Hemisphere were slightly larger. This work is part of a broader scope of analyses of ozone trends comprising many researches the results of which will appear in the 1998 Ozone Trends Assessment Report (IOC/SPARC). That report will indicate that, based on sophisticated analyses of SAGE, Dobson Umkehr, and SBUV (/2) observations, the preponderance of evidence for upper-stratospheric ozone destruction is now incontrovertible.

Studies of interannual variability in SAGE ozone and nitrogen dioxide measurements, especially the presence of seasonal and QBO cycles, were presented by **William Randel** of the National Center for Atmospheric Research. These used the currently archived version 5.93 SAGE data. The SAGE data provide an excellent way to study the QBO effect on ozone, and show that some 2/3 of the signal is in the lower stratosphere with 1/3 in the upper stratosphere. The integrated signal is consistent with that obtained by TOMS, but the vertical dependence looks very different from that obtained with SBUV, which has much less vertical resolution than does SAGE. The same analysis was applied to NO_2, and strong anti-correlation of the QBO effect with that for ozone was seen in the middle stratosphere because of the role NO_2 plays in catalytically destroying ozone; in the lower stratosphere (below 26 km) they are positively correlated. The relationship of the two QBO cycles should provide a clear fingerprint that can be used for testing models. The rest of the variance was studied by doing an empirical orthogonal function (EOF) analysis, skipping the post-Pinatubo period. One interesting result is that there appear to be some discontinuities in the observed EOF contributions across the Pinatubo eruption period —this is true for both ozone and NO_2. Longer-term analysis of the NO_2 data shows evidence for decreases over the time period 1984-1997, although the last few years (1993-1997) show increases; whether this is real is not yet understood.

The effects of aerosols on stratospheric chemistry were discussed by **Hope Michelsen** of AER, Inc. Her particular interest was the role of aerosols on interconversion of chlorine chemistry, especially the way in which the effective threshold temperature for repartitioning of chlorine is increased as aerosol loading is increased. Data from UARS as well as the flight of the Atmospheric Trace Molecule Spectroscopy (ATMOS) instrument aboard the Space Shuttle in 1993 were used for this work. Model results suggest existence of a hysteresis effect—that the rate of chemical reactions as temperature increases is slower than that while it is decreasing.

Results from climatological and modeling studies

carried out using SAGE data were presented by **Matthew Hitchman** of the University of Wisconsin. Several areas of work were summarized, including understanding seasonal zonal asymmetries in the SAGE constituents, the nature of the subtropical airmass boundary, and the use of models to simulate transport of SAGE constituents (the WISCAR 2D model) and the role of convection and gravity waves on constituent distributions (using the Wisconsin non-hydrostatic modeling system). The role of the Aleutian Anticyclone in affecting aerosol distributions was examined, and evidence exists to suggest that one can bring high-aerosol air up from North Africa into the northern Pacific, leading to maximum wintertime aerosols in the anticyclone (while aerosol amounts are reducing in the polar vortex). It appears that Africa represents a significant region in which air gets out of the tropics. In summertime, results suggest that the Indian monsoon may provide a mechanism for moving material from the Northern to the Southern Hemisphere. The results show that troposphere-stratosphere exchange appears to occur preferentially over the summertime oceans downstream of monsoon anticyclones, so in the northern summer it occurs in the western Pacific, while in the southern summer, it occurs in the south central Atlantic Ocean.

The uses of SAGE-observed quantities as input for climate models were presented by **Andrew Lacis** of the NASA Goddard Institute for Space Studies. The stratospheric heating by aerosol particles was shown to occur mainly by the thermal (infrared) contributions; the visible radiation impact was mainly scattering. The aerosol information was originally input into the climate model using column-averaged size distributions, but it seems apparent that one must do a better job, taking into account known evidence for altitude-dependent particle-size distributions. Future models will thus include an improved representation of aerosol properties, and should also have a more-refined treatment of water vapor in the stratosphere.

Studies of atmospheric chemistry using SAGE II data were presented by **Ross Salawitch** of the Jet Propulsion Laboratory. This work emphasized three areas—validation of SAGE NO_2 data, studying the effect of the Pinatubo eruption on NO_2 values, and integrating SAGE observations with those from other sensors. Because of the known limitations of the SAGE NO_2 data, work has focused on the last of these areas. The relationship between aerosol loading and distribution of NO_2 and other nitrogen-containing constituents was studied by use of balloon data using the Mark IV interferometer, when data were available from September 1990, April 1993, and September 1993, corresponding to low (pre-Pinatubo), high, and moderate levels of aerosol loading. Results suggest that the basic picture of aerosol effects on nitrogen oxide repartitioning, especially the evidence of a "saturation" behavior in which there is some aerosol level beyond which greater amounts do not notably effect the partitioning, is correct.

Michael Newchurch summarized some work by **David Rusch** of the University of Colorado, in which an alternative approach for the inversion of SAGE data was developed. In this approach, the geometric inversion is done at each wavelength to obtain extinction vs. altitude profiles, after which Rayleigh scattering is subtracted, and aerosol contributions are then removed by assuming a lognormal aerosol size distribution. This contrasts with the Langley inversion, in which the order of separation and geometric inversion is reversed. Prior comparisons using a method developed at the University of Lille in France suggested that these two methods were quite similar, but the new results showed that differences in the lowest part of the stratosphere may not be negligible (the results are indistinguishable above 25 km). The Colorado algorithm appears to lead to ozone profiles that agree better with some midlatitude ozonesondes than is obtained with the Langley algorithm, but additional work is needed to look at whether the aerosol parameters obtained with the Colorado algorithm are in better or worse agreement with what is known about aerosol distributions. The Colorado method also propagates error bars in a way that better reflects the altitude dependence than does the current Langley algorithm.

The meeting was well attended, with lively discussions, and showed the many applications of the SAGE II data set.

Land Processes DAAC Science Advisory Panel Meets in Landover

— Bryan Bailey (gbbailey@edcmail.cr.usgs.gov), EROS Data Center

The Land Processes Distributed Active Archive Center (DAAC) Science Advisory Panel held a regular meeting at the Raytheon EOSDIS Core System (ECS) Offices in Landover, MD, on February 4-5, 1998. This two-day meeting of the Panel was preceded by a one-day meeting devoted to addressing topics and issues of importance to the DAAC's support of and interaction with the ASTER, MODIS, and Landsat-7 Instrument and Science Teams. That meeting consisted of a short plenary session where "across instrument" topics were discussed, followed by concurrent sessions where instrument-specific topics were addressed. The results of "Instrument Team Day" discussions were presented during the meeting of the full Panel.

Wednesday, February 4, 1998

Panel Co-Chairman, Chris Justice, opened the meeting by stating that the primary focus needs to be on DAAC readiness for the AM-1 launch. Justice noted the DAAC is in a testing phase in various areas where discussion is needed, and he said there are questions of allocation—both hardware and manpower—that need to be answered.

The first item of business was to review the status of action items from the October 1997 Panel meeting. John Dwyer presented information on map projection preferences indicated by users ordering Landsat data. History shows UTM to be the most popular map projection, with SOM a distant second. Alan Strahler pointed out that many MODIS land products will be in the Intergerized Sinusoidal Projection (ISP), so it would be desirable for the DAAC to provide tools by which ancillary or other related data not in the ISP could be transformed to ISP. The DAAC will investigate the possibility of adding ISP to the General Cartographic Transform Package (GCTP). Bryan Bailey reviewed the strategy and plans for making sample ASTER, MODIS, and Landsat 7 data and products available to the general user community in the near-post launch time frame. Panel members were mixed on the issue of whether or not implementing a prototype sample data and product capability was important to its success.

John Daucsavage provided more detailed information on a previous action concerning the archive and management of EOS data and products not yet ready for release to the general user community. ECS has mechanisms to limit distribution of data to users on a designated access list, and these tools and their implementation schedule were described in the presentation. Tom Kalvelage reported on the status of network testing by describing the testing that already has occurred and presenting a schedule for planned testing. Panel members expressed lingering concerns about the status of and plans for network testing. They indicated their belief that network testing must be comprehensive and have metrics to assess performance. Actual blocks of data need to be moved across the networks to adequately test them. It was pointed out that the DAACs really are the customers of the networks, and the responsibility for network development, implementation, and testing lies with the ESDIS Project.

In response to a Panel request, Bill North presented a table that compared dollars budgeted in FY 1998 by the different DAACs for data distribution and user services. The EDC DAAC budgeted amount is substantially more than that of any of the other DAACs. Primary reasons for the difference include the large size of the data sets distributed by the EDC DAAC and the large number of products distributed. Finally, the DAAC provided an overview of the Vegetation Canopy Lidar (VCL) mission and some preliminary information about its potential impact on DAAC resources should the DAAC archive and distribute VCL data and products.

Vanessa Griffin reported on the status of a variety of NASA projects, activities, and other happenings, particularly as they relate to the Earth Science Systems Program Office. She noted that both AM-1 and Landsat-7 have experienced delays that likely will result in launch slips. She said that the Office of Earth Science fared well in the President's budget, and she mentioned some personnel changes occurring in the Office. Griffin reported that 24 Type 2 & 3 Earth Science Information Partners (ESIPs) had been selected as working prototype Federation partners, and cooperative agreements are being negotiated with each selectee. There will be an NRC Workshop on the Federated EOSDIS in late February to explore possible approaches to establishing a "Federated" structure for managing EOSDIS. The DAACs have been invited to participate in the workshop. Griffin reviewed the status of DAAC certification, which should be concluded by early summer. Eleven companies were selected to participate in Phase 1 of the Scientific Data Purchase Program, but Griffin expressed some disappointment that only one company proposed to fly a **new** space mission. One company proposed to use the Land Processes DAAC at EDC for archive and distribution of their products.

H. K. Ramapriyan presented an EOSDIS Overview that addressed overall status, strategy for launch-readiness, emergency back-up plans, and the new paradigm adaptive approach to the PM-era and beyond. Rama noted that the DAACs support a broad and growing user community, and receive orders from about 2300 distinct users each month. The EOS Review Group is meeting this week, and after that meeting a decision will be forthcoming about which system (ECS or emergency back-up) will be used to support generation of standard data products at launch. Rama reviewed the ECS Version 2.0 development strategy whereby enhancements are being delivered in a series of 5 incremental "drops." Activities are being prioritized to ensure "launch critical" functions are operational before launch. Finally, Rama described the New Paradigm-Adaptive Approach, the objective of which is to assure that EOSDIS is responsive to the NASA Earth Science Program and science needs by adapting to new ways of doing business, including more collaborative approaches with PIs, and by evolving from predetermined implementation approaches to hybrid implementation based on cost, technical, and programmatic factors.

Bryan Bailey led a discussion on DAAC interactions with the new Federation ESIPs and the new Data Buy Program selectees. Bailey told Panel members the DAAC is in the process of developing appropriate strategies for interacting with the ESIP and Data Buy selectees, and he said those strategies need to include general criteria against which potential DAAC involvement should be determined. John Dwyer described, in some detail, recent interactions the DAAC and EDC have had with the Earth Satellite Corporation (EarthSat) in support of EarthSat's Phase 1 activities as a successful proposer to the NASA Scientific Data Buy Program. Cooperation includes both provision of data from EDC Landsat archives and distribution of data and products from the DAAC.

In response to a DAAC action to assess the pros and cons of charging for data and data products and to assess the actual feasibility of doing so, John Dwyer led a discussion on possible data charging scenarios. The DAAC's study of data charging issues included identifying some basic principles around which a sound data pricing policy should be established, such as basing charges on true costs of data reproduction and delivery but allowing prices actually charged to be less, or "such as" prices charged should be allowed to vary depending on the media or delivery mechanism used. The reasons identified for charging for data and products included cost recovery and reducing the number of "frivolous" requests. Reasons for not charging include the desire to promote, not inhibit, meaningful use of DAAC data and products. As a result of its study, the DAAC recommended to the Panel that the DAAC start charging for its NALC and GTOPO30 products delivered on hard media. After some discussion, the Panel endorsed the recommendation, and the DAAC took an action to implement a data charging policy and track the impact of the new policy on the number of data and products distributed by the DAAC.

In response to another DAAC action to address potential DAAC-unique extensions, Saud Amer reviewed some of the issues and difficulties in selecting and implementing capabilities not available from the ECS, but which are needed by users. It seems this issue has been one that the DAAC and Panel have been talking about for quite some time without making meaningful progress, for whatever reason. Panel members expressed their frustration that little progress

has been made. Most agree that high priority, potentially DAAC-unique extensions include spatial subsetting, an EOS-HDF conversion tool, and additional map projection options. The DAAC took a new action to characterize the data products it will produce in terms of the types and levels of service required to get "appropriate versions" of the products distributed expediently to users. The requirements will be compared to capabilities available from ECS to determine which additional (DAAC-unique) capabilities should be offered by the DAAC. All recognize that available funding may not be sufficient to implement many, or even any, DAAC-unique extensions.

Instrument Team representatives to the Panel presented brief status overviews related to development of their instrument or other issues, and they summarized discussions held during the previous day's instrument team splinter sessions. Jim Irons reported that Landsat-7 has been in thermal vac twice and experienced power supply problems. Power supply units have been returned to Santa Barbara Remote Sensing, and launch has been slipped from July to the December time frame. Irons also discussed some billing and accounting issues that have to be worked out in order to be able to charge for ETM+ data from the beginning of the mission. Level 0 data will cost no more than $475 per scene, and Level 1 data no more than $600 per scene.

Mike Abrams briefly reviewed the ASTER splinter meeting by mentioning the topics and issues discussed in the meeting, including status of topographic derivative product generation, expedited data service, and development of the ASTER DEM standard data product system. Abrams also summarized highlights of the Joint U.S./Japan ASTER Science Team meeting held in Tokyo in December, including discussion about how non-EOS investigators can acquire ASTER data. This information will be available soon on the ASTER homepage.

Chris Justice reported that there are no major problems with the MODIS instrument, and Science Software Integration and Test (SSI&T) is pretty much on schedule, as well. A major issue exists regarding ECS tiling for Level-3 products, which currently is not on the schedule. Discussions for a work around are being held. Other issues noted by Justice include the uncertainty about production capacity at the DAAC due to the fact that hardware resources will be shared among instruments. It currently appears more hardware is required if MODIS is to meet its 2-year production capacity. Also, at-launch global product availability is in jeopardy. Finally, Justice stressed the need for an end-to-end testing schedule that is developed with MODIS Team input and includes network testing of real data.

Ken McDonald of the Earth Science Data and Information System (ESDIS) Project presented an overview of the EOSDIS client. McDonald summarized the development approach for the client, including the facts that it is being built using an incremental track, EOSDIS client tools can include non-ECS components, tools will evolve over the life of the mission, and Version 0 capabilities are deemed sufficient at launch. Under the current release plan, the Version 0 WWW Information Management System (IMS) will provide user access to ECS data at launch. Integration of JEST in a test environment will be completed in May, and the first operational release of JEST is scheduled for September (1998). McDonald presented and discussed a viewgraph that illustrated user options at various stages of client implementation and one that illustrated the overall architecture of JEST. He cited actions that are being taken to improve the Version 0 WWW IMS and the visibility of JEST development. McDonald concluded that broad access to EOS data will be provided at launch of AM-1 through complementary capabilities offered by the V0 IMS and JEST clients.

Lyn Oleson reviewed the status of the DAAC's 1998 budget and activities. He noted that the budget was not impacted in a major way by recent cuts; in fact, the DAAC received some non-DAAC contingency funds to complete generation of Digital Elevation Model (DEM) and derivative products called for by the Science Working Group for the AM Platform (SWAMP) DEM Working Group. Oleson also reported that recommendations made by the Panel at the last meeting regarding certain relative priorities of activities had been implemented. Oleson said there are no big changes or issues since the last meeting. Emphasis at the DAAC is on launch readiness, testing, and defining resource allocation. Finally, Oleson reported that the visit by the National Research Council (NRC) DAAC Review Committee went well. A great deal of information was exchanged, and the committee made some positive suggestions to the DAAC, including one

to set realistic and measurable success criteria.

The Panel adjourned around 5 p.m. and then met in executive session for about an hour.

Thursday, February 5, 1998

Chris Justice presented information about EOS validation activities, particularly as relates to needs by validation scientists for data sets covering a number of designated test sites. Justice proposes that validation data sets covering certain sites be routinely compiled and made readily accessible to maximize efficiency in meeting multiple demands for the same data over validation sites. The Oak Ridge DAAC is involved in compiling and making available *in situ* data, and he would like the EDC DAAC to step forward and implement a process to "package" needed remotely-sensed data for the validation test sites. Concern was expressed by the DAAC and some Panel members about the impact on DAAC resources that such a major effort would have. The DAAC agreed to further investigate, in cooperation with the Oak Ridge DAAC, a range of potential options for meeting requirements for validation data sets.

Joe Senftle, Deputy Manager of ECS, presented a status overview of ECS development. Senftle briefly discussed various schedules they are trying to meet and the many different types of interactions they have with the Instrument Teams, DAACs, and others to ensure that ECS development occurs expediently and appropriately. Senftle listed the baseline at-launch Product Generation Executives (PGEs) for ASTER and MODIS. There was general concurrence as regards the ASTER PGEs, but there was disagreement between what Senftle showed for MODIS at-launch PGEs and what the MODIS Science Team believes will be ready at launch. There was substantial discussion among the group about MODIS land-product PGE development, delivery, and certification schedules. It was not clear how much of the issue is a matter of semantics and how much warrants the concern expressed by the Panel that certain MODIS products potentially may not be ready at launch. The issue will be investigated further by MODIS, ECS, ESDIS, and the DAAC.

Gordon Knoble, ESDIS network manager, attended the meeting to address Panel concerns about network status and development that surfaced during discussions on Wednesday. Knoble reviewed the networking requirements baseline, which reflects a cut of $8 million compared to the previous (February 1996) baseline. The new baseline requirements also assume a production ramp-up (25-50-75-100) for all Quality Assurance (QA)/Science Computing Facility (SCF) flows. Knoble also discussed networking implementation, including existing connectivity and other connectivity options that are being explored. Substantial discussion about networking took place among Panel members, Knoble, and others in attendance. Frustrations were expressed by Panel members about network performance, as were concerns about an apparent lack of requirements coordination and about the apparent lack of a standard engineering approach in addressing networking problems. The topic was left with general agreement that further work in fully addressing networking issues is needed.

Lyn Oleson reviewed the status of DAAC readiness for the AM-1 and Landsat-7 launches, including the status of ECS hardware installation, software installation, and staffing at the DAAC. He also reviewed ASTER and MODIS SSI&T activities and plans, as well as various other plans related to overall system implementation. Oleson noted major challenges facing the DAAC related to system performance, user expectations, systems maintenance, and developing user community relationships. He also pointed out areas where the DAAC particularly will seek guidance and assistance from the Panel in the future. Jim Irons suggested forming a tiger team to address some of the major challenges facing the DAAC, and he expressed his concern that the DAAC has yet to bring together the fundamental information it needs to effectively operate the DAAC. He suggested that by the next meeting the DAAC needs to produce data flow diagrams for each product it will produce. Furthermore, each PGE the DAAC will receive should have a defined delivery date and acceptance date.

On behalf of the Panel, Chris Justice summarized the discussions the Panel had on Wednesday in executive session. The Panel believes focus now must be on launch—the DAAC needs to be prepared to do its part to make AM-1 and Landsat-7 work. Yet, the Panel believes the DAAC also needs to look to the future. It needs to define where it wants to be 5 years from now. To that end, the Panel encourages the DAAC to engage in formal strategic planning. The Panel also discussed

its membership. Chris Justice will step down from the Co-Chair position and phase out as the MODIS representative to the Panel. Alan Strahler will take Justice's place. In addition, other changes will be made to the membership, and the Panel believes that new members invited to serve on the Panel should be in tune with the future direction of the DAAC. Also, the Panel believes the DAAC needs to think about what it wants from its Advisory Panel and strive to make effective use of the talents and expertise of its members.

As a final activity, the Panel reviewed and listed the action items that had been recorded during the meeting. The next meeting of the Panel will be held at the EROS Data Center on June 2-4, 1998. The meeting adjourned at 12:50 p.m.

Two Studies Will Refine And Expand Solar Monitoring Task

— Douglas Isbell (disbell@mail.hq.nasa.gov), NASA Headquarters, Washington, DC

The Naval Research Laboratory, Washington, DC, and the University of Colorado's Laboratory for Atmospheric and Space Physics in Boulder have been selected by NASA's Office of Earth Science to conduct parallel six-month definition studies of a new small satellite to monitor variations in the amount of radiant solar energy that reaches Earth.

The precise measurements to be obtained by the Total Solar Irradiance Mission (TSIM) will help scientists better understand the relationship between the Sun's variable energy output and its effects on Earth's climate. The six-month feasibility studies will focus on the development of a preliminary system design and operations concept for the cost- capped $23 million mission.

NASA has been measuring the total radiative output of the Sun from the unique perspective of space since the late 1970s. The current sensor being used is called the Active Cavity Radiometer Irradiance Monitor (ACRIM). NASA has flown two ACRIM instruments, including the ACRIM-II instrument onboard NASA's Upper Atmosphere Research Satellite. A third ACRIM instrument is scheduled for launch aboard a dedicated small satellite in October 1999.

TSIM will extend the broad data set gathered by the ACRIM series while exploring a new capability to measure solar irradiance in two discrete spectral bands. Once proven, this operationally-oriented capability is a candidate for flight aboard future National Polar-orbiting Operational Environmental Satellite System missions being planned by a tri-agency partnership among NASA, the Department of Defense, and the National Oceanic and Atmospheric Administration.

"TSIM will be developed in 36 months or less using the same key principles of 'faster, better, cheaper' spacecraft demonstrated by the agency's Discovery Program," said Dr. Ghassem Asrar, NASA Associate Administrator for Earth Science. "We hope to obtain an instrument payload that is lighter and more technologically advanced, yet provides an exciting additional capability that will give us new knowledge about our climate and why it varies."

TSIM is part of NASA's Earth Observing System, a series of advanced remote-sensing satellites designed to provide simultaneous measurements of a broad range of physical, chemical, and biological processes to enable researchers to study the Earth's land, oceans, air, ice, and life as a total system. TSIM also will serve as NASA's contribution to the joint small Science Satellite (SciSat) program with the Canadian Space Agency. NASA and Canada have committed to developing independent science research missions to be launched on a NASA-funded launch vehicle in December 2001, with shared data after launch.

The two selected teams will document their analyses for NASA review by the end of 1998, with one team being selected to proceed with development. TSIM program management will be provided by NASA's Goddard Space Flight Center in Greenbelt, MD.

Sea-viewing Wide Field-of-view Sensor

— Grey Valenti (grey@berfle.gsfc.nasa.gov), NASA Goddard Space Flight Center

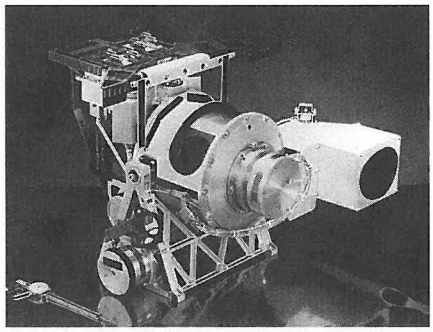
Background and Objectives

The Sea-viewing Wide Field-of-view Sensor (SeaWiFS), was launched on August 1, 1997, from Vandenberg Air Force Base, California. After a month of adjusting its orbit and a few weeks of testing data, SeaWiFS began providing the first ocean color data in over 10 years, and the first continuous, synoptic look at the global biosphere ever.

SeaWiFS was designed to collect ocean color data which are critical for studying ocean primary production and global biogeochemistry, and assessing the ocean's role in the global carbon cycle, as well as fisheries research and coastal management.

As it turns out, SeaWiFS is giving the science community much more than ocean color data. "The images are more than we ever could have hoped for," said Gene Feldman, who heads SeaWiFS's data processing team. "Although originally designed to just study the oceans, we've also developed a way of using it to study the land as well, and as a result, can study the 'global biosphere' for the very first time."

SeaWiFS is a cost-sharing collaboration between the National Aeronautics and Space Administration (NASA) and Orbital Sciences



Photograph of the SeaWiFS Scanner assembly, which scans from west to east (left to right in the figure).

Corporation (OSC) wherein NASA's Goddard Space Flight Center (GSFC) specified the data attributes and bought the research rights to these data. The SeaWiFS Project at GSFC is responsible for the calibration and validation of these data. OSC provided the spacecraft, instrument, and launch, and is responsible for spacecraft operations for five years at a fixed price, while retaining the operational and commercial rights to these data. In late December, the SeaWiFS Project completed its evaluation of the data and determined that the data met all of the contractual specifications.

Satellite ocean color research began with the proof-of-concept Nimbus-7/Coastal Zone Color Scanner (CZCS), which collected data on an irregular temporal and spatial basis from November 1978 to June 1986. Despite coverage limitations and severe degradation in the sensor's sensitivity, the CZCS mission produced a substantial volume of published scientific results on marine ecosystem dynamics, which prompted the U.S. to launch SeaWiFS as a component of NASA's Earth Science Enterprise. SeaWiFS collects global data (ocean and land) every two days. Since operations began on September 18, 1997, in addition to providing global estimates of oceanic chlorophyll-a and other bio-optical quantities to the international research community, a number of improvements in the processing code and algorithms for navigation, calibration, quality control, and atmospheric correction were implemented. Based on the results of the initial validation, a reprocessing of all data was initiated in mid-January and completed by mid-February 1998. At this time, the data products can now be considered science quality.

SeaWiFS Calibration and Validation

Unlike CZCS, an extensive calibration and validation program was developed for SeaWiFS. Of particular importance to the postlaunch validation are the field measurements. The SeaWiFS vicarious calibration uses field measurements from the Marine Optical Buoy (MOBY). MOBY is funded jointly by the SeaWiFS and Moderate Resolution Imaging

Spectroradiometer (MODIS) Projects at GSFC and is under the direction of Dennis Clark of the National Oceanic and Atmospheric Administration (NOAA). MOBY is positioned off Lanai, Hawaii, in optically clear water and under a predominantly marine haze atmosphere to adjust the calibration to obtain the "correct" values for simultaneous and coincident (match-up) data. The initial vicarious calibration was derived from 15 MOBY match-up data sets collected during the first three months of operation. The analyses show agreement to within about 3%, on average, of the prelaunch average normalized, clear water-leaving radiances with no discernible trend in any of the time series.

Independent verification of the SeaWiFS products is possible using match-up data from a number of postlaunch bio-optical cruises. The Atlantic Meridional Transect (AMT) is a primary source of validation data. Twice a year, the Royal Research Ship James Clark Ross steams a meridional transect of the Atlantic Ocean between Grimsby (UK) and Stanley (Falkland Islands), as part of the annual research activities of the British Antarctic Survey. In September, the ship sails from the UK, and the following April it makes the return trip, sailing from Stanley. To date, there have been five AMT cruises. The U.S. participation is established through a collaboration between the SeaWiFS Project and the Plymouth Marine Laboratory. The SeaWiFS participation is directed by SeaWiFS Deputy Project Scientist Stanford Hooker. With the wide diversity of ecosystems encountered (two hemispheres and two seasons are sampled over a period of 30-35 days), an AMT cruise is like many cruises rolled into one, making it inevitable that new observations and new discoveries will emerge on every transect. Later this year, the SeaWiFS Project will also be conducting field experiments with the European Community Joint Research Center in the northern Adriatic Sea.

The initial validation results demonstrate that the SeaWiFS instrument has been stable over the first four months of operation, the vicarious calibration approach using MOBY data results in consistent global water-leaving radiances, and the products meet the accuracy goals over a limited, but diverse, set of validation sites.

SeaWiFS Data Access

Authorized Users

Because the SeaWiFS data are obtained through purchase from OSC, NASA can only distribute SeaWiFS data to users who are undertaking basic or applied research, not to individuals or organizations that are using the data for commercial or routine operational applications. Investigators may become authorized users by submitting a simple application form to the NASA SeaWiFS Project Office with a brief description of their research. The application is available from the SeaWiFS Home Page (http://seawifs.gsfc.nasa.gov/SEAWIFS.html) under "Announcements."

In order to protect the commercial market, the OSC contract contains a two-week embargo on the release of SeaWiFS data by NASA. Because NASA has the contractual responsibility for calibration and validation of the data and derived products, however, the contract contains provisions to allow the distribution of near-real-time data to participants in field studies, and calibration and validation activities.

Near-Real-Time Data Access

SeaWiFS-approved High Resolution Picture Transmission (HRPT) stations will ordinarily receive the software key two weeks after reception of the data. However, the SeaWiFS Project holds 13 real-time agreements for immediate decryption of data. These agreements can be assigned to HRPT stations supporting field studies that are deemed critical by the SeaWiFS Project.

Five of these agreements have gone to U.S. coastal stations, including NASA GSFC, the Naval Research Laboratory at Stennis Space Center, the Monterey Bay Aquarium Research Institute, the University of Alaska at Fairbanks and, in the future, a National Oceanic and Atmospheric Administration/National Marine Fisheries Service facility in Hawaii. The SeaWiFS Project copies decrypted data from these stations in real time.

The other eight agreements can be assigned for times up to three months to other HRPT stations. To receive one of these temporary assignments, an investigator or program office must submit a different application, co-signed by the HRPT station manager, to the SeaWiFS Project. This form is also available from the SeaWiFS Home Page. Any of these 13 stations may

release real-time data to investigators conducting field studies with the approval of the SeaWiFS Project.

Onboard collection of one-kilometer resolution local-area-coverage (LAC) data is scheduled for 10 to 12 minutes each day by the SeaWiFS Project and is submitted as a command sequence to OSC for transmission to the spacecraft. Figure 1 shows the distribution of LAC targets and the areas covered by the satellite on a specific day (Oct. 30, 1997). Several of the targets shown are fixed sites, such as MOBY; these targets are scheduled for every overpass. Onboard LAC data are not scheduled separately if a given site is within the area of a SeaWiFS real-time station. For example, the Bermuda Atlantic Time-Series site is covered by the Bermuda HRPT station and is thus not scheduled separately.

Because data from satellite-mounted ocean color sensors can be extremely useful in planning and carrying out field studies, the SeaWiFS Project will provide real-time images to field investigations who are assisting with calibration and validation. To receive this support, investigators must provide station locations at least seven days in advance. This is the amount of time needed for processing the onboard LAC data acquisition into the spacecraft command sequence. Investigators can tailor products to their needs, specifying the size of the area to be covered or which SeaWiFS geophysical product they want, for example, by filling out an order form available from the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Home Page (http://simbios.gsfc.nasa. gov/) under "Scheduling." Once the SeaWiFS Project receives and processes the data, the requested area is extracted, mapped for the specific project with latitude and longitude grids, and sent by electronic mail to a designated location.

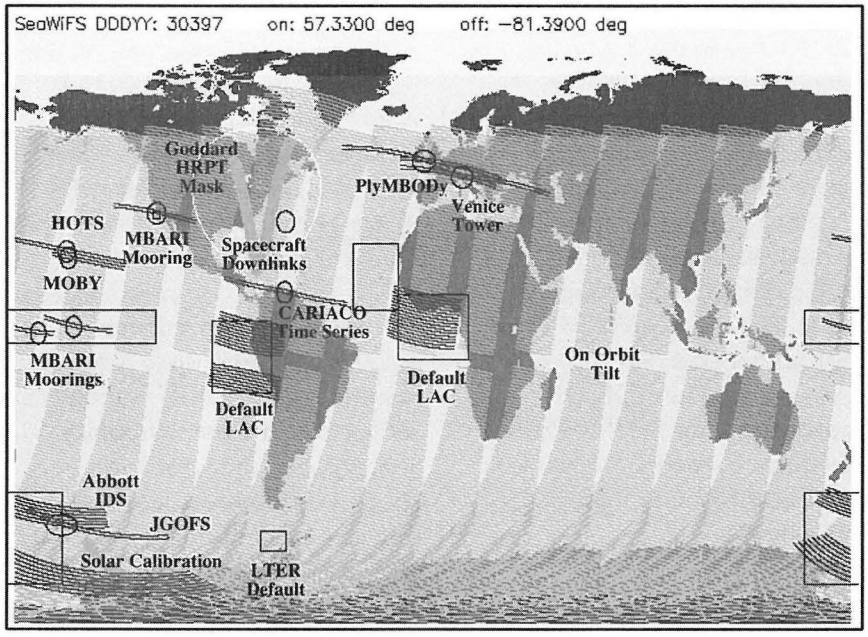


Figure 1. Local Area Coverage (LAC) targets and areas covered by SeaWiFS on October 30, 1997.

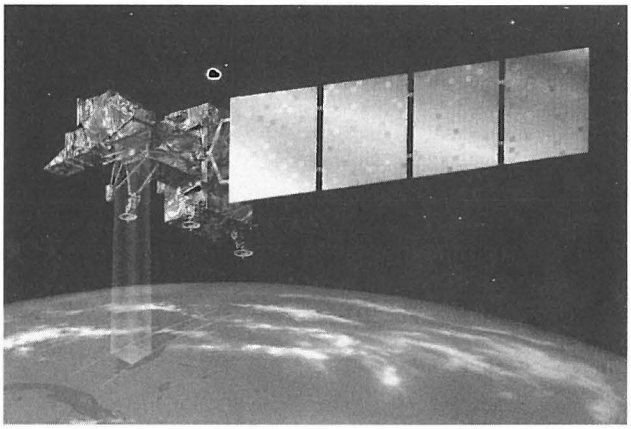
Data Processing Software

In order to expedite the use of SeaWiFS data, the NASA Biogeochemistry Program is supporting the development of the SeaWiFS Data Analysis System (SeaDAS). SeaDAS incorporates the same processing software as the operational SeaWiFS system but in simpler form so that individuals can process SeaWiFS data on medium-range Silicon Graphics and Sun workstations. The code is available free of charge. It can be sent via ftp from the SeaDAS World Wide Web site (http://shark.gsfc.nasa.gov/~http/SeaDAS.html). SeaDAS is also available on CD-ROM. The SeaWiFS Project also provides Level 0 -Level 1 process code to all approved HRPT stations. SeaDAS staff members provide user support and conduct training classes.

The objective of the SeaWiFS Project is to make data as accessible and usable as possible so as to promote the scientific goals of the mission. To assist the data user community in understanding the various technical aspects of ocean color remote sensing and the SeaWiFS Project's development efforts, the Project has supported the publication of 43 technical memorandums and has several others near completion. The series is available from the SeaWiFS Home Page. Users are invited to suggest ways to improve the products generated from the data.

Landsat-7 Launch Delayed

— Douglas Isbell (disbell@mail.hq.nasa.gov), NASA Headquarters, Washington, DC.
— Allen Kenitzer (akenitze@pop100.gsfc.nasa.gov), Lynn Chandler, NASA Goddard Space Flight Center, Greenbelt, MD.



The Landsat-7 Earth science spacecraft will not be launched in July 1998 as planned, due to necessary changes in the design of the electrical power supply hardware for the spacecraft's main instrument. A new target launch date will be set by NASA officials after completion of instrument thermal vacuum tests scheduled for this July.

ETM+ is Landsat-7's only science instrument. As a result of the most recent failure in January, both internally redundant power supplies were returned to their manufacturer. Completion of vacuum testing will be delayed while the power supplies are being repaired, which will consequently delay the launch.

It is not possible to set a precise new date for the launch from Vandenberg Air Force Base, CA, at this time, according to project managers. NASA will now work with its launch contractor, Boeing, on moving the Landsat-7 launch to a mutually agreeable date.

"We're looking at several options in order to minimize the impact to the launch schedule," said Phil Sabelhaus, Landsat-7 project manager at NASA's Goddard Space Flight Center, Greenbelt, MD. "When we understand precisely why the power supply failed and how long it will take to fix the problem, we'll be able to ascertain the impact to the launch schedule."

The enhanced thermatic mapper was designed and built by Raytheon (formerly Hughes) Santa Barbara Remote Sensing, Santa Barbara, CA. The Landsat-7 spacecraft was built by Lockheed Martin Missiles and Space, with integration of the instrument and spacecraft conducted at the company's facility in Valley Forge, PA.

Landsat-7 is the latest installment in a long history of land remote-sensing spacecraft, spanning over 25 years of multispectral imaging of the Earth's surface, starting with the launch of Landsat-1 in 1972. Landsat-5, launched in March 1984, is still transmitting images to several domestic and international ground stations worldwide.

In particular, the science instrument on Landsat-7 will continue a data base of high-resolution Earth imagery begun in 1982 by the Landsat-4 thematic mapper. As changes occur on the Earth's surface due to natural or human-induced events, scientists will be able to study these recent changes with the aid of the archive of similar imagery. Applications include agriculture, forestry, and urban planning.

Landsat-7 will add to the global archive of sun-lit, substantially cloud-free images of the Earth's land surfaces. Approximately one-quarter of the Earth's landmass will be imaged every 16 days, with a emphasis on seasonal changes in vegetation.

Landsat-7 contains several technological improvements over previous Landsat satellites and their instruments. These improvements include better instrument calibra-

(Continued on page 25)

EDUCATION HIGHLIGHTS

NASA Earth Science Enterprise Education Program Update

— Nahid Khazenie (nkhazeni@pop100.gsfc.nasa.gov) Earth Science Systems Program Office, NASA Goddard Space Flight Center

COTF Seeks Reviewers for New Software Package

The NASA Classroom of the Future (COTF) at Wheeling Jesuit University in Wheeling, West Virginia, is actively seeking educators interested in evaluating a new software package for middle school science classrooms.

A previous version of this software for use in high school classrooms won the 1995 Technology and Learning magazine science software of the year award. The new initiative, entitled "Astronomy Village: Investigating the Solar System," is a two-year project funded by a grant from the National Science Foundation. The COTF is hoping to enlist teachers and other educators willing to try the software and provide them with feedback. There is no cost for the beta-test (trial) software.

To learn more about the product and access the beta-test application, please see: http://www.cotf.edu/av2/ and follow the links to "Astronomy Village: Investigating the Solar System."

For more information, contact: John Hornyak, Curriculum Writer, NASA Classroom of the Future, Wheeling Jesuit University, Wheeling, WV 26003, Phone: (304) 243-2494; Fax: (304) 243-2497.

Resources on The Internet

Live from the Rain Forest (LFRF) Website
http://passport.ivv.nasa.gov/rainforest

This site is the preview version, designed to give educators and others all they need to get started on this unique learning adventure. Here you'll find the dates and times of the videos, extensive information about the contents of the Teacher's Guide and Multimedia Kit and how to order them, sample lessons, journals from some of the Smithsonian/Instituto Nacional de Pesquisas da Amazonia (INPA) team who'll be the project's hosts in the Amazon, and a preview of the site itself.

In the coming weeks, much more content and many images will be added to the main sections of the site as they are populated by plants, animals, and people of the rainforest. You can check out the opportunities already available for teachers to talk to teachers and the PTK staff via DISCUSS-LFRF. And you can make contact with PTK "veterans" — mentor teachers who can help you implement the project successfully.

Programs to Improve Teaching & Learning
http://www.ed.gov/pubs/triedandtrue/index.html

Sixteen programs to improve teaching & learning, developed by the Department of Education-supported Regional Educational Labs, are featured in a document recently added to the Department's website: "Tried & True: Tested Ideas for Teaching & Learning."

Each program has an extensive research base, has been kept up-to-date, and has clear evaluation data. Each has been endorsed and supported by all ten Labs and can be adapted to a variety of school and community settings.

Redesigned Education Website
http://www.ed.gov

Faster searches, greater access to information and attractive layouts await users of the newly redesigned Department of Education web site. Student financial

aid materials, tips for parents, statistics and the latest findings on what works in education are among the myriad of documents stored on the site, helping make it one of the most widely used education resources on the Internet.

Science Netlinks
http://www.sciencenetlinks.com

The American Association for the Advancement of Science and MCI have launched Science NetLinks, a Web site to help science teachers, librarians, and other educators identify useful resources, and use those resources in a teaching environment.

NASA Spacelink Library Improvements
http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/

The NASA Spacelink Library has been updated with major changes to the NASA Projects and Instructional Materials directories. The NASA Projects area now features information and references aligned with NASA's four Enterprises: Aeronautics and Space Transportation Technology, Space Science, Human Exploration and Development of Space, and Earth Science.

Changes to the Instructional Materials area include subject-area menus that categorize references and materials more closely with national standards in science and mathematics. Additionally, NASA's Educational Products are now listed in a single, easy-to-read menu.

Our Mission To Planet Earth Teachers Guide On-line
http://spacelink.nasa.gov/Instructional.Materials/NASA.Educational.Products/Our.Mission.to.Planet.Earth/

"Our Mission to Planet Earth: A Guide to Teaching Earth System Science" for grades K-4 includes activities such as setting up a terrarium as an Earth System model to demonstrate the water cycle, the greenhouse effect, and the difference between global warming and cooling. Students can also create their own models of instruments and satellites and learn about careers in Earth System Science.

(Continued from page 23)

Landsat-7 Launch Delayed

tion and a solid-state data recorder capable of storing 100 individual enhanced thematic mapper images of the Earth. This capability will enable Landsat-7 to update a complete global view of Earth's land surfaces seasonally, or approximately four times per year.

NASA also is developing an Advanced Land Imager instrument and related small spacecraft technology that will enable future follow-on measurements to be made by a sensor that is one-fourth the mass of the Enhanced Thematic Mapper and uses only 20 percent of the electrical power, while reducing the instrument's cost by 75 percent.

Landsat-7 was authorized by the Land Remote Sensing Policy Act of 1992, which established a joint NASA-U.S. Air Force program. This was superseded by a second Presidential Directive in 1994, that established a joint program among NASA, the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Geological Survey (USGS).

Landsat-7 is part of NASA's Earth Science Enterprise, a long-term research program designed to study Earth's land, oceans, atmosphere, ice, and life as a total integrated system. Goddard Space Flight Center manages the development of Landsat for NASA's Office of Earth Science in Washington, DC.

The American Geophysical Union and NASA Present Your Chance to Name the First Earth Observing System Spacecraft

Fortieth Anniversary
Pioneering the Future

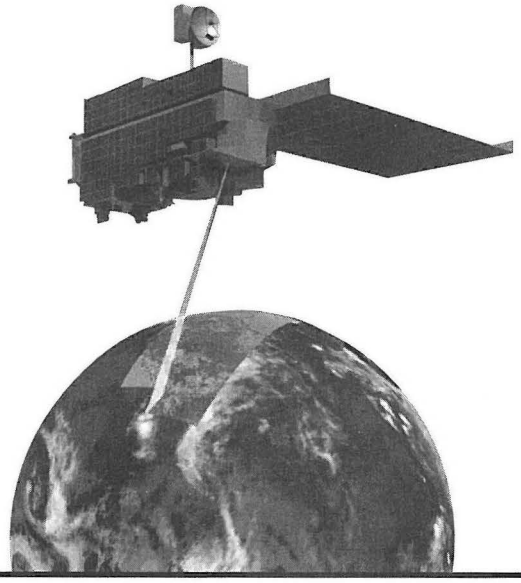
This spacecraft needs a name!

In 1998, NASA plans to launch its first Earth Observing System (EOS) spacecraft that will study the Earth as a whole, global system. Using data from the first EOS satellite and missions that follow it, scientists will be able to create predictive computer models of the Earth's environment that will help us anticipate climate changes and better prepare for them. The first EOS satellite will fly in a near polar-orbit, crossing the Earth's equator during each orbit at approximately 10:30 am local time. At the present time the satellite is known as EOS-AM for this morning crossing of the equator. The AGU and NASA offer you this opportunity to suggest a creative name for the first EOS satellite that reflects the importance of this spacecraft.

The Contest

To enter, choose a person, place, or thing, and describe in 300 words or less why that person, place, or thing represents a new understanding of the whole world. What will you choose? Will you name it after a renowned historical Earth scientist? Or, perhaps a famous ship of antiquity? How about a mythological hero or heroine? When picking a name, you might consider the following questions:

How does the name you chose represent a time of change in Earth's or humankind's history?
What talent or technological capability or attribute is inherent in your name that suggests a global perspective?
How did that person, place, or thing advance science and/or exploration as EOS-AM will?
In what way(s) did the person, place, or thing bring together people from multiple nations to work together toward a common goal, as will EOS-AM?
How did the person, place, or thing you have chosen contribute to humankind, similar to the way EOS-AM will contribute into the new millennium?



Prizes

Five winners will be chosen by a special judging panel of scientists and teachers.

Grand Prize (one awarded):
Round trip airfare to California to see the launch of EOS-AM. The grand prize includes hotel, meals, and transportation to/from the launch site for you and your parents or legal guardian (up to $3,000 total). As a special bonus your school will receive a computer and software enabling access to EOS-AM image data (up to $3000 value).

Runners Up (Four awarded):
Winners will receive a plaque and their essays will be published on AGU and NASA web sites.

Please send your entries to:

EOS-AM
American Geophysical Union
2000 Florida Avenue, NW.
Washington, DC, 20009
eos_am@kosmos.agu.org
For a complete list of rules and
further information about EOS, visit the
AGU website http://www.agu.org
or the
EOS-AM web site http://modarch.gsfc.nasa.gov/EOS-AM

Contest Rules

Any student grades 8-12 is eligible to submit one entry.
The entry must include: name, address, telephone number, grade level, and teacher's name and school address and an essay of up to 300 words (in English). Entry data and essay is to be typed or word-processed to fit on one page.
For public relations, you can also include the name of your local newspaper and its address.
Your entry must be received at AGU by close of business (5:00 pm EDT). Friday, May 29, 1998.
Dependents of AGU employees and NASA, NOAA, JPL, and anyone employed by Earth Science Enterprise or EOS Program Office (including those in the MODIS, MISR, ASTER, MOPITT, and CERES teams) are not eligible to enter.
All entries become the property of NASA. In cases of duplicate names the judging panel's decision will be final.
The top 5 essays will be published on NASA and AGU web sites.
First 500 entries will receive a mission tee shirt, poster, and a mission decal.

EOS Science Calendar

May 14-15
EOS Chemistry/Climate Modeling Meeting, New York, NY. For program contact: Jack Kaye (NASA HQ), e-mail: jkaye@hq.nasa.gov; David Rind (NASA GISS); for logistics contact: Carolyn Paurowski (NASA GISS), e-mail: cpaurowski@giss.nasa.gov.

June 2-4
Land Processes DAAC Science Advisory Panel Meeting, EROS Data Center. Contact Bryan Bailey, e-mail: gbbailey@edcmail.cr.usgs.gov.

June 23-25
AIRS Science Team Meeting. University of Maryland Baltimore County, Baltimore, MD. Contact Hartmut H. Aumann, e-mail: hha@thunder.jpl.nasa.gov.

June 24-26
MODIS Science Team Meeting, location TBD. Contact Mary Floyd, tel. (301) 220-1701, e-mail: mfloyd@ pop200.gsfc.nasa.gov.

Global Change Calendar

June 1-3
First International Conference on Geospatial Information in Agriculture & Forestry. Contact Wendy Raeder, e-mail: raeder@erim.org.

June 1-4
Eleventh Annual Towson University GIS Conference, Baltimore, MD. Contact Jay Morgan, tel. (410) 830-2964, e-mail: jmorgan@towson.edu.

June 8-11
9th Global Warming International Conference & Expo, Hong Kong. Contact Sinyan Shen, tel. 1-603-910-1551, e-mail: syshen@megsinet.net, URL: http://www2.msstate.edu/~krreddy/glowar/glowar.html.

June 8-12
27th International Symposium on Remote Sensing of Environment. Tromso, Norway. Contact Norwegian Space Centre, P.O. Box 113 Skoyen, N-0212 Oslo. Norway. fax: (+47) 22-51-18-01, e-mail: isrse@spacecentre.no, URL: http://www.spacecentre.no/.

June 22-26
Fifth Circumpolar Remote Sensing Symposium, Dundee, Scotland. Contact S.K. Newcombe, e-mail: s.k.newcombe@dundee.ae.uk.

July 6-10
International Geoscience & Remote Sensing Symposium, Seattle, WA. Contact Tammy Stein, tel. (281) 251-6067; fax: (281) 251-6068, e-mail: tstein@phoenix.net.

July 19-24
SPIE International Symposium, Optical Science, Engineering, and Instrumentation, San Diego, CA. Contact William L. Barnes, e-mail: wbarnes@neptune.gsfc.nasa.gov, URL: http://www.spie.org/info/sd/.

July 20-24
9th Australasian Remote Sensing Photogrammetry Conference, Sydney, Australia. Contact Gramme Tupper, tel. (+61) 63-913-143 fax: (+61) 63-913-767, e-mail: tupperg@agric.nsw.gov.au.

August 17-21
International Conference on Satellites, Oceanography & Society, Lisbon, Portugal. Contact David Halpern, e-mail: halpern@pacific.jpl.nasa.gov, or URL: http://www.unesco.org/ioc/iyo/icsos/.

September 1-4
ECO BP '98 International Symposium on Resource & Environmental Monitoring, Budapest. Contact Dr. Gabor Remetey Fulopp, tel. (+36) 1-301-4052, fax: (+36) 1-301-4691, e-mail: gabor.remetey@f-m.x400gw.itb.hu, or URL: http://www.heqyi.com/isprsc7.

September 14-17
SPIE's First International Asia-Pacific Symposium on Remote Sensing of the Atmosphere, Environment & Space, Beijing, China. Contact Jinxue Wang, e-mail: jwang@eos.ucar.edu.

September 21-25
Conference on Satellite Remote Sensing of Clouds and the Atmosphere II. Contact Steve Neeck, e-mail: steve.neeck@gsfc.nasa.gov.

September 27-October 2
13th AIP International Congress, Fremantle, Western Australia. Contact Prof. Brian O'Connor, e-mail: promaco@promaco.com.au; URL: http://www.promaco.com.au.

October 5-7
Fifth International Conference on Remote Sensing for the Marine and Coastal Environments, San Diego. Contact Robert Rogers, tel: (313) 994-1200, ext. 3234, fax: (313) 994-5123, e-mail: marine@erim-int.com, URL: http://www.erim-int.com/CONF/conf.html.

October 25-28
Geological Society of America, Toronto. Call (303) 447-2020; fax: (303) 447-0648.

October 29-November 1
First International Conference on GIS Education, Ypsilanti, MI. Contact Jay Morgan, tel. (410) 830-2964, e-mail: jmorgan@towson.edu.

November 16-19
Ocean Community Conference '98, Baltimore, MD. Contact Pete Allen, e-mail: mts-occ98@ieee.org.

— 1999 —

March 23-26
Progress in Electromagnetics Research Symposium (PIERS 1999), Taipei International Convention Center, Taipei, Taiwan. Call for papers. One-page abstract submission deadline is September 1, 1998. Contact: Prof. Kun Shan Chen, PIERS 1999, Center for Space and Remote Sensing Reserch, National Central University, Chung-Li, Taiwan. tel. (886) 3-425-7232; Fax: (886) 3-425-5535, e-mail: dkschen@csrsr.ncu.edu.tw. or contact Ms. Mei Yuan Lai, tel: (886) 3-425-5535; fax: (886) 3-425-5535; e-mail: maylai@csrsr.ncu.edu.tw. URL: http://piers1999.csrsr. ncu.edu.tw/

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