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Editor's Corner

On December 3, Marty Donohoe, EOS PM Project Manager, retired after more than 30 years of government service, nearly all of which was at Goddard Space Flight Center. Marty, a resident expert on passive radiative coolers, provided enormous guidance in the early days of EOS, both in the planning of future EOS instruments, evaluation of the proposed instruments, and later as Manager of the EOS Instruments Project before the observatory was altered and the AM, PM, and Chemistry Projects formed. The PM-1 spacecraft and instruments are now in development and on schedule for launch in December 2000.

NASA has approved an immediate new start for the Quick Scatterometer (QuikSCAT) mission and has placed the first delivery order issued under the Indefinite Delivery/Indefinite Quantity (ID/IQ) contract for rapid delivery of satellite core-systems to Ball Aerospace Systems Division, Boulder, CO. The ID/IQ procurement method provides NASA a faster method for purchase of satellite systems through a "catalog," allowing for shorter turnaround time from mission conception to launch.

The QuikSCAT mission will fill in the ocean vector-wind data gap created by the loss of the NASA Scatterometer (NSCAT) on the Japanese Advanced Earth Observing Satellite (ADEOS). The NSCAT instrument ceased functioning when ADEOS failed on June 30, 1997. The follow-on scatterometer for monitoring ocean winds, called SeaWinds, is scheduled for launch on the Japanese ADEOS-II spacecraft in 2000. QuikSCAT is planned for launch in November 1998, reducing the data gap by about one-half.

NASA has selected two dozen proposals, in two categories, to develop working prototypes of innovative uses and applications of Earth science data and related research. Known as the Earth Science Information Partners (ESIPs), the awards respond to a July 1996 National Research Council recommendation that NASA evaluate alternative implementation of product generation, publication, and user services for the EOS Data and Information System (EOSDIS).

Two of the three types of ESIPs, Type 2 and Type 3, were reflected in two Cooperative Agreement Notices (CANs) issued by NASA in May 1997 which solicited proposals from all sources, including industry and academia. Type 1 functions are currently performed by the existing Distributed Active Archive Centers.

Type 2 ESIPs are focused on data and information products in support of global change research that are developmental or research-oriented, with emphasis on flexibility and creativity in meeting advanced scientific applications. Type 3 ESIPs will be responsible for extending the benefits of NASA Earth science data and information beyond basic research to a broader user community including private industry, value-added companies, state and local governments, and non-profit organizations (see page 37 for a list of award winners). Successful ESIP 3 organizations are expected to become financially self-sustaining by the end of this pilot project.

The evaluation will be initiated beginning with a limited set of pilot or prototype projects operating in a federated, rather than a centrally managed architecture. The Type 2 and 3 ESIP award winners, together with NASA, will determine the management, system interoperability, and organizational interfaces necessary to establish the Working Prototype Federation.

Dr. Charles F. Kennel, executive vice chancellor at UCLA and former Associate Administrator of NASA's Mission to Planet Earth program, has been selected to serve as director of Scripps Institution of Oceanography at the University of California, San Diego (UCSD). I would like to congratulate him on his new appointment, and welcome the opportunity to work with him again as he once again has an opportunity to play a leadership role in the area of global environmental science, which he came to love while at NASA.

—Michael King
EOS Senior Project Scientist

KUDOS

An EOS Interdisciplinary Science Principal Investigator, Jonathan Foley, Institute for Environmental Studies/Center for Climatic Research, University of Wisconsin, Madison, was recently awarded a Presidential Early Career Award "for his leadership and innovation in modeling the global biosphere—yielding the first of a next generation of Earth system models that dynamically link biological and ecological, hydrological, and climatological processes in ways that are fully interactive." The award includes a $100 K/yr grant to be awarded over the next five years. The Earth Observer and the EOS community wishes to congratulate Prof. Foley on this outstanding achievement.

Minutes of the Thirteenth Mission To Planet Earth/Earth Observing System (MTPE/EOS) Investigators Working Group Meeting

— ***Renny Greenstone*** (rgreenst@pop900.gsfc.nasa.gov), Hughes STX

Note: Direct access to many of the presentations made at this meeting may be achieved by accessing the World Wide Web at the following URL: http://eospso.gsfc.nasa.gov/iwg_presentations/nov97/nov97.html

The 13th meeting of the Investigators Working Group (IWG) of the Mission to Planet Earth/Earth Observing System (MTPE/EOS) took place for three days at the Renaissance Hotel in Atlanta, Georgia, November 4-6, 1997.

Tuesday Morning, November 4

Session on Land Cover and Land Use Change

Michael King, EOS Senior Project Scientist, greeted the attendees and then turned the meeting over to Tony Janetos, who chaired this first session. King explained that EOS Program Scientist, Ghassem Asrar, was unable to attend this meeting.

Janetos remarked briefly that land use/land cover change was an important area of concern for all of us as a nation, not just for us as scientists. He then introduced new interdisciplinary scientist (IDS) principal investigator (PI) **Ralph Dubayah** (University of Maryland), who gave a spirited presentation of "The Vegetation Canopy Lidar (VCL) ESSP Mission: Implications for MTPE/EOS."

Dubayah explained that VCL was the first project to be selected as part of the recently-established Earth System Science Pathfinder (ESSP) program of MTPE. ESSP was established to provide for low-cost quick-turnaround projects that would be performing research where no adequate Earth Observing System program existed. Two missions are selected every two years for ESSP. These missions operate in the "PI mode," where the PI is responsible for an entire project from "cradle to grave." The mandate is to produce data sets. Science analysis is separate.

The principal goal of VCL is mapping of the Earth's land cover. Dubayah said that we need to know the distribution of biomass around the world. Existing land-cover maps show 74% disagreement.

The VCL spacecraft will orbit at 400 km, using five laser beams in a lidar mode, spaced at 2-km intervals, producing an 8-km swath. (Ultimately, there will be a 2 x 2- km product.) The lidars give both canopy heights and topography of the surface. Dubayah said that prior Shuttle missions have shown the feasibility of this laser method. A 5-to-10 times improvement over existing canopy height estimates is expected. Billions of topographic control points at 1-m vertical accuracy will be provided.

Pegasus XL will be the launch vehicle for VCL. There are to be 290 pulses per second over land, and 60-cm vertical resolution is planned.

Sam Goward (University of Maryland) followed with a discussion of "Landsat 7: Resolving Terrestrial Science Issues." He pointed out that the Landsat program started in 1972 and is now celebrating 25 years of continuous operation. Landsat represented the beginning of land monitoring from space in this country. Now, with Landsat 7, we have the beginning of a new Landsat era. One new aspect is the transfer of management responsibility from the private sector to the government.

Landsat 7 will operate in seven spectral bands. It adds a 15-m panchromatic band and a thermal band with 60-m resolution and, with higher precision, the data volume doubles. There will be a seasonally refreshed global archive with 250 scenes per day.

The long-term acquisition plan has these elements: (1) monitor seasonal changes in vegetation types; (2) use NOAA cloud forecasts to see if scenes are worth acquiring (establish priorities); and (3) optimize gain settings to improve acquisitions in different viewing circumstances.

Senior Goward also discussed the synergy between Landsat 7 and the AM-1 mission. Another point he made was that Landsat 7 will provide a link between local activities and global phenomena.

According to Goward, Level 0 data will be available at launch, and Level 1 data will be available a year after launch. Berrien Moore expressed great concern with this delay. Tony Janetos added that NASA has been trying to improve this schedule. There is now funding for 100 scenes per day of Level 1 data. One of the unsolved problems is the software for billing for orders for the data. Steve Running pointed out that there will be no processing of standard higher-level products such as Leaf Area Index (LAI). He urged comparison of the standard MODIS products with the relatively raw Landsat products.

Jing Chen (Canada Center for Remote Sensing) discussed "Northern Biosphere Observation and Modeling Experiment (NBIOME) Recent Results." NBIOME is one of the original international land process interdisciplinary investigations. The major goal is to use EOS data to monitor the state of boreal forests and detect changes as they evolve with climate change. So far they have relied heavily upon AVHRR data. They recalculate NDVI and temperatures every ten days.

They have found that use of their contamination mask is very important. Use of a four-scale plant canopy model gives a good fit to observations. It takes the hot spot into account. They have a scheme called Classification by Progressive Generalization (CPG).

They have now achieved the first-ever net primary productivity (NPP) map of Canada. A program called GEOComp II is scheduled to be complete by the end of 1998. It will be made up of 10-day composites and will be acquired by assimilating MODIS data sets.

Jon Foley (University of Wisconsin, Madison) described his project on "Integrating Biogeochemical, Ecological, and Hydrological Processes in a Dynamic Biosphere." He said that it was really a project to study biosphere/atmosphere interactions, looking at past, present, and future. His team has looked at first-order impacts of climate-driven changes on vegetation patterns. They take into account biospheric feedbacks to the atmosphere, which have usually been ignored in other global-change scenarios.

Foley listed classes of biosphere models in order of increasing time scales: land surface models (found in AGCMs), terrestrial biosystem models, and equilibrium vegetation models.

His group has developed the Integrated Biosphere Simulation (IBIS), which incorporates vegetation dynamics as a new feature. In this model it is possible to "seed" an area and see what grows. The model will then follow the development of trees vs. grasses, distinguishing tree types and grass types. The model can be started with nothing but dirt for the whole world, a "dirt world," and then it will trace out, very credibly, the worldwide distribution of tree types. IBIS has also been used to predict hydrological routings.

Biogeophysical feedbacks have been taken into account in modeling highlands and monsoon-affected lands. Effects of increases in CO_2 have also been simulated. Foley remarked that if boreal forests extend further north, there will be increased warming.

A stepwise iteration of the effects of coupling vegetation changes with land/atmosphere models has already been performed, and now they have achieved synchronous coupling of vegetation and climate change. Using the GENESIS models without introducing "flux corrections" has led to very promising results. However, the model does have problems with topography. It puts mountains like the Rockies and Andes in the wrong places!

Steve Running pointed out that Foley is the recipient of the "Presidential Young Investigator" award (see page 2).

Tom Loveland (USGS) reported on what is now a 3-and-1/2-year effort known as the "1-km Land Cover Project." This activity is led by the USGS, with the University of Nebraska serving as a key partner. Many other groups support this effort as well. The origins of this effort go back to 1990. They have been using 1-km AVHRR data for environmental monitoring purposes. The results of this project will constitute the first-ever global land-cover characteristics database. (Soil characteristics are not included in their data set.)

Loveland said that none of the current land-cover data sets have been validated. They typically have 1°x1° resolution, whereas mesoscale modelers want 1-to-40-km resolution.

Loveland's characterization strategy calls for use of NDVI from the AVHRR 1-km data set. They also take advantage of NASA Pathfinder data. Ten-day composites are basic. They have been carrying out their research on a continent-by-continent basis, with continents subdivided into seasonal land-cover regions. Thus, North America has 205 seasonal land-cover regions. Loveland showed a chart bringing out, by continent, the onset of greenness, the peak of greenness, and the end of greenness.

Loveland's team relies on the users to improve the quality of the data sets. A formal validation activity is underway, with Jack Estes as leader. The validation strategy uses a random sample survey based on IGBP DIScover classes with 25 samples per class. They expect to have at least one validation effort completed before the EOS AM-1 launch.

The group has found the conservation applications of their database to be much larger than they had anticipated.

Mark Harmon (Oregon State University) reported on "Estimating Long-Term Carbon Flux Due to Land-Use Change." Using Landsat data, the group is comparing changes in the Pacific Northwest with changes in Russia over a study period from 1972 to 1991. They have found that one-third of the observed carbon increase in the atmosphere is caused by land-use change.

Going from one disturbed system to another is what makes the difference in effects on carbon. Eco-friendly harvesting has the advantage of leading both to more products and to more carbon storage. Housing is a big component of harvested material, but about 50% of harvested material is lost in the manufacturing process. Overall, 80% of harvested carbon is released into the atmosphere. The interaction of climate change with clear-cut harvested areas may be the most significant element in carbon release into the atmosphere.

Tuesday Afternoon, November 4

Session on Integrated Assessments on Climate Variability and Change: Outcomes of U.S. Regional Workshops (chaired by Eric Barron, Pennsylvania State University)

An introductory presentation was given by **Eric Barron**. He stated that at the time of the Bush administration the USGCRP did not make the connection between global change and national policy. In the present administration, Clinton and Gore have a shared interest in the policy implications of global change. There is a new focus on the human dimension of global change. There is a feeling that we need to do climate-change assessments and take into consideration their impacts.

In a further amplification of this new concern has come the realization that we need to get the elements of society involved in these assessments and their impacts. These elements of society are recognized to be the "stakeholders" in climate change.

Barron outlined three phases in the new process of getting the stakeholders involved with the assessment of climate change and its impacts. In Phase 1 six regional workshops are held. Each workshop is funded by a different agency. White House plus relevant agency representatives meet with local leaders and other people from all walks of life. Typical interests would be fisheries, human health, commerce, industry, recreation, natural hazards, etc. They examine climate-change predictions, consider regional vulnerabilities, and devise mitigation strategies.

In Phase 2, the workshop leaders meet in Washington, DC for a national convenors workshop. About 200 people are expected to attend such a workshop, and they are to show regional assessments leading to a national assessment.

In Phase 3, the first national assessment is to be achieved before 2000, and then there would be follow-ons every five years thereafter.

Barron noted that regional perceptions are becoming stronger as people become aware of such matters as rice paddies serving as a source of methane and thereby having consequences for global warming.

Peter Mouginis-Mark asked about the legal implications of steps that might be taken toward hazard mitigation, and Soroosh Sorooshian replied that the legal field has not shown any interest in this as yet. Berrien Moore noted that he has already taken advantage of some Canadian regional assessment studies.

Berrien Moore (University of New Hampshire) presented the results of the New England Regional Assessments Workshop that was held September 3-5, 1997. He found out that the participants expect information to be available over the next few years. They feel that the currently-available information is not adequate. They are very critical of the information that is available from the EPA. They stress that information needs to be available and be useful. They can use "pragmatic" statements—anything that can be asserted with better than 50% probability will be useful to them. There is a serious need for adult educational materials, not at the K-12 level.

The participants accept the notion that greenhouse gases in the atmosphere will increase for the next 50 years and recognize that the U.S. share of the gases is declining.

Eight sectors were represented at this assessment workshop: natural resources, health, insurance, business/industry, energy/utilities, government resource management, recreation/tourism, and information transfer. Notably, the organizers could not get the banking industry to attend. Of 122 participants, 71 were academics. The final report was almost entirely written by the non-academics.

There were a total of 10 workshop findings in the final report:

1. The scientific evidence for climate change is compelling.
2. Regional assessments are needed.
3. Effective information is needed.
4. Global warming and climate change can be substantial in New England.
5. Levels of uncertainty are high but we need to act now.
6. Current environmental stress will be exacerbated.
7. Public access to relevant data is non existent.
8. El Niño can affect New England weather.
9. Some sectors may benefit from climate change.
10. Incentive programs to slow the rate of CO_2 increase must be developed.

A legal issue that arose at this workshop was related to the possible change in the number of severe storms as a consequence of warm or cool El Niño-type events. Would it be legal to change insurance rates because of anticipated increases in severe storm occurrence? Will there be effects on insurance regulatory laws?

Bruce Barkstrom commented that there is a need for data structures using Geographic Information Systems (GIS). Physical data should be coupled to economic models. Generally, it is necessary to determine just what are the public's needs for information.

Moore said that the workshop group was concerned with the interaction between drought periods and the presence of acid rain. The insurance sector would like to have forecasts on a thirty-year scale. They can't put their hands on good data sources. Bob Dickinson suggested that this is the opportunity for private consultants to step in and supply the answers.

Eric Barron addressed the findings of the Mid-Atlantic States Workshop. For the purposes of this workshop, Mid-Atlantic meant all the areas draining into the Chesapeake Bay. The workshop funding came from the EPA.

A general discussion relating to the difficulties in getting scientific information out to the public followed Barron's presentation. Bob Price said that Goddard has developed a strategy to increase public outreach. Cindy Howell of Goddard is taking the lead. Five different communities that should be reached have been identified, including scientists outside of the Earth science community. Spacecraft launches should be used as triggers to get public attention to advances in science. Scientists must take the action to identify

results that should be brought to public attention. As an example of the new approach, he stated that Veerabhadran Ramanathan has now been made spokesperson along with Yoram Kaufman for the AM-1 mission.

Price said that he has looked to the Hubble Space Telescope Science Institute as a model for scientific outreach. Out of 300 scientists employed at the Institute, some 50 participate successfully in the outreach program. They have a pattern of announcing one "hot" result each month.

Otis Brown said that he is concerned that performing regional assessments does not truly address global warming.

Jeff Richey said that the University of Washington has been taking the lead in working with its community. They divide problems into appropriate target audiences.

Peter Mouginis-Mark said that the Space-Grant Consortia are already doing the job and invited others to check with him on this. On the other hand, Nancy Maynard, Acting Science Division Director for MTPE, said we haven't yet got a good mechanism for getting the word out.

Ron Ritschard (University of Alabama, Huntsville, MSFC) discussed the Southeast Regional Workshop proceedings. The workshop had been held in June of this year. Notable, he said, was the stakeholders' need for results—they want information. They want to know the current climate variability, and they want to know about extreme climate events. In the southeast, agriculture is very sensitive to the occurrence of precipitation at the right time.

At this workshop there were 125 participants and one third of these were stakeholders. The seven sectors represented included agriculture, coastal resources, parks, and public lands. Forestry and agriculture did not participate in the assessment but, independently, they are well advanced in assessment of their problems with climate change. A report of the meeting is now available. Here are some of the findings:

1. Agriculture is very diverse. Because of little irrigation, climate effects are amplified.
2. Interrelations with climate variables are not well understood.
3. Demand for water now exceeds supply in some states. This leads to interstate conflicts.
4. There is a linkage of air quality with temperature change and consequent implications for urban health.

Establishment of a Center for Southeastern Regional Assessments (CSERA) has been proposed. The Center would be a focal point for access to all relevant information and would represent eight sectors of the economy. The Center will support the first National Climate Assessment Report, which is due in December 1999. The Center will also support the IPCC 2001 third assessment, which is to be regional in nature.

Soroosh Sorooshian (University of Arizona) spoke for the Southwest Regional Climate Change Symposium and Workshop. (The workshop concentrated on the Colorado River Basin.) In Arizona the primary water resources are snow melt runoff and ground water. Sorooshian said that water may be the common thread tying together all the U.S. regions.

The reservoir capacity in the Southwest is about four years worth, and 84% of water use is agricultural.

The workshop was conducted by means of the WorldWide Web. There were 199 attendees and 21% were stakeholders. The symposium addressed the question of how climate change affects human activity, and there was a panel discussion on how climate variability and change affect different sectors in the southwest.

The workshop had four primary recommendations as follows: (1) create a regional center; (2) identify how stakeholders use information; (3) incorporate climate data with GIS to produce maps; and (4) the scientists should phrase issues understandably.

Other recommendations had to do with the need to supply climate forecasts and to perform hydrological modeling; the need to provide market information on responses to climate change; the need to address health issues; and the need for sensitivity analyses to change, by sector.

Sorooshian said that traditional climate data are now used in dam development. There has been a correlation between winter precipitation and El Niño, but the correlation has been oversold. Berrien Moore said that it might be a good idea to look at the North Atlantic oscillation for effects in New England. El Niño is not the only driver.

Sorooshian concluded his presentation, saying that hydrological data are scattered among many agencies.

Jeff Dozier (University of California, Santa Barbara) reviewed the California regional assessment activities. The planned workshop has yet to take place, but there is definitely a desire to have an ongoing process. Dozier believes that issues to be addressed should be categorized by more than sectors—systems and then impacts should be added. He has found that the stakeholders are not interested in "Steering Committees." Doug Wheeler, California Secretary for Natural Resources, has agreed to participate in the upcoming workshop. In planning for the workshop Dozier found that a similar assessment was the subject of a book published in 1991, reporting on three workshops: *Global Change and California: Potential Impacts and Responses,* UC Press, 1991. The book reports on findings and recommendations about water, agriculture, natural ecosystems, human dimensions, climate, and energy.

The upcoming workshop will be called the California Regional Climate Change Workshop and will be held on March 9-11 in Santa Barbara. The issues for the workshop have been categorized as Sectors, Systems, and Impacts. Sectors includes water supply/use, agriculture, forestry, coastal recreation, fisheries, land use, and ports. Systems includes ecosystems, predator/prey, food/migration, hydrologic, air, and economic. Impacts includes endangered species, timing and patterns, insurance, and international.

In the discussion that followed Dozier's presentation, several questions were raised and comments offered. Berrien Moore commented that nonlinear responses to climate change events, such as a shift in the California current, could be significant but unpredictable. In New England small changes in storm tracks could be significant.

Gille suggested that the workshop should be looking at renewable resources such as solar and wind power. Other suggestions were to include population growth and fire among the issues to be addressed.

Wednesday Morning, November 5

This morning was devoted to a poster session and no formal presentations were made.

Wednesday Afternoon, November 5

This session was chaired by Michael King, and the lead speaker was William Townsend (NASA Headquarters, Acting Associate Administrator, Office of Mission to Planet Earth) discussing the MTPE/EOS Program and giving Project Updates.

Townsend said that a decision is due by Christmas on the choice for a permanent Associate Administrator for MTPE. Mr. Goldin has said to wait until the new AA is appointed and let him select a replacement Director of the MTPE Science Division. Bob Harriss, the previous Director, has left for a position at Texas A&M University. Meanwhile, Nancy Maynard is serving as the Acting Science Division Director.

Townsend said that MTPE/EOS is in a more-stable funding environment. The appropriations bill was signed the previous week, and MTPE received the amount requested. Some funds were set aside, partly for the regional assessments discussed here on the previous day. Among conditions that were imposed was a limit of $10 M on the "Federation" experiment. The House Science Committee appears to be supportive of MTPE. They are encouraging full funding of our '98 and '99 requests. The Science Subcommittee is pleased with changes we have made in the direction of applications and commercialization. The full committee is still concerned with our "uncosted" funds. The committee feels that perhaps MTPE may be helpful in providing insights that will be helpful to the U.S. side at the upcoming international Kyoto meeting on climate change.

There is an approved $50 M reduction in the president's budget for MTPE applied research and data analysis, due to data purchase funding of $50 M, which was added to the MTPE budget in '96 as a one-time experiment.

Townsend cited several items under the heading of "Current Events."

- The first two ESSP missions have been selected. The Vegetation Canopy Lidar (VCL) mission has a $60 M budget, and the Gravity Recovery and Climate Experiment (GRACE) has a $90 M budget. VCL is to fly in 2000 and is to be followed by GRACE in 2001. In accordance with ESSP philosophy these are highly focused missions with the PIs "in charge of their destiny." A second Announcement of Opportunity (AO) may raise the funding limit to $120 M.

- SeaWiFS was launched successfully on August 1 on OrbView-2 and has returned outstanding ocean-color images. CRISTA-SPAS, a cooperative Shuttle flight was launched in August. The EOSDIS Core System (ECS) was a "qualified" success when tested in August. Radarsat has recently obtained the first high-resolution map of the entire Antarctic continent.

- Earth Science Information Partners (ESIP) types 2 and 3 Cooperative Agreement Notice selections will be awarded in January. These will support the Federation prototype.

- Four LightSAR study results are expected by the end of this year. (The 1-m resolution needed requires use of an X-band system.)

- An instrument incubator Announcement of Opportunity (AO) will be released this November.

- The Lewis mission has failed and the Clark mission has schedule problems.

- Following the loss of ADEOS, NASA is planning a dedicated QuikScat recovery mission to place a SeaWinds instrument in orbit with a proposed November 1998 launch. The next ADEOS may be launched in February 2000.

- TRMM has a scheduled launch in late November.

- The AM-1 and Landsat launches are on target, and SAGE III on Meteor-3M is scheduled for May.

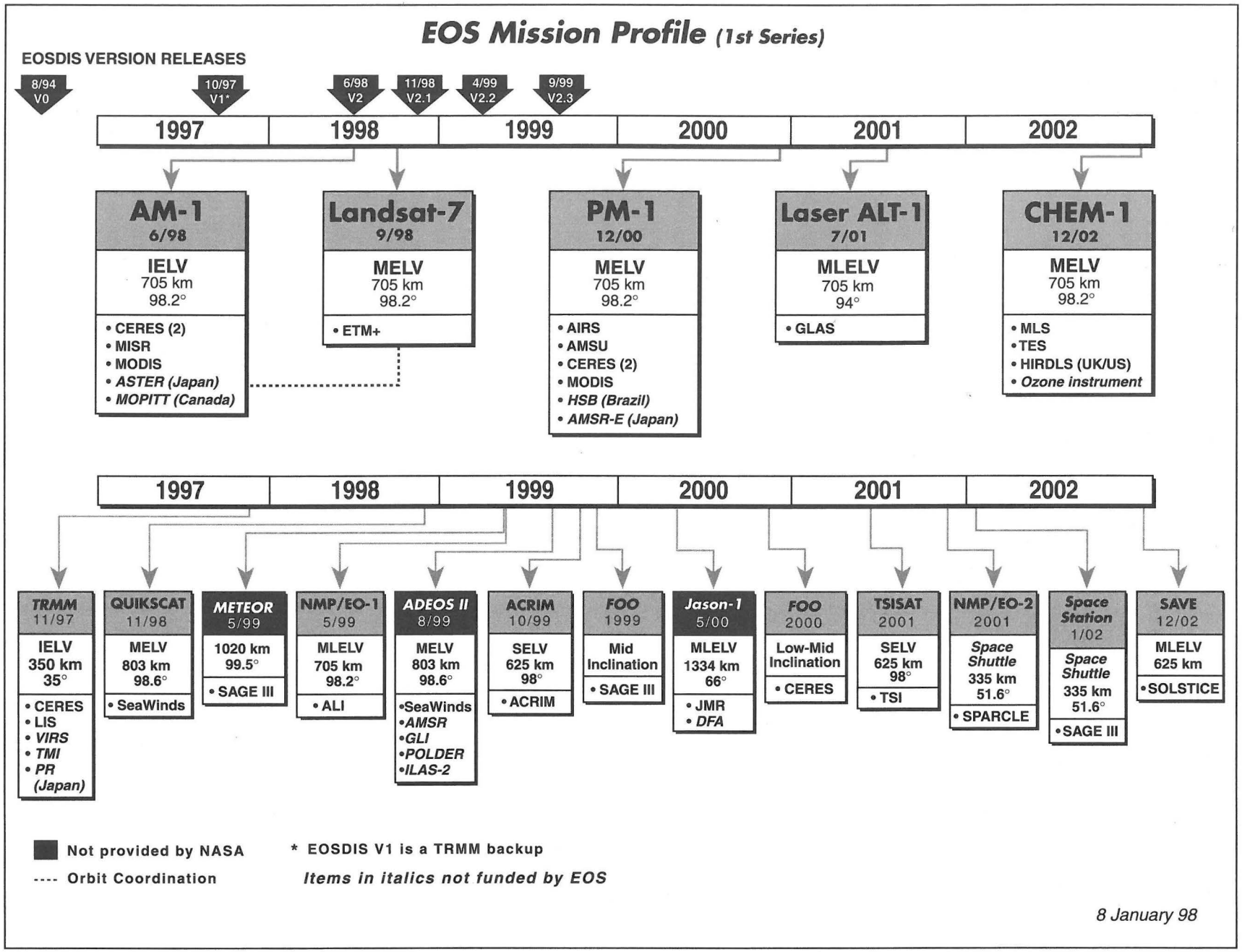
Townsend showed the MTPE Mission Profile thru 2002 (see page 10), and he commented that MTPE coordination with the Integrated Program Office (IPO) of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) is intensifying. NASA has the lead responsibility for advanced technology. Under current plans, NASA will become dependent on NPOESS for atmospheric sounding. NPOESS may fly the Integrated Multispectral Atmospheric Sounder (IMAS) to satisfy both research and operational requirements.

NASA is looking at adding two additional UV channels to the Total Solar Irradiance Sensor Mission (TSIM) and is also considering modifications to MODIS to meet NPOESS' Visible Infrared Imager Radiometer Suite (VIIRS) requirements.

Townsend next discussed the Integrated Global Observing Strategy (IGOS) as the way to coordinate plans for satellite observations of the Earth. Six prototype projects have been selected by the Strategic Implementation Team (SIT). They include, among others, upper air measurements (satellites vs. radiosondes) and long-term ocean biology (consider reducing the overlap of programs).

Townsend said focused efforts will be made in the area of MTPE outreach. There will be funding for this effort.

MTPE is planning a Biennial Review Results Workshop next year focusing on implementation of MTPE after 2002. There is a general understanding that MTPE should be evolutionary, and that there should be reviews of scientific progress and technological advances biennially. Townsend noted that 19 countries now have programs that complement MTPE. He then went on to summarize the recommendations of the Earth System Science and Applications Advisory Committee (ESSAAC). These recommendations were in the three areas of EOSDIS Core System (ECS), future missions, and program balance. Roughly paraphrasing, the recommendations called for: (1) fundamental changes in EOSDIS having to do with limiting its requirements, using an open architecture, and making the data products largely the responsibility of the PIs; (2) reexamining the EOS missions following the PM-1 mission; and (3) improving the balance of resources within MTPE, shifting away somewhat from "hardware" to provide more support for R&A and mission-oriented science.


EOS Mission Profile (1st Series)
EOSDIS VERSION RELEASES
8/94 V0
10/97 V1*
6/98 V2
11/98 V2.1
4/99 V2.2
9/99 V2.3
1997
1998
1999
2000
2001
2002
AM-1 6/98
IELV 705 km 98.2°
• CERES (2)
• MISR
• MODIS
• ASTER (Japan)
• MOPITT (Canada)
Landsat-7 9/98
MELV 705 km 98.2°
• ETM+
PM-1 12/00
MELV 705 km 98.2°
• AIRS
• AMSU
• CERES (2)
• MODIS
• HSB (Brazil)
• AMSR-E (Japan)
Laser ALT-1 7/01
MLELV 705 km 94°
• GLAS
CHEM-1 12/02
MELV 705 km 98.2°
• MLS
• TES
• HIRDLS (UK/US)
• Ozone instrument
1997
1998
1999
2000
2001
2002
TRMM 11/97
IELV 350 km 35°
• CERES
• LIS
• VIRS
• TMI
• PR (Japan)
QUIKSCAT 11/98
MELV 803 km 98.6°
• SeaWinds
METEOR 5/99
1020 km 99.5°
• SAGE III
NMP/EO-1 5/99
MLELV 705 km 98.2°
• ALI
ADEOS II 8/99
MELV 803 km 98.6°
•SeaWinds
•AMSR
•GLI
•POLDER
•ILAS-2
ACRIM 10/99
SELV 625 km 98°
• ACRIM
FOO 1999
Mid Inclination
• SAGE III
Jason-1 5/00
MLELV 1334 km 66°
• JMR
• DFA
FOO 2000
Low-Mid Inclination
• CERES
TSISAT 2001
SELV 625 km 98°
• TSI
NMP/EO-2 2001
Space Shuttle 335 km 51.6°
• SPARCLE
Space Station 1/02
Space Shuttle 335 km 51.6°
• SAGE III
SAVE 12/02
MLELV 625 km
• SOLSTICE
Not provided by NASA
---- Orbit Coordination
* EOSDIS V1 is a TRMM backup
Items in italics not funded by EOS
8 January 98

Townsend reported on the findings of the Independent External Review Board, chaired by Pamela Matson (University of California, Berkeley). This Biennial Review Board met in June and reported preliminary recommendations. Two of them are as follows (severely shortened here):

- Modify the EOS CHEM-1 architecture—in this regard the Board concluded that it would be best to go ahead with the common spacecraft, and it also recommended accelerating the Laser Altimetry Mission to 2001.

- Continue reviewing ECS and make changes to the data processing schedule (see below).

Townsend then reported on the decisions made in response to the Biennial Review recommendations (again severely condensed here):

- The recommendations for the CHEM-1 mission were accepted, including accelerating the Laser Altimetry Mission to 2001.

- Process all satellite data to Level 1 and ramp up Levels 2 and 3 processing capability in a pattern of 25-50-75-100% over the first four years.

- Phase in capability to produce selected interdependent data sets.

- Establish a data processing resources board.

- Adjust program balance to restore R&A funding to historical levels ($165 M) over a few years (this is not inflation adjusted); move management of validation of data to the NASA Headquarters Science Division.

- There should be a technology infusion strategy to drive technology development based on science needs. Technology development should support more cost-effective instrument implementation.

- MTPE implementation after 2002 should be planned to satisfy the five MTPE themes; allow time for learning from first series missions before soliciting follow-on missions; data from AM-1 and Landsat should be used to set requirements for the second EOS series.

Townsend said that the needs for monitoring versus process study measurements should be distinguished in planning future missions. We will continue to develop international partnerships and commercial opportunities. We expect more than 10% savings through development and deployment of cheaper spacecraft. The average cost per mission will be reduced from $600 M for the second EOS series to about $250 M.

Finally, Townsend listed recent MTPE science results including a number of "firsts":

- The first global 1-km land-cover maps from AVHRR satellite data have been produced.

- High-precision mapping of the sea-surface topography by TOPEX/Poseidon shows the bulge in the tropical Pacific Ocean related to El Niño.

- SAR interferometric data allow separation of human-induced changes in surface topography caused by lowering the water table from natural tectonic deformation and stress accumulation.

- AVHRR data have been analyzed to show the lengthening of the growing season in some northern-latitude regions.

- TOMS detected unusually low ozone concentrations in the Arctic in 1997.

There were some comments after Townsend's presentation. Dave Glover said that there is an effort to centralize all data processing operations up to Level 3 at the Johnson Space Center. Mark Schoeberl asked about the effect of consolidating aircraft operations at Dryden, and Townsend said that there could be some problems—there is a shortage of aircraft. Some aircraft time will have to be sought from commercial sources. Townsend also said that the validation program is moving to NASA Headquarters, but the connection between science team validation and Headquarters evaluation is not yet clear.

Chris Scolese, EOS AM-1 Project Manager (GSFC), along with **Yoram Kaufman**, AM-1 Project Scientist (GSFC) gave the status of the AM-1 science, platform, and instrumentation. The big news from Scolese was that the spacecraft is complete, all instruments are on board; and the Deep Space maneuver has been autho-

rized. Of two instrument problems, the MOPITT data problem will be fixed by Monday of the week after this meeting, and a MISR problem is "being worked."

There is a problem with the spacecraft solid-state recorder. The simultaneous record/playback feature is not working, but a fix is available. There is also a problem with the S-band transponder.

The ATLAS 2-AS launch vehicle is on the stand at Vandenberg Air Force Base. The solar array is now at Valley Forge in its folded configuration. Its power exceeds the specification.

Kaufman said that the AM-1 mission presents a new way to look at the Earth as one living system. "AM-1 is a fantastic system!" AM-1 will give a snapshot of the Earth using, for the first time, a set of scientific instruments that are thoroughly calibrated and characterized. It will measure human-induced impacts on the Earth, and will determine the radiative and hydrological forcings of Earth's climate.

Kaufman reviewed the phenomenon of biomass burning, saying that it has both regional and global effects. The highest uncertainty lies in the aerosol climate forcing. Aerosols have more-specific regional effects than trace gases. Kaufman ended his talk by saying that we must be concerned with the impact of this mission in two years not just over the long term. We need an early demonstration of the value of our work.

Sara Graves (University of Alabama, Huntsville) discussed the EOSDIS Review Group (ERG) report. The group has met twice so far and will meet again in February. It has no recommendations that would hurt the AM-1 era instruments. The Group finds the current status of EOSDIS to be suffering from complexity, making for difficult management, and suffering from budget overruns with a shortfall still expected.

For the AM-1 era there is need for EOSDIS capabilities; EOSDIS has had successes; the V0 system is operational; and the DAACs are performing well, providing critical support to users. Relaxation of data interdependencies is required. Achieving the ECS B0' functionality milestone is critical for the launches in 1998. Speaking of the August 28, 1997 test of EOSDIS, she said that the ERG considered that it showed a "qualified" success. They urged that the Alternative Implementation Path be dropped, but the instrument back-up plan should be kept. Significant improvements are still needed prior to the AM-1 launch. There are concerns with the Java interface, and with tiling.

ERG urges that there be no "requirements creep." The DAACs should be more involved in costs.

Looking ahead to the PM-1 era and beyond, the group said that large data volumes should be reduced to save costs; MTPE should look at different architectures and consolidation of processing.

The ERG recommends an adaptive approach which will be less centralized, giving more responsibility to the PIs.

Rick Obenschain (GSFC) reviewed the status of EOSDIS. The EOS Data and Operations System (EDOS) has been successfully tested with the AM-1 spacecraft. Also, the ECS Flight Operations Segment and ECS testbed have been successfully tested. Critical functions were successfully demonstrated at the August 28 review. Of 46 critical areas of functionality only three were not demonstrated.

Obenschain said that the system performance exceeded the ingest-archive goal. According to the incremental development plan, the Java interface will not be ready at launch, nor will automated on-demand user requests be possible. $10 M has been set aside for emergency back-up systems. There is no money in the ESDIS budget for transferring data between DAACs to support interoperability. Using tapes might be a less-expensive alternative. (The network money went to the R&A budget.)

Martha Maiden (GSFC) reported on the EOSDIS Federation Earth Science Information Partners (ESIP) program. She described the National Research Council (NRC) and NASA Response Task Force (RTF) concepts for the Federation. Three concepts were looked at, including Type 1—ESIPs are like DAACs, Type 2—emphasis on flexible service, and Type 3—provide value-added service.

There is a Phase 1 governance approach defined in two Cooperative Agreement Notices with selection already

due November 12 and start-ups to follow in January. Federation issues that have arisen have to do with product quality and peer review, and with intellectual property rights.

Thursday Morning, November 6

Session on Seasonal to Interannual Climate Variability (chaired by Michael Freilich, Oregon State University)

Tim Liu (Jet Propulsion Laboratory) gave a review of "Space-Based Monitoring and Analysis of El Niño." He defines El Niño as a change in trade winds with a related deeper thermocline in the Western Pacific. He used NSCAT, TOPEX, and AVHRR data to show effects of El Niño on near-surface ocean winds, sea level, and sea-surface temperature (SST), respectively. He used OCTS and SeaWiFS data to show the changes in pigments off the coast of South America between December 1996 and September 1997. Similarly, he used MLS data to show a complete reversal in upper-tropospheric water vapor between September 1996 and September 1997. TOPEX data have been used to improve the SST anomaly predictions provided by the National Centers for Environmental Prediction (NCEP).

Byron Tapley (University of Texas-Austin) reviewed the "Gravity Recovery and Climate Experiment (GRACE)," which will provide the gravity measurements required to fully utilize the TOPEX/Poseidon altimeter measurements for global ocean circulation and sea-level studies in the early new millennium. The objective of GRACE is to map the global gravity field with an unparalleled accuracy at intervals of the order of one month for a period of five years. Such data will contain the signatures of a number of time-varying gravity phenomena involved in the mass exchange between the atmosphere, oceans, and solid Earth.

The various components of GRACE are conceived of as being from an off-the-shelf mode. Both the spacecraft and the accelerometer that are used will have CHAMP heritage. The technique involves using two satellites to measure the intersatellite range rate to better than 1 mm s-1. The satellites will be injected at 450-km orbital altitude and, over a period of five years, will decay to about 300 km.

William Lau (Goddard Space Flight Center) addressed "Climate Change and the Global Hydrologic System." His work has a new focus on regional climate modeling. He noted that the GISS T22 ocean model shows reduced warming. Using wavelet analysis he has found two-year and ten-year long-term components in the NCEP SST records. He said that before an equilibrium warming can be established there can be high-latitude cooling as well as low-latitude warming! In his research he will be downscaling global warming into its effects on regional rainfall.

Chuck McClain (Goddard Space Flight Center) presented some "Early SeaWiFS Results." SeaWiFS has served as NASA's trial balloon for the "data buy" approach. In this approach NASA specified the data quality but not the instrument. After a four-year delay, launch of SeaWiFS took place on August 1 of this year and the instrument became operational on September 18. SeaWiFS gives daily coverage with 14 orbits/day.

There has been much emphasis on calibration/validation of the data, starting with simulated data. Lunar calibration using a rollover maneuver is possible. Also MOBY data, off the island of Lanai, are used for vicarious calibration. The SYMBIOS program will provide cross correlation. Information from SeaWiFS is available on its web page.

Data are for both land and sea. They will soon be archiving NDVI data.

Data are to be released only to science users. There is a 2-week embargo on data release, and this will be maintained until January 1998. There is a SeaWiFS Technical Memorandum series, with 1000 subscribers currently, giving SeaWiFS plans and results.

Orbital Sciences charges independently for scenes from SeaWiFS, but it is not clear what the charges are. McClain believes that the charges will run about $100 per scene, probably less than Landsat charges.

McClain showed the distribution of Saharan dust blowing off Africa as brought out by phytoplankton blooms across the Atlantic.

Dave Schimel (National Center for Atmospheric Research) along with **Berrien Moore** and **Rob Braswell**

(both of the University of New Hampshire) presented some recent findings on the "Response of Global Terrestrial Ecosystems to Interannual Temperature Variability." The question being considered is what controls the annual variability in terrestrial ecosystems. There are issues of nitrogen availability and stored soil moisture. In warm years the ecosystem releases CO_2 to the atmosphere. Then some years later there is an anomalous uptake of CO_2 by the biosphere. The respiration response is stronger than the photosynthesis response.

There is strong evidence of a slight asymmetry in the respiration of plants and of microbes. The release of carbon from the soil leads to the lag effects. Schimel stressed that we need to consider the diversity of ecosystem responses to temperature anomalies. He said that, just looking at two vegetation classes, we have seen two different responses.

Schimel reviewed the work of the VMAP project. In VMAP-1 just one year of climatology was reviewed; and in VMAP-2 a historical climatology record was reviewed. "Real" topography was taken into account in the modeling. There was a large impact of nitrogen availability, leading to nitrogen-related trace-gas fluxes.

Bob Dickinson suggested that a lot of the lag response may be due to phenomena in the tropics. Berrien Moore said that EOS data will offer several improvements over AVHRR data through improved station keeping and improved atmospheric corrections.

Thursday Morning/Afternoon, November 6

Session on Atmospheric Chemistry (chaired by P.K. Bhartia, Goddard Space Flight Center)

Gary Rottman (University of Colorado) reviewed the "Influence of Solar Radiation on Climate and Atmospheric Chemistry." Rottman began by showing the global average 342 Wm-2 irradiance reaching the Earth from the sun. He then compared the time variations in irradiance at the top of the atmosphere to the variation in irradiance at the surface of the Earth and commented that the term "solar constant" was an unfortunate one.

The radiation at less than 300 nm is completely absorbed in the stratosphere. There has been a 0.2% enhancement in irradiance between the solar maximum and the minimum. In the UV there is a much greater variation in the short term, as observed during a single rotation of the sun. 30% of the variation in total solar irradiance (TSI) occurs at less than 300 nm. Rottman gave several examples of variations in Earth phenomena that seem to correlate with solar cycle variations. These include variations in atmospheric chemistry and upper stratospheric winds.

Rottman compared the characteristics of the SOLSTICE instrument he is planning for EOS with the corresponding characteristics of SOLSTICE on UARS. He said that spectral measurements with the new instrument will be good to 1 part in 104. Dickinson commented that 30% of the UV below 300 nm is taken up by ozone and the rest goes into the troposphere.

Jeffrey Kiehl (National Center for Atmospheric Research) was not able to give his scheduled presentation, and so the order of presentations was changed with **Ralf Toumi** (Imperial College, London) filling in with a talk on "Chemical, Dynamical, and Radiative Interactions Through the Middle Atmosphere and Thermosphere."

Toumi said that he was representing John Pyle's Interdisciplinary Investigation (IDS). The group now has two chemical transport models (CTMs): SLIMCAT is an isentropic model for stratospheric studies, and TOMCAT is a s-pressure model. Under development are a CTM for surface to mesopause and a coupled GCM.

Midlatitude ozone loss has been seen to be a multi-year process as against seasonal changes in the Arctic and Antarctic. Arctic ozone depletion is a more-complicated process than is Antarctic ozone depletion. The influx of low-value ozone from low latitudes can account for some "apparent" ozone deletion at higher latitudes, in contrast to chemical effects.

In the 1990s, the probability of low temperatures increased considerably thus leading to an increase in PSCs.

There is a possible lightning/ozone feedback process to consider. Lightning can produce NO in the upper troposphere and thus produce ozone. Then lightning

might increase with global warming and thereby lead to still more ozone. Schoeberl pointed out the possibility that an increase in ozone would lead to greater atmospheric stability, thereby suppressing thunderstorms and decreasing lightning.

Toumi pointed out that HALOE data show a trend in increasing water vapor, which is not due just to the addition of methane.

Mark Schoeberl (Goddard Space Flight Center) gave the "Scientific Highlights of the UARS Mission." UARS was launched in September 1991, and eight of the ten instruments are still functioning. CLAES and ISAMS are no longer functioning. There is a yaw maneuver every month to avoid sunlight striking the instruments.

UARS instruments measured both ClO and NO_x but not OH. HALOE provides a methane map. UARS was intended to look for changes in ozone in the mid stratosphere, but later it was found that it could examine ozone-hole chemistry. The extended goals of UARS include looking for trends in UV as well as studying stratospheric chemistry, the QBO cycles, and El Niños. The QBO signal has been detected in zonal winds.

UARS is showing the beginning of a flattening in the amount of CFC byproducts in the 50-km region. MLS data have shown an exciting finding of upper tropospheric water vapor, irrespective of the presence of clouds. MLS can show water vapor at four different levels. The data have also shown El Niño-related changes in water vapor below the tropopause.

Schoeberl listed seven questions that have not been answered by UARS:

1. Stratospheric/tropospheric exchange has not been quantified—data from lower regions are needed.
2. Midlatitude ozone loss in the lower stratosphere has not been quantified.
3. Lower stratosphere chlorine partitioning has not been determined because UARS cannot measure HCl and $ClONO_2$ at the same time.
4. The tropospheric ozone residual cannot be measured.
5. The role of HO_x in stratospheric loss has not been determined. MLS on the Chemistry mission may be able to do this.
6. There is not adequate precision to determine transport and mixing.
7. Wind data from UARS are not adequate.

Following "questions not answered," Schoeberl gave "lessons learned," including the following:

1. Long-lived tracers are needed.
2. The UARS orbital configuration is not optimal—sun-synchronous might have been better.
3. Instrument capabilities should not be focused too tightly.

Daniel Jacob (Harvard University) followed with "Results from Tropospheric Chemistry Aircraft Missions." He said that aircraft are the best platforms for *in situ* studies, for the study of chemical characteristics of atmospheric layers, and for regional mapping of bio-atmosphere fluxes.

Tropospheric ozone largely comes from the stratosphere, but it is also formed as a result of reactions involving UV and water vapor leading to a one-week lifetime. In the tropics the largest source of tropospheric ozone is reactions involving peroxyl radicals with NO. Biomass burning in the South American tropics leads to the production of NO_x and hydrocarbons, thereby producing elevated ozone over the Atlantic.

Jacob described the PEM Tropics campaign, which took place in September 1996. They investigated the impact of biomass burning over the South Pacific using DC-8 and P-3B aircraft. They found thick layers of biomass-burning products all over the Pacific and heavy concentrations of ozone with elevated CO and acetylene but not propane and butane. They determined that this was continental air, possibly from southern Africa or Brazil. They used measurements from Ed Browell's Differential Absorption Lidar (DIAL) instrument in their work. They concluded that the import of biomass-burning pollution accounts for the increase in ozone over the South Pacific.

Jacob said that now there should be another campaign in a region in the South Pacific where biomass burning is not a factor. He also mentioned a campaign using the

P-3 aircraft and focusing on sulfur chemistry in the South Pacific. He pointed out that OH and HO_2 measurements are now available and that OH is the main oxidant of DMS, leading to the production of SO_2.

Michael Gunson (Jet Propulsion Laboratory) described the "Chemistry and Circulation Occultation Spectroscopy Mission." Gunson said that he is deputy to Mike Luther (University of California, Irvine), who is the PI for the mission. He said that this mission was not yet accepted as part of MTPE, but that he will be applying to have it become an ESSP mission. The focus of the mission is to determine what happens to pollution from the surface and where consequent ozone may appear.

The instrument concept is based on Fourier Transform Spectroscopy (FTS) with heritage from the ATMOS project. A technique originated by James Watt is used for linking the two moving mirrors of the FTS. A UV/VIS spectrometer is also incorporated in the instrument. The plan is to have a Pegasus launch, with 18 months lifetime, and an orbital altitude of 440 km with 48-degree inclination. Vertical resolution will depend on the sampling rate, but could be about 1-1/2-to-2 km.

A spring launch has been chosen to permit observations during two northern latitude summers. There is a hope to detect seasonal and latitudinal variations in several types of gases such as ethane. The high spectral resolution of the instrument will allow $ClONO_2$ determination along with many other halogenated species.

In another rearrangement of the schedule **Kelly Chance** (Harvard University) gave "Recent Results from the ERS-2 GOME Instrument." (GOME stands for Global Ozone Monitoring Experiment.) The Smithsonian Astrophysical Observatory is the U.S. investigator on this international program.

GOME was launched in April 1995. It acquires 30,000 spectra per day. It is a nadir-looking instrument with 0.2-to-0.4 nm resolution. GOME also has polarization channels with 16 times higher spatial resolution than the spectral channels. It can measure BrO globally. Operational products include O_3 and NO_2 column density and clouds. Level-2 products are now available. Currently, GOME measurements of ozone are not as good as the TOMS measurements, but they expect to achieve TOMS quality. Ozone profiles compare favorably with ozonesonde profiles and have ~1 scale height vertical resolution. They use an ozone spectrum vs. temperature technique to arrive at the ozone profile. SCIAMACHY (1999) and OMI (on ENVISAT in 2003) will follow as GOME derivatives.

Prasad Kasibhatla (Duke University) presented "A Study of Carbon Monoxide Using Trace Constituent Data Assimilation: A New Approach in Global Tropospheric Chemistry Analysis." The project wants to achieve a better understanding of CO chemistry because of its role in OH chemistry. The OH-CO reaction is the dominant sink for CO. Among sources and sinks for CO are the nonmethane hydrocarbons.

The project uses a chemistry transport model (CTM) developed by the Goddard Data Assimilation Office (DAO). The model has 20 s levels and 2°-latitude-by-2.5°-longitude resolution, spatially.

The project now has 4 tasks: (1) improve on the DAO global CTM; (2) assemble global CO measurement database; (3) analyze CO simulations for 1993/1994; and (4) assimilate CO measurements.

Kasibhatla said that they have compared the model CO with MAPS Shuttle measurements for the spring and then the fall of 1994 and found "fair" agreement. He said, in summary, that they have developed new OH chemistry, using updated kinetic information and they also updated the CO simulation. They are now doing sensitivity analyses. The assimilation procedure to be used has not yet been selected. They could start with a Kalman filter.

Charles Kolb (Aerodyne Research, Inc.) described "Tools to Characterize Urban Respiration." This is a relatively new project that started in February 1997. They analyze urban metabolism and urban respiration. In terms of metabolism, cities consume materials and energy and export/excrete materials. In terms of respiration, cities take in oxygen and emit gaseous pollutants and aerosols. The emissions have both regional and global impacts. Boundary layer emissions are hard to measure from space, so NASA needs surrogate observational variables.

This fall they have begun making testbed city measurements in Manchester, New Hampshire, a city of about 100,000 inhabitants. Following Manchester they will proceed to make measurements in Boston. In doing this they use specially-outfitted vans with various trace-gas monitors on board. They also use various meteorological instruments, mapping devices, GPS receivers, and acoustic sounders. They use releases of SF6 as tracers.

The final speaker of this IWG meeting was **Georgiy Stenchikov** (University of Maryland) on "Impact of Aerosols on Photochemical Ozone Production."

Stenchikov said this group did a case study on July 13-15, 1995, a particularly high ozone incidence time. All the measurements were made at GSFC. They found mostly sulfate and ammonium sulfate aerosols in the Baltimore/Washington, DC area. Values of t were as high as 2.0. Calculations and measurements of photolysis rates showed good agreement. This demonstrated the effect of aerosols on the photolysis rate of NO_2 and thereby on ozone production. Pure scattering aerosols were found to produce the highest levels of ozone. It was found that absorbing dust or smoke aerosols decreased ozone levels.

USGS - News Release

A poster produced from satellite images of the Chesapeake Bay watershed will aid a multi-state effort to restore and manage the Bay's resources, according to the U.S. Geological Survey.

USGS scientists will use the image of the entire 64,000-square mile drainage basin of the Chesapeake Bay to provide a snapshot of recent surface conditions, including vegetation, that can be compared with historical and future images to help produce a report card of progress or setbacks in meeting resource management goals.

"Because the image can provide a key to at least a dozen vegetation types and other land-cover features, it will help us work with other agencies to develop methods for monitoring progress on changes along rivers and streams," said Scott Phillips, USGS Chesapeake Bay Program Coordinator.

"And we hope to work with other agencies to further develop methods that relate land-use change to ecosystem change in the Bay watershed and the Bay," said Phillips.

"As a federal land-management agency with responsibilities in all 50 states, the Natural Resources Conservation Service will use the Chesapeake Bay poster map in solving complex natural resource management issues in the six-state Bay watershed," said Jerry Griswold, NRCS Chesapeake Bay Program Coordinator. "The poster map is also a graphic reminder of the relevance of the Chesapeake Bay and its resources to the thousands of people that live in the watershed."

The USGS also produced the poster as an outreach tool for the public to better understand that activities in the Chesapeake Bay watershed may have an impact on the water quality and living resources of the Bay.

The poster was unveiled at the recent USGS open house in Baltimore, MD, which was attended by many of the cooperating agencies in the Chesapeake Bay Program (CBP). The CBP is a multi-agency effort, started in 1983, to restore the Bay and its resources—the USGS is one of the federal members.

The image mosaic, composed of Landsat Thematic Mapper scenes collected from 1990 through 1994, will be the most complete and current basinwide image to date of the entire Chesapeake Bay. Although still in an experimental stage, the information on the map will be used by the USGS in hard-copy format for educational activities, and in electronic soft-copy format for such applications as land-use analysis.

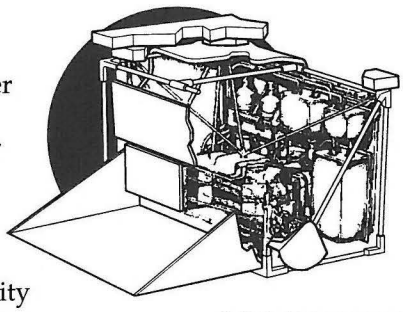
The map is one of the products of the USGS Chesapeake Bay research program, which works with other local, state, and federal agencies to provide the scientific information needed by land and resource managers and other potential users. The information is designed to help improve the understanding of the entire Bay ecosystem and enhance the ability to predict and measure the effects of restoration efforts. Among other activities, the USGS is measuring surface-water and groundwater flow and quality, conducting studies of past and present natural and human-induced changes, providing cartographic analysis, helping to modify hydrologic and geologic models of the Bay system, and working to improve the understanding of living resources in the Bay.

Copies of the map are available for $4.00 each (plus a $3.50 handling charge), from the USGS Branch of Information Services, Denver Federal Center, Box 25286, Denver, Colorado, 80225. Credit card orders may be faxed to (303) 202-4693. For more information about this map call 1-800-435-7627.

As the nation's largest natural resources science and mapping agency, the USGS works in cooperation with nearly 200 organizations to provide reliable, impartial, scientific information to resource managers, planners, and other customers. USGS hydrologists, geologists, biologists, and cartographers work in every state to minimize the loss of life and property from natural disasters, contribute to wise economic and physical development of the nation's natural resources, and enhance the quality of life.

Atmospheric Infrared Sounder (AIRS) Science Team Meeting, October 22-24, 1997

—*H. H. Aumann* (hha@airs1.jpl.nasa.gov), AIRS Project Scientist



AIRS, the Atmospheric Infrared Sounder on the EOS PM-1 platform, is a grating array spectrometer which covers the 3.7 –15.4 μm region of the infrared spectrum. AIRS, in combination with the Advanced Microwave Sounding Unit (AMSU) and the Humidity Sounder Brazil (HSB) microwave sounders on EOS PM-1, will provide global temperature profile sounding capability with better than 1-K rms accuracy in 1-km vertical layers, and water vapor profiles with better than 10% rms accuracy under clear and partially-cloudy conditions in support of operational weather forecasting and climate research. The EOS PM-1 platform is scheduled for launch in December 2000. The spacecraft, built by TRW in Redondo Beach, CA, is the first in a series of common spacecraft for NASA, NOAA, and DoD polar-orbiting missions.

AIRS Hardware Status

The design of AIRS is essentially complete. The program technical focus is now on the AIRS engineering model (EM) and the flight model (FM) build and test. It is a schedule-driven environment focused on completing the EM by October 1997 and delivering the FM by October 1998.

The AIRS EM build is nearing completion. The spectrometer assembly, alignment, and warm wave front testing are complete. The wave front error, with the spectrometer at 300 K, shows excellent optical quality. The wave front error, using a 3.39 μm laser, tests the performance of the spectrometer from the entrance aperture through all optical surfaces, including the diffraction grating, to a retro-reflector mounted on the focal plane. Wave front error measurements with the spectrometer at 150 K and the focal plane at 58 K are the next steps.

AIRS uses a focal plane with 12 arrays, cooled to 55 K using an active cooler. The cooler and the focal plane have been successfully integrated in the engineering model vacuum dewar and tested. This was a major step. Early results are encouraging. Array M12 (14.67-15.4 μm) has a median noise equivalent temperature difference, NEΔT, of 0.4 K with zero outages. Required for the FM is NEΔT=0.35 K or better, with less than 2% outage. Outage is defined as any detector in an array that is a factor of 2 or more worse than the required array median NEΔT. The build of the FM is paced by the IR focal plane build and test.

The AIRS Test and Calibration Facility (ATCF) build is complete and in the final checkout phase. The ATCF has spatial, spectral, and radiometric measurement capability. The ground support data acquisition station and processing software development are almost complete. The data acquisition hardware and processing software demonstrated their capability in support of the cold engineering model dewar testing. The AIRS Instrument Calibration plan, which gives an overview of the spectral, radiometric, and spatial calibration of AIRS, hardware tools (such as the ATCF), software tools, predicted calibration accuracies, and assumptions, is being circulated for final review. The EM testing will serve to validate these tools and assumptions. The plan for the calibration of the flight model includes two end-to-end tests: a spectral calibration test using a 6-m gas cell; and a radiometric test, where the AIRS (mounted in the ATCF) looks upward through a flat folding mirror into a vertical air column. Simultaneously, the same column is viewed with the Atmospheric Emitted Radiance Interferometer (AERI), an uplooking interferometer with spectral resolution and coverage equivalent to AIRS, which has been validated during intensive ground measurement

campaigns. The tools available for AIRS calibration are adequate to meet the Functional Requirements Document (FRD) specified calibration accuracies.

AIRS Data Processing Status

The AIRS Level 1b and Level 2 algorithms have passed peer group reviews and can be downloaded from http://www-airs.jpl.nasa.gov/html/ATBD_home_page/. The retrieval algorithm has four major stages: microwave retrieval, cloud clearing, first product generation using regression, and final product generation. The microwave retrieval uses the 57-GHz AMSU and 183-GHz HSB channels to create a first-guess solution independent of cloud cover. The cloud-clearing combines infrared and microwave channels by using 9 spots on the ground (3 x 3 AIRS footprints centered on an AMSU footprint) to solve for the fractional cloud cover, allowing for the possibility of multiple cloud formations, and cloud-clears using a TIROS-proven cloud clearing concept. The regression algorithm applies pre-calculated coefficients to the cloud-cleared radiances to quickly generate the first temperature and humidity profile solution. The final product is obtained by a physical retrieval. The retrieval accuracy, based on simulated data with up to 80% cloud cover, is 0.7 K rms in the lower troposphere. The moisture retrieval accuracy is better than 10% layer rms. Key to the physical retrieval algorithm is the fast forward algorithm. This algorithm accounts for the reflected thermal radiation and variable CO_2 concentrations. The reflected thermal radiance is computed using 5 predictions to an accuracy of better than 0.1 K. Variations in the CO_2 concentration (1% annual variability and at present a 0.5%/year upward trend) are handled as offsets to the existing fast transmittance calculations. Accuracies are better than the AIRS instrument noise with several easily computed predictors.

The AIRS Science Data Processing System (SDPS) is being developed in the rapid-prototyping mode. Prototype 6 is the current version of the SDPS. The functionality improvements of SDPS Prototype 6 over Prototype 5 include: use of a PCF (process control file) for opening Level 0 data files, Level 1b calibration smoothing across data granule boundaries and initial implementation of DC Restore correction, and integration of a 100-layer rapid transmission algorithm into the team algorithm. Prototype 7 will be the beta delivery to the DAAC, scheduled for June 1998. It will include the following additional functional improvements: full DAAC compatibility (toolkit for I/O and status messages, Earth Science Data Types [ESDTs], metadata), greatly reduced number of output files and use of Hierarchical Data Format (HDF) swath format, updated radiometric and spectral calibration, and re-integration of initial cloud clearing and initial retrieval code.

AIRS Data Product Validation Status

The AIRS Data Product Validation approach is described in the "AIRS Data Product Validation Plan," which was submitted to the EOS Project Science Office in August 1997. The plan can be found on the web at http://eospso.gsfc.nasa.gov/validation/valplans.html. The plan makes extensive use of already-established programs, such as the DOE ARM (Atmospheric Radiation Measurement) program in Oklahoma, and intensive campaigns using aircraft overflights of special test sites such as the CAMEX (Convection and Atmospheric Moisture Experiment) program, in addition to the more than 2000 radiosondes launched daily in support of global operational weather forecasting from balloons. Equipment typically available at special test sites are chilled mirror/frost-point hygrometers at 60-m and 30-m heights and at ground level, and hygrometers on tethered balloons and kite platforms below 1-km height and on aircraft overflights at up to 20-km altitude. Continuous observations of total precipitable water can be made by microwave radiometers, sun photometers, and the GPS (Global Positioning System). Profiles of water vapor and temperature can be made by Raman Lidar and AERI. The next CAMEX, CAMEX 3, is relevant to the AIRS program for the validation of forward and inverse algorithms in the tropical environment. CAMEX 3 is scheduled for August - September 1998 with flights from Florida. On board the NASA ER-2 will be the MODIS Airborne Simulator (MAS), the Microwave Imaging Radiometer (MIR, with 54, 118, and 183 GHz channels similar to AMSU-A and AMSU-B), and the IR Interferometer Sounder (with spectral coverage and resolution equivalent to AIRS), with the cross-track scanning capability. Lidar, an up-looking Fourier transform spectrometer (AERI), and a Differential Absorption Lidar (DIAL) system will be used to characterize the

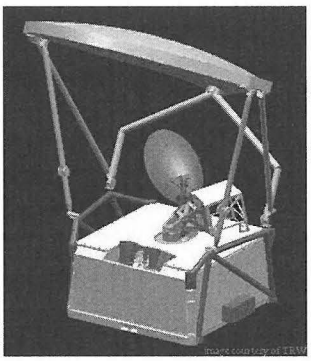
vertical temperature profile and water vapor profile in the lower troposphere with better than 1-km resolution and 5% accuracy.

For the latest information on AIRS and links to other information related to the EOS PM-1 program visit the AIRS homepage at http://www-airs.jpl.nasa.gov.

Joint Advanced Microwave Scanning Radiometer (AMSR) Science Team Meeting

— *E. Lobl* (elena.lobl@msfc.nasa.gov), AMSR-E Science Team Coordinator, Earth System Science Laboratory, University of Alabama in Huntsville

ADEOS-II AMSR homepage: se.eorc.nasda.go.jp/eorc/AMSR/amsr
EOS PM-1 AMSR-E homepage: wwwghcc.msfc.nasa.gov/AMSR



The second Joint AMSR Science Team met on October 28, 1997 at the Earth Observation Research Center (EORC), in Tokyo, Japan. This meeting preceded the ADEOS-II AMSR Workshop. Discussion revolved around the standard data products that Japan and the U.S. will produce from AMSR data.

Paul Hwang (EOS PM Project Office) gave the status of the project, including the status of the instruments that will fly on the PM-1 spacecraft. All instruments are on schedule for delivery to TRW, the spacecraft contractor. He also presented the three action items that were assigned to the Joint AMSR Science Team by the AMSR-E/PM-1/ Ground System Interface meeting, October 13-14 , 1997, held at JPL. The responses to these action items are due January, 1998.

N. Nakagawa (ADEOS-II Program Coordinator) presented the ADEOS-II project status and a short review of the algorithm development schedule and selection process. He also commented on NASDA's 2nd Research Announcement (RA), which has as its objectives: post-launch cal/val activities and the development of research algorithms and their scientific application. This RA will be released at the beginning of 1998.

The AMSR Science Data Validation Plan was discussed briefly. The Japanese scientists agreed to become active participants in the validation process and to assist in the completion of the plan. E. Lobl (AMSR-E Science Team Coordinator) will ensure that this cooperation between the U.S. and Japanese scientists occurs.

The main discussion topic was a comparison between the U.S. and Japanese standard products. The U.S. standard products were illustrated with a diagram showing the AMSR-E standard product generation flow. All U.S. products on this diagram, except Level 1, will be generated in the U.S.

Dr. A. Shibata (ADEOS-II AMSR Chief Scientist) presented the Japanese concept for algorithm development and then showed a list of the Japanese standard products. The main requirements for a standard product algorithm selection are: a) a high score on the

intercomparison; b) level of support to the EORC (in testing the algorithm) and the Earth Observation Center (EOC) in installing it before launch; c) support post-launch calibration; and d) to be simple, if possible. Other important considerations include utilization of AMSR's new frequencies, a reasonable method of correcting bias, and the retrieval algorithms for each parameter to be as independent as possible. Dr. Shibata also presented a tentative schedule for the final algorithm selection.

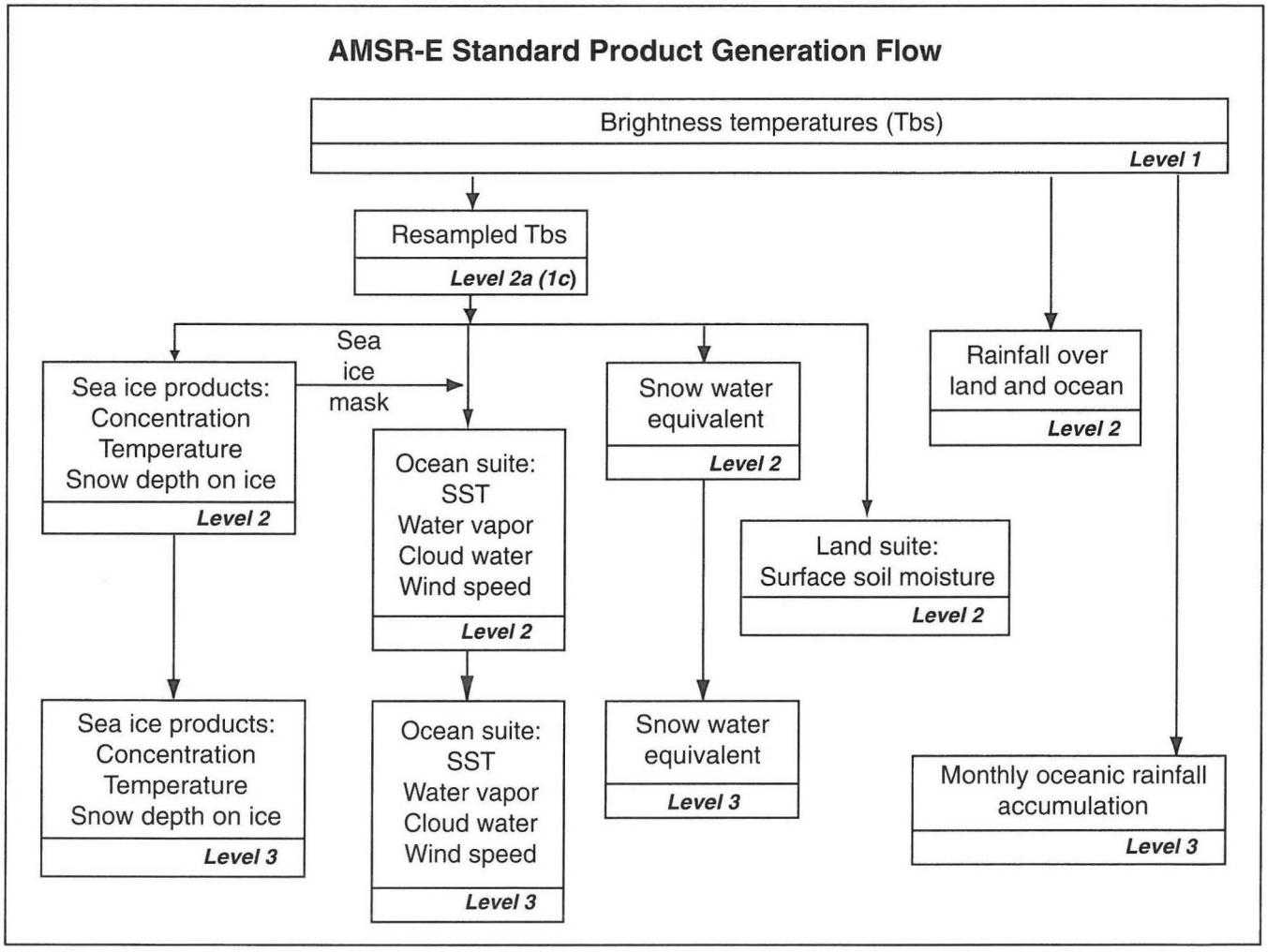
The list of the Japanese standard products follows:

Water vapor	2 byte + quality flag (1 byte)
Cloud liquid water	2 byte + quality flag (1 byte)
Precipitation	2 byte + quality flag (1 byte)
Sea surface wind speed	2 byte + quality flag (1 byte)
Sea surface temperature	2 byte + quality flag (1 byte)
Sea ice concentration	4 byte + quality flag (1 byte)
Snow water equivalent	4 byte + quality flag (1 byte)
Soil moisture	4 byte + quality flag (1 byte)

Note: length of byte not yet determined

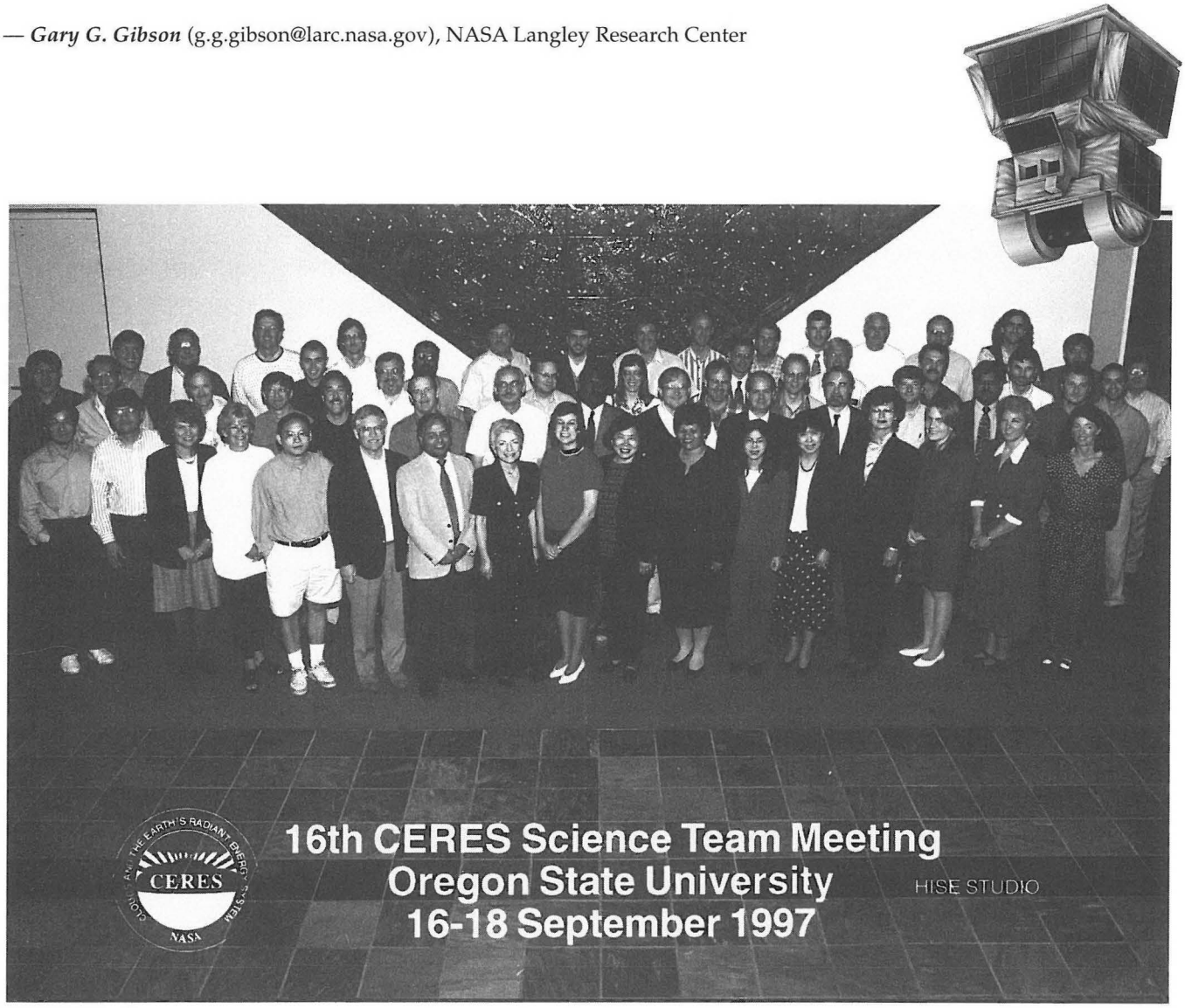
More specific information on the contents of the Japanese standard products will be forthcoming after the selection of the retrieval algorithms.

The meeting was adjourned with no further discussions. The next Joint AMSR Science team meeting is tentatively planned for the end of June 1998.



Clouds and the Earth's Radiant Energy System (CERES) Science Team Meeting

— *Gary G. Gibson* (g.g.gibson@larc.nasa.gov), NASA Langley Research Center



The 16th Clouds and the Earth's Radiant Energy System (CERES) Science Team meeting was held at Oregon State University (OSU) in Corvallis, OR, on September 16-18, 1997. The focus of the meeting was on the status of the Earth Observing System (EOS) program and the EOS Data and Information System (EOSDIS), and the CERES instrument, data management system, algorithms, and validation plans. The first CERES launch is scheduled for November 1997 in Japan on the Tropical Rainfall Measuring Mission (TRMM) spacecraft. The Science Team guides the definition of the CERES instrument and science studies to provide a climate data set suitable for examining the role of clouds in the radiative heat balance of the climate system.

Bruce Wielicki, CERES Co-Principal Investigator, opened the meeting with an EOS program status

report. The EOS AM-1 and EOS PM-1 missions are on schedule. Wielicki, Bruce Barkstrom, and the Science Team officially welcomed three new CERES Co-Investigators: Leo J. Donner of the NOAA Geophysical Fluid Dynamics Laboratory (GFDL), who has cirrus/convective global and regional cloud-modeling expertise; David P. Kratz of the NASA Langley Research Center (LaRC), an expert in longwave radiative transfer; and David F. Young of LaRC, who will lead the Time Interpolation and Spatial Averaging Working Group. The addition of Leo Donner to the team is in response to a recommendation at the last peer review to strengthen the modeling component.

CERES Instrument Status: TRMM and EOS AM-1

Jack Cooper (LaRC) presented the instrument status report. The CERES Proto-Flight Model (PFM) instrument on the TRMM spacecraft successfully completed spacecraft-level testing. The TRMM pre-shipment review was successfully completed in early August, and the spacecraft was shipped to Japan. The primary issue of concern was the azimuth stall anomaly, but the data verified proper bearing operation, and a recovery sequence was successfully demonstrated. The flight model (FM1 and FM2) instruments were successfully integrated on the EOS AM-1 spacecraft, and comprehensive functional tests were completed. Opto-isolator units that were reworked to correct improper tinning of gold-coated parts were subjected to accelerated life-cycle tests to verify integrity of solder joints. One failure occurred after the equivalent of 13 years; no other failures were noted after the equivalent of 50 years. The FM3 sensors for EOS PM-1 were delivered to TRW in late April 1997. Spectral characterization tests completed in early September indicated extremely small air/vacuum shift and drift characteristics. The FM4 sensors were scheduled for delivery in late September. Fabrication of FM3 and FM4 electronic and mechanical assemblies is proceeding on schedule. Based on the units produced thus far, the CERES instrument is designated as a 50-W, 50-kg-class instrument.

Data Systems: EOSDIS, LaRC DAAC, and CERES DMS

Bruce Barkstrom (LaRC) reviewed EOSDIS progress and problems. A demonstration of a prototype system was successful, but reviewers noted concerns over operational aspects of expanding the prototype to full operations. Richard McGinnis (LaRC) presented the status of the Langley TRMM Information System (LaTIS) for CERES data processing at the Langley Distributed Active Archive Center (DAAC). LaTIS development was undertaken because the EOSDIS will not be ready by the time of the TRMM launch. In addition, the Science Working Group for the AM Platform (SWAMP) insisted on an emergency backup system to cover AM-1 processing in case of additional EOSDIS delays. The CERES Science Team remains concerned about the delivery and viability of the EOSDIS Core System. The Science Team strongly preferred to evolve the LaTIS data system from TRMM to EOS-AM/PM, and suggested that such a proposal be submitted to the EOSDIS Project if this could be shown to be cost neutral or cost saving.

Jim Kibler (LaRC) presented the CERES Data Management System (DMS) status. The CERES Release 2 DMS deliveries to the DAAC are proceeding on schedule. End-to-end TRMM mission simulations resolved numerous technical and interface issues and demonstrated the successful operation of the data systems. Near-term plans include completion of LaTIS testing with a month of simulated CERES data prior to the TRMM launch, and maintaining compatibility with both LaTIS and EOSDIS for CERES processing.

CERES Validation

The Science Team reviewed the CERES validation plans. No major problems or issues were identified. Updated validation plans for all CERES subsystems are nearly complete. Bruce Wielicki led a general discussion of the overall validation plan, its shortcomings, and strengths. Wielicki remarked on the lack of tropical land and mid-latitude ocean corroborative data. Michael King of the NASA Goddard Space Flight Center (GSFC) suggested that data taken in a tropical field experiment planned for August-September 1999 (with Moderate Resolution Imaging Spectroradiometer [MODIS] participation) will be quite helpful. Jim Coakley (OSU) updated the group on the Indian Ocean Experiment (INDOEX) planned for February-March 1999. Tom Charlock (LaRC) presented plans for the Workshop for Atmospheric Validation in EOS AM-1 and SAGE III (WAVES) in October, 1997. WAVES will

coordinate new EOS validation investigations with EOS instrument science teams.

Invited Presentations

Dennis Hartmann (University of Washington) briefed the team on "Climate Processes Over the Oceans," an EOS Interdisciplinary Science Investigation. Their goal is to construct an integrated view of atmospheric climate over the oceans. The physical processes considered involve boundary-layer dynamics and resulting fluxes, cloud-scale and mesoscale dynamics, cloud physics, and global-scale circulations. The important phenomena of interest in this investigation include: boundary-layer fluxes of heat, momentum, and moisture; low-level clouds; tropical convective clouds; and midlatitude synoptic systems.

Bob Cess (State University of New York at Stony Brook, SUNY-SB) showed evidence to demonstrate that with the current state of General Circulation Models (GCMs), the seasonal cycle cannot be used to validate a model's ability to predict climate change.

Dave Young (LaRC) gave a status report on reprocessing data from the Earth Radiation Budget Experiment (ERBE). Numerous calibration and modeling improvements are being incorporated and tested in the ERBE algorithm. The final archived ERBE data and the CERES ERBE-like data will use the same algorithm.

Working Group Reports

Instrument Working Group: **Robert B. Lee III** (LaRC) led the Instrument Working Group (WG) meeting. Lee completed a draft of a paper on pre-launch calibrations for the PFM, FM1, and FM2. D. K. Pandey (SAIC) discussed spectral characterization of the CERES sensors and showed results from TRW's Fourier Transform Spectrometer (FTS) Vacuum Spectral Characterization Facility. Kory Priestley (LaRC) presented current operational scan-dependent offsets for the PFM instrument, and preliminary scan-dependent offsets for FM1 and FM2. The offsets will be verified on-orbit while viewing cold space during planned spacecraft pitch-over maneuvers. Priestley also presented a comparison between measured and numerically predicted point response functions for the PFM instrument. Models and data verify that a time offset of 24 ms should be implemented for the PFM instrument. Lou Smith (Virginia Tech) designed a numerical filter to reduce a slow, single thermal mode transient in the PFM total-channel signal to a negligible level.

Cloud Working Group: **Bruce Wielicki** led discussions on the status of cloud-related algorithm and validation activities. He cautioned the group to be very careful in analyzing Visible InfraRed Scanner (VIRS) data from TRMM because the cloud algorithm may be the first real test of calibration accuracies. Jim Coakley showed close comparisons between cloud layers identified using the spatial coherence method and Lidar In-Space Technology Experiment (LITE) data. The LITE data had almost no 100% cloud-free scenes, demonstrating that it is capable of detecting optically-thin clouds. Bryan Baum (LaRC) highlighted some special problem areas with the CERES cloud mask (e.g., smoke over highly-reflective land surfaces), but concentrated on results from discrete ordinate calculations that can be used to establish clear/cloud temperature thresholds in the 10.8-and 3.7-μm channels. Patrick Heck (Analytical Services & Materials, Inc., AS&M) presented new strategies for updating the clear-sky radiance history (CRH) database, including a method for updating albedo based on long-term changes rather than day-to-day variations. Presentations on the construction of Angular Distribution Models (ADMs) by Larry DiGirolamo (University of Arizona) and Yongxiang Hu (Hampton University) stimulated lively discussions on the use of reciprocity in the construction of ADMs for cloudy skies, but more research is needed in this area before firm conclusions can be reached. A related study by Steven Dewitte (Royal Meteorological Institute of Belgium) showed that ADMs derived using the Radiance Pairs Method (RPM) model performed better than four other models in removing the angular dependency of ERBE or ScaRaB (Scanner for Radiation Budget) measurements for clear-sky desert areas.

Surface and Atmospheric Radiation Budget (SARB) Working Group: **Thomas Charlock** (LaRC) led the SARB WG in presenting the status of the Release 2 SARB code and discussing issues regarding the validation of SARB and Surface-only data products. Shi-Keng Yang (NOAA National Centers for Environmental Prediction, NCEP) reviewed the definitions of tropopause height used by various institutions, and

the WG selected 200 hPa and 70 hPa as the upper-troposphere and lower-stratosphere reference levels for archiving SARB-derived heating/cooling rates. Fred Rose (AS&M) incorporated a simplified parameterization of the CKD (Clough, Kneizys, and Davies) water-vapor continuum into the Release 2 version of the SARB code. He also demonstrated the benefit of using a high-resolution surface-elevation map in SARB computations at instrument footprint resolution. Shi-Keng Yang presented details of the Stratospheric Monitoring-Group Ozone Blended Analysis (SMOBA) ozone product that has been adopted as the primary source of ozone for CERES processing. David Rutan (AS&M) presented a database that provides surface optical properties, a digital elevation map, and a land-water percentage map. Tim Alberta (AS&M) presented a brief summary of the CAGEX (CERES/ARM [Atmospheric Radiation Measurement]/GEWEX [Global Energy and Water Cycle Experiment]) Version 2.0.0 data set that was recently released to the science community. The data set consists of multiple sets of meteorological parameters, cloud properties, and aerosol optical properties and distributions taken at the ARM Southern Great Plains (SGP) site during the ARM Enhanced Shortwave Experiment (ARESE) in October 1995. He showed that atmospheric absorption computed with the Fu-Liou radiative transfer model was always lower than the observed values regardless of which input data set was used. Bob Wheeler (AS&M) described the CERES Airborne Radiometer Scanner (ARS) effort to characterize bidirectional reflectance distribution functions for various surface types as a part of CERES validation activities. Wheeler also described the Chesapeake Light Ocean site being readied for radiation and aerosol measurements, also for CERES validation.

Time Interpolation and Spatial Averaging (TISA) Working Group: **David Young** led discussions of software development, validation plans, and ongoing temporal and spatial averaging studies. All TISA subsystems are on-target for delivery to meet TRMM schedules. Lou Smith (Virginia Tech) showed that results from an analytical method for estimating temporal averaging errors for monthly mean LW and albedo compared well with rms errors derived from ERBE data. Dave Doelling (AS&M) presented results of studies to estimate spatial sampling errors for CERES radiation and cloud parameters. Young developed new SW broadband directional models for ERBE and CERES using 60 months of ERBS data.

Investigator Presentation Highlights

Tom Charlock (LaRC) calculated the absorption of SW by a cloudy atmosphere using the Fu-Liou delta 4-stream code. The column atmospheric absorption inferred by differencing GOES-8 and surface radiometers was about 100 Wm^{-2} more than the computed absorption for October 30, 1995, apparently demonstrating anomalous absorption. Calculations included a wide array of remote-sensing inputs for cloud properties. Computed absorption approached measured values only when questionably large aerosol particles were placed in the cloud.

Dominique Crommelynck (Royal Meteorological Institute of Belgium) reported on the status of the Solar Constant Experiment (SOLCON) Hitchhiker mission. SOLCON will make periodic observations of the absolute value of the solar constant using a differential absolute radiometer and a digital processor unit. The next SOLCON Hitchhiker flight is planned for October 1998.

Xiquan Dong of AS&M (representing Patrick Minnis) showed good agreement between boundary layer cloud properties derived from surface measurements during SUCCESS (SUbsonic aircraft: Contrail and Cloud Effects Special Study) and satellite-based retrievals from AVHRR (Advanced Very High Resolution Radiometer) and GOES (Geostationary Operational Environmental Satellite). Cloud reflection and optical depth from GOES were lower than the surface-derived values due to instrument calibration, differences in spectra, view angles, and retrieval methods. The comparison was better for lower values of cloud liquid water path (LWP) than for higher cloud LWPs.

Leo Donner (GFDL) addressed the use of high-resolution, 3-D cloud system models in the development of GCM cumulus parameterizations. The modeled cloud system undergoes a convective-to-stratiform life cycle. The modeled heat source and moisture sink are in broad agreement with observations, but upper-troposphere moisture exceeds observations and cloud/radiation interactions are not well understood. CERES data will be used to evaluate 3-D distributions

of clouds and radiative fluxes, and to examine synoptic evolution of cloud systems.

Qingyuan Han of University of Alabama - Huntsville (representing Ron Welch) showed that POLDER (Polarization and Directionality of Earth Reflectances) data can be used to identify sun glint areas and to discriminate ice-water cloud, thin cirrus over water cloud, and aerosol above cloud. Analysis of cloud morphology effects showed good agreement between POLDER results and plane-parallel predictions for large cloud fields, but revealed substantial differences due to 3-D effects for mesoscale cumulus clouds.

Martial Haeffelin of Virginia Tech (representing David Young) presented methods for reducing temporal sampling errors in CERES monthly mean atmospheric and surface fluxes using regular or solar-zenith-angle-weighted linear interpolation schemes. Temporal sampling errors of CERES monthly mean radiative fluxes were reduced to less than 0.5% and 1% in the SW and LW domains, respectively (on the order of 2 Wm^{-2} in both spectral domains).

Anand Inamdar of Scripps (representing V. Ramanathan) reported on a continuing analysis of water vapor radiative feedback. They analyzed a new data set encompassing a global domain including both the continents and oceans as well as both the ascending and descending branches of the Walker and Hadley cells. They derived the greenhouse effect for oceans and land separately and combined, and mapped observed changes in the atmospheric greenhouse effect and total precipitable water. The coupling between the surface temperature, the atmospheric greenhouse effect, and the vertical distribution of atmospheric water vapor and temperature was examined from the annual cycle.

Bing Lin of Hampton University (representing Bruce Wielicki and Patrick Minnis) analyzed daytime and nighttime scenes containing overlapped clouds over the tropical western Pacific warm pool regions using the combined Special Sensor Microwave/ Imager (SSM/I) and Geostationary Meteorological Satellite (GMS) data. Infrared (IR) and visible (VIS) measurements from GMS are used to detect upper-layer cirrus/anvil decks, while cloud liquid-water temperature and path for lower layers are retrieved from SSM/I microwave (MW) data. Results show that MW, IR, and VIS satellite images provide the signals for overlapping clouds very well.

Norman Loeb of OSU (representing Jim Coakley) reported on the influence of horizontal and vertical cloud inhomogeneities in satellite retrievals of cloud optical depth and liquid water path. At pixel scales ranging from 50 m to 2 km, retrieved cloud properties from predominantly overcast marine stratus show very little sensitivity to pixel resolution. LWP estimates based on radiative transfer schemes which ignore vertical variations in cloud properties overestimate the true LWP. The LWP bias tends to increase with cloud optical depth and with solar and viewing zenith angles.

David Randall (Colorado State University, CSU) reported on EauliqNG, the next generation model for predicting cloud water, cloud ice, rain, and snow. EauliqNG prognosticates cloud amount and the temperature and water vapor mixing ratio of the clear and cloudy portions of each grid cell. EauliqNG fully couples the stratiform cloud and convection parameterizations, allows a mesoscale circulation with different vertical velocities in the clear and cloudy regions, and determines the strength of the mesoscale circulation by requiring that the virtual temperature be the same in the clear and cloudy regions. EauliqNG is currently being tested in the CSU GCM.

David Rutan of AS&M (representing Lou Smith, Virginia Tech) applied principal components analysis to 5 years of Earth Radiation Budget Experiment data to study the diurnal cycle of albedo. Determined that there is very little intraseasonal variability in the first Empirical Orthogonal Function (EOF); over 90% of the seasonal variance is explained by the first three EOFs; the first EOF for land/ocean explains the magnitude of the diurnal variation; and the second EOF accounts for the morning-to-afternoon albedo variability due to clouds.

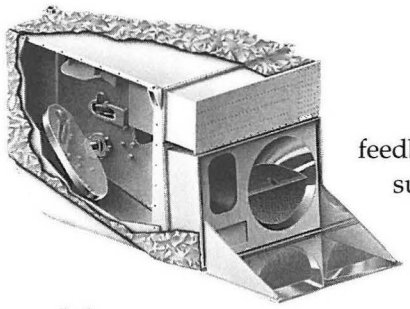
Si-Chee Tsay of GSFC (representing Michael King) reported on cloud mask and cloud property retrieval in the Arctic. The MODIS cloud mask does a good job except for very thin/low-level stratus clouds over sea

(Continued on page 46)

Moderate Resolution Imaging Spectroradiometer (MODIS) Science Team Meeting Summary

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

The complete set of these minutes and attachments is available in Portable Document Format (PDF) on the MODIS Home Page at http://modarch.gsfc.nasa.gov/MODIS/MODIS.html.



Introduction

The MODIS Science Team met on October 22-24, 1997, at the Holiday Inn in College Park, MD. Vince Salomonson, MODIS Team Leader, convened the meeting and welcomed participants. He expressed concern that MODIS is a bit behind the other teams whose instruments will fly on the AM-1 platform, with regard to algorithm preparation, etc., and added that at this meeting he hopes that the Science Data Support Team (SDST) will clarify exactly what deliveries it needs, and when. Turning to the Protoflight Model (PFM) instrument, Salomonson reported that it is on the spacecraft and is scheduled to enter thermal vacuum testing in December. Finally, he announced that some of the newly-selected validation scientists are in attendance today, and welcomed them to the meeting.

MODIS Characterization Support Team (MCST) Presentations

MCST made two presentations to the MST: "Characterization of MODIS in the VIS/NIR and SWIR" (on October 22) and "Characterization of MODIS in the MWIR and LWIR" (on October 24). Bruce Guenther outlined MCST's two primary objectives: first, to provide MST members all they need to know to understand the instrument and accomplish their goals for Level 2 products and above; and second, to acquire feedback from MST members on issues such as the handling of SWIR features in algorithms, as well as what approach to take with the linear or nonlinear algorithm decision.

MCST Summary

Before summarizing the MCST presentations Guenther announced that, during the first instrument comprehensive performance test, telemetry flowed successfully from Valley Forge to the MCST computer facility at GSFC. He reminded MST members that the MCST look-up tables (LUT) use the Santa Barbara Remote Sensing (SBRS) detector-numbering convention, which is inverted from the pixel convention used in the MODIS Level 1 products. Guenther outlined Level 1B file format changes, noting that at this meeting he had hoped to get an MST recommendation as to how to handle the SWIR 500-meter bands "second-sample" problem.

Guenther reviewed the major PFM issues still to be resolved. The stray light issue (On-board Calibrator-Blackbody [OBC-B], for high scan angles, +50 degrees and higher) will be investigated further pending results from an improved FM-1 test. With regard to SWIR radiometric behavior, Guenther cited two issues: the spectral leak, which is now being studied, and the second-sample problem, which might possibly be solved with an algorithm fix on-orbit. MCST is still waiting for access to the Spherical Integrator Source

(SIS), so as to make round-robin measurements; this must be done before March 1998. Salomonson concluded that overall we have a robust instrument; we know what it can and cannot do, and we should expect good results.

Data Production and Readiness Plans

Masuoka reviewed the Version 1 Product Generation Executives (PGE) that have been integrated at the GSFC DAAC (GDAAC), EROS Data Center (EDC) and National Snow and Ice Data Center (NSIDC). He discussed the lessons learned during Version 1, including resolution of environmental issues (i.e., compatibility of things like compilers, toolkits, and standards checkers between the Team Leader Computer Facility [TLCF] and the DAAC).

Steve Wharton presented an overview of the GDAAC Version 2 Science Software Integration & Test (SSI&T) schedule. He reported that Version 1 SSI&T will run through mid-November, after which Version 2 SSI&T will formally begin. He indicated that workarounds are being explored so that more PGEs can be ready in time for launch. He added that the Version 2 SSI&T schedule is much more aggressive than the Version 1 schedule; lessons learned in Version 1, improved coordination between SDST and GDAAC, and the availability of necessary hardware should expedite the Version 2 SSI&T process. Wharton stated that the GDAAC hopes to have 16 PGEs ready for certification testing by April 15, and another 11 PGEs are expected to be ready at launch. Murphy noted that timely code delivery is essential to the GDAAC's maintaining its schedule.

Jeff Eidenshink discussed the EDC Version 1 and 2 SSI&T schedule. He reported that a total of 6 Version 1 PGEs have been delivered so far, and the average infusion time per PGE is 3 weeks. He anticipates that 9 of 31 Version 2 PGEs (all MODIS) should be delivered pre-launch.

Spencer Shiotani reported that NSIDC has completed SSI&T for PGEs 43 (Daily Snow Cover) and 45 (8-day Gridded Snow Cover). Both PGEs have metadata problems that will be deferred to Version 2. Infusion testing is underway for PGE 44 (Daily Sea Ice). PGE 47 (8-day Gridded Sea Ice) has not yet been received.

Masuoka reviewed the Version 2 SSI&T timeline and pointed out that the launch-critical release must be at the DAAC by January 15. The at-launch system must be certified by May 30. Certification testing will encompass 3 days of continuous processing and, among other things, focus on time transitions, terminator crossing, crossing the poles, and handling errors. Turning to the Version 2 schedule, Masuoka reported that many developers have not delivered their code when promised. Late code deliveries ripple through the whole system and can jeopardize other products in a chain.

Network Status

Masuoka summarized network status for Sol Broder. Masuoka announced that the ESDIS network budget will be scrubbed to save money. Broder asks that MST members consider how the downsizing of product volumes will impact the size of Quality Assurance (Q/A) volumes requested.

MODIS Emergency Backup System (MEBS)

Bill Engelmeyer reported that the MEBS has either completed, or is on target to complete, all of its prototyping milestones. MEBS is intended to be ready at launch for some limited processing. MEBS science products can be ordered via the Web at http://ltpwww.gsfc.nasa.gov/MODIS/SDST/mebs.

At-launch Volumes and Loads

Masuoka reviewed the 25, 50, 75, 100% processing ramp-up recommended by the EOS Review Group (ERG) to reduce costs without serious impact to EOS science. He noted that there are more resources at the DAACs than are necessary to satisfy the phased processing requirement at launch. Masuoka called attention to the proposed allocation of resources at the GDAAC. Of the 3,120 total MFLOPS available, 1,507 are available for higher-level products (i.e., higher than Level 1). Based on the June 1997 baseline, higher-level processing at the GDAAC could possibly be divided as follows: MODLAND, 609 MFLOPS; MOCEAN, 701 MFLOPS; and Atmosphere (without Cloud Mask), 197 MFLOPS. Masuoka asked that each of the discipline groups consider whether this strawman allocation of resources at the GDAAC will work and, if not, how should resources be allocated? Al Fleig asked that the discipline groups also consider how they will assist SDST in debugging immediately after launch, as well as how best to make and distribute early images (i.e., "first light products"). Once all of the groups have

answered these questions, it will be necessary to ensure that their respective plans mesh so that MODIS presents a unified position to EOS.

Discipline Group Responses to SDST Questionnaire

MODLAND

At-launch Resource Allocation: Chris Justice indicated that MODLAND would like to test algorithms with a global month of Level 1B data; once the algorithms are tested and verified, then MODLAND would like to make products on a regional basis in order to satisfy the 25% constraint. MODLAND would like to run all of its products operationally at full resolution at a Year+1 and have sufficient resources to support reprocessing of these data.

At-launch Code Problem Resolution Approach: Justice suggested that MODLAND needs to work more as a team with SDST and the GDAAC. Overall, there needs to be a more hands-on approach where the discipline group members can assist in implementing adjustments to code.

Early Products: MODLAND proposes to use the MEBS strings being developed and, through the Land Data Operational Product Evaluation (LDOPE) Facility, run the early products there. Justice proposed that MODIS package up data sets for the community at large, and EDC could distribute these packages via CD or WWW.

MOCEAN

At-launch Resource Allocation: Wayne Esaias reported that MOCEAN plans to make all of its Level 2 products at 1-km resolution, based on hardware available at the GDAAC and MODIS processor allocations; if necessary to meet a 25% constraint, only every other pixel will be used. As more processing comes online, MOCEAN would like to go back and start reprocessing 1 year after launch. Esaias added that a T-1 link exists between Miami and GSFC, although it will have to be utilized to full capacity. The T-3 link planned in the ESDIS baseline must be installed if the Miami Ocean Science Computing Facility (SCF) is to play an active role in the Q/A of ocean data and refining MOCEAN algorithms post-launch.

At-launch Code Problem Resolution Approach: MOCEAN will perform debugging remotely from Miami.

Early Products: MOCEAN believes that it can make products in a matter of days, provided that good Level 1B data are available. Esaias indicated that having Cloud Mask would be helpful, but it is not absolutely necessary. Fluorescence, chlorophyll, and productivity for the visible bands are all important products to disseminate quickly.

Atmosphere

At-launch Resource Allocation: Gumley reported that Atmosphere would meet the 25% constraint by processing data from roughly 8 days a month. UW is concerned that the T-1 line currently in place may not be adequate to get all the necessary Level 1B data, but if the University of Wisconsin (UW) becomes part of the Very-High-Performance Backbone Network Service (VBNS), then the requisite bandwidth will be available. Fleig asked if MOCEAN had any problems with the 8-day Atmosphere plan, and Esaias said that it did not. (Cloud Mask will be produced everywhere all the time anyway.)

At-launch Code Problem Resolution Approach: Atmosphere already has a good working relationship with Rich Hucek and SDST, and there is no need for major changes between now and launch. Much of the Atmosphere group is already on-site at GSFC, and debugging can be done remotely from UW as well.

Early Products: Atmosphere would prefer to produce "first light" images independently.

SDST Summary

Masuoka outlined MODIS PGE delivery priorities, explaining that Priority 1 PGEs include Level 1 products (3), PGEs for EOS Ground System (EGS) certification (15), and at-launch PGEs (19). Priority 2 PGEs are post-launch PGEs, of which there are 27. More PGEs may be added to the post-launch list, depending on deliveries from the MST, the speed with which the SDST and DAAC personnel can get PGEs integrated and tested at the DAACs, and the impact of external requirements changes on our software delivery. Masuoka stressed that, for at-launch PGEs, the software must meet standards and be robust. The schedule for integration is tight, and few Version 2.1 PGEs can be accepted without dropping at-launch PGEs. PGEs that are delivered late may end up post-launch, or cause other PGEs to be moved to post-launch. Masuoka requested that the discipline groups assist

SDST as much as possible with the SSI&T process after delivery, whether this means having somebody on-site or on-call to help fix identified problems. In order to better monitor PGE status, Michael King requested that Masuoka make his PGE tracking spreadsheets available via the Web, and Masuoka agreed to do this.

MODIS Visualization Tool

Dave Santek demonstrated the MODIS Visualization Internet Environment - Wisconsin (MODVIEW) tool. MODVIEW will be Web-based, and enable the user to browse large databases, display MODIS data, and overlay maps, latitude/longitude lines, and ancillary data. More information is available via the Web at http://www.ssec.wisc.edu.

MODIS Cloud Mask Status

Steve Ackerman stated that he intends to address Cloud Mask validation, and focus on visualization of results, "ground truth" (Lidar [Cloud Lidar System (CLS)] and weather observations), users, and intercomparisons with other instruments. Gumley demonstrated the prototype visualization tool, called Sharp, developed at UW using MODIS Airborne Simulator (MAS) data. The software is very user-friendly, and runs on any platform that runs IDL. Among other things, the tool allows the user to add the cloud mask overlay, do some simple band math, and create Graphic Image Format (GIF) files on screen. The software is available on the Web at http://cimss.ssec.wisc.edu/~gumley/sharp/sharp.html. Ackerman presented a series of graphs showing that MAS Cloud Mask results agree with Lidar data. MAS Cloud Mask also compares favorably with AVHRR data. Ackerman reported that MODIS and MISR personnel are now investigating how best to compare data at launch.

ESDIS Status

John Dalton summarized ESDIS Status and discussed the August ECS demo as it pertains to MODIS. He reported that ESDIS is planning for an incremental approach to ECS releases, in order to provide earlier access to high-priority functions and better serve evolving community needs. Dalton noted that the Release B.0', B.0, B.1 series of releases has been replaced by Version 2.0, 2.1, etc.; he reviewed the timeline showing when ESDIS expects to have each version ready. (Version 2.0 is due in June 1998, and Version 2.1 is due in November 1998). Turning to the August demo, Dalton indicated that, overall, it was a success. The original criteria consisted of 46 functions; of these, 3 involved production rules that were not exercised by the available PGEs. MODIS PGEs 1, 2, and 8 were used to demonstrate chaining. Dalton acknowledged that there is much work to be done to tune the ECS system to meet at-launch performance requirements. Performance bottlenecks and tuning steps have been identified, and a plan is in place to support the AM-1 and Landsat-7 data flows. In reviewing the phased development of ECS capabilities to meet at-launch needs, Dalton reported that some automated operations such as system fail-over may be introduced after launch and, therefore, increase the need for manual operations procedures early in the mission. Asked to define certification, Dalton responded that certification means that the DAACs have the operating elements of the system, as well as some PGEs they can use to test and verify that the system does what it is supposed to do. Certification does not mean that all of the at-launch science software is in the system and is fully tested; rather, it is a pre-launch demonstration that the DAAC operators and science software developers can use the system to perform essential functions. Dalton addressed the land tiling issue, stating that the basic capability to gather granules within a tile will be in pre-launch, operationally-tested Drop 3. However, the capability to cluster tiles to make best use of resources will not be integrated until near launch, in Drop 4.

Global Imager (GLI) Status

Hiroshi Murakami presented a status report on NASDA's GLI Science Mission. He explained that GLI is a general purpose, medium-spatial-resolution visible/infrared imager that will make atmosphere, land, and ocean-color observations. GLI is scheduled to be launched in 1999.

AM-1 Status

Ken Anderson reported that the PFM instrument will go into thermal vacuum testing in early- to-mid-December, and it will remain there approximately five weeks. Following thermal vacuum testing, the instrument will be shipped to the West Coast in plenty of time for launch. Anderson announced that there are presently no major concerns that would prevent launch as scheduled in June 1998.

PM-1 Status

Marty Donohoe presented an overview of PM-1 status. Overall the project is in good shape as regards technical and schedule issues, although cost reserves have been reduced. The PM-1 Project will be discussing Integration and Test (I&T) and flight operations with TRW in November. Donohoe indicated that MODIS FM-1 instrument issues now being addressed include the SWIR light leak, test flow modifications, and scan mirror replacement. He thanked Anderson for ensuring that MODIS instrument issues are addressed quickly by SBRS. Donohoe noted that MODLAND had been concerned about FM-1 stability and pointing; he believes that this issue has been resolved and summarized in a memo, but he will double-check this. Claire Parkinson presented an update on the algorithms for the two instruments (AMSR and AIRS) aboard PM-1, but not AM-1. MST members may want to think in terms of collaborative efforts with these two instrument teams.

MOCEAN Splinter Session Summary

Esaias reported that the new validation affiliates are meshing nicely, and he anticipates that they will make major contributions. The Marine Optical Buoy (MOBY) array is deployed and operational, and being used to good effect for SeaWiFS. A SeaWiFS initialization cruise is scheduled for January 10 through February 8. Funds for the MODIS initialization cruise must be obligated within months in order to assure ship availability. Information on MOBY/Marine Optical Characterization Experiment (MOCE) activities and data is available online at: http://moby.mlml.calstate.edu. With regard to the instrument, Esaias indicated that he is investigating the potential benefits of replacing the scan mirror; so far it appears that replacement will provide substantially more useful data near clouds. MOCEAN was pleased to learn that the deep space maneuver has been baselined. With regard to products, Esaias reported that Version 2.0 code will be delivered on schedule; he anticipates that delivery of Version 2.1 code will be on schedule as well, although this schedule remains TBD. Turning to resource allocation, he reiterated that MOCEAN plans to make all of its Level 2 products at 1-km resolution, based on hardware available at the GDAAC and MODIS processor allocations; if necessary to meet a 25% constraint, only every other pixel will be used. As more processing comes online, MOCEAN would like to go back and start reprocessing 1 year after launch.

Atmosphere Splinter Session Summary

King voiced Atmosphere's concern that crosstalk between SWIR bands needs to be better characterized. Guenther has agreed to provide additional analysis, and Atmosphere algorithm developers will assess impacts. Also, the crosstalk in Bands 33 - 36, discussed earlier by Moeller, will have a significant impact on Atmosphere algorithms. King indicated that Atmosphere is very concerned about the subsampling problem, whereby Bands 5 and 7 are well characterized for different pixels than Band 6. He reviewed the dates when Atmosphere code is expected to be delivered to SDST. He noted that execution of Level 3 code requires Version 7.2 of the Fortran compiler, which the GDAAC does not now support. Masuoka has been apprised of this issue, and it is being worked. Finally King reported that a Kalahari desert validation campaign is planned for August/September 1999. This will be a collaborative effort with MODLAND and others.

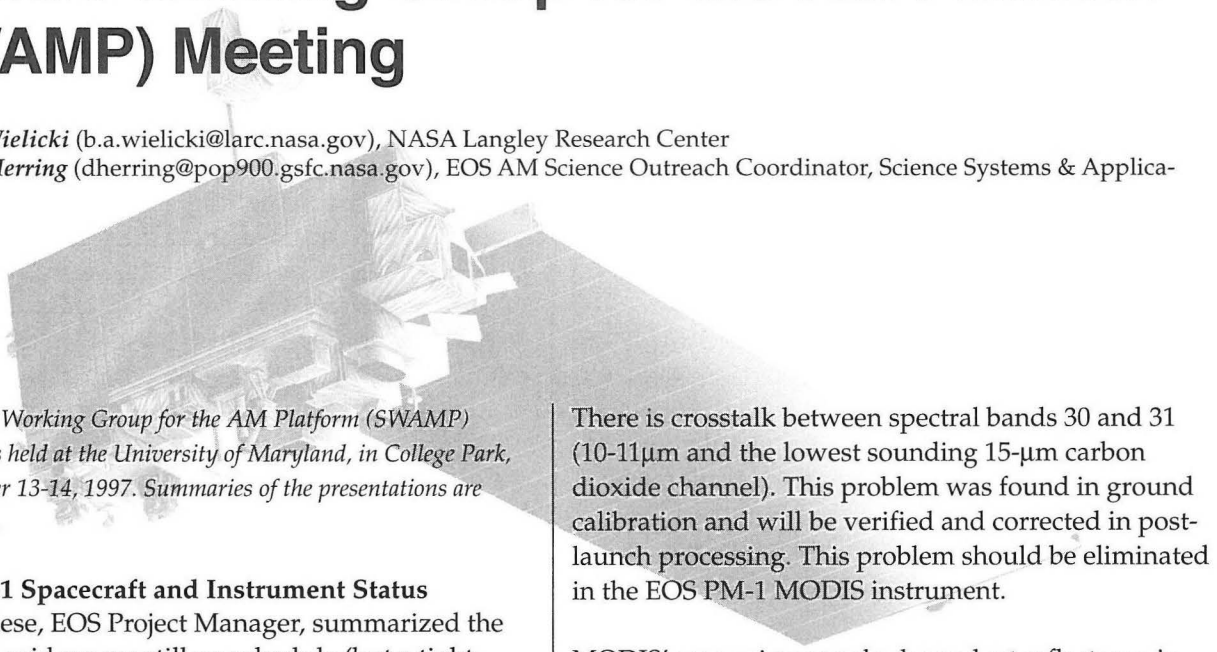
MODLAND Splinter Session Summary

Alan Strahler reported that MODLAND is concerned about the light leaks affecting Bands 6 and 7, but there are no show-stoppers as regards the instrument. MODLAND would like to see faster SDST turnaround on code adjustments; after delivery to SDST, MODLAND developers will chaperone their products through the system. With regard to production reduction, Strahler expressed concern that EOS science is in jeopardy if peer-reviewed products are cut. MODLAND feels that the proposed ramp-up of EOSDIS capacity is too slow. There is the need for full operational capacity to generate the suite of MODLAND global products in near real-time at Launch+1 year, and to start reprocessing those products which have undergone significant refinement, completing the reprocessing by Launch+2 years. Strahler reviewed MODLAND's strategy to meet the proposed ramp-up. As regards early MODIS products, MODLAND recommends land data packages, which would be multi-instrument packages designed to meet general user needs in the first 9 months. (These packages would be coordinated through the Science Working Group for the AM Platform [SWAMP].) Strahler indicated that MODLAND is concerned about network capacity, and would like reassurance that plans will be implemented and DAAC-SCF links will be tested prior to launch (6 months lead time). Finally,

(Continued on page 38)

Science Working Group for the AM Platform (SWAMP) Meeting

— ***Bruce Wielicki*** (b.a.wielicki@larc.nasa.gov), NASA Langley Research Center
—***David Herring*** (dherring@pop900.gsfc.nasa.gov), EOS AM Science Outreach Coordinator, Science Systems & Applications, Inc.



The Science Working Group for the AM Platform (SWAMP) meeting was held at the University of Maryland, in College Park, on November 13-14, 1997. Summaries of the presentations are given below.

EOS AM-1 Spacecraft and Instrument Status
Chris Scolese, EOS Project Manager, summarized the status. He said we are still on schedule (but a tight schedule) for launch on June 30, 1998. The spacecraft is in good shape except for one anomaly with the solid-state recorder. Timing interrupts are conflicting when the memory is asked to simultaneously record and playback at the maximum data rate. This mode would only be used in contingency mode, and Lockheed-Martin is working to fix the problem. MOPITT has to fix some EPROM software to correct a data interface problem. Otherwise, the instruments and spacecraft are looking very good. The thermal vacuum test will start in late December.

Instrument Status Reports
Vince Salomonson, MODIS Team Leader, reported that MODIS was delivered to Valley Forge and is now on the spacecraft. He stated that Bands 5, 6, 7, and 26 have a spectral light leak from 5-μm thermal radiation. This light leak appears to be similar to the leak seen on the TRMM VIRS instrument and can be 1-5 percent of the signal. The leak has been spectrally characterized and will be handled during post-launch processing. This problem will also exist in the EOS PM-1 MODIS instrument.

Salomonson noted that sub 1-km spectral bands differ in response for even and odd samples across the focal plane. This problem too will be handled in post-processing.

There is crosstalk between spectral bands 30 and 31 (10-11μm and the lowest sounding 15-μm carbon dioxide channel). This problem was found in ground calibration and will be verified and corrected in post-launch processing. This problem should be eliminated in the EOS PM-1 MODIS instrument.

MODIS' scan mirror angle-dependent reflectance in the thermal infrared will be determined in orbit using the data from the Calibration Attitude Maneuver (CAM).

Dave Diner, MISR Team Leader, reported that the MISR instrument was delivered to Lockheed-Martin in Valley Forge on May 26, 1997. Subsequent to delivery, a new start-up ROM was installed in the flight computer. Additionally, the MISR firmware was reprogrammed due to an incompatibility between the spacecraft and MISR utilization of the 1553 communications bus. MISR is installed on the spacecraft and the instrument has been successfully operated—good high rate science data have been collected. Currently, an issue regarding occasional failure of the instrument to start properly is being investigated. The working hypothesis is that the flight computer is sensitive to excessive traffic on the 1553 bus during the start-up period, and testing is underway to gain deeper insight. Generally, a retry of the start-up is successful and, once started, the instrument operates properly.

The AirMISR instrument is now flight qualified for flights on the NASA ER-2 aircraft. Flights in August and November 1997 collected high-quality, multi-angle, multi-spectral imagery over Moffett Field, California. Following the August flight, an issue arose regarding interference between the airflow behind the

instrument (which is mounted in the ER-2 nose) and the aircraft pitot tubes (used for airspeed indication). This has subsequently been corrected by the addition of standoffs to the pitot tubes. Currently, flight operations are suspended while the NASA aircraft are moved from Ames to Dryden.

MOPITT and MISR indicated substantial performance problems with their instrument support toolkit (IST) software (developed by ECS) (MISR) and supplied data network links (MOPITT). Fixes are in progress and a working group will be formed to foster improvements in this area. ECS software development has not been as responsive as desired by several of the instrument teams.

JGR Special Issue

Any papers for the *Journal of Geophysical Research* special issue should be submitted by November 30, 1997. The papers should be submitted to JGR Atmospheres with a cover letter indicating preference to publish in the EOS AM-1 special issue. Note that if you do not get revised paper versions in to JGR by July 1, 1998, your paper(s) will not be included in the EOS AM-1 special issue scheduled for Sept. 30, 1998. If late, your paper will be put in a later JGR issue. EOS is planning to pay JGR to print extra copies of the special issue with an EOS AM-1 cover.

EOS Funding

While all of the EOS instrument teams had been forced to use only one-month forward funding into FY98, by the middle of November, little or no FY98 money had been sent to the teams and both MISR and CERES were out of money and borrowing from other programs or delaying essential activities due to a lack of funds. A letter from the SWAMP to this effect was sent to the EOS Project Office to indicate the need to increase transitional funding next year to at least cover the experienced delays we have seen in FY98. Most teams are expecting to get funding by the end of November, roughly two months after the start of the fiscal year. As of November 20, the CERES instrument investigation had still not received any funds.

EOS Validation Plan Concerns

David Starr, EOS validation scientist, reviewed the concepts and responsibilities for validating EOS data products, as well as the results of the recent EOS Validation NRA selections. Detailed information is available from the Validation Homepage. He noted that the Instrument Science Teams (ITs) are primarily responsible for validating their data products. He challenged the ITs to work toward quantitative and systematic definition of the geographical, seasonal, and phenomenological dependencies of the data product uncertainties. Starr noted the importance of forging the necessary connections between the IT activities and those of the new investigations. Toward this end, Tom Charlock (CERES) and Dave Woods (SAGE III) organized the recent Workshop for Atmospheric Validation in EOS AM-1 and SAGE III (WAVES). In addition to CERES and SAGE III, the MISR, MODIS, ASTER, and MOPITT teams participated, as did more than twenty of the new investigators. A smaller meeting concerning ocean-related investigations was held at the recent MODIS meeting, and a Land Validation meeting is planned for December 3-5, 1997, in the GSFC area under the leadership of Chris Justice. Establishing the needed collaborations and data access will be critical for rapid validation results. There will be great pressure for solid results by 18 months after launch.

Starr finished by noting some concerns. He stated that while a tremendous amount of progress has been made by the ISTs over the last two years, the presently-available validation plans were not all up to date. Moreover, the plans could still be markedly improved. Experience indicates that a strong implementation plan leads to a more highly focused effort and more rapid scientific progress. The science and strategy must be tightly interwoven. In particular, improvements could be made in documentation of accuracy goals and error budgets, both for the data products as well as for correlative measurements, and in the definition of the approach or path to validating specific data products. Starr recommended that the teams make serious efforts to develop and implement strategies for managing the validation data and communicating the status and results of their validation work. Functionality and currency are key elements in this respect. Starr also recommended that the teams develop formal plans for comparison of related data products in order that this fundamental activity occur at the earliest opportunity. Lastly, concern was expressed about resources, especially scientists' time, to get the job done. Aircraft resources will also be extremely tight.

EOS AM Outreach Efforts
David Herring, AM Outreach Coordinator, reported that the AM Project Science Office is forming an Executive Committee for Science Outreach (ECSO). Letters of invitation have been sent to the nine desired ECSO members.

The EOS AM-1 brochure is complete and, pending final review, waiting to be printed. You can see a draft of it at http://modarch.gsfc.nasa.gov/EOS-AM.

Digital Elevation Model (DEM)
A SWAMP working group on DEM summarized current status and plans. EDC and MISR have completed 1 km resolution DEM models for the globe. RMS elevation difference between the two maps is 80 m (1 sigma). Validation against the ERS-1 radar altimeter with 2.5-km spatial resolution verifies an accuracy of 40-80 m.

The SWAMP working group recommended that EOS use a merged 1-km DEM which uses the EDC map but replace Greenland with the MISR DEM and replace Australia with the AUSLIG DEM. EDC will merge this optimal data set before launch. The EOS DEM will include land/water mask, water types (e.g., deep ocean, coastal shelf ocean, shallow ocean, large lake, etc), terrain type, and shadow. Format is HDF, data volume is roughly 2- GBytes.

A 100 meter DEM will be available for use only at the GSFC, JPL, and EDC DAACs. This is based on a classified DoD DEM. It will be improved using Shuttle radar data in 2001. Total data volume will be 300-Gbytes.

Questions regarding the DEM/SWG should be referred to Thomas Logan via e-mail, at tom.logan@jpl.nasa.gov.

Ground Control Points Update
Bryan Bailey, Land Processes DAAC Project Scientist, presented the final report from the SWAMP Ground Control Point (GCP) Working Group. The GCPWG was formed by Piers Sellers in 1996 to facilitate cooperation and minimize duplication of effort in addressing GCP-related issues facing the "land" instruments on AM-1 (ASTER, MISR, and MODIS) and Landsat-7. GCPWG objectives included documenting IT requirements for ground control information, defining the characteristics of suitable GCPs for each instrument, identifying existing sources of ground control information, and converging on an approach to meet GCP requirements as efficiently as possible.

Instrument Team requirements for GCPs relate to various geometric calibrations of the instruments and geometric correction of subsets of data or products. For the most part, these can be met by: 1) a series of GCPs positioned along the orbital track of the sensors; and 2) by either a dense concentration of GCPs over a relatively small area or a broader distribution of GCPs over a substantially larger area. In the case of MODIS and MISR, larger spatial features such as lakes or shorelines are needed as GCPs, whereas the higher spatial resolution sensors, ASTER and ETM+, require features such as road intersections or bridges.

The working group developed a consolidated strategy for GCP development that pairs MODIS with MISR and ASTER with ETM+ and involves GCPs along orbital tracks over Eastern Europe/Africa and South America and more randomly distributed GCPs in the U.S. and Australia. In all cases, precision-processed Landsat thematic mapper (TM) data will serve as the chip image base for GCPs required by MODIS and MISR, and U.S. Geological Survey (USGS) digital orthophoto quadrangles (DOQs) or National Imagery and Mapping Agency (NIMA) control image base (CIB) will serve as the chip image base for most GCPs required by ASTER and ETM+. Locational information required to locate the GCPs will come from USGS and NIMA control point databases or map and other sources. Some of the image data and locational data have already been acquired, but much remains to be obtained or produced.

The Working Group concluded that it is completely feasible to meet the vast majority of AM-1 and Landsat 7 GCP requirements prior to launch, and they recommended an approach for achieving that goal. Two primary tasks are required to meet the GCP requirements of MODIS and MISR: 1) purchase or produce remaining required precision-processed TM reference images, and 2) subset those images into the appropriate size, number, and format of GCP image chips. The Working Group recommends that the remaining U.S. TM scenes be purchased by the MODIS and MISR Teams, and that MODIS and MISR each take on the

responsibility for extracting their required GCP image chips from those scenes.

The Working Group recommends that the USGS EROS Data Center be given the responsibility for producing precision-processed TM reference images over the foreign locations identified by MODIS and MISR and that the work be funded by SWAMP. Completed scenes would immediately be sent to MODIS and MISR for extraction of the required GCP images chips. Three primary tasks are required to meet the GCP requirements identified by ASTER and ETM+: 1) purchase remaining required DOQs; 2) "tag" GCP ground features in DOQ and CIB images with locational information, as needed; and 3) subset those images into the appropriate size, number, and format of GCP image chips. The Working Group recommends that the remaining required DOQs be purchased with funds provided by SWAMP. The responsibility for tagging the DOQs with appropriate locational information and for extracting the final image chips should be borne by the ASTER and Landsat-7 Instrument Teams. Nearly all required existing CIB data for production of foreign GCPs already have been provided by NIMA. The USGS EDC will secure those few CIBs that have not yet been received. All CIBs and related NIMA CPDB information will be sent to the ASTER and Landsat 7 Teams for ground feature tagging and/or extraction of final image chips. Finally, the GCPWG recommends that GCPs developed by this activity should be sent to the Land Processes DAAC for archive and general distribution.

The total "out-of-pocket" expenses required to complete production of the required GCPs is estimated at approximately $85,000. SWAMP has accepted the responsibility to identify the required funds, and the effort to complete GCP development prior to launch(es) is underway.

Instrument Data System Backup Plans and Science Software

CERES will select seasonal months and validation sites. MISR will sub-sample pixels for global and select U.S. for full resolution. ASTER will back off to ten level 1B scenes per day, and four level 2 scenes. ASTER will include, at launch, surface temperature, and emissivity.

Edward Masuoka, SDST leader, presented the status of MODIS science software deliveries, and development and testing of the MODIS Emergency Backup System (MEBS). The MEBS completed an "Hour in the Life" test in September with MODIS Version 1 software. In this test, two hours of synthetic Level 0 data was processed by MODIS Level 1 and Level 2 PGEs, producing more than 50 Gbytes of science products. Data were written to the Ampex tape library from the data server at 15 Mbytes/sec and moved between the data server and the science processing systems at 50 Mbytes/sec. There was also an overhead of 25 seconds per tape mount and additional time required to position the tape to the desired file, which reduced the end-to-end performance of writing a file to the archive to 9 Mbytes/sec, and retrieving a file to 7 Mbytes/sec. If the system does need to serve as a backup for EOSDIS, the goal is to produce all MODIS products. Level 1 products will be produced globally and Level 2 and higher products will be produced at limited resolution (ocean products), limited times (1 week a month, atmosphere products), or for limited regions of the world (land products).

MODIS delivered 34 PGEs in Version 1 from June through September. The PGEs were tested with both the SCF and DAAC versions of the SDP Toolkit. These PGEs ran successfully in the ECS system and production threads were run at the DAACs. In Version 2, MODIS plans to deliver 18 PGEs for the EOS Ground System certification tests and 43 at-launch PGEs. The at-launch PGEs will generate all MODIS products but not in all formats nor for all time periods. In particular, most Climate Modeling Grid (CMG) products and most products which are monthly, quarterly, or yearly will not be delivered until post-launch.

Moshe Pniel gave a presentation on the status of ASTER's emergency backup system, being developed jointly by JPL and EDC. The EDC component of the system will receive the Level 1A and 1B tapes from Japan; it will ingest and catalog them and provide JPL with the catalog information. The JPL component of the system will coordinate and prioritize the requests from EDC for the Level 1 data (up to ten Level 1 scenes per week can be requested from EDC), generate up to four Level 2 scenes per week, and provide them to the ASTER Science Team for calibration and validation activities. The status of the system is as follows: the task leads are in place both at JPL and EDC, the requirements have been reviewed and agreed upon by

both sides, the hardware has been procured and is in place, the Level 1 metadata catalog has been agreed upon, and the design review is scheduled for December 1997 at EDC. The system will become operational on June 1, 1998.

Pniel also discussed the status of the science software. The Version 2 software is on track for the February 1998 integration at the EDC DAAC. The algorithm developers delivered their updates to the Version 2 algorithms. The software development team has made all but one of the Version 2 science software deliveries to the algorithm developers for their testing and verification. Japan has delivered updates to the Level 1 interface. An updated (delta) software delivery (version 2.1) is planned for July 1998.

Graham Bothwell, MISR team member, reported that MISR's Version 1 science software delivery to the LaRC DAAC included PGE 1 (Level 1 science data products) and PGE 9 (Level 2 Aerosol/Surface products.) These are two of the larger MISR PGEs. During November and December, early Version 2 system integration and testing is occurring at the Hughes Landover facility for PGE 2 (engineering data), PGE 5 (on-board calibrator data), and PGE 7 (geometric parameters). This is using an early form of the Version 2 ECS for purposes of assisting in ECS development. Formal Version 2 deliveries of MISR PGEs will occur at the LARC DAAC in March-April 1998.

MISR's emergency capability will be a limited one, primarily to support the science team's certification and validation of products, and to support early mission science. System throughput will include approximately one partial orbit per day of Level 2 products, which will allow repeat coverage in a 16-day cycle of a significant representative area such as the continental U.S., or Western Europe and North Africa.

Release of Early EOS Data

The official policy on public release of the EOS data was a nominal instrument checkout period of 90 days, with up to 6 months or more if justified to the Project in writing. This is for at-launch production products. CERES is planning to produce routine ERBE-like top-of-the-atmosphere fluxes within 6 months after launch.

Concern was expressed, however, in the potential misuse of early data by scientists unfamiliar with the preliminary nature of the data and the details of validation of each individual product and parameter. It was generally recognized that many researchers do not look for "flags." It was felt that Principal Investigators should avoid hoarding the data, yet be careful not to release "preliminary garbage" results.

Suggestions for helping users understand data product maturity (or lack thereof) included:

- be sure to use quality flags whenever possible;
- the EOSDIS Web interface should have pop-up warnings for data which has not yet been validated;
- users should sign a form indicating they are aware of the preliminary nature of the data;
- define several data quality levels—something like "Experimental," "Partially Validated," and "Fully Validated." A summary of the validation status could be included in the header of the HDF data product; and
- a Validation Chart should be easily reachable showing the validation status of each EOS Data Product and links to further detail on the validation of individual parameters for each data product.

As it stands right now, only the data quality flags in the data products are useful for assessing data quality level.

EOSDIS Review Group (ERG)

The ERG met in April and October of 1997. They defined success criteria (46) for the August EOSDIS demo. They also reviewed the demo and called it a qualified success (the main issue was performance). At the October meeting, they recommended killing the Alternative Data System plans, but continuing the emergency plans. ECS should deliver software to the DAACs as soon as possible to begin interaction, and should not wait until they think everything is ready. There is a $40-$65 million run out budget problem for ECS. The ERG wanted it to be known that they did NOT recommend the 25 percent/50 percent/75 percent data volume cut—only that this cut be evaluated as a

cost-saving measure. They also did not recommend elimination of all inter-DAAC network transfers for Level 2 data products, but again that its impact should be studied. Both of these actions have been taken, however, and now we must live with them.

(Note: CERES will work with the GSFC DAAC to get the MODIS Level 1b data transferred to the LaRC DAAC by DLT tape [roughly 3-4 tapes per day]. There may also be capacity on an existing T3 line that can be utilized.)

The ERG is concerned about how much of ECS will exist at launch, but clearly some of its capability will be available. The ERG is working on finishing their report from the October meeting and should have it finalized in the next few weeks.

On-Orbit Calibration Attitude Maneuvers
Lisa Shears, of the EOS AM Project, reported that LMMS submitted a final report in June 1997 on the evaluation of feasible technical approaches for implementing the following calibration maneuvers: MODIS Lunar View via Space View Port, Deep Space View Maneuver, and MODIS Solar Diffuser Scattered Light Mapping Maneuver. In October 1997, the EOS Project Office gave authorization to proceed with the LMMS proposal. Implementation of the proposal is scheduled to begin in January 1998, and will be completed prior to launch.

Earth Science Information Partners

Selected Type 2 ESIPs and their titles are:

- "The Distributed Oceanographic Data System: A Framework for Access to Scientific Data in the EOS Federation," led by Peter Cornillon, University of Rhode Island, Narragansett, RI.

- "The Earth System Science Workbench: A Scaleable Infrastructure for ESIPs," led by James Frew, University of California, Santa Barbara, CA.

- "Seasonal to Interannual Earth Science Information Partner (SIESIP)," led by Menas Kafatos, George Mason University, Fairfax, VA.

- "Progressive Mining of Remotely Sensed Data for Environmental and Public Health Applications," led by Chung-Sheng Li, International Business Machines, Yorktown Heights, NY.

- "A Web-Based System for Terrestrial Environmental Research," led by Berrien Moore, University of New Hampshire, Durham, NH.

- "ESP2Net: Earth Science Partners' Private Network," led by Richard Muntz, University of California, Los Angeles, CA.

- "Evolution of Snow Pack in the Southwestern United States: Spatial and Temporal Variability from a Remotely Sensed and In Situ Data Set," led by James J. Simpson, Scripps Institute of Oceanography, University of California, San Diego, CA.

- "Tropical Rainforest Information Center," led by David L. Skole, Michigan State University, East Lansing, MI.

- "An On-Demand Data Processing and Delivery System for Climate Studies Using Passive Microwave Data Sets," led by Roy W. Spencer, Marshall Space Flight Center, Huntsville, AL.

- "A Landcover Earth Science Information Partnership," led by John R. G. Townshend, University of Maryland, College Park, MD.

- "GPS Environmental & Earth Science Information System: GENESIS," led by Thomas P. Yunck, Jet Propulsion Laboratory, Pasadena, CA.

- "Improved Ocean Radar Altimeter and Scatterometer Data and Atmosphere-Ocean Model Simulation for Coastal and Global Change Studies," led by Victor Zlotnicki, Jet Propulsion Laboratory, Pasadena, CA.

Selected Type 3 ESIPs and their titles are:

- "Institutionalizing MTPE Data for Land and Environmental Management," led by Thomas Burk, University of Minnesota, St. Paul, MN.

- "California Land Science Information Partnership," led by Gary Darling, California Resources Agency, Sacramento, CA.

- "Performing a Regional Assessment and Prototyping Internet Accessible MTPE Products for the Upper Rio Grande Basin," led by Stanley Morain, University of New Mexico, Albuquerque, NM.

- "Integrating Environmental and Legal Information Systems," led by Konstantinos Kalpakis, University Space Research Association (USRA), Greenbelt, MD.

- "A Public Access Resource Center (PARC) Empowering the General Public to Use EOSDIS Phase III Operations," led by George Seielstad, Upper Midwest Aerospace Consortium (UMAC), University of North Dakota, Grand Forks, ND.

- "WeatheRoute," led by Kevin Meagher, Reading Information Technology, Inc., Reading, PA.

- "MTPE Education Series," led by Catherine Gautier, Planet Earth Science, Inc., Santa Barbara, CA.

- "Integration and Application of MTPE Data and Information to the San Francisco Bay Area and Monterey Bay Region," led by David Etter, Bay Area Shared Information Consortium (BASIC), Mountain View, CA.

- "Museums Teaching Planet Earth," led by Patricia Reiff, Rice University, Houston, TX.

- "Terrain Intelligence Products from EOS Sensor Data," led by Douglas Kliman, MRJ Associates, Tucson, AZ.

- "NBC News and Information: Extending MTPE Data to the World," led by David Jones, WRC-TV4, Washington, DC.

- "MTPE-Derived Data Products for the Fisheries," led by Patrick Simpson, Scientific Fishery Systems, Inc., Anchorage, AK.

(Continued from page 31)

MODIS Science Team Meeting Summary

Strahler reported that MODLAND feels more confident as regards geolocation. However, MODLAND would like to see a plan for post-launch implementation and a schedule for prototyping/testing the land control-point algorithm, which has slipped from earlier expectations.

Closing Remarks

Salomonson thanked the newly-designated validation scientists for attending the meeting. He also thanked Barbara Conboy and the MODIS Administrative Support Team (MAST) for coordinating the logistics. Salomonson stated that the instrument appears to be in good shape; it is not perfect, but we are aware of the few flaws and are dealing with them accordingly. The next step for the MST is data products, and much remains to be done in this area. Once code is delivered and PGEs are integrated, the Team will turn its attention to validation and science. The next meeting is tentatively scheduled for May 1998 in the GSFC area.

The ECS Collaborative Prototyping Program: Overview and Current Status

— *Carroll A. Hood* (chood@eos.hitc.com), ECS Team

The Collaborative Prototype Program (CPP) invites members of the EOS Science Community to participate in the development of the EOSDIS Core System (ECS). As one component of an overall ECS Prototyping Strategy, CPP has included elements such as Incremental Track Development, Evaluation Packages, Working Groups, and Prototype Workshops. (Please see http://ecsinfo.hitc.com/sec6/sec6.html for more details on the breadth and results of ECS Prototyping activities.)

The CPP participants were selected through a peer-reviewed evaluation process. All proposals met a set of mandatory terms and conditions before making the competitive range for selection. Those that did were evaluated both on technical merit and cost. Evaluation factors for the technical review (which accounted for 80 percent of the overall evaluation) included Understanding the Problem, Relevant Past Performance, Schedule, and Technical Approach. The cost review included a reasonableness check. The Final Selection Authority was the ESDIS ECS Program Manager or his designee.

Currently, there are five active Collaborative Prototype efforts. All are expected to wrap up during the first few months of 1998. The following tables provide a brief synopsis of each effort plus a glimpse of the anticipated final results.

Organization	**University of California at Santa Barbara**
Principal Investigator	Dr. Linda Hill
Description of Activities	This effort is leveraging the Alexandria Digital Library (ADL) Project at UCSB to develop a Gazetteer for ECS. The Gazetteer will enable querying by place name, feature name, etc.
Anticipated Results	The primary results will be an extensible database schema for a Gazetteer (already delivered) and a populated Gazetteer database that includes place names and their corresponding "footprints." The current population includes point footprints for both places and features derived from USGS and NIMA gazetteer data sets. These entries have been complemented by the bounding rectangle for all U.S. states and counties. UCSB continues to solicit information on other gazetteers for possible inclusion into the database.
For More Information	http://ecsinfo.hitc.com/sec6/UCSB-ADL.html
Organization	**Tulane University**
Principal Investigator	Dr. Cris Koutsougeras
Description of Activities	This effort is focused on the development of statistics that can be used to represent

	the content of a data granule. Examples include single valued statistics (i.e., means or moments), histograms, and transform coefficients. These statistics would be placed within the metadata database and would provide a mechanism for users to perform content-based queries without having to apply the query to the data granule directly. (It is assumed that such statistics, once defined for a specific product, would be generated in a post-production processing step, before insertion into the data server.)
Anticipated Results	We anticipate three primary results from this effort: 1) Determining which statistics represent information content of a granule over a variety of applications. NDVI 10-day composites will be used as an initial test data set. These will be proof-of-concept suggestions only; it is anticipated that Instrument Teams (ITs) will define their own content-based statistics. This research, however, may provide some insight or ideas for the ITs to consider. 2) Understanding the implications of storing several classes of statistics within the metadata database. Currently, there is a concept of "Product Specific Attributes" that appears in the B1 data model. These results may provide some insight on the best way to model these statistical attributes to promote efficient storage and enables scientifically motivated querying. 3) Understanding the requirements that would be placed on a search client (such as JEST) in order to take full advantage of the statistics that are generated.
For More Information	http://ecsinfo.hitc.com/sec6/tulane.html
Organization	**Oregon State University**
Principal Investigator	Dr. Mark Abbott
Description of Activities	This effort is focused on the development of tools that support custom client applications related to the access and analysis of oceanographic data sets. This includes the development of both Java-based and Active-X-based clients and frameworks.
Anticipated Results	The full suite of Java and Active-X software will be demonstrated and delivered along with a final report that evaluates JEST and the potential for integrating external, distributed objects into the ECS client framework. Some of the applications may be useful as stand-alone plug-ins for the ECS client. A more general result will be a description of the architecture and the lessons learned in custom client development. These items will be of interest to other groups who wish to develop custom clients with distributed Java or Active-X components.
For More Information	http://ecsinfo.hitc.com/sec6/osu.html

Organization	**University of Alabama at Huntsville**
Principal Investigator	Dr. Sara Graves
Description of Activities	This effort is focused on the development of a data set-independent subsetter. The prototype is designed to operate on data sets that are in HDF-EOS format (swath and grid only) and will enable a user to generate subsets based on location, time, and/or parameter. The subsetter will operate in a client-server-like mode and feature a WWW-based interface.
Anticipated Results	The primary result will be the delivery of Version 2 of the subsetter along with appropriate documentation. Version 2 will permit subsetting even if valid geolocation data are not completely specified, will permit multiple files to be subsetted simultaneously, and will feature a Java-based spatial query tool. In addition, feasibility studies will be performed on integrating the subsetter with a data visualization tool and on allowing the geolocation information to be provided by an external file. If possible, a preliminary version of the subsetter (Version 1.5) may be distributed to the DAACs for early review and evaluation.
For More Information	http://ecsinfo.hitc.com/sec6/uah.html
Organization	**University of New Hampshire**
Principal Investigator	Dr. Berrien Moore
Description of Activities	This activity is focused on the development of custom client for the Humid Tropical Forest Inventory Project (HTFIP) that enables WWW-based query and browse that incorporate the full functionality of a GIS. This involves the bundling of a Java interface, the Spatial Database Engine (SDE) developed by ESRI, and the Oracle DBMS. Another activity is the development of a WWW Browser Plug-in using Formida, a rapid GUI prototyping tool, that would enable rapid review of multiple browse images that are in HDF-EOS format.
Anticipated Results	Specific results include the WWW-based query and browse prototype that incorporates GIS functionality (already developed and undergoing sustaining engineering) and the Browse plug-in. A more general result will be a description of the architecture and the lessons learned in custom client development. These items will be of interest to other groups who wish to develop custom clients with GIS functionality.
For More Information	http://ecsinfo.hitc.com/sec6/UNH.html

For more information about the Collaborative Prototype Program, please contact Carroll A. Hood at 301-925-0351 or via email at chood@eos.hitc.com.

EDUCATION HIGHLIGHTS

Excerpts from NASA Mission to Planet Earth Education Program Update

— ***Nahid Khazenie***, (khazenie@istbsun.gsfc.nasa.gov), Managing Editor

NASA DRYDEN FLIGHT RESEARCH CENTER (DFRC) EARTH SCIENCE EDUCATION ACTIVITIES

The Aerospace Education Service Program in conjunction with the DFRC Educator Resource Center has organized and executed several Earth science teacher workshops. The Center's plan includes curriculum development, teacher workshops, follow-up teacher workshops, and student programs. A unique aspect of the DFRC plan is that it incorporates NASA Earth science themes and educational materials with the DFRC's Pathfinder Aircraft. The Pathfinder aircraft's main customer is NASA Earth science research and operates out of the Pacific Missile Range Facility (PMRF) in Kauai. The first phase of this educational outreach program was to develop and execute teacher workshops. From May 27 to June 11, the education team completed six teacher workshops on three different Hawaiian Islands. The second phase includes five teacher follow-up workshops and a student program available to schools on Kauai.

GLOBE SPANS SEVEN CONTINENTS

During a recent summit with Argentine President Carlos Menem, U.S. President Clinton announced that a school in Antarctica would be part of the Global Learning and Observations to Benefit the Environment (GLOBE) Program. GLOBE schools are now in sixty countries and on all seven continents.

In other GLOBE news, GLOBE student Sarah Moore has written a report on how GLOBE scientists, like Elissa Levine from NASA Goddard, are using GLOBE student data in their research. Her report is online at http://globe.fsl.noaa.gov/reg/newsletter/fall_1997/page5.html.

For an update on GLOBE activities, including a report on the work of the NASA Goddard Scientific Visualization Studio, visit the GLOBE Web Site and review the Fall Newsletter at http://globe.fsl.noaa.gov/.

EARTH FROM ABOVE

http://mirage.usra.edu/esse/earthabove.html

A web page is now available for GSFC scientist Claire Parkinson's book, "Earth From Above." This book provides an introduction to understanding and interpreting satellite images, using illustrative examples. The WWW site provides links to the publisher where you can order the book online, browse the table of contents, and read the book's preface. SPECIAL: The publisher is offering complimentary slide sets from the book for orders exceeding 25 copies as long as supplies last. Each set contains 62 color slides.

OCEANOGRAPHY EDUCATION WEB SITE AND ARTICLES

http://podaac.jpl.nasa.gov/newedu.html

The JPL DAAC has updated its web site of "Education Resources for Oceanography and Earth Sciences," which includes links to classroom material (organized by grade level) and resources for continuing education, field trips/out of class experiences, satellite data/images, and multimedia. Abstracts are provided for most of the listings. A hard-copy version is also available from User Services at: podaac@podaac.jpl.nasa.gov or (818) 354-9890. Two articles about the web site appear in the December issue of "California Educator." This magazine has a readership of 270,000 California teachers.

Polar DAAC User Working Group (PoDAG XII) Meeting

— *K. Steffen* (koni@seaice.colorado.edu), PoDAG Chairman, University of Colorado, Boulder
— *D. Bromwich* (bromwich@polarmet1.mps.ohio-state.edu), PoDAG Co-chair, Ohio State University
— *R. Weaver* (weaver@kryos.colorado.edu), NSIDC DAAC Manager, University of Colorado, Boulder

The 12th meeting of the National Snow and Ice Data Center (NSIDC) Polar DAAC User Working Group (PoDAG) was held June 17-18, 1997 in Boulder, Colorado. Following are the recommendations, action items, and abbreviated minutes of this meeting. Please visit the PoDAG home page at http://www-nsidc.colorado.edu/NASA/PODAG/ for further information. Some of the presentations given at PoDAG XII are linked to this webpage.

Recommendations

Near-Real-Time Ice and Snow Extent Product
The Near-Real-Time Ice and Snow Extent (NISE) product generation, which uses a multifrequency, multipolarization passive microwave algorithm, is supported by the PoDAG members; however, archiving these products is not recommended.

Generation of Microwave-Based Permafrost Extent Maps
PoDAG does not recommend pursuing research and data production on permafrost extent at the NSIDC DAAC at this time. The recommendation may be considered at a later time, with more-promising algorithms. Use of the DAAC resources rather to support ongoing and future field programs in data archiving (e.g., PARCA, SHEBA, and others) is recommended.

K-12 Outreach
PoDAG does strongly support and praise the effort of the NSIDC DAAC in K-12 outreach and curriculum development. However, given the budget constraints for the DAACs in the coming years, use of the DAAC Full Time Equivalents (FTEs) to support this effort is not recommended. Support for K-12 Outreach should be leveraged from special education grants (e.g., from NASA HQ, GLOBE, NSF, and others).

MODIS Snow and Sea-Ice Products
MODIS snow and sea-ice products should be processed in EASE-Grid projection, in addition to the sinusoidal grid. MODIS Level 2 Data should be sent without delay from the GSFC DAAC to the NSIDC DAAC for snow and ice product generation. This is crucial for those in the operational communities who need products within one day. NSIDC believes it can deliver these browse products within this time frame.

MODIS Snow and Ice Production Mask
PoDAG recommends that the current MODIS snow and ice production mask be extended from 40 degrees North and South, to include all areas on the Earth with seasonal snow cover and ice cover.

(1) Update on NSIDC activities since PoDAG XI, by Ron Weaver.

(a) Major Accomplishments — Data Services
(i) Permafrost/frozen ground assessment completed. Report by Tingjun Zhang given in item 12.
(ii) NISE product to be provided to EOS MISR and CERES instrument teams. Report by Anne Nolin in item 7.
(iii) Greenland synthetic aperture radar (SAR) mosaic completed.
(iv) AMSR data from ADEOS II to be archived and distributed by NSIDC.
(v) Arctic and Antarctic Research Institute (AARI, Russia) sea-ice data in EASE-Grid to be distributed by ftp.
(vi) F11 brightness temperature and sea-ice concentration grid CD-ROM processing completed through September 1995. Daily and monthly grids available via ftp. F-13 brightness temperature grid CD-ROM processing completed through

December 1996. Sea-ice concentrations available via ftp through December 1996.

(vii) Special Publication Number 5 on F11/F13 intercomparison nearing completion.

(viii) EASE-Grid processing of passive microwave global brightness temperatures through November 1992.

(ix) Comiso bootstrap algorithm processing under way.

(x) 12,000 AVHRR scenes received and processed.

(xi) Various intra-DAAC support activities completed.

(xii) Transfer of data from MSFC to NSIDC completed.

(b) Major Accomplishments — Systems Engineering

(i) Data Request Tracking Software online.

(ii) Computer room modifications completed.

(iii) EOSDIS Core System Release B Testbed hardware and software installed.

(iv) Release B.0 hardware for EOSDIS Core System installed.

(v) Staffing increased for EOSDIS Core System activities.

(c) Major Accomplishments — Data Support

(i) Richard Armstrong will collaborate with the EOS AMSR instrument team on snow-cover study.

(ii) Anne Nolin will work on a snow-cover reflectance assessment in conjunction with the EOS MISR instrument team.

(2) Role and Charter of PoDAG

(a) PoDAG was originally tasked to provide scientific guidance to the NSIDC DAAC and to the EOSDIS Project regarding such issues as the usefulness and priorities of individual data sets and the addition of new data sets.

(b) NASA Headquarters provided guidance and selected new PoDAG members. NSIDC now proposes new PoDAG members.

(c) PoDAG now reports to Skip Reber, the acting EOSDIS Project Scientist.

(d) Support for PoDAG participation costs needs clarification. NSIDC may undertake to fund PoDAG participation to a limited extent.

(e) Feedback from PoDAG to NSIDC should, in part, involve the development of a long-term plan.

(3) Global Sea-Ice Data Set — Don Cavalieri

(a) A 17-year global sea-ice data set at GSFC that merges SMMR and SSM/I data sets (10/78-9/95) is approaching completion. A NASA Technical Memorandum describing the processing is being prepared.

(4) Passive Microwave Products — Jim Maslanik

(a) Processing of SSM/I sea-ice concentrations through December 1996 was completed with NASA Team and Comiso bootstrap algorithms. New products planned are the global sea-ice data set (see item 3), ice concentrations based on the corrected Comiso bootstrap algorithm, and sea-ice melt onset product based on research by Mark Anderson. Additional publications being prepared are new documentation on SSM/I brightness temperatures and two technical notes on inter-calibration and data corrections. The desirability of distributing multiple sea-ice data sets was discussed.

Previous action items were also considered. The effects of data set intercomparisons on derived sea-ice concentrations were generally small (see item 5). Additional masks to be provided by SSM/I processing are for land contamination and for open ocean weather effects.

(5) Sea-Ice Concentration Product Intercomparison — Julienne Stroeve

(a) The impact of any adjustments to SMMR-, F8-, F11-, and F13-derived sea ice concentrations to improve consistency between different data sets would be only a few percent.

(6) SSM/I Pathfinder EASE-Grid Processing — Mary-Jo Brodzik and Richard Armstrong

(a) Processing of F8 data should be completed by September 1997. F11 and F13 data processing is scheduled to be finished by October 1998.

(b) Richard Armstrong discussed the Northern

Hemisphere product, which combines NOAA weekly snow cover on land with the passive microwave depiction of sea-ice concentration covering 1978 to 1995 on the EASE-Grid. He suggested the formation of an ad hoc working group to identify a snow-water-equivalent algorithm for application to satellite passive microwave data.

(7) NISE Product — Anne Nolin

(a) This product has been proposed to support the processing of data from EOS instruments. The resolution will be 25 km globally, and the delay will be two-to-three days after real-time. Masks will be provided for snow extent and ice caps on land and sea-ice extent over the ocean. Discussion indicated that this experimental SSM/I product should be produced in an operational mode only, and not archived as a research quality data set.

(8) Tools for Use of Multiple Polar Pathfinder Data Sets — Ron Weaver

(a) Six weeks is required for a senior programmer to write the necessary software for the Polar Pathfinder data sets. However, the participants in the Polar Pathfinder project have not yet decided on a common data format. Further more, some uncertainties with the EOS HDF data format still need to be resolved. The recommendation was to revisit this question at the next PoDAG meeting. For more information about the Polar Pathfinder products, please visit the Pathfinder webpage at http://www-nsidc.colorado.edu/NASA/POLAR_PATHFINDERS/.

(9) EOS Cryospheric Working Group — Barry Goodison

(a) A new chairman has not yet been identified, but an individual who is part of one of the EOS interdisciplinary science projects is interested. (Addendum: It is now official that Dr. Robert Crane, Penn. State University, is the new CWG chair. We all wish Rob well in his new task.)

(10) Update on Global Land Ice Monitoring from Space (GLIMS)

(a) The goal is to describe the temporal evolution of all ice extent on land for the purpose of studying climate change. It started with the EOS ASTER instrument, but has evolved to incorporate all appropriate sensors. Tasks involved are much larger than can be handled by a single group, so regional centers have been established. Some progress has been achieved on algorithm development, but much more effort is needed.

(11) Update on AVHRR Polar Pathfinder Data Processing — Ted Scambos

(a) Almost three years of 5-km products have so far been produced. One-km products are being produced for specific area and/or process studies. A cloud mask will be provided, based primarily on cloud motion detection. Distribution is planned to start after mid-1998.

(12) Role of Remote-Sensing Data in Permafrost and Frozen Ground Studies — Tingjun Zhang

(a) NSIDC reviewed a possible new research activity in support of EOSDIS data distribution to be housed at the data center. The application of passive and active satellite microwave observations to detect the thawing and freezing of snow-free ground was summarized. The primary unresolved problem is the need to determine whether the ground is free of snow. Also, the depth of freezing is a key variable for polar hydrological considerations and, in order to obtain it, information in addition to remote-sensing observations is required. Further studies of this application's feasibility are needed.

(13) Workshop on New Approaches to Sea-Ice Observations — Ron Weaver and Koni Steffen

(a) The two-day workshop is designed to assess possible new avenues for sea-ice monitoring during the EOS time period by making use of current and new sensors in combination with process models. The main focus is on data assimilation and how it can advance current remote sensing for sea-ice monitoring on regional and global scales. The proposed date is early December 1997, just prior to the American Geophysical Union Fall Meeting in San Francisco. A draft letter of invitation was circulated. (Addendum: This Workshop was

held in Boulder on December 3-5. The report will be distributed in the first quarter of 1998.)

(14) Educational Outreach — David McGinnis and Brenton Burnett

(a) The K-12 educational initiative of the National Science Foundation's Arctic System Science (ARCSS) program, called Advancing Arctic Research into the Classroom (AARC), was discussed. Some basic observations were that many schools are not Internet-ready, data available are confusing, and students and teachers need tailored information. A developed curriculum with inquiry-based learning is the desirable approach. Both online (World Wide Web) and CD-ROM approaches are needed. Curricula must be built around available online data sets (NASA and NSF), which, in turn, must be adapted for use in the classroom. The course developers will seek funding from a variety of sources.

(15) MODIS Snow and Sea-Ice Products — Robert Wolfe

(a) The processing of the data stream from the EOS MODIS instrument was discussed. Coordination of data processing between GSFC and NSIDC was reviewed, as was the need to have global depiction of all land ice, not just that poleward of 40 degrees latitude. Further consideration is required as to the spatial resolution needed for MODIS products.

(Continued from page 26)

CERES Science Team Meeting

ice in the Arctic and low-level cloud shadow cast from upper-level clouds. Cloud properties retrieval in the Arctic is very sensitive to surface spectral reflectance. Using the 1.24-μm window channel as a non-absorbing channel can reduce the probability of getting multivalued solutions and suppress the effect of multiple reflection between cloud and surface.

Yaping Zhou of SUNY-SB (representing Bob Cess) described an algorithm for calculating the relation between surface downward LW and outgoing LW radiation. Limited observational data and model sensitivity studies showed the correlation between the LW flux ratios and column water vapor to be remarkably invariant to both the presence of clouds and, evidently, also to the vertical distributions of water vapor and temperature.

CERES Educational Outreach

Lin Chambers (LaRC) briefed the team on the CERES S'COOL (Students' Cloud Observations On-Line) Project. Students observe and report clouds at the time of CERES instrument overpass, compare their observations to CERES cloud retrievals, and provide feedback on up- versus down-looking results. The program has already been tested locally and in Europe. CERES also supported preparation of a series of NASA fact sheets for public distribution.

Science Team Logistics

The next CERES Science Team meeting is scheduled for April 21-23, 1998 at the NASA Langley Research Center in Hampton, VA. The major topic will be a review of progress on the validation for each subsystem, with a focus on instrument and ERBE-like data products. Other items will include an assessment of CERES and VIRS data from TRMM, and CERES launch readiness for EOS AM-1 in late June or early July of 1998. Another Science Team meeting will be held in California to coincide with the EOS AM-1 launch.

Minutes of the EOSDIS Panel Meeting

Woods Hole Oceanographic Institution, *Quissett Campus, Carriage House, August 19-21, 1997*

—*David Glover* (david@plaid.whoi.edu), Panel Chair

Attending: David Glover (WHOI, chair), Mark Abbott (OSU), Peter Allan (Rutherford Lab), Bruce Barkstrom (LaRC), G. David Emmitt (Simpsons Assoc.), Bob Evans (RSMAS), Jim Frew (UCSB), David Halpern (JPL), Robert Haskins (JPL), David Nichols(JPL), Moshe Pniel (JPL), Skip Reber (GSFC), Victor Zlotnicki (JPL). Guests: Francesco Bordi (SWAMP), Frank Eden (NRC), Betsy Edwards (GSFC, Code170), Steve Goodman (MSFC), Sara Graves (UAH, ERG), Paul Hwang (PM project), Gary Johnson (CIESIN-SEDAC), Paul Kanciruk (ORNL), Martha Maiden (GSFC Code 170), Rick Obenschain (ESDIS), H.K. Ramapriyan (ESDIS), Joe Senftle (ECS)

19 members of the EOSDIS Panel, along with 13 guests, gathered at the Woods Hole Oceanographic Institution to discuss aspects of a nascent Federation that need immediate attention. There were, however, a number of events in the EOSDIS world that also needed attention and so the first day of the meeting was spent in briefings on these events. These minutes cover the salient facts of the briefings as well as a description of the Federation issues discussions. A white paper is being drafted to capture the discussions and recommendations of the EOSDIS Panel and guests on the important issues surrounding membership, governance, and interoperability.

EOSDIS Cost Modeling

Bruce Barkstrom presented a summary of his latest document detailing his EOSDIS cost model. In his report Bruce breaks the cost of EOSDIS down into people costs and hardware structural costs in an attempt to determine what really drives the cost of EOSDIS. When divided in this manner it becomes evident that the hardware is only 10% of the budget, networks are another 10%, and maintenance and operations are about 23%. The largest single cost in the budget is development, consuming about 24%—before the increased costs associated with the increased effort to develop an operational system; the cost of EOSDIS is largely insensitive to the data volume. These cost figures were arrived at by using the COCOMO model (from 1989) which is based largely on the estimated number of lines of code (LOC) to be generated. In this case a line of code is counted whether it is what we typically think of as a program (C or FORTRAN) or whether it is part of the glue code that holds the many commercial off-the-shelf (COTS) packages used on EOSDIS together. The cost of the development of these lines of code is a non-linear function of the LOC.

Barkstrom finished his presentation with a strategy for reducing the cost of EOSDIS. The embedded centralized development model currently in use is expensive; the cost of EOSDIS can be reduced by changing to a semi-detached mode of development model. He made a case for a substantially decreased emphasis on documentation in this semi-detached mode. In addition, it is necessary to reduce the number of system components and requirements to reduce the total overall work load. Finally, numerical experiments with this model suggest that the development would be less expensive when done as independently distributed development jobs at individual DAACs. Although this engendered considerable discussion, no consensus for a recommendation could be reached by those present.

Plans for August ECS Demonstration

Originally it was hoped that the EOSDIS Panel meeting would be held after the ECS demo/test. Unfortunately the dates for both this meeting and the demo/test did not allow for this. Nevertheless, Rick Obenschain presented the EOSDIS Panel with an update on the plans for and progress towards the demo/test in Landover. He reported that the contractor was on schedule for the demo/test and that of the criteria developed previously by a group of people selected from the EOSDIS Review Group (ERG), which included the chair of the EOSDIS Panel, ECS had obtained an 85-86% success rate.

NASA's EOSDIS Alternate Implementation Plan (EAIP)

After Obenschain's briefing, he discussed the EOSDIS Alternate Implementation Plan (EAIP). At that time the EAIP was being planned in case the ECS contractor failed to make a critical delivery in time for the AM-1 launch, consequently their planning was constrained by the fact that they could not rely on any component of ECS being available. The path they selected for the EAIP would be best described as a hybrid approach wherein the EAIP would be built upon the integration and enhancement of currently available, non-ECS systems, such as Langley TRMM Information System (LaTIS), GSFC TRMM Science System (TSS), Version 0 (v0), the DAACs, and the SCFs currently supported Emergency Back-up Plans. They would follow two basic rules of operation for the EAIP: decentralized implementation management and decentralized architecture. The EAIP was compared to the EOSDIS baseline architecture and potential advantages (direct Instrument Team control of higher level products, increased flexibility during algorithm validation, increased IT and DAAC ownership) and disadvantages (increased schedule risk, IT distraction from research and science, failure to satisfy EOSDIS system-wide requirements) were identified.

Report from the EOSDIS Review Group (ERG)

Sara Graves, Chair of the ERG, gave a report on the meeting ERG held in April 1997. She reviewed the group's charter and provided an overview of the recommendations that came out of their first meeting. This group is charged to look at EOSDIS from a long time-scale, NASA- HQ pointof view. Consequently they are interested in the current status of EOSDIS as well as the prospects for the AM-1 and PM-1 eras and beyond. The five month slip by ECS and the consequent cancellation of ECS Release A (to support TRMM) was discussed. For the AM-1 era, the ERG recommended that the August demo/test should have clear, unambiguous criteria and that feasible backup plans (EAIP) be made in case ECS did not meet these criteria. It was at the April ERG meeting that the DPRB (Skip Reber, chair) was renamed the Data Processing Resources Board (DPRB) with Skip Reber (EOSDIS Project Scientist) chair. In the PM-1 era and beyond, the following recommendations were presented. In particular, the MTPE program should develop lower-cost options that provide appropriate functionality for EOSDIS or its successor. The MTPE program should engender alternative architectures for EOSDIS and present them to the scientific community in terms of trade-offs between cost and functionalities. Graves said it is NASA HQ's desire to make the ERG into a standing committee and that the ERG would meet in October 1997 to discuss this and the results from the August demo/test.

Data Product Cut-back Percentages

Skip Reber presented the mandate from NASA HQ that EOSDIS reduce the data volume at launch and follow a prescribed schedule to ramp up to full processing. At launch, Level 2 and higher data products will be produced at 25% of original volume. Level 2 and higher data products will ramp up to 50% at the end of the first year and to 75% at the end of the second and finally reach 100% at the end of the third year. This applies only to Level 2 and higher products. All Level 0 and Level 1 data will be captured, processed and archived. Reber explained the further restructuring of the DPRB since the April ERG meeting. Now the resource allocation process will have two parts: a peer review group (not the DPRB) to give scientific rationale for resource allocation based on the data product maturity and the DPRB which will help implement these reviews/recommendations.

Based, in part, on Bruce Barkstrom's presentation, we are convinced that cost and data processing rates are not tightly linked. Since data volume is not a major cost driver, and if one can reduce computational requirements via algorithm/coding improvements, some participants wondered if EOS can ramp up production at a faster rate than that proposed at present?

Next Generation InterNet

Bob Evans gave a brief review of the status of next generation internet (NGI) activities. Actually there are at least three activities aimed at providing multi-megabit network services to affiliated academic and agency users (NGI, vBNS, and InterNet-2) which sometimes operate separately and sometimes overlap. The NGI is driven by government agencies and tends to be top-down and slow to implement. The InterNet-2 is more of a bottom-up academic driven endeavor and tends to have a grass-roots flavor. The InterNet-2 to vBNS (very high speed backbone network services) connectivity is an user-paid-for effort and the NGI/vBNS connection has very restrictive access rules.

Since the NASA Science InterNet (NSI) is getting out of the business of being a network access provider, the transition to NGI/I-2 is really a strong candidate to provide high capacity network access to EOS products following a transition period that will likely last several years. It is our expectation that this transition will be rocky at best. There is a NSF program called "Connections" that will be the university pathway for most university internet users. Interestingly enough, the I-2/NGI is expressly forbidden to connect to the commodity internet (what we think of as the regular internet) so once you've made the transition to I-2/NGI you will no longer have access to AOL. Your institution will need to maintain its traditional Internet access arrangements to connect to services (other users) not connected to the newer networks.

SOMO/CSOC/SIS-Study Plans

Skip Reber led a discussion of what the SOMO/CSOC/SIS effort at Johnson Space Center is and where it is heading. Earlier this year it was decided that all of NASA's data handling activities would be handled by a single contractor. This job was given to the Space Operations Management Office (SOMO) at JSC and they created the Consolidated Space Operations Contract (CSOC). Originally this activity was aimed at handling things like TDRSS traffic, the space shuttle telemetry, etc. It was then pointed out that science data could also be handled in this manner. The science data (both space and Earth science) would be handled by the Science Information Services (SIS). The chair of the SIS steering committee (John W. O'Neill) appointed a SIS-study team (chaired by Cheevon "Mi-Mi" B. Lau) to "recommend cost effective science information services that will allow resources to concentrate on science and technology, but yet continue to provide high quality data products and services." The SIS-study team is composed of NASA representatives from codes M, S, U, and Y and is further advised by a lead customer group. The SIS-study team held its first meeting August 19-21, and a report recommending cost effective science information services is due to the steering committee by the end of this year. It deals with general recommendations on best practices and who should be responsible for different activities. Next year the group will look at a representative set of missions to determine if cost savings can be achieved if they follow those practices. The EOSDIS Panel had a lively discussion regarding the nature of this study which is summarized in one of the specific recommendations at the end of the minutes.

Federation Discussions

The remainder of the EOSDIS Panel meeting was given over to discussing the nature of federations and issues that will need to be addressed by the nascent; documents were made available to the panel prior to the meeting. At the meeting the federation discussion was started by a presentation of examples of federations and federation concepts by David Glover. The VISA Corporation and the Internet Engineering Task Force (IETF) were presented as the examples and the science of federalism concepts from J. Gabrinowicz's (University of North Dakota, Department of Space Studies) writings were germane to the discussions.

After the initial group discussion, the gathering was divided into three sub-groups with two of the three nascent federation issues to further discuss. These three issues were: membership, interoperability and governance. The overlap in discussion topics was done to encourage cross-fertilization of ideas when the sub-groups returned to report at the plenary at the end of the meeting. The membership issue dealt with the question: What makes one eligible for membership in the Federation and what does not? For the inter-operability issue, the sub-groups concentrated on the standards the Federation must impose upon itself to make it work. For the governance issue, the sub-groups discussed the systems of checks and balances the Federation must have in place to resolve Edisputes both within and without the Federation and NASA's unique role in this Earth science data federation. The proceedings from these discussions will be detailed in a white paper before the NRC Constitutional Convention.

Specific Recommendations

1) One-Stop Shopping: The EOSDIS Panel recommends that EOSDIS concentrate on the one-stop-shopping aspects of the WWW for finding and obtaining data.

This is due, in large part, to the recognition that the EOSDIS user community is now becoming comfortable with multiple WWW interfaces for finding information and that there are diverse data structures and data access methods required by EOS data producers and data users. In this context we are referring to one-stop-

shopping as equivalent to being able to search all DAACs for all occurrences of the specified data inside a specified or defaulted space time window from a single graphical user interface. We have concluded that this requirement has placed an undue burden upon the developers of ECS and acts as a software development cost driver. In addition, we are not convinced that the maintenance cost beyond the software's initial release will be manageable in the future, particularly in the time frame beyond PM-1. Instead the EOSDIS Panel recommends that the ESDIS project and the ECS contractor provide a well-documented, public interface to enable users to develop or use the paths they find most efficient in searching for the data that interests them. This interface is important because it will encourage continued innovation in search engines and user interfaces, including subsetting and coincidence search tools, in the form of additional software development beyond AM-1. Most of all, use of WWW technology will maximize the leverage of the commercial investments in that technology.

We wish to avoid the possibility of misunderstanding this recommendation. It is not our intention to cancel or delete the concept of one-stop-shopping from EOSDIS, but rather change its emphasis. To facilitate this approach, the Panel recommends that the ESDIS Project and the ECS contractor get JEST online and available to users as soon as possible. In other words, this interface tool must be available in time for user feedback to make a difference before the launch of AM-1. We (as a community) need to balance the desire for cost savings through redirected emphasis of one-stop-shopping on WWW technologies and our strong desire to see JEST completed as soon as possible. We remain concerned that any exercise along these lines not pull the rug out from underneath the interoperability potential of EOSDIS in the name of cost savings.

2) SOMO/CSOC/SIS: The EOSDIS Panel recommends that the SIS-study group stop any study on centralized design and focus on a de-centralized design for processing of Level 1 data (and beyond). Further, they should take careful note of lessons learned from the EOS experience.

Upon review of the SIS-study viewgraphs presented to this group, we perceive that the SIS-study is going in the direction of centralizing design with the goals of lowering costs, eliminating duplication and overlap. We cannot agree with or condone this direction. As part of the evolution of EOSDIS we have learned that a central solution to handle MTPE data for EOS satellites, pre-EOS satellites and *in-situ* data associated with the above is unlikely to provide three key attributes: flexibility, robustness, and innovation. Flexibility brings to the users options for obtaining data and services. Innovation enables the system to rapidly incorporate new technologies and new services. And finally, robustness guarantees that the system will be able to provide adequate services in case of failure of any one component. In addition, we have learned that the L0 processing contract for EOS has been quite successful. The Level 1 (and beyond) processing requirements are instrument unique and cannot be centralized in a cost effective manner.

An architecture built around a set of small, "modular", distributed services and responsibilities, provides much less organizational inertia than a central design. Data processing needs to be under the authority and responsibility of those that understand the data. The concept of a central solution, possibly implemented by a single contractor, to meet the disparate needs of processing, quality control, browsing and distributing Levels 2 or higher science data to oceanographers, planetary geologists, and astrophysicists does not seem to us to be practical nor likely to be successful. We need only look to the NRC report (July 1995) wherein they directed MTPE to retain as a centralized activity only the down-linking of data from the satellite, and its Level 0 and perhaps Level 1 processing, and to distribute the higher level processing and data distribution to a "Federation" of competitively-selected data processing partners.

3) ESDIS Efficiency: The EOSDIS Panel recommends that the MTPE program allow the ESDIS project to "build to cost" within reasonable time windows.

During the course of this EOSDIS Panel meeting we were presented with strong evidence that ESDIS is being kept from managing the EOSDIS project efficiently due to "fire drills" imposed upon them by higher NASA management. While we consider the source, there does seem to be a problem and we suggest that the budget trimming process could be

made more rational by giving the scientific community more visibility into the process by which cost containment decisions are reached. In the past, with the involvement of the science community, restructuring/reshaping/rescoping exercises involved the ESDIS Project coming up with options for requirement reductions and cost savings associated with them and the EOSDIS Panel and/or Payload Panel advised them on priorities and accepted or rejected their recommendations. In this manner, priorities and associated costs were established and the flexibility for the project to work the problem within a specified cost target, in partnership with the scientific community, was and can be realized.

EOS Science Calendar

February 17-18	TES PDR, NASA/Goddard Space Flight Center. Contact: Rudy Larson, e-mail: Rudolph.K.Larsen.1@gsfc.nasa.gov
February 23-25	AIRS Science Team Meeting, Santa Barbara, CA. Contact: George Aumann, e-mail: hha@williwaw.jpl.nasa.gov
April 1-2	EOS PM-1 Science Data Validation Workshop, University of Maryland Inn & Conference Center, College Park, MD. Contact: Mary Floyd, (301) 220-1701, e-mail: mfloyd@pop200.gsfc.nasa.gov
April 21-22	CERES Science Team Meeting, Langley Research Center. Contact Gary Gibson, e-mail: g.g.gibson@larc.nasa.gov

Global Science Calendar

January 25-29	Space Technology & Applications International Forum, Albuquerque, NM. Contact Carolyn Marcum, tel. (505) 277-2813, fax: (505) 277-2814, e-mail: cmarcum@unm.edu.
March 10-13	XVth Oceanology International Exhibition & Conference in Brighton, UK. Contact Bob Munton, tel. +44 (0) 181 949 9222, fax: +44 (0) 181 949 8186/8168, e-mail: versha@spearhead.co.uk.
March 16-20	Workshop on Inverse Modeling of Global Biogeochemical Cycles, Heraklion, Crete. Contact Dork Sahagin, tel. (603) 862-3875, e-mail: gaim@unh.edu, URL at http://gaim_unh.edu.
March 25-29	Association of American Geographers, Boston, MA. Contact AAG, tel. (202) 234-1450, fax: (202) 234-2744, e-mail: gaia@aag.org, Internet URL: http://www.aag.org.
March 30 - April 4	ASPRS-RTI Annual Convention, Tampa, FL. Contact Dan French, tel. (301) 493-0290, fax: (301) 493-0208. e-mail: dfrench@asprs.org.
April 2-4	Johns Hopkins Conference in Environmental Fluid Mechanics, Baltimore. Contact Haydee Salmun, e-mail: haydee@jhu.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 at http://www2.msstate.edu/~krreddy/glowar/glowar.html.
June 8-12	27th International Symposium on Remote Sensing of Environment. Tromso, Norway. Contact 27th International Symposium on Remote Sensing of Environment, Norwegian Space Centre, P.O. Box 113 Skoyen, N-0212 Oslo, Norway. Fax: +47 22 51 18 01, e-mail: isrse@spacecentre.no. Internet URL at http://www.spacecentre.no/
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. Call for Papers. Contact William L. Barnes, 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. 063.913.143, fax 063.913.767, 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 at 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. Internet URL at http://www.heqyi.com/isprsc7.

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