

THE

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Editor's Corner

Michael King
EOS Senior Project Scientist

I'm pleased to report that the Meteor 3M Stratospheric Aerosol and Gas Experiment III (SAGE III) instrument was successfully launched aboard a Ukrainian built Zenit-2 rocket on December 10 from the Baikonur cosmodrome in Kazakhstan. Preparations for launch had been delayed several times due to instrument integration and test problems, and the uncertainties in the southwest Asia region following the events of September 11. At the time of this writing, the SAGE III power and thermal systems are operating normally, and instrument calibration activities have begun. SAGE III will extend accurate, long-term measurements of ozone, aerosols, water vapor, and other key elements of the Earth's atmosphere already acquired from the SAM II, SAGE and SAGE II missions. Another SAGE III instrument is scheduled to fly aboard the International Space Station in February 2005. Data from the SAGE missions are managed at NASA's Langley Research Center in Hampton, VA.

The joint US/French Jason-1 mission was also successfully launched on December 7 from Vandenberg Air Force Base in Lompoc, CA. Jason-1 is the follow-on mission to the highly successful TOPEX/Poseidon mission to accurately measure ocean surface topography for more accurate forecasts of El Niño events, ocean circulation, and other studies of the physical properties of the oceans. Jason-1 was launched aboard a Delta II rocket, which shared its payload with the NASA Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) mission to study changes in the Earth's upper atmosphere. I hope you share my excitement over the launch of these important NASA Earth science missions, and the advances in understanding our Earth system that they bring.

On the subject of mission launches, the EOS Project Science Office has updated and extended its chronology charts of current and future missions. The current mission charts reflect the successful launches of SAGE III and Jason-1, as well as new projected launch dates for Aqua, ICESat and SORCE. In addition, a new mission chronology chart has been added to provide

information for NASA Earth science missions in the 2004 through 2010 time frame. These include Earth System Science Pathfinder missions, the New Millennium Program Earth Observing-3 mission, the The National Polar-orbiting Operational Environmental Satellite System (NPOESS) missions, and several others. The charts are available in gif or pdf format from the "For Scientists" section of the EOS Project Science Office web site at eos.nasa.gov. Accompanying the pdf version of the charts is a list of acronyms including CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations), the new name for the PICASSO-CENA mission

now scheduled for launch along with CloudSat in April 2004.

The first of a planned series of live interactive webcasts describing the EOS Aqua satellite was held on December 19 from the TRW spacecraft assembly facility in Redondo Beach, CA. This interactive webcast featured virtual tours of the spacecraft, live interviews with engineers, and a description of the integration and test activities currently underway. The Aqua webcast series is being produced by Goddard's new Special Project Initiatives Office, in the Aqua Project, and will concentrate on the spacecraft itself. The

next webcast is scheduled for the first week of February and will concentrate on the scientific advances Aqua will bring. Schedules and updates for future Aqua webcasts will be posted on the Aqua web site at aqua.nasa.gov. The launch readiness date for Aqua is April 18, 2002.

Finally, on behalf of *The Earth Observer* staff, I want to take the opportunity to wish you a prosperous and safe new year. 2002 brings many exciting new developments in NASA's Earth Science Program, and we look forward to sharing them with you through *The Earth Observer* newsletter.



International Summer School on Atmospheric and Oceanic Sciences (ISSAOS 2002)

Italian Space Agency (ASI), NASA Center of Excellence - University of L'Aquila

Remote Sensing of the Earth's Environment from Terra

August 25-30, 2002, L'Aquila, Italy

Scuola Superiore Guglielmo, Reiss Romoli

TOPICS

Topics of the course include a review of remote sensing techniques and the analysis of the results of MODIS, CERES, MISR, ASTER and MOPITT experiments

LECTURERS

M. Abbott, L. Di Girolamo, D. Diner, J. Drummond, R. Evans, J. Gille, A. Gillespie, D. Herring, C. Justice, Anne Kahle, Y. Kaufman, M. King, N. Loeb, P. Menzel, S. Platnick, V. Ramanathan, S. Running, A. Strahler, D. Tanré, E. Vermote, M. Verstraete, B. Wielicki, Y. Yamaguchi

VENUE

The workshop will be held in L'Aquila (100 km east of Rome) at the Scuola Superiore Guglielmo Reiss Romoli (SSGRR. www.sgrr.it) that will provide board and lodging. Further information on L'Aquila is available at the University site www.aquila.infn.it

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Pre-registration forms are available at the site: www.aquila.infn.it/terra/index.html

EOS Investigators Working Group Meeting, San Antonio, Texas

— Alan Ward (*alan_ward@sesda.com*), EOS Project Science Office/SSAI, Goddard Space Flight Center

The EOS Investigators Working Group met at the Adam's Mark Hotel in San Antonio, TX, from October 29 to November 1, 2001. Approximately 90 people participated in the two-and-one-half days of meetings. The agenda was composed of six different plenary sessions and the highlights of each presentation are reported below.

Tuesday, 30 October 2001

Session I: Earth Science Enterprise/EOS Status Report, Part I

Jon Ranson, NASA Goddard—Chair

Jon Ranson, Project Scientist for the Terra satellite, provided a status report on Terra. Terra is operating normally and collecting data. The serious anomalies that came up last spring have been dealt with. Ranson mentioned a number of issues that still remain. These include issues related to data availability, data systems, threatened algorithm maintenance budget cuts, and a proposed deep space and lunar calibration maneuver.

Ranson next presented a brief report on the status of each instrument on Terra and showed examples of some of the available data products.

ASTER: All data products for ASTER are provisional or validated save one. Demand for ASTER images increased 10-fold just after the terrorist attacks on September 11.

Ranson spoke about digital elevation model development being done using ASTER data and how this information will help in global glacier measurements. ASTER is also collecting important data that will be used in modeling studies. He showed an example of latent and sensible heat flux results from ASTER team research being conducted in El Reno, OK.

CERES: The CERES instrument on Terra is performing well, and data products are available. A series of CERES instruments are currently or will soon be in orbit, and this will result in a long-term reference for studying climate change. Ranson cited the CERES need for the deep space calibration in order to obtain its instrument offsets. Ranson briefly reviewed the status of CERES data products.

MISR: MISR is also performing well. The team is getting a handle on absolute radiometric measurements; errors are now quite small. Most data products are moving from beta to provisional status. MISR views the Earth from several different viewing angles and is thus ideal for studies of cloud heights and aerosols. Validation work for MISR is being done in field campaigns using AirMISR.

MODIS: So far things are going well for MODIS. The deep space maneuver is desired by the MODIS team to improve sea

surface temperature measurements. MODIS direct broadcast data are now reaching about 50 receiving stations around the world. A rapid response system has been set up for applications such as fire monitoring. The current plan is to have a complete year of MODIS data processed from November 2000 thru November 2001 by the end of 2001. Ranson showed sample data products: snow cover, land cover (provisional), water vapor, cloud top temperature, and global chlorophyll.

MOPITT: MOPITT has had to overcome some problems. Channels 1 thru 4 were lost due to a cooler problem. A chopper also failed in the open position which has impacted data processing for two other channels. Ranson showed some products both before and after the problem indicating that useful data is still being collected. Preliminary post-anomaly results indicate that, with the remaining four channels, total column carbon monoxide and methane retrievals are possible. MOPITT plans to release beta products for 14 months of data collected prior to the anomaly by the end of 2001.

Claire Parkinson, Aqua Project Scientist from NASA Goddard, was next to speak. She provided an update on the Aqua mission, beginning with the hardware, then discussing recent progress of each of the four Aqua science teams, and concluding with recent and on-going Aqua outreach activities. Aqua has completed two major tests over the past few months: the baseline System Comprehensive Performance Test and a 45-day thermal vacuum test completed on October 10. Both tests were successful, but there are several problems that have to be corrected before the spacecraft can proceed to Vandenberg Air Force Base for the Aqua launch. Remaining work includes fixing floating mode pins in nine spacecraft system units, fixing flawed transformers in 22 units, and retorquing

several hundred bolts. There is a chance, however, that the mission could still launch on schedule in late March 2002. Parkinson showed photographs of the spacecraft and each of the Earth-observing instruments just before their entrance into the thermal vacuum chamber. Next she highlighted key recent activities of the four science teams. The MODIS and CERES teams are busy analyzing, validating, and publishing Terra data, and both teams are generating impressive new results. The AIRS/AMSU/HSB and AMSR-E teams are busy planning validation activities and integrating into their efforts the new validation groups selected in response to the Aqua Validation NASA Research Announcement (NRA). The AIRS/AMSU/HSB team is also working toward eventual assimilation of AIRS/AMSU/HSB data into weather forecasting models. Regarding outreach, Parkinson showed three products produced this year by Aqua groups: an AMSR-E brochure, an AIRS/AMSU/HSB brochure, and an Aqua lithograph. She then explained that in-progress outreach activities include an Aqua brochure, an Aqua Science Writers' Guide, a set of Aqua trading cards, Aqua launch and orbit animations, science visualizations, videotaping of Aqua scientists for an educational CD-ROM and the world wide web, and an Aqua science-outreach website, which is now on-line at aqua.nasa.gov. She concluded her presentation by showing an impressive draft Aqua animation created by Jesse Allen.

Jay Zwally, Project Scientist for ICESat from NASA Goddard, was the next speaker. He presented an update on the status of ICESat. Zwally reviewed the history of the project. This began as the Geoscience Laser Ranging System and was descoped down to the Geoscience Laser Altimeter System—now the principal instrument on ICESat. The spacecraft is now ready to go. Zwally also reviewed the science objectives which include ice sheet mass balance and sea level

change studies, applications in atmospheric science using lidar measurements, and other objectives including canopy height studies—though not with the detail of the proposed Vegetation Canopy Lidar mission. Next, he discussed the characteristics of the spacecraft and talked about the altimeter and lidar. A number of technical issues have been resolved and the GLAS instrument is ready for full environmental testing. Lastly, Zwally touched on calibration and validation issues and data processing and distribution.

William Chu, Project Scientist for SAGE III from NASA Langley, was next to speak. He gave an update on the status of SAGE III. This project began back in 1995. The original instrument had problems that couldn't be solved in time for a November 2001 launch so the team turned to a backup instrument. Then issues arose in the aftermath of the attacks on September 11 because the Baikonur launch site is perilously close to the Russian border with Afghanistan. After much wrangling, a team from Langley was allowed to travel to Russia to prepare for launch. (ED. SAGE III was successfully launched on December 10, 2001, after an abbreviated integration and testing activity at Baikonur.) Chu also reviewed how activities have progressed since the last meeting of the IWG. He talked about activities leading up to the launch, and touched on the planned mission to deploy a SAGE III instrument on the International Space Station. The team is still targeting a Space Station launch in 2005.

Gary Rottman, the Principal Investigator for the Solar Radiation and Climate Experiment (SORCE) from the University of Colorado, was the next speaker. This EOS mission is being managed in a PI mode from the Laboratory for Atmospheric and Space Physics (LASP) of the University of Colorado. The science

objectives of SORCE emphasize both the continuation of the ACRIMSAT observation of total solar irradiance (TSI) and the measurement of the solar spectral irradiance as well. The four SORCE instruments cover the entire spectral range from the ultraviolet to the visible to the near infrared. The Total Irradiance Monitor (TIM) is a new device to measure TSI using electrical substitution radiometry, but with improved electronics and materials to achieve an order of magnitude improvement in accuracy and precision. The Solar Stellar Irradiance Comparison Experiment (SOLSTICE) is a second generation of the highly successful SOLSTICE operating on UARS for the past ten years and measuring the solar ultraviolet from 120 to 320 nm. The Spectral Irradiance Monitor (SIM) is an entirely new development that will for the first time record spectral irradiance from 300 to 2000 nm with sufficient precision and accuracy to determine solar variability at these longer wavelengths.

The SORCE instruments are in final stages of flight build and calibration at LASP and will be assembled into the Instrument Module (IM) in early December. Orbital Science Corp. is the University's industrial partner and is preparing the Spacecraft Bus. The IM and Bus will be integrated at the Orbital Dulles facility early next year, and spacecraft level testing will then proceed through the spring of 2002. Launch aboard a Pegasus XL is still scheduled for the end of July 2002 from the Kennedy Space Center, and the spacecraft and instruments will then be operated from a control center at LASP for a period of five years.

Lee-Lueng Fu, Jason-1 Project Scientist from the Jet Propulsion Laboratory, was the next speaker. He reviewed the progress of activities leading up to the launch of Jason-1. This is a follow-on mission to the very successful US-French TOPEX/Poseidon mission. Modern technology has resulted in a spacecraft that

weighs only one-fifth that of TOPEX/Poseidon but is still every bit as capable. The goal for Jason-1 is to continue spaceborne ocean topography measurements. Recent delays have been attributed to problems with the solar array drive motors. Fu also discussed calibration and validation efforts related to Jason-1. There is a calibration/validation location known as Harvest Platform at Point Conception, CA, and another location in Corsica, France. He also briefly spoke about some of the planned data products for Jason-1. One of the most interesting things about the upcoming Jason-1 launch is that if all goes as planned, there will be an opportunity for TOPEX/Poseidon and Jason-1 to be in orbit at the same time. This is seen as a great opportunity to study ocean mesoscale eddy motion. These eddies carry most of the kinetic energy in the ocean and are very much of interest to oceanographers. Beyond Jason-1, a Jason-2 launch is planned, and then instruments onboard the National Polar-orbiting Operational Environmental Satellite (NPOESS) should continue these measurements. (ED. Jason-1 was successfully launched on December 7, 2001.)

Bob Murphy from NASA Goddard next spoke about the planned NPOESS and NPOESS Preparatory Project (NPP) missions. These have been developed by several competing Total System Performance Responsibility Contractors. A single contractor is to be selected late in 2002. This is a very different way of doing business for NASA; the contractor will operate the satellite. Murphy discussed the proposed payload for the missions. These new missions should definitely advance science and help to improve climate models. He also touched on environmental data records and indicated which sensors would be used for this. The plan is for NPP to be launched in late 2005 and be a follow-on to Terra. NPOESS will come

later in the decade. Murphy went over some details for the proposed instruments for NPP including the following: Visible Infrared Imaging Radiometer Suite, Cross Track Infrared Sounder, and Advanced Technology Microwave Sounder. He touched on operational and research data products that are expected. The goal is that the processing be much faster than for the Terra mission. There is definitely a research-to-operations transition; the idea is that this be a mission that will bridge between operational and research needs. He also talked about the spacecraft, science data system, and science team. In mid-2002 an NRA will be released to solicit participants for the NPP science team.

Jim Irons from NASA Goddard next spoke about the Landsat Data Continuity Mission (LDCM). LDCM will be the follow-on mission to Landsat 7 and will be a data buy done in partnership with the U.S. Geological Survey. In June 1999 there was a Request for Information to private industry to assess their plans for missions like LDCM. Private industry expressed no interest in performing this type of mission on their own but would gladly work with NASA. Hence, NASA and USGS have decided to procure LDCM data from a privately owned and privately operated system. A two-phased procurement process has been initiated. The first phase is formulation and the second phase is implementation. A Request for Proposals (RFP) for formulation phase studies was released on November 1, 2001. Irons gave some idea of how the relationship between the government and the contractor will function. The government will not specify the hardware requirements or require oversight. The government will specify the delivery of LDCM data to an active data archive and will set a start time for data acquisition. Private companies will hopefully share some of the cost. Irons showed a diagram illustrating the Architectural Trade

Space. He also reviewed the LDCM data specifications. The LDCM may provide data for two new bands, one at 443 nm to study coastal areas and aerosols and another at 1375 nm to look at cirrus clouds, depending on the outcome of cost studies during the formulation phase. The cost of providing data for two thermal bands will also be studied during formulation. Irons is concerned that the cost of the thermal band data will be considered too high for the LDCM. Data policy is another crucial component for LDCM. The LDCM will collect at least 250 scenes each day for NASA. The private contractor will be able to sell commercially data that exceed NASA's requirements. Irons discussed a schedule of events for LDCM, including what has happened to date and what is planned for the future. For more information, log on to the LDCM Web Site at ldcm.nasa.gov.

Mark Schoeberl, Aura Project Scientist from NASA Goddard, was the next speaker. He spoke about the status of the Aura mission and also talked about constellation flying. Aura is at the point where integration and testing is beginning. There are still quite a few outstanding hardware issues, but the team is trying to learn from the experiences of the Aqua spacecraft, which is essentially identical to Aura. Aura carries a complement of four instruments and its focus will be on atmospheric chemistry. Schoeberl went through each instrument and discussed its status. These include: the Microwave Limb Sounder (MLS), the High Resolution Dynamics Limb Sounder (HIRDLS), the Tropospheric Emission Spectrometer (TES), and the Ozone Monitoring Instrument (OMI). Aura is currently scheduled for launch sometime in 2003. Aura and Aqua are being built and tested at the same facility so if Aqua takes longer than scheduled, Aura will obviously be delayed as well. Also, if the threatened algorithm budget cuts become reality, this

could significantly impact the Aura data products.

The remainder of Schoeberl's presentation focused on the subject of constellation or formation flying. He showed an animation of the so-called "A Train" including Aqua, Aura, CloudSat, CALIPSO (formerly PICASSO/CENA), and PARASOL. He went into detail on each component of the "A Train" and suggested science that might be made possible with formation flying that could not otherwise be obtained.

Session II: Variability in The Earth System

Claire Parkinson, NASA Goddard—Chair

The first speaker in the second session was **Daniel Jacob** from Harvard University. Jacob has been using data from the GOME satellite to look at nitrogen dioxide (NO₂) and formaldehyde, and data from TOMS to look at ozone. Jacob discussed the retrieval algorithm for NO₂ from GOME. They fit the data to a spectrum and then remove the portion that is attributed to the stratosphere and the portion remaining is the tropospheric NO₂. Jacob commented that this process is much easier for NO₂ than similar techniques used for O₃. From there a three-dimensional atmospheric chemistry model is employed to get the vertical profile of NO₂, which allows them to come up with an air mass value. Obviously, the presence of clouds causes problems with this retrieval algorithm but GOME seems to be doing a reasonable job of capturing the overall pattern. Jacob then discussed the well-known wave one pattern that is observed in tropospheric ozone, interannual variability of ozone and touched on ozone enhancement by lightning. The remainder of the presentation focused on the Trace-P campaign whose goal was to quantify sources of the Asian chemical outflow plume. The desire is to integrate results from Trace-P into the ongoing discussions

over environmental treaties and their enforcement. Preliminary results indicate that China's claims of reductions in CO₂ emissions may be off by 20-30%.

Boris Khattatov, from the National Center for Atmospheric Research, spoke next and talked about inverse modeling of surface sources of CO. He is using the MOPITT instrument onboard Terra for his work together with inverse modeling techniques. Khattatov began his presentation with a brief discussion of the CO inversion technique and the transport model he is using known as MOZART 2. Measurements and model both go into the inversion and the relationship between the two is non-linear, so a linearization of the model must be employed. They can either use finite difference methods or do what is referred to as differentiation of the code. Khattatov summarized the advantages and disadvantages of each technique. This particular study used preliminary data from MOPITT as input to the inverse linearized MOZART 2 model. He used a series of animations to illustrate the results of the study. CO originating in different locations around the world was color coded so that it could be tracked as it moved around in the atmosphere. Khattatov talked about some of the factors that control CO emissions. A singular value decomposition technique is used to quantify how much information can be retrieved from the measurements. The results demonstrate that it is quite feasible to trace CO and track it back to its source region, which could be very helpful in formulating policy and enforcing treaties.

Bruce Wielecki from NASA Langley, spoke on the subject of tropical radiative fluxes. He has been studying the subject of decadal variability and employs data from numerous satellites ranging from Nimbus 7 to Terra. The amount of variation in the radiative flux in the tropics varies by much

more than one would expect over the time series. The observations were first thought to be measurement errors resulting from calibration of the various sensors, but rigorous analysis reveals that the sensors have not changed over the period. The change observed in the data during the 1990s is quite real. It appears that current models are able to detect large anomalies (like El Niño) but fail to detect smaller scale anomalies that can still have a huge impact on climate. Physical explanations for the observations are not known as of yet, but a couple of things are known. The Hadley and Walker cells have, in general, strengthened during the 1990s. Also, there are indications that lapse rates have changed. These changes may be contributing to the changes in radiative flux in the tropics. Further research is needed to conclusively determine the causes.

David Salstein from Atmospheric and Environmental Research, Incorporated and Byron Tapley from the University of Texas at Austin have been collaborating on a study of momentum and mass variability in the Earth system as it relates to Earth system dynamics. The basic thesis is that the Earth functions as a dynamic system exchanging mass and momentum among its components. Angular momentum changes in either the atmosphere or ocean components are accounted for in that of the solid Earth. In this way, the matter and motion contributions to angular momentum in three components lead to variations in the Earth's rotation rate, as reckoned by small but measurable changes in the length of day and the motions of the pole. Atmosphere, oceans, and the solid Earth exchange angular momentum by means of normal torques from pressure gradients against topographic features, like mountains, and tangential stresses between components. Mass variations in the atmosphere and ocean are detected as changes in the gravitational field of the planet. The planet's gravity field can be detected by perturbations of orbits of geodetic satellites;

the Gravity Recovery and Climate Experiment (GRACE), scheduled for a March 2002 launch, will determine time-variable gravity, and will be especially useful for isolating varying signals of terrestrial water storage. considerations.

Lee-Lueng Fu from the Jet Propulsion Laboratory was the next speaker. He has been working with Bo Qiu at the University of Hawaii on a study to examine long-term changes in the surface topography of the North Pacific Ocean. They wish to decipher how much of the variability can be attributed to the El Niño Southern Oscillation (ENSO) and how much can be attributed to wind forcing. The effects of ENSO have been considered an important factor in determining the interannual variability of the North Pacific Ocean circulation through Rossby waves generated at the eastern boundary of the ocean. The analysis of an eight-year record of the sea surface height observations made by the TOPEX/Poseidon satellite indicates that the influence of ENSO has limited offshore extent, which diminishes from 3,000-4,000 km at 10° N to 200-300 km at 50° N. The variability of the interior ocean is primarily driven by wind. The effects of high-frequency wind variability accumulate along the characteristics of Rossby waves in the time-longitude domain and result in low-frequency oceanic variability to the west of the forcing region. Simulations of a simple linear, two-layer model of the ocean driven by wind stress curl are highly correlated with the observations. The results suggest that the role of Rossby waves is like an integrator that links the high-frequency variability of wind to low-frequency response of the ocean that has potential influence on the climate of the North Pacific.

Mike Newchurch, University of Alabama in Huntsville (UAH), described the Regional Atmospheric Profiling Center for

Discovery (RAPCD) [pronounced Rhapsody] a newly created research facility at the National Space Science and Technology Center (NSSTC) in Huntsville, AL. The particular scientific foci of this laboratory include the following three areas: 1) predicting surface ozone and aerosol concentrations; transport, cloud, power-plant plume, and lightning processes affecting air quality; and the diurnal behavior of the boundary layer. 2) aerosol foci comprise aerosol composition and optical property detection especially for hydrophilic and organic (anthropogenic and biogenic) aerosols. 3) Satellite calibration and validation foci include providing ozone and aerosol profiles for AIRS, TES, OMI, SAGE III, MLS, CALIPSO, GOME, MISR, and SCIAMACHY. Validating upcoming EOS satellite measurements of ozone by AIRS, OMI, and TES, for example, requires accurately measured profiles by ozonesonde or lidar and knowledge of the satellite averaging kernels resulting from the physics of radiative transfer. Newchurch and collaborators in RAPCD described an ambitious plan for this satellite validation within the context of the planned measurement and modeling activities. Newchurch anticipates hosting intercomparison campaigns and field experiments staged out of Huntsville for a variety of atmospheric chemistry and meteorological investigations. He invites interested investigators to collaborate with him on RAPCD. Visit the RAPCD website at nsstc.uah.edu/atmchem.

Wednesday, October 31, 2001

Session III: Earth Science Enterprise (ESE)/EOS Status Report, Part II

Michael King, NASA Goddard - Chair

The first scheduled speaker for this session was to be **Ghassem Asrar** from NASA Headquarters, but he was unable to attend. **Jack Kaye**, also from NASA Headquarters, combined some of Asrar's presentation into

his own. He presented the status and future of ESE and also spoke about ESE Strategic Planning. Kaye began with a review of the status of the Enterprise. His assessment is that the Enterprise has been performing quite well in scientific research, including observations and modeling, and in its applications, technology and education/outreach activities. NASA's sponsors and stakeholders in the Administration and Congress look to NASA to help provide answers to specific questions about global change to help establish environmental policy that is based on sound data. He mentioned that the current budget for fiscal year 2002 has yet to be fully resolved. The House and Senate had passed different versions, which had not been resolved as of the meeting.

Kaye next addressed future plans for the ESE through 2010. It is significant that in budgets submitted to Congress for both fiscal years 2001 and 2002, the Administration authorized NASA to proceed with the development of seven new missions. These included NPP, LDCM, Global Precipitation Mission (GPM) and new missions to study ocean topography, ocean surface winds, total solar irradiance, and total ozone. These missions are designed to continue data records that have been started by current missions. NASA ESE also intends to maintain a rigorous line of the Earth System Science Pathfinder missions. He talked briefly about recent NRA selections relating to these and other missions.

The next portion of the talk focused on strategic planning. Kaye touched on the three strategies that have been or are being developed: research, technology and applications. He reminded everyone that ESE exists to provide objective, scientific information to decision-makers. The NASA Research Plan is thus built around providing specific answers to five big questions

relating to how Earth's climate is changing and what the consequences are for life on Earth. A series of 23 more specific questions fall under the five main questions. The questions are organized to address issues of variability, forcing, response, consequences, and prediction of the Earth System. More focus is placed on the first three areas in the early years (one has to understand the current state before one can predict and determine consequences) of the plan, but some work is being done in all five areas. Kaye also spoke about the Applications Plan. It breaks down into applications research, validation and verification, and applications demonstrations. NASA will partner with other federal agencies, and with state, local, and tribal governments to achieve their goals for this area. A number of priority theme areas have been established.

For the remainder of the talk, Kaye presented some remarks on the Government Performance and Results Act and how NASA is complying. He discussed the fiscal year 2002 plan and the performance review from fiscal year 2001. He tried to illustrate the difficulty of meeting metrics for an agency dealing in scientific research and satellite missions. Quantifying success in science is quite difficult so one has to be very careful about how one writes metrics. He also talked a little bit about the U.S. Global Change Research Plan and about the President's Rose Garden speech of June 11, 2001 on climate change. The Climate Change Research Initiative has been created as a result of directives from that speech, and the interagency effort organized under the Department of Commerce has led to the development of material that has been provided to the Administration for consideration.

Vanessa Griffin from NASA Goddard was the next speaker and her talk focused on the status of EOSDIS data processing and a

status report on the data system. Griffin briefly reviewed the definitions of beta, provisional and validated data products. She then reviewed data availability for each instrument on Terra. She showed a series of graphs that depicted how data processing is progressing and explained some of the peaks and valleys on each graph. This was followed by production graphs for each instrument on Terra and a depiction of the volume of data distributed. The presentation ended with some information on future plans for EOSDIS including discussion of how the upcoming Aqua launch will impact Terra data availability. Griffin also touched on plans for new missions and talked about the concept of data pools. She also discussed community input into the DAACs and the newly created Data Access Working Group. She ended with a discussion of outreach efforts including a new program for outreach to universities to provide new scientists with hands on training on searching for and ordering EOSDIS data.

Vince Salomonson from NASA Goddard spoke next and presented an update on MODIS data processing. He started with an overview of the high quality products that the instrument and attendant algorithms are capable of producing for atmosphere, ocean, and land studies. He then progressed into talking about the status and plans for data products. In particular, he described the status of "Collection 3" reprocessing of MODIS products and indicated that a full year of consistently processed products should be available by or very near the end of calendar year 2001. Using Level 1 and atmosphere products as examples, he showed how the status of products can be accessed on the Web through the MODIS Home Page. Most products are currently provisional, but many should soon reach validated status. Salomonson also indicated that a MODIS Data Products Review Team has been

established for the purpose of assessing how to provide improvements in the magnitude, timeliness, and consistency in the output of data products. He ended his talk by discussing the evolution of tools for accessing MODIS products. He talked about tools that currently exist and touched on future plans.

Session IV: Radiative Forcing

Bruce Wielicki, NASA Langley - Chair

The first speaker in the fourth session was **Hank Shugart** from the University of Virginia. His talk focused on land-atmosphere feedbacks in Southern Africa. Shugart and his colleagues are looking into the implications of the results of ecological modeling studies for assessing environmental change in Africa. The question posed by the research is whether or not two stable states exist for African savanna—one that is relatively richer in nutrients and one that is significantly nutrient deprived. There seem to be complex feedbacks between the environment and vegetation. Shugart et al. have been conducting model studies along with natural experiments in the field. He has been studying the so-called IGBP Kalahari Transect. A large rainfall gradient exists over the 1300 km north-south extent of the Kalahari and the vegetation varies considerably as a consequence. The underlying soil, however, is rather homogeneous and there are no significant changes in topography. This set of conditions makes it an ideal location for ecologic studies of vegetation response to variations in rainfall. From here, Shugart went on to describe the landscape vegetation model that is being developed. These models scale upward from leaf to patch to multi-patch in an effort to capture the heterogeneity of the vegetation. These are non-linear models. One of the models used in conjunction with a satellite-based tree cover product produced by the University of Maryland predicts changes in the burnable material to fuel wildfires across

Africa. A second model can produce detailed stem maps and will be used as an alternative to the tree cover maps to develop predictive maps of changes of fuels in the future. The intent of the project is to progress from using the satellite data as test data for the model. The hope is to develop predictive capabilities. Doing so might help in diagnosing regional emissions of CO₂ into the atmosphere, an important policy issue both locally and globally.

Robert Wood from the University of Washington gave the first of two talks that looked to assess the validity of the so-called Iris Hypothesis. Wood has been working with Dennis Hartmann, also from the University of Washington. The Iris Hypothesis comes from Richard Lindzen et al. and essentially states that as sea surface temperature increases, regions of high clouds associated with deep convection shrink in the tropics which lead to more outgoing longwave radiation and a strong negative forcing on climate. Lindzen postulates that this could help offset global warming. Wood gave some additional background on the subject. Clouds and water vapor are certainly a major uncertainty in climate modeling studies. It is well known that, in the tropics, regions of moisture correlate to regions of deep convection and that emitted radiation is larger in clear areas. Hence, Lindzen made his Iris Hypothesis and Wood and Hartmann set out to investigate its validity. Wood proceeded to review Lindzen's analysis and pointed out some weaknesses. Lindzen's idea is that the area of cirrus clouds around convection shrinks. Crucial factors in the Lindzen study seem to be cloud fraction and cloud-weighted SST. However, Wood and Hartmann have concluded that the correlation Lindzen finds is caused not by changes to the tropical high clouds associated with deep convection, but by changes in high clouds towards the subtropics. These subtropical clouds are separated from the deep convec-

tive regions by around 1000 km and unrelated to them physically. They found that a negative forcing could be produced without changing the amount of tropical cloudiness at all and, in fact, the negative forcing postulated by Lindzen seems to be an artifact of how they define cloud-weighted SST.

Lin Chambers from NASA Langley followed Wood and spoke about using data from CERES to test the Iris Hypotheses. She began by reviewing the Lindzen work and focused on his idea of atmospheric moisturization. He uses a 3.5° Box Model with categories for the extratropics, moist tropics (further subdivided into clear moist and cloudy moist regions) and dry tropics. Chambers sought to find out whether or not CERES data from TRMM supported Lindzen's hypotheses. The modeled radiative fluxes of Lindzen et al. are replaced by CERES directly observed broadband radiation fields. The observations show that the clouds have much higher albedos and moderately larger longwave fluxes than those assumed by Lindzen et al. As a result, decreases in these clouds would cause a significant but weak positive feedback to the climate system, instead of providing a strong negative feedback as Lindzen suggests.

Robert Cess from the State University of New York at Stony Brook spoke next and talked about changes in tropical cloudiness that were observed during the 1997-1998 El Niño. Satellite measurements of both cloud vertical structure and cloud-radiative forcing have been used to show that during the strong 1997/98 El Niño there was a substantial change in cloud vertical structure over the tropical Pacific Ocean. Relative to normal years, cloud altitudes were lower in the western portion of the Pacific and higher in the eastern portion. The reason for these redistributions was a collapse of the Walker circulation and

enhanced large-scale upward motion over the eastern Pacific, both caused by the lack of a zonal sea surface temperature gradient during the El Niño. It is proposed that these cloud structure changes, which significantly impact satellite measurements of the tropical Pacific's radiation budget, would serve as one useful means of testing cloud-climate interactions in climate models.

Andrew Dessler from the University of Maryland was the next speaker. His talk focused on the location and impact of thin cirrus clouds. The thesis is that thin cirrus clouds (clouds with optical depth $\ll 1$) play a potentially important role in the Earth system, both as a moderator of short and longwave radiation and as a regulator of the humidity of the stratosphere. The Moderate Resolution Imaging Spectro-radiometer (MODIS) onboard the Terra satellite has a channel at 1.375 μm that is specifically designed to detect these clouds. Using measurements obtained June 6-8, 2001 between 30°N-30°S, Dessler showed that these clouds are ubiquitous throughout the tropics, occurring in about half of the 1 km by 1 km MODIS pixels that had been identified as clear sky by the MODIS cloud-mask. The thin cirrus are not uniformly distributed, but appear more frequently near deep convection. These thin cirrus have optical depths generally below ~ 0.04 . Regressing longwave flux data from the CERES against optical depth, shows that these thin clouds decrease longwave flux by 0.69 W/m² per 0.01 increase in optical depth. This translates into longwave forcing of 3-4 W/m² near convection and zero away from convection. Over the whole tropics, the average longwave forcing is 0.9 W/m².

V. Ramanathan from Scripps Institution of Oceanography was next to speak and talked about aerosol forcing, climate, and the hydrological cycle. Specifically, he consid-

ered the impact of aerosols on radiative forcing. He showed results on the Asian Brown Cloud as observed by the Indian Ocean Experiment (INDOEX). This brownish haze extends all the way from the Himalyas to the equatorial Indian Ocean. The objective is to characterize Asian haze and he showed a graphic showing the constituents of Asian haze. Approximately 75% of the constituents appear to be anthropogenic in nature. He added that data from Terra may help reduce uncertainty about the impact of clouds in this region. Ramanathan is also considering how precipitation patterns will be impacted by Asian haze. His final observation was that Asian pollution bears a striking resemblance to the types of pollution that were common in this country 50 years ago. It is estimated that SO₂ emissions in Asia could double within 20 years.

Session V: Responses and Field Campaigns

Michael King, NASA Goddard - Chair

Phillip Russell was the first speaker in this session. His work involves combining suborbital and satellite measurements to study aerosols and gas radiative-climatic effects. Russell showed illustrative results from three recent field campaigns: the Puerto Rico Dust Experiment (PRIDE), the Southern African Regional Science Initiative (SAFARI-2000), and the Asia-Pacific Aerosol Characterization Experiment (ACE-Asia). Results included the use of airborne sun photometry to test aerosol retrievals by MODIS, MISR, TOMS, and SeaWiFS, plus many comparisons among the airborne sun photometer measurements and those by ground-based and airborne radiometers, lidars and *in situ* samplers and sensors. Also shown was the use of airborne solar spectral flux radiometry to measure aerosol absorption, which can be combined with airborne sun photometry to determine aerosol single scattering albedo (the ratio of

scattering to extinction). Comparing and combining the suborbital and satellite measurements allows the development of a mutually consistent description of aerosol properties and effects, including chemical and microphysical makeup, optical properties, and effects on satellite-measured radiance and radiative energy exchange (aerosol forcing). The talk concluded with an illustration of combining satellite and suborbital measurements to estimate aerosol radiative forcing in the western Pacific region studied by ACE-Asia. Specifically, the SeaWiFS-derived monthly average aerosol optical depth for April 2001 was combined with aerosol intensive properties and vertical distributions determined in ACE-Asia. These combined inputs were used to compute the aerosol depletion of downwelling solar radiation at the surface and the aerosol increase in upwelling radiation at the top of the atmosphere.

The next speaker was Jeffrey Reid from the SPAWAR Systems Center in San Diego, CA, speaking on the Fire Locating and Modeling of Burning Emissions (FLAMBE) project. This project was initiated by a NASA IDS grant, and includes cooperation between NASA, US Navy, NOAA and university scientists. The purpose of FLAMBE is to monitor biomass burning and burning emissions on a global scale through the integration of remote sensing data with global and regional transport models in real time. FLAMBE is currently utilizing real time satellite data from GOES weather satellites and fire products based on the Automated Biomass Burning Algorithm (ABBA) that are generated for the Western Hemisphere every 30 minutes with only a 90-minute processing delay. The project is currently collaborating with other investigators to gain global coverage using MODIS. Once generated, the fire products are used to input smoke fluxes into the Naval Research Laboratory Aerosol Analysis and Prediction System, where advection

forecasts are performed for up to 5 days. Subsequent radiative transfer calculations are used to estimate top of atmosphere and surface radiative forcing as well as surface layer visibility. Validation studies in combination with AERONET sun photometer data shows that the FLAMBE system correlates well with observations. Data are available to the scientific community in real time, including smoke and fire products for planning and research purposes. A web site has been developed (aerosol.spawar.navy.mil/flambe) that distributes the fire product and transport data.

Robbie Hood from NASA Marshall was the next speaker. She gave an overview of the Fourth Convection and Moisture Experiment (CAMEX-4) that has recently been completed. She started by going over the history of the CAMEX program and reviewing the participants. NASA undertook this mission jointly with NOAA. She discussed the main research areas, three main questions, and then more specific research topics. She also discussed the field operations that employed two aircraft (a DC-8 and an ER-2) and an unpiloted aerospace vehicle known as Aerosonde. Hood reported that there were not as many storms during CAMEX-4 as during CAMEX-3 but still they were able to obtain some interesting results. They don't really have a good explanation why hurricane activity was suppressed this season. The westerlies were quite strong and, while they didn't completely inhibit formation of tropical cyclones, they may have prevented them from becoming intense storms. Hence there were quite a number of fairly weak storms and few impacted the US mainland. She then discussed each storm that the CAMEX-4 investigators examined (Chantale, Erin, Gabrielle and Humberto) and reviewed key accomplishments.

Steve Running from the University of

Montana was the final speaker for the second day. He talked about recent research to examine the cause of accelerated vegetation productivity in North America. Running spoke about the so-called North American carbon sink. Enhanced carbon uptake implies enhanced vegetation productivity, that is plants absorb CO_2 . So the question that Running's group is trying to answer is: What is forcing this enhancement in vegetation productivity? Could it be warming, increased CO_2 , or land cover change? Running showed a carbon balance time series for the whole century and Net Primary Productivity (NPP) definitely seems to be on the rise! Running sought to determine if the CO_2 signal alone could account for this increase and found that it could not. In fact the precipitation signal over the century tends to correlate with the NPP signal much better than any other factor. For most of the U.S., water appears to be the limiting factor in determining NPP. Running also showed hydrologic trends for the continental U.S. Humidity levels are trending upward. Hence, combining increased humidity with increased precipitation makes a strong case that water is the most important factor in explaining increased NPP. CO_2 increases are having an impact, but precipitation changes seem more important. Running mentioned that there is inadequate land cover data to judge what impact change in land cover is having on the changes in NPP that have been observed.

Thursday, November 1, 2001

Session VI: Numerical Weather and Climate Prediction

Robert Atlas, NASA Goddard - Chair

Michele Rienecker from NASA Goddard was the first speaker and she presented an overview of the NASA Seasonal-to-Interannual Prediction Project (NSIPP). She reviewed the project goals and then presented some of the activities that are

specifically related to satellite observations of the land and ocean. The primary measurements of interest are from satellite altimetry, AVHRR, and microwave measurements of the surface wind field and of soil moisture. The ocean is sparsely sampled; the exception to this is in the tropical Pacific, with the Tropical Atmosphere Ocean mooring array deployed as a result of the 1982-1983 El Niño. Satellite data are clearly helping to increase the data coverage over the global ocean, but samples only the ocean surface. Data assimilation is crucial to project the surface information to the subsurface ocean for the initialization of coupled forecasts of El Niño. Rienecker demonstrated the Ensemble Kalman Filter assimilation technique used to merge data from satellites with ocean models. On land, predictability studies show the potential for assimilated soil moisture data to increase the accuracy of precipitation predictions. Combining soil moisture data and SST data enhances the predictability of summertime precipitation considerably beyond SST data alone. Assimilation focuses on soil moisture measurements, and to assist a new soil moisture dataset is being developed by the Hydrologic Sciences Branch at NASA Goddard. In the future, NSIPP plans to use sea surface temperature data from MODIS, surface altimetry from Jason, and soil moisture and snow data from AMSR.

Bob Atlas from NASA Goddard spoke next on the subject of atmospheric modeling and data assimilation at the Data Assimilation Office (DAO). He briefly reviewed the background and mission of the DAO and then reviewed the history of data assimilation at the DAO. He discussed the evolution of the GEOS system, which is now up to version 4. He discussed improvements that have been made to the model over time. Atlas showed some results from GEOS-3 that fairly accurately depict meteorological phenomena such as cyclones and fronts.

The next portion of the presentation focused on GEOS-4, the state-of-the-art model being employed by DAO. It is a finite-volume GCM and simulates meteorological phenomena even better than GEOS-3. It also does a very realistic simulation of hurricanes for the resolution it employs and performs very well for analysis and prediction. A criticism of GEOS-3 was that it was not computationally efficient; GEOS-4 is much more efficient. The improved computational efficiency should allow GEOS-4 to be used for climate studies. Atlas ended by discussing major development plans at DAO for the next 2-5 years. These include improvements in cloud microphysics, greenhouse gas chemistry, sea ice simulation, skin temperature and the implementation of geodesic grids, which was also discussed in the final presentation of the session.

Richard Rood from NASA Goddard was the next speaker. He talked about the Joint Center for Satellite Data Assimilation (JCSDA), a joint NASA/NOAA venture. Rood discussed the motivating factors behind the creation of this program. Among them were: a need to make more widespread utilization of satellite data; a need to prepare for the influx of data from future satellite missions; and a need for end-to-end participation by data assimilation experts in the creation of new instruments. These ideas are consistent with existing science structure. Additionally, there is a critical need to establish pathways between research and operations, retrieval and assimilation and climate and weather. Rood went on to discuss the organizational structure of JCSDA. NASA and NOAA are currently involved and the Navy might also get involved. He then discussed four problem areas where JCSDA feels it can contribute; these include short-term research, long-term systems research, infrastructure, and projects. He also talked about the critical links to instrument teams.

Assimilation needs to be considered from day one of the instrument design process. Fast forward models and radiance products have to be developed and retrieval problems addressed. The idea is to figure out which projects are most important scientifically and mesh that with those that are most important from a programmatic standpoint. He presented an overview of infrastructure science focusing on surface measurements and radiation measurements. These are linked to the various geophysical parameters that are of interest. The focus is on the parameters that need to be more precisely and accurately measured rather than on specific instruments.

Cynthia Rosenzweig from the NASA Goddard Institute for Space Studies discussed the Metropolitan East Coast Regional Assessment (MECRA) for USGCRP. It focuses on climate change and a global city—New York. Large cities are at the forefront of both vulnerability and adaptation to climate impacts. The MECRA is one of the regional components of the U.S. National Assessment of the Potential Consequences of Climate Variability and Change, organized by the U.S. Global Change Research Program. The goal of each regional assessment is to investigate potential impacts of climate variability and change on the natural systems and human activities of a specific geographical area of the United States. The assessment covered the 31 counties of the New York City Metropolitan Region and examined how three interacting elements of large cities react and respond to climate variability and change. These elements are people (i.e., socio-demographic conditions), place (i.e., physical and ecological systems), and pulse (i.e., decision-making and economic activities). Seven sector studies form the core of the interacting elements: Sea-Level Rise and Coasts, Infrastructure, Wetlands, Water Supply, Public Health, Energy Demand, and Institutional Deci-

sion-Making. The results of the MECRA indicate that the biophysical and societal impacts of projected climate change will be primarily negative over the long term. Furthermore, the assessment illustrates that environmental conditions of the Metropolitan East Coast Region (MECRA) will be more dynamic than the recent past. Regional decision-makers need to create policies that will help the MECRA to adapt and mitigate climate change simultaneously and equitably. NASA has an important role to play in assessment research, incorporating remote sensing tools and climate models to project global and regional climate change and associated impacts. These activities contribute to improved decision-making in regional and local governments and to education and public outreach.

Moustafa Chahine from Jet Propulsion Laboratory spoke next and talked about the contributions the AIRS/AMSU/HSB instruments on the Aqua satellite are expected to make toward improving numerical weather prediction. Chahine started with some background motivating this research. The Atmospheric Infrared Sounder (AIRS) with the Advanced Microwave Sounding Unit (AMSU) and the Humidity Sounder for Brazil (HSB) on the Aqua mission represent the most advanced sounding system ever deployed in space. Improving the world weather observing system is an essential objective of Earth science because the atmospheric phenomena that govern long-term climate are the same as those which manifest themselves in transient weather perturbations. AIRS/AMSU/HSB observations are, therefore, equally applicable to both climate and weather studies for assimilation into the operational forecast by General Circulation Models and will lead to substantial increase in mid- and long-range weather forecast skills. The AIRS/AMSU/HSB sounding system is capable of measuring atmospheric

temperature profiles with radiosonde accuracy of 1° K per 1 km thick layers under both cloud-free and cloudy conditions, in the presence of up to 80% clouds in the fields of view, while the accuracy of the derived moisture profiles will exceed that obtained by radiosondes. Cloud-free and cloud-cleared radiances will also be produced for direct assimilation into MWP models. Furthermore, the sounding system provides additional data on land and ocean surface temperature and emissivity as well as cloud cover.

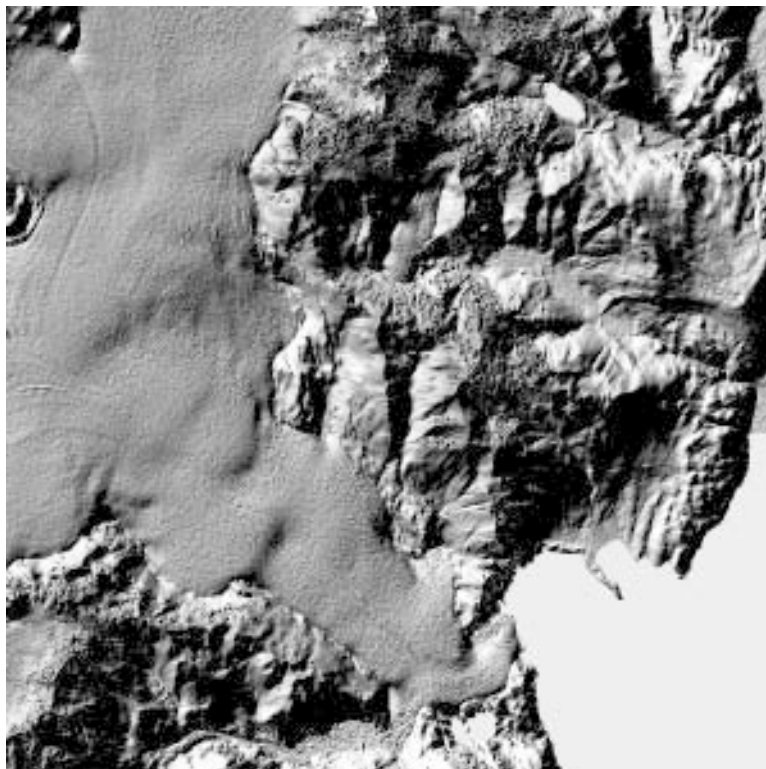
Steven Ghan from the Pacific Northwest National Laboratory was the next speaker. His topic was global climate simulation at 5 kilometer resolutions. Assessments of the impacts of climate change typically require information at scales of 10 km or less. Such a resolution will not be achieved by global climate models for many years. Ghan and his colleagues have developed an alternative to explicit resolution that can meet the needs of climate change impact assessment now. They apply a physically based, subgrid-scale treatment of the influence of orography on temperature, clouds, precipitation, and land surface hydrology to a global climate model. The treatment represents subgrid variations in surface elevation in terms of fractional area distributions of discrete elevation classes. For each class it calculates the height rise/descent of air parcels traveling through the grid cell, and applies the influence of the rise/descent to the temperature and humidity profiles of the elevation class. Cloud, radiative, and surface processes are calculated separately for each elevation class using the same physical parameterizations used by the model without the subgrid parameterization. The simulated climate fields for each elevation class can then be distributed in post-processing according to the spatial distribution of surface elevation within each grid cell. Parallel 10-year simulations with and without the subgrid

treatment have been performed. The simulated temperature, precipitation and snow water are mapped to 2.5 minute (~ 5 km) resolution and compared with gridded analyses of station measurements. The simulation with the subgrid scheme produces a much more realistic distribution of snow water and significantly more realistic distributions of temperature and precipitation than the simulation without the subgrid scheme. Moreover, the grid cell means of most other fields are virtually unchanged by the subgrid scheme. This suggests that the tuning of the climate model without the subgrid scheme is also applicable to the model with the scheme.

Todd D. Ringler from Colorado State was the final speaker of the session and of the meeting. He has been working with David A. Randall on using geodesic grids for modeling and data analysis. Ringler provided an introduction to geodesic grids and highlighted their potential for both numerical modeling and data analysis. The Colorado State University (CSU) AGCM uses spherical geodesic grids to discretize the surface of the sphere. These grids have several properties that make them attractive for numerical modeling. The grid-cell area and distance between grid cells is nearly constant over the entire sphere. This grid-cell area varies by less than 5% over the sphere and the distance between cell centers varies by less than 20% over the sphere. This results in a highly homogenous grid to tile the sphere. The grid is also highly isotropic. As opposed to triangular or quadrilateral grids, all grid-cell neighbors on geodesic grids lie across cell walls. This results in a more accurate simulation of isotropic processes, such as gravity wave propagation. The properties that make geodesic grids attractive for numerical modeling also make these grids an attractive choice for data analysis. These grids can be mapped to a logically two-dimensional data structure, as well as a one-dimensional data

structure. It is also possible to remap this system into other coordinate systems and interpolate the results. They use a system called the Spherical Conservative

Remapping and Interpolation Package that can interpolate data to and from geodesic grids in an efficient and robust manner.



The patagonian ice field is situated in Los Glaciales National Park, Argentina. It is the largest continental ice field outside the Antarctic. (Greenland is an island.) With a length of about 600 kilometers and a surface of nearly 2,300 square kilometers, this area is four times larger than the Alps.

The picture above shows the Viedma glacier flowing to Lake Viedma. Gray shades correspond to elevation, based on data acquired by the Shuttle Radar Topography Mission (SRTM). The explorer Antonia de Viedma visited this region first in 1782. At the top of the image, just to the right of the glacier, is the 3,375-meter-high Mount Fitzroy. Because of the steepness of the mountain and the persistently poor weather it is very hard to climb.

Image courtesy German Aerospace Center SRTM team

KUDOS

The following awards were presented to EOS colleagues at the recent American Geophysical Union Annual Meeting in San Francisco.

Dr. James E. Hansen, Director of NASA's Goddard Institute for Space Studies, an EOS Interdisciplinary Science (IDS) Principal Investigator and Adjunct Professor at Columbia University, was awarded the 2001 Roger Revelle Medal "for outstanding contributions toward an understanding of the Earth's atmospheric processes, including its dynamics, chemistry, and radiation; the roles of atmosphere, atmosphere-ocean coupling or atmosphere-land coupling in determining the climate, biogeochemical cycles, or other key elements of the integrated climate system."

Dr. Byron Tapley, an Earth System Science Pathfinder Principal Investigator and professor at University of Texas, was awarded the 2001 Charles A. Whitten Medal "for his original and innovative applications of statistical orbit determination theory and leadership in understanding the Earth's geodesy."

Dr. Paul Falkowski, an EOS Interdisciplinary Science (IDS) Co-Investigator and professor at Rutgers University, was elected a Fellow "for shaping our understanding of biogeochemical cycles in the oceans and their coupling to climate change."

Dr. Roger C. Bales, an EOS Interdisciplinary Science (IDS) Co-Investigator and professor at University of Arizona, was elected a Fellow "for outstanding contributions to the understanding of the interface of hydrology and biogeochemistry in snow, ice, and porous media."

The following awards were presented to EOS colleagues at the recent American Meteorological Society Annual Meeting in Orlando:

Dr. V. Ramanathan, a Co-Investigator on the CERES Science Team and professor at the University of California, San Diego, was awarded the Carl-Gustaf Rossby Research Medal "for fundamental insights into the radiative roles of clouds, aerosols, and key gases in the earth's climate system."

Dr. Lee-Lueng Fu, a Jason-1 and TOPEX/Poseidon Project Scientist and Senior Research Scientist and Land Scientist at the Jet Propulsion Laboratory, was awarded the Verner E. Suomi Award "for simultaneously maintaining the science focus of the TOPEX/Poseidon mission and producing datasets of great importance across the earth sciences."

Dr. Robert Bales, an EOS Interdisciplinary Science (IDS) Co-Investigator and professor at the University of Arizona, was elected a Fellow of AMS.

The following students received NASA's Earth Science Enterprise Graduate Fellowships:

Matthew J. Haugland, The University of Oklahoma, Norman, Oklahoma

Stephanie A. Stroman, The University of Oklahoma, Norman, Oklahoma

Tracy K. Depue, The Colorado State University, Fort Collins, Colorado

Daryl T. Kleist, The University of Wisconsin-Madison, Madison, Wisconsin

AND . . .

Dr. David Halpern, a co-investigator of the EOS SeaWinds Team and a Senior Research Scientist at the Jet Propulsion Laboratory, has been elected a Fellow of the American Association for the Advancement of Science (AAAS) "for basic research in air-sea interactions in tropical oceans and for coordinating international efforts in measuring ocean surface quantities from satellites."

The Earth Observer staff would like to congratulate these members of the EOS community for their outstanding contributions to NASA and the Earth Observing System Program.

USGS to Distribute EO-1 Data

—Ray Byrnes, rbyrnes@usgs.gov, USGS, Reston, VA

—Ron Beck, beck@usgs.gov, USGS, Sioux Falls, SD

(Excerpts from a Press Release dated January 22, 2002)

The U.S. Geological Survey (USGS) is teaming up with NASA to extend the useful life of the Earth Observing 1 (EO-1) technology demonstration satellite. NASA officially completed the EO-1 mission in November 2001, but the two agencies, already management partners for the Landsat satellite program, have agreed to work together to extend EO-1 operations through February 2002 and then continue on a month-by-month basis.

EO-1 archive data and new acquisitions from two of its three prototype sensors, the Advanced Land Imager and Hyperion, can now be ordered from the USGS, with the first products slated to be shipped in early February.

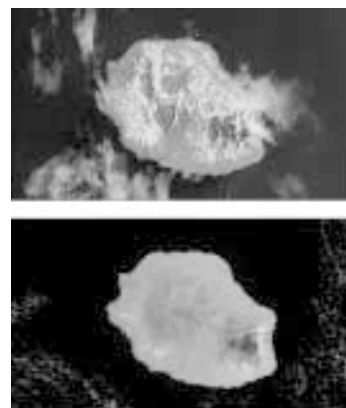
Extending the EO-1 mission enables both agencies to sustain their research and development efforts while providing opportunities for the broader research community to obtain sample data over specified sites. USGS and NASA scientists believe both Landsat-like and “hyperspectral” data types from EO-1 could prove to be valuable in global land cover studies, ecosystem monitoring, mineral and petroleum prospecting, and agricultural crop discrimination and assessment, among other potential applications. No restrictions will be placed on users obtaining EO-1 products from the USGS.

Although this demonstration satellite carries no back-up systems, it has performed optimally since its November 2000 launch and still has enough fuel onboard to maintain its orbital position for at least two more years. Barring technical failure, data user demand from across the remote sensing community will determine the longevity of extended mission operations.

EO-1 data is sold at the cost of satellite operation, data processing, and customer interface costs, with the first-scene acquisition attempt by either sensor costing \$2000. Allowances will be made for repeat attempts due to excessive cloud cover, but on a limited basis. Previously captured data can be ordered from the EO-1 archive at \$500.00 per scene from each sensor. A small number of sample scenes will also be available at no cost via electronic retrieval.

The USGS and NASA will review EO-1 operations on a monthly basis. Depending on order volume and spacecraft health, satellite decommissioning could occur as early as April 2002 or as late as the spring of 2005.

More information on data inquiries and ordering is available at eo1.usgs.gov or by calling USGS Customer Services at (605) 594-6151. Information about the EO-1 satellite and sensors is available at: eo1.gsfc.nasa.gov.



Réunion Island Volcano Erupts

On January 16, 2002, lava that had begun flowing on January 5 from the Piton de la Fournaise volcano on the French island of Réunion abruptly decreased, marking the end of the volcano's most recent eruption. These MODIS images of Réunion, located off the southeastern coast of Madagascar in the Indian Ocean, were captured on the last day of the eruption (top) and two days later (bottom).

The volcano itself is located on the southeast side of the island and is dark gray compared to the surrounding vegetation. Beneath clouds and smoke, MODIS detected the hot lava pouring down the volcano's flanks into the Indian Ocean. Earthquake activity on the northeast flank continued even after the eruption had stopped, but by January 21 had dropped to a sufficiently low enough level that the 24-hour surveillance by the local observatory was suspended.

Réunion is essentially all volcano, with the northwest portion of the island built on the remains of an extinct volcano, and the southeast half built on the basaltic shield of 8,630-foot Piton de la Fournaise. A basaltic shield volcano is one with a broad, gentle slope built by the eruption of fluid basalt lava. Basalt lava flows easily across the ground remaining hot and fluid for long distances, and so they often result in enormous, low-angle cones.

The Piton de la Fournaise is one of Earth's most active volcanoes, erupting over 150 times in the last few hundred years, and it has been the subject of NASA research because of its likeness to the volcanoes of Mars.

Image courtesy Jacques Descloitres, MODIS Land Rapid Response Team at NASA GSFC

PO-DAAC User Working Group Meeting, Pasadena, CA

— Victor Zlotnicki (*vz@pacific.jpl.nasa.gov*), Jet Propulsion Laboratory

The User Working Group of the Physical Oceanography Distributed Active Archive Center (PO-DAAC's UWG) held a meeting November 14-15, 2001, at the Raytheon ITSS facility in Pasadena, California.

Present were UWG members Robert Evans (Chair, U. of Miami), David Glover (Woods Hole Oceanog. Inst.), Sydney Levitus (NOAA/NODC), W. Tim Liu (Jet Propulsion Lab.), C. K. Shum (Ohio State U.), Detlef Stammer (U. California-San Diego), and Victor Zlotnicki (JPL). Absent due to illness was Catherine Gautier (U. California-Santa Barbara). On behalf of PO-DAAC, participants included Donald Collins (Manager), Robert Benada (Deputy Mgr.), Christopher Finch (System Engineer), Jorge Vazquez (science), Johan Berlin (System Administration), Sue Heinz (User Services), Ying Mei Chen (Sustaining Engineering), as well as staff members Kessler, Buning, Armstrong, Reed, Lungu, Sumagaysay and, again, Zlotnicki (science). Susan Olden, ESDIS, joined by telephone. Stephen Wharton, NewDISS, joined by telephone the morning of November 14.

D. Collins made available the PO-DAAC presentation viewgraphs electronically before the meeting. S. Wharton did likewise with his NewDISS presentation.

S. Wharton explained the vision of NewDISS: to allow new missions, science teams, and applications projects to implement their own data systems and services while maintaining an aggregated system-wide interoperability. Among the many points he made: 1) NewDISS is not a large data system development effort with centrally controlled requirements, design, implementation, and operation; 2) NewDISS emphasizes the importance of engaging the data user and producer communities in the process; 3) NewDISS teams selected by NASA will develop and operate flight mission and science/applications data systems.

He envisions a future network of ESE data systems and providers that is flexible, effective, and accountable. Questions from the UWG centered on clarification of the 'Petri Dish' graphic depicting the relation of the various elements of NewDISS: What is the difference between applications and science data centers? What would PO-DAAC look like in that graphic? What is the mechanism to fund services that cut across projects?

D. Collins presented the next major topic, labeled "Business Development Issues." NewDISS is a competitive environment, where each DAAC or other data activity

competes to perform data services for new NASA Projects, or other data producers, and is funded to perform these services by the data producer. A brief description of some key future missions was given (GRACE, Salinity, and others). PO-DAAC currently has agreements with TOPEX/Poseidon, SeaWinds/QuikScat, Jason-1, GRACE, and SeaWinds/ADEOS II. All agreements except GRACE are funded by the ESDIS project. PO-DAAC is currently actively pursuing other such agreements with proposed but not yet approved missions, as well as products generated by the user community. Several issues arise here. For small NASA missions of the ESSP type, each Project Manager will only fund the marginal cost of delivering their data once, mostly to the immediate science team, since flight hardware and other components have priority. For user-generated products, the user (usually a scientist or small science team) will not pay a Data Center for distribution and user support when placing them on an ftp site might satisfy the short-term goals. For projects, such choices are firmed up early before mission approval; hence the need to be part of the proposal, or close to the proposers. JPL missions provide important synergies: shared personnel, facilities, and local engineering talent. However, they are not guaranteed.

R. Benada presented the next topic, the FY 2001 accomplishments. PO-DAAC delivered actual data to about 5,580 users by ftp (up from 4,200 the year before), and provided media (CD-ROM, tape, etc.) to about 1,040 science users (down from 1,800 the year before). The 1300 user-increase in electronic access more than offsets the 800 user-drop in media access, since PO-DAAC has actively encouraged electronic data retrieval to minimize costs. In addition, PO-DAAC served another 11,700 general public and education users (down from 45,000 the year before) as non-

serious users were actively rejected this past year. The main 'live' datasets were from TOPEX/Poseidon and QuikScat, plus Sea Surface Temperatures from AVHRR and ATSR, plus a number of data sets from previous satellites. Details of the hardware architecture and personnel structure were also presented. Efforts during the past year were also focused on system security (NASA 2810.1 requirements) and building a reliable real-time system to handle AMSR/ADEOS II and other data.

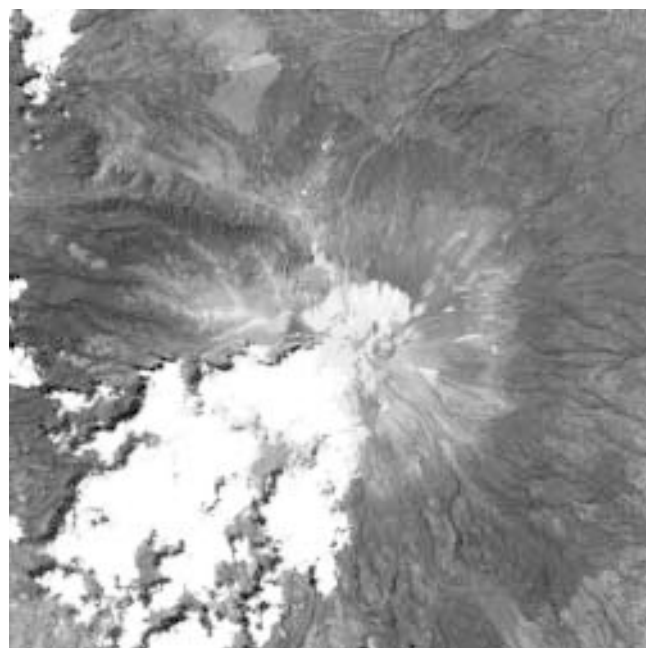
D. Collins and R. Benada then presented the FY 2002 Annual Work Plan (which the UWG had previously exchanged by email, and approved before submission to GSFC). Active preparations for Jason-1 (launched December 7, 2001), GRACE, AMSR-E on Aqua, and AMSR on ADEOS II are underway, as is support for derived datasets (e.g., MODIS Sea Surface Temperatures in

coordination with the GSFC DAAC, WOCE CD-ROM, etc.), plus software maintenance or minor development (e.g. GIS support, subsetting, EDGRS to SCRS statistics conversion, etc.).

The lively discussion during and after the formal presentations touched upon several topics, briefly listed in this paragraph. 1) The need for predictable funding (there is no lack of ocean satellite data). 2) The comparison of the cost of running a data center against the cost of science investigations or data synthesis activities. 3) The need to educate NASA and scientists on the difference between the work done by a DAAC against data delivered by a graduate student with an ftp site. 4) The need for data 'version control' and the difficulty of maintaining it when the data move electronically rather than on hard media. 5) The usefulness of bringing TMI data to

PO-DAAC. 6) The need for PO-DAAC to deliver many derived products from altimetry and scatterometry, e.g., mean sea surface height, mean and seasonal wave height, mean and seasonal wind, and higher resolution mapped products. 7) The need to manage hardware renewal in a planned manner.

The meeting adjourned at noon on November 15.



Popocatepetl Heats Up

From its space-based perspective aboard NASA's Terra satellite, the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) was watching as Popocatepetl awoke from its slumber late last year. ASTER acquired this composite image of the volcano on September 6, 2000. In this scene, dark gray represents vegetation, bright white represents clouds, and light gray represents bare rocks. The lava dome is clearly visible in the crater.

User Working Group Meeting: Socioeconomic Data and Applications Center, November 2001

—Robert S. Chen (bchen@ciesin.columbia.edu) and Deborah Balk (dbalk@ciesin.columbia.edu), Columbia University



Original gridded population of the world dataset created in 1994-1995. Black represents the most densely populated areas.

The User Working Group of the Socioeconomic Data and Applications Center (SEDAC) met November 8-9, 2001 at the Morningside Heights campus of Columbia University in New York. The focus of the meeting was to review SEDAC's progress in FY01 and to initiate discussion of SEDAC's longer term strategic priorities for development of new data products and services.

This was the first meeting of the SEDAC UWG since Prof. Michael Goodchild of the University of California, Santa Barbara, became the new chair. The UWG has also gained six new members, and the terms of two members ended in 2001. The current membership list as of January 2002 is given at the end of this article.

Background

SEDAC is one of eight Distributed Active

Archive Centers (DAACs) in the Earth Observing System Data and Information System. SEDAC's core mission is to synthesize Earth science and socioeconomic data and information in support of research, applied, and policy users and to serve as an "Information Gateway" between the socioeconomic and Earth science communities.

SEDAC supports the Earth Science Enterprise research strategy with regard to human-induced changes in the Earth System and consequences of change for human civilization. SEDAC also serves many applied and policy users from around the world and participates in a range of international programs and networks including the World Data Center system of the International Council of Scientific Unions (ICSU), the Intergovernmental Panel on Climate Change (IPCC), and the

International Human Dimensions of Global Environmental Change Programme (IHDP).

The SEDAC UWG typically meets twice per year. Its membership is drawn from a wide range of scientific disciplines including the Earth sciences, social sciences, and computer science, and includes representatives from applied user communities such as the press and state-level organizations. The UWG's primary role is to advise SEDAC and NASA on user community needs, on SEDAC's progress in meeting those needs, and on priorities for addressing emerging issues and challenges.

Review of FY01 Progress

The November meeting reviewed SEDAC's recent progress in developing and releasing new data products and services. This included release of the Gridded Population of the World (GPW), Version 2 dataset in final form along with derived tabular and ancillary data and a detailed working paper; dissemination of the Oak Ridge National Laboratory LandScan 2000 dataset and the 2001 Environmental Sustainability Index database and report; and publication of two online, peer-reviewed articles concerning global population projections. During this period, SEDAC also released an interactive Web site on "Potential Impacts of Climate Change on World Food Supply: Datasets from a Major Crop Modeling Study" and a Web site in support of the Population Environment Research Network (see box on Page 20).

Four main activities received special attention. In response to a prior UWG recommendation, SEDAC had provided extensive support to the 2001 Open Meeting of the Human Dimensions of Global Environmental Change Research Community, held October 6-8, 2001, in Rio de Janeiro, Brazil. One of SEDAC's

Project Scientists, Marc Levy, served as co-chair of the International Scientific Planning Committee. SEDAC is the host of the meeting Web site and coordinated abstract submission and selection, registration, and subsequent online dissemination of papers and presentations. Six papers by the SEDAC staff on a variety of topics made it through the review process and were presented in Rio. In addition, two SEDAC staff members led a two-day metadata training session after the Open Meeting that included 12 participants from developing countries (funded under a cooperative agreement with the U.S.

Federal Geographic Data Committee). Approximately 275 researchers from 50 different countries and a range of disciplines attended the Open Meeting, and by all accounts found the meeting valuable and stimulating. Planning for the 2003 Open Meeting has begun.

A second set of activities revolve around new data products based in part on SEDAC's global gridded population data. In response to strong interest from the IPCC Task Group on Climate Impact Assessment (TGCIA), SEDAC is developing a set of projected spatial distributions of

population and income consistent with the scenarios developed for the IPCC Special Report on Emission Scenarios (SRES). SEDAC Project Scientist Stuart Gaffin, who was one of the SRES lead authors, is working closely with the TGCIA and with the SRES modeling groups to ensure that the projected population and income scenarios meet the needs of the international impact assessment community. SEDAC is also working with the International Food Policy Research Institute (IFPRI) and the World Bank to develop a detailed global database on urban and rural population distribution, expected to be of

New SEDAC Data Products and Services

Online Data

- Gridded Population of the World, Version 2, including new ancillary and tabular data, sedac.ciesin.columbia.edu/plue/gpw
- LandScan 2000, sedac.ciesin.columbia.edu/plue/gpw/landscan
- Potential Impacts of Climate Change on World Food Supply Data Sets from a Major Crop Modeling Study, sedac.ciesin.columbia.edu/giss_crop_study/index.html
- Environmental Sustainability Index, www.ciesin.columbia.edu/indicators/ESI/
- Ramsar Wetlands Data Gateway prototype, sedac.ciesin.columbia.edu/ramsardg/

Online Guides

- "A Guide to Global Population Projections," Demographic Research, Vol. 4, Article 8, www.demographic-research.org/.
- "World Population Futures," Population Bulletin, Vol. 56, No. 3, www.prb.org/Content/NavigationMenu/PRB/AboutPRB/Population_Bulletin2/World_Population_Futures.htm
- "Transforming Population Data for Interdisciplinary Usages: From Census to Grid" (working paper), sedac.ciesin.columbia.edu/plue/gpw/GPWdocumentation.pdf
- CIESIN Metadata Resources Guide (beta version), beta.www.ciesin.columbia.edu/metadata.html

Other SEDAC-Supported Information Resources

- Population Environment Research Network, www.populationenvironmentresearch.org/
- United Nations Geographic Information Working Group, Second Administrative Level Boundaries Project site, sedac.ciesin.columbia.edu/UN/UNGIWG/
- Papers presented at the 2001 Open Meeting of the Human Dimensions of Global Environmental Change Research Community, sedac.ciesin.columbia.edu/openmeeting/downloads.html
- Papers presented at the Workshop on Photooxidants, Particles, and Haze across the Arctic and North Atlantic: Transport Observations and Models, www.ciesin.columbia.edu/pph/papers.html

broad interest to both natural and social scientists.

The third effort reviewed at the meeting was the ongoing development and updating of online information resources, generally known as “guides.” In support of its Information Gateway mission, SEDAC maintains several different types of guides, including “thematic” guides on a number of human dimensions research topics as well as an extensive guide to human dimensions metadata. SEDAC is currently conducting a major overhaul and update of a number of these guides. In addition, SEDAC has recently published two guides on population projections in the peer-reviewed literature (*Demographic Research and the Population Bulletin*) which are available online at www.ciesin.columbia.edu/TG/PP/pp-home.html.

Finally, the UWG reviewed progress in developing the Ramsar Wetlands Data Gateway, an online tool developed in support of the Ramsar Convention on Wetlands. The current prototype provides access to an integrated, spatial database on the more than 1,000 wetlands around the world designated as Ramsar sites, including detailed environmental, ecological, and socioeconomic data reported through the treaty secretariat, spatial data on population density and land cover, and location and boundary data. The prototype also directly links with the USGS Landsat 7 Data Viewer to provide comparable imagery for Ramsar sites.

Comments and Recommendations

The UWG, in its recommendation letter, endorsed strong SEDAC involvement in planning for the 2003 Open Meeting,

emphasizing that it is an “excellent opportunity for SEDAC to advance its basic mission, particularly at the international level.” The UWG noted the “exciting developments with respect to gridded world population distributions...and the high level of interest in the user community” and highlighted the key role that such data products play in adding value to remotely sensed data. They were pleased by the data integration and dissemination approach embodied in the Ramsar Wetlands Data Gateway prototype and suggested that they “would like to see this approach generalized across the entire set of SEDAC holdings, in a homogeneous interface that demonstrates a high level of interoperability between individual data sets.”

With regard to online guides, the UWG recommended that new guides focus on remote sensing and, in particular, the

UWG Membership as of January 2002

Michael F. Goodchild, Department of Geography, University of California, Santa Barbara, Chair
 Robert W. Corell, American Meteorological Society; Susan L. Cutter, Department of Geography, University of South Carolina;
 David Easterling, National Climatic Data Center; William E. Easterling, Department of Geography, Pennsylvania State University;
 Myron P. Gutmann, Inter-University Consortium for Political and Social Research, University of Michigan; Robert Harriss, Environmental and Societal Impacts Group, National Center for Atmospheric Research; Chris J. Johannsen, Laboratory for Applications of Remote Sensing, Purdue University; Dan Keating, The Washington Post; Susan Carson Lambert, Office of Geographic Information, State of Kentucky; Melanie Loots, University of Illinois at Urbana-Champaign; Neil Leary, International START Secretariat; Joel Morrison, Center for Mapping, Ohio State University; Dennis S. Ojima, Natural Resource Ecology Laboratory, Colorado State University; Daniel Reifsnyder, U.S. Department of State; Ronald R. Rindfuss, Department of Sociology, the University of North Carolina; Cynthia E. Rosenzweig, Goddard Institute for Space Studies, NASA (ex officio); June Thormodsgard, EROS Data Center, US Geological Survey (ex officio)

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 Chris Small, SEDAC Project Scientist, small@ldeo.columbia.edu, (845) 365-8354
 SEDAC User Services, ciesin.info@ciesin.columbia.edu, (845) 365-8920, fax (845) 365-8922.

application of remote sensing to understanding human aspects of the Earth system, the integration of socioeconomic and environmental data, and the use of SEDAC's data resources and services. They also recommended regular review of current and future guides to ensure that they do not become outdated.

Strategic Planning

During the past several UWG meetings, it has addressed various aspects of SEDAC's overall mission from a strategic viewpoint, including outreach, the Information Gateway mission, and targeting of state and local users. At the November meeting, the UWG heard presentations on sustainability science and hazard vulnerability assessment as possible new directions for SEDAC data and information resource development.

The UWG recommended a rapid acceleration of strategic planning efforts, focusing on SEDAC's overall priorities and core

competencies. The UWG noted that there is growing interest in the socioeconomic dimensions of the Earth system, increased recognition of the value of remotely sensed data in understanding human-environment interactions, and rapid improvements in Internet-based technologies for finding, accessing, and utilizing data. The UWG also recognized the potential impacts the September 11 terrorist attack may have on the directions of U.S. science and funding priorities.

Specifically, the UWG noted the great potential for innovative solutions that emphasize integration across diverse data sources, scales, and ways of organizing data and provide value-added services based on data, in addition to traditional data dissemination. The UWG endorsed SEDAC's efforts to work with the Open GIS Consortium and explore data access through new initiatives such as ESRI's Geography Network. The group recommended exploration of partnerships with

other groups involved with remote sensing applications, such as the National Consortia for Remote Sensing in Transportation. In particular, the UWG noted that it was important that SEDAC continue to lead in the exploitation of the latest technological developments and, in this context, continually reexamine its basic approach to data dissemination.

As a next step, the UWG recommended that a subcommittee of the UWG meet with SEDAC's core management team in early 2002 to develop a strategic framework for SEDAC's development, focusing on core competencies and strategies. This would be presented at the next full UWG meeting, to be held in the Washington DC area to facilitate increased involvement of NASA staff in these strategic discussions.



Jack Estes—In Memoriam

Jack Estes, University of California, Santa Barbara, passed away on March 9, 2001. Jack had served as a member of the SEDAC UWG from 1993 to 2001 and as chair from 1995 to 1999. He was instrumental in SEDAC's establishment, evolution, and success, and provided wise guidance to SEDAC on a wide range of issues.

Jack was, of course, a leading figure in the national and international remote sensing community. He led the International Steering Committee for Global Mapping and had recently worked with NASA to install an optical quality window on the International Space Station to support remote sensing observations. Jack taught at UCSB for more than 30 years and served as Director of the Remote Sensing Unit. He was a member of the Board of Trustees of CIESIN prior to its move to Columbia University.

At the November meeting, UWG members and SEDAC staff commemorated Jack's accomplishments and shared anecdotes on their interactions with him over the years. All of Jack's colleagues on the UWG, and all of us at SEDAC, wish to express our deep condolences to Jack's family, colleagues, and friends around the world.

Put Your Research In The News

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Tell NASA's Earth Science News Team about your soon-to-be published papers. Over the past year, the News Team has achieved worldwide news coverage of NASA-funded Earth Science stories—including appearances in USA Today, NY Times, The Weather Channel, CNN, UPI, AP, BBC News. Become a part of the action.

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NASA/Goddard Space Flight Center
Code 912.1 - SSAI
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EMAIL: rgutro.pop900.gsfc.nasa.gov
Tel. (301) 286-4044



Stephanie Stockman,
Code 921/SSAI, NASA
Goddard Space Flight
Center, was chosen to carry
the Olympic Torch as it
passed through Washington,
DC. Stephanie, who
suffers from MS, ran the
Marine Core Marathon last
year. She was nominated by
her mother and aunt and
selected for her sheer
determination and “can-do”
spirit.

New Generation of CERES Radiation Budget Data Available

—Bruce Wielicki (b.a. wielicki@larc.nasa.gov), NASA Langley Research Center

The CERES Science and Data Teams, and the Langley Atmospheric Sciences Data Center would like to announce the availability of the first of a new generation of radiation budget data products from CERES: CER_SSF_TRMM-PFM-VIRS_Edition2A.

This CERES data product (SSF for Single Satellite Flux) goes well beyond the capability of the current CERES ERBE-Like ES-8 TOA flux data product that you may now be using. It represents a fundamentally new capability in accuracy, as well as integration of aerosol, cloud properties, TOA and Surface radiative fluxes for each CERES field of view.

The data product has been validated, is ready for scientific use and publication, and the Data Quality Summary documenting parameter accuracies is available when ordering the TRMM CERES SSF Edition 2 data product, or may be viewed using the CERES Home Page (asd-www.larc.nasa.gov/ceres/new_ASDCeres.html).

The product can be ordered through the EOS Data Gateway, or the Langley Atmospheric Sciences Data Center at eosweb.larc.nasa.gov/HBDOCS/langley_web_tool.html.

Examples of advances in the new CERES SSF data product:

- 1) TOA Fluxes that are factors of 3 to 4 more accurate than ERBE S-8 or ERBE-Like ES-8 TOA fluxes. A new generation of measured Earth anisotropy provides this capability. For example, the new anisotropy models account for observed anisotropy variations due to land surface type, ocean wind speed and aerosol loading, cloud fraction, cloud optical depth, cloud emissivity, cloud height, column water vapor, and temperature lapse rate.
- 2) Cloud Properties (fractional coverage, temperature, height, water phase, particle size, optical depth frequency distribution, infrared emissivity, and cloud layering) all determined using the TRMM VIRS 2 km imager data and then mapped into the spatial response function of each CERES broadband 10 km field-of-view (FOV). The cloud property/CERES FOV spatial matching is estimated to be accurate to within 1% of CERES broadband radiance. The cloud properties are considered to be state of the art, and include such advances as use of ECMWF skin temperature and temperature/humidity profiles to account for changing weather conditions when applying cloud mask algorithms. Nighttime clouds include detection of thin cirrus and estimation of cloud emissivity for non-black cirrus clouds.
- 3) Aerosol Properties over water backgrounds (aerosol optical depth and Ångström exponent).
- 4) Because of the new angular (anisotropy) models and much more accurate cloud identification than possible with the ERBE-Like data products, clear-sky fluxes are much more accurate than for the ERBE experiment or for CERES ERBE-Like fluxes. This is important to studies of aerosol radiative forcing, water vapor greenhouse effects, etc.
- 5) A major limitation of the ERBE data products is their applicability only to gridded monthly mean clear-sky or all-sky fluxes. If ERBE fluxes are analyzed for only optically thin or thick clouds, they will give substantial flux biases because the anisotropy corrections are only designed to handle simple clear, partly cloudy, mostly cloudy, and overcast conditions. CERES fluxes are capable of accurate fluxes as a function of cloud optical depth and cloud type. Note that even for CERES, however, users should be sure to average fluxes over all viewing zenith angles to obtain the best accuracy. Errors will be higher if only one viewing zenith angle such as nadir is used.
- 6) New surface level shortwave (SW) and longwave (LW) upward and downward flux estimates. These fluxes are derived using algorithms and parameterizations that attempt to tie the surface fluxes as closely as possible to the CERES TOA fluxes. Relatively close relationships

exist for clear and all-sky SW fluxes and for clear-sky LW fluxes. For all-sky surface LW fluxes, the CERES cloud properties, and ECWMF near surface temperature and water vapor are used to estimate downward LW fluxes. These algorithms are analogous to the GEWEX Surface Radiation Budget algorithms. A more rigorous Fu-Liou radiative transfer estimate of surface and in-atmosphere radiative fluxes constrained against observed TOA fluxes will be available in validated form for TRMM data in February 2002 in the CERES CRS product (see 8a).

- 7) Note that because of a voltage converter failure on the CERES instrument on TRMM, the data products are only available for January 1998 through August 1998, and for March 2000. But the 1998 period captures the peak of the 1998 El Niño event through its disappearance in summer of 1998. The CERES instrument was then turned off until the CERES Terra instruments began taking data in March 2000, to assure an overlapping climate record. Agreement of the CERES and TRMM instrument calibrations in March and early April 2000 were within 0.5% for all channels.
- 8) It is expected that this new data product will enable fundamentally new approaches to testing cloud and climate models, as well as examining the role of cloud feedback in the climate system. Examples are the ability to accurately examine radiative fluxes for cloud systems and cloud types, not just for monthly mean grid box values. The TRMM data also include estimates of precipitation and latent heat fluxes, allowing an examination of both the latent and radiative

diabatic heating terms that dominate the tropical energy balance. New advances are also expected for studies of atmospheric solar absorption in clear and cloudy atmospheres when combined with surface radiative flux sites such as ARM and BSRN.

There are three additional major steps in this new generation of radiation data products that are expected to be completed for TRMM in 2002. All of the products below maintain the integration of cloud, aerosol, and radiative fluxes.

- a) CRS: instantaneous field-of-view data product that adds within-atmosphere radiative fluxes. This product also adds a more rigorous constraint through radiative modeling of surface fluxes, atmosphere fluxes, observed cloud and aerosol; all constrained to be consistent with CERES observed TOA fluxes at the same time and location. This data product will be available in beta version in early December 2001, and in the validated version in February 2002.
- b) SFCAVG: 1° gridded daily average and monthly average TOA and Surface fluxes, cloud and aerosol properties. Uses CERES SSF TOA and surface fluxes to provide time averaged data. Expect factor of 3 improvement over ERBE-Like diurnal sampling errors through inclusion of a radiation diurnal cycle estimate using 3-hourly geostationary data. Expect beta version in early December 2001 and validated version in March 2002.
- c) AVG: 1° gridded daily average and monthly average data. Unlike SFCAVG, this product includes within-atmosphere fluxes and uses the CERES CRS data as input. Like SFCAVG this product uses 3-hourly

geostationary data to improve corrections for diurnal cycle of radiation. Expect TRMM beta version in May 2002 and validated version in August 2002.

We hope you find this new data product useful in your research. The products discussed above are also being developed to handle the Terra and Aqua missions with comparable or improved accuracies. Terra and Aqua will also extend these data products to global observations, and extend the continuously overlapped radiation data record that goes back to Nimbus 7 in 1978. Because it requires two years of angular sampling to provide optimal angular dependence models tailored to each satellite orbit, the Terra versions of these new data products will begin validated delivery in late 2002 with the SSF. Meanwhile, validated Terra ERBE-Like ES-8 TOA flux data products are already available for all Terra months.

We will provide similar announcements as the additional validated data products become available.





The Hotspot: The American Geophysical Union Conference in San Francisco brought forth many interesting NASA and EOS-funded topics. Some of the stories that obtained good press coverage are highlighted here.

“Cotton Doesn’t Shrink From Climate Change” (December 15), The Daily Camera, Boulder, CO

EOS-funded researchers **Linda Mearns** and **Ruth Doherty** found that cotton yields are likely to increase in the Southeastern United States if carbon dioxide levels continue to rise as projected this century, and if farmers can adapt their agricultural practices to the resulting climate change.

“Methane Explosion Warmed the Prehistoric Earth, Possible Again” (December 10), National Geographic Magazine on-line, Scientific American on-line, United Press International

Research by **Gavin Schmidt** of NASA/GISS on a tremendous release of methane gas frozen beneath the sea floor 55 million years ago, was highlighted from his American Geophysical Union presentation. He confirmed that the methane heated the Earth by up to 13°F (7°C) 55 million years ago.

“Satellite Data Help Researchers Track Carbon in Northern Hemisphere Forests”

(December 11), Associated Press, Canadian Broadcasting Service

NASA-funded Earth Science researchers including **Compton Tucker** (NASA/GSFC) and **Ranga Myneni** (Boston University), using high-resolution maps of carbon storage derived from NASA-developed satellite data sets, suggest that forests in the United States, Europe and Russia have been storing nearly 700 million metric tons of carbon a year during the 1980s and 1990s.

“Red Alert! ‘Recycled’ Ozone Adds to Health Hazards in Zambia” (December 10), ScienceDaily.com

Anne Thompson and **Jacqueline Witte** (both NASA/GSFC) analyzed harmful low-level ozone or “smog” over the African country of Zambia and measured high amounts of pollution throughout the burning season in the year 2000. They discovered that the pollution is “recycled” from other southern African countries.

“The Sun’s Chilly Impact on Earth” (December 6), Scripps Howard News Service, Tech TV broadcast, Seattle Post Intelligencer

Drew Shindell of NASA/GISS used a computer climate model to reinforce the long-standing theory that low solar activity could have changed the atmospheric

circulation in the Northern Hemisphere from the 1400s to the 1700s and triggered a “Little Ice Age” in several regions including North America and Europe.

“Melting Glaciers Shut Down Gulf Stream in Past” (November 25), United Press International, USA Today

Research by **David Rind** (NASA/GISS) made the news in November. He found that a large input of freshwater into the Atlantic may have shut down the Gulf Stream about 11.5 to 13 thousand years ago, causing Western Europe to cool down.

“Satellite Data Confirms Warming of Earth’s Climate” (November 20), ENN.com, Knight-Ridder News Wire, Weather.com

Jim Hansen (NASA/GISS) and **Marc Imhoff** (NASA/GSFC) used data from satellites and weather stations to find that the air temperature near the Earth’s surface has warmed on average by 1°F (0.6°C) globally over the last century.



Earth Science Education Program Update

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

NASA Kid's Web Site En Espanol

NASA's popular educational Web site, Space Place, has announced a new Spanish-language version for children and their families. The Web site at spaceplace.jpl.nasa.gov and its new Spanish companion at spaceplace.jpl.nasa.gov/espanol serve children 8 to 13 years of age. The site contains approximately 40 activities, including games and "amazing facts" about space, Earth and NASA.

TerraFly ***terrafly.com***

Partnering with USGS, IBM, NASA, NSF, and other sources, this site offers aerial images of nearly all the U.S., searchable by address or zip code. Users can zoom, pan in any direction, switch between geographic and UTM coordinates, and create new frames for multiple image comparisons (including topographic maps). To access all functionality, click on the "advanced" button and when a new window appears select the "expert" option—this activates the zoom function.

4th Annual Summer S'COOL Workshop

The NASA CERES S'COOL Project will hold their 4th Annual Summer S'COOL Workshop on July 17-24, 2002 at NASA

Langley Research Center in Hampton, Virginia. This year's workshop is geared for elementary teachers (3rd-6th grade) with minimal science background. Participants will be introduced to S'COOL—Students' Cloud Observations On-Line—the project that involves school children in real science. They will learn to classify cloud types and collect other measurements during field observations. They will also become comfortable with using technology in working with data and making comparisons. Join us this summer to become a keen observer and bring NASA research into your classroom in a fun and practical way. Room and board as well as travel will be covered for selected participants. Teachers from all 50 states and Puerto Rico are welcome to apply. A graduate credit option will be available. The workshop will be limited to 20 participants.

Please contact Joyce Watkins, Administrative Assistant, for an application at scool@larc.nasa.gov or SAIC, Attn: S'COOL, One Enterprise Pkwy, Suite 300, Hampton, VA 23666-5845 Tel.: (757) 827-4848 Fax: (757) 825-9129. Completed applications must be postmarked by March 31, 2002. For more information about participating in the S'COOL Project see our website scool.larc.nasa.gov.

GLOBE Program

The Global Learning and Observations to Benefit the Environment (GLOBE) Program has released an Announcement of Opportunity (AO) seeking proposals in four specific areas

- Area 1—Scientific Involvement in GLOBE and its Measurements
- Area 2—Development of Educational Materials
- Area 3—Evaluation
- Area 4—Professional Development Activities and Materials for Teachers

NSF awards to U.S. institutions and GLOBE Agreements with non-U.S. institutions will be for up to 42 months with an approximate starting date of August 2002. Under this Solicitation it is anticipated that 15 to 40 proposals (including international participants) will be selected. Approximately 15 awards to U.S. institutions are expected to total approximately \$2.0 million per year, depending on the quality of the proposals received and the availability of funds.

For more information see: www.nsf.gov/pubs/2002/nsf02013/nsf02013.htm



EOS Science Calendar

February 26-28

Science Data Processing and HDF/HDF-EOS Workshop, Martin's Crosswinds, Greenbelt, Maryland. Contact: Mike Seabloom, tel. (301) 286-2406, Mary Repp, tel. (301) 286-1006, Richard Ullman at (301) 614-5228 or URL: that.gsfc.nasa.gov/gss/workshop2002/. Send e-mail to sdpworkshop2002@majordomo.gsfc.nasa.gov

March 4-6

AIRSAR Earth Science and Applications Workshop, NASA Jet Propulsion Laboratory. Contact David Imel, e-mail: imel@jpl.nasa.gov. For detailed information see Website at airsar.jpl.nasa.gov.

March 5-8

2002 AVIRIS Earth Science and Applications Workshop, Pasadena, CA. Contact Robert Green, email: rog@spectra.jpl.nasa.gov, URL: aviris.jpl.nasa.gov/.

July 22-26

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

Global Change Calendar

February 14-19

American Association for the Advancement of Science, Boston. Contact: AAAS Meetings Dept. 1200 New York Ave. NW. Washington, DC 20005, tel. (202) 326-6450; e-mail: aaasmeeting@aaas.org; Website at www.aaasmeeting.org.

March 5-8

Oceanology International 2002, Excel, London, UK. Contact Kari Jaeobson, e-mail: kjaeobson@pgi.com, URL: www.oceanologyinternational.com.

April 7-12

29th International Symposium on Remote Sensing of Environment "Information for Sustainability and Development," Buenos Aires, Argentina. Call for Papers. Contact Secretariat, e-mail: 29isrse@conae.gov.ar, URL: www.symposia.org.

April 22-26

2002 American Society of Photogrammetry and Remote Sensing Annual Conference, Washington, DC. See Website at www.fig2002.com/.

May 28-June 1

American Geophysical Union (AGU) 2002 Spring Meeting, Washington DC. See Website at www.agu.org/.

May 20-22

Seventh International Conference Remote Sensing for Marine and Coastal Environments, Miami. Call for Papers. Contact Nancy Wallman. e-mail: nancy.wallman@veridian.com; URL: www.erim-int.com/CONF/marine/MARINE.html.

June 5-7

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

June 11-13

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

July 7-10

2nd Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) Science Conference, Manaus, Brazil. Contact Flavio Luizao of the National Institute for Space Research (INPE), Manaus, Brazil, e-mail: luizao@cptec.inpe.br.

July 9-12

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

September 2-6

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

September 3-6

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

September 9-13

ISPRS Commission III Symposium 2002, Graz, Austria. Contact Institute for Computer Graphics and Vision, tel. +43 316 873-5011, email: office@icg.tu-graz.ac.at, URL: www.icg.tu-graz.ac.at/isprs

September 18-25

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

October 14-19

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

October 26-28

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

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