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INSIDE THIS ISSUE

Editor's Corner

The NASA Research Announcement (NRA) for new investigations and investigators for the Earth Observing System was distributed via the Internet (through both the Mission to Planet Earth and EOS Project Science Office home pages on World Wide Web) on September 22, and proposals were due by December 1. A total of 336 proposals were received in response to this solicitation, which can be categorized as follows:

Landsat Team Member/Leader	40	Interdisciplinary Investigations	134
MODIS Team Member	35	New Investigator Program	65
AIRS Team Member	3	Science Education Grant Supplement	21
TRMM Team Member	8	Late and Non-responsive	22
Passive Microwave Team Member	8		

Due to the 3-week government furlough, which included NASA, followed by the second largest snow storm this century in the Washington, DC, area, the evaluation and selection process will likely not be completed until April.

On December 15 the NASA Program Management Council (PMC), consisting of the NASA Chief Scientist, Comptroller, Associate Administrators, and chaired by the Deputy Administrator, met to reexamine the reshaping of the EOS program that was reviewed by the National Academy of Sciences' Board on Sustainable Development last July and described in the last issue of *The Earth Observer*. The PMC was very supportive of the community consensus process that was pursued in developing the EOS strategy for technology infusion and evolution in the second and third series of spaceflight missions. Furthermore, they approved the approach of periodic (biennial) reviews of the EOS program, and recommended drafting the Program Management Agreement, the "contract" between the Associate Administrator of Mission to Planet Earth and the NASA Administrator for the implementation of the EOS program, around the 24 critical EOS measurements set. This important strategic set of key measurements is now available on World Wide Web, along

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with the latest EOS mission profile that is consistent with the EOS reshaped program.

In an effort to foster effective communication within the EOS community, electronic mail distribution lists were established a couple of years ago by the Project Science Office. The latest revision to these lists (see below) makes it possible to rapidly communicate to any EOS Panel or Working Group, the Investigators Working Group (IWG), the Science Executive Committee (SEC), or a subset of EOS investigators constituting the Principal Investigators and Team Leaders of interdisciplinary or instrument science teams, both of which have recently been established. These lists are constantly being revised, and include up-to-date membership and e-mail addresses. One can readily find out who is subscribed to a given list server by accessing World Wide Web at http://spso.gsfc. nasa.gov/spso_homepage.html, and checking under Directory for List Server. In addition, one can do a search for the address, phone, fax, and e-mail address of any individual using our on-line EOS Directory, also available through World Wide Web. Please note that Goddard has implemented a centerwide list server, known as listserv, so all mail should now be addressed to listserv, e.g., iwg-payload@listserv.gsfc.nasa.gov, instead of the previous ltpmail address.

An EOS Science Executive Committee (SEC) meeting was held in Annapolis on the evening of November 30. The chairman of the SEC, Prof. Eric Barron, reminded the SEC that his two year term as chairman ends January 1996. Following much discussion, the SEC decided that the chairman, like all other panel chairs, could be reelected for a second (succeeding) term. Following an election in December, Eric Barron was reelected chairman of the SEC for one more term. The SEC also discussed progress that has been made to date on the EOS Science Implementation Plan, discussed the schedule for completing the seven science theme chapters, and assigned lead chapter authors for the final three science integration chapters. The target for completion of this comprehensive document is April-May 1996, at which point it will be distributed to the EOS community as well as posted on World Wide Web.

Finally, the Payload Panel met in Annapolis on November 28-30 to focus on three important items: (i) The Office of Mission to Planet Earth's (MTPE) plans for an integrated observing strategy including new sensor technology as well as convergence with operational observing systems; (ii) EOSDIS in light of the recent NRC Board on Sustainable Development (BSD) recommendation to develop a system based on a "federation of partners selected through a competitive process;" and (iii) the EOS strategy for study of atmospheric chemistry in regards to the BSD recommendation to focus Chemistry-1 on tropospheric ozone and its precursors. Due to the furlough in December, the completion of the Payload Panel Report has been delayed, and will therefore appear in the next issue of *The Earth Observer*.

—Michael King
EOS Senior Project Scientist

Electronic Mail Distribution Lists

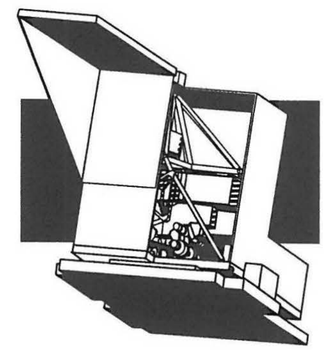
e-mail name	distribution
iwg	Investigators Working Group (all EOS PIs, Co-Is, Team Members, and Team Leaders)
iwg-atmospheres	Atmospheres Panel
iwg-biogeochem	Biogeochemical Cycles Panel
iwg-land	Land Panel
iwg-oceans	Oceans Panel
iwg-modeling	Modeling Panel
iwg-climate_and_hydrology	Physical Climate & Hydrology Panel
iwg-data_quality	Data Quality Panel
iwg-eosdis	EOSDIS Panel
iwg-cryo_working_group	Cryosphere Working Group
iwg-SWAMP	Science Working Group for the AM Platform (SWAMP)
iwg-payload	Payload Panel
iwg-sec	Science Executive Committee
iwg-everybody	Union of everyone subscribed to any e-mail distribution list managed by the Project Science Office
iwg-management	Management (Headquarters and Goddard Space Flight Center)
ids_pi	Interdisciplinary Science PIs
instr_pi_and_tl	Instrument PIs and Team Leaders

† To distribute a message to one of the lists, use the following format in the To: field of your message: e-mail name@listserv.gsfc.nasa.gov (e.g., iwg-sec@listserv. gsfc.nasa.gov)

Science Team Meetings

12th TES/AES Science Team Meeting

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



The 12th TES/AES Science Team meeting was held at AER Inc. in Cambridge, MA on December 12-15, 1995. Our hosts were Tony Clough and Pat Brown of AER. This was a very well-attended meeting with several representatives from each of the institutions involved in TES and AES.

The meeting began with an overview by Joe McNeal (NASA HQ) of the recent multiple reviews of TES and the CHEM-1 platform that were initiated as a consequence of the National Academy's Board on Sustainable Development (BSD) report of last summer. In particular, a community-wide workshop was convened at the Goddard Institute for Space Studies (GISS) in November to investigate not only TES but the whole issue of the interplay of remote sensing and the more traditional *in situ* studies of tropospheric chemistry, including the contributions of our colleagues in Japan and Europe. The workshop general chair was Daniel Jacob (Harvard), and working groups on Policy, Atmospheric Chemistry, and Aerosols were led by Dan Albritton (NOAA), Jennifer Logan (Harvard), and Pat McCormick (NASA LaRC), respectively. The workshop was strongly supportive of TES, but there is no doubt that it has caused us to re-evaluate our strategy for making global surveys of tropospheric ozone and its precursors and to focus more strongly on limb retrievals, especially for the active nitrogen species.

Tom Glavich (JPL) then brought us up-to-date on the TES instrument project. As the engineering team has grown, so has the level of detail in the design. The focus now is to produce a viable baseline design for the System Concept Review (what used to be called Conceptual Design and Cost Review) to be held mid-year 1996.

Jennifer Logan (Harvard) discussed the atmospheric chemistry portion of the GISS workshop, which concluded that while several pre-CHEM-1 instruments (from the US, ESA, and Japan) would provide some information useful to tropospheric chemistry, only TES has the potential for measuring O_3, CO and the critical upper-tropospheric precursors NO, HNO_3 and H_2O near-simultaneously and in the same air-mass and that, therefore, it is essential that TES retain this capability (which demands both limb and nadir-viewing). The workshop further found that TES has been descoped continuously over the past few years to the point that further reductions would eliminate necessary capabilities, although the TES team continues to seek new technologies to reduce demands on resources (in space and on the ground). It was further agreed by all that a collaborative, rather than competitive, approach among the developers and deployers of remote sensing systems and the more-traditional *in situ* techniques is essential for the future health of the field.

Reinhard Beer (JPL) then presented a draft of the report of the Atmospheres Panel of the EOS Payload Panel (kindly provided by the chairman, Rich Zurek) that enthusiastically endorsed the conclusions of the GISS workshop and further proposed that such workshops become regular events.

Tony Clough and Pat Brown (AER) showed preliminary results of trial limb retrievals of ozone precursors, based on profiles provided by Daniel Jacob and Jennifer Logan. The provisional conclusions were that HNO_3 and H_2O could be done down to cloud tops with excellent precision (1-2%), NO is likely to be more difficult (20-30% precision) and NO_2 may be impossible (in the troposphere). One added difficulty with NO is the high temperature (~1000K), and probable non-LTE (local thermodynamic equilibrium), thermospheric component, which must be corrected for. These studies will be continued for a wide variety of conditions, the climatology for which will be provided by the Harvard group.

Consequences of both the GISS workshop and the AER study were that: (*i*) we must spend a considerably greater fraction of a month generating global distributions than we had originally planned (because of concerns about persistent cloud cover in particular regions), and (*ii*) that the specific observational strategy must be more-heavily weighted towards limb views of the upper troposphere, especially for NO. The impact of these new requirements on component lifetime will be investigated by the engineering team and resolved in time for the next edition of the Science Requirements Document (planned to be issued in April 1996).

Some discussion ensued on the subject of publication policy ("free for all" on the ATMOS model vs. group publication on the High Energy Physics model vs PI directives). Joe McNeal promised to provide a copy of the policy adopted by the UARS project, and we will revisit this topic at a future meeting.

Following this, we had the first of 3 sessions discussing the Algorithm Theoretical Basis Document (ATBD — the primary deliverable of the Science Team). We began by reviewing a draft outline that was generated at a special meeting held in Denver last summer. The outline was refined, and a new version will be issued in a subsequent newsletter when some additional input from Clive Rodgers (Oxford) and Tony Clough becomes available. The team nevertheless re-iterated its intention to develop a new "community," Level 2 retrieval algorithm that will draw on the best features of LBLRTM and SEASCRAPE (and, incidentally, be compared to them as part of the validation process).

Tony Clough showed the outcome of his analysis of the role of spectral resolution on remote sensing from space. This shows that we have made the correct choice (spectral resolution comparable to the width of weak features). Coarser resolution provides insufficient information (retrieval error increases dramatically), and is much more susceptible to systematic error because signal-to-noise ratio does not increase indefinitely, as simple-minded analyses suggest.

Clough followed with an analysis of the probability of seeing to the surface as a function of season, based on the old IRIS-D data. The results are very interesting and will be very helpful in the replanning of our global observation strategy.

Jack Margolis (JPL) discussed some of the "lessons learned" from AES calibration. It seems clear that we have underestimated the frequency with which we must perform TES radiometric calibrations, and this, too, must be factored into our updated observation strategy.

Peter Venters (Oxford) showed his current design for the TES in-flight calibration sub-system (little changed from last year) and then described his initial efforts at generating a full calibration budget. This suggests that the required 1% accuracy is feasible below about 1500 cm^{-1}, marginal between 1500 and 2500 cm^{-1}, and probably impossible (by a factor of 2-3) above 2500 cm^{-1}. This conclusion is not unexpected and should not have a major impact on retrieval accuracy because the signal-to-noise ratio will decline at about the same rate, i.e., measurement error is still likely to dominate.

Following two more sessions on the ATBD, Steve Larson (JPL) explained the software development and change control process. There remains some concern among the Science Team that such controls either insulate the team from the process (which may be desirable) or, alternatively, take up much of the team's time in trying to follow, and validate, what is going on. Nevertheless, the team recognizes that some form of control must be exercised, but remains apprehensive.

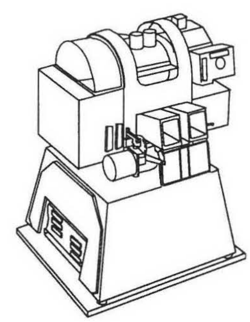
Helen Worden (JPL) outlined the final version of the paper on the two western wildfires measured by AES in 1994. The paper has been submitted to JGR. The results show that significant useful information about biomass burning can be extracted from spectral remote sensing that is complementary to that acquired during controlled burns, although it does seem that there is no such thing as a "typical" wildfire.

David Rider and Helen Worden (JPL) then described progress on the analysis of data from the 1995 Southern Oxidants Study Nashville Intensive Campaign. The high humidity and air stagnation conditions that prevailed during the week that we made our observations (in addition to problems of determining the transmittance of the ZnSe aircraft window under flight conditions) are making analysis more difficult than we had anticipated. Nevertheless, our retrieved temperature and humidity profiles compare well to radiosonde data acquired at the same time, so we expect the remaining difficulties to be solved in the near future.

Curt Rinsland (LaRC) showed some test results from an improved solar irradiance model obtained from Harvard/Smithsonian Astrophysical Observatory. There are still concerns: (*i*) about validating this model against (essentially non-existent) observations, and (*ii*) modeling the major expected variations in solar CO during the solar cycle. The MAPS experiment has shown that over, for example, desert areas the solar reflection contribution even in the CO fundamental region is not negligible.

An invitation to hold a 1996 team meeting at Oxford was tentatively accepted. However, we will first hold a meeting at JPL shortly before the System Concept Review in order that the Science Team can become better acquainted with the Engineering Team. ■

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



— **Bruce R. Barkstrom** (brb@ceres.larc.nasa.gov), Principal Investigator, and
Gary G. Gibson, NASA Langley Research Center

The 12th Clouds and the Earth's Radiant Energy System (CERES) Science Team meeting was held September 20-22, 1995, at the NASA Langley Research Center (LaRC) in Hampton, VA. The focus of the meeting was CERES instrument status, algorithm development, and validation. The CERES instrument is designed to provide a climate data set suitable for examining the role of clouds in the radiative heat balance of the climate system. The CERES Science Team blends expertise in broadband radiometry, cloud and radiation remote sensing, and climate modeling. The Science Team guides the definition of the CERES instrument and science studies.

CERES Instrument Status

Robert B. Lee III and Leonard Kopia (LaRC) presented the instrument status report. The CERES instrument weight and power are forecast to be very close to allocations for both the Tropical Rainfall Measuring Mission (TRMM) and Earth Observing System (EOS) satellites. Instrument assembly for the Proto-Flight Model (PFM) was completed in May, and instrument performance during initial vacuum testing was excellent. Modifications to reduce Electro-Magnetic Compatibility (EMC) exceedances to acceptable levels were completed. Vibration testing and thermal balance/thermal vacuum testing were also successfully completed.

Final calibration and comprehensive functional tests were on target for a mid-October delivery to the Goddard Space Flight Center. Integration on the TRMM spacecraft is scheduled to begin in January. EOS AM flight model (FM-1 and FM-2) detectors and mirror coatings passed inspection. The FM-1 main contamination cover (MCC) experienced several anomalies as a result of vibration testing, but operated successfully. The MCC caging device is being reworked and will be qualified on FM-2.

The CERES absolute radiometric calibration facility provides calibration of each instrument over its full spectral range, field of view, and dynamic range. CERES PFM calibration results showed that: (*i*) sensor offsets are stable and vary less than 3 counts with elevation angle, (*ii*) mirror attenuator mosaic (MAM) calibration mechanisms should yield solar calibrations at the 0.5% precision level, and (*iii*) the PFM sensors have a second thermal time constant which, if uncorrected, may increase the instantaneous measurement errors above 0.5% for longwave (LW) and 1.0% for shortwave (SW). A correction algorithm is being developed.

Data Management System

Jim Kibler gave a detailed status report on each subsystem including a summary of data products and code development. Code development is generally on schedule with some modules now undergoing testing. Challenging areas include the validation of submitted science code for cloud analysis, the size of the meteorological, ozone, and aerosol product (25 MB per hour), and memory requirements for executing the Surface and Atmospheric Radiation Budget (SARB) prototype code. Kibler also reported on the development of graphics tools to assist software development and support production processing and validation. Near-term plans include the implementation and testing of Release 1 science algorithms, delivery of the Release 1 code and test data sets to the LaRC Distributed Active Archive Center (DAAC) for integration and testing, and definition of requirements for Release 2 (TRMM flight processing system).

Bob Lutz, Quality Assurance (QA) Scientist in the Earth Science Data and Information System (ESDIS) Science Office at GSFC, presented a science QA procedure for EOS products. He provided a framework for understanding the operational QA methodology utilized by the Instrument Teams, identifying the QA requirements of the users of the data products, and ensuring that the EOS Data and Information System (EOSDIS) satisfies the requirements of both of these communities.

Instrument Working Group

The Instrument Working Group was led by Robert B. Lee III (LaRC). The Release 1 algorithm is set for test runs in November and will be delivered to the DAAC in January 1996. Procedures were established for flight count conversion coefficient instrument gain and offset determinations. Ground-derived coefficients are used as preliminary flight coefficients. The Release 2 (flight) version is currently being defined as a refined Version 1 including special data handling features for in-flight calibrations and validation. A preliminary validation plan draft was prepared, which includes flight calibration analyses (internal calibration module and MAM), multi-channel comparisons (Inversion Working Group), multi-satellite intercomparisons (Time Interpolation and Spatial Averaging [TISA] Working Group), single spacecraft cross-track and rotating azimuth plane instrument comparisons, and geolocation/coastline detection studies.

John Chapman (LaRC) reported on a CERES instrument simulator that is being developed to allow flight operational familiarity with the instrument prior to launch. The simulator development is a joint effort of the Data Management Office and the Langley Summer Scholars Program, which is coordinated through the LaRC University Affairs Office. The PC-based CERES simulator consists of circuit cards functionally identical to the flight items, but using low-cost commercial microcircuits and components. One simulator application is for use as a testbed for functionality checking of atypical memory uploads and for anomaly investigations.

Joint Cloud and Inversion (Top-of-Atmosphere Fluxes) Working Group

The Working Group was led by Bruce Wielicki (CERES Interdisciplanary Science PI). Bryan Baum (LaRC) reported that the Version 1 prototype code is up and running. A global data processing strategy has been developed and implemented that can be used with other imagers. All submitted Co-I algorithms have been integrated and the code exercised using 3 hours of Advanced Very High Resolution Radiometer (AVHRR) Global Area Coverage (GAC) data. The stage is now set for Science Team involvement to guide the application of algorithms. CERES cloud retrieval follows these steps: (*i*) apply cloud mask, (*ii*) update clear-sky map, (*iii*) classify clouds and detect cloud layers, (*iv*) locate cloud-top heights for each layer, (*v*) derive cloud microphysical and optical properties, and (*vi*) convolve imager results with the CERES field of view. Short-term goals are to make Satellite Image Visualization System (SIVIS) software and CERES cloud output available to the team, develop production code, and process the CERES cloud algorithm at the LaRC DAAC under Pathfinder. Long-term goals are to implement nighttime algorithms, implement strategies for smoke/fire-covered areas, sunglint, mountains, etc., and improve quality control (QC)/exception handling capabilities.

Michael King, EOS Senior Project Scientist, gave an overview of the lessons learned during the Arctic Radiation Measurements in Column Atmosphere-surface System (ARMCAS) experiment. ARMCAS involved satellite remote sensing, two high-altitude and boundary-layer aircraft measurements, and surface remote sensing with ground truth observations to better understand radiative processes in the Arctic. King also summarized the current Moderate-resolution Imaging Spectroradiometer (MODIS) status, which is of particular interest since MODIS data will be used to derive cloud properties for CERES.

Several science studies were reported which aim at enhancing cloud estimation/analysis capabilities and could affect validation planning. Bing Lin (LaRC) presented a method for estimating multi-level cloud liquid water path (LWP) and height (±1 km) from satellite passive microwave and optical measurements in oceanic environments. Lin Chambers (LaRC) compared 2D and plane-parallel methods for optical depth retrieval for ocean boundary layer clouds. The rms optical depth retrieval error was 10.5%, with a maximum error of 40%. Applying a cloud-aspect-ratio-based correction reduces the rms and maximum errors to 4.5% and 18%, respectively. The retrieval of cloud aspect ratio is under investigation. James Coakley (Oregon State) showed the effect of spatial subsampling of MODIS data on cloud retrievals.

V. Ramanathan (Scripps) submitted a new clear-sky LW top-of-atmosphere (TOA)-to-surface flux parameterization method. Larry Stowe (NESDIS) presented an improved algorithm for aerosol remote sensing, which he is testing with AVHRR data. Ronald Welch (South Dakota) completed his new cloud masking algorithm and Qingyuan Han (South Dakota) presented some results of recent studies relating cloud microphysics and albedo. Coakley showed that Spatial Coherence inferences of layered cloud structures correlated closely with lidar returns taken during the Lidar In-space Technology Experiment (LITE) mission. He also compared reflectivities predicted using plane-parallel radiative transfer theory to observed data for single layer clouds and found significant discrepancies. This is particularly important since plane-parallel radiative transfer theory is the mainstay of cloud retrieval algorithms and radiation schemes in climate models. This is one of the primary reasons CERES will develop new empirical models of anisotropy to convert radiance measurements to estimates of radiative flux. Richard Green (LaRC) developed new SW angular distribution models (ADMs) from Nimbus-7 ERB data using the Radiance Pairs Method (RPM). Green also presented the CERES-proposed EOS grid and results of a regridding error analysis.

Patrick Minnis (LaRC) presented a comparison of cloud property retrievals using the daytime (visible, 10.7, and 3.9 μm) and nighttime (10.7, 12, and 3.9 μm) algorithms. Minnis also showed initial results of an error analysis of the daytime cloud microphysical property retrieval algorithm which has been applied globally to determine cloud phase, effective particle size, and optical depth. Dual solutions and limited dynamic range contribute to difficulties in retrieving water droplet radius in backscatter viewing conditions.

The Working Group identified several key areas of research and development that are being examined for Release 2 cloud and TOA flux algorithms: Particle size retrieval algorithms (day and night), vertical dependence of cloud particle size, TRMM Visible Infrared Scanner (VIRS) ocean aerosol algorithm, nighttime polar cloud mask, 2-D and 3-D effects on derived cloud properties, addition of sounder cloud heights, multi-layer cloud mask and properties algorithms, microwave cloud property retrievals, beam filling for 2-km VIRS footprints, ADM simulations, and RPM versions of Earth Radiation Budget Experiment (ERBE) ADMs.

Surface and Atmospheric Radiation Budget (SARB) Working Group

Thomas Charlock (LaRC) led SARB Working Group discussions on analysis methods, algorithms, and validation. One objective of the CERES investigation is to better estimate broadband shortwave and longwave fluxes at the surface and within the atmospheric column. Because obtaining surface fluxes is much more difficult than measuring TOA fluxes, CERES is pursuing two independent approaches. First, simple parameterization methods are used to directly determine surface LW and SW fluxes from TOA data. Second, cloud physical and narrowband radiative properties derived from cloud imager data are used along with atmospheric temperature and humidity profiles in a radiative transfer model to calculate broadband radiative fluxes at the surface of the Earth, through the atmosphere, and up to the TOA. The Science Team has decided to provide flux divergence calculations initially at the tropopause and at several levels in the stratosphere. Later work will add 500 mb and additional tropospheric levels as warranted by validation studies.

Release 1 SARB software modules have all been developed and are being integrated for the January code run-through. Most meteorological, ozone, and aerosol auxiliary input data for October 1986 have been acquired.

V. Ramanathan suggested that SARB tie the full within-atmosphere code to the results of the parameterized surface-only retrieval for consistency between the two methods. It was concluded that this constraint would be applied if validation showed that the parameterized surface fluxes were more accurate than the model calculations constrained to TOA fluxes. Robert Cess (Stony Brook) presented new results to support the theory of anomalously high atmospheric SW absorption. David Randall (Colorado State) discussed a recent statement from 30 international scientists at climate modeling and numerical weather prediction centers stressing the importance of continuing calibrated broadband global measurements of the Earth's radiation budget. He and his colleagues concluded that such measurements are fundamental and essential for monitoring, understanding, and predicting the state of the climate system and should continue without interruption into the indefinite future.

Shashi Gupta (LaRC) developed new LW surface emissivity maps for Release 1. The new maps incorporate spatial variability based on surface/vegetation classification maps along with emissivity measurements. Temporal variability is included by superimposing seasonally-dependent snow/ice maps on the underlying surface maps. David Rutan (representing Louis Smith) presented a methodology for determining surface spectral reflectance for various scene types. The spectral reflectivities are averaged over the CERES footprint and used as surface boundary conditions for the Fu and Liou radiative transfer model.

Shi-Keng Yang (representing Jim Miller) discussed the global surface reflectance and surface albedo data at the National Centers for Environmental Prediction (NCEP) as well as Reanalysis Project validation results using ERBE data. Maurice Blackmon (NCAR) compared a 4-D data assimilation technique and NCEP/NCAR (National Center for Atmospheric Research) Reanalysis Project results and showed that the two methods produce substantially different atmospheric heating rates. The ongoing Reanalysis Project provides a unique opportunity for studying and evaluating the cloud and radiation fields generated from a state-of-the-art global data assimilation system.

One of the most difficult SARB problems is the case of determining surface downward longwave fluxes when there is a middle-level or upper-level optically thick cloud present over a lower-level cloud. Charlock showed that the largest uncertainty in the LW fluxes at the surface is not in estimating the thickness of an observed cloud to get cloud base from cloud top, but in knowing the amount of cloud overlap, i.e., the presence of multi-layer clouds. The Cloud Working Group is investigating the use of a passive microwave instrument (or a more sophisticated imager/microwave combined multi-channel retrieval) to detect the lower cloud and measure LWP over oceans.

David Kratz (LaRC) presented a validation plan for the TOA-to-surface parameterization approach that depends on the availability of simultaneous TOA and surface measured LW and SW net fluxes. A limited validation data set has been produced from measurements taken at the Atmospheric Radiation Measurement (ARM) Cloud and Radiation Testbed (CART) site in Oklahoma in 1994. Cess provided information on SW narrowband instruments to be used during the ARM Enhanced Shortwave Experiment (ARESE) in September 1995 and at other ARM sites in the future.

Charlock and Charles Whitlock (LaRC) presented a SARB validation plan that relies on the CERES/ARM/GEWEX (Global Energy and Water Cycle Experiment) Experiment (CAGEX) and several surface networks. The Working Group strongly endorsed the CAGEX activity. Whitlock discussed surface fluxes from a number of measurement networks including ARM, NOAA Integrated Surface Irradiance Study (ISIS) sites, World Climate Research Program (WCRP) Baseline Surface Radiation Network (BSRN) at selected sites around the world, and an operational instrument tower (Walker Site) in Virginia. He also showed initial albedo and bidirectional reflectance results from the CERES helicopter tests. The Working Group suggested that some field experiments should be delayed, if possible, to have overlap with CERES for validation.

Time Interpolation and Spatial Averaging (TISA) Working Group

Takmeng Wong and David Young (LaRC) led the TISA Working Group where the agenda encompassed satellite sampling, temporal interpolation, algorithm development, code generation, and validation planning. Wong used cloud parameters over the ARM site derived using the Hybrid Bispectral Threshold Method (HBTM) to evaluate methods for interpolating cloud amount, visible optical depth, infrared emissivity, cloud top height, cloud base height, and cloud effective height. Results showed that cloud temporal interpolation errors are large for the CERES single satellite product and decrease as the number of satellites increases. He showed that the use of cloud products from geostationary satellites could significantly reduce CERES cloud interpolation errors. Claudia Stubenrauch (representing Robert Kandel) showed that ERBE TOA SW flux diurnal interpolations could be improved by using 3-hourly International Satellite Cloud Climatology Project (ISCCP) cloud cover and cloud visible reflectance data.

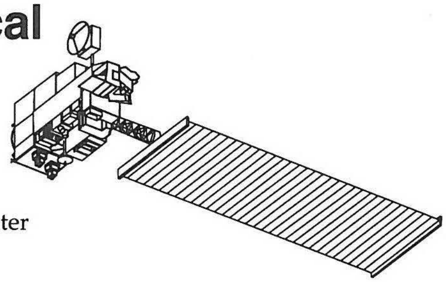
The development of algorithms for TISA Release 1 Subsystems is on schedule. Subsystems were sized and coding/testing is in progress and on schedule for transmittal to the DAAC in January. The issues of module duplication in different Subsystems and of using local time versus GMT are being reviewed. QC formats and validation graphics were finalized.

Minnis presented a TISA validation plan outline. Validation is required for LW and SW TOA total-sky flux, LW and SW TOA clear-sky flux, window radiance, LW surface flux, atmospheric flux, cloud amount (total and levels), cloud particle size, cloud liquid and ice water path, cloud emittance and optical depth (daytime only), and cloud height and thickness. Pre-launch validation involves applying CERES algorithms to ERBE data and comparing the results to "truth" data from other satellite and surface observations. When CERES data are available, qualitative evaluations will be made based on comparisons to previous ERBE data, ERBE wide-field-of-view data (if available), Scanner for Radiation Budget (ScaRaB) data (if available), GOES cloud properties, ARM data, CAGEX, and operational ground station observations. EOS AM results will also be validated by comparison with TRMM data. A tentative list of CERES validation regions representing a range of surface types and climate regimes was identified.

Meeting Wrap-Up

Validation plans are due by March 31, 1996. The next CERES Science Team meeting is scheduled for March 13-15, 1996 at the Goddard Space Flight Center. Major topics will include approval of the CERES validation plan as well as discussions of Release 1 algorithm tests. ■

Science Working Group for the AM Platform (SWAMP) and AM Session of the American Geophysical Union (AGU) Fall Meeting



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Chris Scolese (cscolese@seamis1.gsfc.nasa.gov), NASA Goddard Space Flight Center

The Science Working Group for the AM Platform (SWAMP) met at the Goddard Space Flight Center (GSFC) on November 2-3, 1995. On December 15, 1995, there was a related AGU session on science and the EOS AM-1 platform.

The SWAMP meeting was opened by EOS AM Project Scientist, Piers Sellers. Chris Scolese, EOS AM Project Manager, presented the Project Status and the Team Leaders/Principal Investigators gave updates for the MODIS, MISR, ASTER, MOPITT, and CERES instruments. The meeting continued with sessions on Calibration, Digital Elevation Models (DEMs), Gridding, Test Data Sets, Validation, Science Workshops, Science Software Management, Landsat-7/AM-1 Issues, and EOS Data Products. The essential points made in these sessions are given below.

Lunar Calibration

Joe Bolek presented the recent findings of the engineering assessment for lunar calibration:

◊ The lunar view maneuver is technically feasible; only software modifications are required.

◊ The science rationale and justification need to be very solid.

◊ Funding for the software changes needs to be identified.

◊ A decision needs to be made at NASA/GSFC to go ahead and make the necessary changes.

Jim Butler presented the scientific assessment for lunar calibration, which is to be summarized in a "White Paper." The lunar maneuver has direct science benefits to ASTER, MISR, and MODIS, while the dark space view has benefits for all five EOS AM-1 instruments.

There were discussions about various methods for entering and leaving the maneuvers (combinations of yaw-pitch-pitch-yaw or roll-pitch-pitch-roll, etc.), which need to be considered to:

◊ ensure that the MODIS thermal cooler does not get overly warmed by Earth radiation;

◊ allow all the MISR cameras to see the moon; and

◊ allow different incident-view angles for MODIS and MISR.

To accommodate all of the above safely, it may be necessary to conduct maneuvers on two orbits. It was proposed that the suite of full lunar/space viewing maneuvers be conducted only occasionally; from one per year (maximum) to three times in the mission (minimum).

Calibration Plan

Jim Butler reviewed the current state of the EOS Project Calibration Plan, which exists in draft form. The plan includes material from:

◊ Instrument Calibration Plans: these have all been delivered for EOS AM-1, were updated at the Preliminary Design Review (PDR) and Critical Design Review (CDR), and have been peer-reviewed.

◊ Calibration Algorithm Theoretical Basis Documents (ATBDs.)

◊ Calibration SubPanel, which has not met for a while. (The next meeting will be in early 1996.)

The calibration plan will incorporate information about:

◊ Pre-launch calibration.

◊ Post-launch calibration.
  (a) On-board devices.
  (b) Vicarious (Earth viewing).
  (c) Vicarious (lunar/space viewing).
  (d) Cross-calibration, i.e. with other simultaneous satellite acquisitions.

Digital Elevation Models (DEMs)

Nevin Bryant (JPL) reported on the current status of DEMs being developed for EOS. A 1-km Defense Mapping Agency (DMA)-based product should be available in 1996, with hopes for a 500-m/100-m product in early 1998.

Work needs to be done to:

◊ define the sequence of tasks needed to generate DEM-based products from the "raw" DEM material to achieve the above goals;

◊ define the requirements for the various software tools to be applied to the EOS DEM data, so that the DEM can be usefully accessed by instrument algorithms.

Gridding

Piers Sellers reviewed the "via dolorosa" of the gridding schemes for EOS AM. After much discussion, it has been concluded that:

◊ No single gridding scheme can be imposed on the EOS AM-1 teams for Level 3 (L3) products—there is too much variation in the requirements of the groups, e.g., polar products versus cloud products.

◊ The need for uniform, easy-to-use products for use by modelers has been recognized by all teams.

It has been decided that the EOS AM-1 teams will generate analogues of their L3 products (and, perhaps, some of the L2 products) to a "modeling" grid with the following properties:

◊ 1° x 1° resolution, or nested 0.5° x 0.5° or 0.25° x 0.25°; with grid cells bounded by integer latitude/longitude lines and starting from 180° W, 90° N and reading text-wise, i.e., left to right, thereafter.

◊ Monthly time resolution, or 10-day resolution with three periods per month such that the intervals run: 1-10, 11-21, 21-end of the month

◊ If diurnally-resolved products are to be produced, they should conform to conventional UTC timemarks, e.g., 00Z, 03Z, 06Z, etc.

◊ Common land/sea mask (to be determined by the GSFC/DAAC).

◊ Ralph Kahn (JPL) should continue to pursue the hexagon-nested grid. This approach may offer the best long-term solution to the gridding problem for L3 products.

Test Data Sets

Skip Reber (EOS Deputy Senior Project Scientist) reported on the recent Test Data Set Workshop. He is coordinating progress towards a common test data set to be used by all EOS AM-1 teams. This may be a data period of one week in October 1986 or a period in 1987.

Validation

David Starr reviewed validation activities:

◊ A Validation Workshop will be held in the Spring of 1996. This will include linkages with other programs and field experiments.

◊ There will be a NASA Research Announcement (NRA) for validation activities in 1996. Emphasis will be placed on the importance of the instrument teams' needs and the breadth of application, i.e., number of teams/products benefited by a single activity.

Science Workshops

Three disciplinary workshops have been proposed. These will follow-up on the ATBD reviews by providing a forum for the discussion of EOS product improvements, additions, and synergisms (multi-instrument products).

Land Workshop

The workshop will take place in May 1996, after the selection of the new EOS investigators. It will consist of two segments:

1. A status review where all the existing and new team members will present their algorithms.

2. The workshop itself, articulated as follows:

   ◊ Surface radiances, reflectances, emittances

   ◊ Land cover classification, fraction of photosynthetically absorbed radiation (FPAR), leaf area index (LAI), roughness length, etc.

   ◊ Downstream products: photosynthesis, evapotranspiration (E-T,) Gross Primary Productivity (GPP), etc.

Atmospheric Workshop

Michael King reported that this was in a very early planning stage. Graeme Stephens had agreed to co-chair.

Oceans Workshop

Chuck McClain outlined some discussion topics for the Oceans Workshop:

◊ Review of geophysical algorithm status

◊ Quality control of products

◊ Product specification and formats (L1-> L3).

Science Software Management Reviews

Francesco Bordi reviewed the main points emerging from the Science Software Reviews (SSRs) for MODIS, MISR, ASTER, and MOPITT. The common concerns raised by all teams were:

◊ Metadata and browse requirements literature

◊ EOS-HDF delivery schedule (late delivery could severely impact V1.0 deliveries)

◊ Availability of remote testing at DAACs

◊ Proposed restructuring of EOSDIS

Landsat-7 and EOS AM-1

All SWAMP members present concurred that having Landsat-7 and EOS AM-1 fly close together in time was highly desirable.

Redefinition and Additions of EOS Products

There are some differences of opinion as to what is or is not a standard/research product. Michael King and Ghassem Asrar will work on specifying a procedure for defining the status of a product, how to change its status, and how to add/delete a product.

EOS AM-1 Session at AGU

There was an American Geophysical Union special session on science and the EOS AM-1 platform. There were a total of 15 oral presentations and 12 posters. The overall standard of the papers was very high and was appropriate for the AGU audience; that is, the focus was on the science that we expect EOS AM-1 to deliver and how we are going about it (algorithms, validation, etc.) rather than a technical review of the guts of the instruments.

The speakers and poster presenters for the session were:

Oral: Sellers, Salomonson, Ackerman, Kahn, Davies, Kahle, Tsu, Schmugge, Gillespie, Matsunaga, Drummond, Pan, Kaufman, Barkstrom, Stobie.

Poster: Slater, Wan, Therrien, Edwards, Rokke, Smith, Yu, Pierl, Khalsa, Case, Kahn, Wang.

Next SWAMP Meeting

The next full-up SWAMP meeting will be held in conjunction with the Science Software Management Reviews for all the EOS AM-1 teams during the week of March 18-22, 1996. ■

Report of EOSDIS Panel Meeting Woods Hole, MA. September 27-29, 1995

— **David M. Glover** (dglover@whoi.edu), Chair of EOSDIS Panel

Panel Meeting

The EOSDIS Panel and invited DAAC scientists attended a meeting held on the Quissett Campus of the Woods Hole Oceanographic Institution September 27-29. The primary purpose of this meeting was to discuss how we could aid Bruce Barkstrom in his attempt to independently cost EOSDIS and to discuss the recommendations recently made by the National Research Council (NRC).

In particular, the NRC made two recommendations that applied directly to EOSDIS:

NRC EOSDIS Recommendation #1

Components of the EOSDIS now under development for flight control, data downlink, and initial processing should be retained but streamlined.

NRC EOSDIS Recommendation #2

a) Responsibility for product generation and publication and for user services should be transferred to a federation of partners selected through a competitive process open to all.

b) To effect this recommendation, it will be necessary to examine the systems implications of reconfiguring EOSDIS as a loosely-coupled federation of quasi-autonomous partner organizations, each with a contractual obligation to perform a subset of the tasks involved in preparing and distributing scientifically reliable products at Level 2 and higher, identifying in particular those functions or services to the federation that must be provided centrally and those for which responsibility can be delegated to the partners.

The NRC Report

Most of the first day was taken up with an open and free-ranging dialog with John Dutton (Penn State). He started the discussion with a walk through of the NRC report, in particular, Appendix F. In his presentation Dutton stated that it was clear to the NRC subcommittee on EOSDIS that the management challenges of EOSDIS will be much more difficult to solve than the technological ones. He compared the cost of running EOSDIS to a number of other enterprises (national laboratories, universities, airlines) and made the point that some cost more on a per employee basis than others. But when he examined EOSDIS the cost was head and shoulders above the others. Why? Dutton reiterated a plea from the NRC report: we need the right model for EOSDIS — re-engineering the system won't solve the problem. In addition, scientists must take more responsibility for EOSDIS.

In discussion afterwards, Dutton admitted that many of the recommendations were based on intuition, only. When he was asked if he or the panel were aware of the Independent Architecture Studies, Dutton told us that they became aware of them after the NRC had finished its study. In addition, it seemed to the EOSDIS Panel that the numbered subparts of the two main recommendations of Appendix F were actually recommended studies that should be done right away. Finally, Dutton stressed the need for a reliable cost estimate of the recommended federated data system to be made available as soon as possible.

Independent EOSDIS Cost Model

Bruce Barkstrom presented a questionnaire designed to explore the depth of consensus within the Panel on four primary ingredients of his cost model: hardware, people, distribution, and development. The results were analyzed by Barkstrom and presented to the panel on the last day. The amount of concurrence was surprising, as were the bimodal distributions. It was decided that a similar exercise be done with the entire IWG, perhaps at the next IWG meeting.

The xDR Improvement Process

Skip Reber presented the results from, and requested further input into, the xDR (EOSDIS Core Sytem [ECS] development track) improvement process. Of the many excellent ideas obtained (mostly via e-mail), only the suggestion that the reviews be broken into parallel sessions met with any strong opposition. It was commented that the flow of information about the review should also be improved. Currently the information density supplied to the board members is either overwhelming (six shelf feet of documentation) or "underwhelming" (viewgraphs of low information content). It was suggested that the review board could prepare a list of questions to focus the discussion quickly on items of interest; perhaps about half of the discussion could be handled this way. Other recommended improvements (fewer people, less theatrical presentations, alternative presentations, less-formal Review Item Discrepancy Documents [RIDs], early demonstrations of system capabilities) were met with general approval, although the number of people attending may be very difficult to reduce.

Data Assimilation Office (DAO) Status Report

Richard Rood presented a brief overview of the current status of the DAO. His primary objective was to encourage more panel members to become involved in the DAO operations. Menas Kafatos volunteered to become more involved in the activities of the DAO.

Agenda Modification

At the beginning of the second day it was decided by the group that breaking the meeting into two splinter groups (one for discussing the NRC report recommendations and one for helping Barkstrom better design his EOSDIS cost model) would be counter to the desires of the group. Consequently, the agenda was reorganized to allow for full participation in all discussions.

Headquarters/Goddard Code 170 Reorganization and Relationship to EOSDIS Panel

Vanessa Griffin presented the status of the latest reorganization of NASA Headquarters Office of Mission To Planet Earth (MTPE) and the new relationships between EOSDIS and the Mission to Planet Earth Office (Code 170) at GSFC. Essentially Code 170 has been put in charge of *all implementation* issues, *science* remains at Headquarters (except for responsibility for funding of the EOS instrument science teams). Dixon Butler will move to the Science Division. He will head up the EOSDIS NRC response team for the next 12 months. The primary programmatic interface for the Data Panel has moved to GSFC Code 170. Only the top positions in the revised organization have been filled at this time.

NASA's Plans for Responding to the NRC Recommendations

Vanessa Griffin also gave a presentation on NASA's response to the NRC recommendations relative to EOSDIS. The question that occupies their thoughts is not whether to follow the NRC recommendations, but rather how to follow and when. NASA has organized four "streams" of activity to respond to the NRC recommendations. The first is to determine the "objects" of competition. The basis of these objects is the standard data product list. The second stream is to decide what values, "business rules," and standards must be kept common. A common values workshop was subsequently held at GSFC November 6-8 to help define these; it was by invitation only. The third stream is to model the enterprise and its functions. The constitution of the United States is a model for a federated system; we need something similar for the proposed federated data system. The last stream deals with drafting the solicitation and determining which mechanism ought to be used, i. e., Announcement of Opportunity (AO), Cooperative Agreement Notice (CAN) or NASA Research Announcement (NRA). NASA Headquarters asked the EOSDIS Panel to strengthen its role within the IWG and to help engage more users in the NRC response process.

ESDIS's Thoughts on NRC Recommendations

H.K. Ramapriyan presented the ESDIS project's views on the NRC recommendations in lieu of Dale Harris. He told us that the Project stands ready to work with the community to do the best job possible, within the constraints of the NRC report, for a revised mission with reallocation of funding to a broader community. He informed us of the existence of a steering committee (Kennel, Price, King, Harriss), a core study team (Butler, 3 project members, 3 science members, 2 Headquarters members, 1 Hughes Applied Information Systems [HAIS] liaison), and the formation of active analysis support teams. All of these groups are to support the initiation of a study that will clearly articulate new mission goals for EOSDIS; develop a process that permits adequate science community review; develop a schedule that takes launch pressures, etc., into account; and develops a process where costs, schedules, requirements, and expectations are aligned.

DAAC Managers' Response to NRC Recommendations

Michael Goodman (MSFC) presented the DAAC managers' response to the NRC report recommendations. Their response was a model of what EOSDIS data processing responsibilities might look like in a federated system. They propose a three-category system wherein data products will be managed according to the category they fall into. Category one would contain data that have high standards for continuity, quality, rigor, consistency, and promptness. These data products would be managed by the government (Level 0 archiving, Level 1 processing and archive). Category two would contain data with known "downstream dependencies" so that, if they were not produced on time, other data products would suffer. These data products would be managed by a federation tightly controlled by the government (much in the same way the DAACs are managed today). The final category of data products would be those that focus on innovation, have broad participation by the user community, and show a high degree of flexibility in product design. These products would be managed by a self-governing board under the aforementioned federation.

This model was brought up again later when the group was discussing bootstrapping the current system of DAACs into a federated system of data producers and became known as the DAAC managers' model.

Status Report from the Ad Hoc Working Group on Consumers (AHWGC)

Bill Emery (Colorado) presented some results from the first 11 responses to the call for input from the Interdisciplinary Science (IDS) teams. Some clear modalities have shown up in the data. In the statistics compiled so far two things have stood out clearly: (*i*) users want the data in monthly "chunks," and (*ii*) they prefer to receive the data as the result of a standing subscription order. Emery is hoping that the remaining 18 IDS teams will get their responses in soon.

Introduction of the SSIG

Bruce Barkstrom gave a brief introduction to a group recently formed. The Subsetting Special Interest Group (SSIG) has a mission to develop descriptions of experiences and needs, to use this information to develop EOSDIS requirements, and make this information available on the World-Wide Web. Their first workshop was subsequently held at Langley November 8-9, 1995 (see report on page 18).

Governance Model for a Federated Data System

The remainder of the EOSDIS Panel meeting was given over to a discussion of how a federated data system should be organized, empowered, and started. Although the details of this discussion will be given in a following report, a summary is provided here to provide a flavor of the discussion. The first and most important consideration was given to the framework of such a federation of data centers. A number of examples were drawn, but two were used more often than the others: (*i*) analogy to the constitution of the federal republic of the United States of America, and (*ii*) examples drawn from the development and growth of the Internet.

The suggested political model for a federation of data centers had as its components: the entities involved in, the purposes of, the activities of, the rules governing, and the means for activating and revising the federation. Some parts of this structure were filled out more completely than others, but the discussion led to an enlivened exchange of ideas. First and foremost the entities involved in the constitution of the federated data centers were discussed. After a relatively brief discussion, it was decided that the federation should include users, producer/users, and producers of EOS data.

The purpose of a federation of data centers should be to stimulate creativity, provide understanding of the data, preserve the data, increase stakeholder's participation, and improve the flexibility of the system overall. Activities of the federation should include producing the data, making the data available (publishing, distributing), providing infrastructure, developing mechanisms to accomplish these things, storing the data, and supporting the users.

Certainly, the problems surrounding the *governance* of a federated system of data centers are larger than the technological problems associated with it. Therefore, a system of rules will be required in order to govern the interactions between the various parts. For no other reason than that the U.S. Federal Government has three parts, the rules section was divided into three parts: developing plans, implementing plans, and adjudicating disputes. Developing plans should include deciding which items should be controlled (standards, interfaces, etc.); establishing requirements for participation in the federation; establishing standards, interfaces, and protocols; and providing the principles for resource allocation. The part that implements these plans should document the standards, define the interfaces, allocate resources, and engage in rapid prototyping. The part that adjudicates disputes received a lot of discussion, but in the end no clear mixture of mechanisms could be agreed upon, and this part was identified as requiring further study.

The final major section of this constitution, the activation and revision part, was discussed, and it was agreed that the means for these two critical activities would have to be worked out early if there was to be any hope of bootstrapping this federated system into action. Along those lines, three models were presented.

The first model was the DAAC managers' model, which has already been reported, above (see section "DAAC Managers' Response to NRC Recommendations"). The second model presented was a refinement of the Independent Architecture Study presented to the NASA and ECS contractor in September 1994. In both cases, Menas Kafatos made a presentation of a federated system that featured both tight and loose coupling between the data centers. Those data centers that should be tightly coupled are those that produce standards for Level zero and one (L0 and L1) data products. The remaining data centers should be loosely coupled, allowing them to produce higher level data products that would be stored at, and accessed from, a data warehouse. The data warehouse would then act as a data cache layer between the users and producers, and would optimize data production because higher level products would only be produced when requested and would have a finite lifetime in the data warehouse. This model was known as the George Mason University model.

A third model, presented by David Glover, was an outgrowth of conversations with Mark Abbott (who could not be at the meeting). This model concentrated on the maturity of the algorithms producing the standard data products. It was suggested that those data products that were considered mature, i.e. were in current use by and trusted by Earth scientists, be produced as currently planned (at the DAACs). But those standard data products that were to be produced by developing algorithms, be produced by the winners of an open competition. This model was considered to be a variation on the George Mason model, where the mature algorithm data products would be produced by a tightly coupled system of centers (the DAACs), and the developing algorithm data products would be produced by successful proposers to an open competition. This model was known as the Abbott *et al.* model.

Of these three models of a federated system implementation, it was concluded that the models were not incompatible but rather focused on different aspects of what the federation should or could be.

Motions Voted

At the close of the final day of the meeting motions were made and voted upon by the following people: Bryan Bailey (EDC), Bruce Barkstrom (LaRC), Bill Emery (CU), Bob Evans (RSMAS), Nahum Gershon (MITRE), David Glover (WHOI), Michael Goodman (MSFC), Bob Haskins (JPL), Michelle Holm (NSIDC), Menas Kafatos (GMU), Anne Kahle (ASTER), Hendrik Meij (SEDAC), Skip Reber (GSFC), Robb Turner (ORNL), Carl Wales (ASF), Warren Wiscombe (GSFC), Victor Zlotnicki (JPL). It was agreed at the beginning that all (except Butler, Ramapriyan, and Vanessa Griffin) who had been present for the discussions, should be allowed to vote.

Bruce Barkstrom advanced the concept that the EOSDIS Panel needed to have three working groups — producers, consumers, and systems oversight. This led to a discussion of the nature and role of the EOSDIS Panel. The conclusion of the discussion could be characterized as an aspiration for the Panel to serve as the proto-group for the governance of the federation. In Barkstrom's words, "the EOSDIS Panel has to accept real responsibility and not just advise and criticize."

MOTION 1:

Bruce Barkstrom moved that a group be formed to write a new charter for the EOSDIS Panel with three subgroups along the lines he presented as a step toward adopting a new approach to governance. This amounts to "self-chartering" the Data Panel into the role of a proto-governing body.

VOTE: This motion passed with only one nay vote.

MOTION 2:

The question was then put to the group as to whether there was concurrence on Recommendation 2, Item (a) "Responsibility for product generation and publication and for user services should be transferred to a federation...," (see above). The recommendation was read aloud prior to voting.

VOTE: The vote was 6 for, 8 against, with 2 abstentions.

MOTION 3:

The question was then put to the group as to whether there was concurrence on Recommendation 2, Item (b) "examine the systems implications...," (see above). The recommendation was read aloud prior to voting.

VOTE: The vote was unanimous in favor of such concurrence.

MOTION 4:

Menas Kafatos moved that full implementation of the federated approach should not be before the launch of AM-1 or TRMM; some sort of partial implementation should be sought. Given these two conditions, the group would favor a federated approach as recommended.

VOTE: The vote was unanimous in favor.

MOTION 5:

It was then moved that the definition of a federated system should be expanded to include the users, regardless of whether they receive government money to use the data.

VOTE: The vote was unanimous in favor.

MOTION 6:

It was then moved to task the Ad Hoc Working Group on Production (AHWGP) to categorize algorithms into categories "mature" and "developing" of the Abbott *et al.* model and report back to the EOSDIS Panel. The AHWGC was tasked with the responsibility of reviewing the AHWGP's categorization so that the two activities would produce the intersection between algorithm readiness and user demand. In the discussion it was stressed that the essence of the first category was intended to be the existence of a ready demand for the product shortly after launch.

VOTE: This motion passed unanimously.

MOTION 7:

It was moved that the DAAC managers' model be recommended to the Response Task Force (RTF), the group NASA has established led by Dixon Butler, as a basis for studying the federation concept along with the EOSDIS Panel's view of the federation, and include the users and producers, their concerns, and the flow of information within a federation.

VOTE: This motion passed unanimously. ■

Articles

Subsetting Special Interest Group (SSIG) Workshop

— **Bill Emery** (emery@orbit.colorado.edu), University of Colorado
Bruce Barkstrom (brb@ceres.larc.nasa.gov), NASA Langley Research Center

The importance of subsetting large data sets has been widely discussed by people concerned with the implementation of EOSDIS. During the EOSDIS Release A Critical Design Review (CDR) in August 1995, Bruce Barkstrom, Bill Emery, and Marti Szczur (GSFC) discussed the idea of having a workshop on subsetting where people interested in subsetting would get together, discuss their present experience with subsetting, and discuss the future needs for subsetting within EOSDIS. After many delays due to scheduling conflicts, the Subsetting Special Interest Group (SSIG) held a workshop at NASA's Langley Research Center on November 8 - 9, 1995. About 40 people from the academic community, NASA centers, and the ESDIS Project participated. Papers presented each day dealt with user experiences or expected EOS capabilities. Also discussions were held leading to an improved understanding of subsetting requirements for EOSDIS. The SSIG Web page (http://ecsinfo.hitc.com/ssig/ssig.html) provides abstracts for the papers presented at the meeting, as well as a current listing of the planned EOSDIS Core System (ECS) data-type services, and some references regarding HDF-EOS. We intend to provide electronic publication of the papers presented, and refine the requirements that appeared at the meeting.

As stated at the outset of the meeting, the purposes of the workshop were:

1. To obtain good summaries of subsetting experiences by users as well as "theoretical views" of subsetting.
2. Obtain a summary of the current capabilities/plans of the EOSDIS.
3. Set up a priority list of data sets for which subsetting seems to be important, and define methods of implementing subsetting and select tests of subsetting that ESDIS and the user community can use to evaluate the EOSDIS implementation of subsetting.

The first day started with presentations on: Interactive User Subsetting in the Colorado EOSDIS Testbed (W. Emery/D. Baldwin [http://jester.colorado.edu/EOSDIS.html]); Coincidence and Subsetting with OTCS/LIS at the MSFC DAAC (P. Meyer/S. Graves [http://wwwghcc.msfc.nasa.gov/ghcc_home.html]); EDC DAAC Experience with 1 km AVHRR (J. Eidenschink [http://edcwww.cr.usgs.gov/landdaac/1KM/1kmhomepage.html]); Correlative Browse Studies (M. Kafatos/R. Yang); AVHRR Subsetting (A. C. Sundar/R. Welch); AVHRR-SST Subsetting at JPL (A. Tran; [http://podaac-www.jpl.nasa.gov/sst/subset.html]), MODIS Subsetting (L. Fishtahler); and finally a series of presentations from the ECS project: ECS Overview (A. Endal), Data Server Subsetting/Sampling/Averaging (C. Horgan), and EOSHDF (D. Wynne, L. Klein).

The afternoon was devoted to a general group discussion of working group definitions. Some substantial changes were made, and the participants were separated into four working groups as listed below.

The second day began with three papers: ERBE

Subsetting and Content-Based Searching (B. Barkstrom), Subsetting of Assimilated Level 4 Products (J. Stobie), and the LaRC DAAC Experience (T. Feltman). The rest of the day was devoted to the working group meetings and a summary of their results.

WORKSHOP WORKING GROUPS

While the papers will provide the formal record of the experiences and expectations that went into the meeting, some of the most important work was conducted in four working groups, where participants could more fully exchange views than was possible in the plenary sessions. The groups formed towards the end of the first day of the workshop were:

1. WG on User Needs and Requirements — Jim Stobie. This group was to consider particularly the following issues: what subsetting services users need and want; how cost influences the selection of subsetting services; what kind of subsetting tools users need; where does subsetting stop and analysis begin?

2. WG on Subsetting for Storage and Network Transmission — Ben Kobler. This group dealt with these issues: should the results of a subsetting service be archived or discarded; compression, filing, and interleaving of results in the subset product?

3. WG on Production Subsetting — Bruce Barkstrom. This group considered production issues, such as what subsetting services are particular to data production and who should be responsible for them; what metadata is required for subsetting, and what metadata should subsetting produce?

4. WG on Subsetting Methods — Ted Meyer. This group dealt with such issues as: what processing steps should be included for such subsetting processes as sampling, averaging, and other volume reduction methods; what user support and documentation are needed; what mechanisms and processes are needed to review and validate data types for particular subsetting methods?

WORKING GROUP RECOMMENDATIONS

1. WG on User Needs and Requirements

Users should be able to order data subsets based on geographic limits (x, y, z), temporal limits, and by variable. This group felt that subsetting that alters data values should not be included in the requirements, which would limit possibilities for averaging, smoothing, or interpolating, but which would include subsampling. The cost of the subsetting service was viewed as a useful way to allow for a rational selection of the service. Also simplicity of subsetting service should provide a way to prioritize it — simpler has higher priority.

This group felt that EOS View may provide a good basis for subsetting, but that more-exotic tools should be left to the scientific community. Once data had been subsetted from an original granule, this group did feel that it was useful to allow further subsetting by value, which could be done through a tool at the scientist's workstation.

On subsetting swath data, the group felt that it was important that the subsetting function should not change the data values. However, it did appear that the subsetting functionality would be the same as that for gridded data. We note that during discussions in the "plenary" session, the consensus that emerged was that swath data by scan-line, which was suggested by Hughes, was an appropriate level of service for users.

2. WG on Subsetting for Storage and Network Transmission

This WG developed the following list of functions that the storage system could do in order to facilitate subsetting. These items are listed in more-or-less increasing level of difficulty:

a. Monitor file access patterns to identify when reorganization of tape files appears justified.

b. Identify subsets that have high usage, both to improve service to users and to provide justification for reorganizing the data.

c. Provide flexibility in system design to allow the usage and access patterns to determine the tradeoff between storage and transmission.

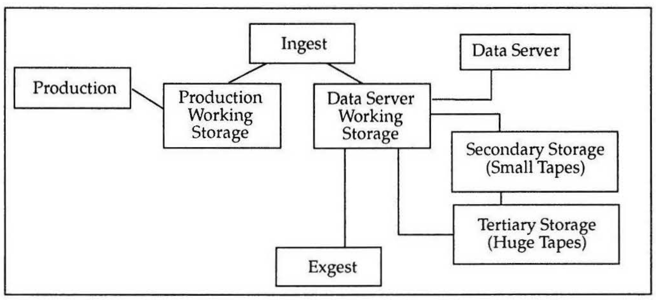
d. Allow subsetted data to be stored and reused by a wider community.

e. Allow content-based subsets to be developed and stored.

f. Allow different portions of a file to be stored on different media.

3. WG on Production Subsetting

The WG on Production Subsetting felt it useful to try to provide a simple model of the connection between data production and the data server part of EOSDIS:



In this model, both secondary and tertiary storage are much slower than the RAID disks that make up the Production and Data Server Working Storage. This WG felt it was important to note that there are external subsets that go out through the "Exgest" service, but that there is also the potential for subsetting that influences the way in which the system handles the partitioning between Working Storage and the tape storage. As a matter of philosophy, this WG felt that all production subsetting for standard data products involve JOBS. If jobs are done in the data server, we will call them "Queries;" if they are done in production, we call them Product Generation Executives (PGEs). The PGE characteristics include a scheduled, standing order approach to scheduling, and subsetting done on the upstream side of a flow to reduce volume. The Query characteristics include: dynamic and unscheduled response to anomalies (QA) or validation. It appeared most reasonable to expect the Investigation Teams responsible for receiving the data subset to define the services needed.

The Production WG did feel that subsetting for data production could be spatial, temporal, or parameter based. They could also see that there were two sources of difficulty that need to be accommodated in production subsetting: multigranule subsetting where there is a spatial discontinuity between two subsets, and one involving different parameters in different granules.

4. WG on Subsetting Methods

The WG on Subsetting Methods developed a list of functions that might be part of a subsetting service and prioritized them. The functions fall into 3 general classes: subsetting, e.g., subsetting, sampling; reduction, e.g., averaging, compositing; and transformation, e.g., reprojection, re-interleaving. The prioritized list is:

Function Subset	Priority
By Geography	1
By Time Interval	1
By Parameter/Variable	1
With a Mask	1-
Land/Sea/Other	1
User Defined	?
Compress/Decompress	1
Select by Content	1
Subset by Selection	1
Create Mask	1
Calculate (+, -, X, /, other simple functions)	2
Statistics	2
Ceiling	2
Floor	2
Average	1
Spatial Subsample	3
Spatial Neighbor	3
3D	3
Temporal	2-
Region/Mask/Selection	2
Differentials	3
Interpolate	3
Reprojection	4
Compositing	4

Masking	1
Geotransform	2
Data Type Transform	4
Re-Interleaving	3
Subsampling	1
Sequence Process for Optimal Processing	5
Journaling	1
Undo, Redo based on history	3

This WG also felt that much further work needed to be done to explore making the definitions of these phrases more precise, and to evaluate the proposed functions against data types. Thus, we need to develop a description for each function, and to note the dependencies of one function on others. ■

ECS Ships First Release to NASA on Schedule and Cost

— **Chris Smith** (csmith@eos.hitc.com), Ir1 Release Manager, Hughes Information Technology Corp.

Interim Release 1 (Ir1) of the EOS Core System (ECS) is being delivered to sites as you read this. Successfully developed on planned schedule and cost, this first installment of ECS provides key capabilities to prepare for its Release A and B successors. In addition to the hardware and commercial software already installed at the Goddard, Langley, and EROS Data Center Distributed Active Archive Centers (DAACs), and the Hughes Engineering Development Facility (EDF), these sites will be receiving custom software and final configurations through January, 1996.

Ir1 capabilities include a suite of specialized tools to support ECS Science Software Integration and Test (SSI&T), early Tropical Rainfall Measuring Mission (TRMM) interface testing, and early introduction of the state-of-the-art, highly evolvable ECS infrastructure as described briefly below.

Science Software I&T

A major goal of Ir1 is to provide early capabilities for the integration and test of science software. The science software is being developed by various Mission to Planet Earth (MTPE) science investigators to generate the data products that ECS will manage and distribute on an unprecedented scale. The science software, for this release, includes Version 1 of the TRMM instrument science software and beta versions of EOS AM-1 instrument science software.

Ir1 provides an environment for the refinement of the integration and test processes to be performed by each ECS DAAC. A variety of integration and test tools are provided, including compilers, math libraries, code checkers, configuration management tools, resource monitoring tools, and visualization and display tools for results checking. Dynamic software test tools are also provided including: a prototype scheduler based on Platinum's Autosys scheduler to register, queue, and run encapsulated science software components (product generation executives or "PGEs") singly or in dependent chains; profiling tools; and a DAAC toolkit that includes "hooks" into the ECS system management framework.

The integration and test capabilities of the release enable the science software to test the portability of the software from the developers computing environment to the DAAC environment. The science software utilizes an ECS Science Data Processing Toolkit designed to facilitate the portability of science software. The current Toolkit (Version 5, also delivered on-time in August 1995) is provided for the developers' computing facilities and for the DAAC. Ir1 supports the testing of the compatibility of both Science Computing Facility (SCF) and DAAC instantiations of the toolkit.

TRMM Interface Testing

The second purpose of the release is to support early testing of key ECS external interfaces. The testing directly supports interface development for ECS Release A, and provides support to the TRMM Project for the development of the TRMM ground system. The TRMM interfaces to be tested include data ingest interfaces between the TRMM Science Data Processing Facility and the Langley and Goddard DAACs, and the interfaces between the TRMM Science and Data Information System (TSDIS) and the Goddard and Marshall DAACs. In addition, the release will test interfaces for the ingest of data from NOAA and the Goddard Data Assimilation Office.

ECS Infrastructure

Ir1 provides an early implementation of ECS' system and network management capabilities as well as its distributed communication services. These services form an infrastructure that supports the functioning of the application software and the operation of the release as a whole. This infrastructure is designed to be reusable for Release A.

The infrastructure supports services for event logging, file transfer, e-mail, bulletin boards, and virtual terminals. A number of Distributed Computing Environment (DCE)-based services are supported, including security services, user authorization, user account management, and directory and naming services. The infrastructure provides a system management capability for fault and performance monitoring, and for network management and monitoring.

A network management capability is provided to support the "shadow management" of some of the network components of the EOSDIS Version 0 system. These components are fully transitioned to EOSDIS Version 1 with Release A. The infrastructure also provides configuration management software, office automation tools, and a World Wide Web browser.

Risk Reduction

ECS is one of the world's largest and most complex data systems. The delivery of Ir1 reduces both the schedule risk and the technical risk for the ECS program as a whole. The early development and shakedown of the science software, external interfaces, and the reusable infrastructure insures that critical Release A functionality will be completed well before the deployment of Release A in late 1996. Over 75,000 lines of custom software, 32 commercial software packages, and 5 Unix environments including Silicon Graphics Inc. (SGI), Sun Microsystems Inc. (Sun), and Hewlett Packard (HP) have already gone into the making of this first installment of ECS capability.

Ir1 is expected to be available for (EOS/TRMM) Instrument Team (IT) and DAAC use in February, 1996. ■

Stochastic Aspects in Estimating the Probability of Producing Good Products by a System

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Recently, Barkstrom (1995) applied a model, which is used in manufacturing systems engineering for machines that fail and have to be repaired, to estimate the probability of producing good data with an algorithm. In addition, he discussed the implications of this interesting model for EOS data production, and proposed four "brain teasers" for reader involvement at the end of the article.

Briefly, the first "brain teaser" is to either provide a more-detailed justification (than in Barkstrom) for Eq. 1 below or suggest an alternative form. The purpose of this short paper is to discuss the stochastic aspect of his first "brain teaser," which will also influence any answers to the second to fourth "brain teasers."

Following Barkstrom, the probability (q) of producing good data with an algorithm can be estimated by

$$q = \frac{1}{1 + T_r p} \quad (1)$$

with

$$p = p_0 \exp(-t/\lambda_p) \quad (2)$$

where t is time, p_0 is the rate at which errors are discovered initially, λ_p is the error discovery lifetime, and $Tr = 1/r$ with r being the rate at which errors are fixed (corrected). Although the exponential decrease of p with time was considered in Eq. (2) in Barkstrom, T_r was taken as an empirical constant.

As mentioned by Barkstrom from his Earth Radiation Budget Experiment (ERBE) experience, different times were needed to repair different errors in ERBE algorithms. When working on numerical model development in the past few years, I have also had a similar experience: Initially, many errors occur but they are quite easy to fix; as time goes by, fewer errors are left but the mean time to fix them is usually longer. Usually, the model can be run without a floating-point error but gives unreasonable results. In that case, the fixing time can be short or long, largely depending upon the experience, talent, and luck of the researchers. Therefore, instead of assuming a constant T_r in Barkstrom, it may be more reasonable to assume

$$T_r = T_{r0} \exp(t/\lambda_r)\zeta \quad (3)$$

where λ_r is the "error repair time" (consistent with the definition of λ_p in Eq. (2)), and ζ is a random number with a mean value of unity. Using Eqs. (1)-(3), we obtain

$$q = \frac{1}{1 + T_{r0} p_0 \exp(-t/\lambda)\zeta} \quad (4)$$

with

$$\frac{1}{\lambda} = \frac{1}{\lambda_p} - \frac{1}{\lambda_r} \quad (5)$$

Therefore, if ζ is taken as unity, Eq. (4) is the same as Eq. (3) in Barkstrom except that λ is given in Eq. (5) instead of being λ_p in Barkstrom. In other words, without considering the stochastic effects, Eq. 3 in Barkstrom can also account for both the exponential decrease of p and the exponential increase of T_r with time.

When we consider the stochastic aspect of Eq. (4), we assume the probability density function of ζ

$$f(\zeta) = e^{-\zeta} \text{ for } 0 < \zeta < \infty \quad (6)$$

so that the expected, i.e., mean value $E(\zeta) = 1$.

Using Eqs. (4) and (6), we can obtain the expected (i.e., mean) value of q

$$E(q) = \int_0^\infty \frac{e^{-\zeta}}{1 + T_{r0} p_0 \exp(-t/\lambda)\zeta} d\zeta \quad (7)$$

and the standard deviation of q, $S(q)$ comes from

$$S^2(q) = \int_0^{\infty} q^2(\zeta) e^{-\zeta} \, d\zeta - E^2(q) \qquad (8)$$

Equation (7) can be solved numerically in a computer; it can also be converted to a standard Exponential Integration (which is one of many special mathematical functions), and then solved using mathematical tables. We can also obtain from Eqs. (7)-(8)

$$S^2(q) = \frac{1}{p_0 T_{r0} \exp(-t/\lambda)} [1 - E(q)] - E^2(q) \qquad (9)$$

so that $S(q)$ can be easily computed.

Using the empirical values in Barkstrom, i.e., $p_0 = 24$ per year, $T_{r0} = 0.5$ year, and $\lambda = 0.3$ year, Figure 1 shows $E(q)$ and $S(q)$ as a function of time. The implication of Fig. 1 is that, depending on their experience and luck, and the complexity of the computer code, different EOS algorithm teams will spend different time periods to obtain good results. For instance, if we define t_{rep} to be the time period after which $E(q)$ is greater than 0.99 (as in Barkstrom) so that data reprocessing can start, then $t_{rep} = 2.1$ years for a team following the $E(q)$ curve (as in Barkstrom), $t_{rep} = 1.4$ years for a team following the $E(q) + S(q)$ curve, and $t_{rep} = 2.3$ years for a team following the $E(q)-S(q)$ curve. If data from various instruments on EOS satellites are needed for multidisciplinary studies, EOSDIS data users have to wait for a longer period of time than users using data from a single instrument only.

It is also seen from Fig. 1 that the standard deviation $S(q)$ is quite large during the first year with a peak at $t = 0.5$ year. This implies that the progress of different EOS algorithm teams could be quite different during the first year. Therefore, additional efforts should be made by various algorithm teams during the first year.

Note that $E(q)$ is slightly different from q in Barkstrom, and it can be proved mathematically that, with the probability density function in Eq. (6), $E(q)$ is always slightly larger than q with $\zeta = 1$. However, this difference does not affect our discussions here. Note also that the functional forms assumed in Eqs. (3)-(4) are based on our experience; however, use of different functional forms with a stochastic component should not change our results qualitatively.

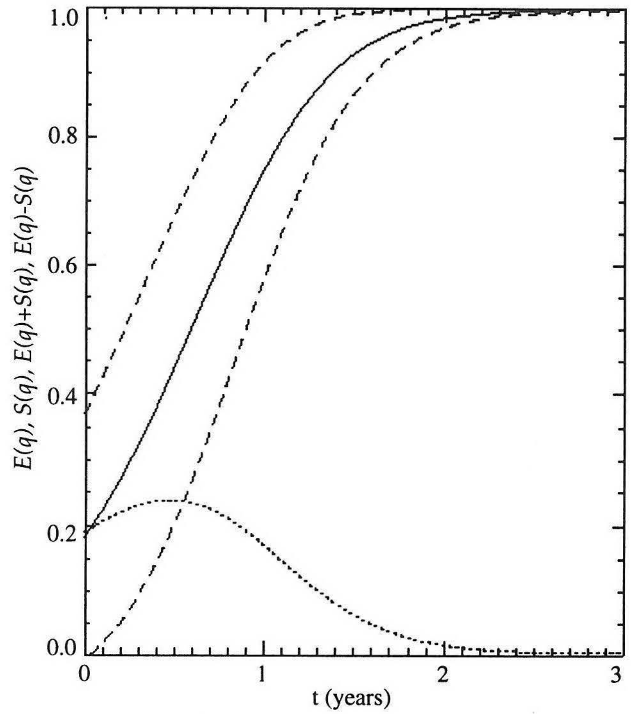

Figure 1. The mean value (E) and standard deviation (S) of q as a function of time, denoted by solid and dotted lines respectively. ($E(q) + S(q)$) and ($E(q) - S(q)$) are denoted by dashed lines above and below the solid line respectively.

In summary, we have shown that Eq. (3) in Barkstrom can be used to account for both the exponential decrease of the error discovery rate with time and the exponential increase of the error repair rate with time. In addition, even with the same parameters in Eq. (4), depending on luck, different EOS algorithm teams will spend different time periods to obtain good data. This provides an answer to Barkstrom's first "brain teaser," and will also affect any answers to the three other "brain teasers."

Acknowledgement: This work was supported by NSF grant ATM-9419715.

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Barkstrom, B., 1995: The good, the bad, and the useful: Do things ever go right? ***The Earth Observer***, 7 , 46-49.

Data Assimilation Configurations for TRMM and AM1

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The Goddard Data Assimilation Office (DAO) plans to produce a hierarchy of products during the TRMM and EOS AM-1 eras. Some of these will be produced only as needed while others will be produced routinely. Although we're still in the definition phase of the specific products, the special configurations of the Goddard EOS Data Assimilation System (GEOS DAS) we expect to use are given below. In addition, following these special configurations is a brief description of the basic GEOS DAS followed by some hints on selecting a product. Feedback on these plans is welcome. Please contact Jim Stobie.

Special Configurations

First-Look Analysis (routinely produced)
The first-look analysis takes the basic GEOS DAS configuration and adds a special "fly-through" module. This module extracts incremental analysis update (IAU) data (see basic GEOS DAS below) at every model time step (approximately one minute) along a given satellite subtrack. The first-look analysis runs daily 12 to 24 hours after data time using primarily non-EOS data (see Table 1).

Table 1.

First Look Input Data

◊ Surface Observations (land, ship, buoy)
- Wind, temperature, moisture

◊ Sounding Balloons (rawinsonde)
- Wind, temperature, moisture

◊ Aircraft (ASDAR, ACARS, AIREPS, etc.)
- Heights, winds

◊ Satellite
- Temperature: TOVS, SSM/T, GPS
- Winds: SSM/I, ERS-1, NSCAT (ADEOS), Cloud Track
- Moisture: SSM/I, TOVS, TMI (TRMM)

GCM Forecast/Simulation (provided as needed)
The GCM forecast/simulation looks like the basic GEOS DAS except that the objective analysis portion is turned off. The only outside data that enter the system are the boundary conditions such as sea surface temperature climatology. This configuration is used to produce 10-day forecasts for various NASA field experiments. It is also used to produce multi-year simulations that investigate the climatology of the GCM itself. Such investigations are needed to isolate real climate signals from artificial model climate signals.

Final-Platform Analysis (provided as needed)
The final platform analysis is just like the basic configuration except it brings the new EOS observations into the objective analysis. It is called a final "platform" analysis because it will be tailored to the observations from a given EOS platform such as AM-1 or CHEM-1. It will usually be run several months after data time to allow full processing of the EOS instrument retrievals.

Off-line Analysis (Produced routinely and as needed)
A typical off-line analysis uses information from a first-look or final-platform analysis as input to another assimilation system. This input is assimilated with EOS and/or other observations to produce special off-line analysis products. An example of this is the current DAO constituent assimilation effort that uses winds from the GEOS DAS to drive a tracer model for off-line N_2O assimilation. The major distinction between an off-line analysis and a normal analysis is that the off-line products do not cycle back into the GEOS DAS. During the TRMM/AM-1 era off-line analyses of CO and O_3 will be provided.

Pocket Analysis (produced as needed)
Pocket analyses are just like the final platform analyses except that selected instrument data are excluded from the assimilation. By excluding a given instrument type from the assimilation, its impact on the climatic signal of the overall system can be assessed.

Pocket analyses are important to determine if certain short-lived instruments produce artificial climate signals within the GEOS DAS and, if so, how these artificial signals might be reduced.

Reanalysis (routinely produced)
These are our primary archive products. Reanalyses configurations look exactly like the corresponding original analyses. For example, a platform reanalysis looks just like a platform analysis. The major distinction is that during a given reanalysis, no changes are permitted to the assimilation algorithms. This is done to eliminate false climatic signals that sometimes result from intermittent algorithm changes. Approximately once every 4 years the DAO reanalyzes the past 20 years of data using the latest data assimilation techniques. In addition, shorter term reanalyses (several months to several years) are conducted periodically to satisfy specific scientific requirements.

Basic GEOS DAS

Data assimilation combines observations from many different instruments with a general circulation model (GCM) to produce gridded data sets (for a complete list of assimilation products see DAO homepage, http://dao.gsfc.nasa.gov/). Here's how the basic assimilation process works:

Cycling The GEOS DAS operates on a fixed-length cycle (currently 6-hours). That is, it gathers observations in 6 hour blocks and uses them to correct the GCM's estimates for that same time period. Figure 1 shows a typical cycle.

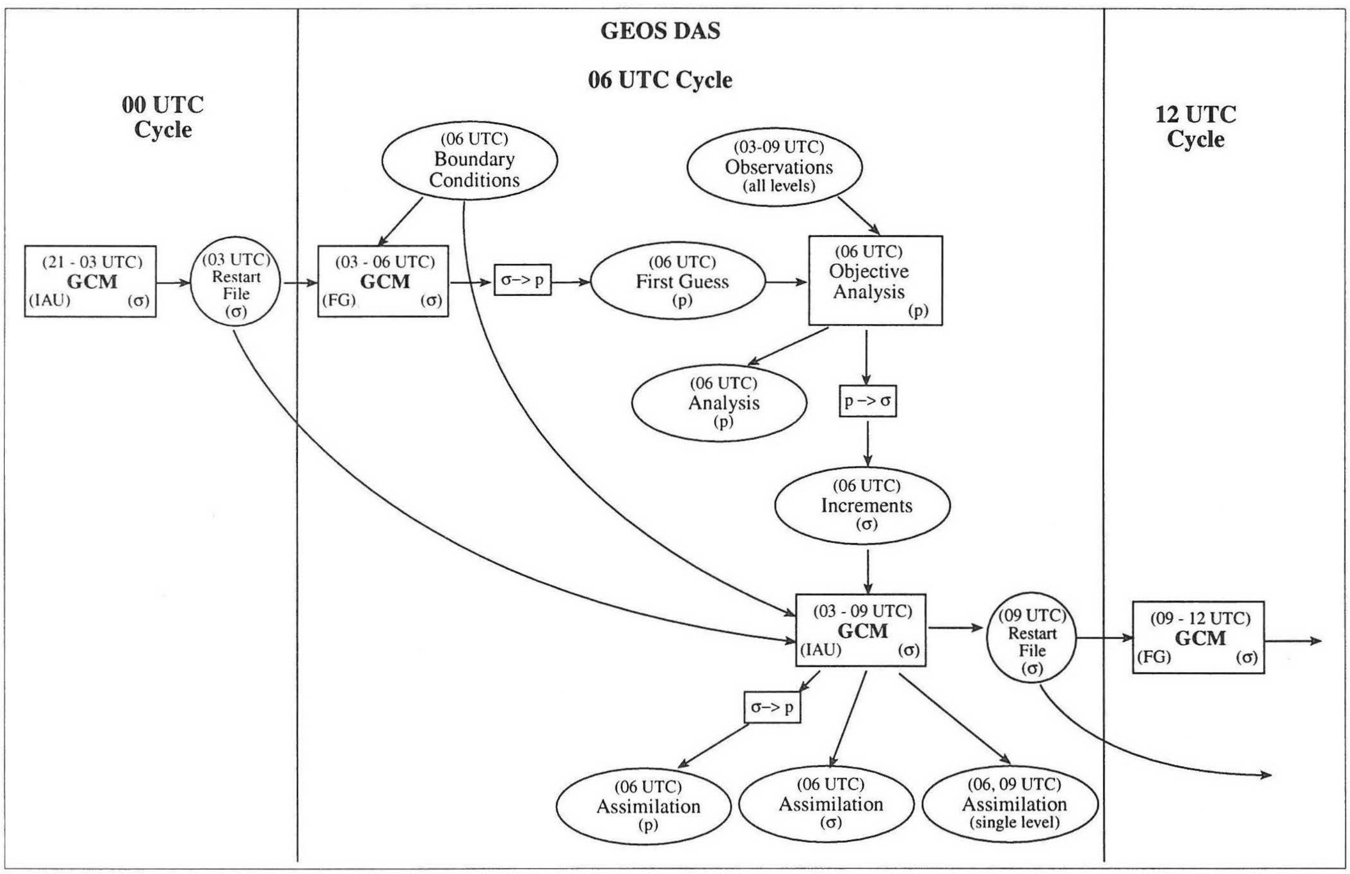

Figure 1. Typical 6-hour cycle of the GEOS DAS. Processes are rectangles and data files are ovals. Times (UTC) are shown at the top of each process or data file. The vertical coordinate (pressure or sigma) is shown at the bottom or lower right corner. In the lower left corner, the GCM integrations are identified as either an incremental analysis update (IAU) or first guess (FG). Vertical interpolation steps between sigma and pressure levels are shown in the small rectangles.

First Guess Each cycle begins with a restart file from the previous cycle. Using this for its initial conditions and boundary conditions from other sources, e.g.. sea surface temperature, terrain elevation, etc., the GCM integrates 3 hours into the future to produce the *first guess*.

Objective Analysis Observations (EOS and non-EOS) are gathered for the 6 hours surrounding the valid time of the first guess. For example, if the first guess valid time is 06 UTC, then observations from 03 to 09 UTC are used. An objective analysis system compares these observations with the first guess and produces a set of gridded corrections. These corrections are called analysis *increments*. One assimilation technique is to apply these increments all at once to the first guess, producing the *analysis* in Figure 1.

IAU The GEOS DAS uses another method called the incremental analysis update (IAU). Rather than putting the increments in all at once at 06 UTC, IAU goes back and reruns the GCM from 03 to 09 UTC, gradually inserting the analysis increments at each model time step. This has several benefits including the ability to produce *assimilations* at much higher temporal resolution. Thus, even though data are gathered in 6 hour blocks, each single-level product is provided every 3 hours through the IAU process. Multi-level (pressure and sigma) assimilations are still archived every 6 hours, but are based on the same IAU process. Furthermore, a first-look analysis (see below) uses IAU to provide selected fields at very high temporal resolution along the satellite subtrack for use by TRMM and AM-1 instrument retrievals. The same boundary conditions that went into the first guess are also used for the IAU.

Mandatory Pressure vs. Sigma Levels The World Meteorological Organization (WMO) has established the following mandatory pressure levels:

1000 mb	300 mb	50 mb	3.0 mb
925 mb	250 mb	30 mb	2.0 mb
850 mb	200 mb	20 mb	1.0 mb
700 mb	150 mb	10 mb	0.7 mb
500 mb	100 mb	7 mb	0.5 mb
400 mb	70 mb	5 mb	0.4 mb

The objective analysis is done at these mandatory pressure levels, while the GCM operates on model sigma levels. The GCM sigma levels are based on the following formula:

$$\sigma = (p - p_t) / (p_s - p_t)$$

where: p = pressure of the sigma level,
p_t = pressure at the top of the GCM,
p_s = surface pressure.

The GEOS DAS GCM uses approximately 70 sigma levels from the surface to 0.01 mb. Interpolation steps between sigma and pressure levels are indicated by the small rectangles in Figure 1.

Continuing the Cycle The next 6-hour segment begins by creating a new restart file at 09 UTC and then extending the GCM integration 3 more hours to 12 UTC. The first guess (FG) integration is done without analysis increments.

Selecting a Product

The GEOS DAS provides the user with many product options. The *assimilations* on pressure surfaces are compatible with a wide variety of other data sets since they are on the WMO mandatory pressure levels. However, for the user who demands higher vertical resolution or wants to avoid the final sigma-to-pressure interpolation, the *assimilations* on sigma surfaces are the best choice. The *boundary conditions, observations,* and *increments* are available for users who want to delve deeper into the sources of the assimilated products. Finally, the *first guess* and *analysis* products are more for internal monitoring of the GEOS DAS performance and are not recommended for detailed climatic studies. ■

International Global Atmospheric Chemistry Program Focus on Atmospheric Aerosols: Direct Aerosol Radiative Forcing

— **John Ogren** (johno@cmdl.noaa.gov), NOAA Climate Monitoring and Diagnostics Laboratory

Introduction

Perturbation of the Earth's radiative budget due to scattering and absorption of solar and terrestrial radiation by anthropogenic aerosols is called *direct aerosol radiative forcing*. In major industrialized regions, the radiative forcing of climate by anthropogenic sulfate aerosols has been calculated to exceed in magnitude the forcing by anthropogenic carbon dioxide, although the signs of the two forcings are opposite. Consequently, much attention has been given in recent years to improving the model calculations of the direct aerosol radiative forcing, and to quantifying the uncertainties of the estimates. At present, there is a great need for observational data on aerosols relevant to aerosol forcing of climate.

The objective of this activity of the International Global Atmospheric Chemistry Project's (IGAC's) Focus on Atmospheric Aerosols is:

> to determine, primarily through observations, the magnitude, uncertainty, chemical sources, and temporal and spatial variations of the direct radiative climate forcing by aerosols of various types, e.g., sulfates, organics, mineral dust.

The emphasis on an observationally-based determination is designed to complement the model-based determinations of aerosol forcing contained within IGAC's Global Integration and Modelling activity. Both approaches use radiative transfer models, but with different inputs to the radiative transfer calculations. The observational approach is based on regional- and global-scale measurements of aerosol properties to evaluate the direct aerosol radiative forcing. In contrast, the modelling approach uses chemical transport models and aerosol microphysical models to evaluate the global distribution of aerosol size distribution and chemical composition, from which the required aerosol radiative properties are calculated. Both approaches require assumptions about the behavior of the system, and the advantage of employing both is that their assumptions are very different. Taken together, these two separate approaches will allow an assessment of the confidence that can be placed on the results. The two approaches are not completely independent, however, as the observational results will also be used to develop model parameterizations and to validate model predictions. Conversely, modelling will play a key role in the design of experiments and interpretation of their results.

Achieving an observationally-based determination of the direct aerosol radiative forcing requires integration of remotely-sensed and *in-situ* observations, from satellite, aircraft, and surface-based platforms. The necessary components, and the specific tasks for this activity, can be summarized as:

1. satellite-based remote inference of aerosol radiative properties;
2. surface-based remote observations of aerosol radiative properties;
3. *in-situ* observations of aerosol radiative, chemical, and microphysical properties;
4. closure studies to test the combined ability of measurements and models to describe aerosol radiative properties and aerosol-induced radiative flux perturbations; and
5. integration of the multi-platform observations to determine the direct aerosol radiative forcing.

Task 1. Satellite-Based Remote Observations

There are many existing and planned satellite platforms that include sensors that are sensitive to aerosols. In some cases, determination of aerosol properties is part of the primary mission of the sensor; in others, aerosols interfere with the primary measurement. In all cases, there is a need to develop and validate the algorithms used to calculate aerosol properties from the satellite-based observations. Generally, these are ill-posed retrievals requiring assumptions that must be justified with data. The aim of this element is to assemble an international group, with representatives from the various satellite science teams, whose goal is to:

> devise and implement a coordinated strategy for obtaining the surface-based and in-situ observations needed to validate the algorithms for retrieving aerosol properties from the satellite observations.

Clearly, the surface-based remote observations in Task 2 will play a key role in this validation, but additional observations will also be required.

Task 2. Surface-Based Remote Observations

Although satellites are required to provide global-scale coverage, remote aerosol observations from the surface provide invaluable data for evaluating trends and validating the satellite observations. Surface-based observations are particularly important on the continents where satellite retrieval of aerosol properties is particularly difficult. There are many instruments, including hand-held or tracking sun photometers, shadowband radiometers, and sky-scanning radiometers, that are currently being used to determine aerosol optical depth and related aerosol properties. The WMO's Global Atmosphere Watch is attempting to establish a network of stations that will determine, among other things, aerosol optical depth. Likewise, the Baseline Surface Radiation Network of the World Climate Research Program has as a secondary objective the determination of aerosol optical depth. The goal of this task is not to duplicate these efforts, but rather to:

> 1) encourage, advise, and coordinate national and international programs so that the surface-based remote aerosol observations can be used for validation of satellite observations and for regional-scale determination of direct aerosol radiative forcing, and 2) supplement the national and international programs with additional sites where a more-comprehensive suite of aerosol and radiation measurements are obtained.

A more-comprehensive suite of measurements will provide multiple, independent observations of aerosol radiative properties and their effects on radiative fields. These observations can be used to evaluate the validity of the approaches being used in the established networks, as well as provide a basis for closure experiments (Task 4). The desired sensors include sky radiometers, shadowband radiometers, sun photometers, and lidars.

Task 3. *In-Situ* Observations

Remote sensing methods can be used to determine the global-scale distribution and temporal variability of aerosol optical depth, and can provide additional information on the column-average scattering phase function and vertical profile of aerosol extinction or backscattering. *In-situ* observations from the surface, aircraft, and balloons are a necessary complement to these methods because they provide measurements of the aerosol single-scatter albedo, phase function, and humidity-dependence of aerosol radiative properties, as well as establish the connection between the chemical and microphysical properties of the particles, e.g., composition, size distribution, shape, and their radiative properties. As in Task 2, there are existing national and international programs for obtaining such measurements, and the goals of this task are to:

> 1) advise and coordinate national and international programs for observations of aerosol properties so that their results can be used in evaluation of direct aerosol radiative forcing, and 2) supplement the national and international programs with additional platforms where a more-comprehensive suite of aerosol and radiation measurements is obtained.

The more-comprehensive measurements include the scattering phase function, hygroscopic growth characteristics, and state of mixture of compositions and shapes as a function of particle size. A detailed chemical characterization of the aerosol is also required to link the radiative effects of the aerosol particles to their chemical sources. Observational platforms include fixed, ground-based sites for characterizing a range of different aerosol types, supplemented with ship- and aircraft-based transects to characterize the horizontal and vertical distributions of the key aerosol properties.

One of the primary objectives of the Baseline Surface Radiation Network (BSRN) is to measure the Earth radiation budget at the surface, in order to provide a database for validation of satellite-based Earth radiation budget sensors (ERBE, CERES, SCARAB). Given the role of aerosols in perturbing the Earth radiation budget, the BSRN has recommended that measurements of aerosol optical depth also be obtained at BSRN sites. Another objective of this task is to coordinate the *in-situ* observations of aerosols with programs focused on the surface radiation budget, so that a combined aerosol/radiation data set can be obtained.

Task 4. Closure Studies

This element will combine elements from Tasks 1-3 in focused experiments in order to:

> evaluate the consistency of models and measurements of aerosol radiative properties and of radiative transfer through a turbid atmosphere, using column-closure experiments.

Some of the specific parameters to be studied include the surface and top-of-atmosphere radiation budgets, the radiative flux perturbation by an aerosol layer, the aerosol optical depth, and the aerosol scattering phase function. Additional closure experiments of aerosol scattering and absorption coefficients are needed and will be a component of the Aerosol Characterization and Process Studies (ACAPS) activity.

The primary approach for this task is to coordinate international, multi-platform, multi-sensor field programs that are designed to compare measured radiative properties and fluxes with values calculated from observed aerosol properties. Two such programs that are currently planned are the Aerosol Characterization Experiments (ACE) and the Tropospheric Aerosol Radiative Forcing Experiment (TARFOX). This task also includes evaluation of the uncertainties of algorithms for retrieving aerosol radiative and microphysical properties from remote-sensing techniques.

Task 5. Integration

Integration of the various parts of this Activity will yield its key product, an observationally-based evaluation of global-scale, direct aerosol radiative forcing, along with its uncertainties and chemical causes. The components of this integration are (*i*) to merge the data sets obtained with remote-sensing techniques (aerosol radiative properties) with *in-situ* determinations of aerosol chemical, microphysical, and radiative properties for different aerosol types, to determine the global-scale distribution of aerosol radiative properties; (*ii*) to use radiative transfer models to calculate the resulting radiative forcing; (*iii*) to compare the calculated forcing with measurements of the Earth radiation budget; (*iv*) to assess remaining uncertainties; and (*v*) to recommend future research priorities.

Existing sets of observations from previous field programs can be very useful for achieving the goals of this IGAC activity. Analysis of such data sets and merging of their results with the results of future measurement programs is planned, with particular attention to be paid to the complications introduced by the absence of standardized aerosol sampling and analysis protocols. (The ACAPS activity includes development of standardized methods, and new experiments focused on direct aerosol radiative forcing will take advantage of methods developed by ACAPS.)

Linkages

Other IGAC activities will be conducting research that relates to this activity, including aerosol process and closure studies (Aerosol Characterization and Process

Studies), Aerosol-Cloud Interactions, radiative effects of stratospheric aerosols (Stratospheric Aerosols), and characterization of aerosols in specific regions (Biomass Burning Experiment, Polar Atmospheric and Snow Chemistry, North Atlantic Regional Experiment [NARE], East Asian/North Pacific Regional Experiment [APARE], ...). Close coordination will also be maintained with the Global Integration and Modelling activity, so that the experiments in Tasks 1-4 are optimally designed and their results are used for model validation.

Outside of IGAC, the obvious candidates for close coordination are the WMO/GAW and WCRP/BSRN programs. On a national scale, the U.S. Department of Energy's Atmospheric Radiation Measurements (ARM) Program is conducting experiments that are closely related to Tasks 2-4.

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* pending formal approval of the IGAC Executive Committee

** invited ■

NOAA Satellites and Public Health Risk Assessment: Epidemiology of Schistosomiasis in the Lower Nile Valley

— **Oscar K. Huh** (oscar@antares.csi.lsu.edu), Earth Scan Laboratory, Coastal Studies Institute, Louisiana State University

John B. Malone, School of Veterinary Medicine, Louisiana State University

Parasites that cause schistosomiasis are a major health hazard in many tropical/subtropical regions of the globe. Disease control programs need basic environmental risk assessment capabilities for this human parasitic disease. The application of advanced satellite remote sensing and geographic information systems (GIS) technology is opening new technically and cost-effective approaches to these long-term public health problems.

In this study, sponsored initially by the National Institutes of Health/National Institute of Allergy and Infective Diseases grant R15, then by the Binational Fulbright Commission (Cairo, Egypt), and the Egyptian Ministry of Health/USAID, we experimented with AVHRR thermal imagery and a multi-year epidemiological data base.

The basic hypothesis was that diurnal surface temperature difference maps (ΔT) calculated from the early morning and mid afternoon NOAA/AVHRR 1.1 km resolution overpasses, would allow us to discriminate soil moisture domains in the vicinity of the Nile Delta. A further hypothesis was that the wettest of these domains would harbor the parasites and drier zones would have lower infection rates or be clear of the parasite.

The mechanism: a portion of the life cycle of these parasites *requires snails as host*—fewer snails, fewer parasites. In the drier zones of the region snail populations are suppressed or die back, collapsing the infection rate. Infective stages invade the host during water contact after skin penetration of cercaria released by snail vectors that live in irrigation canals and other water bodies.

In the preliminary studies, surface temperature patterns in the Nile Delta region were characterized in a classification of T_{max}, T_{mix}, and ΔT images for August 16, 1990, that reflected the classic *S. mansoni* prevalence maps described by Scott in 1937. The broad thermal domains seen in the August 16, 1990 image were seasonally stable in the October 18, 1990 and February 14, 1991 ΔT images, suggesting that permanent features, not vegetation or climate, were responsible for patterns seen. Normalized difference vegetation index images (NDVI) for each day revealed no apparent relationship to thermal patterns.

Using the TeraScan™ software, an analysis was done on the diurnal ΔT AVHRR images of August 1990 and February 1991 to study the relationship of regional thermal domains to historic *S. mansoni* and *S. haematobium* distribution in the Nile delta. In both ΔT images, a series of temperature/distance profiles revealed a decrease in ΔT values of approximately 2°C at points approximating Scott's transition from low to high prevalence of *S. mansoni*. Analysis continued with an epidemiological data base at 41 rural sites involved in surface surveys conducted in 1935, 1983, and 1991. An analysis using the Spearman rank correlation coefficient between median ΔT values and *S. mansoni* prevalence indicated that lower ΔT values reflect wetter hydrological regimes that are more suitable for the parasite propagation (Malone, J.B. *et al.*, 1994). These results were confirmed by similar analyses of individual images, seasonal composites, and annual composites of a 1990-91 monthly ΔT and NDVI time series. In preliminary work, snail vector population density was greatest in wetter moisture domains of low ΔT.

Dramatic recent success in schistosomiasis control has been realized in Egypt by a campaign of mass chemotherapy supplemented by molluscicide use and a television-based public education program (El Khoby, personal communication). Identification of environmental indicators of high risk of infection may facilitate provision of more-frequent chemotherapy and focus molluscicide application for areas of high prevalence that may serve as reservoirs for reintroduction into well-controlled areas.

Satellite environmental remote sensing capabilities combined with GIS technology are providing new ways to address classic concepts of landscape epidemiology, i.e., diseases having natural habitats in well-defined ecosystems where pathogens, vectors, and natural hosts form associations within which the pathogens circulate.

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Mission To Planet Earth Associate Administrator To Return To UCLA

Douglas Isbell, NASA Headquarters, Washington, DC (Phone: 202/358-1753)
Brian Dunbar, NASA Headquarters, Washington, DC (Phone: 202/358-1600)

Dr. Charles F. Kennel, NASA Associate Administrator for the Office of Mission to Planet Earth, will leave the space agency by late spring to return to the University of California, Los Angeles, NASA Administrator Daniel Goldin announced today.

Kennel has been appointed by the University of California Board of Regents as the new Executive Vice Chancellor and Chief Academic Officer of UCLA. He started work at NASA in January 1994 under a two-year appointment from his post as a professor in the UCLA Department of Physics.

"Under the leadership of Charlie Kennel, the Mission to Planet Earth program has made significant progress in helping improve our understanding of our changing planet," Goldin said. "Dr. Kennel has been instrumental in putting the program on a sound budgetary footing while emphasizing its solid science focus. He has also led development of a coordinated educational program that will help increase students' understanding of Earth's environment."

Key agency accomplishments during Kennel's tenure as Associate Administrator include the restructuring of NASA's Earth Observing System, increasing usage of advanced technology in the agency's future Earth science missions, the definition of the first steps toward an integrated global observing strategy, and the launch of the first next-generation GOES weather satellite.

"I am extraordinarily grateful to NASA, and especially to Dan Goldin, for giving me the opportunity to work on such a fascinating program, which deals with issues of importance to the whole world," Kennel said. "I've met and worked with some of the most creative and dedicated people I have ever known. It is especially satisfying that I will now be able to apply what I learned from them on behalf of my home institution, UCLA."

Kennel received an A.B. from Harvard College in 1959 and a Ph.D. in Astrophysical Sciences from Princeton University in 1964. He has been a tenured member of the UCLA Department of Physics since 1967, and was its chairman from 1983 to 1986. He is the author or co-author of more than 225 experimental and theoretical publications in plasma physics, space plasma physics, planetary science, astrophysics, and nonlinear science.

Dr. Kennel has been a Fulbright scholar, a Guggenheim scholar, and a Fairchild Professor at the California Institute of Technology. He is a fellow of the American Geophysical Union, the American Physical Society, the American Association for the Advancement of Science, and a member of the International Academy of Astronautics and the U.S. National Academy of Sciences. ■

EOSDIS V0 IMS WWW Gateway (Version 1.0 Beta)

— **Yonsook Enloe** (yonsook@killians.gsfc.nasa.gov) (301) 286-0794
NASA/Goddard Space Flight Center, Code 505, Greenbelt, MD 20771

Version 1.0 Beta of the EOSDIS V0 IMS WWW Gateway has been installed and is now ready for access. Best viewed through Netscape (v1.1N or better) or a HTML 3.0 savvy browser, this version of the Gateway can be found at the following URL: http://eos.nasa.gov/imswelcome.

For the first time via the World Wide Web, this version provides end-to-end functionality, including a basic product ordering capability. Following is a synopsis of the functionality that is now available:

◊ Inventory Search by: Parameter, Source, Sensor, Dataset ID, Data Center, Date Rangem, and Geographic Region

◊ Dataset Listing

◊ Granules Listing

◊ Granules Attribute Comparison

◊ Integrated Browse

◊ Access to Definitions

◊ Guide Information

◊ Access to Master Directory Information

◊ Ability to Select Packages for Ordering

◊ Product Ordering (including User Profile information)

◊ User Interface Customization

◊ Comments Facility

◊ Online, Integrated, and Context-sensitive Help

Though some of these services were available in previous versions of the Gateway, many have been modified and improved, and are now available with enhanced capability. Many improvements have resulted from comments that were received from Users.

We encourage you to use the Gateway again, try out the new features, and continue to send us your comments. The Gateway will continue to evolve and improve and we will make new versions available as soon as they are ready to be released. The Gateway is now hosted by a server class SGI and is capable of handling a high volume of accesses.

EOS Science Calendar

February 27-29	AIRS Science Team Meeting, Santa Barbara, CA. Contact: George Aumann (hha@airs1.jpl.nasa.gov).
March 13-15	CERES Science Team Meeting, NASA/GSFC, Bldg. 32, Room 103/109, Greenbelt, MD. Contact: Kelly Whetzel (whetzel@ltpmail.gsfc.nasa.gov), (301) 220-1701.
March 21-22	SWAMP Meeting, Valley Forge, PA. Contact: Piers Sellers (piers@imogen.gsfc.nasa.gov), (301) 286-4173.
May 1-3	MODIS Science Team Meeting, NASA/GSFC. Contact: Barbara Conboy (barbara.conboy@ltpmail.gsfc.nasa.gov), (301) 286-5411.
May 13-15	Validation Workshop, NASA/GSFC. Contact: Tim Suttles (suttles@ltpmail.gsfc.nasa.gov), (301) 441-4028.
May 16-18	SWAMP Land Workshop, Greenbelt, MD. Contact: Piers Sellers (piers@imogen.gsfc.nasa.gov), (301) 286-4173.
June 10-14	ASTER Science Team Meeting, Seattle, Washington. Contact: Anne Kahle (anne@aster.jpl.nasa.gov) or H. Tsu, (tsu@ersdac.op.jp).

Global Change Science Calendar

March 5-8	Oceanology International 96 — The Global Ocean, Brighton, UK. Contact Bob Munton at Bob_Munton@spearhead.co.uk.
March 6-8	ISPRS Workshop on New Developments in Geographic Information Systems, Milan, Italy. Call for Papers. Contact James B. Johnston, Tel. (318) 266-8556, FAX: (318) 266-8616, e-mail: johnstonj@nwrc.gov.
March 25-29	8th Australasian Remote Sensing Conference, Canberra ACT. Call for Papers. Contact Secretariat: ACTS, GPO Box 2200, Canberra ACT 2601, Tel. (06) 257-3299, FAX: (06) 257-3256, e-mail: acts@ozemail.com.au.
March 25-29	26th International Symposium on Remote Sensing of Environment, Vancouver, British Columbia, Canada. Contact: Patricia Maisonville, Tel. (604) 231-2370, FAX: (604) 666-8123, e-mail: trish@globe.apfnet.org.
April 8-9	IEEE Southwest Symposium on Image Analysis and Interpretation, San Antonio, TX. Call for Papers. Contact Jeff Rodriquez (rodriquez@ece. arizona.edu), Tel. (520) 621-8732, FAX: (520) 621-8076. For further information see URL: http://www.ece.arizona.edu/conferences/swsymp96.
April 9-13	AAG Conference, Charlotte, NC. Contact Kevin Fitzpatrick, Tel. (202) 234-1450, FAX: (202) 234-2744, e-mail: GAIA@AAG.ORG.
April 22-24	ASPRS/ACSM Annual Convention, Baltimore, MD. Contact Convention Coordinator, 5410 Grosvenor Lane, Suite 100, Bethesda, MD 20814.
May 12-15	ICASSP '96, Atlanta, GA. For information see WWW at http://www.ee.gatech.edu/conferences/icass'96 or e-mail: icassp96-info@eedsp.gatech.edu.
May 20-24	American Geophysical Union, Baltimore, MD. Contact: Karol Snyder, Tel. (202) 462-6900, FAX : (202) 328-0566.
May 27-31	1996 International Geoscience and Remote Sensing Symposium (IGARSS '96), Lincoln, NE. Call for papers. See IGARSS'96 WWW at http://doppler.unl.edu/igarss96, e-mail: stein@harc.edu, Tel. (713) 291-9222, or FAX: (713) 291-9224.
June 4-7	Ninth Annual Towson State University GIS Conference, Baltimore, MD. Contact Jay Morgan, Tel. (410) 830-2964, FAX: (410) 830-3888, e-mail: e7g4mor@toe.towson.edu.
June 16-20	American Society of Limnology and Oceanography Annual Meeting, University of Wisconsin at Milwaukee. Call for Papers. Contact Susan Weiler, FAX: (509) 527-5961, e-mail: weiler@whitman.edu.
June 17-21	Second International Scientific Conference on the Energy and Water Cycle, Washington, D.C. Contact International GEWEX Project Office at (202) 863-0012, e-mail: gewex@cais.com or Judy Cole, e-mail: cole@stcnet.com, FAX: (804) 865-8721.
June 24-27	Second International Airborne Remote Sensing Conference and Exhibition: Technology, Measurements, and Analysis, San Francisco, CA. Contact Robert Rogers, ERIM Conferences, Box 134001, Ann Arbor, MI 48113-4001; Tel. (313) 994-1200, ext. 3234, FAX: (313) 994-5123, e-mail: raeder@erim.org. Infromation available on WWW at http://www.erim.org/CONF/.
July 9-19	International Society for Photogrammetry & Remote Sensing, Vienna, Austria. Contact Lawrence Fritz, Secretary General, Tel. (301) 460-9046, FAX: (301) 460-0021.
August 4-9	SPIE Annual Meeting, Denver, CO. Contact Diane Robinson, Tel. (363) 676-3290 Ext. 357, e-mail: diane@spie.org.
August 20-22	William T. Pecora Memorial Remote Sensing Symposium, "Human Interaction with the Environment-Perspective from Space," Sioux Falls, SD. For preliminary program information, contact Gary Johnson, Technical Program Chair, at pecora13@edcserver1.cr.usgs.gov.

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