Minutes of the Aqua Science Working Group Meeting

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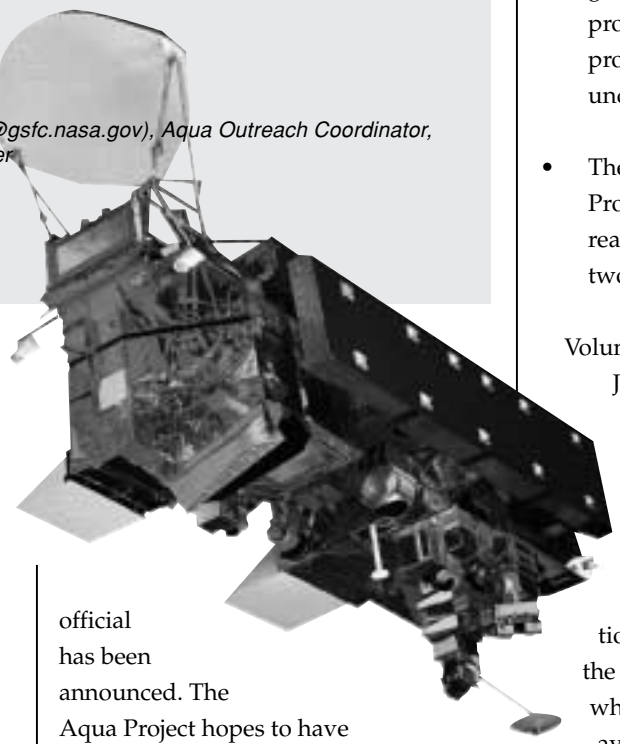

The Aqua Science Working Group met at the Goddard Space Flight Center (GSFC) on September 12, 2000, and was chaired by Claire Parkinson, the Aqua Project Scientist. Parkinson opened the meeting at 8:30 a.m. by welcoming the attendees and then introducing Steve Cole of the EOS Project Science Office Science News and Information Team. Cole stated that the EOS Science News and Information Team has helped to get information about EOS research into the news media that has reached an audience of more than six million in its first year. The EOS News Team facilitates responsible and balanced science reporting in the mass media, and that team works closely with EOS researchers and their institutions' public information staffs to write press releases, arrange press conferences, and publish media guides on NASA Earth Science missions. Cole encouraged all in attendance to make use of his team to improve and expand public understanding of global change research. Early next year, Cole will be working with Parkinson and Aqua scientists on a "Science Writers Guide" to Aqua.

Following Cole's remarks, Parkinson presented an update on the status of the Aqua mission, noting that the Aqua launch will most likely occur no earlier than May 7, 2001, although nothing official has been announced. The Aqua Project hopes to have a firm launch date in place by the end of October 2000. *[Ed. Note: The offical date is now no earlier than July 12, 2001.]* Other status updates from Parkinson included:

- Spacecraft electrical integration has been completed.
- The second review of the Integrated Mission Timeline (IMT) took place on July 13-14, 2000, with the next IMT scheduled for October.
- The Comprehensive Performance Test (CPT) was completed on August 23, 2000.
- Planning is underway for a gain change in two MODIS circuit boards in order to improve the accuracy of MODIS-derived sea surface temperatures.
- The first and second stages of the launch vehicle are completed.
- The NASA Research Announcement (NRA) for Aqua Validation generated a large number of proposal submissions. The review process for these proposals is now underway.
- The second volume of the EOS Data Products Handbook should be ready for printing within the next two weeks.

Volume 2 covers ACRIMSAT, Aqua, Jason-1, Landsat 7, Meteor 3M, QuikScat, QuikTOMS, and Vegetation Canopy Lidar (VCL) and will provide descriptions of the standard and research data products, file sizes, spatial and temporal resolutions, and information on where the products can be obtained and whether or not a browse product is available.

Concerning Aqua outreach initiatives, the first installment in the Aqua Series of NASA Fact Sheets has been completed. Titled "The Water Cycle" and written by Steve Graham, Claire Parkinson, and Mous Chahine, this fact sheet gives an overview of Earth's water cycle and how the Aqua mission will contribute to an increased understanding of its role in global change. Those EOS and Aqua parties interested in obtaining hard copies of the fact sheet are encouraged to contact Steve Graham, e-mail: steven.m.graham.2 @gsfc.nasa.gov. It can also be found online at earthobservatory.nasa.gov/ Library/Water. Work has begun on the second fact sheet in the series, titled "Weather Forecasting," as well as the Aqua brochure. The AMSR-E brochure is in press.

Following Parkinson's Aqua update,

Bruce Barkstrom, the CERES Team Leader, provided an update on the CERES investigation. He noted that all major activation activities are completed on Terra CERES, with the exception of the deep space maneuver. To date, the Terra instruments have performed exceptionally well, with reasonably good fixes on geolocation and coastline navigation.

Barkstrom then moved on to the science impact on CERES of Earth Science Data and Information System (ESDIS) capacity limitations. He reiterated that the CERES Science mission provides a peer-reviewed science investigation in five areas:

- The continuation of the Earth Radiation Budget Experiment (ERBE) measurements of the Earth's radiation budget and cloud forcings.
- Improvement of scene identification of radiation budget with simultaneous and collocated imager data (VIRS and MODIS).
- Provision of new angular distribution models to cut instantaneous Earth radiation budget (ERB) flux errors in half.
- Provision of empirical surface radiation budget fluxes.
- Provision of atmospheric flux profiles (shortwave and longwave).

Barkstrom noted that the last four bullets are new areas of major scientific improvement.

There has been a major investment in the CERES instrument, validation, and software. Five instruments have been developed and are flying or will fly on three platforms. The CERES team has invested three years of work in the scientific validation of TRMM data. The investment in CERES production code is large, with about 600,000 lines of scientific code and about 45,000 lines of production scripts.

Regarding the CERES effort to reduce hardware capacity requirements, Barkstrom provided a number of instances:

First, ingest is down six times from the original estimates. The original ESDIS/EOSDIS Core System (ECS) ingest rates included one MODIS stream for each CERES instrument. CERES recommended not only reducing to one MODIS stream per satellite but also subsetting to only one third of channels.

Second, the CERES Surface and Atmospheric Radiation Budget (SARB) algorithms have reduced central processing unit (CPU) needs by a factor of 10.

Third, personal efforts by Barkstrom on the Ad Hoc Working Group on Production (AHWGP) resulted in reducing 19 ESDIS/ECS working groups to one working group that produced a preliminary summary of needs in two weeks using e-mail and that provided final capacity estimates within six months. This work reduced the uncertainty and cost of the total EOSDIS system.

Fourth, the CERES team is considering the impact of using reduced imager resolution data in its cloud algorithms, although this reduction may increase spatial noise.

Fifth, the team is considering the possible removal of clear-sky reflectance history in the same algorithms, which may reduce cloud detectability.

It is clear that reducing hardware capacity carries a substantial scientific risk for these algorithms.

Commenting on the current state of CERES data production, Barkstrom noted that the TRMM ERBE-like data products have been available from the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC) for some time and that Terra ERBE-like data products have been available in beta form since very shortly after the covers opened late in February. The CERES Team expects to release an "Edition 1" version of the Terra ERBE-like data products shortly along with TRMM instantaneous cloud properties. Owing to the TRMM instrument failure, only about one year of TRMM data will be available. On Terra, EOS Data and Operations System (EDOS)/ECS problems have been hampered as intermittent dropouts have prevented producing daily and monthly data products.

The current CERES approach to capacity estimation involves improving the data production schedule to cover TRMM, Terra, and Aqua. CERES has developed software to tie the production schedule to hardware capacity needs and production workforce. The standard NASA approach based on Level 0, Level 1, Level 2, and Level 3 data does not describe the phased validation and production approach CERES uses. In the CERES schedule, there is a need to reprocess some data products before validating others. In addition, CERES will begin to use a "non-delay" schedule as a baseline and examine schedule slips and associated cost increases as a function of capacity reduction. CERES

primarily needs a three-fold CPU increase over the ESDIS profile.

The science impact of a reduced hardware capacity critically lowers the ability of the EOS program to reduce uncertainty in cloud-radiation interaction. This effectively lessens the ability of EOS to (1) provide improved long-term cloud properties, (2) reduce the uncertainty in angular distribution models and top of atmosphere (TOA) fluxes, (3) improve the surface radiation budget, and (4) provide new information on the atmospheric budget. In addition, there would be a probable reduction in the EOSDIS user community. Also, a reduced capacity would slow improvements in commercial data products used by solar energy and home-building industries, and reduce the ability to provide timely data to students who participate in the CERES outreach program called Students' Cloud Observations On Line (S'COOL).

Next, Bob Murphy of the MODIS Science Team presented sample Terra MODIS results and provided an Aqua MODIS update on behalf of Vince Salomonson, who was unable to attend the meeting.

Murphy began by stating that MODIS is working well, and in general, signal to noise ratios (SNR) and noise equivalent delta temperatures (NEDT) are better than pre-launch. Band-to-band registration is good and most early striping problems have been resolved. The team is still adjusting focal plan biases to optimize performance, as optical cross-talk in medium wavelength infrared (MWIR) and short wavelength infrared (SWIR) persists. Also, the noise injection into analog to digital conversion (ADC) problem results in 10-11 bit long wavelength infrared (LWIR) bands, so they need to switch to the MODIS B side electronics. Because of this problem, a resistor swap has been requested for the Aqua MODIS. (Note: The resistor swap was approved on October 2.) A deep space maneuver for the Terra spacecraft is planned for January 2001.

Next, Murphy showcased a series of MODIS images including Enhanced Vegetation Index (EVI), cloud mask, water vapor, thin cirrus, cloud top pressure, cloud optical thickness, cloud particle effective radius, aerosols (African dust), and sea surface temperature.

A current issue being worked is the timeliness of ephemeris data. Murphy noted that the Tracking and Data Relay Satellite System (TDRSS) On-board Navigation System (TONS) on Terra provides real time orbit data needed for geolocation. For Aqua, these data must come from the post-processed ephemeris that is not available for 40 hours after the first data collection for each day. ESDIS estimates that more frequent ephemeris data would involve a one-time ECS software costs of approximately $150K and that yearly cost would vary depending on desired frequency (2 ephemera per day - $52K, 4 ephemera per day - $112K, 6 ephemera per day - $172K). At the present time, the processing chain from EDOS through the Goddard Earth Sciences Distributed Active Archive Center (GES DAAC) and to the MODIS Adaptive Processing System (MODAPS, a MODIS Principal Investigator-led processing system) takes more than a week so it is not necessary to provide the more frequent ephemeris updates. Ultimately the entire system must be optimized so that data can move from EDOS through the GES DAAC and into MODAPS in 48 hours. To achieve that requirement, it will be necessary to provide the ephemeris updates more frequently. The target for reaching this timeliness should be launch plus 6 months.

Following Murphy, Kathy Amidon, from the Aqua Instrument Planning Group Support, provided a summary of the Integrated Mission Timeline (IMT). Amidon noted that the second IMT Review was held on July 13-14 and was attended by members of the Aqua Project, TRW, Instrument Operations Teams, and the Flight Operations Team. The current version of the IMT is based on previous IMT reviews from March and July 2000. She noted that MODIS yaw maneuvers previously planned for days 26-27 and 30-31 have been rescheduled to days 29-30 and 36-37. This is because MODIS elects to wait until day 15 to begin its outgassing procedure. Since MODIS activities stay in the same order, the first set of yaw maneuvers slips out to days 29-30.

A table was included that summarizes all planned instrument modes during spacecraft maneuvers. It is still the preference of the AIRS team not to perform deep space constant pitch maneuvers, so the question remains which calibration activities would need to be repeated. If all calibration activities need to be repeated, then AIRS would not complete activation checkout until approximately day 85.

Next, Amidon noted that CERES yaw maneuvers appear to be incompatible with MODIS yaw maneuvers. CERES solar calibrations probably cannot piggyback on MODIS yaw maneuvers because of the orbital timing of the yaw maneuvers, the duration of attitude hold at the yaw offset attitude, and the yaw angle sequences. MODIS wants to maneuver to a yaw-offset attitude, hold

for approximately five minutes, and return to nominal attitude once per orbit. These yaw maneuvers would be centered roughly over the orbital South Pole, which is approximately 10-15 minutes after the spacecraft experiences sunrise. Each orbit will have a different (incremental) yaw offset currently varying from 16.5° to 0°. CERES, on the other hand, wants to maneuver to a yaw offset attitude of approximately 15° and hold attitude for roughly 35 minutes before returning to nominal attitude of 0° yaw. The beginning of the maneuver would be at approximately sunrise minus two minutes, so the maneuver back would be at approximately sunrise plus 33 minutes. CERES first wants an orbit sunrise at 0° yaw, followed by an orbit sunrise at 15° yaw, followed by an orbit at 0° yaw, and wants to perform this sequence twice. The MODIS sequence does not allow for 0° yaw orbits between their incremented yaw offsets and does not want to sit in the yaw offset attitude for 35 minutes. Consequently, an additional maneuver sequence has been proposed to satisfy CERES solar calibration requirements and is currently under evaluation.

Lastly, Amidon noted that the next Aqua IMT Review is currently scheduled for October 17-18, 2000.

After a short break and guided tour of the Aqua Flight Operations Facility (narrated by Fran Wasiak), the meeting reconvened with presentations by Ed Masuoka of the MODIS Science Data Support Team and Bruce Barkstrom of the CERES Team on Terra and Aqua Data Processing Issues. Masuoka presented first on MODIS lessons from Terra regarding data systems and product release. He noted that a spacecraft design flaw has resulted in bit-flips in high data rate instrument Level 0 data, and that the ground system lost capacity and robustness due to budget constraints. In July 2000, EDOS had hardware failures and capacity bottlenecks followed by difficulty processing Level 0 with bit-flips in August 2000.

From a science perspective, six months to a year are required to get releasable products after initial data acquisition. The performance of MODIS on orbit required calibration software changes and there were on average 10 science algorithm changes per higher level product (Level 2 and Level 3 products.) The performance of the data system and bit-flip problems resulted in days with large data gaps, and since products are now being released to the public, solid data days are very important. Additional problems with data ordering have been encountered, as ordering data using the EOS Data Gateway (EDG) is cumbersome, slow, and intermittent, and frequently leaves the user with the impression that no products are in the archive. Another flaw in product ordering is that large data orders (15 GB) do not get filled, but do not fail either, so it is only later that the end-user is notified via email from DAAC user support. The Quality Assurance metadata update tool (QAMUT) needs substantial work to improve its efficiency in handling the updating of a large number of data sets.

Next, Masuoka commented on the current status and issues related to MODIS data production at the GSFC DAAC. He noted that some two-hour Level 0 data sets are truncated due to file transfer protocol (FTP) problems, and they are unable to achieve robust processing of Level 1 products in the GSFC DAAC as production problems in the EOSDIS Core System (ECS) release 5B are being manifested as gaps in the Level 1 data products.

MODAPS is processing the data that arrive from GSFC, and is currently running 10-30 days behind acquisition. MODAPS data production is exceeding A+ baseline (the average daily product volume and average daily number of files that MODIS is allowed to store in each of the MODIS DAACs) for delivery and the MODIS Science Team is working closely with them to prioritize production. Currently, the science team is making trades between keeping production near current day and processing complete days for time series. Delays in acquiring complete days (95% of Level 1) from EDOS/GDAAC is an issue and it is taking up to a month to fill holes in a day when EDOS reprocessing is required.

Impacts of the current problems include having not processed all of the MODIS Level 0 data that has been acquired. There exist a large number of days that haven't been produced due to system inefficiencies. The system is unable to produce consistently, even at 96 A+ levels, mainly due to the incomplete delivery of Level 1 products to MODAPS, greatly hampering higher-level product generation and validation efforts. Masuoka noted that they have lost as many clear views of validation sites to "bit flips" and EDOS problems as to cloud cover. In addition, increased archive capacity is needed above the 96 baseline to store higher level MODIS science products. Estimates were developed before any code was completed and is now inadequate to store these MODIS products.

A delay in production of complete Level 0 products for data days has held up downstream production at GDAAC and

MODAPS. The production backlogs have resulted in having to move data from online storage to tape archive with associated overhead of retrieval and further delays in producing Level 3 composite products (8-, 16-, and 32-day products). Reprocessing is a high priority due to large gaps in the data record and the beta quality of the science algorithms that produced the products. Currently there is no capacity to reprocess and keep up with the current production at the same time. The MODIS team needs significantly more reprocessing and ingest capacity at the DAACs to reprocess the science data and insert reprocessed products into the archives.

Barkstrom then continued this theme by giving an overview of the EOS data issues workshop held on June 1-2, 2000 at GSFC. The gathering constituted the inaugural meeting of a Science Working Group on Data (SWGD). Participants included (1) Terra instrument team representatives from CERES, MISR, MODIS, MOPITT, (2) EOS Project and ESDIS Project representatives, (3) EOS Project Science Office representatives, including the Terra and Aqua Project Scientists, and (4) DAAC and Science Investigator-led Processing System (SIPS) representatives.

He noted that the immediate EOSDIS situation appears to have improved as early EDOS problems are being solved, although EDOS remains backlogged. The Working Group formed because the system remains unstable and appears to be systematically under-sized. There is concern that the lack of hardware will delay the scientific validation effort by 2-3 years minimum. The SWGD hardware appraisal needed to deal with validation and reprocessing shows a need of about $15 million in computer hardware in FY01 and FY02 to solve the problems, with small additions in later years (~$2M).

During the workshop, the participants discussed the current operating status of EOSDIS, and in particular the lower than expected throughput and how it should be addressed. They noted that the February 1996 baseline sizing used to implement EOSDIS is not adequate to support the science data needs. Because that baseline was established before the algorithms were developed and could be run in the production environment, it did not have a clear empirical basis. In addition, the 1996 baseline does not appear to have been based on previous NASA experience in validating and producing Earth science data. Terra instrument team representatives presented revised system sizing estimates based on current experience and improved understanding of the EOS production environment. The group noted that the current performance of the system has yet to meet an operational level of production equivalent to the Option A+ first year capacity of 1x (product generation executable rate equals the input data rate from the satellite) of Level 1 products and .5x (product generation executable rate is .5 of the input data rate from the satellite) of Level 2 and higher products as volumes specified in the 1996 baseline.

The primary finding from the working group meeting was the need for a marked increase in the system capacity to generate data products. The current budget situation is difficult on all sides. It is clear that there will need to be frank and open discussions between all of the parties involved in EOSDIS regarding possible options. One area of concern is the impact of the rapid evolution of information technology on the obsolescence of the current system. This impact suggests that we may need to move rapidly from the current system to the more distributed system being envisioned for the new Data Information Systems and Services (NewDISS).

[Ed. Note: See article on page 32 for progress in the performance of the EOSDIS system since this meeting.]

The next topic of discussion was possible formation flying amongst the EOS afternoon constellation of satellites. As introduced by Parkinson, Al Chang, the Aqua Deputy Project Scientist, will be representing Aqua scientists at upcoming meetings this fall on the issue of formation flying amongst Aqua, PICASSO-CENA, Cloudsat, Aura, and PARASOL (French micro-satellite containing POLDER), the set of upcoming EOS satellites taking measurements in the afternoon. Chang outlined the issues involved, including fuel expenditure, mission risks, and measurement enhancements, and solicited from the audience any concerns or support for formation flying. Ed Macie of the Earth Science Missions Operations (ESMO) Project presented more detail on the Constellation Coordination of the Afternoon Train. Macie said the ESMO at GSFC has been designated as the focal point for coordination of the Earth Science morning and afternoon constellations. Their charter is to design and implement a constellation plan to maximize the science return, minimize operations, demonstrate various formation-flying technologies, and provide a focal point for communication and coordination between missions.

The Morning Train includes Landsat 7, Terra, EO-1, and SAC-C and the Afternoon Train includes Aqua, PICASSO-CENA, CloudSat, Aura, and

PARASOL. Barkstrom noted that the ESMO needs to have a clearer picture of the PICASSO-CENA/CloudSat precession across the swath, and that the PICASSO-CENA team should follow up on this with GSFC. In addition, the point was brought up that in the forward scattering direction near the equator, MODIS sees a lot of sun glint in clear skies. The major concern on formation flying right now is the gap in time needed between Aura and Aqua since they use the same polar ground stations. This is not a problem for Terra/Aqua since they will be rarely overhead at the same time, and PICASSO-Cena/CloudSat since different ground stations will be used. The current philosophy of the train constellation is that Aqua leads and other satellites respond to any Aqua orbital changes in elevation or inclination.

There will be a Morning Constellation Working Group meeting at NASA Headquarters on September 15, 2000 and an Afternoon Constellation Working Group Meeting sometime in late October. *[Ed. Note: the afternoon constellation meeting was changed to November 28, 2000.]* Current plans and activities call for:

- establishing Missions Operations Working Groups and Charters;
- developing a Mission Implementation Plan (morning constellation draft being reviewed);
- prototyping a web-enabled Earth Science Collaborator tool for the Morning Constellation for dissemination of information, analysis, and coordination of constellation activities;
- a system demonstration in January 2001;
- reviewing and updating the Flight Dynamics and Network studies as needed, and maintaining insight for identification and resolution issues; and
- defining and developing agreements between missions and services as required.

After returning from lunch, the group heard from Akira Shibata, the Japanese AMSR-E Team Leader, who presented a National Space Development Agency of Japan (NASDA) AMSR-E Science Team Update. Shibata noted that the AMSR-E data will be available after 24 hours following the collection of data. Shibata also showed sea surface temperature maps from the TRMM Microwave Imager (TMI), and he discussed the merits of the inclusion of 6 GHz channels on AMSR. These merits include more accurate sea surface temperature, soil moisture, sea surface wind speed and precipitation data.

Shibata noted that main efforts for validation are concentrating on making match up data sets. Operational data on water vapor, sea surface winds, sea surface temperatures, precipitation, and snow depth have been collected through the global telecommunications system (GTS), the internet, and JMA. Experimental data will be collected by field campaigns and automatic stations maintained by the PIs and NASDA. These data will include water vapor, cloud water, precipitation, sea ice, snow depth, and soil moisture.

Data distribution from the Earth Observation Research Center (EORC) (for PIs and authorized persons):

Level 1B	6 hours online, tape
Level 2	24 hours online, tape
Level 3	1.5 days online, tape
Subsetting	6 hours online
Matchup data	2 days online

Reports of Japanese scientific activities on the usefulness of 10 GHz data of TRMM Microwave Imager (TMI) have been prepared on sea surface temperature (SST) by Shibata and Murakami, precipitation by Aonashi, sea surface wind speed under rainy conditions by Shibata, and soil moisture by Koike.

Shibata also commented on the merits of 6 GHz of AMSR/AMSR-E by saying that more accurate SST, soil moisture, sea surface wind speed, and precipitation measurements will be available. In addition, some new applications are anticipated for snow and sea ice. Concerns for 6 GHz include interference from artificial sources like the 10 GHz of TMI.

Following Shibata, Roy Spencer, the NASA AMSR-E Team Leader, offered an update on NASA AMSR-E progress and issues. Spencer noted that all algorithm software has been handed off to SIPS (except sea ice) and that SIPS interface testing with Remote Sensing Systems (RSS) and National Snow and Ice Data Center (NSIDC) is progressing normally. Regarding passive microwave calibration, the TMI calibration bias has been traced to a probable loss of all vacuum deposited aluminum (VDA) coating on the main reflector, due to atomic oxygen in its 350 km orbit. Also, a passive microwave rainfall mystery exists in that various estimates of tropical ocean rainfall change during El Niño Southern Oscillation (ENSO) (+10% during warm phase) is at least double that inferred from surface energy and atmospheric radiation balance considerations (possible explanations for these observations include rainfall efficiency and drop

size distribution change). The TRMM radar actually shows a decrease during the warm phase (may be due to drop size distribution change).

Spencer also noted that there will be an AMSR-E workshop in Kyoto, from October 30 to November 1, 2000.

After Spencer, George Aumann, the AIRS Project Scientist, offered a status update on the AIRS/AMSU/HSB program. Aumann began by stating that the scientific objectives of the AIRS/AMSU/HSB instrument suite are to improve operational weather forecasting and study the weather and climate related processes related to temperature and moisture profiles, surface temperature and emissivities, and cloud properties.

Aumann noted that the instrument suite passed the warm Comprehensive Performance Test (CPT) at TRW, and the cold Thermal Vacuum (TVAC) is the next scheduled test.

Version 2 product generation software (PGS) has been installed at the GSFC DAAC and Level 1b software performance is being verified using flight model data from the TVAC tests. Based on these tests, the instrument is demonstrating excellent radiometric and spectral performance.

The instrument team continues to work on the implementation of the Validation Plan. The validation processing system is being prepared at JPL with the goal of having fully characterized Level 1b data at launch +7 months and T(p) (temperature profile as a function of atmospheric pressure), q(p) (water vapor profile as a function of atmospheric pressure), and T_surface (surface skin temperature) products at launch +12 months.

For routine global meteorological observation support, plans include the use of 100 co-located atmospheric truth sets from worldwide routine radiosondes (expect about 10 to be cloud free) and 300 "surface reports" from ocean buoys and ships per day for sea surface temperature validation (expect about 30 to be cloud free, 15 of these at night). In addition, a routine meteorological data set will be used for operational quality assurance.

For dedicated temporary support, plans include the use of 16 atmospheric state truth periods per day from the U.S. and five other countries for three months coordinated with EOS Aqua overflights.

Concerning the NASA Research Announcement for EOS Aqua validation support, 36 proposals were received related to AIRS/AMSU/HSB and they expect to have funding for approximately 8 of the proposals. The funded proposals are expected to support the validation effort with an additional 50 research-type radiosonde launches per year, many of them with chilled mirror hygrometers, and 40 special floating buoy measurements per day, for the three-year proposal period.

Next, Aumann spoke about the new task of AIRS data forecast impact assessment. There is a letter of agreement between NOAA and NASA (James Baker and Dan Goldin) to assess impact of AIRS data on operational forecast by launch +12 months. NOAA understands what information is needed to improve weather forecasts and sees the AIRS instrument as the way to provide this important information. The National Centers for Environmental Prediction (NCEP) and the European Center for Medium-range Weather Forecasting (ECMWF) have determined that achieving a major positive forecast impact requires satellite data that provides:

- lower tropospheric sounding with minimal surface mixing;
- accurate surface temperature and emissivity;
- mid-tropospheric and higher water vapor sounding channels; and
- accurate (and scene independent) error characterization.

Currently, none of these data is provided by infrared or microwave sounders, but will be provided by AIRS.

Aumann noted that NCEP and ECMWF have great expectations for AIRS to have a high impact on weather forecasting. They are currently working with NOAA/NESDIS to expedite AIRS data transfer within three hours of receipt on the ground. Operational forecast systems (NCEP, ECMWF) have switched from Level 2 data assimilation to Level 1b data assimilation. The initial impact assessment will be based on the evaluation of specific forecast "bust" cases over North America and Western Europe.

Lastly, Aumann commented on an Aqua instrument inter-instrument cross comparison. There is significant Level 1b spectral and spatial overlap between MODIS/AIRS/CERES and AMSU/HSB/AMSR-E. Also there is significant Level 2 product overlap between MODIS/AIRS/AMSR-E for sea surface temperature, MODIS/AIRS for cloud height, cloud fraction, and cloud top temperature, and AIRS/AMSU/AMSR-E for cloud liquid water and total water column. Aumann then displayed an example comparing an SST product for

a single AIRS footprint and corresponding MODIS field of 15 x 15 footprints. AIRS SST claimed an accuracy of 0.5K root mean squared (RMS) for a single footprint, while MODIS SST claimed an accuracy of 0.2K RMS. He clarified that successful inter-instrument cross-comparison does not constitute validation, but if simple uniform areas are picked, this could be an important step in the development of multi-instrument data products, or at the least, the products could contain information that could be used for new products.

Following Aumann, Peter Hildebrand, the Deputy Aqua Project Scientist for Validation, provided an update on Aqua validation activities. Hildebrand discussed areas of concern for Aqua validation, which include the scheduling of validation field efforts. Hildebrand noted that flexibility needs to be built into the planning of field efforts and critical validation campaigns should be delayed until the time is right (i.e., everything is working). Also, there exists the need for development of alternative modes of data collection for use during start-up so initial calibration and validation needs can be met.

Other areas of concern are the expectation of supporting measurements from other instruments and the cooperation of common validation efforts.

There are also concerns about the data system, ground stations, and data delivery planning. Terra has a complete direct downlink data path that is unavailable for Aqua. Concerning the archival of validation data sets, the model appears to have individual teams/sites do the archival. This will be facilitated using standard data formats and planning for eventual migration to a DAAC.

Other validation impacts noted by Hildebrand are the needs for deep space looks for calibration, the scheduling of validation efforts due to time lost following launch due to getting to the proper orbit, and the effects of re-competition on the science teams.

Action items suggested by Hildebrand included increasing communications by holding validation meetings on the day prior to the Science Working Group Meeting and having regular validation meetings and telecons. Finally, he suggested the creation of an Aqua validation document that identifies the planned validation activities and sources of validation data.

The meeting concluded at 4:00 p.m. with a guided tour of the Goddard DAAC facilities narrated by Steve Kempler, the Goddard DAAC Manager.

The next Aqua Science Working Group meeting is scheduled for Thursday, February 8, 2001 at Goddard.

Software tool being distributed by NASA's Jet Propulsion Laboratory

— Linda A. Hunt (l.a.hunt@LARC.NASA.GOV), NASA Langley Research Center

A software tool for visualization of MISR and AirMISR data files, misr_view, is now being distributed by NASA's Jet Propulsion Laboratory.

misr_view is an IDL-based and graphical user interface-driven display and analysis tool for use with many types of MISR and AirMISR data. It is specificially designed for use with those MISR and AirMISR files that use the HDF-EOS "grid" interface. These include MISR L1B2 georectified (map-projected) radiance, MISR L1B3 radiometric cloud masks, all MISR Level 2 geophysical products, the MISR Ancillary Geographic Product, and AirMISR L1B2 georectified radiances. For MISR data, the user interface provides data selection for specified orbits, paths, or observation dates, and enables translation between these modes of identification. The interface to AirMISR data is simplified. The display and analysis tools include simultaneous display of several data planes through color assignment, contrast enhancement, data value query, image rotation, creation of stereo anaglyphs, zooming, and linked analysis and view windows.

misr_view has been developed by the Visualization and Earth Science Applications Group of the Image Processing Applications and Development Section at the Jet Propulsion Laboratory. Version 3.3 of misr_view, which includes a User's Guide, is available for download free of charge from JPL, upon completion of a misr_view license agreement:
URL: osa.jpl.nasa.gov/MISR_SW_LICENSES/license.visualization

MISR and AirMISR data are available from the Atmospheric Sciences Data Center at NASA Langley Research Center:

Science User and Data Services Office
Atmospheric Sciences Data Center
NASA Langley Research Center
MS 157D
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Phone: (757) 864-8656
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URL: http://eosweb.larc.nasa.gov