MODIS Science Team Meeting Minutes

October 10 - 11, 1996

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MODIS SCIENCE INTEREST GROUP
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GLOSSARY OF ACRONYMS

ADEOS	Advanced Earth Observing Satellite
AFGL	Air Force Geophysics Lab
AGU	American Geophysical Union
AHWGP	*Ad Hoc* Working Group on Production
AIRS	Atmospheric Infrared Sounder
AO	Announcement of Opportunity
APAR	Absorbed Photosynthetically Active Radiation
API	Application Programmable Interface
ARVI	Atmospherically Resistant Vegetation Index
ASAS	Advanced Solid State Array Spectrometer
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATBD	Algorithm Theoretical Basis Document
ATMOS	Atmospheric Trace Molecule Spectrometer
ATSR	Along Track Scanning Radiometer
AVHRR	Advanced Very High Resolution Radiometer
AVIRIS	Advanced Visible and Infrared Imaging Spectrometer
BAT	Bench Acceptance Test
BATS	Basic Atlantic Time Series
BCS	Blackbody Calibration Source
BOREAS	Boreal Ecosystem Atmospheric Study
BRDF	Bidirectional Reflection Distribution Function
CAR	Cloud Absorption Radiometer
cc	cubic convolution
CCB	Configuration Control Board
CCN	Cloud Condensation Nuclei
CCRS	Canada Centre for Remote Sensing
CDHF	Central Data Handling Facility
CDR	Critical Design Review
CEES	Committee on Earth and Environmental Sciences
CEOS	Committee on Earth Observation Satellites
CERES	Clouds and the Earth's Radiant Energy System
CIESIN	Consortium for International Earth Science Information Network
CNES	Centre National d'Etudes Spatiales (French Space Agency)
COTS	Computer Off-The-Shelf
CPU	Central Processing Unit
CZCS	Coastal Zone Color Scanner
DAAC	Distributed Active Archive Center
DADS	Data Access and Distribution System
DCW	Digital Chart of the World
DEM	Digital Elevation Model
DIS	Data and Information System
DMA	Defense Mapping Agency
DMCF	Dedicated MODIS Calibration Facility
DoD	Department of Defense
DOE	Department of Energy
DPFT	Data Processing Focus Team
DPWG	Data Processing Working Group
DSWG	Data System Working Group

DTED	Digital Terrain and Elevation Data
ΔPDR	Delta Preliminary Design Review
ECS	EOS Core System (part of EOSDIS)
Ecom	EOS Communications
EDC	EROS Data Center
EDOS	EOS Data and Operations System
EDR	Environmental Data Record
EFS	Electronic Filing System
EM	Engineering Model
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
EPA	Environmental Protection Agency
ER-2	Earth Resources-2 (Aircraft)
ERS	ESA Remote Sensing Satellite
ESA	European Space Agency
ESDIS	Earth Science Data and Information System
ESIP	Earth Science Information Partners
ESTAR	Electronically Steered Thinned Array Radiometer
FIFE	First ISLSCP Field Experiment
FM	Flight Model
FOV	Field of View
FPAR	Fraction of Photosynthetically Active Radiation
FTP	File Transfer Protocol
FY	Fiscal Year
GAC	Global Area Coverage
GCM	General Circulation Model
GCOS	Global Change Observing System
GE	General Electric
GIFOV	Ground Instantaneous Field-Of-View
GLAS	Geoscience Laser Altimeter System
GLI	Global Imager
GLRS	Geoscience Laser Ranging System (now GLAS)
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GSC	General Sciences Corporation
GSFC	(NASA) Goddard Space Flight Center
GSOP	Ground System Operations
GTOS	Global Terrestrial Observing System
HAPEX	Hydrological-Atmospheric Pilot Experiment
HDF	Hierarchical Data Format
HIRS	High Resolution Infrared Radiation Sounder
HOTS	Hawaii Ocean Time Series
HQ	Headquarters
HRIR	High Resolution Imaging Radiometer
HRPT	High Resolution Picture Transmission
HRV	High Resolution Visible
HTML	Hypertext Markup Language
I & T	Integration and Test
ICD	Interface Control Document
IDS	Interdisciplinary Science
IFOV	Instantaneous Field-Of-View
IGBP	International Geosphere-Biosphere Program
IMS	Information Management System
IORD	Integrated Operational Requirements Document

IPAR	Incident Photosynthetically Active Radiation
IPO	Integrated Program Office
ISCCP	International Satellite Cloud Climatology Project
ISLSCP	International Satellite Land Surface Climatology Project
IV&V	Independent Validation and Verification
IWG	Investigators Working Group
JERS	Japanese Earth Resources Satellite
JGR	Journal of Geophysical Research
JPL	Jet Propulsion Laboratory
JRC	Joint Research Center
JUWOC	Japan-U.S. Working Group on Ocean Color
K	Kelvin (a unit of temperature measurement)
LAC	Local Area Coverage
LAI	Leaf Area Index
LaRC	NASA Langley Research Center
LARS	Laboratory for Applications of Remote Sensing
LBA	Large-scale Biosphere-Atmosphere experiment in Amazonia
LCD	Liquid Crystal Display
LTER	Long-Term Ecological Research
LUT	Look-Up Table
MAB	Man and Biosphere
MAS	MODIS Airborne Simulator
MAT	MODIS Algorithm Team
McIDAS	Man-computer Interactive Data Access System
MCST	MODIS Characterization Support Team
MERIS	Medium Resolution Imaging Spectrometer
MFLOP	Mega FLOP, or a million floating point operations per second
MGBC	MODIS Ground Based Calibrator
MISR	Multiangle Imaging Spectro-Radiometer
MOBY	Marine Optical Buoy
MODARCH	MODIS Document Archive
MODIS	Moderate-Resolution Imaging Spectroradiometer
MODLAND	MODIS Land Discipline Group
MOPITT	Measurements of Pollution in the Troposphere
MOU	Memorandum of Understanding
MPCA	MODIS Polarization Compensation Assembly
MSS	Multispectral Scanner (Landsat)
MST	MODIS Science Team
MTF	Modulation Transfer Function
MTPE	Mission to Planet Earth
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency of Japan`
NASIC	NASA Aircraft Satellite Instrument Calibration
NDVI	Normalized Difference Vegetative Index
NCEP	National Center for Environmental Prediction
NEΔL	Noise Equivalent Radiance Difference
NEΔT	Noise Equivalent Temperature Difference
NESDIS	National Environmental Satellite Data and Information Service
NIR	near-infrared
NIST	National Institute of Standards and Technology
nn	nearest neighbor
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	Net Primary Productivity

NPS	National Park Service
NRC	National Research Council
NSF	National Science Foundation
NSIDC	National Snow and Ice Data Center
OBC	On-Board Calibrator
OCR	Optical Character Recognition
OCTS	Ocean Color and Temperature Scanner
ONR	Office of Naval Research
OSC	Orbital Sciences Corporation
OSTP	Office of Science and Technology Policy
PAR	Photosynthetically Active Radiation
PDQ	Panel on Data Quality
PDR	Preliminary Design Review
PFM	Protoflight Model
PGS	Product Generation System
PI	Principal Investigator
POLDER	Polarization and Directionality of Reflectances
QA	quality assurance
QC	quality control
QCAL	calibrated and quantized scaled radiance
RAI	Ressler Associates, Inc.
RAID	Redundant Array of Inexpensive Disks
RDC	Research and Data Systems Corporation
RFP	Request for Proposals
RMS	Room Mean Squared
RSS	Root Sum Squared
SAR	Synthetic Aperture Radar
SBRC	Santa Barbara Research Center (changed to SBRS)
SBRS	Santa Barbara Remote Sensing
SCAR	Smoke, Clouds, and Radiation Experiment
SCF	Science Computing Facility
SDP	Science Data Processing
SDSM	Solar Diffuser Stability Monitor
SDST	Science Data Support Team
SeaWiFS	Sea-viewing Wide Field of View Sensor
SIS	Spherical Integrating Source
SNR	Signal-to-Noise Ratio
SOW	Statement of Work
SPDB	Science Processing Database
SPSO	Science Processing Support Office
SRC	Systems and Research Center
SRCA	Spectroradiometric Calibration Assembly
SSAI	Science Systems and Applications, Inc.
SSMA	Spectral/Scatter Measurement Assembly
SST	Sea Surface Temperature
STIKSCAT	Stick Scatterometer
SWAMP	Science Working Group for the AM Platform
SWIR	Shortwave Infrared
SIMBIOS	Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies
TAC	Test and Analysis Computer
TBD	To Be Determined
TDI	Time Delay and Integration
TDRSS	Tracking and Data Relay Satellite System

TIMS	Thermal Imaging Spectrometer
TIR	Thermal Infrared
TLCF	Team Leader Computing Facility
TM	Thematic Mapper (Landsat)
TOA	Top Of the Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TONS	TDRSS On-board Navigation System
TRMM	Tropical Rainfall Measuring Mission
UARS	Upper Atmosphere Research Satellite
UPN	Unique Project Number
URL	Uniform Resource Locator
USGS	United States Geological Survey
UT	Universal Time
VAS	VISSR Atmospheric Sounder
VC	Vicarious Calibration
VISSR	Visible / Infrared Spin Scan Radiometer
VIS	Visible
WAIS	Wide-Area Information Servers
WVS	World Vector Shoreline
WWW	Worldwide Web

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ATTACHMENTS

Note: Below is the list of handouts and viewgraphs that were presented at the meeting. The box above is a hyperlink to the World Wide Web (WWW) page containing those handouts in one or more of three formats—Microsoft Word, MS PowerPoint, or Portable Document Format (PDF). The URL for the WWW page of attachments is `http://modarch.gsfc.nasa.gov/MODIS/Attach1096.html`.

If you are unable to access any of the attachments or have questions, contact David Herring at Code 922, NASA / GSFC, Greenbelt, MD 20771; call (301) 286-9515; or e-mail herring@pop900.gsfc.nasa.gov.

TITLE	AUTHOR
1. Science Team Meeting Agenda	David Herring
2. EOS Senior Project Scientist Status Report	Michael King
3. EOS AM Platform Overall Status Report	Chris Scolese
4. EOSDIS Plans to Support Development	John Dalton
5. EOS AM Project Scientist Presentation on Planned Activities	Yoram Kaufman
6. SDST Status Report	Ed Masuoka
7. GATES System Overview	Dennis Chesters
8. MOCEAN's Definition of a "Data Day"	Bob Evans
9. SBRS Test Schedule Update	Bruce Guenther
10. An Overview of EOSDIS Core System	Jeff Masek
11. Release B Requirements	Paula Hagan
12. Averaging and Subsetting Tools Workshop	Robert Wolfe
13. Working Group on Algorithm Change, Reprocessing, and Prioritization	Paul Menzel
14. Draft MODIS Level 1B Quality Assurance Plan	Mike Jones
15. High Temporal Resolution Products from the Goddard EOS Data Assimilation System (GEOS DAS)	Jim Stobie & Yong Li
16. Preliminary Results of ADEOS Initial Mission Checkout	Teruyuki Nakajima & Haruhisa Shimoda
17. ADEOS Concerns and Milestones	S. Sobue
18. Geolocation Workshop Summary	Alan Strahler
19. At-Launch Production Scenarios	Paul Menzel
20. Averaging & Subsetting Workshop Summary	John Townshend
21. Quality Assurance Workshop Summary	Wayne Esaias
22. Interactions for EOS PM-1	Robert Murphy
23. Algorithm Developers Workshop Summary	Liam Gumley
24. Calibration Workshop Summary	Phil Slater
25. MODLAND Summary	Chris Justice

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1.0 SUMMARIES OF THE MINUTES

The meeting was chaired and called to order by Vince Salomonson, MODIS team leader. Salomonson presented the meeting agenda (Attachment 1).

Minutes for Science Team Meeting sessions were taken by David Herring, Mike Heney, Dave Toll, and Locke Stuart—MODIS Administrative Support Team (MAST) personnel.

1.1 EOS Project Science Status Report

Michael King, EOS Senior Project Scientist, announced that most EOS Algorithm Theoretical Basis Documents (ATBDs) have been submitted to his office (see Attachment 2). However, the MODIS team is by far the most delinquent in its submissions—at the time of this presentation there are still 13 MODIS ATBDs outstanding. He noted that none of the Land Group's ATBDs are in; however, he recognized that the Land Group held their own ATBD review recently and is making revisions based on results of that review. Based upon that review, it is felt that the Land ATBDs show considerable maturity and most are ready for implementation. King stated that all 9 land ATBD revisions are due to the EOS Project Science Office by November 1, and the remaining four ocean ATBDs were due August 15 and are therefore past due.

King reminded the Team that the ATBD reviews are forthcoming. The Atmosphere and Ocean Group's ATBDs will be reviewed November 19 - 21 (along with those of MISR and CERES). The Land Group's ATBDs will be reviewed December 10 - 11 (along with MISR land, ASTER, LIS, MOPITT, and SeaWinds).

King reported that a draft NASA Research Announcement (NRA) on the correlative measurement program for EOS-wide validation was recently written by Tim Suttles, EOS Project Science Office Frank Hoge asked if MODIS Science Team members will be allowed to respond to the NRA. King responded that that decision has not yet been made.

King announced that four of ten chapters to be included in the *EOS Science Implementation Plan* have been received. The plan is expected to be completed by Spring 1997 and will be available both as hard copy and as a document available via World Wide Web.

King told the Team that the *EOS Data Products Handbook* is in the final stages of review. The handbook describes all EOS AM-1 and TRMM data products and presents data flow diagrams. He noted that only the MODIS sections of that handbook are still outstanding.

1.2 EOS AM Platform Status

Chris Scolese, EOS AM project manager, reported that the EOS AM-1 platform is still on track for a June 1998 launch (see Attachment 3). Flight hardware is currently being delivered and installed, and spacecraft integration has begun. The launch vehicle and launch facilities are also progressing well. Scolese said that deliveries of ASTER and CERES are imminent. MISR is making good progress, but still awaits system level tests. Scolese is concerned that the MOPITT schedule is currently very tight, and MODIS development is now lagging.

Scolese showed a chart listing the top ten issues facing EOS AM-1. Issue #2 is that the MODIS schedule contingency is eroding. Testing of the MEM (main electronics module) continues and the resistor networks will be replaced in November. Scolese assured the Team that we won't launch a compromised instrument. He feels that although it won't be perfect, MODIS will be the best Earth sensor ever flown.

Scolese pointed out that Valley Forge is closing down in June 1998. This drives the EOS spacecraft schedule somewhat to be fully integrated, tested, and ready to launch before that date.

Issue #10 concerns the impact on end-to-end testing caused by a more than 20-week slip of EOSDIS production software. Scolese said that it is not clear at this time how this problem will be resolved.

Scolese stated that the MODIS flight model 2 (FM-2) was deleted as directed in the POP 96 budget; however, the Project Office is still pursuing an advanced technology MODIS instrument, or AMODIS. He stated that the AM Project is planning to implement a small yaw and roll maneuver for calibration purposes. He said that in order to move forward on planning for maneuvers there needs to be a consensus among all EOS instrument teams in favor of the maneuver. Scolese stated that it is cheaper to implement a joystick approach to the spacecraft maneuvers, rather than creating new software at this point.

Yoram Kaufman, the new EOS AM Project Scientist replacing Piers Sellers, stated that he will deliver a consensus letter on October 18 after the SWAMP meeting.

1.2.1 EOS AM-2 Status

Scolese reported that the AM Project has been participating in Payload Panel and Code 170 sponsored studies for determining the second EOS platform series. The office is also supporting imager studies on NPOESS (National Polar-orbiting Operational Environmental Satellite System). The idea is to determine whether EOS' and NPOESS' science requirements can be met through a combination of advanced and alternative technologies. The AM Project is currently evaluating the cost drivers and looking for ways to shrink the mission size.

1.3 EOSDIS Plans to Support Development of At-Launch Production Software

John Dalton, ESDIS Deputy Project Manager, reported that the replanning of EOSDIS is in progress, but no final decisions have been made yet. He stated that the replanning process includes a detailed review and feedback from the EOS instrument teams and DAACs. Dalton presented an overview of the replan strategy (see Attachment 4).

There has been a significant slip—from December 1996 to May 1997—in the scheduled delivery of Release A of the science processing segment of ECS (EOSDIS Core System) in the data server portion. According to Dalton, one factor contributing to the slip was underestimation of code size required for the data server at the Critical Design Review (CDR). Another factor was that there were COTS (computer off-the-shelf) software product incompatibilities across vendor platforms. Also, there has been difficulty recruiting and retaining expertise in key technologies, such as C++ and Distributed Computing Environment (DCE). Dalton concluded that planned recovery through parallel development is not feasible due to serial dependencies within the system. As a result of the above problems, ECS failed its Test Readiness Review (TRR) on August 5 - 6.

Dalton said the suggested replan approach, for the initial Release A software delivery, is to support TRMM and early EOS AM-1/Landsat-7 testing. The mission critical and essential functions will be integrated first. The Release B upgrades to support AM-1 will be performed on parallel hardware strings to avoid any impacts to TRMM operations. ESDIS is working with EDC and JPL to define the minimum essential capability required at those sites to support ASTER and SeaWinds testing.

Dalton showed a preliminary schedule for the EOSDIS replan activities. He stated that, regarding syntax, production rules will not be used in Release A, because it is data driven. Nominal temporal boundaries are represented in the ODL (On-line Data Library) files available on their World Wide Web site. Examples of the production rules for Release B will be provided by the end of October 1996.

Dalton reported that support for the integerized sinusoidal grid in HDF-EOS is a new software requirement. Additionally, geographic search support will be available in the Release B timeframe in the data server for single DAAC production.

Dalton introduced the "Standard Data Product Resources Board," whose purpose is to assess and decide upon approval of changes to resource requirements, and ensure equitable allocation of resources for standard product generation, archival and distribution.

Mark Abbott asked how users will access EOS data. Via the Internet? Dalton responded affirmatively—via the Internet. Abbott said he is concerned that throughput will go down too far, greatly hampering electronic data distribution. Specifically, he is concerned that the system won't deliver Level 3 products, which he feels users will want.

1.4 EOS AM Project Scientist Presentation on Planned Activities

Salomonson introduced Yoram Kaufman, the new EOS AM Project Scientist succeeding Piers Sellers. Kaufman began his presentation by showing an organizational chart of the EOS AM Project Office personnel (see Attachment 5). Jon Ranson is the deputy AM Project Scientist, Jim Collatz is the Associate Project Scientist in relation to IDS investigations, and Francesco Bordi is the AM Project liaison.

Regarding MODIS instrument testing at Valley Forge, Kaufman asked for help from the

MODIS Team in defining a simple, overall check of the system. Kaufman said he supports on-orbit maneuvers as part of the optimization of the whole MODIS calibration concept. He feels that steps should be taken to minimize risk to the platform; and alternatives to maneuvers should be prepared in case they are needed during the life of the mission. Kaufman told the Team that a letter will be delivered by Friday, October 18, stating the EOS instrument teams' need for maneuvers.

Kaufman proposed renaming the AM-1 spacecraft EOS-Arrhenius, after S. Arrhenius, who published an article in 1896 in the *Philosophy Magazine and Journal of Science* in which he calculated the effects of doubling the amount of carbon dioxide in the atmosphere. Kaufman would like to establish a center for EOS and EOS-Arrhenius in the National Air and Space Museum.

Kaufman stated that there is a need to freeze the EOSDIS requirements for the February 1996 request. He feels that we need to begin implementing boundaries and operating conditions now. He suggested reducing the resolution of data products to 50-by-50 km to improve pixel selection requirements and increase signal to noise. These product would be expanded to better spatial resolutions later about 2 years after launch.

Kaufman suggested a list of specific scientific objectives for EOS-Arrhenius:
- provide the first state distribution of the main Earth-atmosphere coupled measurements,
- improve the knowledge of detection of human impacts on climate, "fingerprints" and long-term climate prediction,
- provide observations that will improve forecasts of the timing and geographical extent of transient climatic anomalies,
- improve seasonal and inter-annual predictions
- develop technologies for disaster prediction and characterization and risk reduction from wildfires, volcanoes, floods, and droughts, and
- start EOS monitoring of the change in climate and global environment.

1.5 SDST Status Report
Ed Masuoka, SDST leader, reported that the Version 1 software deliveries have slipped 3 - 4 months. He told the Team that all software except the Level 3 Atmosphere products are on schedule for the Version 1 delivery deadline. He showed a milestone chart of the software delivery timelines (see Attachment 6). However, there is no Release A system at the DAACs that can support MODIS' integration and testing needs.

Masuoka discussed plans for the Team Leader Computing Facility (TLCF) in 1997. He hopes to increase the computer processing power next year by adding more newer generation SGI systems. He also plans to add more RAID (Redundant Array of Inexpensive Disks) on the fiber channel.

Regarding the Release A slip, Masuoka point out that this creates more time for the Science Team software deliveries, and allows for adequate time for SDST to conduct its tests in the TLCF. However, the slip causes a compressed testing schedule at the DAACs. To compensate, he suggested that the MODIS Team define its most important tests and identify dedicated test strings. The Team should work with SDST to develop more streamlined testing procedures, and plan on working with several testing shifts at the DAAC. Masuoka said that Version 1 testing will parallel the Version 2 science software delivery. The burden will be on SDST and the science software developers to support changes in the two version of the software.

Regarding the software tests, Masuoka proffered that Science Team members must get to the point where they are sure their software handles errors. If the software breaks under nominal conditions, it will almost surely break in the DAAC.

Masuoka added that he is unsure whether ECS will be able to produce MODIS products at launch, which is a serious concern. Also, network bandwidth is a concern; however, Masuoka said that the network links ESDIS plans to install next year should provide the needed bandwidth. Masuoka would like all open issues that affect science software developers to be resolved by December 1996—including production rules syntax, HDF-EOS support for MODIS' nested integerized sinusoidal grids, and the standard data product toolkit (SDP-TK) compatibility across all products.

1.6 GATES System Overview

Dennis Chesters, of NASA GSFC Code 913, presented an overview of GATES—the Geostationary Advanced Technology Environmental System. GATES is a newly-planned, geosynchronous satellite for imaging weather and climate. It is currently scheduled to launch in 2000 or 2001. (See attachment 7.)

Chesters proffered that because GATES is in a geosynchronous orbit, it offers an excellent opportunity for cross calibration across all polar orbiting Earth observing satellites.

1.7 Discipline Groups' Definitions of "Data Day"

Paul Fisher reported that MODLAND has a temporally defined 24-hour "data day" that is coincident with Greenwich Mean Time.

Bob Evans stated that MOCEAN defines its data day as roughly all data taken between the time the sensor crosses the 180° meridian, and completion of the fourteenth subsequent orbit. (Please refer to Attachment 8 for more details.) He said MOCEAN will have two data day starts: one for night-time data and one for day time.

Michael King stated that the Atmosphere Group currently has no preference for defining a data day. The group plans to review the other group's definitions and select one of those.

1.8 Cross Product Dependencies

Al Fleig, of SDST, told the Team that at present, the only intra-MODIS product interdependencies center around the aerosol products. Other than those products, the products are already set up. He stated that from SDST's perspective, this is not a big issue for MODIS as the algorithms are already chained.

1.9 SBRS Test Schedule Update

Bruce Guenther gave an update on SBRS' test schedule plans, based on yesterday's recommendations from the Science Team (see Attachment 9). He said that testing of the electronics will take 33 days, and is already underway. Afterward, SBRS will complete installation of the onboard calibrators and aperture doors, which will take 11 days. Then begins ambient testing, which will last 31 days. For spectral tests, SBRS will do one or two bands in each focal plane while the instrument is in thermal vacuum. Guenther listed the recommendations made by the Science Team, as well as some test deletion options that would save 11.5 days.

2.0 TOOLS FOR AVERAGING, SUBSETTING, AND MAP PROJECTION

Chair: John Townshend **Sponsors:** Chris Justice and Barbara Putney

2.1 Overview

The primary objective of this workshop is to have MODIS people understand the current and proposed averaging, subsetting and map projection tools by the EOSDIS Core System (ECS). In addition, an objective was for ECS to receive comments back from the MODIS team about any key deficiencies. Last, an objective of the MODIS team was to also represent the broader "user community". Jeff Masek and Paula Hagan from the ECS Science Office provided an overview presentation of the ECS averaging, subsetting and map projection tools (Attachments 10 and 11). Robert Wolfe (SDST) presented SDST related issues on Level 3 Products, data storage problems, and standard vs on-demand options (Attachment 12).

2.2 ECS Overview

Masek provided an overview of ECS subsetting tools (Attachment 10). He emphasized the client (i.e., user) and the related data processing. The ECS basic item for searching is a "granule" that refers to a file or in the case of remote sensing typically an image scene. However, the granule can be non-image data such as field site data. The ECS includes data collections and also advertises locations of alternate data sets. Masek said the system supports primarily data subsetting and contains a user help guide. Andy Endahl (ECS Science Office) reported that there is no direct connection between ECS and Landsat-7 subsetting procedures, likely resulting in a significantly different set of procedures.

ECS has a <u>viewing</u> toolkit that first projects images to latitude and longitude and then maps to one of many other map projections. However, there is no capability provided by ECS to project an image to a new file. Hence, viewers can browse images with different projections but do not have the capability to receive any output data other than using a latitude and longitude projection. The reason given by ECS is that they were recommended not to alter pixel values by processes such as resampling. Townshend, Justice and Strahler indicated that a choice of projections is wanted by MODIS and the at-large user community. Townshend wondered who then will provide tools. Wolfe said that SDST is working on map projections for internal use. Further, ECS reported they are not supporting data set averaging, names or mask capability under Release B.

Masek said EOSView is designed for browse and entire granules (e.g., images). In addition, EOSView will permit inspection of tabular data (e.g., metadata). Masek said that EOSView is designed for an X-term environment. The system is not based on PCs or MACs; however, some basic features will be available, especially if an X-based interface is attached. It was reported that 8-bit color displays will be able to view ECS color images. Masek said the extent of viewing and ordering through the world wide web is to be determined. He emphasized that EOSView is not designed as a scientific analytical tool.

2.3 ECS Subsetting

Paula Hagan gave a presentation on ECS subsetting (Attachment 11). She said that subsetting will be emphasized. She said all subset image requests will include the entire image line because of logistical constraints. All subsets are now planned by rectangular area only. ECS recognizes the need to have requirements for polygonal areas. Data subsampling will be permitted (e.g., subsampling every Nth data point in area by row and column). In addition, only contiguous bands may be selected. For example, selection of bands 3-9 will be permitted; however requests for skipped bands (bands 1, 3, & 5) is not and must be selected under a separate inquiry. In addition, all viewing and searching is for a single time and location. Hence, no spatial mosaicing or temporal compositing will be supported under one order. Further, if a granule is defined by time, the user can subset from the beginning or end but not from within.

2.4 SDST

Robert Wolfe (SDST) presented a summary of MODIS Level 3 Product Options, the Global Product Size, On-demand versus standard Products, and Level 2G Surface Reflectance (Attachment 12). In addition, he summarized the large computer storage size of global products. For example, a global 500-m pixels scene with five bands will require 2.2 to 3.5 GB of storage. Wolfe said there will be standard products with processing options setup and fixed by the MODIS Science Team.

Wolfe and Townshend said that not having geometrically corrected MODIS bands for users to generate their own products with the MODIS bowtie effect will be disappointing to many users. Townshend recommends that MODIS directly deal with this issue soon.

2.5 Concluding Remarks

Townshend concluded that there are several issues that require linkages between ECS and MODIS that must be enhanced. Determining who will be doing map projections is an important issue. In addition, providing calibrated reflectance data without the MODIS bow tie effect is needed by the broader user community. Townshend noted that the subsetting and related tools will need significant improvement to satisfy most user needs.

2.6 Action Items

1. Townshend and Justice provide MODIS and user community inputs to Larry Fishtahler of SDST for possible ECS averaging and subsetting tool deficiencies.
2. MODIS to establish a focus group to represent MODIS and the “User Communities”

needs on ECS averaging, map projections, and subsetting tools.

3.0 AT-LAUNCH PRODUCTION SCENARIOS

Menzel opened the session, and noted that the focus of the roundtable would be on changing algorithms in the post-launch period after data processing has begun. The group would not address the need to update algorithms between the Version 2 delivery date and launch; although that is a legitimate topic, the group's focus was on the post-launch timeframe.

Menzel outlined his concepts for determining when algorithms should be changed, included as Attachment 13. He suggested that the process should allow for rapid implementation of revised algorithms in the immediate post-launch period, to allow errors in the code to be fixed quickly; later, as the code stabilized, more rigorous review and configuration management become appropriate.

He suggested that NOAA's experience with GOES-8 could be a good model for MODIS; scan mirror emissivity and hardware characterization were able to be done quickly, allowing researchers to revise their algorithms accordingly.

A concern was raised about documenting changes; the scientific basis for making changes is currently documented in the ATBDs. This could be lost in a rapid-change environment early on; this may need to be addressed.

Reprocessing scenarios were discussed, and the impact of limited computing and networking resources on reprocessing. Given the fact that changing algorithms will require that the data be reprocessed at some point, a strategy for what to reprocess and when will need to be formulated. Early on, this could mean discontinuities in data products, as the algorithms used to produce them changes between one data set and the next.

Paul Chan presented the DAAC's strawman change plan scenario. He indicated a need to do exercises with SDST to learn how to implement changes and get the time required to implement a change down.

Ed Masuoka provided an overview of the TLCF hardware and network configuration as planned for the at-launch time period.

Much of the discussion centered on the availability of sufficient data to test algorithms on. Storage and data transfer (network) constraints were seen to be a major issue. A good data subsetting capability will be required; attention to data architecture considerations could help with this. The availability of a "golden day" data set would also be useful, as would other pre-made data subsets. It was noted that a "golden day" dataset wouldn't be useful for products like the 16-day BRDF product, an appropriate subset would be needed in these cases.

The mechanics and interactions of making changes was also discussed; some method of notifying those who use a data product that the algorithm has been changed is needed. Testing of running strings will likely occur at the TLCF, and migrated to the DAAC once testing is complete.

Menzel summarized the discussions and listed the actions he'd like to see come out of the group. Masuoka and the discipline groups will work on a strawman proposal for configuration management and responsivity post-launch; the discipline groups will also draft specifications for test data sets derived from real data, including time, geolocation, and resolution (sparseness) requirements. It was suggested that the Science Team put together a group to discuss computer resource allocation, both at the TLCF and possibly at the DAAC. Menzel also indicated an interest in determining what the mechanism would be for deciding when to reprocess once the algorithms became relatively stable.

4.0 INTERACTIONS FOR EOS PM-1

The working group session was chaired by Mark Abbott and sponsored by Robert Murphy. Steve Running, William Barnes, Alan Strahler, Zhengming Wan, Paul Menzel, Janet Campbell, Didier Tanré, Yoram Kaufman, Steve Running, and Phil Slater (science team members) were present. Jim Butler, Barbara Putney, Claire Parkinson (PM Project Scientist), Paul Westmeyer (AM Project), Robert Murphy, Harry Montgomery, Peter Minnett, Dan LaPorte, Brij Gambhir, Jerry Godden, Kirsten Parker, Ed Masuoka, Liam Gumley, Crystal Schaff, Bruce Guenther, and Phil Tiellet also attended.

4.1 Sensor Performance

4.1.1 Differences in Sensor Design

Barnes identified PM as being essentially the same as AM. Scatter in the near infrared will be reduced (E2 lens). The first dichroic is changed, to give less scatter, but there is increased polarization. This may be corrected with a compensator, according to Pagano. He felt that it would be doable in a couple of weeks. The compensator is designed to offer about 80-90 percent transmission. Campbell felt that this is a fair signal-to-noise trade.

The two major problems were identified as crosstalk and scatter / polarization. Crosstalk is considerable in bands 33-36, and from bands 5, 6, and 7 into 26. There is no current plan to correct for this in FM-1 (PM-1). Barnes emphasized the lack of contingency funding on PM-1, and therefore the unlikelihood of instituting any substantive changes. The Science Team agreed to support fixing band 26 crosstalk as a top priority. Menzel suggested that NOAA would be interested in seeing that the long wavelengths are corrected, if MODIS is to be considered a future operational instrument candidate.

4.1.2 Cross Calibration

When limited to the reflected bands, cross calibration is no problem. The thermal bands add complications.

4.1.3 Pre-launch Characterization

Guenther is concerned that MODIS science team members need to review planned instrument specifications and compare them to current instrument capabilities. An assessment then needs to be made of essential tests and improvements. Guenther also stressed duplicate tests with different approaches to assure a successful understanding of the character of the instrument. Pagano assured the team that SBRS now knows better how to test the instrument. Pagano further suggested that SBRS should spend one more week on the protoflight model (AM-1), to improve knowledge of the infrared detectors. Minnett strongly recommended a zinc-selenide vacuum chamber window. Guenther and Barnes agreed. Substantial discussion ensued on thermal infrared characterization: alternate vacuum facilities, deep-space maneuvers, mirror measurements. Slater reiterated the value of solar radiation calibration. Westmeyer suggested that time is short in the preparation of AM-1, and that any characterization plans for PM-1 should wait until after the AM-1 launch.

4.2 Platform Characteristics

4.2.1 Orbit Phasing

Murphy noted that both AM-1 and PM-1 could cross the pole at the same time. If done, orbit phasing for global coverage and avoidance of sun glint becomes an issue. Discussion ensued on the value of such phasing, and was compared to obtaining the same radiometric information by observing the moon. Butler averred that it is important to do the cross-calibration to 2.5 percent. Slater felt that simultaneous observations could get to the 2 percent level (relative). It was suggested that Watson Gregg be invited to do precision calculations. Slater wondered if there were the possibility of lower latitude simultaneous passes, to which the response was negative.

4.2.2 Deep Space Maneuver

Parkinson confirmed that AIRS wants minimal maneuvers. Gambhir reported that the lunar and deep space maneuvers need to be about the same magnitude on AM and PM. Parkinson further reported that the PM Project Manager thinks any of the maneuvers are doable, and is awaiting a mandate from the science teams. Butler suggested that all instrument teams identify a point of contact for maneuver discussions.

4.2.3 Ground System Capabilities

Westmeyer discussed tracking station plans, and cited the northern X-band receiving stations located near Gilmore Creek, Alaska and Belvedere, Spitzbergen. EOS AM-1, PM-1, and Landsat 7 all want to use the same site, and pretty much at the same time. Murphy pointed out that a station can only handle two satellites at once. Westmeyer reminded the session that there are also EO-1 and EO-2. Westmeyer feels that there needs to be launch constraints, so that satellites cross at different times. Westmeyer identified the phasing as a Code 170 issue—probably Paul Caruso.

4.2.4 Pointing

ASTER drove the pointing requirements for AM-1. PM must meet MODIS requirements, which have not been scoped to be as stringent as ASTER. Strahler insisted that the MODIS PM pointing requirements are wrong. If pointing is relaxed on PM-1 there will be a severe science problem. MODIS is capable of registering to about 0.1 pixel. If there is a need to merge AM and PM data, pixels must be located as well in one as the other.

4.3 Data System Issues

4.3.1 Algorithm Delivery Schedules
Masuoka noted that, in the same way that there are three deliveries for AM, the team should expect three deliveries for PM, each a year apart, with the final delivery a year before launch. Parkinson assured the team that the ECS will not change until after PM launches. The need for three PM deliveries was questioned: there is no need to check out the processing system. Masuoka feels that there may be a need to change the algorithms for PM since there are both new products and changed products. Abbott wanted to know if it would be possible to wait for AM data processing "lessons learned," and apply them to PM. Masuoka feels that the processing system should be more mature, and PM should represent an incremental increase in processing sophistication. Abbott questioned the changes in the Level 0 type data, and Westmeyer proffered that they all look the same. Godden suggested that Level 1B may have image restoration implemented, and it may be standard on PM.

4.4 Science Opportunities

4.4.1 New Products and Composites
Campbell urged that MODIS must have compatible products between the Land and Oceans Group. She was concerned about inland bodies of water. BRDF will be better characterized, but will not be a new algorithm. Running expects some new Level 3 products. Wan felt that PM would improve snow products. Kaufman said that fire detection and characterization will benefit. Aerosols will be interesting in that their variation will be noted during the day. Abbott noted that morning and afternoon observations of chlorophyll fluorescence will improve ocean productivity models. Masuoka noted that multidays, multitimes will incur further storage impact.

4.4.2 Interactions with Other PM-1 Sensors
Strahler addressed thermal BRDF, and found additional strength in MODIS and MISR combined. Parkinson noted that sea surface temperature fields should be improved, and suggested combining AIRS and MODIS. AMSR will be helpful for day / night comparisons and products. Minnett felt that the best advantage is going to be in avoiding clouds. He stressed that the PM overpass time needs to be about 4 p.m., not close to noon. Menzel insisted that AIRS will need MODIS to do cloud properties, and that there will be improved cloud characterization.

5.0 QUALITY ASSURANCE PLAN OVERVIEW

Esaias opened the session with a survey of the discipline group and support group schedules and plans for handling QA requirements.

Mike Jones provided a summary of the Level 1B QA that will be incorporated into the Level 1B product (Attachment 14). He noted that the DAAC would provide engineering data statistics from all granules to the TLCF. MCST has the capability to work with entire granules to do additional QA, but does not plan to do this on a regular basis. There is a procedure defined for adjusting calibration coefficients on a regular (6 month) basis; this involves interaction with the Calibration Review Board. A "golden set" will be used to validate the revised calibration coefficients. Initially, will get actual 1B (and 1A) data and will re-run products, to validate Level 1B quality.

The individual discipline groups discussed their schedules for delivering their Version 2 software, which will incorporate QA flags in the code. Esaias raised the question of whether there was enough bandwidth available to do more than production QA/QC, on a discipline-group basis.

Bob Lutz discussed the ESDIS QA requirements. A concern arose about QA data flow back to the DAAC, and how it would be integrated. Because of the timing of system software deliveries for the DAAC, there will be no time to test the QA data flow before launch. Esaias expressed concern that his ability to access IMS (Information Management System) data during the immediate post-launch period would be dependent on the QA update procedures working properly. If this is the case, then it might be prudent to specify that only run-time QA be used during the initial 6-month period, so that problems with the IMS (Information Management System) database won't hamper the team's ability to get needed data out of the system.

There was also discussion about the time lag factor in producing QA flags, and its impact on running strings. Ideally, you would like to have a chance to QA your product and set the flags before it is used downstream in the production of another product. The issue of how to manage what could be conflicting requirements to have data available for use downstream rapidly vs. getting QA done and propagating the results back to the DAAC needs to be examined.

Al Fleig discussed SDST's QA plans. He reminded everyone that the output specifications for level 2 V2 products must have QA outputs defined by December 1 For Version 2, SDST will do Level 1B QA, and will have a data base of test data and comparison data. They will support LDOPE, and will provide tools for display, matching with truth data, etc. SDST will try to do quasi-QA production as requested by the Science Team, provided their needs are made known sufficiently in advance.

6.0 ATMOSPHERE SPLINTER GROUP MINUTES

The Atmosphere Discipline Group held its first splinter session of the meeting on October 9 to discuss issues of general concern. Michael King, group leader, chaired the session and listed the major items he feels need discussing.

6.1 1-km Resolution Data Products

King said that one topic to discuss is the spatial integration of Atmosphere data products to 1-km resolution. He asked where will this be done, and by whom? This process doesn't show up in any of the algorithm data flow diagrams. He noted that some products use multiple channels and variable resolutions. Both the CERES and MISR teams want 1-km resolution MODIS Level 1B and atmosphere data products.

King also stated that he doesn't know the sources for surface reflectance and surface temperature for his own cloud product algorithm.

Regarding the merging of certain data products, King said that the group has agreed to produce a single MOD06 cloud product. This will be done in post processing. Rich Hucek stated that he thinks this will be a complicated process.

6.2 Direct Broadcast

King reminded the team that MODIS will launch in about 21 months with direct broadcast capability. He sees no reason why every individual data user should reinvent cloud masks and other processes. He feels it would be useful to provide tools for processing to direct broadcast stations so they can generate their own products.

Gumley pointed out that MCST too must make its code available for direct broadcast. Menzel added that direct broadcast could facilitate use of MODIS data for early detection of forest fires, which could save millions of dollars.

6.3 Atmosphere Data Flow Diagram

King pointed out that in the Atmosphere flow diagram, after Level 1A processing, there are two big branches for geolocation and Level 1B processing, so that Level 1B does not have geolocation for latitude and longitude in it. Yet, he said, every product the group produces downstream must read both of those. He would like Level 1B and geolocation to be merged into a single file, along with nadir look data.

6.4 MODIS-DAO Interactions

King said he would like to get closure on the issue of ancillary data availability, particularly moisture and temperature profiles, which are needed for most MODIS and CERES algorithms. He said that there have been three ancillary data activities ongoing at various levels.

The first, led by Liam Gumley, has been to obtain NCEP (National Center for Environmental Prediction) data in grid format and interpolate to MODIS pixels in each granule. Gumley is doing much of the work using NOAA heritage code. An attempt was made to deliver this code to SDST, but it wasn't accepted. The second activity is being done by the CERES team. They have developed a global grid in which they interpolate ancillary data vertically at 2.5 degrees latitude and longitude. The third activity for producing and distributing ancillary data is being undertaken by the Data Assimilation Office (DAO). However, there is currently very little interaction between the DAO and the MODIS team. King noted that CERES plans to use DAO data as well.

King introduced Jim Stobie and Yong Li, of the DAO, to present an overview of its ancillary data products (refer to Attachment 15 for details). Stobie stated that beginning in

June 1998, the DAO will produce a new set of high temporal resolution products tailored specifically to the needs of the EOS AM-1 instruments. The horizontal resolution will be $2 \times 2.5°$ at launch, and will increase to $1° \times 1°$ resolution about six months after launch. For vertical resolution, there will be 24 mandatory pressure levels (from 1000 to 0.4 hPa), or 70 sigma levels. Stobie said, for instance, if the team should need temperature over the ocean every 10 minutes, the DAO can provide those data.

Stobie distributed a list of planned products mapped to the needs of each instrument. He feels that the DAO will pay closer attention to the needs of the instrument teams than will the NCEP. And, the DAO's archived products will be according to EOS standards. It is preparing now for an ATBD review to be held next year.

King stated that the Atmosphere Group is very impressed with the DAO and plans to work more closely with that office.

6.5 Instrument Testing Issues

As instrument development proceeds, there are several areas requiring concentration. For instance, the point spread function needs to be better understood. Its value across the spectral channels must be known. The effect on the algorithms must be considered.

Menzel brought up the problem of accommodating both visible and IR channels in the same system. There was concern that both could not be accommodated effectively in one instrument. King mentioned that IR is needed for cloud masking as well as for many cloud property determinations. Menzel's statement arises from the fact that a mirror coating, when optimized for visible channels, causes some degradation in the IR, in addition to introducing an angular dependence. Workaround methods were discussed, including deep space views and modeling. Additionally, multiple deep space views would be required, to quantize any mirror contamination. AIRS' resistance to maneuvers on PM-1 were discussed, and it was argued that AIRS will eventually recognize the value of deep space viewing maneuvers. The potential differences between AM-1 and PM-1 were discussed, and arguably not well understood.

6.6 Data Processing

The identification of file specifications for Levels 2 & 3 was considered a priority, since these specs must be frozen for Version 2 software delivery (December). The aggregation of products into a single file was addressed (particularly MODs 04, 05, & 06). Data processing "versions" must be designated in a logical fashion since each of these data products contains output from separate processes that may be upgraded independently. There was also an energetic discussion about including geolocation and calibrated radiances in individual archived products, from Level 1B through Level 3. The practical needs for this information, particularly as MODIS interacts with other instruments (CERES & MISR), were discussed. Data storage volumes were considered, and it was determined to be sufficient to sample geolocation and radiance on a 5×5 km grid. This should not cause a significant increase (2 percent) in data volume.

6.7 Atmosphere Discipline Group Meeting

King suggested that the Atmospheres Discipline Group needs an additional meeting, and recommended setting aside time in November near Goddard following the ATBD review of the MODIS atmosphere products.

6.8 QA Plan Requirement

King attended the Quality Assessment working group and noted that other discipline groups have selected one person as a focal point. Allen Chu was requested, and agreed to serve. He will prepare for a one-day workshop on Nov. 6. Chu will review the draft plan, and understand what other groups are doing. David Roy was referenced as a contact. There was a discussion of flags, and their value to the user community. Flags are generally considered useful to the team members, but are often overlooked by external users.

6.9 Data Day

Previously Atmospheres had expressed no strong opinion between temporal or geographic definitions of a data day. King expressed interest in following CERES' lead. Bryan Baum clarified that CERES is taking the last day of previous month and a little of the following month to define a data month, but is unsure of their proposal for the data day. [Subsequent to the MODIS meeting, King confirmed that CERES has adopted a simple UTC definition of the day, which matches the choice of the MODIS land group]. King supported Greenwich time as Atmospheres' definition of a data day, with the calendar month being the data month, and with 8-day gridded data being accumulated continuously.

6.10 Post-Launch Working Environments (Data Resources)

Menzel expressed a need to draft a scenario by the end of the calendar year. Test data sets were discussed, particularly what constitutes a test data set. A "golden day" or "benchmark" data set should be established for comparison, as data are reprocessed using different parameters and constants, and modified algorithms. Fleig cautioned that any "test" data set should cover all seasons and all latitudes. Menzel felt that it could be a multi-instrument data set. King asked the group to give additional thought to what the data set should look like and contain.

Menzel recommended that a subgroup be established within MODIS to guide the TLCF and DAAC on resource allocation. This should be a quick response subgroup. Menzel cited NOAA's Product Oversight Panels, which review new science proposals, and send worthy ones forward to the satellite science review board. Beyond baseline data production, what is MODIS' process for judging science needs, and concomitant devotion of resources? King felt that SWAMP should have an input to the proposed process. Exchange of data among DAACs was discussed, wherein the network bandwidth exists, but protocols are not established.

6.11 Software Modules or Pieces for Direct Broadcast

The question was raised regarding the usefulness of Atmosphere products for direct broadcast. It was clarified that all 36 MODIS bands will be broadcast. Are there products for which MODIS should make software available for *ad hoc* product production? Menzel felt that calibration and geolocation software is essential, and that this may be a commercial venture. In response to a question about MCST's intentions, Fleig suggested that MCST will put out on the Web yesterday's calibration package, which will be reasonably accurate. Menzel felt that MODIS would benefit from international participation. Masuoka felt that MODIS needs to fashion Level 1B data for direct broadcast. Masuoka volunteered that he will accept a list of requirements from the Discipline Group, and will consider what is possible.

7.0 OCEAN SPLINTER GROUP MINUTES

7.1 Polarization

There was a detailed discussion of the polarization sensitivity issue on the MODIS instrument, including the potential effects on the algorithms of an uncharacterized problem, and the likely problems with using modeling as a solution. Esaias indicated that it's worth slipping launch a couple of months to get needed measurements if it improves characterization and understanding of MODIS. Diane Wickland agreed that this is a big enough issue to push on, and suggested that the question "If you can't get a state-of-the-art instrument, do you still get an incremental improvement with MODIS?" would likely be asked, and that an answer should be prepared.

Tom Pagano of SBRS sat in with the oceans group to discuss the polarization model. Strategies for modifying the testing schedule to allow for characterization of the instrument's polarization response were discussed; this included setting priorities for other testing and looking at what could be given up in order to free time for polarization characterization.

There were some concerns about de-watering. Pagano believes that the detectors will re-absorb water after coming out of thermal vacuum, which may affect their response.

Pagano suggested that the polarization models should be finished, and that the Science Team should propose a test suite. It would help if they could restrict the number of bands and scan angles as much as possible. Evans suggested fully characterizing one side of the mirror, and doing spot checks on the second as a way to reduce the testing load.

Some worry about proper characterization of 2-θ situation as well as 4-θ was expressed.

7.2 SeaWiFS Status Update

SeaWiFS status was discussed. At the start of an abbreviated thermal vacuum test, a component failed due to a bad aluminum-to-gold solder; this appears to be a subcontractor workmanship issue, and is being addressed. Otherwise, there were no significant problems in thermal vacuum testing. The horizon sensors are also being reworked. The instrument appears to be on track for its scheduled launch on March 5, 1997.

7.3 MOBY Status Update

MOBY (Marine Optical Buoy) status and deployment plans were discussed. Data quality is better than was expected. There is some pressure from the international community to begin routine deployments of the MOBY buoys as early as possible, but there is the risk of damage to the instrument before SeaWiFS launches. Dennis Clark would prefer to not commit to routine deployment until after one full cycle of instrument deploys (each instrument deployed once), at which time a decision would be made on how to proceed.

7.4 Validation Plans

There was discussion of aircraft campaigns and cruises for oceans validation and SeaWiFS initialization. The February MOBY pick-up could provide an opportunity for a coordinated campaign between Carder and Gordon.

The SIMBIOS panel will meet December 10. About forty proposals have been submitted to date.

7.5 General Discussions

The group worked on preparing their summary for the Plenary session. Esaias said he is encouraged by the Project Office’s flexibility and willingness to support Ocean’s needs.

The possibility of supporting SBRS with calibrating their transfer radiometers was raised; it was decided that Arizona would work this out of their existing fund. It was noted that MCST is diverting a lot of resources to helping SBRS on getting through testing. This is a very important thing for them to be doing, although it has the downside that it must occur at the expense of other work.

8.0 FINAL PLENARY SESSION

8.1 ADEOS Status Report

Teruyuki Nakajima, University of Tokyo, announced that ADEOS successfully launched on August 17, 1996. He reported that all sensors onboard are now fully operational, and showed some sample image data (see Attachment 16). He also listed the URLs for several World Wide Web sites with additional information on ADEOS sensors.

Nakajima listed the GLI (Global Imager) network modules for calibration and validation that he would now like to establish.

S. Sobue, of NASDA, said that NASDA would like for NASA / NOAA to process, archive, and distribute intensive OCTS Local Area Coverage (LAC) data in the United States if U.S. scientists are interested in the data. He said NASDA will process and distribute OCTS LAC data near Japan and in South America. He listed some of the major milestones ADEOS has reached, as well as those forthcoming (Attachment 17).

8.2 Geolocation Workshop Summary

Alan Strahler presented a summary of the Geolocation Workshop (see Attachment 18). He listed the following as potential sources of geolocation error: position of center of mass of the spacecraft, spacecraft attitude, and pointing accuracy of the MODIS instrument. He feels that the Team must understand the sources of dynamic geolocation error so that these errors may be corrected with software. He strongly advocated establishing ground control points to measure and remove geolocation bias. These ground control points should be stratified with respect to cloud cover, latitude and longitude, and day/night.

Strahler recommended developing a phased approach. He stated that we must characterize MODIS' geolocation bias early so that by the time of launch a system will be in place to give the static error to within 10 meters. He believes EDC has the resources needed to do this at launch. Strahler said that MODIS could use the AVHRR control points library. He asked Jeff Eidenshink to report back on EDC's control point holdings.

8.3 At-Launch Production Scenarios Summary

Paul Menzel reported that the following question was raised during this workshop: What should be the process for changing algorithms, reprocessing, and allocation of resources? Menzel suggested that there will not be a stable production environment at launch and that the algorithms will likely change dynamically. He feels that tracking these changes will be very important.

Menzel presented the NESDIS procedure for reviewing products in the post-launch period (see Attachment 19). He also listed the action items assigned at the workshop.

8.4 Averaging and Subsetting Workshop Summary

John Townshend reported that at this workshop ECS gave an overview of the software tools being developed and made available for averaging, subsetting, map projections, and identifying key deficiencies of data products. Townshend noted, however, that resampling and remapping procedures are not currently being considered. He asked who will develop the software tools for these procedures?

Townshend identified two issues that need to be addressed: 1) EOS data users may get far more data than they request from EOSDIS; and 2) geographic requests for data that crosses granules will require multiple orders and only rectangular areas can be requested. Before launch, Townshend would like to test the ECS toolkit on simulated MODIS data.

Townshend added that requests involving multitemporal images may be difficult; and he is concerned about the lack of tools facilitating multisensor data use. He stated that there is general agreement that there needs to be better communication between ECS and the Science Team. He feels that the MODIS data sets as generated through EOSDIS will likely fail to satisfy many users outside the MODIS Science Team because there is a lack of tools for pre-processing.

Skip Reber pointed out that there is a forum for communication between the science teams, and ESDIS and the DAACs, but perhaps the right people are not attending that forum (Data System Working Group). (Refer to Attachment 20 for more details.)

8.5 Quality Assurance Workshop Summary

Wayne Esaias stated that the goal of this workshop was to assess the status of the MODIS Quality Assurance Plan. The plan is required by ECS in about one month so that they can implement the functionality which will provide MODIS product developers with the information and system for assessing the quality of the MODIS data products. (Refer to Attachment 21 for more details.)

Esaias reported that MODLAND has a draft of their QA plan out for comment; they expect to release their revised draft by November 15. The Ocean Group has met and discussed QA, but has yet to produce a draft plan. The Atmosphere Group has not yet begun to address QA. Esaias stated that it is possible to get convergence within the MODIS Science Team on metadata quality flags. He said he expects that all Version 1 code will contain flag information and software needed to generate QA flags.

Esaias stated that there is concern regarding the readiness of the DAACs to run the QA procedures. He said there is a wide range of opinions as to where QA should take place and how new QA information gets put back into the database. Another concern is the complexity of the post-production process.

8.6 Interactions for EOS PM-1 Summary

Robert Murphy summarized the discussions on interactions for EOS PM-1 (see Attachment 22). Regarding testing and characterization of the MODIS instruments, it was determined that there are no significant differences between the MODIS Protoflight Model (PFM), which will fly on EOS AM-1, and the MODIS Flight Model-1, which will fly on the PM-1, that make any difference to the Science Team.

Some deficiencies in the PFM were identified that could, in principle, be fixed. Among the correctable deficiencies are the D1 dichroic interaction with Bands 8 and 9, and the crosstalk in bands 31 - 36. It was also felt that the MODIS Calibration Chamber could be equipped with a zinc selenide (ZeSe) window, and that solar calibration could be reintroduced.

Regarding cross calibration, Murphy stated that the use of lunar calibration now seems unlikely. However, orbit phasing with other platforms could provide simultaneous views at the poles. Ed Zalewski, University of Arizona, will later provide better descriptions of the options for cross calibration.

Murphy noted that EOS PM-1 has much lower specifications for pointing accuracy than does AM-1, which was “driven” by ASTER and MISR. He feels that the MODIS pointing specification for AM-1 and PM-1 is incorrect—it should be ten times better.

8.7 Algorithm Developers Workshop Summary

Liam Gumley, University of Wisconsin-Madison, presented an overview of the algorithm developers discussions (see Attachment 23). He stated that the purpose of this workshop was to provide a forum where the MODIS algorithm developers could discuss issues and concerns, and share lessons learned. Also, a demonstration of SIVIS (Satellite Imagery Visualization System), a free software tool for SGI computers, was given at this session. This tool is available on the World Wide Web at `http://mistral.larc.nasa.gov/~vasanth`.

Gumley reported the algorithm developers need a stable period for developing Version 2 software between December 1996 and the Version 2 delivery deadline. This will allow developers to integrate tools, data, and specifications and work on science algorithm development too. They will also need to better understand and plan for HDF-EOS.

Gumley said there are two options for ancillary data: 1) NCEP data could be obtained for Science Team members, who will be responsible for unpacking and resampling; or 2) Use data from the DAO (Data Assimilation Office). Gumley stated that the DAO is responsive to users' needs.

Gumley said that good communication will be important during the algorithm test process. Developers will want to know test results in a timely manner. He suggested making certain selected results available on the Web.

8.8 Calibration Workshop Summary

Phil Slater summarized discussions at the MODIS Calibration Workshop (see Attachment 24). He plans to validate the calibration coefficients using two independent vicarious calibration methods—one method is reflectance-based and the other is radiance-based. Slater proposed an intensive validation campaign during the A&E period. He said he is likely to conduct smaller campaigns at two-month intervals, and then one intensive campaign per year.

The first joint vicarious calibration field campaign—held at Lunar Lake and Railroad Playa in early June—compared TOA (top of the atmosphere) radiances. Team members from ASTER (from both Japan and JPL), MISR, MODIS, South Dakota State University, and University of Arizona participated. Preliminary results from that campaign are still being studied.

Slater introduced Ed Zalewski, University of Arizona, who proposed assisting SBRS in its absolute radiance calibration. Zalewski conducted a cross comparison of the calibration of SBRS' Spherical Integrating Source (SIS) during the month prior to their bulbs burning out. He plans to bring back transfer radiometers to help SBRS verify its SIS and characterize MODIS' signal to noise ratio (SNR). He also wants to help verify the SIS' and MODIS' radiometric stability during ambient and thermal vacuum tests, as well as before and after vibration tests.

8.9 MODLAND Summary

Chris Justice summarized the Land Group's deliberations (see Attachment 25). Regarding MODIS instrument tests, he said there is a need for an explicit timeline for tests from present to delivery, with scenarios to address any slips in the test schedule. He encouraged MCST and the MODIS Project to continue their current level of attention to SBRS' testing.

Following John Dalton's presentation on the delayed delivery of ECS, Justice stated that MODLAND is concerned that both team and community expectations will not be met in the first six to twelve months after launch. As a result, he feels there needs to be a coordinated MODIS/MODLAND strategy with timelines for securing the post-launch data stream needed for QA and validation. It is critical that the broader science community has access to MODIS data as soon as possible after launch. Justice said he is also concerned that ECS toolkits will fall short of the needs for MODIS team members and data users. Justice encouraged a SWAMP initiative to address product generation interdependencies under the phased ECS delivery.

Justice reported that geolocation is a major concern on the EOS PM platform. He said the bottom line is that the MODIS PM land products must have at least the same locational accuracy as the AM products.

Justice announced that by the next Science Team Meeting, MODLAND will have developed its QA Plan and its QA implementation plan. Justice reported that MODLAND's validation plans are evolving rapidly towards a community validation initiative based around aircraft flights, continuous test site monitoring, and mini-campaigns. The Land Group would like to work more closely with other instrument and IDS scientists. For instance, MODLAND is planning to be an active participant in the upcoming LBA (Large-scale Biosphere-Atmosphere experiment in Amazonia) campaigns.

In response to the MODIS Project Scientist's questions concerning validation timing and planning, Justice proffered that, for contingency planning in terms of validation campaigns, Project must provide a first cut assessment of realistic launch slip scenarios. Justice also stated that the Land Group at this time has no critical external logistic dependencies for validation in the first quarter after launch. However, it is critical that ESDIS provide sufficient data to support an effective QA activity immediately post launch and enough data to permit extensive validation during the first year.

8.10 Ocean Group Summary

Wayne Esaias reported that the Ocean Group is very encouraged with the approaches being taken by SBRS, MCST, and the MODIS Project Office to ensure that MODIS meets our challenging science requirements. He stated that MOCEAN is fully committed to the Level 1 mission requirements. He proffered that success in achieving the sea surface temperature and polarization requirements, and the on-orbit spacecraft maneuver, will enable MODIS and MTPE to address key ocean climate questions that are beyond the capability of *in situ* and satellite observing systems presently available. Esaias commended SBRS and MCST for sharing preliminary test results and openly discussing the implications.

Esaias announced that MOBY II was deployed off the coast of Lanai, HI, on September

14, 1996. He told the team that the daily network transmission of data to the SeaWiFS Project is underway and so far the data quality is excellent. The MOBY instrument is unique in its ability to synthesize the spectral band responses of any ocean color sensor. It will play a role in the initialization of OCTS, SeaWiFS, and MODIS. (See Attachment 26 for more details.)

8.11 Atmosphere Group Summary

Yoram Kaufman told the Team that all Atmosphere ATBDs have been submitted to the EOS Project Science Office, and all its validation viewgraphs are completed. The Atmosphere QA plan is still to be determined—Allen Chu was designated to take the lead on developing that plan, as well as representing the group at the November 6 QA workshop at GSFC.

Kaufman announced that the Atmosphere Group prefers MODLAND's definition of a data day—standard GMT. The group also prefers an 8-day temporal grid, in addition to the daily and monthly level-3 averaging periods.

He reported that a new version (6) of MAS data processing software was released to replace version 5. He noted that any data processed using version 5 should be reprocessed using the newer version.

Kaufman stated that Atmosphere would like to make some software modules available for processing direct broadcast data. He recommended that calibration coefficients and software be made available on the World Wide Web for processing direct broadcast data. He said there is also a need for a software package for visualizing images at Level 1B with latitude and longitude markers.

Regarding interactions with the Data Assimilation Office (DAO), Kaufman said the group feels that the DAO produces a very impressive list of products, and they see the DAO as very responsive to the discipline groups. Thus, the Atmosphere Group plans to work more closely with the DAO in the future. For instance, the group is planning a test of operational NCEP models to run parallel with DAO tests.

Regarding upcoming MODIS thermal vacuum tests, the group recommends characterizing longwave infrared band (31 with 32 - 36) crosstalk—both spectral and spatial—using existing data. Kaufman also recommends better characterization of the crosstalk between bands 27 and 5, 6, and 7 with additional thermal vacuum testing. (Refer to Attachment 27 for more details on testing recommendations.)

Kaufman encouraged MCST and SBRS to develop a model for the effect of the coating on the scan mirror's infrared properties for both EOS AM and PM MODIS instruments. He also advocates lab tests of the mirror for at least the EOS PM instrument.

8.12 Closing Remarks

Vince Salomonson noted that the MODIS team has learned of some critical issues facing EOSDIS and challenged it to help EOSDIS evolve so that they can better accommodate all of the EOS science teams.

He showed the team a letter that he drafted and intends to send to the EOS AM Project Office in which the MODIS Team's concerns regarding testing and spacecraft maneuvers are clearly stated. Salomonson asked for feedback from the team on the letter before he sends it.

Salomonson thanked everyone who attended this meeting and announced that the tentative dates for the next meeting are May 13 - 16, 1997.