MODIS Science Interest Group
Minutes

November 15 - 17, 1995

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LIST OF ATTACHMENTS

Note: the box above is a hyperlink to a World Wide Web list of the handouts distributed at the MODIS Science Interest Group. These handouts are stored in MODARCH as attachments to these minutes. The handouts that were submitted electronically, as requested, are already available. Those handouts that were submitted in hardcopy form only are being scanned and will be made available as soon as possible.

If you are unable to access any of the attachments or have questions, contact David Herring at Code 920.2, NASA / GSFC, Greenbelt, MD 20771; call (301) 286-9515; or e-mail herring@ltpmail.gsfc.nasa.gov.

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GLOSSARY OF ACRONYMS

ADEOS	Advanced Earth Observing Satellite
AFGL	Air Force Geophysical Lab
AGU	American Geophysical Union
AHWGP	*Ad Hoc* Working Group Panel
AIRS	Atmospheric Infrared Sounder
AO	Announcement of Opportunity
APAR	Absorbed Photosynthetic 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
BATERISTA	Biosphere-Atmosphere Transfers / Ecological Research / In situ Studies in Amazonia
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 Nucleii
CCRS	Canadian Center 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 Earth's Radiant Energy System
CIESIN	Consortium for International Earth Science Information)
CNES	Centre National d'Etudes Spatiales (French Space Agency)
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 Information System or Display 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
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
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-2	ESA Remote Sensing Satellite
ESA	European Space Agency
ESDIS	Earth Science Data and Information System
ESTAR	Electronically Steered Thinned Array Radiometer
FIFE	First ISLSCP Field Experiment
FOV	Field of View
FTP	File Transfer Protocol
FY	Fiscal Year
GAC	Global Area Coverage
GCM	Global Climate Model; also General Circulation Model
GCOS	Global Change Observing System
GE	General Electric
GIFOV	ground instantaneous field-of-view
GLAS	Goddard Laser Altimeter System
GLI	Global Imager
GLRS	Goddard Laser Ranging System (now GLAS)
GOES	Geostationary Operational Environmental Satellite
GOOS	Global Ocean Observing System
GSC	General Sciences Corporation
GSFC	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
IPAR	Incident Photosynthetic Active Radiation
ISCCP	International Satellite Cloud Climatology Project
ISLSCP	International Satellite Land Surface Climatology Project
IV&V	Independent Validation and Verification
IWG	Instrument Working Group

JERS	Japanese Earth Resources Satellite
JGR	Journal of Geophysical Review
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
LAMBADA	Large-scale Atmospheric Moisture Budget of Amazonia / Data Assimilation
LARS	Laboratory for Applications of Remote Sensing
LBA	Large-scale Biosphere-Atmosphere experiment in Amazonia
LCD	Liquid Crystal Display
LTER	Long-Term Ecological Research
MAB	Man and Biosphere
MAS	MODIS Airborne Simulator
MAT	MODIS Algorithm Team
McIDAS	Man-computer Interactive Data Access System
MCST	MODIS Calibration Support Team
MERIS	Medium Resolution Imaging Spectrometer
MFLOP	Mega FLOP, or a million floating point operations
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
NE∆L	Net Effective Radiance Difference
NE∆T	Net Effective Temperature Difference
NESDIS	National Environmental Satellite, Data, and Information Service
NIR	near-infrared
NIST	National Institute of Standards and Technology
NMC	National Meteorological Center
nn	nearest neighbor
NOAA	National Oceanic and Atmospheric Administration
NPP	Net Primary Productivity
NPS	National Park Service
NSF	National Science Foundation
NSIDC	National Snow and Ice Data Center
OBC	On-Board Calibration
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 Planning
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.
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
SCAR	Smoke, Cloud, and Radiation Experiment
SCF	Scientific 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 Integrator Source
SNR	Signal-to-Noise Ratio
SOW	Statement of Work
SPDB	Science Processing Database
SPSO	Science Product 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 AM Platform
SWIR	shortwave-infrared
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
VAS	VISSR Atmospheric Sounder

VC	vicarious calibration
VIRSR	Visible/Infrared Scanning Radiometer
VIS	visible
WAIS	Wide-Area Information Servers
WVS	World Vector Shoreline
WWW	Worldwide Web

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1.0 PLENARY DISCUSSIONS

Due to the U.S. Government furlough, the MODIS Science Team Meeting was canceled. In lieu of that meeting, MODIS science interest group discussions were held in the GSFC Building 8 Auditorium. These discussions were led by Chris Justice, MODLAND discipline group leader.

1.1 EOS AM-1 Project Status

Chris Scolese, EOS Project Manager, gave a brief status report on the EOS AM platform. Scolese stated that much of the AM hardware has already been delivered and is being integrated and tested. A facility was commissioned at Valley Forge to house the EOS AM ground support equipment. Scolese said that system testing is proceeding and that there are no serious difficulties in the overall EOS mission.

He showed a picture of the CERES instrument scheduled to fly on the TRMM platform in August 1997 (see Attachment 1). That CERES is currently being tested at GSFC in Building 7. Scolese also showed pictures of the MODIS and MISR Engineering Models (EMs). The ASTER EM is also currently being built, but, Scolese noted, has lagged behind the other instruments in development due to difficulties in the Thermal Infrared (TIR) instrument and other subsystems.

Scolese pointed out that EOS AM-1 has received a strong endorsement from the National Academy of Sciences. Additionally, EOS received a favorable review from Headquarters Code B. Scolese presented a list of his top 10 issues; MODIS was not on the list.

1.1.1 Options for a MODIS on EOS AM-2

Scolese stated that EOS PM-1 will fly a copy of the current MODIS. However, he reported that based on findings by the new NASA Mission to Planet Earth Future Direction Study group, there are two options for a MODIS instrument on EOS AM-2: (1) Build a radically different MODIS that could cover a range of new technologies--possibly including multiple cameras and a hyperspectral capability. This new MODIS would take advantage of the latest breakthroughs in science and engineering. (2) Fly a copy of the current MODIS or a MODIS-light. Scolese stated that the EOS AM-1 Project is considering all of these possibilities.

Salomonson added that the MODIS Science Team must provide direction for the MODIS instrument to be used on AM-2. He asked the Science Team to produce a statement that reflects their requirements for a MODIS-light.

1.2 EOS Project Science Report

Michael King, EOS Senior Project Scientist, reported that the EOS mission profile is constantly changing; he presented a chart illustrating the current mission profile (see Attachment 2). King announced that the new Mission to Planet Earth NASA Research Announcement (NRA) was posted on the World Wide Web for public perusal. So far, about 500 letters of intent have been submitted, many of which are MODIS-related. Proposals are due Dec. 15, 1995. Selections will be made around March 15, 1996, and new investigators will be added around July 1996.

1.2.1 EOS Budget

King reported that the FY96 budget has not yet been determined by Congress. However, according to all those proposed, CIESIN will be cut by $6 million. He commented that the proposed Senate budget would be manageable, but that the proposed House budget reduction would be devastating to Mission to Planet Earth.

1.2.2 Issues & Concerns Facing EOS

King emphasized that EOS investigators must remain focused on, and should not challenge, the 24 scientific measurement sets established at the outset of the EOS mission. There is a need to clearly identify the EOS science needs as distinct and separate from the commercial yields of EOS. EOS investigators must help promote the awareness that, unlike other space-based remote sensing programs, EOS requires calibration and validation data, as well as continuous data sets. Hopefully, this awareness will help offset possible future budget cuts.

There was some discussion as to whether NASA will be technology-driven or science-driven in the future. King pointed out that placing an emphasis on new technology does not take into account the conservative observation-based approach preferred by most scientists. Additionally, algorithm development is expensive; considerable cost and time penalties are incurred with every hardware modification. However, King noted that too many winds of change may be redirecting NASA's focus onto developing new technology. Salomonson encouraged the MODIS Team to strive for a balance between pushing new science and new technology.

1.3 EOSDIS Status Report

John Dalton, EOSDIS Deputy Project Manager, delivered a status report on EOSDIS (see Attachment 3). He reported that EOSDIS recently completed its Critical Design Review, as well as its Preliminary Design Review for AM-1. The EOSDIS Core System flight operations CDR was also a success. Hardware and software for the Interim Release of ECS to support early testing with TRMM will be delivered and integrated at the GSFC, LaRC, and EDC DAACs in December 1996.

Dalton stated that EOSDIS is also doing some program reshaping due to budgetary constraints. Flight operations will be automated, but the approach has shifted to keeping one operator at each position rather than totally automating the system. He pointed out that if the EOS spacecraft goes into a "Safe-Hold" mode, at worst we would lose two consecutive shifts (no more than 5 percent) of data over the 16-day orbit cycle.

In similarly automated spacecraft operations in other programs, more than 99.9 percent of the data is successfully acquired.

Dalton told attendees that EOSDIS is planning to use ground stations to receive data rather than TDRSS beginning with PM-1. AM-1 will be transferred from TDRSS to ground stations with PM-1 launch. There is, however, an open question on the spacecraft side of the cost trade. A final decision will be made after a study by the winning Common Spacecraft contractor.

1.3.1 Science Data Processing Toolkit

Dalton reported that all EOS instrument teams have successfully installed and used the Science Data Processing Toolkit. IMSL licenses are available for all instrument teams.

Justice asked if there is a forum for providing feedback on the toolkit. Dalton responded that EOSDIS will gather feedback through its interfaces to the instrument teams and through the DAACs.

1.3.2 Quick Look Data

Dalton stated that the capability for delivering quick look data was removed during last year's Rebaselining cost reduction. At that time, no one stated a need for it. However, later some investigators proffered that they need periodic quick look data. In response, EOSDIS is planning to provide a limited amount (2 percent) of "expedited data" as requested by the Team Leaders.

1.3.3 Cost Assessment

Dalton stated that a big issue facing EOSDIS is cost--currently an assessment of requirements versus cost is being done. A top level model is being used in evaluating system design alternatives. Currently, EOSDIS is trying to assign costs to its requirements by mapping operations concepts functions to Level 2 processing requirements. Dalton hopes to complete the first phase of this cost assessment--the mapping of requirements to operations flows--by the end of December 1995.

Dalton told the team that a World Wide Web gateway has been established for accessing Version 0 data. The gateway can be accessed using Netscape or Mosaic, and uses the Version 0 Information Management System to distribute catalog search, browse, and data order requests to the various DAACs. The URL for the WWW V0 gateway is `http://harp.gsfc.nasa.gov/ims-bin/pub/imswelcome`.

1.4 MODIS Project Report

Richard Weber, MODIS Instrument Systems Manager, briefly discussed his top technical concerns facing MODIS (see Attachment 4). He stated that transient response is a chief concern; however, SBRC has now included point spread function measurements in its test plans. SBRC is testing the Protoflight Model (PFM) scan motor.

He noted that the Band 26 filter has been replaced with a filter that is reportedly compliant with the specification. The Engineering Model (EM) electronics problems have been corrected in the PFM. The radiative cooler concerns were ameliorated by successful thermal vacuum tests done in October.

Weber reported that the EM testing and analysis is complete and some changes were made in the PFM as a result of lessons learned. The PFM build is now well underway, however, cost and schedule remain a concern.

Weber announced that Hughes reversed its decision to move SBRC to El Segundo. Also, effective in December, SBRC is changing its name to Santa Barbara Remote Sensing (SBRS). Tom Pagano, of SBRC, stated that SBRS will be more effective and its rates will decrease as a result of its organization change.

1.4.1 SBRC's MODIS Status Report

Pagano reported that construction of the MODIS EM was a highly successful effort--SBRC learned a lot and proved out the essential optical characteristics of the MODIS design (see Attachment 5). He added that the design proved robust and that there were no instrument failures during thermal vacuum testing. The mainframe, radiative cooler, and scan mirror are being refurbished for use on one of the flight models. Pagano told the team that the ground support equipment is now in place, and that the calibration chamber has been fully demonstrated.

Pagano reported that on the EM all bands met specification except bands 5, 6, 8, 29, 33, 35, and 36. Some of the EM detectors suffered premature saturation, but this has been corrected in the PFM. Polarization is within specification (worst case is less than 3 percent). He pointed out that the near field response is out of spec--it is a very challenging requirement.

Near field response is better than most predecessor instruments. SBRC compared the near field response of MODIS to other sensors and found that MODIS compares favorably. Currently, MODIS doesn't meet specs on near field response in the near infrared and visible regions of the spectrum.

Pagano stated that MODIS' modulation transfer function (MTF) meets specification and its band-to-band registration meets both the spec and the goal. Paul Menzel inquired as to the MTF of Band 33. Pagano conceded that there are still some noise issues on Band 33. He told Menzel that he will send him the line spread functions for that band.

SBRC will soon resume subsystem vibration testing of the PFM--they have not yet shaken the aft optics. During vibration testing of the EM aft optics, there was a bond failure and the near infrared lenses became loose. So SBRC is going back and rebonding the aft optics on the PFM to ensure stability.

Pagano said the biggest risk for registration is between the cooled and uncooled focal planes. The specifications for the MODIS filters are quite challenging and have proven to be quite an accomplishment by SBRC. Test data for Band 26 is forthcoming. Pagano noted that the test data from the filter vendor indicates that the filter is within specs.

Pagano reported that SBRC has improved the radiometric accuracy expected for the PFM model data. SBRC has now demonstrated the “master curve” approach for improving radiometric calibration in the thermal infrared. Using EM test data, SBRC backed out the voltages from the focal plane as a function of radiance level and found that the detectors follow a consistent curve. The technique should prove invaluable for characterizing and calibrating the instrument. Additionally, ground-based solar reflectance calibration is planned for MODIS which will allow for testing of the solar diffuser and solar diffuser stability monitor (SDSM). Pagano showed a schematic illustrating how the solar reflectance calibration test will be done. He acknowledged that the inputs from NASA and the University of Arizona are essential for this test.

Pagano stated that the MODIS flight model onboard calibration hardware is now being developed. The SRCA is in good shape and the primary subsystems are complete. He said the PFM build will be completed in the first quarter of 1996 and testing will begin. He noted that there is no slack time in the schedule should any major problems arise during thermal vacuum or vibration testing.

Pagano showed a short video of the assembly of the MODIS EM (Attachment 6).

1.5 Global Imager (GLI) Status Report

Teruyuki Nakajima, of the University of Tokyo, informed the team that ADEOS II will launch in 1998. That satellite will carry two core sensors--GLI and AMSR. Additionally, ADEOS II will fly POLDER II and Seawinds (see Attachment 7).

NASDA recently completed the preliminary design review for the GLI PFM; the critical design review will be held late in 1996. Nakajima showed some performance specifications for the instrument. GLI will have 36 channels, many of which are in the visible region of the spectrum, but not very many for conducting science in the infrared. Some MODIS channels were duplicated for Ocean discipline science, such as two channels near 865 microns.

Nakajima stated that NASDA recently released a new GLI Research Announcement (RA) and he hopes that many MODIS Team members will submit proposals. Additionally, a second NASDA RA for calibration / validation campaigns will be issued in 1996. Nakajima said the GLI Team would like to collaborate with the MODIS Team on a concerted calibration effort. Currently, no collaborative talks between the two agencies are underway and Nakajima hopes to facilitate getting talks underway very soon.

1.6 Options for a Possible MODIS-light

Bill Barnes, MODIS instrument scientist, reported that serious consideration is being given to designing a new MODIS to fly on EOS platforms after EOS PM-1. NASA hopes to take advantage of new technologies to improve MODIS’ performance, while at the same time rendering the instrument lighter and cheaper to build. Barnes summarized several options for a possible MODIS-light put forth by different groups (see Attachment 8).

One proposal submitted by SBRC is basically a scaled-down version of the current MODIS with no onboard calibration hardware. However, so far this approach has not generated a lot of enthusiasm at NASA HQ because it is considered “evolutionary” and HQ wants a “revolutionary” approach.

Barnes said that a proposal for a MODIS AT (for Advanced Technology) has been put forth. However, because it involves new technology, this version of MODIS would have to be rebid. Therefore, Barnes could not at this point give details of the MODIS AT design because that information is proprietary.

Another suggestion is to build ten small MODIS instruments and fly them in formation. That way, if one quits only one-tenth of the data is lost. This approach, so far, is not being seriously considered.

Barnes pointed that that whereas on one hand there is interest in preserving the science objectives of MODIS and maintaining continuity in the dataset, on the other hand there is interest in flying a Landsat along with MODIS on the AM-2 platform, which may require weight savings measures to be taken in the EOS system to make room.

Barnes explained that the SBRC version of a MODIS-light would not include a spectroradiometric calibration assembly or a solar diffuser stability monitor. It would fit in a package four times smaller than the current MODIS, at about half the weight and power consumption. The same bands (with the same focal plane assemblies) and optics would be used. In short, the idea is to use the same performance specifications.

Salomonson encouraged each MODIS Science Team member to play a role in the writing of specifications for a new MODIS based on the premise that the Team’s current algorithms and science data products must be maintained.

1.7 MODIS Administrative Support Team Report

Locke Stuart announced that Barbara Conboy is the new MODIS Administrative Support Team (MAST) leader.

1.8 SCAR - B Campaign

Yoram Kaufman, Atmosphere group member, presented a summary report on the SCAR - B (Smoke, Clouds, and Radiation - Brazil) campaign held in August and September of this year (see Attachment 9). The goal of SCAR-B is to characterize the effects of biomass burning on the atmosphere. Kaufman listed the aircraft and instruments used in the campaign--the NASA ER-2, U. of Washington’s C131, and a Brazilian Bandierante were flown with various instruments for gathering remote sensing and *in situ* data. Participating in the campaign were scientists from NASA GSFC, the U.S. Forest Service, the U. of Arizona, the U. of Wisconsin-Madison, the U. of

Washington, the U. of Alaska, and Brazil's U. of Sao Paulo. AERONET, a network of 11 sun photometers, was set up by Brent Holben, of NASA GSFC, and Brazil's INPE. GOES and AVHRR image data were also obtained over Brazil during the campaign.

Kaufman reported that all elements of the mission worked well and that there was excellent collaboration among the American and Brazilian scientists. He stated that this past year was one of the smokiest in Brazil's history--the ER-2 pilot reported literally flying over thousands of kilometers without seeing the ground due to the smoke!

1.8.1 MODLAND Participation in SCAR-B

Alfredo Huete, MODLAND member, reported on his participation in SCAR-B. His goal was to investigate the effects of aerosols and smoke on vegetation indices. Specifically, he hoped to determine the saturation or linearity of the vegetation indices for dense vegetation types in the Amazon. Another goal was to assess the relationships between vegetation indices and biophysical parameters for different vegetation types.

Whereas he had originally planned for about 20 investigators from the land science community to participate, the Brazilian government decided at the last minute to not allow studies of the ground. This greatly restricted Huete's involvement in SCAR-B.

1.9 MODLAND-BOREAS Interactions

Justice stated that it takes too long to get BOREAS data after each campaign. The MODLAND group is interested in reviewing BOREAS data. He noted that it only took 4 - 5 months to obtain SCAR-C data.

Steve Running discussed MODLAND's intentions to participate in upcoming BOREAS IFCs (Intensive Field Campaigns). From Feb. 27 - March 15, 1996, MODLAND will participate in the snow radiation and remote sensing campaign. From April 2 - 23, and then again from July 9 - Aug. 9 and Oct. 1 - 21, they will cooperate in the terrestrial ecology, hydrology, tower flux, and trace gas studies. Alan Strahler plans to obtain data from ASAS, PARABOLA, and MAS (from previous campaigns) for developing his bidirectional reflectance distribution function (BRDF) product. Huete will use data from those same instruments in developing his Version 1 and snow backgrounds data products. Zhengming Wan is using MAS data in refining his land surface temperature algorithm. Running is using MAS and ground data to polish his land cover, leaf area index, and net primary productivity products. Jan-Peter Muller will use ASAS data to develop his BRDF product.

1.9.1 MODIS Snow and Ice Campaigns

Dorothy Hall, MODLAND member, presented an overview of her involvement with BOREAS, as well as her campaign in Alaska earlier this year (see Attachment 10). Her objective in these campaigns is to develop and refine her algorithm--SNOMAP--for remote sensing of snow and ice from space. Specifically, SNOMAP will differentiate snow and ice from clouds and map those MODIS image data pixels that contain snow and ice. The highly reflective nature of snow and ice, and the large extent to which it covers the surface of the Northern Hemisphere during the winter, make it an important determinant of the Earth's radiation balance.

Hall observed that we need to get better at remotely sensing the ground from over dense forests, as well as differentiating between snow in coniferous trees and ground snow cover. She plans to participate in BOREAS in 1996 where she will have access to ASAS, AVIRIS, and PARABOLA data. She plans to measure carbon dioxide and snowmelt fluxes within the boreal forest.

Halls future work includes determination of the limitations of SNOMAP in forested areas and in conditions of low solar illumination. She also plans to work with Yoram Kaufman in developing an atmosphere correction algorithm over areas with extensive snow and ice coverage.

1.9.2 Producing Simulated Data Using MAS

Steve Ungar, SDST member, reported on his efforts to produce false color composite data taken by MAS from the C130 during BOREAS (see Attachment 11). He showed images taken over Candle Lake, in Saskatchewan, Canada, in which data taken in the thermal bands reveals hydrothermal processes taking place in the lake. Ungar stated that MAS captured temperature variations of within 0.2 degrees Celsius.

Ungar is developing a scheme for navigational correction of data from MAS.

1.12 MODIS Land Surface Temperature (LST) Campaigns

Zhengming Wan gave an overview of his LST field campaigns in 1995 in which he used a portable thermal infrared emission spectrometer at various LST test sites (see Attachment 12). Wan reported that he plans four LST validation campaigns in 1996 and has requested daytime and evening MAS flights for each.

1.12 MAST Campaign Support

David Herring, MAST technical manager, suggested that the Science Team may wish to consider using MAST to support its field campaigns (see Attachment 13). He listed areas of expertise that MAST could provide. He pointed out that field campaign support could prove particularly useful during the Team's post-launch validation activities.

2.0 ROUNDTABLE DISCUSSION SESSIONS

2.1 MODIS Software Delivery

Ed Masuoka, SDST leader, provided a status update on the Beta Software Delivery and reviewed the Version 1 Software Delivery schedule for data products (see Attachments 14 and 15). He noted that the Version 1 delivery schedule was driven by the need to comply with the schedule of deliverables under the Team Leader Working Agreement, which includes an integrated Version 1 software system in December 1996 and an integrated Version 2 software system in November 1997. The purpose of the Version 1 system was to allow end-to-end testing and of the system and to produce system metrics, and that of the Version 2 software was to be the first cut at the "at launch" system in terms of both science and processing. A concern was raised about the schedule for delivery of the ECS grid/swath products, as these will impact the data products software deliveries.

2.1.1 Software Testing Process

Al Flieg followed with a set of presentations on the Software Testing Process, Synthetic Data, Test Data, and MODIS Data Quality Assurance (Attachments 16 - 18). The initial concept of software testing was that the Science Team members would be responsible for testing their science algorithms, and SDST would test the integrated processing flow. As the understanding of the testing process has evolved, the requirements and responsibilities have become more complex. Testing will need to be a more cooperative effort. Especially important is for the Science Teams to provide test data sets along with their routines, identifying the inputs used and resulting output, so that SDST can verify that it has not changed anything during the integration process. There will also need to be some level of cooperation in testing science strings, where a number of processes need to run end-to-end.

2.1.2 Test Data

Fleig noted that test data may be used to test science, programming, ancillary processing, and operations, and that it was incumbent on the group doing the testing to obtain or produce the appropriate test data. Possible sources include measured data from other sensors, synthetic data, artificial data without physical meaning (such as a checkerboard or striped pattern), truth data, etc. It was suggested that it could be useful to use common sources for test data, selecting common dates and areas, and it was noted that it is helpful to know what the correct answers for a given data set are in order to evaluate the processes.

2.1.3 Synthetic Data

Fleig noted that programs exist to generate consistent Level 0, Level 1A, and Level 1B data sets, as well as some ancillary data. A number of synthetic MODIS "scenes" were displayed. There was some discussion of the need for clouds in the ancillary data set, and plans for doing so were described. Fleig reported that the SDST synthetic data plan was available, and requested feedback from the Science Team. Specifically, he is looking for individual requirements for synthetic data sets, and will compile a list of these. He will also work on requirements for oceans test data, including clouds.

2.1.4 Qualtiy Assurance

Fleig stated that QA is not data validation--it is a "sanity check" on the data during processing. QA is done both at the DAAC during production processing, as well as after production processing, either at the DAAC, TLCF, or SCF, and is reflected in the QA flags that accompany the data products. Fleig touched on the requirements of performing QA, including cost, time, personnel, and computing resources. Especially important is the QA plan--it allows for an understanding of the resource requirements post launch, allows individual processes to know what QA information will be available from other products that will impact their product, and will establish an infrastructure to support the collection and distribution of data. The ECS needs the QA plans in order to establish processing, storage, and network requirements. The DAACs need QA plans to establish staffing, training, and scheduling requirements. The coding for QA should be included in the Version 1 software deliveries. During the ensuing discussion, Fleig suggested that QA processing will require more than half of the computing resources post-launch.

2.2 On Orbit MODIS Data Acquisition Scenarios

This session was moderated by Bruce Guenther, MCST team leader. Ed Knight presented "On-Orbit Plans for Commanding the MODIS Instrument" to the Data Acquisition Session (Attachment 19). The presentation is based on the "MODIS Operations Concept Document," Version 1.2 by Kirsten Parker and Ed Knight. Knight reported on tentative plans for the MODIS Instrument Operations Team (IOT) to provide development, planning, and scheduling of the MODIS on-orbit operational activities and procedures. Knight summarized five topics: 1) Operations Context; 2) Operations Database; 3) Activity Scheduling; 4) Operational Activities; and 5) Future Plans.

2.2.1 Operations Context

Knight summarized an initial effort of the planned operational activities and procedures. MCST works in conjunction with SBRC to provide command and telemetry procedures for MODIS. The plan is to provide scheduling and use of MODIS to the EOS AM Flight Operations Team (FOT). The goal is to optimize data products without overstepping any of its operational limitations. The IOT will reside at the MODIS Team Leader Computer Facility. There will be a baseline schedule for MODIS at all times. Ninety percent of the time, this is simple data collection in day and night modes. The other 10 percent of the time is when commands for special calibration and data quality procedures are executed.

2.2.2 Operations Database

Knight reported the Operations Database contains the activities, commands, schedules, telemetry, and associated data to control MODIS.

2.2.3 Activity Scheduling

Knight said the IOT will have a baseline schedule completed one year before launch. Any changes to the baseline operations plan once MODIS is in orbit will require submission of revisions between three weeks and two days before the target day. Last-minute changes are for emergency/high priority only, and are at the discretion of the Mission Operations Manager. Knight said only a small proportion of the IOT special requests will negatively impact the collection of Earth view data.

Data following a disaster will arrive within two days of the event, normally. This can be sped up to a few hours using an expedited data service still under development. If expedited data requires a change in the way the instrument is operated, such as a change in the vicarious field campaign, the IOT needs to be notified.

2.2.4 Operational Activities
Attachment 19 provides operational activities tables for instrument maintenance, data collection, calibration, orbit characteristics, and data quality for MODIS.

2.2.5 Future Plans
The Operations Concept Document Version 1.2 will be reviewed and completed by December 1995. Information from the IOT will go to the MODIS Science Team for review in January 1996. The Version 2.0 document will incorporate information from the Validation Plan, Level 1B 1996 ATBD, and, if available, PFM results. Guenther said additional planning will be implemented for coordination of IOT/FOT commands between AM-1 sensors. Guenther concluded that the orbital planning by IOT and MCST is proceeding well. Guenther said the MODIS team should review the information listed in the activity tables carefully. Knight is requesting from the MODIS Science Team inputs on any discipline science-related issues.

2.3 Gridding
How MODIS products will be mapped was discussed during the gridding session, moderated by Chris Justice.

2.3.1 Toward a Regional Global Image Base System
Sam Goward, U. of Maryland, presented "Toward a Rational Global Image Base System" (Attachment 20). He reported that all two dimensional image mapping schemes introduce problems and errors (e.g.'s, mensuration errors, inter-data incompatibility, data volume increase, etc.). He reports gridding techniques using Spherical Data Structures and Native Data Systems with "on-demand" mapping provide an improved method for mapping global-scale image data. Native data "on-demand" systems is currently used at Univ. of Maryland, NASA Pafhinder, and others. The advantages of the "on demand systems" is that errors are only introduced when needed for that application. Furthermore, "on demand" systems may typically meet most computational requirements. Goward reported Spherical Data Systems more optimally use the Earth's sphere. In addition, the Spherical Data System may permit universal data exchange. However, the Spherical Data Systems require additional development and testing. Furthermore, compatibility with Geographic Information Sytems may cause short term problems. Goward said you can still derive two-dimensional outputs for viewing from three-dimensional projections.

2.3.2 Polar Grid Issues
Greg Scharfen, of the National Snow and Ice Data Center (NSIDC), presented "Polar Gridding Issues" (Attachment 21). Scharfen said the two dimensional mapping projections used in many global applications such as the ISCCP technique do not adequately meet MODIS sea and ice data product gridding requirements. A letter will be sent by NSIDC to MODIS stating concerns of using an ISCCP-derived grid for MODIS level 3 products. NSIDC evaluated using the EASE Grid (azimuthal equal area projection having a grid cell aspect ratio from 1 to 1 at the poles to 2 to 1 at the equator) previously adapted for SSMI products. Their preliminary work indicated converting

Level 2 MODIS data significantly reduces the gridding error in comparison to converting Level 3 MODIS data.

2.3.3 EOS Common Grid Proposal
Robert Wolfe, of Hughes STX, presented “EOS Common Grid Proposal” (Attachment 22). Wolfe reported that the EOS AM-1 instrument members from CERES, MODIS, and MISR could not agree on a consensus approach for gridding and each will choose their own. For the coarser grids at 1/4 degree and 1 degree they agreed to use an equal angle projection. He reported the MODIS Oceans Team will use the ISCCP grid. The SDST will have flexibility to work with one of several different grids for land and atmospheres. The SDST will continue to work gridding-related issues with the MODIS Science Team.

2.3.4 Proposed Grid Characteristics
Piers Sellers, EOS AM project scientist, presented “Proposed Grid Characteristics” for climate modelers (Attachment 23). Sellers said a proposal to have a common nested grid for all EOS AM-1 Level 3 products was rejected due to too many specialized instruments and user needs. Sellers reported the global climate, NWP, Carbon Cycle, and Oceanography modelers recommend an equal angle grid at 1-degree by 1-degree resolution. They recommend having nested cells at 0.5 degree and 0.25 degree for some land and ocean products. The gridded data will be integrated in 10 and/or 30 day sets. The scheme is nearly the same as the ISLSCP 1-degree by 1-degree grid convention (800-1300 users). Instrument teams will generate the gridding schemes themselves. Sellers said most modelers want NASA to do the best job and not place the gridding burden on the user.

2.4 EOS AM-1 Validation Coordination
The validation discussions were moderated by David Starr, EOS validation scientist, and Chris Justice.

2.4.1 MODIS and EOS AM Validation Status
Starr summarized EOS-AM validation requirements (see Attachment 24). He said the success of EOS is largely dependent on both the quality of the data and the access and utility of the data. A major theme is to ensure validation data is accessible to as many investigators as possible. An NRA is planned for release in August 1996 to support specific essential validation elements with broad applicability (multiple instruments and products). The validation plan must include what the science team will do and what potentially could be done by others. Attachment 24 specifies what the plan should include along with an outline to ensure that most topics are covered. Additional validation work is planned to augment the EOS investigators through an NRA to be released in August 1996.

The science team is encouraged to cooperate with other scientists and groups to maximize validation planning. Linkages with the EOS IDS, NSF, DOE, NOAA, GEWEX, and other teams is strongly encouraged. A validation workshop is planned for May 1996 in Greenbelt, MD. Workshop participants will include AM-1 instrument teams, a LIS instrument team (TRMM), a SAGE-III instrument team (METEOR), the Data Assimilation Team, the SIMBIOS Team (Ocean Color), EOS IDS Teams, IWG Panels, and the EOS Project Science Office. The workshop will likely be organized using fundamental product themes (e.g.'s, atmospheric correction, radiometric calibration, and BRDF) and higher order geophysical product themes (e.g.'s, clouds, Earth radiation budget, and ocean color). Abbot indicated the validation priorities should come from the scientists. Running emphasized the early lead time to set up a framework with other agencies for validation planning. Justice recommended having a validation strawman in place as much as possible prior to the workshop.

2.4.2 Atmosphere Group Validation Plan

Yoram Kaufman reported on validation plans for five Atmosphere Group products: 1) aerosol products; 2) total precipitating water vapor; 3) fire products; 4) cloud mask; and 5) cloud top properties and cloud phase (see Attachment 25). More validation effort is needed for aerosols and cloud properties than for water vapor. The Atmosphere Group is emphasizing validation using *in situ* data and aircraft ("field") campaigns. They are coordinating the update of the AFGL atmospheric models completed in the 1960s and 1970s.

2.4.3 Ocean Group Validation Plan

Wayne Esaias reported on the Ocean Group's validation plan (see Attachment 26). The Ocean Group validation plan is in conjunction with the Sensor Intercomparison and Merging for Biological and Interdisciplinary Studies (SIMBIOS). SIMBIOS is a plan resulting from a workshop with 85 investigators associated with five ocean missions. SIMBIOS emphasizes an intercomparison of satellite sensor data. A delay in the SeaWiFS launch from three years ago has necessitated revised Ocean validation efforts. A major theme will be to share and coordinate validation data among the international science community. Attachment 26 also includes a diagram showing existing and proposed in-water validation sites and regions. Also given are the proposed and existing sun photometer sites used for atmospheric corrections.

2.4.4 Land Group Validation Plan

Chris Justice summarized the status of the land validation effort (see Attachment 27). The Land validation effort involves a five-tiered effort drawing upon the GTOS (Global Terrestrial Observing System) plan in conjunction with the IGBP and the United Nations. The five tiers are 1) "International" intensive research over a period of time (e.g.'s ISLSCP, BOREAS, and IGBP transects), 2) "Research Centers" having long-term measurements (e.g., research centers stratified by biome), 3) "National" (e.g.'s, static sites with temporal updates such as the LTERS, and anchor points for IGBP transects); 4) "Periodic Plots" for a given product that are statistically sampled, and 5) "Satellite Data" from low to high spatial resolution. Justice said there are inherent strengths and weaknesses with each of the tiers that to a degree complement one another. For example, the "Periodic Plots" are needed for many of the MODIS data products to fill in holes in tiers 1-3. Justice reports there is considerably more validation work required to determine data collection analysis, minimum requirements, funding, etc. He said coordination is ongoing with GTOS, pathfinder activities, and NASA. He recommends efforts to maximize validation efforts by involving the international community. Tim Suttles (STX) is organizing a land validation workshop, with Diane Wickland (NASA HQ) serving as the chairperson, in January 1996.

2.5 MODIS Document Development and Distribution Plan

Herring began his presentation with an overview of the new NASA standards for computer interoperability (see Attachments 28 and 29). All NASA center information officers (CIOs) will soon be directed to ensure that all NASA employees have access to an interoperable workstation equipped with standard software for word processing, spreadsheet building, presentation designing, electronic mail, calendar/schedule planning, and basic Internet access. The idea is to facilitate fully platform-independent interaction among NASA employees. Herring noted that Netscape and Adobe Acrobat will be mandatory for everyone.

Independent of the new NASA CIO guidelines, Herring surveyed existing commercial and public domain software that will enable the entire MODIS Team to share files across computer platforms. He recommends that for word processing, all team members should use either the latest versions of Microsoft Word or WordPerfect. Graphics should be saved as Encapsulated PostScript (EPS) for inclusion in documents or presentations, and as GIF or JPEG for placement on the World Wide Web. For submission to the MODIS Document Archive (MODARCH) documents should be submitted in one of the following file formats: MS Word, WordPerfect, MS PowerPoint, PostScript, or Adobe's Portable Document Format (PDF).

2.5.1 MODARCH Security Issue

The MODARCH EFS (or Electronic Filing System) archive has been password protected in order to prevent non-U.S. citizens from accessing certain MODIS contract deliverable documents. The password will be given only to team members who are U.S. citizens or Green Card holders. Anyone else wishing to access MODARCH must submit a request in writing to Chris Scolese, EOS Project Manager.

3.0 DISCIPLINE SPLINTER SESSIONS

3.1 MODLAND Group Discussions

MODLAND Group Leader Chris Justice chaired these discussions. A status review of the Beta data product deliveries for MODLAND was provided.

Funding was discussed, especially with reference to computing resources. There is a concern that the total processing requirements for MODIS data products may be underestimated. Another concern is that current network capabilities will not support using the TLCFs to sufficiently augment total processing capabilities. Funding for processor and network upgrades is an important issue.

The need for continuing to improve communications between the MODLAND team members and the support groups (MCST and SDST) was discussed.

A summary of the findings from the October SAP meeting was provided by Robert Wolfe. Primary issues resulting from that meeting were the Version 1 software schedule, the maturity of ancillary data sets, the need to define production rules, version control, and robustness of code.

A series of reports from recent workshops followed, including the Vegetation Indices workshop, the Land Cover workshop in Montana, the Snow and Ice meeting hosted by GSFC, ISPRA's Fire meeting, a Cloud workshop at Wisconsin, a BRDF meeting in Boston, and the recent SWAMP meeting. Discussions were held on proposed meetings and workshops for the coming year.

Regarding validation plans, it was suggested that planning should be in progress for the out years--2001 and beyond. Requirements for test sites, airborne campaigns, relationships with BOREAS and other field campaigns should be discussed further.

The interactions and relationships between Surface Reflectance, BRDF, and FPAR products were discussed in detail. Different algorithms for deriving the products were compared, and the use of the products in the data processing stream was examined.

3.1.1. Field Campaigns

3.1.1.1 BOREAS

Forrest Hall reported that BOREAS is looking for financial and scientific support from MODLAND for BOREAS aircraft campaigns. The $15K to $20K committed by some of the MODLAND team for aircraft data support should assist BOREAS to obtain additional commitments from NASA HQ. Tentative BOREAS plans call for AIRSAR and ASAS data for July and August and AIRSAR only in February. Alfredo Huete and Alan Strahler are interested primarily in the summer data. Dorothy Hall has interest in the BOREAS moss data collection.

3.1.1.2 LBA

Hall said there will be a meeting in July 1996 to discuss plans for the LBA in Amazonia for a field campaign in 1999. Land science issues include surface energy, carbon cycling, land cover change, and remote sensing science. Hall and Steve Prince, U. of Maryland, have been asked by NASA HQ to prioritize LBA remote sensing research by indicating 1) existing capabilities, 2) capability with some research, and 3) extensive research required prior to implementation.

3.1.1.3 GCIP

Hall said the GEWEX GCIP is the next major campaign planned. Justice said the GCIP may provide MODLAND the opportunity to get extensive validation data through collaborations. E.T. Engman can be contacted for hydrology-related matters and Sellers for ISLSCP contacts.

3.1.2 Global Imager

The pending GLI Research Announcement for developing retrieval algorithms and related studies to produce standard products was discussed. GLI is a scanning radiometer with 36 channels covering the spectral range from 0.38 to 12.0 µm with 1-km and 250-m spatial resolutions and a swath width of 1600 km. Huete will be the point of contact for coordination between MODLAND and Japanese GLI scientists.

3.1.3 MODIS Follow-On Sensor

Pagano reported on SBRC's earlier MODIS Lite presentation since having no SRCA, a different scanner and an overall smaller version of the current MODIS was not accepted. Instead SBRC is pursuing a multiple linear array (MLA) pushbroom radiometer having high spectral resolution bands (i.e., 128 bands) with a 110 degrees swath. Strahler is concerned about radiometric calibration, infrared band quality, and data continuity with MODIS. Pagano is concerned with data rate limitations and the IR technology associated with an MLA design. SBRC plans to host a working group and would like one to two people from MODLAND. Strahler and Justice will assist with Land reviews of the MODIS LITE proposals.

3.1.4 GSFC DAAC

Chan requested a discussion of how the GSFC DAAC can establish a closer working relationship with MODLAND. Justice suggested that the DAAC help provide assistance on networking issues and help provide computer resources to assist the Land Group with the large volume synthetic data set being developed for Version 1 prototyping. In addition, the linkages between SDST, DAAC, and MODLAND should be further developed in the area of lessons learned from the GAC Pathfinder at the DAAC and lessons learned from the Land Beta delivery.

3.1.5 Modeling Ouputs

Justice suggested that the MODLAND products to be output at the resolutions suitable for climate modelling should be reassessed in light of the presentation given by Sellers in the Gridding Session (see Attachment 23). Running stated that climate modelers are just one of several modeling groups with special needs for MODIS data products and that he will take the climate modelers' recommendations to the IWG land group. Strahler said that different products will need different treatment for presentation at the 1-degree resolution.

3.1.6 Validation Plans

Justice said MODLAND will try and configure their Validation Plan to fit into the guidelines summarized by Starr (see Attachment 24). Fleig will provide the first "generic" part of the Validation Plan for MODIS. Justice said the post-launch validation planning could be a group response. Justice will lead the group validation response with assistance from MODLAND. The remainder should be done separately for each data product. Fleig said there will be some data quality issues manifest in data products such as ghosting and spectral drift that should be incorporated into the MODLAND validation. Running provided an overview of the status of the MODLAND test site initiative.

3.1.7 Aircraft Sensor Development

Justice said the SPO will be authorizing design and development of additional aircraft sensor(s) for EOS instruments. One option being considered is a MAS-2 for flight on the C-130 with some ASTER channels (i.e., MASTER). Also under consideration is a MISR simulator and an upgraded ASAS. Mike King, Jim Irons, Dave Diner, and Anne Kahle are the primary contacts. Zhengming Wan is the MODLAND point of contact for MASTER.

3.2 Ocean Discipline Group Discussions

3.2.1 GLI AO

The Group agreed to submit a joint proposal, which is due Dec. 22. The Japanese GLI instrument, which is similar to MODIS, could make use of many of the same algorithms being developed for MODIS. Mark Abbott agreed to be the “hub” for proposal assembly, and expects the Ocean Group members to send him appropriate text.

3.2.2 Ocean Simulated Data

Evans will simulate chlorophyll fields. Esaias intends to supply his own simulated data.

3.2.3 Validation Plan

Esaias presented an exemplary outline (Attachment 24), prepared by David Starr. Abbott suggested emulating the SeaWiFS plan. It was generally decided that the plan would be developed on a product-by-product basis, with a synoptic foreword. Validation planning will begin with FY96, and will not address previous validation efforts. In addition to Clark’s work, Gordon stressed the importance of SIMBIOS. Esaias requested two or three pages on what each team member is doing, by Dec. 1. There was discussion of a “focussed” activity, wherein a “validation” area is selected for a concentrated effort--perhaps off of NW Africa in 1999. Esaias suggested a month of ship time once a year for an ocean validation cruise. This would be a single-point cruise. Discussions about funding such a cruise led to the sense that individual cruise efforts are of greater concern. Collaborations with other agencies (NSF, Navy) were also considered important.

3.2.4 Data Correction Algorithms

Barnes wants to know if MCST should aggressively pursue data correction algorithms. Funding would have to come out of the science team member budgets. Esaias felt that uncorrected instrument anomalies which impact science will have to be supported. In response to Gordon’s enquiry, Barnes averred that there is a low-level correction algorithm study effort. Gordon felt this is reasonable, until the protoflight model (PFM) is better understood. Esaias suggested that a place-holder correction should be created, but shouldn’t involve several man-years’ of effort. When point spread functions (PSF) are measured by SBRC, Godden and Qiu should review and recommend the necessary action. Gordon stressed the need to consider both near-field and far-field response.

3.2.5 Bright Target Effects

Because of costs and complexities, the Team cannot commit to completely correcting the effects at launch. Esaias recommended a cloud proximity switch. Atmospheric scattered radiance also needs to be considered. Peter Minette felt that the effect in the infrared is not major. The MTF is good; the PSF will be an issue, but not to the same degree as in the visible. Good pre-launch characterization is important. Evans was concerned about the possibility of field energy getting in and impinging on the blackbody (BB). Minette felt that the effect is well-characterized by SBRC. Non-blackness will not be an issue as on AVHRR. MODIS will respond in the infrared more like an ATSR. The mirror is more of a problem: the temperature of the mirror should be very well known. Minette further felt that it will be difficult to differentiate between mirror and atmospheric problems.

3.2.6 MCST Advisory Group
Esaias wants to set up an MCST advisory panel on Jan. 19 at GSFC. Empaneled are Esaias, Gordon, Slater, Menzel, Vermote, and Kaufman. Esaias explained that the purpose of the advisory panel is to render the Science Team responsive to MCST, and *vice versa.*.

3.2.7 New Technology MODIS
Gordon reviewed the Murphy (MODIS Project Scientist) document. Carder is concerned about the signal-to-noise ratio (SNR), which is dependent on the way of binning. At least 1000:1 SNR is needed for 250 m pixels, which can be obtained by integrating. The Team feels strongly that they need to get involved in specifying the characteristics of any follow-on MODIS, and hopes the MODIS Project Scientist will lead the Team involvement.

3.2.8 Algorithm Delivery
All Ocean Group algorithms are in Evans' hands, except coccolith. He is preparing a Version 1 delivery within 3 months. Evans needs all Version 1 algorithms by the end of February.

3.3 Atmosphere Group Discussions
Michael King, Atmosphere Discipline Group leader, chaired the group discussions and presented the agenda.

3.3.1 Validation Plan
King stated that each Science Team member is required by contract to provide a validation plan for each data product. He expects the MODIS Validation Plan for the whole team to be about 30 to 40 pages. Kaufman and Menzel volunteered to take the lead on gathering the Atmosphere Group's validation plans. The plan to prepare a first draft by the end of November 1995.

3.3.2 Lessons Learned, Software Delivery Status, and Future Plans
Liam Gumley, U. of Wisconsin-Madison, summarized the proceedings of the Programmers' Forum. He observed that the meeting was directed toward establishing lines of communication among the MODIS programmers in order to share common

tools and, hopefully, save time and effort. For example, Gumley said, MODLAND is developing Level 1 to 3 read / write tools that will be useful to the Atmosphere Group too.

The Group recognized that it needs to begin working on Level 3 code. King stated that someone would be identified in the near future to begin developing Atmosphere's Level 3 code. He reminded the group that the Level 3 beta delivery to SDST is in March 1996.

3.3.3 SCAR -B Science Results

Kaufman reported that SCAR - B was a huge success; however, SCAR investigators are still determining how to analyze the data so there aren't yet many science results to report. He plans to begin analyzing data over the fire sources and then statistically correlate the smoke data to individual fires. Ultimately, he wants to connect the amount of smoke output to the intensity of the fire to determine if there is a direct relationship or relevance. He will also examine smoke properties to try to characterize particle size distribution. Kaufman hopes to gain an understanding of the lifetime transport of smoke from Brazilian biomass burning to determine how it is interacting with clouds and aerosols over the Atlantic Ocean.

3.3.4 MAS Status

King announced that because the MODIS Airborne Simulator (MAS) is being used so frequently, it needs more frequent refurbishment for proper calibration and characterization. King discussed the schedule for MAS flights in the upcoming year. Notably, it will fly in the SUCCESS and TARFOX campaigns.

King said there is still the possibility of MAS overflights of Mauna Loa and the MOBY site off Lanai, HI. However, that campaign should be delayed at least a year in order to coordinate with SeaWiFS and ADEOS II overflights. The launch of both of those platforms has been delayed.

Chris Moeller discussed in detail the hardware upgrades to MAS this year.

3.3.5 Science Advisory Panel Update

Kathy Strabala summarized the deliberations at the recent Science Advisory Panel. She reminded the Group that the Level 3 beta software delivery is upcoming, yet the Atmosphere group is perceived as being behind and somewhat uncoordinated in it software deliveries. The Version 1 software delivery deadline is January 1996. King stated that his Version 1 code will not be ready in January.

Strabala told the Group that there are two efforts underway to produce synthetic data: 1) synthetic data for testing computations, strings, and end-to-end tests; and 2) synthetic data for test data sets. According to Strabala, Paul Menzel feels that real data should be used in the Atmosphere test data sets as that is the best way to test the science. The Atmosphere Group agreed that simulated data is not useful and therefore no funding should go toward its production.

3.3.6 Airborne Sensor Workshop

King briefly summarized the Airborne Sensor Workshop held Oct. 2 at NASA Ames. Two possible new airborne sensors were proposed at that workshop--1) a MISR Airborne Simulator using one EM model MISR camera that could be mounted in the nose of the ER-2; and 2) MODLAND and ASTER are interested in jointly building a version 2 MODIS Airborne Simulator for use on low-flying aircraft. It would be a MODIS-ASTER Simulator, called MASTER.

4.0 FINAL PLENARY SESSION

4.1 MOCEAN Discipline Report

Wayne Esaias, MOCEAN group leader, delivered the summary report of the Ocean Group discussions (see Attachment 30). Regarding the bright target effect in MODIS, Esaias feels that good progress has been made to characterize the instrument. However, he suggested that it is too early to commit to solutions. He stated that our goal should be to have a simple correction procedure defined at launch as a research product. This product would involve two steps: (1) estimating cloud radiances for those channels that saturate, and (2) producing point spread functions.

Esaias announced that the MCST Advisory Group will meet in January 1996, following MCST's audits. This group will be comprised of Esaias, Paul Menzel, Eric Vermote, Peter Minnett, Chris Justice, and Phil Slater.

Esaias stated that Ocean Group members will submit two-page summaries of their validations plans to him by Dec. 1, 1995. He will then synthesize these inputs into a single plan that is synergistic with the SIMBIOS approach. The Ocean Group feels that NASA should fund focused cruises for its validation exercises.

Esaias reported that an agreement has been reached for an acceptable approach and timetable for producing simulated data. Regarding algorithm code delivery, Esaias told the team that all MOCEAN elements are in Bob Evans' computer. The Ocean Group members are all working toward an early delivery to hopefully avoid any conflict with the SeaWiFS launch, and to hopefully minimize changes in directions in EOSDIS.

Esaias said MOCEAN is excited about the new GLI RA. The group feels that there are many similarities between the GLI and MODIS and that both teams would benefit from closely cooperating with one another. Mark Abbott is heading up the writing of MOCEAN's proposal--inputs are to be to him by Dec. 1.

4.2 Atmosphere Discipline Group Report

Michael King, Atmosphere group leader, summarized his group's discussions (see Attachment 31 for details).

4.3 MODLAND Group Report

Justice, Land Discipline Group leader, presented an overview of MODLAND's deliberations (see Attachment 32). Justice stated that MODLAND will continue to participate in the next BOREAS campaign(s); however, MAS is not currently planned for use in those.

MODLAND is very interested in collaborating with the GLI Team. Justice stated that the group will contribute to a joint proposal. Justice is particularly interested in comparative data sets from the two instruments. Alfredo Huete will take the lead on collecting proposal inputs from MODLAND members.

Justice reported that the group's validation plan is now under construction, with emphasis being placed on test sites. MODLAND is considering two possible packages for data collections: (1) vegetation and characteristic structure, and (2) radiation data for albedo and temperature.

Regarding data delivery, another MODLAND-SDST meeting is planned for February 1996 for Version 1 planning. Justice asked SDST to report back to the Science Team any lessons learned from the beta delivery. Also, the Science Team would benefit from knowing how the DAACs are working with the software that has been delivered so that team members can get their code running back at their respective labs.

In their discussions, MODLAND reached no conclusions on the DAAC recompetition. MODLAND has relationships with both EDC and the GSFC DAAC. The possibility of an early EOS AM-1 launch was a surprise and a concern to the Land Group.

<u>4.3.1 Action Items</u>

1. *MODLAND*: Determine the MODIS product requirements from the EOS IDS teams.
2. *Strahler and Huete*: Provide aircraft support funding to Forrest Hall for BOREAS.
3. *Running*: Present Climate Modelers' recommendations, summarized by Sellers, to the IWG Land panel.
4. *Justice*: Draft an outline of the land post-launch validation plan for MODLAND by mid-December.
5. *Fleig*: Assist MODLAND with the first part of the MODIS Validation Plan.
6. *Huete*: Coordinate a MODLAND proposal in response to the AO for GLI.
7. *Strahler and Justice*: Forward MODLAND's inputs to the design of a follow-on MODIS to SBRC.

4.4 Calibration Discipline Group Report

Stuart Biggar, U. of Arizona, reported on the Calibration Group's meeting with the Japanese to discuss calibration issues. He asked how close a working relationship does MODIS want with the GLI team?

Biggar stated that the infrared calibration review at the University of Wisconsin-Madison went well. Menzel agreed, adding that his concerns about infrared calibration have diminished appreciably due to the reviews. Biggar reminded the Team that there are two more calibration reviews planned, and that any Science Team member is encouraged to attend.

Biggar stated that he and Phil Slater are advising MCST in their development of the new Level 1B ATBD. They also contributed to MCST's version 2.0 MODIS Calibration Plan. Additionally, they are working on cooperative experiments with the ASTER and MISR teams for calibration and validation.

Biggar showed a list of calibration action items (see Attachments 33).

4.5 Closing Remarks

Prior to the conclusion of the MODIS Science Interest Group discussions, Masuoka presented SDST's list of action items (see Attachment 34).

Salomonson recognized the team's focus on the transient response issues and said he appreciated their comments. He agreed that the team may want to consider developing a software correction research product for Level 1B data. Salomonson said the team must also continue to focus on validation planning.

He congratulated the team on meeting its beta software delivery deadlines, and proffered that the team must not fall behind on subsequent software delivery deadlines.

Salomonson observed that a "new technology" MODIS seems imminent and encouraged the Science Team to help guide its development.

He announced that the next MODIS Science Team Meeting is tentatively scheduled for May 1 - 3, 1996.