MODIS SCIENCE TEAM MEETING

MINUTES

24 -26 SEPTEMBER, 1990

NASA/Goddard Space Flight Center

Greenbelt, Maryland

MODIS SCIENCE TEAM MEETING

25 - 26 September, 1990

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List of Attachments

Those attachments which were distributed at the meeting or are fully described herein are *not* attached to these Minutes; they are available from archive by contacting Harold Oseroff, Code 920, NASA/Goddard Space Flight Center, Greenbelt, MD 20771; Tel: (301) 286-9538.

P 1: MODIS-N Summary ---------- (Distributed at Meeting)
P 2: MODIS-T Status ---------- (Distributed at Meeting)
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MODIS MEETING ATTENDEES

ABBOTT, MARK
ABEL, PETER
ACKERMAN, STEVE
ANDREWS, MIKE
ARDANUY, PHIL
BANDEEN, BILL
BARKER, JOHN
BARNES, WILLIAM
BARNSLEY, MIKE
BARTON, IAN
BASS, BILL
BIGGAR, STUART
BLAISDELL, JOHN
BROWN, OTIS
BROWNE, ROBERT
BUSALACCI, TONY
BUTLER, JIM
CARDER, KENDALL
CARNEGGIE, DAVID
CASE, DAVID
CHANG, HYO D.
CLARK, DENNIS
CONBOY, BARBARA
DONOHOE, MARTIN
DOZIER, JEFF
EICHHORN, BILL
ESAIAS, WAYNE
EVANS, ROBERT
FLEIG, AL
GATLIN, JIM
GOFF, THOMAS
GORDON, HOWARD
GREG, WATSON
GREENSTONE, REYNOLD
GUENTHER, BRUCE
HALL, DOROTHY
HAN, DAESOO
HARDING, LARRY
HARNDEN, JOANN
HEATHERINGTON, SAMUEL
HOGE, FRANK
HOYT, DOUG
HUEGEL, FRED
HUETE, ALFREDO
HUNT, RAY
HURLEY, ED
JUSTICE, CHRISTOPHER
KATZ, ROBERT
KAUFMAN, YOURAM
KING, MICHAEL
KOUVARIS, LOUIS
KRISHMAN, RAVI
KUMAR, RAVI
KYLE, LEE
LEWIS, MARLON
LINDSAY, JOHN
LU, YUN-CHI
MACKIE, MARIA
MAGNER, TOM
MAREBOYANA, MANOHAR
MAYMON, PETER
MCCLAIN, CHARLES
McDONALD, MAC
McKAY, AL
MECHERIKUNNEL, ANN
MENTZEL, SUSAN
MITCHELL, GREG
MULLER, JAN-PETER
NEECK, STEVEN
OSEROFF, HAROLD
OSTROW, HARVEY
PARSLOW, JOHN
PETERSON, ROBERT
RAMAPRIYAN, H
RESSLER, JERRY
REXRODE, LISA
RIGGS, GEORGE
ROBERTO, MIKE
SAFFRIN, HARVEY
SALOMONSON, VINCENT
SCOTT, STAN
SCHOLS, JACK
SLATER, PHIL
SMITH, JAMES
SOFFEN, GERALD
STRAHLER, ALAN
STUART, LOCKE
SUSSKIND, JOEL
TANRE, DIDIER
TEILLET, PHIL
THOMPSON, LES
TILTON, JAMES
TOWNSEND, JOHN
VANDERBILT, VERN
WAN, ZHENGMING
WEBER, RICHARD
WHARTON, STEPHEN
WICKLAND, DIANE
WILLIAMS, DAVID
WILLIAMS, DARREL
WOLFORD, TOM
ZUKOR, DOROTHY

MODIS SCIENCE TEAM MEETING: SEP 24 TO 26, 1990

PLENARY SESSION

WELCOME AND MODIS STATUS REVIEW

V. Salomonson chaired the meeting. He said that in spite of procurement and programmatic problems, he expects MODIS-N and -T to be funded. MODIS is a key instrument on the EOS platform. About 90 people attended some or all of the meeting sessions.

Coverage Included in Minutes: Only comments are given here on subjects which are well documented in the handouts distributed during the meeting, to economize on the length of the minutes.

IWG Meeting: V. Salomonson said that the IWG meeting will be held at NASA/Langley, Nov. 6 -8. MODIS team members may want to attend since many of the issues discussed at the Payload Advisory Panel will be further discussed there. On Nov. 7, there will be presentations on Platform-A instruments; which may be of interest to team members. V. Salomonson will give a 25 minute presentation on MODIS.

Data Products: There are more than 2200 data products in the EOSDIS data base. The team members responsible for producing MODIS Data Products and the IDS experimenters should come to an understanding (during the next two months) so that the data products will satisfy the IDS requirements.

Funding: V. Salomonson said that funding is substantially reduced for MST members for FY 91. He hopes that funding will be considerably increased in FY 92 and beyond.

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MODIS-N SUMMARY

W. Barnes gave a summary of MODIS-N including design status, characteristics, spectral bands & and performance drivers. He said that the only recommended descope option was to reduce the spatial resolution of MODIS-N pixels to 250, 500 and 1000 m. J. Dozier said that he does not expect any other descope options to be exercised unless MODIS costs increase substantially over current expectations.

W. Barnes said that due to the Phase-B contract terms and SEB sensitivity, there was no CDCR (Conceptual Design and Cost Review) technical evaluation. The technical evaluation will be performed by the SEB after receipt of the proposals. The GSFC team is doing CDCR evaluation based on Phase-B reports. (Attachment P1 was distributed at the meeting.)

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MODIS-T STATUS

MODIS-T Status Summary: A half scale model of MODIS-T was displayed by W. Browne and T. Magner. This model was used during the presentation to illustrate MODIS-T components, optics, mechanisms etc. Incorporation of composite mode (single imaging mode, single integration time = 1.13 ms; ocean gain = 6.1 times land gain; auto gain control depending on whether a pixel is land or water) into the bands was emphasized. The CDCR Instrument evaluation resulted in the following ratings: Technical = Acceptable; Risk = Moderate; Management = Good. The Execution Phase management plan for the instrument has been approved by T. Huber (Code 700) and V. Salomonson (Code 900). NASA/HQ presented the details and status of MODIS-T to J. Alexander and OSSA (Office of Space Science and Applications) Steering Committee. J. Alexander presented these results to L. Fisk, who has not yet formally selected the instrument. There is continuing discussion emphasizing addressing the need for MODIS-T, since MERIS does not have tilt capability. MERIS has been designed for coastal, high latitude targets (Europe) where sun glint is not a problem. With MERIS, there is expected to be 35 % data loss due to sun glint. It will need more than 12 days for global coverage in the tropics. (Attachments P-2 and P2A were distributed at the meeting.)

Calibration Contamination Study for MODIS-T: T. Magner gave a brief overview of the calibration contamination study conducted by Code 730 for MODIS-T. They studied the effect of nonuniform coatings of contamination deposited on the mirror over a long term (five years), at different scan angles, and the consequent effect on system calibration.

A study of change in sun angle, Beta, with time including platform drift in the proposed EOS orbit has also been performed in conjunction with the solar diffuser design studies.

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EOS STATUS, SCHEDULE, MODIS RESPONSIBILITIES & FUNDING

Key Meetings/Presentations: J. Dozier gave dates for the following important EOS meetings/presentations:
Payload Advisory Panel Meeting: 28 - 30 August, 1990
NASA/HQ Code S Retreat(Earth Sciences Div.):6 to 9 Sep.,1990
Presentations to L. Fisk = Sep. 20, 26 etc., 1990
Presentations to Truly = ? (To be scheduled)
Approved Budget from Congress: ? (hopefully soon)
Payload Announcement: ? (date unknown)

(J. Dozier hopes that all of the above events would have occurred before the IWG meeting.)
EOS IWG Meeting: 6 - 9 November, 1990
Official Version of MODIS-N Phase C/D Specifications: January, 1991
EOSDIS Contract Award : May 1992 ?

EOS-A Payload: J.Dozier said that the Payload Advisory Panel recommended MODIS-N to be on EOS-A; MODIS-T should also be on EOS-A but its need should be justified, since MERIS will be on the ESA platform. He said that in the core payload there may be some changes, including some space physics instruments.

If the High Resolution Imaging Spectrometer (HIRIS) is not on the EOS-A platform, MST members may be able to substitute ITIR (Intermediate Thermal Infrared Radiometer) data, which will provide high spatial but not high spectral resolution. ITIR has similar bands to TM (Thematic Mapper), except the blue band, but has a swath of only 60 km. In this case, funding for a "surface truth" aircraft program, including AVIRIS data, will increase to help people needing high spatial and spectral resolution data. M. Abbott said that initially there was a possibility of having only 2 identical HIRIS instruments instead of 3 to save money. J. Dozier said that does not save much money. (Attachment P3 was distributed at the meeting.)

MODIS Budget: J.Dozier reported that the FY 91 budget for MODIS is constrained, but he was optimistic that it will increase considerably in the future years. He wants to understand in more detail and depth the justifications for ship time, buoy measurements and the MOTCF (MODIS Ocean Team Computing Facility). He said that ship time, buoy time, aircraft time and their expected funding sources should be clearly stated in the proposals. (He pointed out that less than 10 percent of the EOS data will be validated.) M. Lewis said that, although NASA has not paid for ship time in the past, there is possibly now more flexibility. J. Dozier emphasized that all users of EOS data should get their data from EOSDIS. All EOS data and products will be available to all users and there will be no period of exclusive access to data by any group.

Comments About MODIS Ocean Team (MOT) and MST Funding: J. Dozier said that the MOT should give him a brief summary and justification of the ship requirements, buoy requirements and MOTCF. He is under considerable pressure to defend every part of the EOS budget. H. Gordon said that the most economical way of developing software for the MOT is having MOTCF, i.e., if each MOT member had to understand the EOSDIS interfaces, they would need to hire software engineers. M. Lewis emphasized that the Ocean Discipline Group is planning to do more of the software steps, which had been outlined by

A. Fleig, than the other discipline groups, thus increasing their cost. MST is the largest team among all EOS Facility Instrument Teams; justification in defense of its budget is important. O. Brown and W. Esaias said that this is the first time they have gotten any feedback from the EOS Project Office about funding of their proposals. J. Dozier said that funding for science and algorithm development cannot be separated realistically.

Grants Versus Contracts: K. Carder emphasized that most team members get their funding from grants as opposed to contracts. In the contracts, the MST members have to commit in writing to produce certain products and meet the milestone schedules for these products. They do not know the EOSDIS interfaces and architecture; and feel uncomfortable in signing the contract. H. Gordon said that contracts require a lot more reporting of technical and financial information, taking away a significant portion of his, and his secretary's, time. V. Salomonson said that some of the reporting requirements have been relaxed, i.e., financial 533 reports are required quarterly instead of monthly for the MST members. J. Dozier said the contracts vehicle (as opposed to grants) is needed since the EOS schedule is extremely tight, including delivery of a large number of data products. A grant cannot easily handle partial funding, whereas a contract can. In addition, a grant can not be given for a long period of time like 10 years.

EOSDIS Schedule: If the EOS launch slips to December '98, then all of the associated schedules including development of algorithms will slip correspondingly. M. Abbott said that there is a problem in that some of the ship cruises cannot be postponed. Such a large complex system like EOSDIS and long term (about a decade) planning & corresponding funding has never been done before by NASA.

EOS Data Acquisition & Processing: J. Dozier said that EOS will acquire about 2 terabytes of data per day. If a data product is used widely, it will be produced routinely. On the other hand, limited use data products will be produced on demand. As far as improvements in technology over the next decade, he expects considerable improvements in ground data processing - -improved networks, higher speed, increased data rate for easy access to data, improved software programs etc., but not as significant an improvement in on-board (platform) data processing. The algorithms will be reviewed by "internal" peer review groups. J-P. Muller said that simulated data should be used for testing the algorithms. O. Brown commented that algorithms tested on simulated data will obviously also have to be tested on real data. (For further details see Attachment P4--attached.)

Software Development at TLCF (Team Leader Computing Facility): J-P. Muller said that some MST members are not planning to complete all the steps of software development outlined by A. Fleig. In addition, foreign MST members are not funded by NASA and may not have sufficient funding from their respective governments to complete the s/w development for their products. He wants to know if TLCF will have sufficient resources to complete the steps of software development requested by US and foreign members. V. Salomonson said that there is some limited flexibility (resources) in the TLCF to complete the steps.

Also, J-P. Muller said that it is difficult to get commitment for funding from UK for a long term (about a decade). J. Dozier said that NASA/HQ and the EOS Project Office will help in trying to get cooperation in funding commitments from foreign governments.

Standard Products Versus Special Products: C. Justice said that definitions of the standard and special products need to be clarified.

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PROPOSAL FUNDING AND IMPLEMENTATION

Funding for Current Year: L. Stuart said that next year's contract (approximately Dec. 15, 1990 through Dec. 15, 1991) will be similar to last year's contract but not as financially austere. MST members will probably get $5,000 each between now and Dec. 15 to complete funding on this year's contract. That sum will be subtracted from the amount they receive next year. The worst case scenario is that they will receive no money until after the end of this calender year, i.e., if the money comes in the first quarter of FY 1991, it will take some time to do the paper work before money can be sent to the MST members. In this case, NASA may request a no cost extension to current contracts to maintain continuity. Unfortunately, NASA cannot authorize MST members to spend money until they actually receive authority to do so. About half of the MST members responded to the request for suggested FY 91 tasks, and those provisions have been incorporated into their generic statement of work. Due to the current tight budget, MST members will be mainly able to attend MST meetings, update data product tables, do modest field experimentation or instrument development, purchase a limited amount of hardware or software, address the method and extent of algorithm development, and write a final technical report of 5 to 10 pages; there will not be much progress in actual algorithm development. If there are any major expenditures, including purchasing hardware, which require moving budgeted funds around, team members should inform L. Stuart or H. Oseroff. R. Evans said that it will be helpful if NASA can

send a letter stating clearly that no paper work is required for changes to what is stated in the budget. Without this letter, team members have to do paper work for making any minor budgetary changes. The request for revised cost proposals will come out shortly. US MST members should respond to this request as soon as possible so that they can get their money quickly. Foreign MST members do not need to send financial reports or a revised cost proposal since they are not being funded by NASA. (Attachment P5 was distributed at the meeting.)

J-P. Muller asked if NASA aircraft can be used to acquire data in Britain and other areas. L. Stuart said that the if the NASA aircraft was planning to fly over Britain anyway, it may be able to take requested data. However, J.-P. Muller will need to submit such requests to NASA Headquarters.

Funding for Future Years: Assuming sufficient funding is available after Dec. 15, 1991, a long term "Execution Phase" contract for about a decade will be negotiated, subject to yearly revisions based on budgetary vicissitudes.

Copies of Technical Proposals to Contractors: MST members generally agreed that copies of their technical proposals may be used by NASA-approved contractors to determine algorithm development requirements and data system interfaces. A.Fleig will develop the following procedure:

Prepare a list of names of contractors who need copies of certain MODIS technical proposals. Keep a record of their names and corresponding technical proposals received by them. If any MST member does not agree with this procedure, he should contact A. Fleig indicating his objections.

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EOSDIS SOFTWARE STANDARDS

A. Fleig said that in about a month an electronic bulletin board based on Unix will be available. It will be available through any of the major electronic mail networks. Unless you tell A. Fleig otherwise, your first initial and last name will be used to set up access.

EOS Data Products: A. Fleig said that there are about 2200 input and output data products tabulated for EOS. Each data product could have its own data format, which would give rise to a very large number of formats. It is difficult to develop algorithms for the data products because EOSDIS has not yet specified its architecture. He showed a preliminary version of a report on "Scientific Software Standards for EOS" to be released on Oct. 1. Criteria of a good format are easy access, storage efficiency, easy conversion from

one format to another, ability to sebset, etc. Any suggestions about format or software standards should be given to A. Fleig. There is a meeting of system engineers on November 15 to discuss issues like this including the format of DAAC (Distributed Active Archive Center). Persons who have a strong interest can be included in the mailing list. Any software copyrighted by an organization should be purchasable at a reasonable price.

M. Abbott said that sometimes it is useful to have a specified environment and a translator which can translate into a new format, as well as expand. J. Barker said that one possibility is to have a very flexible system where the header specifies the format and the system should be able to read this format.

EOSDIS Milestone Schedule: A. Fleig said that the schedule should be consistent with the resources available. Since the budget for the current year is tight, he will try to get the schedule changed by the EOS Project and NASA/HQ.

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MODIS LEVEL-1 PROCESSING SYSTEM DESIGN

D. Han gave an overview of "MODIS Level-1 Processing System Design" including design methodology, design features, input data requirements, platform ancillary data required for the MODIS Data System, geolocation error sources for MODIS at nadir, Level 1A and 1B functions and data, other output products and questions on Levels-1A and -1B. He clarified that the role of the Science Data Support Team is strictly software development and data processing, and not "Science", and thus does not overlap with the MST activities.

Earth Location: There was much discussion on computing earth locations at anchor points (less than 1% of data) and then interpolating in between anchor points with errors of less than 10 m, without considering any topographic information. (This is discussed in further detail in the Ocean Discipline Group meeting.) D. Han clarified that topographic corrections (DEM/DTM) are not applied to the level 1 data. A particular spheroid for representing the Earth (Clark 1866, International Spheroid, etc.) has not been decided yet. If better earth location accuracy is needed, D. Han should be told.

Number of Level 1B Products: D. Han said that the current plan is to produce only one set of Level 1B data. R. Evans said that to achieve high accuracies for the data products of atmosphere, land and oceans, there will be a need to apply different sets of calibration coefficients based on radiative transfer equations, solar & lunar calibration, instrument calibration etc. This problem was discussed in

detail in discipline group meetings. (Attachment P6 was distributed at the meeting.)

Platform Ancillary Data: O. Brown said that there should be specifications on pitch, roll, yaw, and velocities in the x, y and z directions.

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IMPACT OF MISREGISTRATION ON CHANGE DETECTION

J. Townshend gave this presentation, including the crucial role of MODIS in global change in land surfaces. Effective global change detection requires high spatial resolution, calibration accuracy and registration accuracy. He summarized his results as follows: (1) There is a rapid increase in 'noise' (or error) for even small registration errors; (2) compared with real changes in NDVI, the 'noise' can become overwhelming even for small misregistrations; (3) registration accuracy of 0.2 pixel or better is highly desirable; (4) for global change, ground control points cannot be used from a practical point of view to achieve this registration accuracy as it will involve a tremendous amount of resources (i.e., using computer intensive autocorrelation or some similar algorithm for registration). O. Brown said that to achieve a high subpixel accuracy of 0.1 pixel, high quality HIRIS or a similar data set will be needed. It was mentioned that, in the case of Thematic Mapper (TM) data, classification accuracy increased significantly with increased registration accuracy. He said that the land discipline group should indicate quantitatively their registration accuracy requirements. C. Justice said that he would advocate an overall end-to-end system test to determine overall system accuracy taking into account registration errors, S/N ratios, earth location errors, etc. (Attachment P7 was distributed at the meeting.)

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INSTRUMENT PERFORMANCE CHARACTERIZATION/ CALIBRATION

J. Barker and P. Slater gave a presentation on Instrument Performance Characterization/Calibration activity by the MCST (MODIS Characterization Support Team). The topics included MCST overview, reports, characterization/ calibration, Level-1 products, activities by phase, product sensitivity to calibration, utility products, program elements, MODIS scenarios, and conclusions on calibration. J. Barker showed the organizational relationship of the MCST to the MODIS Science Team, and MCST to the EOS/MODIS Project Team. The presentation covered a large number of problems, studies and issues. J.Barker gave the following priorities for the MCST work: Primary: Instrument-related system

characterization/calibration. Secondary: Cooperative Team Member-MCST discipline-related product sensitivity to calibration. Tertiary: Utility products. He gave the following MODIS calibration challenges and concerns:

Instrument Related: (1) Methodology for pre-launch to on-orbit transfer of standards; (2) Methodology for creating (a) "Quick-Look" data flags; (b) Separate data streams for full data and partial data; (3) Contamination of primary mirrors and/or detectors; (4) Launching protoflight models, wherein they are not available for follow-up calibration tests.

Calibration-Related: (1) Methodology for cross-calibration at vendor; (2) Spacecraft-level end-to-end performance tests; (3) Time to return instruments to vendors after initial integration; (4) Single orbit MODIS-N data substitution into MODIS-T gap; (5) Verification of solar calibration methodology; (6) Verification of lunar calibration methodology; (7) Multi-orbit, multi-date reflectance calibration.

Data Related: (1) Common computer hardware and software interfaces; (2) Efficient direct near-real time MCST access to: (a) all MODIS data; (b) selected raw data from other sensors; (3) Simulation of three days of MODIS data; (4) Early requirement for algorithm delivery (December '94); (5) Documentation overload.

(Attachments P8 and P8A were distributed at the meeting.)

MODIS SCIENCE TEAM MEETING
25 - 26 September, 1990
LAND DISCIPLINE GROUP
MINUTES

ATTENDEES: C. Justice (Group Leader), A. Huete, R. Hunt, V. Vanderbilt, D. Hall, J. -P. Muller, M. Barnsley, A. Strahler, J. Townshend, D. Toll (Executive Secretary), D. Carneggie (USGS/EDC; Land DAAC), P. Tiellet (Canada Centre for Remote Sensing).

Note: At the request of the Group Leader, C. Justice, these minutes only include those points that were chosen to be included at his discretion, and do not attempt to reflect the extensive discussions held in the Group Meeting. These minutes therefore represent only a small portion of the total discussion.

MODIS PRODUCT DESIGNATIONS

TUESDAY, 25 SEPTEMBER, 1990

* Y. Kaufman noted that the atmospheric correction on surface reflectance derivation is more accurate than for land leaving radiance. There is a need for an internal working group to resolve the MODIS at-launch land leaving radiance description (Group: Tanre, Kaufman, Strahler, and Muller)

* Y. Kaufman emphasized the need for a MODIS simulator. Also AVIRIS data are needed for spectral related studies. (He may want to define an extra wavelength on MODIS.)

* Wan indicated that 3.7μm may saturate over land fires. The sensitivity of the high gain is an important issue (3.7μm and 11.0μm). The 3.7μm response function needs to be held at specification, and should be similar to other thermal band response functions.

* Ian Barton gave a brief presentation on the Along Track Surface Radiometer (ATSR) on ERS-1 and ERS-2. The sensor has 4 bands at 1.6μm, 3.7μm, 10.8μm, and 11.9μm, with a 1 km grid size, a 20° scan angle, and a 52° forward scan. The research goal is to derive surface emissivity estimates.

* Tanre suggested that incident photosynthetically active radiation (IPAR) should be considered an at-launch product.

* J. Dozier indicated a need to have the MODIS Land Group produce topographic related definitions, and not to define topographic acquisitions. In addition, he needs background information in an attempt to have DMA declassify topographic data. Dozier also indicated that aircraft support will be part of the EOS budget, and not part of case studies.

* P. Slater needs the land-related specifications for band-to-band registration, subpixel registration, resampling with a scanning mechanism, requirement changes with viewing geometry changes, etc.

* J. Barker needs inputs ASAP on any calibration-related requests.

* R. Hunt recommended net primary productivity (NPP - daily), evapotranspiration (daily), and attenuation of photosynthetically active radiation (APAR) could all become at-launch products. Leaf area index (LAI) should remain a post-launch product.

* D. Han indicated that EOSDIS can purchase simulator data to support MODIS-related work. This includes Landsat Thematic Mapper (TM) and SPOT High Resolution - Visible (HRV) data. The team should come up with a summary of their collective needs.

* A need was indicated by the Land Group to degrade TM and/or AVIRIS data using the MODIS system modulation transfer function (MTF) to simulate MODIS-N spatial resolution. They thought MCST (Barker) could pursue this procedure for the group.

* No geographic information system (GIS) is incorporated into EOSDIS. The group (especially R. Hunt) indicated a need for a GIS, handling different data integrations, with the capability to integrate formats in addition to raster data (e.g., polygonal data).

* The MODIS at-launch products cloud mask/shadow, subpixel cloud effects, terrain correction, spatial heterogeneity, and atmospheric correction all should be "Utility Algorithms". The post-launch products terrain correction and bidirectional reflectance distribution function (BRDF) correction to radiance also should be "Utility Algorithms". The team will be expected to support the Science Data Support Team's development of these algorithms.

WEDNESDAY, 26 SEPTEMBER, 1990

* C. Justice suggested that the processing design chain of events is still needed for each MODIS product. Each PI should define his georeferencing, atmospheric correction, and EOS and non-EOS data requirements.

* D. Carneggie gave a presentation on the USGS Global Land Information Service and their plans as a Land DAAC in support of MODIS. It is important to note that approximately 100,000 1978-1984 Landsat scenes are scheduled to be converted for preservation by 1994 from high-density tape to a more permanent storage device (e.g., cartridge). In addition, 400,000 pre-1978 wideband formatted Landsat scenes may be preserved. These are all scenes which have been collected, but not yet converted to a user format.

* D. Carneggie said that the most recent thinking is that the EDC DAAC will archive and distribute Level 2 data. The EDC Land DAAC will also process Level 3 and 4 data. Version 0 plans by EDC also include archiving and processing of AVIRIS and TIMS data. AVHRR LAC products will be generated and distributed.

  - Muller expressed a strong need for ASAS data. V. Salomonson recommended an attempt to work out data needs through Jim Irons (GSFC) and NASA HQ.

  - Al Fleig said that the MODIS Science Team should be permitted to use Level 2 data and other EOSDIS data at no charge, when used to develop and validate MODIS products. The MODIS products then would only be cleared for processing by the EDC DAAC after validation. V. Salomonson said that products should be verified in a "reasonable" time period (e.g., less than 1 year) and then released to the EDC DAAC for processing and distribution as a standard product. A. Fleig defined a "standard product" as a MODIS product that will be processed continuously over a period of time (e.g., daily to yearly), and a "special product" as one that only will be processed a set number of times, at probably irregular intervals.

* D. Carneggie concluded his presentation with an indication of EDC support for processing and archiving data such as AVIRIS, TIMS, AVHRR, MODIS simulator, and Landsat TM and MSS. He noted that much of the pre-1985 Landsat data may be obtained for the price of processing, plus a small "fee". The data are available to personnel working on government contracts (such as MODIS). In addition, Landsat data purchased through EDC instead of EOSAT is easier for government contractors to share (considering the EOSAT Trade Secret protection act). Further, EDC

can provide support for satellite data-related searches, TM data spatial degradation (to simulate MODIS data), and topographic data. EDC also expressed a willingness to host a MODIS Land Discipline Group meeting.

STRAHLER: "MODIS-T for LAND"

A. Strahler gave a presentation on MODIS-T related properties for land sensing. His talk was given concurrently to the Ocean and Land Groups. He summarized 2 important and unique attributes about MODIS-T as related to land: spectral and tilt characteristics. Attachments L 1 and L 2 address previous correspondence on the subject, and are attached. Attachment L 3 is described in these Minutes.

Spectral Characteristics: MODIS-T may be the only imaging spectrometer on Platform-A (if HIRIS is delayed). Further, MODIS-T is capable of short-term global coverage, whereas HIRIS, due to the fine spatial resolution, cannot be realistically processed at a global level. There were several land applications noted where fine spectral resolution may improve the accuracy of the algorithm: soil color (Huete), precision vegetative indices (Justice and Running), stress detection (blue shift of red edge), etc. He noted that the land spectral characteristics studies should be "non-conflicting" with ocean operation, now that MODIS-T will have a composite mode of operation.

Tilt Characteristics: Ability to collect off-nadir measurements allows assessment of 3-D surface structure. BRDF inference will lead to more accurate albedo estimates, etc. BRDF acquisition in a tilt mode generally conflicts with ocean use, except for limited areas in continental centers.

Strahler described BRDF as the radiance output for a given input irradiance. BRDF is a fundamental property of a surface; it is also spectrally dependent. He noted the importance of the "hotspot". The hotspot is the peak in radiance of a 3-D surface where the illumination and observation positions coincide (i.e., shadows are hidden), and hence the scene appears bright. The rate of fall-off is related to the shape of the projections. He presented modelled BRDFs, displayed as 3-D plots, with changes in the shape of the BRDF related to the structure of the canopy and the percent canopy cover.

He indicated that there are 2 ways to derive BRDF for a surface: 1) make lab measurements under conditions of unidirectional irradiance, with a unidirectional-derived radiance using a radiometer having a small field of view; 2) use an empirical model (e.g., 3 parameter model by Walthall, 8-10 parameter spherical harmonics, 6-8 parameter optimal fit directional

Kriging model, many-parameter least squares fit, or a deterministic model (e.g., modified Hapke model using 5 parameters, SAIL/Goel model for a leaf canopy with approximately 8 parameters, and Strahler tree model with 5 parameters). The fitting procedure to estimate the BRDF from the parameters implies an inversion procedure. He noted that the deterministic models may have physical meaning. Further, he indicated that more than one directional-derived reflectance does not make a BRDF. One string of directional measurements does not make a BRDF either, except in the case where the string goes through the hotspot, and the BRDF model is known to fit well. He also noted that the real-world fluxes of solar irradiances at the surface are hemispheric and directional (i.e., diffuse radiation in addition to direct solar radiation). Hence, the phrase "hemispheric-directional" is more accurate in describing measured radiances than using "bidirectional", unless the diffuse can be ignored.

Deriving a BRDF from space is constrained by the sun's position with respect to the platform velocity vector. This is a function of crossing time, latitude, and season. For fixed orbital paths in a 16 day repeat cycle, for MODIS-T each ground point is viewed by ≥8 orbits. Hence ≥8 "strings" are possible for each ground observation point, where a string represents a set of tilts for a single overpass.

Instrument characteristics were noted for MODIS-T: 50° fore-aft tilt, ±45° side-to-side (scan). For MISR: cosine of surface viewing angles of 0.3, 0.5, 0.7, 0.9, 1.0 ..., width 27° @400 km. For HIRIS: +60° to -30° tilt, ±45° scan. Strahler noted that to sense hotspots regularly over the globe, a special orbit would be needed.

Next, he showed how a tree-canopy BRDF could be sensed by MODIS, HIRIS, and MISR. He noted that, because MISR does not have the swath width of MODIS-T, there is much smaller likelihood of sensing the hotspot. Further, a much larger portion of the BRDF may be sampled with MODIS-T. He demonstrated these points for an equatorial crossing, and again for a acquisition at 10 minutes past the equator (N36°). In the next vugraph he used Barnsley's work to depict the significant difference in BRDF sampling capabilities of MISR *versus* MODIS-T for a sampling period of 16 days during the vernal equinox in England. Inspection of the polar plot indicated the sampling frequency is approximately 10 times more extensive with MODIS-T than with MISR. He concluded that MISR is not the answer for accurate retrieval of fully parameterized BRDFs; MODIS-T appears to be the only EOS answer.

An Ocean Group member indicated that the Barnsley data in the polar plot described above is likely incorrect; however Muller suggested that the data are correct, based on a discussion which he had with the MISR PI, D. Diner.

Salomonson said that, in his opinion, MISR, due to its continuous acquisition mode, is the primary input instrument for BRDF. The coverage and capability of MISR is complemented by MODIS-T and HIRIS, for different reasons in each case.

Strahler posed the question of whether global BRDFs can be estimated from MODIS-T. He then attempted to provide an answer through an example. He presented a chart showing the trade-off between the number of tilt positions and area covered, observing that with fewer tilts a much larger area can be covered. In an example of a $20X10^6$ km^2 area (e.g., South America) at 40° latitude, and a 40° longitude width, the area could be covered in 21 orbits, with 26 available orbits in a 16 day cycle. However, he noted that if 3-4 strings are needed per ground point, and there is a decrease in the number of strings available due to cloud cover, then the coverage needed for a quarter continental area would need to be increased from a 16 day cycle to a 32 day cycle. Strahler noted that due to sun angle and plant phenology changes, a 32 day cycle may confound BRDF measurements. In this scenario, Strahler assumed a rectangular area for the tilt, scan. This was pointed out by Esaias to be in error due to the projected curvature of the scan swath, that is more pronounced at high scan angles due to Earth curvature effects. (Strahler responds later that the difference in area is small when 6-8 scans are acquired for each tilt position, as would be the case for a global or regional BRDF mode.)

Strahler indicated that, in specifications giving exclusive ocean priority for tilting, the spectral work for land observations would be mostly supported. However, for BRDF work the data or test sites would be limited to deep continental interiors, excluding numerous land areas.

In a shared mode, such as one-quarter land and three-quarters ocean, Strahler emphasized that MODIS-N would provide the Ocean Group with data continuity for the most important products, as is the plan for MODIS-N to fill in the equatorial gap. He remarked that acquisitions may be changed dynamically to adjust for the weather.

In a latitudinal-based priority operations mode, Strahler suggested that perhaps the Ocean Group could use MODIS-T within ±32.5° solar declination, and MODIS-N at greater latitudes. In this scenario, MODIS-T data could be used by the Land Group to estimate BRDFs for the entire continents with improved spectral viewing. Esaias responded that, although use of MODIS-N is possible, MODIS-T will have a significantly higher signal-to-noise ratio in critical bands, and will provide much more accurate products. Further, there are daily global products, such as phycoerythrin concentration, that simply cannot be produced without MODIS-T.

MODIS SCIENCE TEAM MEETING: SEP 24 TO 26, 1990

OCEAN DISCIPLINE GROUP SESSION (SEP. 25 AND 26)

Comments About MODIS Ocean Team (MOT) and MST Funding: Dozier said that the MOT should give him a brief summary and justification of the ship requirements, buoy requirements, and MOTCF. He is under considerable pressure to defend every part of the EOS budget. The MST is the largest team among all EOS Facility Instrument Teams and thus needs more justification in defense of its budget. O. Brown and W. Esaias had said during the plenary session that this is the first time they have gotten any feedback from the EOS Project Office about funding of their proposals.

Write-Up for Justification of MOT Funding: J. Dozier said that he needs a brief (about one page) write up for justification of validation of algorithms, ship time, buoy time and MOTCF. He wants to understand these justifications well so that he can accurately present these to NASA/HQ. One basic question is how extensive a validation is needed in order to have confidence in the algorithms.

MOT Validation Funding: O. Brown said that other disciplines have grossly underestimated their budgets. The budgets being requested by MOT is a bare minimum to perform the work. For example, the number of buoys needed for validation results to be statistically significant is an order of magnitude more than requested in the proposal.

Funding for Ship Measurements: D. Clark said that it is difficult to give details of validation since the Execution Phase Proposals were limited to about 20 pages. He said that he cannot go to other agencies like NSF (National Science Foundation), NOAA, etc. to get such a large amount of ship time needed for validating ocean data products. Thus, NASA/HQ needs to either arrange ship time through another agency or pay for ship time in the MODIS funding. W. Esaias said that MOT is not prepared to sign the contract for Execution Phase without commitment from NASA for adequate ship time. J. Dozier said that if NASA had owned ships, it would be easier to get ship time. M. Lewis said that there is a need for dedicated ship cruises to go to specific places at specific times. W. Esaias pointed out that DOE, mother agency with no ships but strong oceanographic program, funds P.I.'s for ship time on UNDLS vessels, and that NASA funded ship time for the Nimbus CZCS Net Team.

AVHRR and ATSR Data for Validation: O. Brown said that Tucker et. al. will produce AVHRR data for validation in the infrared (IR). He wants to know how to get ATSR (Along Track Scanning Radiometer) data. A good computing facility--the MOTCF--is needed in 1992 - 93 and not in 1996.

MOT Validation By Foreign Investigators: J. Parslow gave an overview of the field program, although this will not be funded by NASA, because it does not fund the foreign investigators. He said that he will participate in JGOFS, WOCE (World Ocean Circulation Experiment) and TOGA (Tropical Oceans Global Atmosphere) campaigns to get data (in-situ optical measurements, phytoplankton pigments and physical oceanographic measurements including sea surface temperature) in the southern oceans, equatorial Pacific, and tropical oceans.

Funding for Aircraft Data: J. Dozier said that the proposal should include the required funding for aircraft data and give details like the type of aircraft needed.

MOT Algorithm Development Funding: H. Gordon said that the most economical way of developing software for the MOT is through the MOTCF; i.e., if each MOT member had to understand the EOSDIS interfaces, they will need to hire software engineers. M. Lewis emphasized that the ocean discipline group is planning to do more of the software steps, which had been outlined by A. Fleig, than the other discipline groups, thus increasing their cost. Thus, performing some of those software steps in the TLCF (Team Leader Computing Facility) will not save any money. M. Abbott said that there is no funding for inter-sensor algorithm development. For example, IDS (Interdisciplinary Science) investigators will be producing many inter-sensor products. A. Fleig said that such inter-sensor products should be encouraged, listed in the list of EOS products and investigators/team members should try to get funding.

Data Products in JPL's Data Base: A. Fleig said that he went through the entire ocean data products list generated by the JPL. M. Abbott said that there are 42 sea surface data products. This list was distributed during the meeting. A. Fleig and Y. Lu will compare this list with the Goddard data base and find the corresponding product numbers in their data base. There are only about 20 products in the Goddard list related to physical oceanography.

Changes to the Data Product Tables: W. Esaias wanted to know why the standard data products are under configuration control nine years before launch, requiring reasons for all changes need to be given. A. Fleig said that the Project Office insists on this. Sufficient reason might be simply that the change will produce better results.

A. Fleig said that any input EOS and Non-EOS products, whether funded by NASA or not, should be clearly indicted in the data product tables. More information is always better.

MOT Funding and Schedule: M. Abbott said it is difficult to give precise details of the precise funding requirements since the EOS launch schedule is not firm yet.

MOT Computing Facility (MOTCF): W. Esaias said that the ocean data products are interrelated and thus a central computing facility is needed. R. Evans said that it is important to spend money now for MOTCF so that we will be able to deal with terabytes of EOS data. J. Dozier said that if EOSDIS is to be functional and successful, everybody has to order data only through EOSDIS; i.e., MOTCF is only for development of algorithms and not for routine archive and distribution. All data sets developed including validation data sets will be available through EOSDIS. He stated his concern that the MOTCF will provide a "back door" to data for oceans.

R. Evans said that his Execution Phase proposal states very clearly, " The MOTCF will be used to compute and track MODIS calibration, establish a sensor calibration and in-situ data base, develop product algorithms, evaluate new and existing algorithms using in-situ cruise and mooring data, and provide a computing platform for radiative simulations.". He made it very clear that MOTCF will not be a provider or distributor of products.

J. Dozier said that it is not illegal to produce a standard product at MOTCF but it should be archived in DAAC (Distributed Active Archive Center) for its accessibility & distribution to others. In addition, A. Fleig said that if a data product produced by an algorithm is not frequently used, then it can be put in MOTCF. However, if MOT receives a large number of requests for this product, then it should be put into EOSDIS. O. Brown said that one advantage of getting data sets directly from MOTCF is that he can get matched and merged data sets of level 0 and higher levels of standard and non-standard (research) products. In addition, J. Parslow said that MOTCF may have a more recent version of some of the products since they will be trying to improve and update their algorithms.

J. Dozier said that the question is: how big a MOTCF is needed? R. Evans said that the size of MOTCF is based on their experience with CZCS (Coastal Zone Color Scanner) data. Similarly, one can estimate computing facilities for global processing of AVHRR and SeaWiFS data. Of course, due to rapidly evolving computer technology and prices of computers, it is extremely difficult to estimate such costs.

EOSDIS Level 0: In 1994, for testing EOSDIS level 0, computational needs will grow to terabytes. It will be a real challenge to bring a team of investigators together to resolve the issues related to this subject. O. Brown said (and A. Fleig agreed) that the EOSDIS schedule is not

consistent with the funding. M. Abbott said that he worked with 2 IDS (Interdisciplinary Science) persons and there are no good reasons for certain milestones at certain times. J. Dozier said that the schedule was similar to the one for UARS (Upper Atmosphere Research Satellite), where computer facilities were grossly undersized.

EOS Scientific Software Standards: During the Plenary Session A. Fleig showed a preliminary version of a report on "Scientific Software Standards for EOS" to be released on Oct. 1. Criteria of a good format are easy access, storage efficiency, easy conversion from one format to another, ability to sebset, etc. Any suggestions about format or software standards should be given to A. Fleig. There is a meeting of system engineers on Nov. 15 to discuss issues like this, including the format of DAAC. Persons who have a strong interest can be included in the mailing list. Any software copyrighted by an organization should be purchasable at a reasonable price. There was further discussion on this subject. O. Brown said that this is the first time they had heard of this report.

Development of DAAC: R. Evans said that there should be input from scientists in the development of DAAC. M. Abbott said that there has been very little input of scientists in DAAC development. V. Salomonson said that scientists have to continually try to give their input and keep science up front. A. Fleig said that the DAACs were selected in close connection with the user community. J. Dozier said that there should be enough money for development of DAAC, and money allotted for Science should not be used for that purpose. He said that the Science Advisory Panel has not exercised much oversight of this matter; they have been very busy with contractor selection. After the EOSDIS Phase C/D contract has been awarded, they will have more time to investigate this matter. R. Evans said that it will be useful to provide the names of people working DAAC and further details of the areas of their work so that science input can be given to them. A. Fleig said that a bulletin board can be put in each DAAC.

BRDF for Ocean Applications Using MODIS-T: W. Esaias gave a one page summary on BRDF (Attachment L2). The Ocean and Land Groups will decide what additional study related to land/ocean coverage in the composite mode at different tilt angles, etc., should be completed by RDC (Research and Data Systems Corporation).

BRDF for Land Applications Using MODIS-T: There was a presentation on this subject by A. Strahler which is included in the minutes of Land Discipline Group.

IDS Requirements Versus MODIS Output Products: M. Abbott said that we should try to compare IDS requirements for

MODIS with the MODIS output products. Some compromises may be needed between IDS investigators and MST members so that MODIS output products can satisfy IDS requirements.

MCST RESPONSIBILITY RELATED TO OCEAN DISCIPLINE

Parametric Sensitivity Studies: J. Barker gave a presentation related to the responsibilities of the MCST related to the Ocean Discipline Group. He said that three members of MOT--P. Slater, O. Brown and R. Evans--will work with MCST in conducting parametric sensitivity studies to estimate errors in the following data products:

Pre-Launch: Total Visible Radiances; Total Near-IR Radiances; Water-Leaving Visible Radiance; and Regional Sea Surface Temperature.

Post-Launch: Global Sea Surface Temperature; and data set calibration.

H. Gordon said that the discipline-related parametric sensitivity to calibration varies from one product to another. R. Evans wants to have specifications for the two blackbodies to be used for calibration.

Calibration in Field and Laboratory: O. Brown asked about the plan for thermal vacuum testing for calibration of MODIS. J. Barker said that, as of yet, no definite plans have been made for such a facility. P. Slater said that a detailed calibration test plan needs to be prepared. He and B. Guenther are planning to use panels and ultra stable portable radiometers for laboratory and field calibration--this is the responsibility of the calibration group. B. Guenther said that issues like this need to be addressed at a broader scale to the EOS Calibration Advisory Panel.

J. Barker said that there will be some money from the Project Office for calibration using the test data available by the MODIS-N contractor. The contractor will make sure that deliverables are EOSDIS-compatible.

MODIS-N Phase C/D/ Specifications: W. Barnes said that when the MODIS-N specifications are released, it will become public information. J. Barker suggested that, at that time, we should send these specifications to the team members. J. Barker said that it will be a lot of work to make sure that specifications like dark target in a bright field, and vice versa, are met.

Experience from Previous Instruments: J. Barker indicated that the experience gained from previous instruments like AVHRR, TM, MSS etc. will be quite useful for MODIS. He is a member of the Systems Design Review Team for GOES-I. From experience with GOES-I, lessons can be learned in the areas

of contamination, overshoot problems in imaging, need for detailed traceability of calibration, end-to-end system integration and testing, scan mirror and thermal gradient distortions. However, O. Brown said that there is no general agreement on the calibration and other parameters for NOAA-7, -8 & -9. So, it is difficult to transfer some of that knowledge directly to MODIS. B. Guenther said that with limited resources, we have to do high priority items and fulfill our MODIS obligations.

Calibrating Instruments with Same Standards: D. Clark said that he, and others, will be using instruments to perform in-situ measurements. He would like all of the instruments used for in-situ measurements to be calibrated with the same standard references used by the EOS calibration group, so that their measurements can be compared on a fair and equal basis. B. Guenther said that the current plan calls for such calibration of in-situ instruments in the wavelength region 0.4 to 2.5 um. He cannot at this time commit to doing similar calibration in the TIR (Thermal Infrared). NBS lamps can be sent to different facilities to pinpoint the differences in calibration.

Numerous Calibration Methods: J. Barker said that he will investigate different methods of calibration but there will be only one official method, and corresponding parameters, for each of the data products. The persons who want to use different calibration methods can apply coefficients of those methods to level 0 data.

Thermal Models: O. Brown wanted to know at what level of detail will the thermal models will be available for calibration of each instrument. J. Barker said that he had envisioned a very extensive system end-to-end model. The models to be used have not been determined yet. He will investigate what thermal models are available. J. Barker said that thermal (operating temperature etc.) sensitivity of the instrument is a major issue.

Post-Launch Validation: R. Evans said that he can give his plans for post-launch validation of algorithms after there is a consistent processing algorithm for calibration after launch. J. Barker said that historically after testing the system, it is turned into operational mode. B. Guenther likes to have continued early and frequent interactions on these and other calibration issues and requirements. For this reason, J. Barker suggested devoting a day before and after the next MST meeting for calibration-related issues. P. Slater said that it is very important to be able to obtain accurate calibration over the entire swath.

MODIS-T GLOBAL LAND COVERAGE SIMULATION

W. Gregg, Research Data Systems Corporation, presented the results of "Simulation of Global Coverage by MODIS-T" by W. Gregg, G. Riggs and P. Ardanuy, to examine the effects of the dual land/ocean gain mode. In this scenario, gain may be switched between scans (but not within scans) to be useful for either land observations or ocean observations, but not both simultaneously.

Method of Simulation: The EOS orbit (altitude 705 km), and scan characteristics of MODIS-T with a swath of 90 degrees and tilt angle up to 50 degrees was simulated. The "CZCS Tilt Strategy" was used for simulation of ocean coverage to avoid sun glint. The ocean mode was used if there were any pixels of oceans in the scan (even one pixel) and land mode if there were no ocean pixels in the scan. In the ocean mode, they found that 78% of the land can viewed over the course of 16 days. However, near coast lines, the satellite views land only at the highest scan angle. However, certain areas of the world are never viewed because they are too narrow to fill the scan completely, i.e., Northern Australia, India, Mexico, southern South America.

Simulation of Ocean Coverage: They have also simulated coverage of the ocean at a tilt angle of 50 degrees using the land mode if there were any pixels of land in the scan (even one pixel) and ocean mode if there were no land pixels in the scan. They found that only 88.6% of the ocean was viewed over a period of 16 days, a period considerably longer than required for oceans (2 days). Also, the coverage of coasts is not very useful because they were covered entirely at the scan edges (satellite zenith angle of 81 degrees). A copy of the their handout can be obtained from H. Oseroff, Code 920, NASA/GSFC, Greenbelt, MD20771. Tel: 301-286-9538.

Different Tilt Angles for BRDF Studies: O. Brown said that C. Justice mentioned that a low tilt angle of only + or - 20 degrees will not be useful for BRDF studies for land applications. H. Gordon said that for most ocean applications, the tilt is less than 20 degrees because of polarization specifications. J. Parslow said that at a tilt angle of 50 degrees, the pixel size is about 8 times larger than the center pixel at nadir.

Other Instruments for BRDF: MISR is an excellent instrument for doing global BRDF studies. However, J. Parslow said that it covers a narrow strip and does not always see the hot spot. Data from MISR and HIRIS will be available for doing BRDF studies.

General Comments about BRDF: There was a general consensus in MOT that the Land Discipline Group needs a detailed

proposed strategy (and its utility) for BRDF measurements. There is also interest in seasonal variations of BRDF for land applications. O. Brown said that MODIS-T has a limited utility for BRDF studies of the plant canopies, since their individual sizes are much smaller than the resolution of the instrument. There was a general consensus of the MOT that the Land Discipline Group can get a reasonable coverage of land for BRDF studies when MODIS-T is not covering any ocean pixels.

The opinion of MOT about this subject of BRDF studies for land applications is given in the summary given by W. Esaias. A response from W. Esaias in response to very comprehensive position paper on use of MODIS-T for land BRDF studies is attached (Attachment L2). J-P. Muller and A. Strahler emphasized that MODIS-T covers a very limited land area (isolated spots) for BRDF studies. W. Esaias said that they should try to have the test sites at places where coverage by MODIS-T would not impact ocean monitoring. He also suggested that NASA/HQ should hear the arguments on this matter from Ocean as well as Land Discipline Groups. J-P. Muller said that the data from MISR and MODIS-T is complementary and both are essential for his studies.

Comments about BRDF from MOT: W. Esaias gave a presentation about BRDF, MOT priorities etc. He recommended that the Terrestrial BRDF community attempt to improve the BRDF capability of MISR, especially MISR-1, MISR-2, MISR-3 etc. to provide the required land BRDF coverage. He pointed out that the Land Discipline Group should focus on most critical BRDF issues which need limited occasional coverage.

Time of Satellite Crossing: M. Abbott said that, at the last Payload Panel, there was a presentation showing likelihood of more cloud-free global land coverage at 10:30 a.m. (satellite crossing at the ascending node) than the currently planned at 1:30 p.m.

Orbital Model for Earth Location: P. Ardanuy referred to D. Han's presentation in the plenary session in which Han indicated the calculation of earth location at anchor points and then interpolation between those points. W. Gregg said that he had used modified Scripps code for calculation of earth location. R. Evans said that an orbital model whose elements are computed from GPS is needed. O. Brown gave an example of the PPT-7 model, where orbital elements are computed from GPS, i.e., the time history of GPS is the current orbital set rather than rubber-sheeting.

MODIS SCIENCE TEAM MEETING
25 - 26 September, 1990
ATMOSPHERE DISCIPLINE GROUP
MINUTES

The Atmosphere Discipline Group meeting was chaired by Mike King, and attended by Steve Ackerman (for Paul Menzel), Yoram Kaufman, Didier Tanre (team members), Phil Ardanuy (RDC), Lee Kyle and Locke Stuart.

Calibration and characterization needs and efforts were presented by John Barker and Phil Slater. Mike King was appointed to the Group for Peer Review of Algorithms. Major concern was expressed over the stringent specifications for channel center frequencies and bandwidths. Yoram Kaufman suggested that if some of the specifications cause undue expense in implementation, Atmosphere would be willing to reconsider their requirements. Specifications for the bands at 905 and 940 nm might be relaxed; 653 and 936 nm are probably very close to requirements. Barker promised that, if the cost of implementation is high, Group Leaders will be advised.

Phil Ardanuy expressed concern over the application of only one calibration procedure for all conditions. Barker averred that several different methodologies would be tracked, but only one calibration applied in the creation of the Level 1-B product. If it becomes apparent that a better method exists, that method will be applied.

Mike King assured Phil Slater that he needed full-scan calibration in order to obtain calibrated global coverage, and that between-band registration (250 vs. 500 vs. 1000m) is important. A quantitative value for registration was not available; 2% calibration accuracy across-scan is probably sufficient.

Cross-talk was discussed, and the effect of spectral, radiative, and electronic cross-talk mentioned. Barker said that ground processing may be able to compensate for these effects.

Barker asked which products were most sensitive to calibration. King and Kaufman replied that Cloud and Aerosol Optical Thickness, and Single-Scattering Albedo were probably most sensitive.

Discussions ensued on the instrument development process, and NASA's influence on that development. Barker reported that NASA would not have an on-site representative at the contractor, but would receive all test data. A fully functional engineering model will be developed; the flight prototype will be flown.

Data product turnaround was also discussed. Barker warned that any need for "rapid" turnaround (shorter than the specified 48 hours) must be known.

Kaufman suggested a need for real-time data to track clouds and aerosols for field experiment updates. Barker suggested that the system may be stable enough to provide good calibration "guesses" ahead of time, which could be applied to a limited amount of available near real-time data. **Kaufman was assigned the task of putting together a scenario for quick response.**

Steve Ackerman will work with Al Fleig on data formats and grids, particularly concerning the review of documentation.

Corrections were made to the MODIS data products, as listed in the EOS Data Product tables furnished by Yun-Chi Lu. **Ravi Kumar will post these corrections, and provide them to Lu.**

An Airborne MODIS-N Simulator (AMS) was the main subject of concern and discussion for the Atmosphere Discipline Group. Attachment S 3 gives the details of the instrument -- its heritage, design, and specifications. Attachments A 1, A 2, and A 3 are largely described in the Summary Session, and are not included.

The Atmosphere and Land Groups convened to discuss possible Land support for the simulator, which is designed to fly on the ER-2, but not to the exclusion of its flight on other aircraft. King traced the history of the development of the spectrometer, and its value in replacing existing spectrometers.

The cost to modify the current Wildfire spectrometer was addressed; Chris Justice felt that the instrument would be valuable in providing a source of simulated data to EOSDIS, and that they or Project should fund its development. If other sources of funding were unavailable or insufficient, Justice felt that some members of the Land Group would be willing to contribute. Diane Wickland suggested that the SR&T Program might offer a source of funding.

AMS use in conjunction with the Multispectral Atmosphere Mapping Sensor (MAMS) was discussed. Possible conflict with the Land Group's need for NOAA AVHRR data was noted. With immediate availability of funding, the simulator could be ready for flight by June '92. Since the simulator is a modification of the Ames' Wildfire spectrometer, Wickland stressed the need to have a full understanding with the Wildfire users on scheduling the instrument.

Further separate discussions of the **AMS** by the Atmosphere Group centered on the selection of bands. The 8.5μm channel will likely be added to MAMS. The 0.47μm channel is preferred on AMS, but may be a problem, and may also have to be added to MAMS. Another important addition is the 1.6μm channel.

The instrument's use in **future Atmosphere Experiments** was addressed: HAPEX (Niger) in September, 1992, and Brazil Trace Gases in August/September, 1992.

MODIS SCIENCE TEAM MEETING
25 - 26 September, 1990
CALIBRATION DISCIPLINE GROUP
MINUTES

The Calibration Discipline Group Meeting, held on 25 and 26 September, was chaired by Phil Slater. Attendees were J. Barker, W. Barnes, H. Ostrow, B. Guenther, L. Thompson, R. Weber, T. Magner, W. Browne, P. Abel, W. Eichhorn, S. Biggar, J. Butler, D. Hoyt, and A. Mecherikunnel (Executive Secretary)

The first morning was spent on MODIS-T calibration review, and W. Eichhorn gave a calibration scenario and made a presentation on MODIS-T calibration requirements. A copy of Eichhorn's presentation is on file (Attachment C 1).

The MODIS-T calibration scenario calls for extensive ground calibration and instrument characterization, absolute solar calibration over the Equator with the diffuser plate, a solar sphere used to track diffuser plate degradation and to provide a constant reference signal for system stability tests, spectral calibration using an internal source, and two Silicon photodiodes to monitor contamination and changes in flux in the integrating sphere.

The MODIS-T calibration requirements are: ±5% NIST traceable; ±2% solar reflectance calibration -- i.e., diffuser plate; ±1% stability over 2 weeks; spectral calibration required in orbit; calibration at any angle between ±20°; and lunar truth calibration.

Barker stated that experience with AVHRR and GOES calibrations will be used for MODIS calibration-related studies. Guenther added that the SEAWIFS calibration activity will serve as a pathfinder.

Barker mentioned that MODIS-T lunar and solar calibrations are possible over the North Pole and South Pole, respectively.

Slater voiced concern over the choice of diffuser materials. He added that JPL is planning visual fluorescence testing of diffuser materials in conjunction with MISR at TRW; he will try to get information regarding those tests.

Barnes pointed out that further study is needed to estimate the tolerances of the filters for the channels at 940 and 960 nm.

The MODIS-T specification of 2.3% does not apply to the spectral bands below 430 nm, and Barnes stated that further studies are needed on this problem.

While discussing the use of a double integrating sphere in place of a single sphere, Slater stated that the double sphere configuration may add uncertainty to the ratio of the 2 signals -- how much energy goes from one sphere to the other.

Issues of paddle wheel versus barrel roll scan mechanisms were discussed. The Barrel roll mechanism has less polarization and no contamination problem; however band-to-band misregistration is a possibility. For the paddle wheel scan mechanism, band-to-band registration is O.K. R. Weber will study the two mechanisms.

The afternoon of 25 September was devoted to separate discussions, led by John Barker, with the other discipline groups. Emphasis was on discipline-related calibration questions specific to each group. Barker wants a set of products most highly sensitive to calibration from each group. He also needs one person to produce a scenario for the most demanding case, and volunteers from each group to review calibration algorithms.

Atmosphere Group: Concerned with MODIS-N only. Major calibration issues are: absolute radiometric and spectral calibrations and stability; the tolerances for filters of channels at 940 and 960 nm; absolute calibration for a full scan (Mike King); review of the calibration algorithms (Mike King); and production of a scenario for the product requiring the most demanding calibration.

Land Group: Needs calibration in terms of VIS/NIR, thermal IR, etc., and simulation for characterization of the instrument. C. Justice wants absolute radiometric accuracy for ±45°. A math model will be studied by P. Muller. The Land Group requires end-to-end simulation with respect to stray light, radiances, irradiances, and thermal gradient.

Oceans Group: Requires 1% absolute calibration in the thermal region, and absolute calibration over the entire range. Chlorophyll studies require better absolute calibration than presently called for. Attachment C 2 addresses the issue of improved thermal accuracy; the problem will be studied following contract award. O. Brown is concerned that different people are using different instruments calibrated against different standards, using different calibration methods. Efforts should be made to calibrate instruments using similar standards and sources so that they can be intercompared. Slater and Guenther can support this effort.

September 26 was spent mainly in reviewing MODIS-T specifications, as requested by Slater.

According to Slater, the calibrations/characterizations need a single focal point. The philosophy of the MODIS Calibration Support Team should be "Calibration/Characterization/Geometry; Blend/Trend/Defend".

MODIS SCIENCE TEAM MEETING
25 - 26 September, 1990

DISCIPLINE GROUP

SUMMARIES

EXTENT OF COVERAGE

Only the presentation portions not covered in the summary vugraphs (Attachments S 1-4), are given here.

Calibration Group

Uniformity of Calibration: O. Brown is concerned that different people are using instruments calibrated against different standards, using different methods for calibration. Effort should be made to calibrate all these instruments uniformly so that results obtained by them can be compared on a fair and equal basis. B. Guenther and P. Slater will support this effort.

Calibration by the Double Sphere Method: There is concern about the level of radiance using the double sphere method of calibration. If there is a 1% drop in the reflectance of the sphere, output of the sphere drops by 10%. Use of a single sphere plus signal integration may be a trade-off to using the double sphere method.

Diffuser Plate: there is concern about the choice of material for the diffuser plate.

Paddle Wheel Approach: R. Weber expressed concern about non-uniform contamination of the paddle wheel scanner. T. Magner had given an overview in the plenary session on a study conducted by an engineering

team at GSFC about the effect at different scan angles of nonuniform coatings of contamination deposited on mirror surfaces over the long term (five years). The effect on mirror reflectance and consequently system calibration was addressed.

In the "barrel" mode, the same part of the mirror is used; however band-to-band registration is apparently not as satisfactory as in the "paddle wheel" mode (this needs to be verified).

MODIS-N Stability: Stability can be verified at ground reference sites.

Polarization Specifications in the 415nm Band: The Ocean Discipline Group does not want to relax the polarization requirement of 2.3%. It is presently difficult to meet this specification. The polarization of the source used to study the effect of polarization on spectral and spatial response needs to be specified.

Ocean Group

The summary presentation for the Oceans Discipline Group was given by W. Esaias (Attachment S 2). Points of emphasis follow:

BRDF: W. Esaias emphasized that MODIS-T BRDF studies shall not interfere with the daily global acquisition of (ocean productivity) data. Regional activities must be of lower priority, and BRDF, as measured by MODIS-T, cannot be global on the required time scale.

Actions/Issues/Concerns: A number of actions were assigned, issues discussed. Particular mention should be made of concerns about purchasing EOS data for validation efforts, plans for validation/simulation experiments, and plans for the next Oceans Discipline Group meeting.

Level 1 Processing: Attitude rates need to be specified. What is the need for a Browse facility?

MODIS Calibration Support Team: Pre-launch efforts should emphasize *characterization,* not calibration; there will be a considerable expense in transferring pre-launch calibration to the post-launch era -- perhaps with ineffectual results in the visible spectral region. Stability and blackbody performance of MODIS-N is of concern.

Ocean Group Costs and Reviews: Had a productive meeting with J. Dozier; will address 4 areas of concern: 1) validation approach, 2) team computing, 3) Ship time, and 4) drifters/moorings. It is to be stressed that the Oceans Computing Facility will be *complementary* to EOSDIS, *not* competitive.

Atmospheres Group

Mike King gave the details of various scanning radiometers which can be used as MODIS simulators. He is in the process of determining the most desirable radiometer for simulating MODIS (atmospheric, land) data within tight budget constraints. He gave an evaluation of various radiometers, including their estimated costs.

Land Group

C. Justice summarized the Land Discipline Group's discussions and highlights in the plenary session on Wednesday, 26 September, 1990. The vugraphs which he presented are in Attachment S 4. Following are the portions not covered in the vugraphs.

C. Justice says that he wants the MODIS Calibration Support Team (MCST) to conduct an end-to-end system test to determine radiometric and geometric accuracy, including registration (temporal, geodetic, band-to-band). He needs to give the topographic requirements of the Land Discipline Group to J. Dozier. The Land and Ocean Discipline Groups need to get together with D. Han to decide what additional studies need to be conducted regarding land/ocean coverage at different MODIS-T tilt angles. P. Slater said that the improvement in accuracy in going from 8 bits to 12 bits in a MODIS simulator, and corresponding science benefits, needs to be determined. Y. Kaufman said that it is important to emphasize the surface truth field experiments, and input sources of data like TM (Thematic Mapper). C. Justice should give his Earth location requirements to D. Han.

Chairman's Summary & Closing Remarks

V. Salomonson concluded the meeting with the following summary /remarks:

MODIS Data Products: He said that Science Team (MST) and Interdisciplinary Science (IDS) members need to address differences and come to agreement so that MODIS output data products satisfy IDS requirements.

Calibration Pre-Launch Management Plan: There is an International Coordination Working Group (ICWG) which has representatives from NASA, NOAA, ESA (European Space Agency), and Japan, wherein such management will be discussed. Significant progress in the development of this plan for MODIS should be evident by the next MST meeting.

Geophysical Parameters Validation Plan: Ground, sea (ship, buoy), and aircraft measurements need to be well planned. In the algorithm development process, there will be successive versions of the algorithms, and each version will have a peer review. Group Leaders were urged to concentrate their efforts on this plan, and have the outline and sketch by next MST meeting.

Next MST Meeting: He expects the Statement of Work (SOW) for the Execution Phase long-term (ten year) contract to be written in April-May, 1991. Therefore a convenient time for the next MST meeting would be the February-March period, so that details of the SOW can be discussed.

V. Salomonson said that he was pleased with the progress made during this meeting. Unfortunately, the budget for FY '91 is tight for the team members and team leader. He expects the Execution Phase budget -- supportive of team member proposals -- to begin in FY '92. He thanked the audience for their attentiveness and participation.

MODIS SCIENCE TEAM MEETING
25 - 26 September, 1990

ACTION ITEMS

Introduction: All action items generated during the plenary session ("General"), and discipline group meetings (each group listed individually), are listed. Where possible, actions are assigned by name; schedule for milestones and completion is given, if assigned. Because of the complicity of responsibility, actions are frequently listed more than once, under different responsible parties and sections.

General

V. Salomonson

Calibration Discussions at the next MST Meeting: J. Barker averred that considerable effort will be involved to make sure that specifications (like a dark target in a bright field, *et vice versa*), are met. B. Guenther wants to have early and frequent interactions on these and other calibration issues and requirements, For this reason, J. Barker suggested to hold discipline group discussions of calibration related issues a day before and after the next MST meeting. V. Salomonson will make the decision in consultation with team members regarding how much time should be given to calibration at the next MST meeting.

J. Barker

MODIS Characterization Support Team (MCST) Activities: According to the MODIS Ocean Team (MOT), the emphasis of MCST should be on pre-launch characterization and not on pre-launch absolute calibration. The MOT believes that it is almost impossible to transfer pre-launch absolute calibra-

tion in the visible spectrum to post-launch calibration. A significant amount of money can be saved by deleting this portion of the effort. On the other hand, it is desirable to do pre-launch absolute calibration for thermal IR, since it can be transferred to post-launch.

End-To-End Test: C. Justice said that he would advocate an overall end-to-end system test to determine system accuracy, taking into account registration errors, signal-to-noise ratios, Earth location errors, etc.

MCST Priorities: Since the budget is tight, priorities for MCST need to be developed, and only high priority items (like pre-launch characterization) should be addressed. A list of priorities for MCST needs to be developed in concert with the MST.

Quick Look Data: There was much discussion on the need for quick look data. Quick look data are helpful, since they show the cloud cover, quality, any visible noise, or other problems. If there is a problem in a certain isolated area of a higher level product, one can go back to Level 1 data to determine the cause of the problem. O. Brown said that, in the beginning, a quick look browse for Level 1B will be often used. After the system has become operational and established, and higher level products are being produced, the image browse facility will not be needed. Thus, it is felt that the image browse facility will have *very limited* utility. W. Esaias will check the MODIS Phase C/D Specifications for "Browse" (image as well as other data). He will consult with MOT members to find their requirements for it. W. Esaias and other discipline group leaders will give their feedback to J. Barker and D. Han, who will work with W. Barnes for possible modifications of the Phase C/D Specifications.

Calibration Plan: Barker should have outlined and sketched the chapters of the plan by next MST meeting.

W. Barnes

MODIS Phase C/D Specifications: Work with the MOT and other members to include attitude rates in the MODIS Phase C/D Specifications. Stability and blackbody performance should be reviewed in consultation with O. Brown and others, and appropriate changes made.

Platform Ancillary Data: O. Brown said that there should be specifications on pitch, roll, yaw, and velocities in the x, y, and z directions. W. Barnes will look into this matter.

J. Dozier

Development of DAAC: R. Evans said that there should be input from scientists on the development of DAAC. M. Abbott said that there has been very little scientist input in DAAC development. V. Salomonson said that scientists have to continually try to give their input, and keep science up front. A. Fleig said that the DAACs were selected in close connection with the user community. J. Dozier said that there should be enough money for development of the DAACs, and money allotted to science should not be used for that purpose. He said that the Science Advisory Panel has not had time to exercise much oversight in this matter. After the EOSDIS Phase C/D contract has been awarded, they will have more time to investigate. R. Evans said that it would be useful to provide the names of people working on DAAC, and further details of the areas of their work, so that science input can be given to them. A. Fleig said that a bulletin board can be put in each DAAC.

A. Fleig

Copies of Proposals for Contractors: MST members generally agreed that copies of their technical proposals may be used by NASA-approved contractors to determine algorithm development requirements and data system interfaces.

A. Fleig will develop the following procedure:
Prepare a list of names of contractors at RDC (Research and Data Systems Corporation), *et al.*, who need copies of certain MODIS technical proposals. Keep a record of their names and the corresponding technical proposals received by them. If any MST member does not agree with this procedure, he should contact A. Fleig, indicating his objections.

EOS Data Products: There is a need for coordinated data sets for IDS, MCST, EOSDIS, etc. Consider the possibility of creating additional categories, like validation data products, etc. in the EOS Data Products data base.

Changes to the Data Product Tables: W. Esaias wanted to know why the standard data products are under configuration control 9 years before launch, and why reasons for all changes must be given. A. Fleig will check into this.

A. Fleig said that any input of EOS and non-EOS products, whether funded by NASA or not, should be clearly indicated in the data product tables. More information is always safer!

IDS Requirements *versus* MODIS Output Products: M. Abbott said that we should try to compare Interdisciplinary Science (IDS) requirements for MODIS data with the MODIS output products. Some compromises may be needed between IDS investigators and MST members, so that MODIS output products can satisfy IDS requirements.

Data Products in JPL's Data Base: A. Fleig said that he went through the entire ocean data products list generated by JPL. M. Abbott said that there are 42 sea surface data products. This list was distributed at the meeting. A. Fleig and Y. Lu will compare this list with the Goddard data base, and find the corresponding products in JPL's data base. There are only about 20 products in Goddard's list related to physical oceanography.

Revised EOS Milestone Schedule: W. Esaias said that, at the next MST meeting, there will be discussions about the intended approach for algorithm peer reviews. A. Fleig will work with the Project Office to come up with a rational and consistent schedule of the milestones for a December '98 launch. A. Fleig said that the schedule should be consistent with the resources available. Since the budget for the current year (FY '91) is tight, he will try to get the schedule changed by the EOS Project and NASA HQ to reflect the budgetary delay.

D. Han

Earth Location: Need to understand the approach for georeferencing (Earth location model). It is highly desirable to have a single reference model. D. Han, RDC, and the MST (H. Gordon, W. Esaias, etc.) should work together to address this issue.

MODIS SDST (Science Data Support Team) Complementing MST: Coordinate with MST to determine what work in algorithm development will be done by MODIS SDST to complement the MODIS Ocean Team, and other discipline groups.

MODIS-T Ocean/Land Coverage: The MST Ocean and Land Groups will recommend to D. Han additional study related to land/ocean coverage in the composite mode at different tilt angles, to be completed using the support contractor, RDC (Research and Data Systems Corporation).

Definition of Levels for Data Products: C. Justice requests that the definitions for various levels of MODIS data products be clarified.

Number of Level 1B Products: D. Han said that the current plan is to produce only one set of Level 1B data. R. Evans said that, to achieve high accuracies for data products to study atmosphere, land, and ocean parameters, different sets of calibration coefficients, based on radiative transfer equations, solar and lunar calibration, instrument calibration, etc., will need to be applied. V. Salomonson, W. Barnes, D. Han, J. Barker, etc. will study the problem in consultation with team members.

C. Justice

Earth Location Accuracy: There was much discussion on computing Earth location at anchor points (less than 1% of the data) and interpolating between anchor points to an error of less than 10 meters, without considering any topographic information. (This was discussed further in the Ocean Discipline Group meeting.) D. Han clarified that topographic corrections (DEM/DTM) are not applied to the level 1 data. V. Salomonson said that a particular spheroid for representing the Earth (Clark 1866, International, etc.) has not been selected yet. If better Earth location accuracy, especially by the Land Discipline Group, is needed, D. Han will be advised. V. Salomonson said that the Land Discipline Group should indicate quantitatively their registration accuracy requirements.

C. Justice, W. Esaias, M. King, and P. Slater

Aircraft Data Requirements Summary: Tables distributed during the MST meeting should be checked; corrections should be marked and the sheets returned to L. Stuart.

Updating MODIS Data Product Tables: MODIS Data Product tables were distributed during the MST meeting. The MST should check the product specifications carefully, make any necessary corrections, and give them to L. Stuart.

Geophysical Parameters Validation Plan: Each Group Leader is responsible for the development of this plan, and should have a sketch of the plan in time for the next MST meeting.

L. Stuart & R. Kumar

Dates for the Next MST Meeting: Check the schedule of MST and MTT members for February - March, 1991, tentatively set the dates of the meeting, and reserve the conference rooms in Building 26.

Copies of MODIS-N Phase C/D Specifications: W. Barnes said that, when the MODIS-N specifications are released, it will be public information. J. Barker suggested that the Specifications be sent to team members, when they are released.

V. Salomonson and M. King

Funding for MODIS Simulator: Several possibilities exist: 1) NASA HQ may want to support the development of a simulator (SR&T Program?); 2) Project Office may be willing to contribute; and 3) MST members may contribute a share. V. Salomonson and M. King should work out a likely approach to defining the scope of the simulator, and to obtaining additional funds.

Oceans

W. Esaias

ATSR Specifications: Get ATSR specifications from Ian Barton next week (October 1 - 5).

Priority Ocean Data Products: Prioritize the MODIS Ocean Data Products. The current list had been prioritized by responding to the 5 golden questions.

Level 1 Comments: Give comments about the Level 1 processing scenario to D. Han. The comments made by the MST during the meeting will be included in the Minutes.

Review EOS Software Standards: R. Evans and M. Abbott will review the "EOS Software Standards for Algorithms", with help from W. Esaias.

Aircraft, Ship, and Computing Requirements: Prepare a detailed list of aircraft flights and ship measurements needed by MOT (MODIS Ocean Team) members. Give a brief summary and justification of the MOTCF (MOT Computing Facility), and ship and buoy requirements for ocean data products development and validation, to J. Dozier. Dozier also needs a response to the proposal reviewers' comments.

Add M. Lewis to the MOT: W. Esaias would like to nominate M. Lewis to be an associate team member of the MOT.

Need for a MOT Meeting: It was felt that it may not be necessary to hold a separate MOT Meeting prior to the next MST, if the MST is held in the February - March 1991 time frame.

Land

MODIS PRODUCTS

Strahler, Muller, Tanre, Kaufman

Land-Leaving Radiance Definition: Better define the land-leaving radiance at-launch product (e.g., to surface hemispherical - directional reflectance).

Z. Wan & I. Barton

ATSR Utilization: Confer on the ATSR-derived land emissivity product (non-EOS data) as ancillary input data for land surface temperature estimation. Dr. Wan to Liaise with IGBP Surface Temperature Working Group.

Justice, Huete, Vanderbilt, Muller, Strahler, *et. al.*

Processing Sequence: Each user by the next meeting should identify the processing sequence related to their product generation, including georeferencing, atmospheric correction, and ancillary data (EOS and non-EOS) requirements (w/Hunt, D. Hall, Barnsley, and Townshend).

CALIBRATION AND SPECIFICATIONS

Z. Wan

Thermal Calibration: Monitor MCST thermal calibration activities.

V. Vanderbilt

Optical Calibration: Maintain optical calibration contact with the MCST.

A. Huete

Calibration Processing Scenario: Provide a demanding calibration related processing scenario for the MCST.

A. Strahler

Data Format: Responsible for data format activities with interface to EOS-DIS (A. Fleig).

J. Townshend & J.-P. Muller

Geometric Specifications: Further develop the geometric specifications for MODIS.

Justice, Townshend, Strahler, Muller

Geometric Accuracy: Stress importance to MCST of MODIS-N and -T scene geometric accuracy.

V. Vanderbilt

EOSP: Liaise closely with the EOSP Team.

EOSDIS

D. Han

Product Level Definition: EOSDIS needs to provide improved definition of product levels, and "standard" and "special" designations.

GIS: EOSDIS should provide a GIS capability.

BRDF

Muller and Strahler

Acquisitions and Capabilities: Study MODIS-T in relation to the MISR land BRDF acquisitions and capabilities. Coordinate with the Ocean Team on RDC contract support related to BRDF acquisition scenarios.

TOPOGRAPHY

Muller

Topographic Data Needs: Define needs from a MODIS land science perspective. Members to send input (and vu-graph of supporting material, if possible) to J. Dozier by 15 October.

SIMULATION, TEST SITES, AND VALIDATION

Stuart

Mutual Purchases: Examine the EOS acquisition plan for the acquisition and purchase of mutually usable SPOT and TM data with MODIS, IDS, Projects, and EOSDIS.

Justice, Esaias, King, & Stuart

Test Site Coordination: Coordinate selection of test sites with Land, Ocean, and Atmosphere Teams. MAST should support the Land Team in test site studies, as required.

Justice

HAPEX: Coordinate Niger HAPEX II test site activities (FY '91 & '92).

Aircraft Simulation: Coordinate MODIS aircraft simulator procurement support from the Land Group to provide assistance to M. King. All Land Group members are requested to indicate to Justice the dollar support they are prepared to contribute to this activity based on projected FY '91 funds.

D. Hall

Forest Dynamics: Keep the team informed on developments and data acquisition plans for the Howland, Maine test site activities (FY '91)

Huete

Field Experiment: Keep the team informed on developments and data acquisition plans for the Walnut Gulch field activities (FY '91)

Muller

Field Experiment: Keep the team informed on developments and data acquisition plans for the European field activity (EFEDA - FY '91)

D. Carneggie

Simulation with AVHRR: It would be useful for USGS/EDC to provide MODIS simulation support through AVHRR 1 km data

Aircraft Data: It would be useful for USGS/EDC to provide aircraft data processing, archiving, and distribution support of selected (e.g., AVIRIS and ASAS) data.

Calibration

J. Barker

End-to-End Study: MCST work on an end-to-end study of sensor specifications in the context of land cover change. A first priority is to focus on the geometric specifications. Need total expected potential error and cost.

Standard Simulation Procedures: With D. Carneggie, process TM or AVIRIS data to come up with standard procedures for MODIS-related simulations.

Calibration Plan: Draft Calibration Plan (technical, management, pre-launch and post-launch) by next MST meeting.

Feedback: Summarize inputs on the MCST Feedback sheet.

Registration: Evaluate registration: geodesic, temporal, band-to-band.

W. Barnes

Polarization: Evaluate accuracy specification shorter than 430 nm.

Filter Tolerances: Evaluate for the 940 nm and 960 nm channels (w/Kaufman).

Contamination: Evaluate for mirror, diffuser plate, etc.

IR Saturation: Evaluate the saturation of the thermal IR bands and the IR response function (requested by Wan).

B. Guenther

Field Equipment Calibration: Address methodology for calibration of aircraft instruments.

Integrating Sphere Degradation: Evaluate.

Double *vs.* Single Integrating Sphere: Evaluate calibration accuracy.

R. Weber

Scan Mechanism: Paddle wheel *vs.* Barrel decision for MODIS-T.

P. Slater

Coating Fluorescence: Study fluorescence of diffuser coating materials.

Evans, Huete, and Kaufman

Processing Scenario: Produce calibration demanding processing scenario for their respective discipline groups.

Atmosphere

Y. Kaufman

Filter Tolerances: Can specifications be relaxed on MODIS-N channel band-pass tolerances (water vapor bands)?

Processing Scenario: Work up the most rigorous data processing scenario for the product most sensitive to calibration, and furnish to the Calibration Group

Quick Response Data Products: Assemble a scenario of the need and requirements for "quick response" data products (less than 48 hours).

M. King

Aircraft Simulator: Determine funding sources for the MODIS Aircraft Simulator

S. Ackerman

Data Formats and Grids: Work with A. Fleig.