Interactions with EOS PM-1

Testing and Characterization

- Identified expected differences between the PFM MODIS (which flies on AM-1) and FM1 (which flies on PM-2). There are no differences which will make much difference to the science team.
- Identified deficiencies in PFM that could, in principle, be fixed. Barnes to provide a more complete list. Among the correctable deficiencies are
  - D1 Dichroic interaction with bands 8 & 9 (New design or polarization compensater)
  - Cross talk in bands 31-36. (A fix would remove the spectral spatial ambiguity.)
- MODIS Calibration Chamber (MCC) could be equipped with sense window
- Solar Calibration could be re-introduced.

Cross Calibration Issues

- Use of lunar calibration unlikely.
- Orbit phasing could provide simultaneous views at poles.
  - Post 2000 will use direct downlink in lieu of TDRSS. Adds a constraint to orbit phasing.
  - Global refresh period, especially for oceans also constrains orbit phasing
- Ed Zalewski to provide better definition of options for cross calibration.

Pointing

- PM-1 Has much lower specification for pointing.
- On AM-1, MODIS got a "free ride" as ASTER and MISR drove the system.
- MODIS specification, for AM-1 and PM-1 was incorrect. Should be 10X better.

S/C Maneuvers

- Project is nominally prepared to allow.
- Strong opposition by AIRS.

Data Issues

- For existing products, we will substitute V1 or V2 code for PM's Beta and V1 Code Deliveries
- New Products for PM-1 will meet PM-1's delivery schedule
- ECS to be asked to coordinate delivery schedules between AM and PM projects
- Some new products will impact staging at DAAC.

New Products & Better Products

- More cloud-free data to be used in compositing
- "Diurnal" Changes and wider range of viewing/illumination geometry for
  - BRDF
  - Land surface temperature
  - Fire detection
  - Productivity using fluorescence bands
- Other PM-1 Instruments
  - AMSR can provide diurnal temperature variations
  - AIRS wants to use MODIS high resolution (x-y) sounding.

To: 421/Manager, AM Project
From: 900/Director of Earth Sciences & MODIS Science Team Leader
Subject: MODIS Instrument Status (Issues?)

During the just completed MODIS Science Team Meeting we conducted a comprehensive review of the projected capabilities of the MODIS PFM instrument to meet the science objectives of the MODIS science team. Our review was based upon presentations made by SBRS personnel and by our internal team, the MCST. In preparation for this review, we have had extensive and productive interactions between SBRS, MCST, and numerous members of the MODIS science team.

I want to convey to you the sense of the MODIS Science Team about the status of the MODIS Protoflight Model (PFM) as regards its expected performance characteristics and the expected quality of characterization information which is needed for input to the algorithms for the various data products.

The most important issues are those which we project will cause us to fail to meet a Level 1 requirement as described in the EOS project plan. Almost as important are issues which will result in the failure of any algorithm needed to produce one of the 39 data products.

Our two greatest concerns at this time are the lack of proper characterization of the instrument polarization and a host of issues associated with characterizing the long wave infrared bands. Both of these issues, if not satisfactorily resolved, will result in a break with Level 1 requirements.

Polarization: All ocean biophysical data products depend upon the atmosphericaly corrected water leaving radiances provided by MOD XX. This algorithm depends critically upon proper measurements of instrument polarization. All tests indicate that the instrument polarization is relatively high (>??%) and cannot be ignored. If we cannot properly characterize the polarization, then all ocean biophysical data products will fail; most of them will fail in the terms defined in the EOS Project Plan's Level 1 Requirements. See Appendix A.

The polarization tests conducted to date are flawed and not satisfactory for use in the algorithms. The presence of a 4 theta variability in the polarization tests with the PSA has not been explained, and there is no way to decide between the filtered and unfiltered data. The alternate tests using the IAC are encouraging, but cannot be reconciled with those using the PSA. Thus we have three sets of results (2 from the PSA, 1 from the IAC) with no rationale for selection of which results to believe. It is tempting to accept the results from the ad-hoc IAC-based test and reject those from the sophisticated, custom designed SPA. However, selecting the result we like best would be comparable to the decision made by the Hubble project when it chose to believe the measurements from a sophisticated collimator without reconciling them with those from a similar device.

To resolve this issue we must have believable results. Failure to deliver polarization characterization is not an acceptable option. Additional testing would be on the critical path, and we are anxious to avoid that. We have asked Dr. Howard Gordon to lead a small task

force to work with SBRS to evaluate the new data and models and recommend a course of action. The options are:

1) Accept the IAC measurements and the implicit model of the problem as demonstrating that the 4 theta problem is an SPMA test artifact.
    1a) Use the filtered test data from the SPMA tests.
    1b) Use the test data from the IAC, acquiring a complete test data set using the IAC
2) Reject the IAC measurements and require an acceptable model for the SPMA results
    2a) Validate the model using the IAC or some TBD test system. Use new model to interpret SPMA (and IAC?) data.
    2b) Accept the new model without validation. Use new model to interpret SPMA (and IAC?) data.
3) Reject the IAC measurements with no further modeling.
    3a) Use the unfiltered SPMA data.
    3b) Use the filtered SPMA data.

Options 1a, 2b, 3a, and 3b have the minimum schedule impact. Options 3a and 3b, however, are equivalent to giving up on a defensible rationale for the decision. Option 2b poses some risk, depending on the strength of the model.

Any decision which results in conducting additional measurements with either the IAC or the SPMA has the advantage that bands 2 & 5, which were not acquired in the SPMA tests, could be measured with little additional schedule impact.

Until a recommendation can be made, we think that a lien of 8 days be made on the critical path test plan. This is based upon a complete repeat of the SPMA tests. A recommendation will be made by October 25.

Long Wave Thermal Infrared Issues: The retrieval of sea surface temperature depends on:
1) Unambiguous knowledge of the in-band spectral response of bands 30-36.
2) The capability to correct for out-of-band plus out-of-pixel response of bands 30-36.
3) Relative knowledge of the response versus scan angle variation to 1 part in 1,000 in the LWIR.
4) Scan mirror temperature to 1° C.

Failure in any one of these areas may result in failure of the Level 1 requirement for SST and serious damage to the land surface temperature algorithm. Failure to obtain the in-band spectral response could result in the permanent loss in the capability to use the radiative transfer based algorithms. The fall back empirical algorithm cannot ever be tuned to the required accuracy. The observed cross-talk from hot bands which see to the surface with cold cloud top bands can destroy the ability to ever obtain the cloud top temperatures and aerosol concentrations. The loss of the aerosol measurements will add to the error budgets of land and ocean temperatures and atmospheric corrections for the VISNIR region.

<u>The current test plan is being adapted to assure that the necessary knowledge will be obtained</u>. There are decisions on test details which need to be made in close coordination with the

Science Team. A task group, to be chaired by Peter Minnett, has been appointed to interact with MCST and thereby with SBRS on the design and conduct of these tests.

Task Force on Polarization:
Howard Gordon (Chair)
Gene Waluschka
Gerry Godden

Task Force on LWIR
Peter Minett (Chair)
Zeng Meng Wan
Ed Knight
Chris Moeller
Paul Menzel
Ottis Brown

Appendix A.

Product		Problem	Level 1 Req. Breaks	Algorithm Breaks	Algorithm Compromised*
# XX	Water Leaving Radiance	Polarization	●		
# XX	Chlorophyl	Polarization		●	
# XX	Aerolsols	Band 7 SNR			●
# XX	Cirrus Prop	Band 5*26 X-talk		●	