Quarterly Progress Report
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Near-Term Objectives

1) Review and comment on proposed changes to MODIS instrument specifications 2) Review MODIS data products 3) Review and revise MODIS Software Development Plan 4) Continue development of Science Compute Facility 5) Analysis of bio-optical and sea surface temperature data as part of algorithm development

Task Progress

1) Sensor Performance

I recently received proposed descope options for MODIS as part of an overall effort to reduce costs for the EOS program. These options will be considered in more detail in the upcoming quarter.

2) MODIS Data Products

As part of the NASA Red Team/Blue Team activities, the program has proposed a much reduced data product list for MODIS. Although the focus was on only products that could be produced at launch, there were numerous products that could easily be produced and in fact, should be produced. In some cases, this included "intermediate" products that are made in the process of producing some geophysical quantity. Examples include information on atmospheric aerosols that are used in atmospheric correction. In other cases, valuable data sets were left off the list.

I proposed that NASA establish a more formal process and review of these data products that would review every data product, including those proposed by NASA Headquarters. This must be a joint process between the EOS Investigators Working Group as well as those responsible for for producing data products.

We need to take a new approach, rather than try to clean up a flawed system. We should first identify the critical data products (by sensor) without regard to temporal or spatial resolution. The criteria for "critical data product" should include an assessment of the science need for the product, its heritage, and its "reasonableness." We should not focus only on products that are ready to run at launch. I think is short-sighted; there will be little incentive to develop new, more complicated products with this approach. In fact, the whole product list process, has alternately swung between these two extremes of too conservative and too expansive. I think we need to strike a balance between these two. I also think some level of redundancy is not bad, such as multiple estimates of incident photosynthetically available radiation (PAR). Investigators often use different approaches, even with the same sensor data set. Making a priori choices as to which is the best approach is not prudent.

In terms of MODIS, I suggested the following changes to the HQ list:

Chlorophyll fluorescence efficiency (3211/3212) is the ratio of fluorescence to the chlorophyll concentration (as derived from other MODIS channels). The efficiency can be used in models of primary productivity or in estimating the light response of phytoplankton, one of the primary variables in carbon fixation.

Chlorophyll via fluorescence (2566/2567) is a straightforward product derived from fluorescence line height. Although the radiance ratio method is the primary approach for global chlorophyll estimates, fluorescence will be superior in regions of high chlorophyll and turbid, coastal waters.

Ocean water attenuation (2031/2032, 3199/3200, and 3206/3207) is necessary for models of mixed layer depth and primary productivity. These models are well-developed.

Suspended solids concentration (3085/3086) is also important in estimating riverine fluxes of material into the coastal ocean.

Products related to coccolith concentration (2577/2578 and perhaps 2556/2557) should be retained. The enhanced backscatter from coccoliths must be accounted for in the bio-optical algorithms used to derive a range of other ocean products such as pigment and productivity. More importantly, coccolithophores are the primary producers of DMS in the ocean, which is important for cloud formation.

Pigment concentration (2591/2591) is the combination of chlorophyll plus associated degradation products. It should be retained for continuity with the CZCS, SeaWiFS, and EOS-Color data sets. These latter sensors are less sensitive and are not able to distinguish chlorophyll from the degradation products (unlike MODIS).

Phytoplankton backscatter coefficient (2555/2558) will be useful for distinguishing the types of phytoplankton in the upper ocean. As various types have different photosynthetic characteristics, these data should improve our productivity estimates. Similar estimates should be possible from SeaWiFS so there is heritage for these products.

The atmosphere products (2295/2296 and 2344/2345) are essential intermediate products that are used for data validation and quality checking.

There are several instrument-related data products that should also be retained. These include the instrument characterization and calibration products to be developed by Salomonson and Barker. The data masks (3660/3661 and 2282/2283/2284) must be retained so that subsequent processing focuses on the regions of interest (i.e., fluorescence is calculated for ocean pixels, not cloud or land).

3) MODIS Software Development

I have continued our analysis of Explorer (from Silicon Graphics) and Khoros (from Univ. of New Mexico) as data visualization environments for MODIS software development. The present systems leave much to be desired in terms of ease of use as well as in functionality. All of them "break" the underlying links to the original data, making it difficult to use visualization as an effective component of data processing.

We are continuing to work with the University of Miami on the use of massively parallel computers for advanced algorithm development. Advanced atmospheric correction models for SeaWiFS (as an analog for MODIS) appear to require considerably more compute power, so parallel algorithms may be an effective solution.

I completed a draft of the introductory material on a strategy for ocean color observations for the next ten years. With the launch of SeaWiFS next year, there should be continuous global ocean color measurements well into the next century. As these sensors will have different performance characteristics (as well being launched by different nations), we must have a plan to link these sets into a coherent time series.

4) Science Compute Facility

We have continued to monitor the computer industry in terms of high speed networking and data storage. Thus far, a cost-effective solution has not been found. We continue to research object-oriented methods, especially in terms of data management.

The CM-200 from Thinking Machines is being used for cloud masking of AVHRR imagery, using neural net techniques. We have reviewed the basic methods and implemented the code. However, we are continuing to work on the X-Windows interface.

5) Data Analysis

I have completed analysis of bio-optical drifter data and continue to work on a manuscript for publication. Results were reported in the Semi-Annual report.

We are studying the impact of different satellite viewing geometries on SST retrievals. Our approach is to use all of the available AVHRR imagery from the U.S. west coast and look for consistent patterns. Preliminary results indicate that SST is strongly affected by view angle at large angles. This is somewhat different than results from Miami which indicate little influence. We are using two parallel architectures (the CM-200 and the IBM cluster) to do this analysis, which is giving us valuable experience with using parallel languages.

Anticipated Activities

1) MODIS Sensor Performance

I will participate in the Descope review that will take place at the next MODIS team meeting.

2) MODIS Data Products

I will continue to revise the data dependency charts being produced by the MODIS project. I expect that the IWG will begin a serious effort to define MODIS data products.

3) Software Development

We will begin testing Explorer 2.0 from Silicon Graphics. Much-needed functionality will be included in this release, and we will work with Miami to define the role of Explorer in data processing and visualization.

I expect to complete hiring of a new data person, who will focus on advanced information management techniques, including object-oriented data management. This person will work on methods to handle multiple data types, as well as techniques for linking the data visualization process with data management.

4) Science Compute Facility

I will define the networking infrastructure required for our SCF. This will likely include Fiber Channel Standard (FCS) for linking high-speed equipment. I hope to acquire a router than can handle multiple protocols to sit between the high-speed fabric and the College local area network.

5) Data Analysis

I will complete the drifter manuscript and submit it for publication. I will complete the view angle analysis and begin to write the accompanying manuscript.

Problems/Corrective Actions

The only problem has been the difficulty in locating a suitable data management person. This should be solved in the next few weeks; I have received applications from several qualified individuals.