QUARTERLY REPORT

(for January - March 1994)

Contract No. NAS5-31363

# OCEAN OBSERVATIONS WITH EOS/MODIS: Algorithm Development and Post Launch Studies

by

Howard R. Gordon
University of Miami
Department of Physics
Coral Gables, FL 33124

Submitted April 12, 1994

I shall describe developments (if any) in each of the major task categories.

## 1. Atmospheric Correction Algorithm Development.

### a. Near-term Objectives:

(i) Investigate the effects of stratospheric aerosol on the behavior of the proposed atmospheric correction algorithm.

(ii) Investigate the effects of vertical structure in the aerosol concentration and type on the behavior of the proposed atmospheric correction algorithm.

(iii) Investigate the effects of polarization on the behavior of the proposed atmospheric correction algorithm.

(iv) Begin examination of ways to improve the accuracy and the speed of our implementation of the proposed algorithm.

### b. Task Progress:

(i) We have added a third layer to our radiative transfer code to include stratospheric aerosols. A literature search was carried out and three stratospheric aerosol models were selected representing a background stratospheric aerosol, a fresh volcanic aerosol, and an aged volcanic aerosol. Computations of the optical properties of the aerosol were carried out and radiative transfer simulations have been started.

(ii) A Monte Carlo code employing a 50-layer atmosphere is being developed to carry out this investigation. It will also include the effects of a rough surface. We envisage this code will eventually emerge as our standard for producing pseudo MODIS data with which to test our correction algorithm.

(iii) Polarization effects will be added to the code in (ii); however, probably not during the next quarter.

(iv) In the implementation of our correction algorithm, extensive lookup tables are required for each aerosol model we employ. These give radiances for the various viewing directions and solar positions. The viewing and solar azimuths are incorporated via a Fourier transform (series). [For a complete description, see the MODIS water-leaving radiance ATBD.] We have started to investigate the use of azimuthal interpolation in place of the Fourier transform. This will increase the size of the tables; however, it may increase the speed. Also, the radiances for eight aerosol optical depths were fit to a simple linear expression in optical depth. We found that the fit was greatly improved by using a quadratic expression in place of the linear. In the implementation using the Fourier transform, this increases the size of the lookup tables by 50%.

c. Anticipated Activities During the Next Quarter:

(i) Continue radiative transfer simulations to produce pseudo data. Analyze the pseudo data by inserting it in the present implementation of the correction algorithm and examining the accuracy of the resulting correction.

(ii) Finish development of the Monte Carlo code and begin simulations using realistic vertical profiles.

(iii) Begin considerations for adding polarization effects to the Monte Carlo code in (ii).

(iv) Complete the study of improving the speed by carrying out studies of the timing and accuracy of the Fourier transform vs. interpolation schemes for incorporating the azimuthal variations of the radiance.

2. Whitecap Correction Algorithm.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: Revise the the paper that was submitted to Applied Optics on whitecap effects.

3. In-water Radiance Distribution Schedule.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: None, progress requires data acquisition at sea. Next opportunity for such appears to be November 1994.

4. Residual Instrument Polarization.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: None.

5. Direct Sun Glint Correction.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: None.

6. Prelaunch Atmospheric Correction Validation Schedule.

a. Near-term Objectives: The objectives of this task are two fold. First, we need to demonstrate that our atmospheric correction scheme will work to the required accuracy. To effect this we will apply the algorithm to compute the sky radiance in the blue from measurements in the near infrared. We should be able to do this to about the same accuracy as looking downward from space. Second, we need to study the aerosol phase function and its spectral variation in order to verify the applicability of the aerosol models. To effect these requires instrumentation for measuring the sky radiance and the optical thickness of the atmosphere. Such instrumentation is available in our laboratory and has been modified to operate with the relevant MODIS spectral bands. Our near-term objective is to learn how to invert sky radiance to obtain aerosol optical properties, to carry out such inversions, and to study the variation of the phase function with wavelength.

b. Task Progress: We have planned a field trip to Key West, FL in early April to obtain sky radiance and other aerosol data. Key West is a small island and was chosen to simulate as much as possible measurements made from a ship, i.e., to reduce the perturbation by the land as much as possible.

c. Anticipated Activities During the Next Quarter: We plan analysis of sky imagery obtained at Key West for the aerosol optical properties. We hope this will allow us to identify the significant experimental and computational problems involved in

the retrieval process and to begin to address them. To retrieve the aerosol properties, a nearly perfectly cloud-free sky is required. If weather conditions during the first trip are unfavorable, i.e., the sky is never cloud free, a second trip to Key West will be carried out in late May or early June.

We are continuing our design of a solar aureole camera; however, with the anticipated funding cuts, it appears unlikely that we will be able to build it.

7. Detached Coccolith Algorithm and Post Launch Studies.

a. Near-term Objectives: Complete ATBD.

b. Task Progress: Completed ATBD.

c. Anticipated Activities During the Next Quarter: We will begin detailed analysis of the backscattering by detached coccoliths and its dependence on species.

8. Post Launch Vicarious Calibration/Initialization.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: None.

9. Single Scattered Aerosol Radiance and PAR Algorithms.

a. Near-term Objectives: None.

b. Task Progress: None.

c. Anticipated Activities During the Next Quarter: None.

## OTHER DEVELOPMENTS

The PI and other personnel on the project devoted virtually all of their effort on the project in January and February toward revising the Algorithm Theoretical Basis Document (ATBD) for normalized water leaving radiance. The ABTD's for Normalized water-leaving radiance (along with aerosol products) and detached coccoliths were delivered to M. King on February 28, 1994.