Quarterly Report for June - September, 1996
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Abstract

The algorithm-development activities at USF during the third quarter of 1996 have concentrated on field data collection and theoretical modeling. Four bio-optics experiments were conducted: one weekend cruise (TWIST) to Anclote Key, FL., one cruise in Dry Tortugas area (Cobop 96) accompanied by a NOAA P3 airplane overflight, two cruises in South China Sea, and one in Chesapeake Bay area. Two abstracts were submitted for a conference presentation in Halifax, Canada.

Tasks Accomplished:

1. Four research expeditions were completed:

   a. Coastal Benthic Optical Properties (COBOP 96)

      1) July 10 - July 24

      2) ONR-funded ship time and aircraft overflight time

      3) Three major transect lines in coral reef environment were studied along with, one deep water, oligotrophic station offshore used to calibrate airplane data.

      4) Data set useful for developing bottom-discrimination algorithms and to observe error induced by bottom reflectance.

   b. East China Sea (two cruises)

      1) July 15 to August 12

      2) Taiwan NSF-funded ship time

3) Transects from Kuroshio onto the continental shelf and into coastal plumes from rivers.

4) Test and modify Case II chl a algorithm for CDOM-rich waters.

c. Chesapeake Outflow Plume Experiment I (COPE I)

1) September 13 to 28

2) ONR-funded shiptime on R/V Seward Johnson

3) Transects from the mouth of Chesapeake Bay to Cape Hatteras

4) Test and modify Case II chl a algorithms for CDOM-rich waters.

d. TWIST cruise to Anclote Key, Florida

1) July 1996

2) ONR-funded shiptime on R/V Bellows

3) Gain knowledge about the phytoplanton population size distribution and understand the effects of pathlength elongation on various sizes and types of phytoplankton.

2. An abstract titled " Protocols for R_{rs} measurements from clear to turbid waters ". By Lee at el. was submitted to the Ocean Optics XIII conference in Halifax, Nova Scotia, Canada, Oct. 22-25, 1996 for presentation.

Remote-sensing reflectance (R_{rs}, ratio of the water-leaving radiance to downwelling irradiance just above the surface) and inherent optical properties of oceanic waters are important parameters for ocean optics. Due to surface reflectance, R_{rs} or water-leaving radiance is difficult to measure from above the surface. It usually is derived by correcting for the reflected skylight in the measured above-water upwelling radiance using a theoretical Fresnel reflectance value (Quick-and-Easy method). The errors of this method derived R_{rs} will be getting bigger for coastal

waters where the blue signals are low. We partition the skylight into Rayleigh and aerosol contributions, remove the Rayleigh contribution using the Fresnel reflectance, and correct the aerosol/glint contribution using optimization algorithm. During the process, R_{rs} and in-water inherent optical properties are derived at the same time. For measurements of 45 sites made in the Gulf of Mexico and Arabian Sea with chl_a concentrations ranging from 0.07 to 49 mg/m^3, the derived R_{rs} and inherent optical property values were compared with those from in-water measurements. It was found that the ratios of $R_{rs}(440)/R_{rs}(550)$ were very consistent with in-water values (- 10% Root-Mean-Square-Difference for chl_a < 1.5 mg/m^3). Also, for chl_a < 1.5 mg/m^3, the Quick-and-Easy (Q&E) method derived R_{rs}.

3. A paper titiled " Polarization of remote-sensing reflectance measured 90^o to the solar plane" by Lee, Z.P., Carder, K.L., Peacock, T.G., Steward, R.G., was submitted to the Ocean Optics XIII conference in Halifax, Nova Scotia, Canada, Oct. 22-25, 1996 for presentation.

Remote-sensing reflectance (ratio of the water-leaving radiance to the downwelling irradiance above the surface) were derived for measurements made in a plane 90^o to the solar plane and in a direction 30^o to nadir. These measurements, carried out to see if the water-leaving radiance in that direction is highly polarized, were made with and without a vertical polarizer in front of the sensor. For 28 pairs of measurements with chlorophyll_a concentrations ranging from 0.07 to 38 mg/m^3, sun angles from 18^o to 66^o from zenith, clear to cloudy skies, and for optically shallow and deep waters, we did not see significant variations between the polarized and unpolarized results. Statistical comparisons of polarized to unpolarized results provided R^2 values of 0.990, 0.998, and 0.999 with slopes 1.011, 0.981 and 1.009 for wavelengths at 440, 550 and 630 nm, respectively. These results suggest that although the under water light field is partially polarized, the water-leaving radiance 90^o to the solar plane and 30^o (22^o underwater) to

the nadir is not highly polarized.

Anticipated Activities:

1. The relationships between temperature anomalies and the packaging effect and nutrients will be explored in order to reduce uncertainty in the chlorophyll algorithm Bering Sea dataand upwelling data from Arabian Sea , Montery Bay and East China Sea will be used in the analyses.

2. Identifying AVIRIS images containing well defined clouds and shadows using machine learning methods(neural networks) before the images have been calibrated and corrected for atmospheric effects will be attempted.

3. Two papers are in preparation by Lee et al.: a. "Removal of reflected sky-light and retrieval of in-water inherent optical properties using water remote-sensing reflectance". And b. "Polarization of remote-sensing reflectance measured at 90 degrees to the solar plane".

4. Research expeditions to be completed :

a. Gulf of Mexico (Loop Current, Dry Tortugas)

1) November 14 to 21

2) MODIS-funded shiptime

3) Transects from the Florida Keys into the Loop Current .

4) Test/modify Case I and Case II MODIS algorithms using OCTS data for the first time.