

COASTAL MIXING AND OPTICS

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LONG-TERM GOALS

The long-term goal of this study is to relate optical and fluid dynamic processes on scales of centimeters to tens of meters in the vertical.

OBJECTIVES

The objectives of this study are to address the following questions:

- Under what circumstances do the physical forcing mechanisms determine the optical properties and hence radiative transfer?
- Does mixing affect the dissolved and particulate components differently?
- Can the distribution of dissolved and particulate optical substances be used as tracers of physical processes?
- How is radiative transfer affected by small-scale layering of optical properties?

APPROACH

Our approach is to combine two seasons of field data collected at the Coastal Mixing and Optics central site, along with observations and data from other investigators to compare and contrast the relationships between the optical and physical distributions during two distinct time periods.

We participated in the second year field campaign aboard the R/V Knorr. Six scientific groups participated in this cruise, sampling a complete suite of hydrographic and optical properties during the daytime, and microstructure profiling during the night. Our sampling

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employed the SLOW Descent Rate Optical Platform (SLOWDROP) which measures the small-scale (centimeters) hydrographic and optical properties of the water column.

We are performing analysis of the data collected by our group on board the R/V Seward Johnson during the first year of the Coastal Mixing and Optics program. We are collaborating with other groups involved with this program to gain more insight to the questions stated in the objectives.

WORK COMPLETED

We completed collection of IOP data during the 1997 Coastal Mixing and Optics cruise aboard the R/V Knorr from April 24 to May 13, 1997. The SLOW Descent Rate Optical Platform (SLOWDROP) was used to obtain high vertical resolution (~ 4 cm) measurements of optical and hydrographic parameters. Mounted on the platform were a SBE 911+ CTD, an unfiltered WET Labs ac-9, a filtered ($0.2 \mu\text{m}$) ac-9, a spectral fluorometer (SAFire), a prototype backscattering meter, and a TRACOR WHAPS (high frequency acoustic instrument). A WET Labs MODAPS unit was used to archive the data from the instruments. From the ac-9 measurements we are able to derive total, particulate, and dissolved absorption with the total attenuation and scattering coefficients.

During the first half of this cruise, we collected over 100 vertical profiles. During the second half of cruise, we integrated two of our ac-9's onto the Texas A&M University's POPS sampling platform. Using this configuration we collected an additional 50 profiles.

We have processed the entire data set collected during the 1996 and 1997 cruises and have made them available via our anonymous ftp site (photon.oce.orst.edu) and via CDROM.

We have worked with the OSU SeaSoar and mooring groups to provide vicarious calibrations of their instruments.

We have utilized the IOP data and the apparent optical data coefficient data provided by Dr. Sosik (WHOI), to test the relationships between the absorption and diffuse attenuation coefficient (Zaneveld, et. al., 1996).

The IOP data from both the 1996 and 1997 cruises has been used in development of a remote sensing IOP spectral model (Barnard, et. al., 1997).

RESULTS

Analyses performed on the 1996 SLOWDROP data collected from the Coastal Mixing and Optics central site, and with the collaboration of other investigators, we observe the following results.

- Strong vertical stratification allowed solitons to exist. Internal waves were responsible for the greatest portion of the vertical variability on time scales of one hour or less (Fig. 1).
- A salinity intrusion occurred with no apparent optical signature. This may imply that non-physical processes are important in determining the vertical structure of the optical parameters in this region.
- The formation and destruction of a pronounced peak in the phytoplankton distribution was observed over the course of approximately 4 days (Fig. 2). Mixing levels measured by Dr. Gregg's group (UW) did not indicate unusual mixing conditions during this period. We are currently working with Dr. Barth's group (OSU) to determine if this feature was the result of an advected phytoplankton patch.
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- Hurricane Eduoard resulted in the largest mixing event (Zaneveld, et. al., 1997; see Fig. 2).

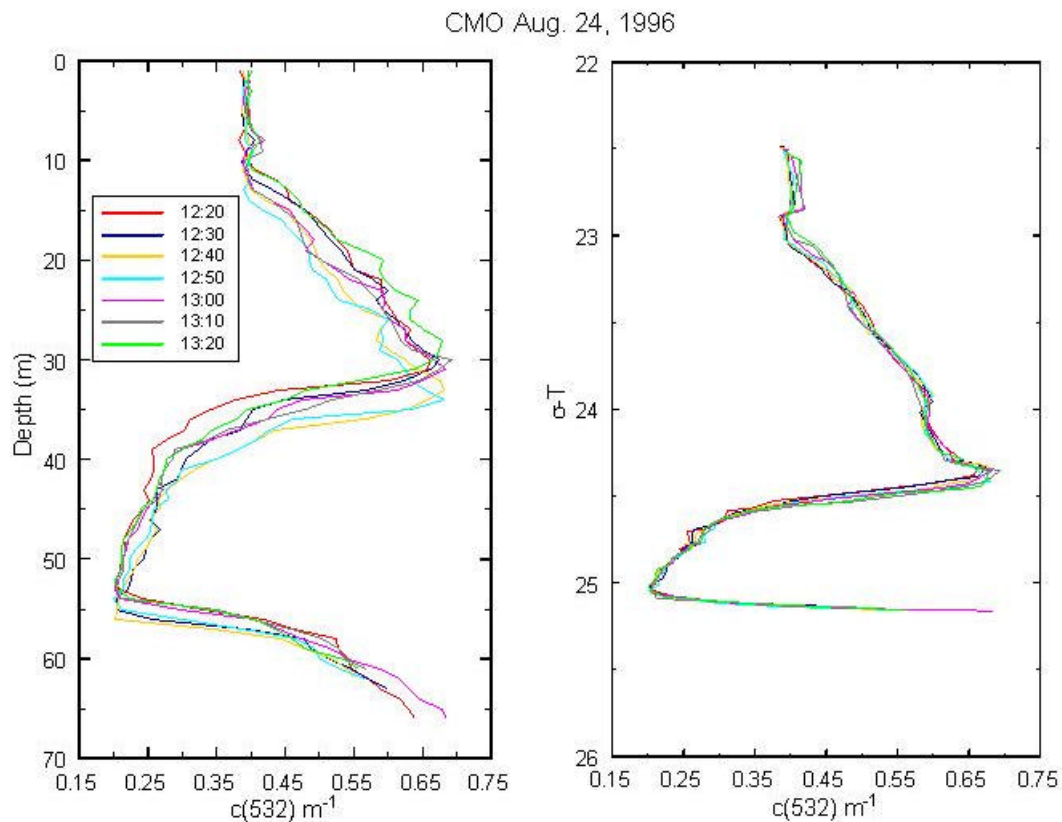


Fig. 1 - Beam attenuation at 532 nm during one hour of sampling is plotted versus depth and density.

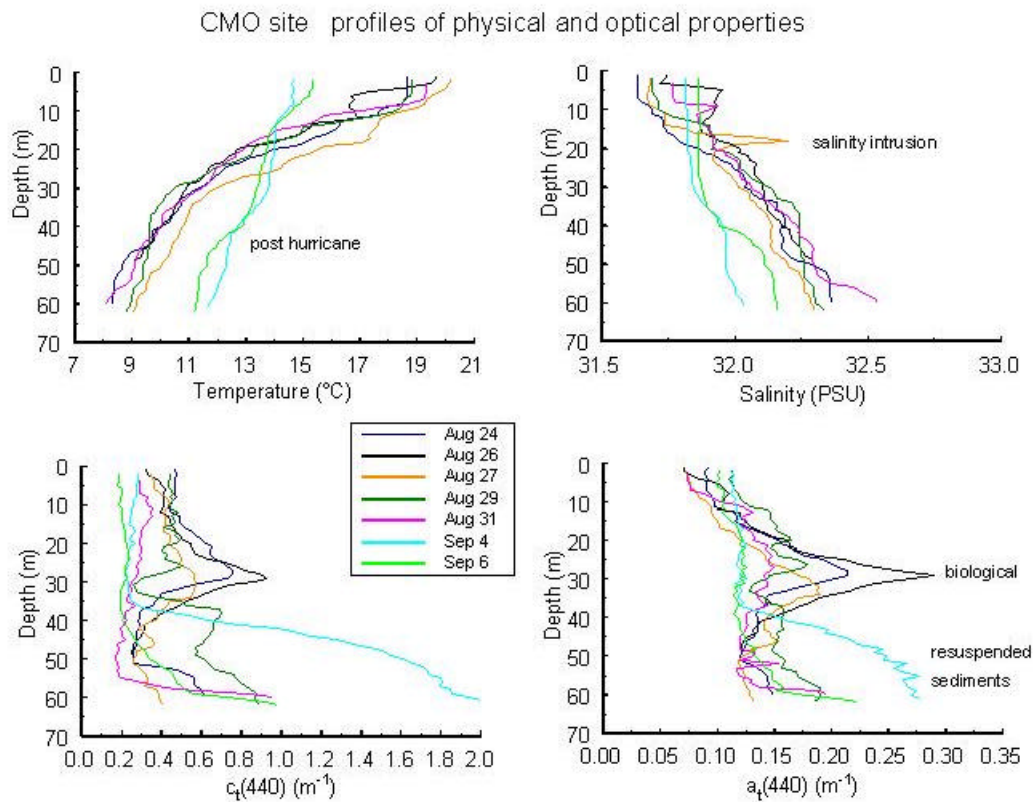


Fig. 2 - Profiles of physical and optical parameters collected during the 1996 CMO cruise.

From an initial analyses of the 1997 SLOWDROP data in comparison to the results from the 1996 campaign, we observe the following.

- Weaker vertical stratification and higher wind speeds provided for stronger mixing. This provided more uniform distribution of optical properties, thus reducing the short-time scale variability.

IMPACT/APPLICATIONS

The 1996 and 1997 data sets will be useful in estimating time and space scales in which physical and biological processes control the distribution of optical material. The

contrasts between the two data sets will provide information on the influence of stratification and mixing on the optical variations and signatures.

TRANSITIONS

We have worked with the OSU mooring and SeaSoar groups to provide assistance in vicarious calibrations of the absorption and attenuation data. Our high resolution data has also assisted these groups in relating the large-scale distributions to the finer scale.

We have assisted the microstructure group (UW) with interpretation of their scattering instrument data.

We have worked Dr. Sosik to provide assistance in relating the apparent and inherent optical property measurements.

This data is also provided to the NASA SIMBIOS project office as a calibration and validation data set for the ADEOS/OCTS ocean color sensor.

RELATED PROJECTS

NASA SIMBIOS – optical data provided to NASA for validation and calibration data for the ocean color remote sensing platforms.

NASA SeaWiFS – data implemented in our global IOP data set for use in developing new ocean color remote sensing algorithms.

This data provides spectral IOP signature and distribution information in coastal waters for use in comparison to other ONR data sets (COPE; LOE).

The LOE and CMO data sets provide information on the constraining effects of individual physical mechanisms (such as internal waves) on the IOP structure.

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