Oceanographic Expedition Bloom 2008

Optical and Hydrographic Characterization of Microalgal Blooms Along the Continental Shelf of Argentina

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Introduction

The oceanic circulation between 40° and 60° S is controlled by the Antarctic Circumpolar Current (ACC), a strong, eastward-flowing current that, in the absence of land masses, circles the globe around Antarctica. A branch of the ACC, the strong, cold Malvinas Current, flows northward along the continental shelf of Argentina until it reaches the weak, warm southward-flowing Brazil Current offshore the Rio de la Plata estuary (south-western margin of the south Atlantic subtropical gyre) (Figure 1). The sharp gradient in temperature and salinity associated to the confluence of these two currents generates highly energetic interactions and the formation of mesoscale eddies, characterized by alternating zones of low and high-productivity. Another major feature that contributes to the complexity of the region is the large input of nutrients, colored dissolved organic matter (CDOM) and sediments from the riverine discharge of Rio de la Plata. The combination of all these factors stimulates the proliferation of phytoplankton blooms along these Argentinean waters.

BLOOM 2008 was an oceanographic expedition sponsored by the Instituto Canario de Ciencias Marinas (ICCM) in Gran Canaria (Spain) and conducted aboard the Spanish Research Vessel Hespérides (Figure 2). This international expedition departed on March 13 from Punta Arenas, Chile and ended on March 28, 2008 in Mar del Plata, Argentina. The main goals of this oceanographic cruise were: (1) to gain a comprehensive knowledge about the inherent optical properties (IOPs) of the phytoplankton communities and CDOM along the continental shelf of Argentina; (2) to evaluate the relationship between these IOPs and the hydrographic characteristics; (3) to characterize the composition of phytoplankton communities and CDOM based on their optical properties; (4) and to develop new algorithms for the classification of phytoplankton blooms based on ocean color data obtained from satellites. A total of twenty-seven stations (seven transects) (Figure 3) were sampled between Puerto Deseado (67°02' S, 52°37' W) and Mar del Plata (57°09' S, 38°47'W). Stations selection was based on near real-time ocean color imagery to ensure sampling within phytoplankton bloom areas. Data acquisition combined radiometric, hydrographic and taxonomic components.

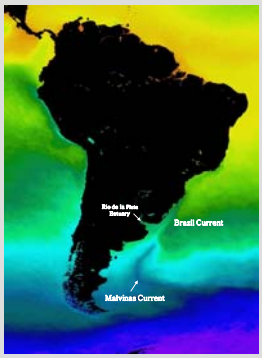

Figure 1. MODIS-Aqua SST (2007 annual average) showing major currents influencing the Argentinian continental shelf.

Figure 2. Spanish Research Vessel Hespérides.

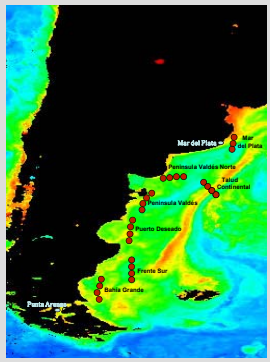

Figure 3. MODIS-Aqua (February 2008 monthly average) Chlorophyll image showing microalgal blooms and location of transects and sampling stations.

Participating Institutions

- Instituto Canario de Ciencias Marinas (ICCM)
- Universidad de Puerto Rico-Mayagüez (UPRM)
- Universidad de Vigo (UV)
- Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP)

Figure 4. Scientific personnel that participated in BLOOM 2008.

Taxonomic component

The characterization of phytoplankton populations involved flow cytometry (Figure 5) and light microscopy techniques.

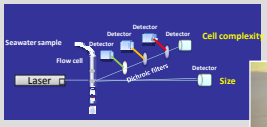

Figure 5. Flow cytometry diagram (above) and the Becton Dickinson FACScalibur flow cytometer used on board (right).

Acknowledgements

Participation of Deborah Cedeño and Yasmín Detrés was sponsored by the NOAA Center for Atmospheric Sciences (NCAS) and by the UPR Sea Grant College Program.

Hydrographic component

A CTD/rosette was deployed at the oceanographic stations. From the water samples collected the following analyses were p

- Chlorophyll, salinity, temperature and oxygen profile determinations.
- Nutrients (colorimetry), photosynthetic pigments (HPLC), dissolved oxygen (titulation), CDOM spectrofluorometry and particulate matter absorption.

Figure 6. CTD/rosette and instruments employed for the hydrographic characterization.

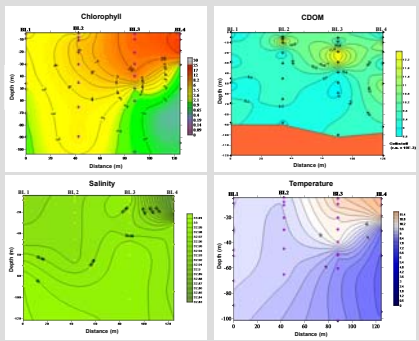

Figure 7. Graphic examples of some hydrographic parameters measured during BLOOM 2008.

Radiometric component

Above surface and underwater apparent optical properties (AOPs), including water-leaving radiance (Lw) and downwelling irradiance (Ed), were measured using a GER 1500 spectroradiometer and a Satlantic OCP-100FF multispectral radiometer, respectively. The GER 1500 data were used to determine remote sensing reflectance (Rrs), an optical property that can be related to the IOPs and is used to validate ocean color satellite sensor data. Satlantic data were used to generate the reflectance factor and vertical attenuation coefficient (Kd) profiles.

Figure 8. GER 1500 spectroradiometer (left) and Rrs spectra corresponding to Bahía Grande transect (right).

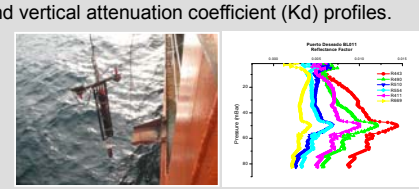

Figure 9. Satlantic OCP-100FF radiometer (left) and reflectance profile corresponding to Puerto Deseado transect (right).