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The role of physical forcing on the structure of inherent and apparent optical properties in the Po River plume

B. Jones (1,3), I. Cetinic (1,4), C. Lee (2), Z. Zheng (1), and M. Ragan (1)

(1) Marine Environmental Biology, University of Southern California, Los Angeles, CA, USA, (2) Applied Physics Laboratory, University of Washington, Seattle, WA, USA, (3) Marine Environmental Biology, University of Southern California, Los Angeles, CA, USA (bjones@usc.edu / Fax: 01 213-740-8123 / Phone: 01 213-740-5765), (4) Division of Biology, Faculty of Science, University of Zagreb, Zagreb, Croatia

The discharge of the Po River into the northern Adriatic Sea is the major process contributing to bio-optical properties in this region. The plume of the Po River was mapped in February 2003 and June 2003, using the Trisoarus towed undulating vehicle equipped with a CTD, WetLabs AC9 for inherent optical properties, chlorophyll and CDOM fluorometers, beam transmissometer and dissolved oxygen sensor. The physical forcing of the system differed dramatically between the two seasons. During February, the Po River discharge rate was approximately 1250 $m^3 \cdot s^{-1}$, about average for this period. Frequent Bora Wind forcing structured the plume into a narrow feature that projected across the basin and penetrated nearly the entire water column. In contrast, river discharge during June averaged about 600 $m^3 \cdot s^{-1}$, about one third of the average rate for this season, and wind forcing was minimal during this period.

The vertical and horizontal distributions of optical properties are complex in the river regime. During winter, the regions adjacent to the plume were well mixed both physically and optically, with the exception of some near-bottom nepheloid layers. Within the plume stratification imposed by the plume buoyancy resulted in multiple layers including a nearsurface low salinity layer high in suspended particulate and CDOM attenuation, a mid-depth particle maximum, and occasional bottom nepheloid layers. Chlorophyll concentration was comparatively low within the plume despite high nutrient concentrations. Therefore, upper layer optical characteristics within the plume were primarily affected by terrigenous suspended particulate matter, and to some extent CDOM.

Despite the seasonally low river discharge rate during early summer, the lack of strong wind forcing enabled the plume to spread widely over the surface of the northern Adriatic Sea. The resulting thin, strongly stratified surface layer was high in phytoplankton abundance, CDOM, and suspended particulate material. The intermediate water column was relatively low in suspended particulate material and a nepheloid layer near bottom again resulted in high attenuation. Both phytoplankton and CDOM contributed to the high optical absorption in the upper layer. Because nearsurface layer was thin, but optically dense, remote sensing reflectance was not well correlated with subsurface optical properties.