NUTRIENTS AND SUSPENDED MATTER IN THE PO RIVER PLUME (ADRIATIC SEA) DURING A RECENT FLOOD EVENT.

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Abstract

After the Po River flood occurred in October 2000, an oceanographic survey was carried out in the prodelta area of the northern Adriatic. The flood supplied highly turbid freshwater, rich in inorganic nutrients, which was dispersed following the main cyclonic circulation. The suspended sediment settled close to the coast. In the southern branch of the plume, the decrease in turbidity and the availability of nutrients favoured the development of phytoplankton blooms.

Key Words: Po River - Flood Dispersion - Adriatic Sea

Introduction

In October 2000, after a long period of intensive precipitation particularly over the northwestern part of Italy , a flood of the Po River took place causing great damage along most areas of the river basin. The Po River, 673 km long, is the largest Italian river and supplies over 50% of the fresh water to the northern Adriatic basin. The river input heavily influences the hydrodynamics and biogeochemistry of the Adriatic, and it represents one of the greatest freshwater contributors to the Mediterranean Sea. The annual mean river discharge is approximately 1500 m^3 s^{-1}, with 2 relative peaks of 2,000-4,000 m^3 s^{-1} in spring and in autumn. The river provides about 50% of the external annual input of nutrients to the northern Adriatic, and it has been estimated that this input of nutrients is of the same order of magnitude as the regeneration rate (1).

During the flood event, the water discharge reached 12000 m^3 s^{-1}, with a daily mean maximum value of 9650 m^3 s^{-1}, representing the highest flood of the last decade and one of the major flood events in the past century after that which occurred in 1951.To study the effects of the flood event in the Adriatic coastal area and the dispersion of the suspended matter supplied by the river, a few days after the Po River flood water reached the Adriatic Sea (26-27 October 2000), an oceanographic survey , on board the Italian R/V *U. D'Ancona* (IBM, CNR) was carried out in the prodelta area.

A pool of 27 stations, along 5 transects offshore the river mouths was sampled (Fig.1). Continuos vertical CTD profiles of temperature, salinity, pH, dissolved oxygen, fluorescence and turbidity were performed at each station, and at selected stations discrete water samples were collected for determination of dissolved oxygen, pH, total suspended matter (dry weight), particulate organic carbon, particulate nitrogen, organic carbon stable isotopes, dissolved nutrients, particle size spectra and concentration, and phytoplankton abundance and composition.

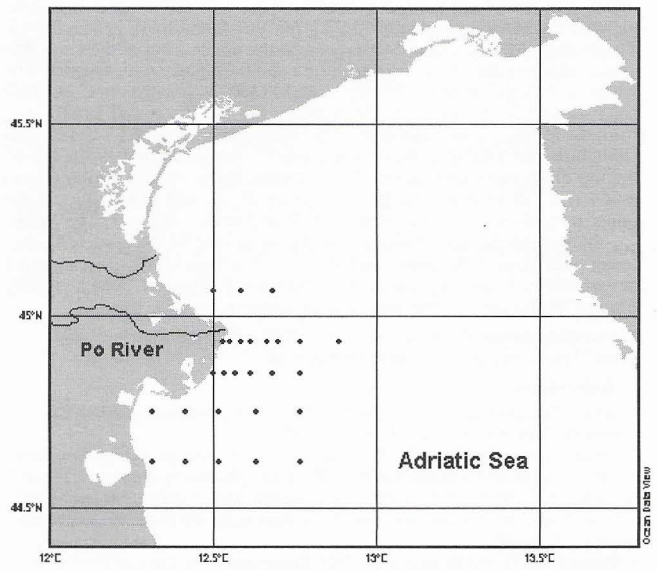

Fig. 1. Sampling stations

Results and Discussion

During the flood event, the river plume spread eastward and southward following the main cyclonic circulation. A thin surface layer (1-1.5 m thick) of very low salinity water (P.S.U. ranging from 2.23 to 10.85), extended out of the main river mouth to about 18 km from Punta Maestra. This layer displayed high turbidity and suspended matter concentration that was mainly inorganic in nature. Total suspended matter was on average 11.4 mg l^{-1}, with a peak value of 15.8 mg l^{-1} and a mean particle concentration of 185 x 10^3 particles cm^{-3}. The fine lithogenic fraction (particle diameter < 5 μm) was prevalent and the organic δ ^{13}C values were very negative, down to -26.81‰, confirming the terrestrial origin of the organic particulate material (2).

The surface layer showed high concentrations of dissolved inorganic nitrogen (DIN), SiO_4 and PO_4 (maximum values for DIN =112 μM, SiO_4 =122 μM and PO_4 =1.14 μM) in the eastward branch of the riverine plume.

In the low salinity water in front of the main river mouth, phytoplankton abundance and biomass were not particularly high (7.9 x 10^5 cell l^{-1}; 16.4 μgC l^{-1}, respectively), probably due to the high turbidity. The algal community was mainly represented by nanoflagellates and diatoms, together with some freshwater species belonging to chlorophyceans and cyanophyceans.

In the southward branch of the plume, surface salinity progressively increased to values higher than 10 P.S.U.; the decreased turbidity and the availability of inorganic nutrients favoured the development of phytoplankton blooms, with oxygen saturation values up to 200%, high fluorescence, and POC concentration reaching 2 mg l^{-1}. Here, the δ ^{13}C values were less negative (up to -21.38‰) indicating a marine origin of the POC. At the surface, nitrate, silicate and phosphate concentrations decreased probably as a consequence of the consumption by the phytoplankton bloom, whereas high NH_3 and PO_4 concentrations were found near the bottom where regeneration processes prevailed. The phytoplankton bloom at the surface was mainly composed of diatoms with an abundance of 50 x 10^6 cell l^{-1} and biomass of 1144 μgC l^{-1}, which represented more than 55% of the POC.

In the prodelta area close to the coast, high suspended matter concentration (up to 30 mg l^{-1} and particle concentration 300 x 10^3 particles cm^{-3}) with particles of larger diameters (~ 6-8 μm), and low δ ^{13}C values were recorded near the bottom indicating that flocculation processes and rapid vertical transfer of the suspended sediment to the seabed were effective (3).

Suspended-sediment inventory in the benthic nepheloid layer was similar to that in the surface plume. Considering the limited water energy observed at that time, the sediments rapidly transferred to the seabed during the flood are assumed to have a high potential for resuspension during more energetic conditions in the Northern Adriatic.

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