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Physical and biogeochemical processes controlling particle fluxes variability and carbon export in the Southern Adriatic

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In open ocean, the pool of particulate organic carbon is mainly determined by phytoplankton production occurring in the upper water column, which in turn is controlled by nutrients availability, supplied by the seasonal mixing, deep convection events and coastal-offshore exchanges. Then, the biological pump controls the transport of carbon from the upper surface layer to the deep ocean and further to the sediment. Moored intercepting sediment traps have proven to be very useful tools to study the temporal variability of sinking matter in the deep ocean, where primary productivity may be estimated by the amount of the organic matter that falls out from the photic zone. In contrast, along the continental margins, gravity-driven processes as submarine landslides, turbidity currents and dense water cascading events may episodically transfer large amounts of sediment and organic matter to the deep ocean, which may have a significant impact on the supply of organic matter to deep-sea ecosystems and on the amount of carbon stored on continental margins and in ocean basins.
The Adriatic Sea is one of the major sites of dense water formation in the Mediterranean Sea. Two different dense water generation processes have been described: 1) a shelf type, occurring during cold and dry winters in the North Adriatic (North Adriatic Dense Water), which spreads southward along the western Italian shelf and cascades in the southern Adriatic basin; and 2) a deep-convection type, which takes place in late winter–early spring in the centre of a permanent cyclonic gyre in the southern Adriatic, which vertically mixes the water column down to variable depths.
In this study we show downward particle fluxes measured in a station located in the centre of the Southern Adriatic Pit from November 2006 to August 2008 with the aim to investigate the main physical and biogeochemical processes controlling particle fluxes variability and carbon export in the Southern Adriatic sea.
Sediment trap samples were collected at two different depths, below the photic layer (168 m) and near the bottom (1174 m), and analysed for total mass flux, for total and organic carbon, total nitrogen, carbonates, stable isotope of organic carbon (δ13Corg) and biogenic silica contents. The results have been integrated and compared with data obtained from previous research projects, carried out in the same area in 1994-1995 and 1997-1998, and in the Bari canyon, along the western margin of the Southern Adriatic Sea during 2004-2005.
Fluxes of particulate matter showed high seasonal and interannual variability, with maximum values in late winter-spring season. The organic carbon flux, followed the same seasonal trend, with higher values below the photic zone and peaks in spring, related to blooms of silicates and/or carbonates phytoplankton organisms (e.g. diatoms, coccolithophorids). The organic carbon export from the photic layer was of 5.2 g C m-2 y-1, and 2.1 g C m-2 y-1 reached the bottom. Climatological cycles, and, in particular, the maximum depth of the convective vertical mixing determined the high fluxes measured in 1998 and in 2008 springs.
Total mass fluxes measured at the bottom trap were twofold those measured below the photic layer, and showed a high lithogenic fraction, highlighting the presence of advective processes that appear particularly active in the area. These processes can be correlated with the spreading of dense waters coming from the north and central Adriatic, generally observed in spring. The elemental and isotopic composition of bottom trap samples, resulted similar to that of samples collected in the south-western Adriatic slope, corroborating the assumption that lateral advection other than vertical input were contributing to bottom particle fluxes.