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Po river plume patterns variability and dynamics: a numerical modeling and statistical approach.

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Processes and dynamics of estuarine-shelf environments are defined by many drivers, some of the most important being riverine inputs, winds (and wind driven currents) and tides. Two of them are directly involved in the formation and spatial evolution of a coastal river plume: on the one hand the amount of fresh water entering into the sea through river' discharge, on the other hand the direction and intensity of winds blowing over the domain.
The Adriatic Sea is generally considered a dilution basin due to the large amount of freshwater inputs received. These inputs have a significant influence on the basin, both from a physical point of view (by affecting buoyancy) and on the biogeochemical characteristics (by introducing large quantities of nutrients, which sustain primary production in the areas interested by the rivers' plumes). The Po River (mean daily discharge between 275 and 11600 m3/s, yearly mean of 1500 m3/s) is the single largest freshwater source of the Adriatic; its discharges result in a plume that directly influences the characteristics of the coastal areas of the whole Northern sub-basin and as far South as Ancona. The development of strong lateral gradients in salinity is an all year around driver (particularly in Spring and Autumn) of the general and coastal circulation, and influences the water column vertical structure and an important process such as the formation of the Northern Adriatic Dense Water.
The Po plume generally follows two major patterns of evolution: southward along the Italian coasts in a ribbon that can fill the whole water column, or across the northern part of the basin toward the Istrian coasts in a generally more stratified condition.
A model-based assessment, albeit semi-quantitative, of the dynamics and variability of the Po plume has not been yet reported in literature. In this work we investigated its dynamics by means of an 8 years (2003-2010) numerical simulation with the Regional Ocean Modelling System (ROMS). The model has been implemented on a 2 km regular grid for with surface fluxes come from an high-resolution meteorological model (COSMO I7), open boundary conditions at Otranto Straits come from an existing operational Mediterranean model (MFSTEP), main diurnal and semidiurnal tidal components are imposed at the open boundary, and main rivers discharge (including Po) are introduced as freshwater mass fluxes as measured by river gauges closest to the rivers' mouths.