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Po River plume and Northern Adriatic Dense Waters: a modeling and statistical approach.

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The semi enclosed Adriatic Sea, located in the North-Eastern part of the Mediterranean Sea, is a small regional sea strongly influenced by riverine inputs. In its northern shallow sub-basin both the physical and biogeochemical features are strongly influenced by the Po River (together with some other minor ones) through its freshwater plume, by buoyancy changes and nutrients and sediments loads. The major outcomes of this interaction are on primary production, on the rising of hypoxic and anoxic bottom water conditions, on the formation of strong salinity gradients (that influence the water column structure and both coastal and basinwide circulation) and on the formation processes of the Northern Adriatic Dense Water (NAdDW).

The NAdDW is a dense water mass that is formed during winter in the shallow Northern Adriatic under buoyancy loss conditions; it then travels southwardly along the Italian coasts reaching the Southern Adriatic after a few months. The NAdDW formation process is mostly locally wind driven but it has been proved that freshwater discharges play an important preconditioning role, starting since the summer previous to the formation period.

To investigate the relationship between the Po plume (as a preconditioning factor) and the subsequent dense water formation, the results obtained by a numerical simulation with the Regional Ocean Modelling System (ROMS) have been statistically analyzed. The model has been implemented over the whole basin with a 2 km regular grid, and surface fluxes computed through a bulk fluxes formulation using an high resolution meteorological model (COSMO I7). The only open boundary (the Otranto Strait) is imposed from an operational Mediterranean model (MFS) and main rivers discharges are introduced as a freshwater mass fluxes measured by river gauges closest to the rivers' mouths. The model was run for 8 years, from 2003 to 2010.

The Po plume was analysed with a 2x3 Self-Organizing Map (SOM) and two major antithetic patterns were found: i) a wide plume that extends well into the basin; ii) a smaller one confined to the coastal area.

We speculate that, beside the freshwater amount discharged, also the plume shape (i.e. its spreading) can play a role in preconditioning the wintertime NAdDW formation. To test this hypothesis, the probability distribution of the 6 SOM's Best Matching Units during the period of preconditoning are compared to the heat losses and the amount of dense water formed during the subsequent winter.