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Oceanographic modelling of the Northern Adriatic

Rodolfo Bolanos (1), Jacob Tornfeldt (1), Alvise Benetazzo (2), Sandro Carniel (2), and Mauro Sclavo (2)
(1) DHI, Agern Allé 5, DK-2970 Hørsholm, Denmark (rbol@dhigroup.com), (2) CNR-ISMAR, Arsenale-Tesa 104, Castello 2737/F, I-30122 Venice, Italy

The Adriatic Sea is located in the Eastern Mediterranean. It is approximately 780 km long and 200 km wide. Its central and southern portions have two large-scale depressions. The general circulation is cyclonic with southeastward flows along the western side and northwestward flows along the eastern side. The western coastline is characterized by the Po River delta.
Circulation in the Northern Adriatic is characterized by the interactions of tidal currents, bathymetric constraint, wind forcing and density gradients induced by river input and heat exchange. These interactions represent a challenge for numerical modeling and are the focus of the present work. Observations of current profile and numerical modeling are used to study the dynamics of the Northern Adriatic.
The 3D-modelling is performed with the MIKE 3 model. MIKE 3 is based on the numerical solution of the 3D incompressible Reynolds averaged Navier-Stokes equations subject to the assumptions of Boussinesq and of hydrostatic pressure. The free surface is taken into account using a sigma-coordinate transformation approach. Initial salinity and temperature conditions together with boundary temperature, salinity and current velocity components are obtained from daily MyOcean products. Boundary conditions from MyOcean are combined with half-hourly tidal boundary condition. The atmospheric forcing employed was provided by the Italian operational atmospheric model COSMO-I7, a local implementation of the Lokal Model. The model has a 7 km horizontal resolution providing outputs every 1 hour.
An ADCP installed at the Acqua Alta tower location is used to analyze the current temporal and vertical structure. The ADCP is bottom mounted at a depth of 16 m and with a vertical resolution of 1 m. The studied period is from 1 September 2010 to 31 August 2011 allowing the study of some of the seasonal features and different atmospheric events.
Observed surface velocity presents more variability than the bottom velocity and it is strongly influenced by wind events. However there are some strong events observed in the bottom velocity which can be very relevant for near bed processes. The model reproduce the main features of the Adriatic, a southeast current in the western part and a northwestern in the east. The wind represent the main forcing mechanism in the study location, atmospheric heat exchange and density gradients are of second order. Wave radiation stress did not show any significant contribution into the depth averaged velocity at the studied location, this however might not be the case in more nearshore locations. Spectra of observed depth averaged currents during the studied period showed a clear peak in the inertial period and another one in lower frequencies (33 hr). Interestingly model spectra presents a strong signal component in a semidiurnal period which is absent on the observations, this will be further discussed together with an assessment of the model boundary, general model setup and the methodology used for combining tidal and MyOcean boundary conditions, these issues are pre-requisites for consistent long term simulation of Northern Adriatic current velocities.