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Performance analysis of coupled and uncoupled hydrodynamic and wave models in the northern Adriatic Sea

Claudia Busca (1), Alessandro Coluccelli (1), Andrea Valentini (2), Alvise Benetazzo (3), Davide Bonaldo (3), Giovanni Bortoluzzi (4), Sandro Carniel (3), Francesco Falcieri (3), Tiziana Paccagnella (2), Mariangela Ravaioli (4), Francesco Riminucci (4), Mauro Sclavo (3), and Aniello Russo (1)

(1) Università Politecnica delle Marche, Life and Environmental Sciences, Ancona, Italy (c.busca@univpm.it), (2) Regional Environmental Agency of Emilia-Romagna, Hydro-Meteo-Clima Service, Bologna, Italy, (3) National Research Council, Institute of Marine Sciences, Venice, Italy, (4) National Research Council, Institute of Marine Sciences, Bologna, Italy

The complex dynamics of the Adriatic Sea are the result of geographical position, orography and bathymetry, as well as rivers discharge and meteorological conditions that influence, more strongly, the shallow northern part. Such complexity requires a constant monitoring of marine conditions in order to support several activities (marine resources management, naval operations, emergency management, shipping, tourism, as well as scientific ones). Platforms, buoys and mooring located in Adriatic Sea supply almost continuously real time punctual information, which can be spatially extended, with some limitations, by drifters and remote sensing. Operational forecasting systems represent valid tools to provide a complete tridimensional coverage of the area, with a high spatial and temporal resolution.

The Hydro-Meteo-Clima Service of the Emilia-Romagna Environmental Agency (ARPA-SIMC, Bologna, Italy) and the Dept. of Life and Environmental Sciences of Università Politecnica delle Marche (DISVA-UNIVPM, Ancona, Italy), in collaboration with the Institute of Marine Science of the National Research Council (ISMAR-CNR, Italy) operationally run several wave and hydrodynamic models on the Adriatic Sea. The main implementations are based on the Regional Ocean Modeling System (ROMS), the wave model Simulating WAves Nearshore (SWAN), and the coupling of the former two models in the Coupled Ocean-Atmosphere-Wave-Sediment Transport (COAWST) system. Horizontal resolutions of the different systems range from the 2 km of AdriaROMS to the 0.5 km of the recently implemented northern Adriatic COAWST. Forecasts are produced every day for the subsequent 72 hour with hourly resolution. All the systems compute the fluxes exchanged through the interface with the atmosphere from the numerical weather prediction system named COSMO-I7, an implementation for Italy of the Consortium for Small-scale Modeling (COSMO) model, at 7 km horizontal resolution.

Considering the several operational implementations currently running, there is the need to: assess their forecast skill; quantitatively evaluate if the new, coupled systems provide better performances than the uncoupled ones; individuate weaknesses and eventual time trends in the forecasts quality, their causes, and actions to improve the systems.

This work presents a first effort aimed to satisfy such need. We employ in situ and remote sensing data collected starting from November 2011, in particular: temperature and salinity data collected during several oceanographic cruises, sea surface temperature derived from satellite measurements, waves, sea level and currents measurements from oceanographic buoys and platforms; specific observational activities funded by the Italian Flagship project RITMARE allowed to collect new measurements in NA coastal areas. Data-model comparison is firstly performed with exploratory qualitative comparisons in order to highlight discrepancies between observed and forecasted data, then a quantitative comparison is performed through the computation of standard statistical scores (root mean square error, mean error, mean bias, standard deviation, cross-correlation). Results are plotted in Taylor diagrams for a rapid evaluation of the overall performances.