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Investigating and forecasting coastal Adriatic surface currents by using neural networks (NEURAL)

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We present major components of the project NEURAL (www.izor.hr/neural) funded by the Unity Through Knowledge Fund (www.ukf.hr). The project aims to investigate and to build an efficient and reliable prototype of the ocean surface current forecasting system, based on high-frequency (HF) radar measurements, numerical weather prediction (NWP) model outputs and neural network algorithms (Self-Organising Maps). The Self-Organising Maps (SOM) method, a kind of neural network algorithms that performs a nonlinear smooth mapping of high-dimensional input data into the elements of a low-dimensional array, has previously been used on historical HF radar measurements and NWP Aladin/HR wind fields, which were operational in the northern Adriatic during 2008. It was found that the SOM surface currents patterns and associated SOM surface currents and winds patterns were highly correlated, indicating the predominance of the wind-driven forcing on the measured ocean currents. Therefore, a forecasting system has been proposed, that will use operational NWP products for the Adriatic region, then search for the closest SOM solutions in wind fields and finally to forecast ocean currents by using associated SOM patterns in HF radar currents.

Such a prototype forecasting system will be tested on a long and quality-checked HF radar surface currents dataset available in the northern Adriatic, where the first part of the series will be used for the training of the SOM and the second part for assessing the skill performance of the surface currents hindcast. Two NWP systems will be used on the project: (1) high-resolution non-hydrostatic research WRF-ARW model based at the Faculty of Mathematics and Physics of the University of Ljubljana, and (2) operational Aladin/HR NWP system of the Meteorological and Hydrological Service of Croatia. The prototype forecasting system will be also tested in the middle Adriatic after the collection of substantially long high-quality surface currents dataset, which will be achieved by two WERA HF radars to be installed and become operational in early 2014.

The advantages of the forecasting operational system based on neural networks versus classical oceanographic models are numerous: (i) their results are based on real data and therefore highly reliable, (ii) they need several orders of magnitude less computational time and resources than a full-scale 3D prognostic model based on Navier-Stokes equations in appropriate resolution, and (iii) forecasts can be made available to final users in a very short time. Within the project, the forecasts will be issued only for areas covered by ocean measurements; however, ocean model results may substitute HF radar measurements in such an ocean forecasting system and may be equally used. It is expected that the prototype ocean surface currents forecasting system will become operational in 2015.