FORM TO BE COMPLETED BY PROJECT LEADER

MID TERM RESEARCH/TECHNOLOGY REPORT

REPORT NUMBER:

PERIOD COVERED: FROM 15/10/2013 UNTIL 14/10/2014

Please note that this a comprehensive Mid-term (12 months) research/technology report which should include all information submitted with your preceding research/technology reports. The **scanned report with signatures** shall be sent to the following e-mail address: ured@ukf.hr. When sending the reports to the UKF, please use the option "Request a read receipt for this message". The delivery receipt is the confirmation that your report has been submitted. **Please do not send this report by registered mail.**

1. Project info

a) Project title:

Interpreting and forecasting Adriatic surface currents by an artificial brain (NEURAL)

b) Name of the Project leader and Co-leader:

Ivica Vilibić   Nedjeljka Žagar

c) Duration of the project (months) and type of the grant:

24   1B

d) Leading Organization (full name, address, and contact person details):

Institute of Oceanography and Fisheries, Šetalište I. Meštrovića 63, HR-21000 Split, Croatia, URL: http://www.izor.hr, contact: Ivica Vilibić, vilibic@izor.hr

e) Other organizations involved
(full name, address, web address and contact person details):

University of Ljubljana, Faculty of Mathematics and Physics, Department of Physics, Chair of Meteorology, Jadranska 19, SI-1000 Ljubljana, Slovenia, URL: http://meteo.fmf.uni-lj.si, contact: Nedjeljka Žagar, nedjeljka.zagar@fmf.uni-lj.si

Meteorological and Hydrological Service , Grič 3, HR-10000 Zagreb, Croatia, URL: http://meteo.hr, contact: Martina Tudor, tudor@cirus.dhz.hr

2. Work plan and timetable of the project

a) Milestones

please describe milestones realized; if not all the milestones are realized according to those stated in the original application form please explain why and what actions have been taken to resolve problems encountered (use Tahoma 11, max 2000 words, add word count)

Word count: 1260

The work plan and timetable of the project has been realized as planned, except for Task 7, which has a slight delay due to other activities carried out on the project. Namely, a significant part of some tasks which are planned for year 2 of the project are executed in year 1. The following tasks and milestones have been accomplished in year 1:

Task 1. Setup of operational procedures for the HF radar network.
Milestone 1. Operational procedures for HF radar network ready to use (month 4).

Through collaboration with the IPA Cross-Border Adriatic Programme funded project HAZADR (www.hazadr.eu), it was planned to purchase and install a pair of high-frequency radars in the area of middle Adriatic. The procedure for purchasing the equipment through the HAZADR project was initiated in the second half of 2013. The equipment was delivered to the institute in January 2014, while its installation at two sites, Cape Ražanj (island of Brač) and Cape Stončica (island of Vis) was carried out during second half of February 2014. The radars become operational in early March 2013, and the measured current fields are available at http://jadran.izor.hr/hazadr.
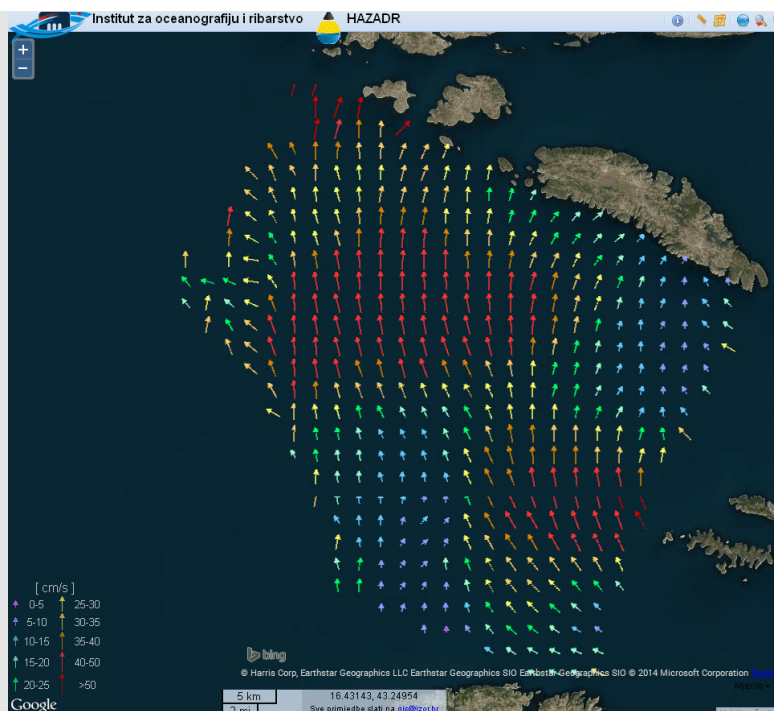
Surface currents measured in the middle Adriatic on 25 March 2014 14:00 CET (available at http://jadran.izor.hr/hazadr).

Task 2. High-level quality control of new and historic HF radar data.

Milestone 2. Historical hourly HF radar data from the northern Adriatic re-assessed through delayed-mode quality control procedures (month 6).

Historical surface current dataset collected in the northern Adriatic between 2007 and 2010 was collected and processed via the robust quality control procedures described by Cosoli et al. (2012). The dataset consists of radial and total current vectors gridded over the area, computed from data collected by three operating HF radar sites, Savudrija, Zub and Bibbione. Such a dataset is extended version of the originally planned dataset, as additional available data was detected and processed with the respect of original project plan (2009-2010).

Furthermore, a discussion on data analysis approaches carried out at the kick-off meeting introduced a possibility of inclusion of original radial HF radar data series to the SOM analyses and their intercomparison to the results performed on already processes HF radar data. The preparation of these data was initiated in this reporting period and is finished in month 7. Such an analysis allowed for quantification of validity of procedures applied within the planned forecasting system. Following the analyses, a manuscript has been written and submitted to the WoS journal Computers & Geosciences in October 2014.

Task 3. Mesoscale reanalysis and forecast of the atmospheric fields by Aladin/HR and WRF-ARW models.

Milestone 4. Aladin/HR surface model fields available for the northern Adriatic area (month 6) and middle Adriatic area (month 14) covered by HF radar measurements.

According to the work plan, the reanalysis of the high-resolution Aladin/HR operational model was performed between July 2007 and December 2012, and the hourly wind data was provided over the northern Adriatic area on 2 km grid resolution. This action required an extensive computational time, which were provided by the project partner, Meteorological and Hydrological Service of the Republic of Croatia. These data has been be used as input to the SOM analyses (Tasks 4 and 5), together with surface current data measured by HF radars. Also, this data will be used for creation of operational current forecast and for assessing their abilities and skill parameters (Task 6), to be conducted in the following months.

Milestone 5. WRF-ARW surface model fields available for the northern Adriatic area (month 8) and middle Adriatic area (month 16) covered by HF radar measurements.

Co-PI with his team did the reanalysis of weather conditions for the northern Adriatic between February and November 2008 by using WRF-ARW model (finished in month 9). Therefore, two state-of-the-art high resolution models become available for the northern Adriatic area. Currently an intercomparison between two high-resolution models is in progress, which was not originally planned on the project, and which will probably end in a peer-review paper to be submitted in a half-year period to a meteorological WoS journal.

In addition to the work performed to reach milestones in the first year of the project, a noteworthy work has been done on other proposed actions and tasks that have milestones in the following reporting periods. Namely, WRF-ARW modeling system is installed and become operational at the Co-PI institution (see http://meteo.fmf.uni-lj.si/NEURAL), providing operational wind forecasts for the middle Adriatic area. This action has been originally planned for the month 16 of the project.
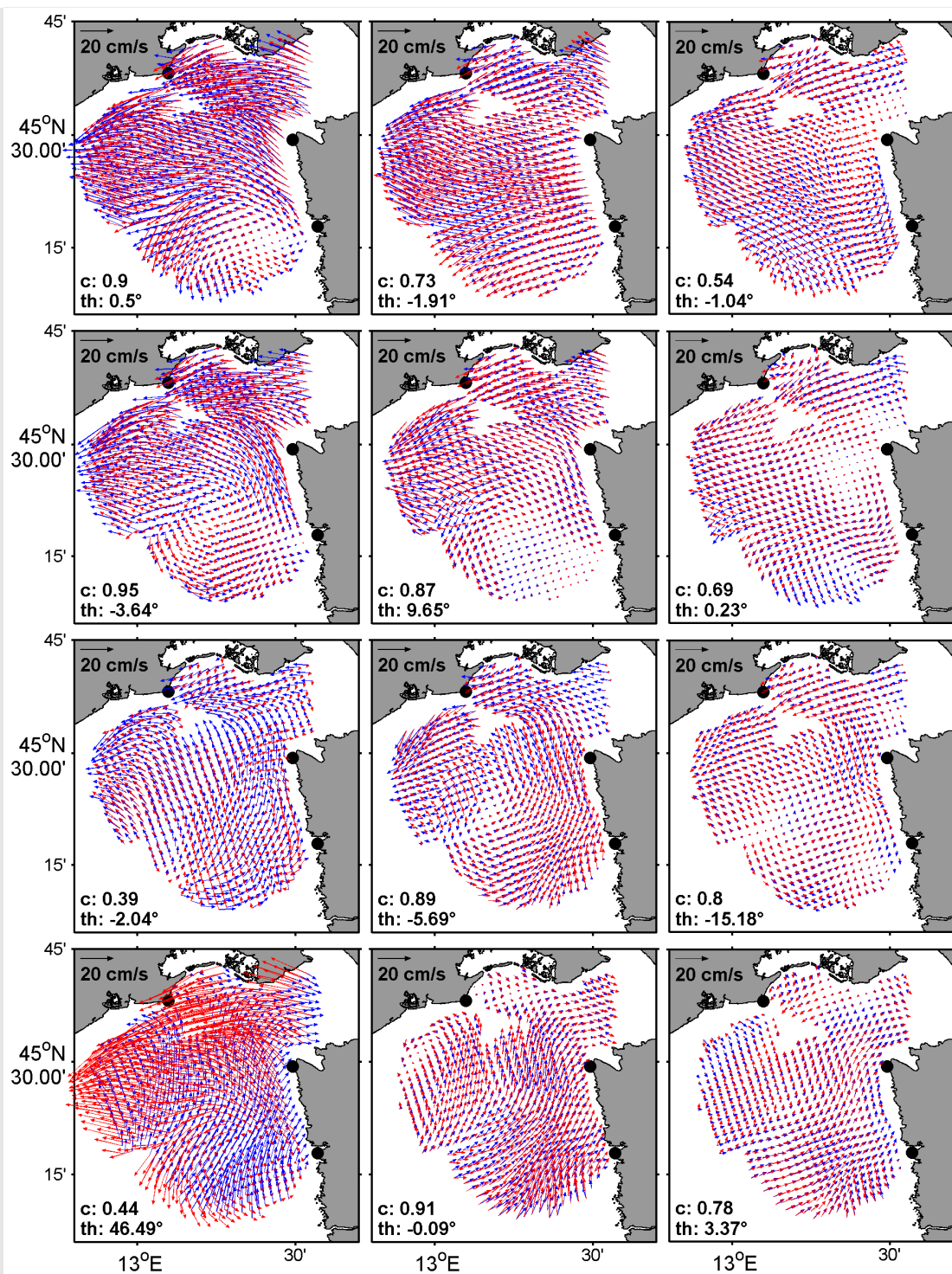
Qualitative comparison of 12 characteristic surface current patterns in the summer-autumn period of 2008 in the northern Adriatic, computed by applying first the SOM on radials and then doing the coordinate transform, and vice versa.
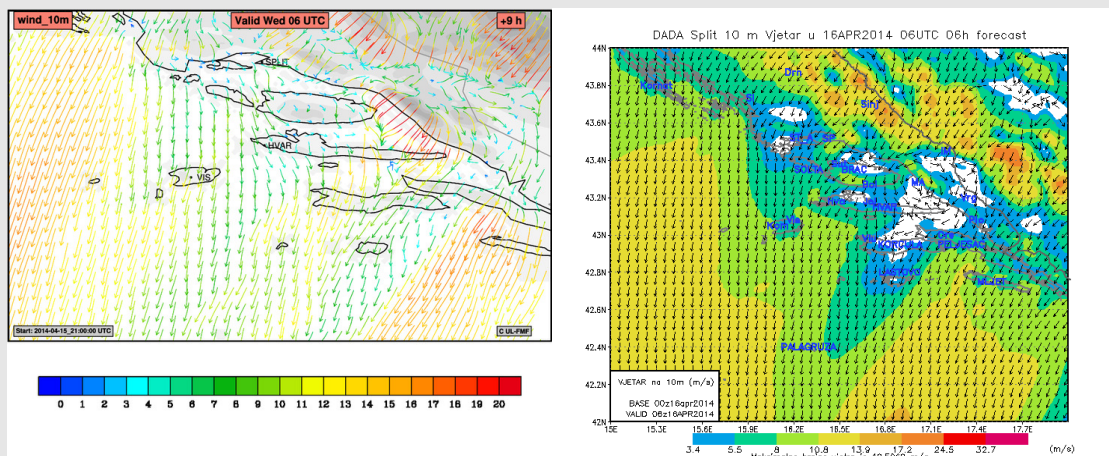
Surface wind forecast from the WRF model (left) and operational ALADIN model at the national weather service (right). Both forecasts are valid at 6 UTC (8 o'clock local time) on 16 April 2014

**Task 4. Tuning the neural network parameters for optimal performance.**

Milestone 6. Neural network parameters tested and the best parameters chosen, northern Adriatic site (month 9), middle Adriatic site (month 17).

The obtained surface currents and both Aladin and WRF-ARW surface winds have been introduced to SOM analysis and a number of experiments have been set up to test and choose the best configuration for the forecasting system. We chose the 3x4 SOM matrix, sheet style, ep neighbouring function and batch training algorithm. All of this has been done for the northern Adriatic area.

Task 5. Obtaining characteristic patterns of surface currents and meteo model data through learning process.

Milestone 7. Characteristic patterns of surface ocean currents computed for both northern (month 10) and middle Adriatic HF radar sites (month 18).

Different experiments on the northern Adriatic dataset have been conducted, by introducing various input current (original, detided, lp33 filtered) and wind (Aladin, WRF-ARW, original, lp33 filtered, different spatial coverage) data to the SOM analysis. Comparison between different SOM solutions has been done by using conventional data metrics (complex correlation, veering angle, root mean square error, bias). This analysis provided nice scientific results and will be used for creation of the research paper, to be published in a peer-review oceanographic journal in the following months.
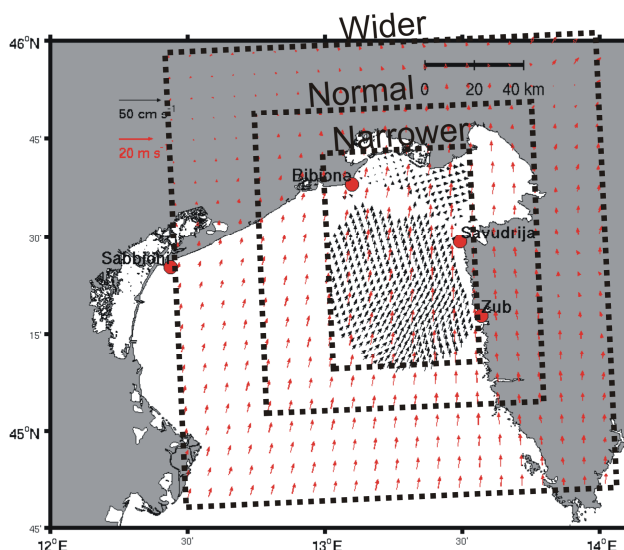
Changing the domain of the weather model as an input to joint SOM analysis in the northern Adriatic.

In addition to these tasks, some of the work planned for the second year has been already done in the first year. For example, protocols for the data transfer and visualization of both HF radar and surface wind field (Aladin/HR and WRF-ARW) through the ORACLE database and GIS-oriented programming have been developed (milestone 9).

Three project proposal related to the NEURAL project have been submitted in the reporting period, the first at national level as a research project to the Croatian Science Foundation call (project ODA), the second at international level as a research project to the Horizon 2020 BG-9 Call (project EMILIA), and the third at international level to the ERC CoG 2014 Call (SINAI project); the last dealing with signal processing implementation in geosciences and environmental sciences, leaded by PI Ivica Vilibić.

Finally, a dissemination of the project has been carried out through the reporting period. Three targeted lectures about the project have been held, the first for high-level specialists in the audience at the leading Croatian research institution, Ruđer Bošković Institute, held in December 2014, the second for public in the frame of Festival of Science in April 2014 and the third at the Croatian-Italian oceanography workshop on the Adriatic Sea, held in Institute of Oceanography and Fisheries in May 2014.