Oceanographic system to control the impact of construction works in the sea in a sensitive coastal area - Case Study

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The construction work at the sea close to the protected natural area can have a very bad influence on the environmental conditions in that area. One of the typical cases of possible negative influence on the very sensitive protected natural area Pantan is construction works on the bridge between land and Island of Čiovo in the town of Trogir, Adriatic Sea. The one km long bridge is being built at a relatively shallow water with a maximum depth of 5 meters so that the structure of the bridge rests on eight supporting pillars buried in the bottom of the sea. Bridge is located very close (500 meters) to the protected area Pantan that belongs where valuable marine and land flora and fauna resides. In specific oceanographic conditions, sediments from the sea bottom during excavation can be easily transported towards protected area of Pantan and badly influence on the flora and fauna. Therefore, the contractor as part of the license for the construction of the bridge has to perform "on-line" monitoring of standard meteorological and oceanographic parameters at the station positioned close to the middle of the bridge (Figure 1).

Data acquisition and transmission from station to the management centre must be performed at one-minute intervals by sending automatic warning and SMS message. This short interval is needed to have an ability of quick response on oceanographic condition. According to licence rules, reconstruction of currents field in the wide area of the bridge and calculation of sediments transportation to the protection area of Pantan must be done by its measuring data and numeric model. Beside this, control measurements of the optical parameters and chlorophyll_a have be performed every 15 days at the 8 stations in the wide are of the bridge including protected area of Pantan. Basically, the automatic monitoring system must instantly warn bridge authorities to stop construction work in the case when sediment transportation can reach the area of Pantan.

Figure 1: Location of bridge, Pantan area and measuring

For these purposes, IOF was developed automatic measuring warning system for early warning of the management staff of the bridge construction, which includes automatic measuring oceanographic station with data transmission in real time to the RDBMS located in the Institute, where data are processed, assimilated into the numerical model.

Besides accessories (anchoring system, night light, solar cells, etc.) measuring station consists of embedded processor with GSM module and two sensors: Vaisala WXT520 meteorological multiparameter sensor (wind speed and direction, air temperature, humidity and pressure, and rain) mounted at the mast three meters above sea surface and RDI ADCP Doppler acoustic currents profiler (u, v and z current components of 6 cells along water column from the bottom to the surface). Output results from measuring system can be retrieved from IOF web page: *http://faust.izor.hr/automjerenja/ciovo?*

Results

All acquired data is stored locally in SD card and automatically sent to the MEDAS database located in the Institute of oceanography and fisheries by FTP protocol. Upon finishing data uploading in database automatic procedure starts and validates received data mainly correcting values outside of the broad range of specific parameters. For data visualization and data quality assurance High Charts and JavaScript API is used for presentation of all parameters except for visualization of multilevel sea currents, for which special JavaScript procedure was developed (Figure 2).

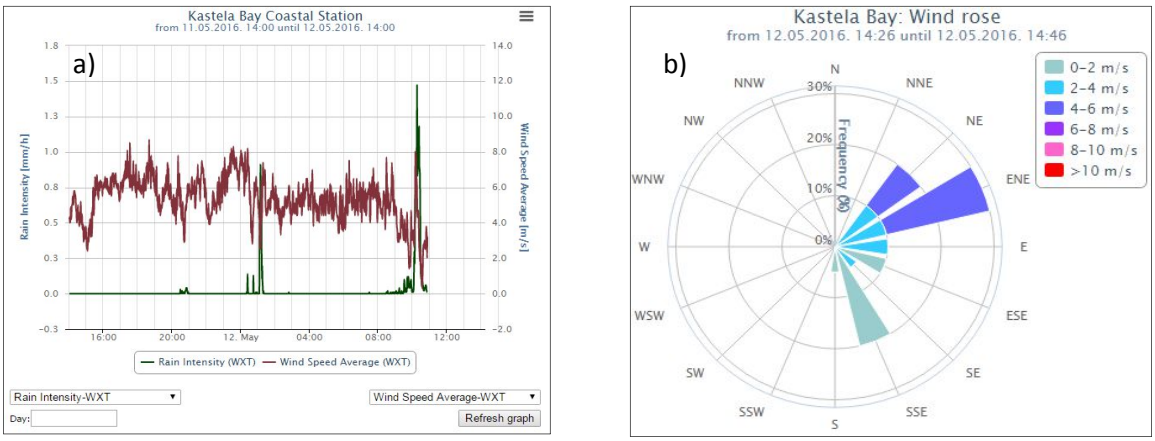

Figure 2: Example of view of two measured parameters and wind speed and direction (wind rouse)

Next step is starting of procedure for testing of meteorological and oceanographic conditions in the area under consideration from acquired data and in advance defined an arbitrary number of rules, which can be adjusted via web pages. These rules define maximal and average values and directions of wind and currents in all measuring layers and their duration, which represent the edge between conditions suitable for construct works or not. If averaged measured values exceed values in predefined arbitrary rules table, the database automatically sends a warning to the management of bridge construction to stop with work by sound flashing red header and alarm sound at the web page at the local computer and send SMS message to responsible persons.

Wind and currents data from Station are automatically uploaded as input data in numerical model ROMS (physical dynamics in the sea) and its output results is upload to SIM model (for simulation of sediments movements), which is operated for the west part of the Kaštela Bay (Figure 3).

For the period of the system operation (from July 28, 2015 to May 13, 2016) more than 99.93 % of measurements data have been successfully transmitted and processed in receiving centre. In this period alarm was fired in 333 times with average duration about 91 minutes. According the alarm about 7.1 % of time was not suitable for construction works in the sea. These events occur due the fact that deeply and wide part of the Kaštela Bay ended by shallow and narrow channel at the west, in which during pass, stronger winds generate relatively strong currents, which can transport sediments from area of bridge to the protected area of Pantan in a short time (less than half hour).

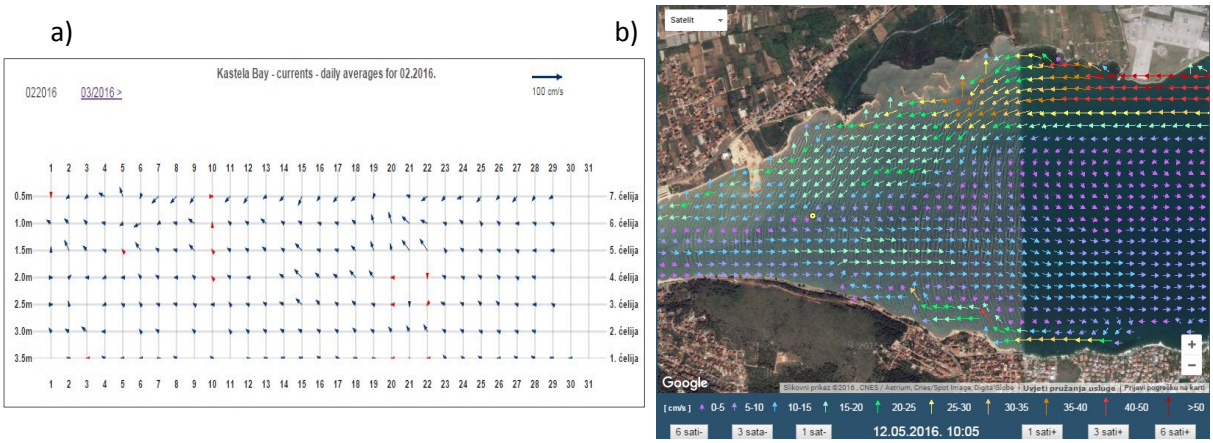

Figure 3: Daily average of the sea currents measured at the Station (a) and sea currents field reconstructed by numerical model (b)