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An observatory system for physical and biogeochemical parameters in the northern Adriatic Sea: the "Acqua Alta" oceanographic platform

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The history of the "Acqua Alta" oceanographic platform (http://www.ismar.cnr.it/infrastructures/piattaforma-acqua-alta) started more than forty years ago, shortly after the dramatic surge that affected the city of Venice in late 1966.
Since then, benefiting also from recent funding acquired within the National Flagship Project RITMARE, great efforts have been devoted to monitor the oceanographic and atmospheric conditions in the Northern Adriatic Sea (NA), in the proximity of the Venice lagoon.
Nowadays the "Acqua Alta", located on a 16 m depth area, represents a success story of the Institute of Marine Sciences (ISMAR) of the Italian National Research Council (CNR), that manages the structure and used collected data to improve the knowledge of the fragile sea environment that surrounds the Venetian littoral.

The directional wave observations started in 1979, representing one of the world longest continuous series. On the sea surface, waves are now routinely observed by means of a submerged acoustic-Doppler system that provides burst of directional wave data, including significant wave height, mean wave period and direction of propagation. Currently these wave parameters are integrated with the data collected by a stereo-video system (namely Wave Acquisition Stereo System, WASS) that provides the 3-D profile of the wavy sea surface. WASS data are unleashing a "new view" for ocean waves providing the complete space-time dynamics of wave groups.
Moreover, a series of multiparameters probes permits to measure the vertical distribution of sea temperature (at nine depths from the surface to the bottom), salinity (three positions), dissolved oxygen (two positions), and turbidity close to the sea bottom. The collected data are continuously used to track the water masses that enter, leave, and are produced within the NA. A striking example is provided by the temperature and salinity data used to follow the exceptional dense water formation that occurred in this basin during winter 2012.
Biological (phyto- and zooplankton) and chemical (dissolved nutrients) measurements are routinely acquired at "Acqua Alta", with periodic sampling on the water column within the Italian Long Term Ecological Research (LTER) network. Two high-resolution webcams have been installed on the submerged structures at -3m and -15m. The main aim is the evaluation of ichthyologic populations of the area for long-term ecological studies, and the real-time images represent a valuable tool as early-warning systems (large mucus aggregates, jellyfish swarms, etc.).
A data collection system has been installed in order to test the suitability of OGC Sensor Web Enablement services, exploiting in particular the Sensor Observation Service (SOS) and the associated SensorML and O&M standards (http://geosk.ve.ismar.cnr.it). The toweris also part of the The Aerosol Robotic Network (AERONET), originally developed to evaluate aerosol optical properties and validate satellite retrievals of those properties at various scales with measurements from worldwide distributed autonomous sun photometers
Most of the available data are also used to validate operational and research numerical models employed in the area, among which the Italian AdriaROMS 4.0 and NA-COAWST systems, the Slovenian NAPOM and atmosphere-ocean two-way coupled systems, and are related to other existing coastal observatory sites (e.g. the PALOMA buoy in Trieste, http://www.ts.ismar.cnr.it; CNR buoys S1 and E1, http://s1.bo.ismar.cnr.it; the VIDA buoy in Piran, http://buoy.mbss.org).
Detailed intercomparisons with the output of meteorological and wave models has allowed a keen correction of the meteorological output, leading to the best wave forecast systems available in the Adriatic and Mediterranean Sea (http://ricerca.ismar.cnr.it/MODELLI/ONDE_MED_ITALIA/page-html/nettuno/NETTUNO$_2$.html).
Last but not least, "Acqua Alta" represents a privileged facility for testing "state of the art" ocean technology

systems. For instance, during the 2014 cruise “CARPET” the Autonomous Underwater Vehicle REMUS-100 (Hydroid Inc.) and the turbulence profiler MSS-90 (a free-falling Micro Structure probe) were employed simultaneously in proximity of the tower, to define the winter conditions of the basin and to accurately track the plume regions of the rivers discharging into it.