Real Time Marine Data Acquisition: the Coastal Oceanographic Observatory Network in Adriatic Sea

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Abstract

Currently, several operational marine centres issue routine seasonal forecasts produced with coupled ocean-atmosphere models. For good result they require also real-time knowledge of the state of marine area as regard as oceanographic and atmospheric parameters. Effectiveness of marine climate knowledge and predictability resides in fast, reliable, scattered and numerous information on the initial marine and atmospheric conditions. The aim of this work is to present a review of the existing real time stations in the Adriatic sea and a critic state of the art with the aim to propose a new single and standardized coastal oceanographic observatory network based on previous existing oceanographic buoys set up by different projects and institutions and with various features. The network ISMAR could be based on various oceanographic buoys located along the Adriatic Sea coastal waters transmitting real time data, accessible, after a data quality control and sensor/instrument field calibration validation, on internet by a web site. In this way it will be possible to have a single system of real time oceanographic and meteorological standardized data available for regional stakeholders, policy makers, economic operators, environmental safety and tourists. Data will also be useful to improve forecast systems active for the Adriatic Sea.

1 Introduction

In the states most advanced in the world, about two decades ago, officials agency of environmental protection and scientists realized that the nation had to integrate the assets of its many sea and coastal observing systems and focus them on providing solutions to societal needs solutions that address the missions of several agencies and organizations. Catastrophic weather events, coastal pollution, harmful algal blooms, declines in living marine resources, and climate change underscore the importance of creating a more integrated approach to providing data and information needed to manage and mitigate the impacts of human activities, natural disasters, and

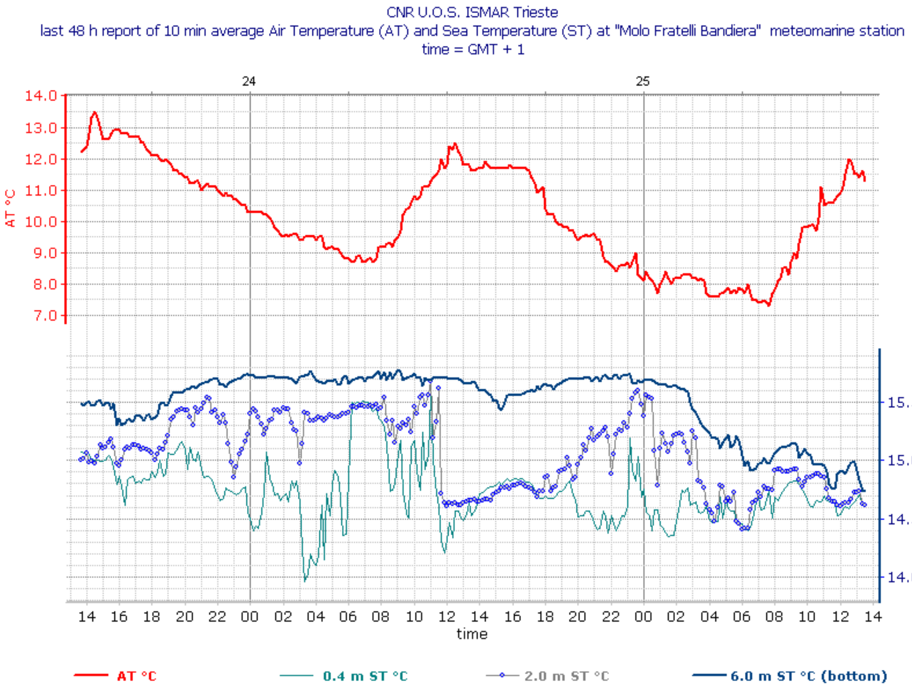

Figure 1: Plot of air (AT) and sea (ST) temperature form 23 to 25 November 2010

climate change on goods and services provided by the sea, and coasts. While the nation has developed some of the most sophisticated and comprehensive lakes, estuarine, and marine monitoring programs in the world, these individual programs are not as robust, effective, or comprehensive as they could be in protecting the societal and economic security of the nation, and therefore in providing the quality of life our citizens expect [1, 2].

The Marine Environment and Security for the European Area (MERSEA) Strand-1 Project was established in January 2003 to conduct an 18-month preparatory study of the key issues in setting up the marine elements of the joint European Commission (EC) and European Space Agency (ESA) initiative on Global Monitoring for Environment and Security (GMES).

The motivation for the marine element of GMES arises from the wide range of international bodies, treaties, conventions, and organizations at global, regional, and national levels concerned with monitoring and protecting the marine environment in Europe. The United Nations Convention on the Law of the Sea (UNCLOS 1982) provides the regulatory framework at the global level for all activities at sea. Supporting these are the International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978), the framework for preventing dumping of pollutant material (London Dumping Convention 1972), and the International Convention

Station name	Geographical position
Trieste	45°38.836' N, 13°45.658' E
Paloma	45°37.097' N, 13°33.913' E
Acqua Alta	45°18.830' N, 12°30.530' E
S1	44°44.552' N, 12°27.429' E
E1	44°08.599' N, 12°34.219' E
TeleSenigallia	43°44.210' N, 13°13.130' E
S6	41°32.755' N, 16°02.675' E

Table 1: AIOOS network components positions

on Oil Pollution Preparedness, Response, and Cooperation (OPRC 1990). These are complemented by specific conventions and agreements for particular maritime regions, such as the Oslo and Paris Commission (OSPAR) for the Northeast Atlantic and the European shelf seas, the Helsinki Convention (HELCOM) for the Baltic, the Barcelona Convention for the Mediterranean, and the Copenhagen and Bonn agreements. These legal frameworks set the foundation for policies on sustainable development and protection of the seas. Their overarching goal is to establish a sound balance between economic and social benefit on one hand and acceptable environmental impact on the other hand. International agreements place obligations on nations to monitor the marine environment. GMES (www.gmes.info) is a response at the European level to provide a common infrastructure for meeting this need, while serving as the European contribution to the Global Earth Observation System of Systems (GEOSS) (www.geoss.org/) [3].

In the Adriatic sea, the first approaches of coastal oceanographic observatory systems are beginning with ISMAR-CNR network. As an example of data acquisition, Figure 1 reports near-real time data of air temperature and sea temperature at different depths at Trieste, from 23 to 25 November 2010.

The Adriatic Sea is the most continental basin of the Mediterranean Sea. It lies between the Italian peninsula and the Balkans and is elongated longitudinally, with its major axis (about 800 km by 200 km) in NW-SE direction. The basin shows clear morphological differences along both the longitudinal and the transversal axes and has been divided into northern, middle and southern subbasins [4]. The Adriatic Sea has complicated morphology and bathymetry. The western coast is low and generally sandy, while the eastern coast is rugged, with multiple islands and coves. The northern subbasin, extending from the northernmost coastline to the 100 m isobath, is extremely shallow (mean depth

Figure 2: Geographical position of buoy, research vessel (Urania, G. Dallaporta, Tecnopesca II), platform and other fixed sites (red circles) located in Adriatic Sea managed by Institute of Marine Science (ISMAR), National Research Council (CNR)

30 m) with a very gradual topographic slope along its major axis. It is characterized by strong river runoff; indeed, the Po and the other northern Italian rivers are believed to contribute about 20% of the whole Mediterranean river runoff [5]. The middle Adriatic is a transition zone between northern and southern subbasins, with the three Jabuka depressions reaching 270 m depth. The southern subbasin is characterized by a wide depression about 1200 m in depth. Water exchange with the Mediterranean takes place through the Otranto Strait, which has an 800 m deep sill. The present study focuses on the northern and central continental Adriatic margin, where circulation is mainly controlled by wind stress and river discharge. Two currents dominate circulation in the Adriatic: the West Adriatic Current (WAC) flows toward southeast along the western (Italian) coast, and the East Adriatic Current (EAC) flowing northwest along the eastern (Croatian) coast [4, 6]. Being a continental basin, the Adriatic Sea circulation and water masses are strongly influenced by atmospheric forcing [7, 8, 9]. The major winds blowing over the Adriatic Sea are Bora and Sirocco.

Bora winds are generally from the northeast and are associated with a high-pressure system over central Europe [3]. Bora is a cold and dry wind where air spills through gaps in the Dinaric situated along the Adriatic's eastern shore, resulting in intense wind jets at specific points along the Adri-

Air	Hydrology
Air temperature	Water level
Atmospheric pressure	Wave
Humidity	Current
Wind direction	Water temperature
Wind speed	Salinity
Wind gust	Dissolved oxygen
	Turbidity

Table 2: Some common network parameter

atic eastern coast due to catabatic effects [8]. The Bora wind system causes the free sea surface to rise near the coast and this intensifies a coastal current toward the south (WAC).

2 Buoys, platforms and other fixed site

Table 1 showes the list of the network that are operative at the moment. Other systems (e.g. “S6”, 41°32.755’ N, 16°02.675’ E), that were active until a few years ago could join the infrastructure in the next future.
ISMAR-CNR operates several multi-parametric observing systems, most of them are placed along the Italian coasts and transmit data in real time to the receiving stations at coast (Acqua alta, S1, E1). Some of the systems such as Paloma and TeleSenigallia are operating in near real time while and S6 is not operating in real time now, but can be developed in this direction. The station locations are reported in Figure 2. Table 2 showes the list of the common network parameters.

3 Integrated ocean observing system benefit

Adriatic Integrated Ocean Observing System (AIOOS) will provide data and information products needed to significantly improve the nation’s ability to achieve these four interrelated societal benefits:

- Improving predictions of climate changes and weather and their consequences on coastal communities and national economy;
- Improving the safety and efficiency of maritime operations;
- Mitigating effects of natural disasters;
- Protecting and restoring healthy coastal ecosystems.

These benefits will be accomplished by efficiently linking observations to modeling via data management and communications to provide services, products, and decisionsupport tools needed to achieve these goals. To maximize the societal benefits, AIOOS must focus development efforts on ready assets and the greatest opportunities for valuable, synergistic uses. AIOOS is a complex system of systems that is best implemented in stages. Phased implementation requires the prioritization of existing assets that monitor variables that are essential and common to more than one societal benefit. The highest priority assets measure these core variables, using both in situ and remote sensing platforms, to provide new or existing products that can be improved by integrating data from more than one program, institution, or agency.

4 The future goals

- Compare existing ocean observing systems data to check the quality and consistency of the products and information;
- Identify and develop high-priority sensors and associated algorithms;
- Production of well-documented, sustainable, reliable, and quality-controlled data streams produced by existing monitoring assets;
- Choice of critical ocean variables and provisioning of high-quality, well-documented data in a timely fashion;
- Integrated data products for more accurate and timely assessment of environmental conditions.

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