Near Real-Time Oceanographic Data Management through Sensor Web Enablement (SWE) Standards

Latest devepolments

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Abstract—**Realizing a system to harmonize and disseminate heterogeneous data, collected by different meteo-oceanographic buoys is a challenge. In this paper, we describe a procedure for data validation, conversion in a homogeneous and standard format and dissemination adopting Sensor Web Enablement (SWE) using XML (eXtensible Markup Language) and OGC (Open Geospatial Consortium) standards. To meet the needs of different scientific communities as RITMARE (La Ricerca ITaliana per il MARE), Jerico (Towards a joint European research infrastructure network for coastal observatories), MyOcean, ODIP (Ocean Data Interoperability Platform), FixO3 (Fixed-point Open Ocean Observatories), we decided to adopt SWE standard allowing interoperability between data in near real-time, using SensorML (Sensor Model Language) and O&M (Observations and Measurements) standards in a Sensor Observation Service. With last developments, we are able to distribute new collected data in real-time.**

Keywords-Sensor Web; Real Time data; Marine Observations.

I. INTRODUCTION

"The OGC's Sensor Web Enablement (SWE) standards enable developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and usable via the Web"[1].

A meteo-oceanographic buoy is an array of sensors that monitor environmental parameters, such as temperature, salinity, meteorological conditions, etc.

Measurements made from different sensor systems are acquired using heterogeneous data formats.

The first objective is data sharing; maintaining interoperability and resilience; the second request is to provide new collected data to national and international communities, as RITMARE, JERICO, MyOcean and FixO3. To satisfy both issues and to share open access (near) real-time data and homogeneous data, we used new technologies such as the SWE, using SensorML and O&M standard in a Sensor Observation Service (SOS).

In detail, in this paper, we describe the methodology adopted illustrating each element included into the procedure (Section II) and we synthetized the aims of this paper in Section III.

II. METHODOLOGY

This system developed by OGS (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale), is the answer for the need to find a standard procedure to share (near) real-time data collected by the meteo-oceanographic MAMBO1 buoy (in the North Adriatic Sea) and the observatory site E2M3A (in the South Adriatic Sea). This procedure has seven different elements [2] (Figure 1):

- two different **buoys** that acquire data in (near) real-time: the meteo-marine buoy Monitoraggio AMBientale Operativo (MAMBO1), placed in the Gulf of Trieste, equipped with a meteorological station and two multi-parametric probes, and the E2-M3A, situated in the South Adriatic Sea, hosting the meteo station including a radiometer aimed, to collect air-sea interaction measurements, and a mooring with sensors for physical and biochemical parameters [3];

- **RTLoader** (Real-Time Loader) permits to store in a database real-time heterogeneous data, coming from different kind of instruments and with different formats. This is possible converting XML standard into an object language, using Java Architecture for XML Binding (JAXB). It allows converting heterogeneous ASCII files formats in a unique XML common format. After this, the software "XML2DB" converts XML input into Java objects and then inserts the measurements and the associated metadata into a PostgreSQL database;

- **RTValidator** checks, in the database, the quality of the data, applying some different algorithms developed following the European protocols [4][5] eventually tuned to the regional statistics [6]. The validation process assigns a quality flag without changing or deleting any data points;

- **RTWs** is the RESTful Web Service used to extract data from the database accepting simple request parameterized with temporal range and the output format. It is written using Java and open source libraries like Spring and Jersey;

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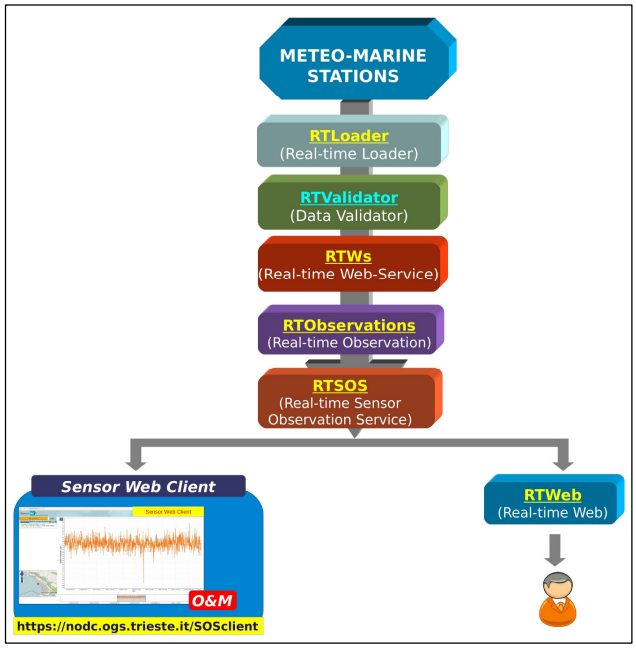

Figure 1. Work flow

- **RTWeb** is the web interface that allows querying the database using the Web Service RTWs. It extracts data into a down-loadable file, satisfying the conditions selected by the users;

- **RTObservations** is a real-time automatic procedure that permits to insert Observations into the Sensor Observation Service. This new element can load in near real-time data into a SOS, using an OGC standard format O&M. This is possible applying a Batch() operation and a POST request using JSON as payload.

- **RTSOS** is an OGC Sensor Observation Service (SOS) that enables to integrate real-time observations of heterogeneous sensors into a Spatial Data Infrastructure. It works using standard requests (e.g., *DescribeSensor()*). The descriptions of sensors and observations are stored in a PostgreSQL/PostGIS database using standard metadata format (respectively SensorML and O&M) and standard requests (*InsertSensor()* and *InsertObservation()*). Then, the data can be obtained by request *GetObservation()* and geo-located by *GetFeatureOfInterset()* [7].
  Also a Web interface was used, in order to visualize observations, the sensors position, their observed properties and long term trends of observations. It has been implemented using JavaScript toolkits (OpenLayers, GeoExt and ExtJS) [8].

III. CONCLUSION

To answer the needs of different scientific communities as RITMARE, Jerico, MyOcean, ODIP and FixO3, we developed an automatic system to store in near real-time data acquired by two different meteo-oceanographic buoys. Also, we decided to use an innovative technology, adopting OGC standards as SensorML and O&M, using a Sensor Observation Service (SOS), to disseminate these data. A new element is developed, the RTObservations, to store automatically the near real-time data into a Sensor Observation Service, using standard requests. This solution gives us the possibility to share open access and standardized data and to have the opportunity to cooperate, analyze and use new technologies.

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