(Near) real-time data publication for coastal and deep-sea observing system using OGC Sensor Web Enablement (SWE) standards

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Introduction

The aim of this paper is to describe the system developed at OGS to share in (near) real-time validated data from two meteo-oceanographic buoys (MAMBO1 in the North Adriatic Sea and E2M3A in the South Adriatic Sea) using OGC Sensor Web Enablement (SWE) standards aligned with several Oceanographic communities (EUROFLEETS2, FixO3 , Jerico-Next, ODIP II, RITMARE and SeaDataNet). The Web Client developed by 52° North is adopted for data visualization and it is accessible from NODC/OGS web portal.

Marine (near) real-time data are collected in multiple data format and converted into homogeneous and standard formats, using XML and OGC (Open Geospatial Consortium) standards for data transport and representation. The adoption of Sensor Web Enablement (SWE) specifications enables real time integration of data and all metadata related to the measuring sensors, data processing and calibration, data quality control, allowing a full description of the available data.

Devices

Two marine observatories acquiring meteo-oceanographic data in (near) real-time are currently maintained by OGS: the meteo-marine buoy Monitoraggio AMBientale Operativo (MAMBO1), placed in the Gulf of Trieste and the E2-M3A located in the South Adriatic Sea. The coastal station is equipped with a meteorological station and multi-parametric probes. The deep-sea observatory system is hosting a meteo station aimed to collect air-sea interaction measurements and a deep mooring with sensors for physical and biochemical parameters. Sensors (listed in tab.1) and data are described using Sensor Model Language (SensorML) and Observations and Measurements (O&M) schemas, respectively.

E2-M3A	
Oceanographic parameters	Sensor
Temperature and salinity	Seabird SBE37-SM
pHT	Sunburst SAMI pH
pCO2	Pro Oceanus CO2-Pro
pressure	Seabird SBE37-ODO
O2	Seabird SBE37-ODO
Temperature and salinity	Seabird SBE37-SM
Meteorological parameters	Sensor
Atmosferic pressure	Young 61202
Wind speed and direction	Young 04106
Air temperature	Young 41372
Relative humidity	Young 41372
Solar radiation	Eppley PSP
IR radiation	Eppley PSP

MAMBO1	
Oceanographic parameters	Sensor
Atmosferic pressure	Young mod. 61201
Air temperature	Young mod. 41372VC
Wind speed and direction	Young Wind Monitor
Relative humidity	Young mod. 41372VC
Temperature and salinity	Seabird SBE37-SM
pH	Sunburst SAMI pH Pro
pCO2	Pro Oceanus CO2 Pro
O2	Seabird SBE37-ODO
Temperature and salinity	Sea Bird16
O2	Sea Bird SBE43
pH	Sea Bird SBE18
Fluorescence	Wetlab Eco-AFL/FL
Turbidity	Wetlab Eco-NTU
Solar radiation	Wetlab Eco-PAR
Temperature and salinity	Sea Bird16
pH	Sea Bird16
O2	Sea Bird16

Tab. 1 - List of sensors managed using SWE standards

Data-flow

The data management in (near) real-time, is composed by (fig. 1): two meteo-marine stations; the RT-Loader (Real-Time Loader), permits to store into a relational database real-time heterogeneous

data and to validate them applying a procedure to qualify the data values using DB-Validator (Database Validator); the DB (Relational Database); the Web Service, used for data distribution in NetCDF format and a RT-Web (Real-Time Web Interface) to discover and extract data.

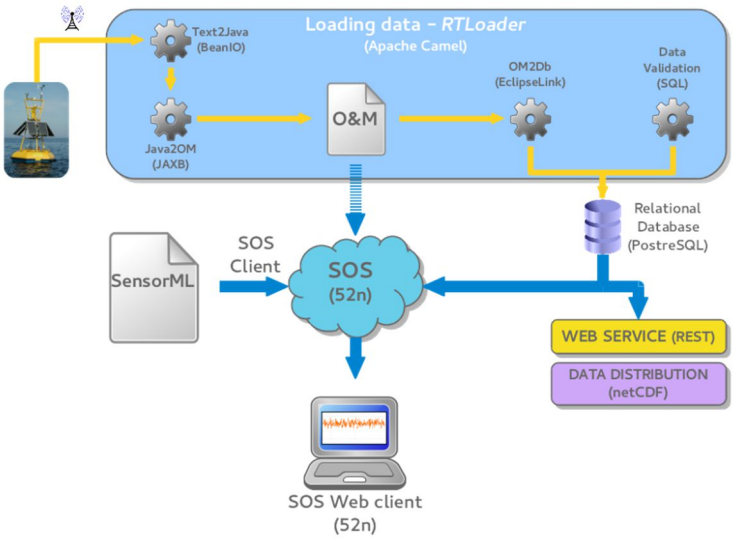

Fig. 1: Real-Time Oceanographic Data Management System

We adapted the previous management system to use the OGC standards such as Sensor Model Language (SensorML) and Observations and Measurements (O&M). We developed a SensorML and O&M profiles using BODC vocabularies, that guarantees both a standard way to exchange information (OGC's standard) and, at the same time, semantic interoperability. To realize it we use a Sensor Observation Service (SOS), developed by 52° North. In details, we use an application to insert measurements from relational database to SOS service and a SOS Client to load information about sensors. In the future, we will insert data directly from RT-Loader (dotted arrow in fig. 1). At the end, a Web Client gives us the opportunity to visualize easily, data and metadata (fig.2).

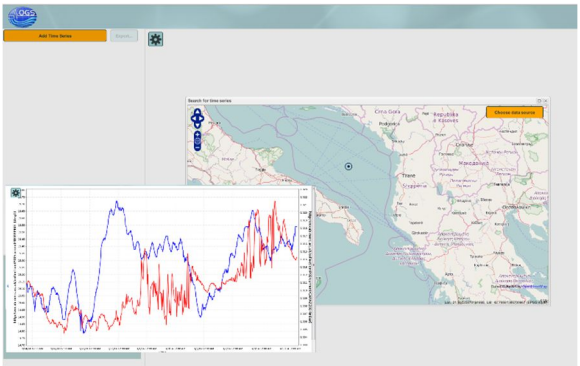

Fig. 2: Sensor Observation Service - Web Client

Conclusions and future development

The main objective of the approach presented in this paper is to share data in (near) real-time using OGC's Sensor Web Enablement (SWE) protocols to guarantee a standard system to share data, as well as, BODC vocabularies to ensure semantic interoperability. A critical analysis of this approach, point out as a positive aspect is the adoption of international standard for data, metadata and management procedures, giving the opportunity to connect with other marine data management infrastructures (e.g. SeaDataNet and EMODnet). On the other hand, considering that a data flow already existed, including a dedicated database, an effort has been necessary to include this new system. In addition, others negative aspects are: few choices of servers, client software and libraries available and the lack of a user friendly automatic management interface, for metadata compilation. But we expect that a direct link to newly developed sensors speaking O&M, soon or later, it will be available.

As future perspective, we plan, as first step, to adopt the same standards gradually for all observing system to manage others different kinds of platforms such as gliders and floats, using the same standard in (near) real-time and to have a common system where data and parameters acquired by different platforms can be jointly compared.