Discovery and access of glider data based on the Sensor Web Enablement (SWE) standards: a proposed architecture

D. Hayes[1], J. Buck[2], S. Jirka[3], M. Rieke[3]

[1]Cyprus Subsea Consulting and Services CSCS Ltd, Cyprus
[2]National Oceanographic Center, UK
[3]52°North GmbH, Germany

Introduction

We investigated the current state of glider data management by analyzing the approach of COTS gliders such as SEA EXPLORER, Seaglider and SLOCUM. Based on this analysis we provide recommendations on how Sensor Web technology may be used to facilitate the distribution of collected glider data and to support the integration of this data with observations and further geospatial data from other sources. Thus, the re-use of glider observations will become easier for scientists. At the same time, glider operators will receive support and guidance how to optimise glider data management and distribution.

Sensor Web Enablement

The Sensor Web Enablement (SWE) framework developed by the Open Geospatial Consortium (OGC) aims to provide and maintain standards for the interoperable integration of sensors and their observation data into Web-based (spatial) data infrastructures [1]. We identified the following standards as relevant for interoperable glider data management:

- **Sensor Observation Service (SOS)** - pull-based access to observation data as well as sensor metadata [2]
- **Observation & Measurements (O&M)** – model and an XML encoding for data observed by sensors [3]
- **Sensor Model Language (SensorML)** – data model and XML encoding for metadata about sensors and measurement processes [4]

Figure 1 illustrates the relation between the above described concepts.

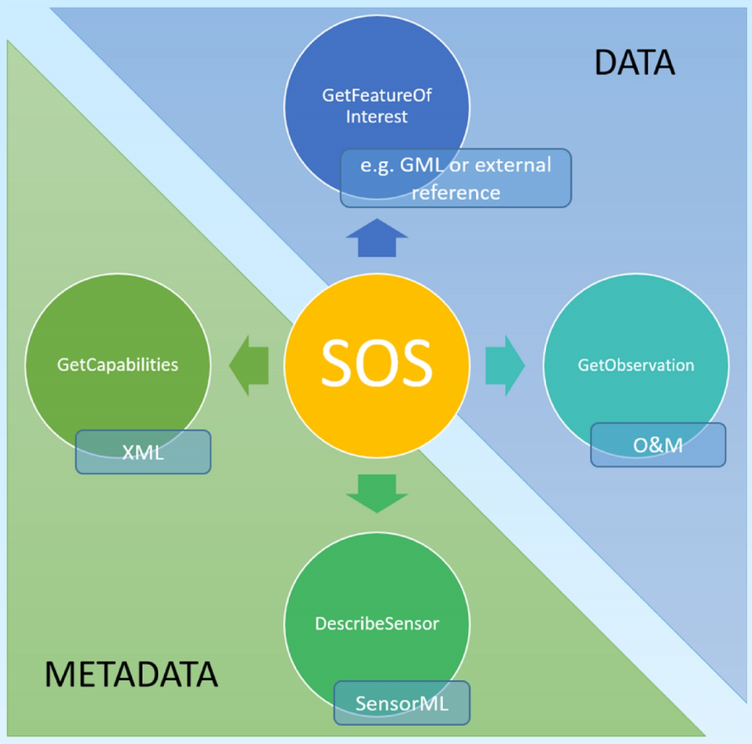


Figure 1. OGC Sensor Observation Service overview.

Data Model

O&M is the native data model served by an SOS instance. An **O&M Observation** is a self-describing entity, providing information on the time of measurement, the observed phenomenon, the feature of interest (e.g. a specific sea area) and the applied sensor. This information allows the interoperable integration into existing software solutions. For instance the geographical and temporal extent of a glider mission can be easily visualised.

O&M provides means to carry the actual measurement values inline of the data model. Still, this does not apply to existing glider data workflows. Therefore, we defined a way to **reference existing EGO NetCDF files** from an O&M Observations (see Figure 2). This approach allows the straightforward integration into existing data management solutions. A client software visualising mission data using the O&M model can then use the reference to provide a download link to the actual EGO NetCDF files.

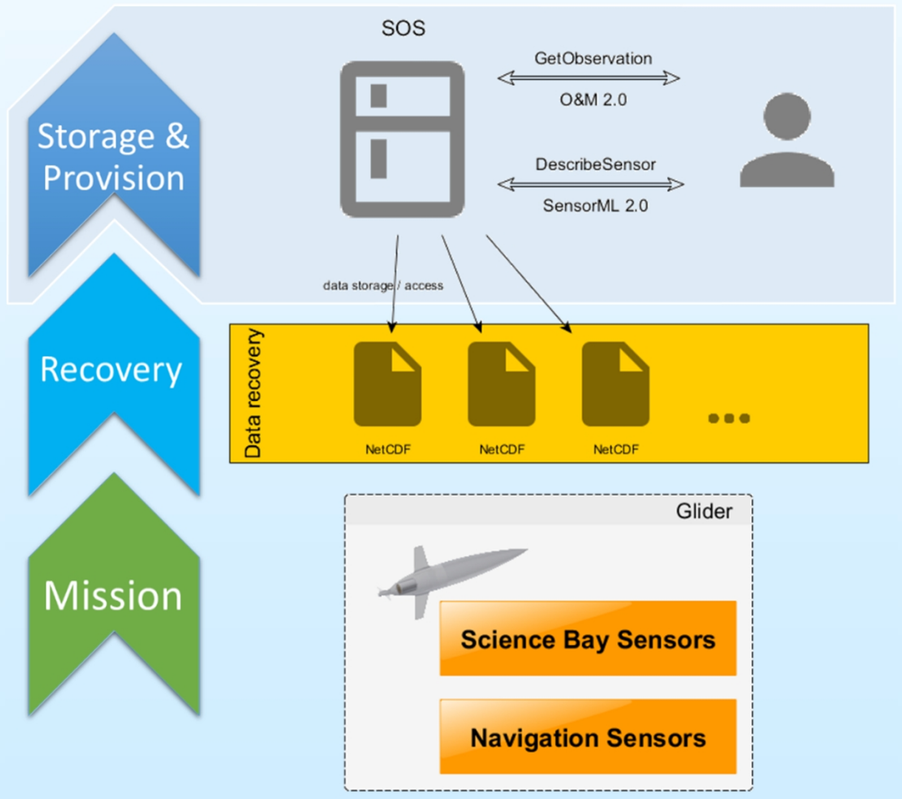


Figure 3 . Contribution of Sensor Web Architecture to Glider Data Management

Glider Metadata

In the scope of this activity we also worked on streamlining the approach on metadata definition and provision across related research projects (BRIDGES, COMMON SENSE, NeXOS, SCHeMA). The joint efforts will result in metadata models based on SensorML that use existing ontologies and vocabularies to enhance interoperability of metadata in the Oceans community.

The resulting metadata model has the following core features:

- Hierarchical approach to describe relationships between platforms (gliders), instruments and detectors
- Utilising sensor type descriptions to avoid redundant information
- Comprehensive range of metadata properties that can be handled

Conclusions

The developed system architecture integrates the Sensor Web concepts into the world of glider data management. SOS servers can be used to discover glider mission data and to access the resulting observations (encoded as EGO NetCDF). Currently, the system is a conceptual state, however core building blocks such as SOS server implementations, SOS viewers and metadata editors are already available as Open Source software.

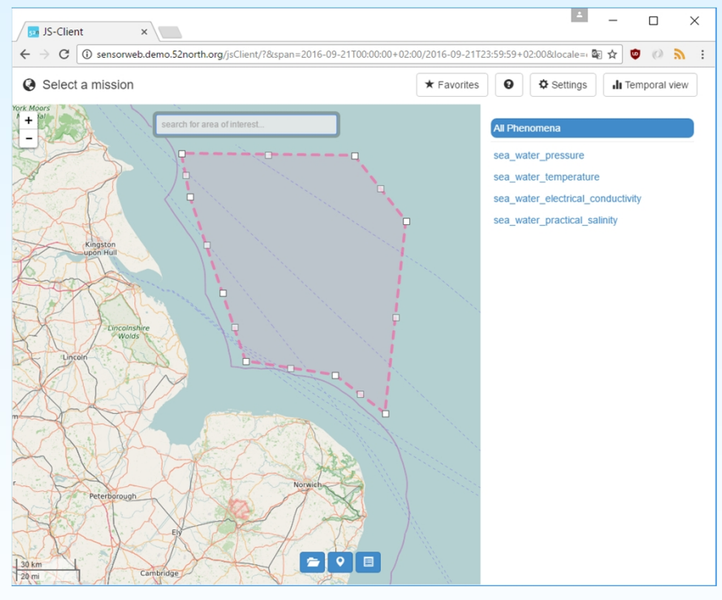
Marine data scientists are invited to review our approach and test the available software building blocks.

Future Work

- Development of a prototype to prove the systems architecture approach (using Open Source software)

  → **from *glider data* through *Sensor Web* to *discovery and access of data* via client software**

- Improvements on the system architecture based on feedback and discussion
- Further work on Glider metadata profiles (using SensorML)
- Investigations on a similar approach for glider mission planning
- Dissemination of (near-)real time data using Internet of Things concepts (e.g. MQTT)



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