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15–17 MARCH 2016, LONDON, EXCEL

Presentation of pilot with SWE for observation platforms in the Adriatic Sea

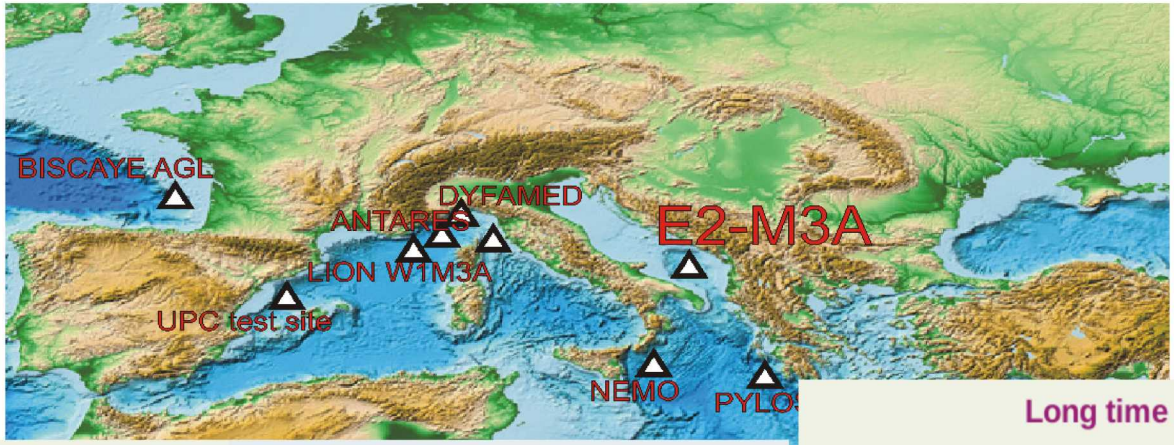
E. Partescano, A. Brosich and A. Giorgetti

Workshop Sensor Web Enablement (SWE) – 15th March 2016 - London

OGS

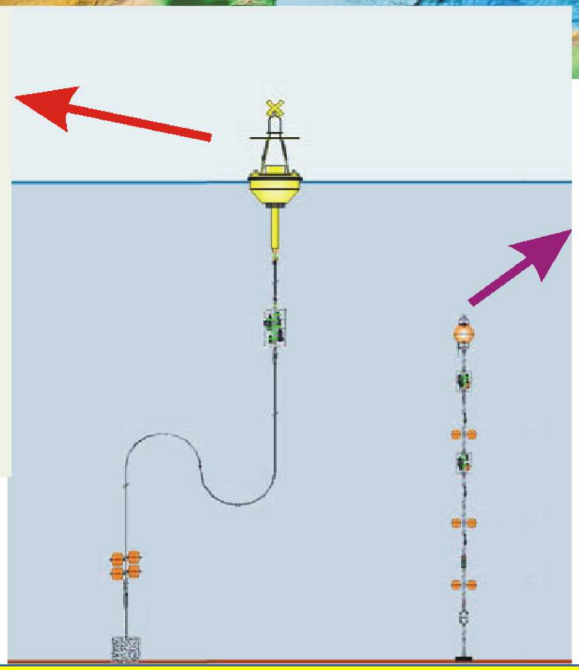
Device and Data

E2-M3A



Real time (surface data)

Oceanographic parameters	Depth	Sampling interval
Temperature and Salinity	15 m	1 h
pH	15 m	12 h
pCO2	15 m	12 h
Meteorological parameters		
Atmosferic Pressure	3.5 m asl	30 min
Wind speed and direction	4.0 m asl	30 min
Air temperature	3.5 m asl	30 min
Relative humidity	3.5 m asl	30 min
Solar radiation	2.0 m asl	30 min



Long time series

Oceanographic parameters	Depth	Sampling interval
Temperature and Salinity	565, 1000, 1170 m	1 h
Temperature and Salinity	365, 765 m	3 h
Pressure	365, 565, 765, 1000 m	3 h
Turbidity	1204 m	1 h
Dissolved Oxygen	365, 765 m	3 h
Trasmittance	365, 765 m	3 h
Currents (profiling)	150-300 m	1 h
Current	1180 m	1 h

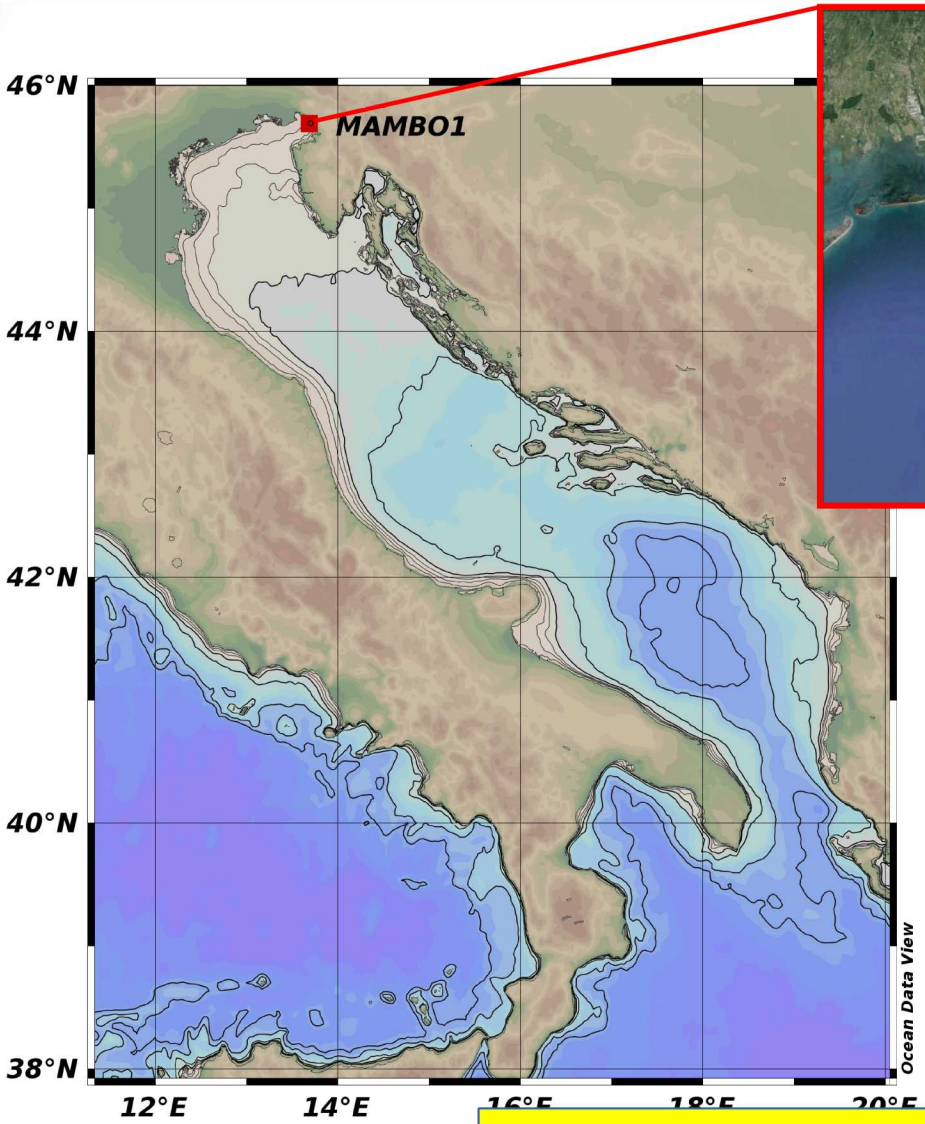
http://nettuno.ogs.trieste.it/e2-m3a

Device and Data

E2-M3A

Oceanographic parameters	Depth	Sensor
Temperature and salinity	2 m	Seabird SBE37-SM
pHT	2 m	Sunburst SAMI pH
pCO2	2 m	Pro Oceanus CO2-Pro
pressure	2 m	Seabird SBE37-ODO
O2	2 m	Seabird SBE37-ODO
Temperature and salinity	15 m	Seabird SBE37-SM
Meteorological parameters	**Depth**	**Sensor**
Atmosferic pressure	3.5 m asl	Young 61202
Wind speed and direction	4 m asl	Young 04106
Air temperature	3.5 m asl	Young 41372
Relative humidity	3.5 m asl	Young 41372
Solar radiation	2 m asl	Eppley PSP
IR radiation	2 m asl	Eppley PSP

Device and Data MAMBO1

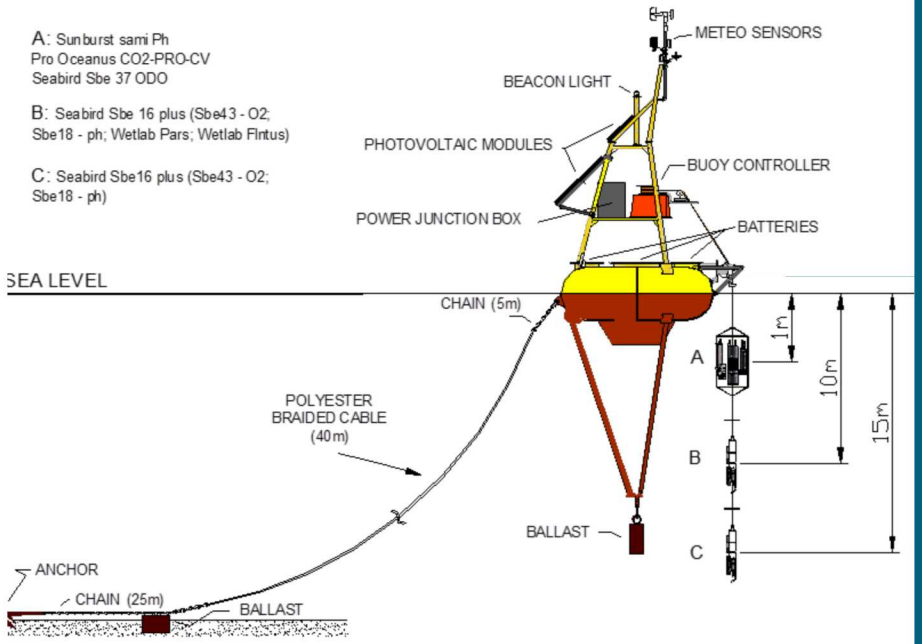


Meteo-oceanographic coastal buoy named "MAMBO1" (Monitoraggio AMBientale Operativo) is located in the Gulf of Trieste (northern Adriatic Sea)

http://nettuno.ogs.trieste.it/mambo

Device and Data MAMBO1

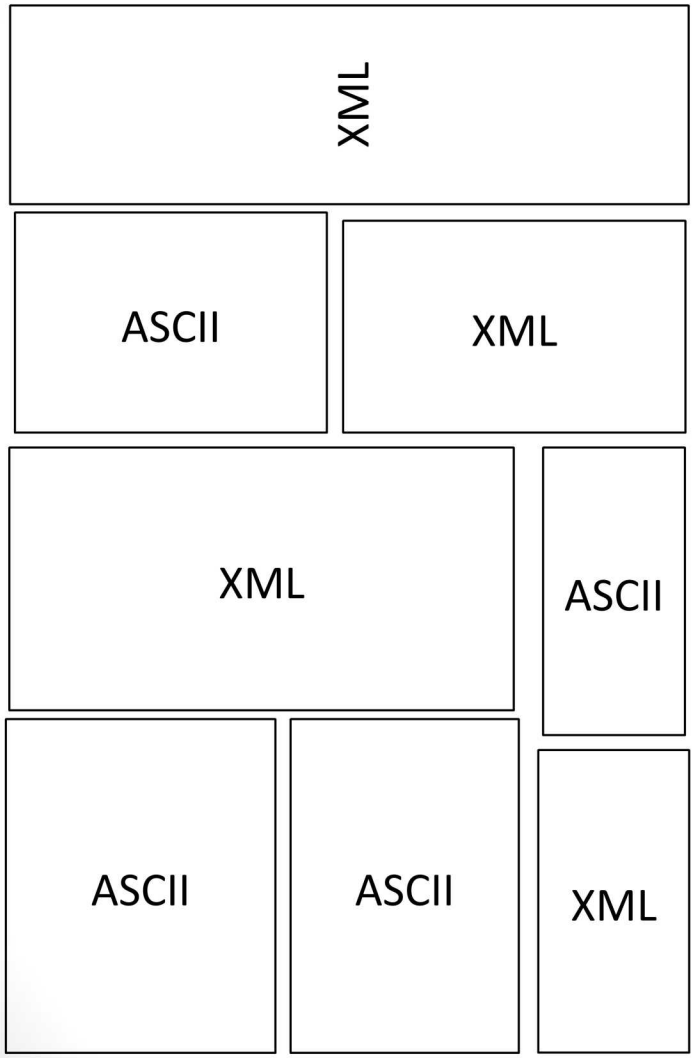
Oceanographic parameters	Sensor	Depth
Atmosferic pressure	Young mod. 61201	sup
Air temperature	Young mod. 41372VC	sup
Wind speed and direction	Young Wind Monitor	sup
Relative humidity	Young mod. 41372VC	sup
Temperature and salinity	Seabird SBE37-SM	1 m
pH	Sunburst SAMI pH Pro	1 m
pCO2	Pro Oceanus CO2 Pro	1 m
O2	Seabird SBE37-ODO	1 m
Temperature and salinity	Sea Bird16	10 m
O2	Sea Bird SBE43	10 m
pH	Sea Bird SBE18	10 m
Fluorescence	Wetlab Eco-AFL/FL	10 m
Turbidity	Wetlab Eco-NTU	10 m
Solar radiation	Wetlab Eco-PAR	10 m
Temperature and salinity	Sea Bird16	15 m
pH	Sea Bird16	15 m
O2	Sea Bird16	15 m



Complexity of information:

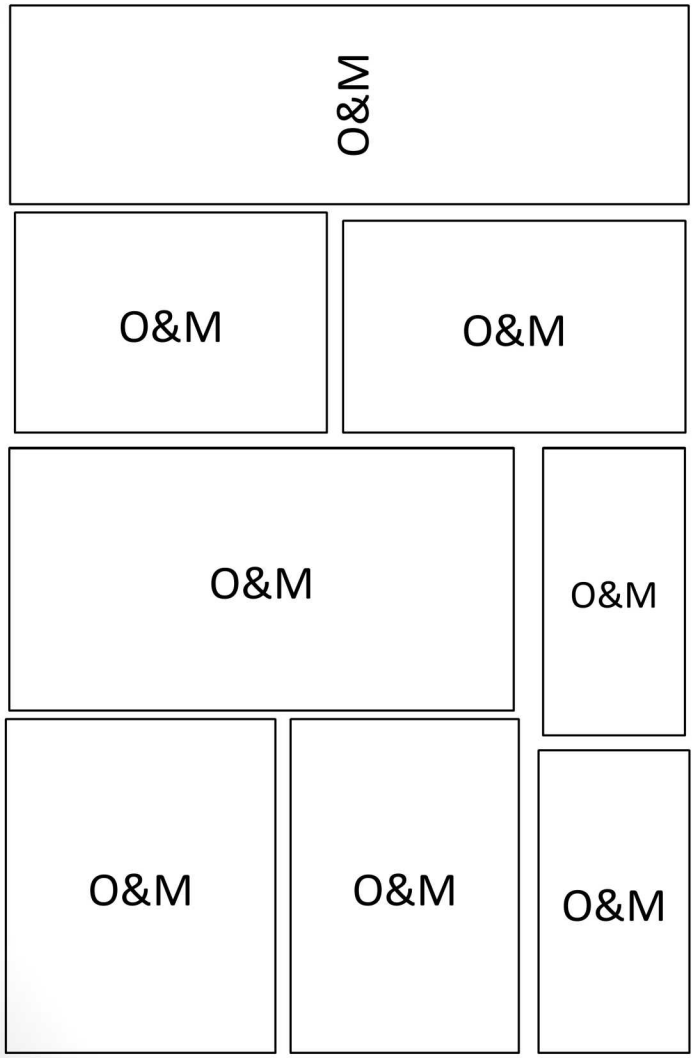
- data are acquired using different instruments
- different matrices
- acquired with different tools and methodologies
- at different spatial and temporal resolution
- specific procedures are developed to manage and distribute real-time data

Complexity of information:



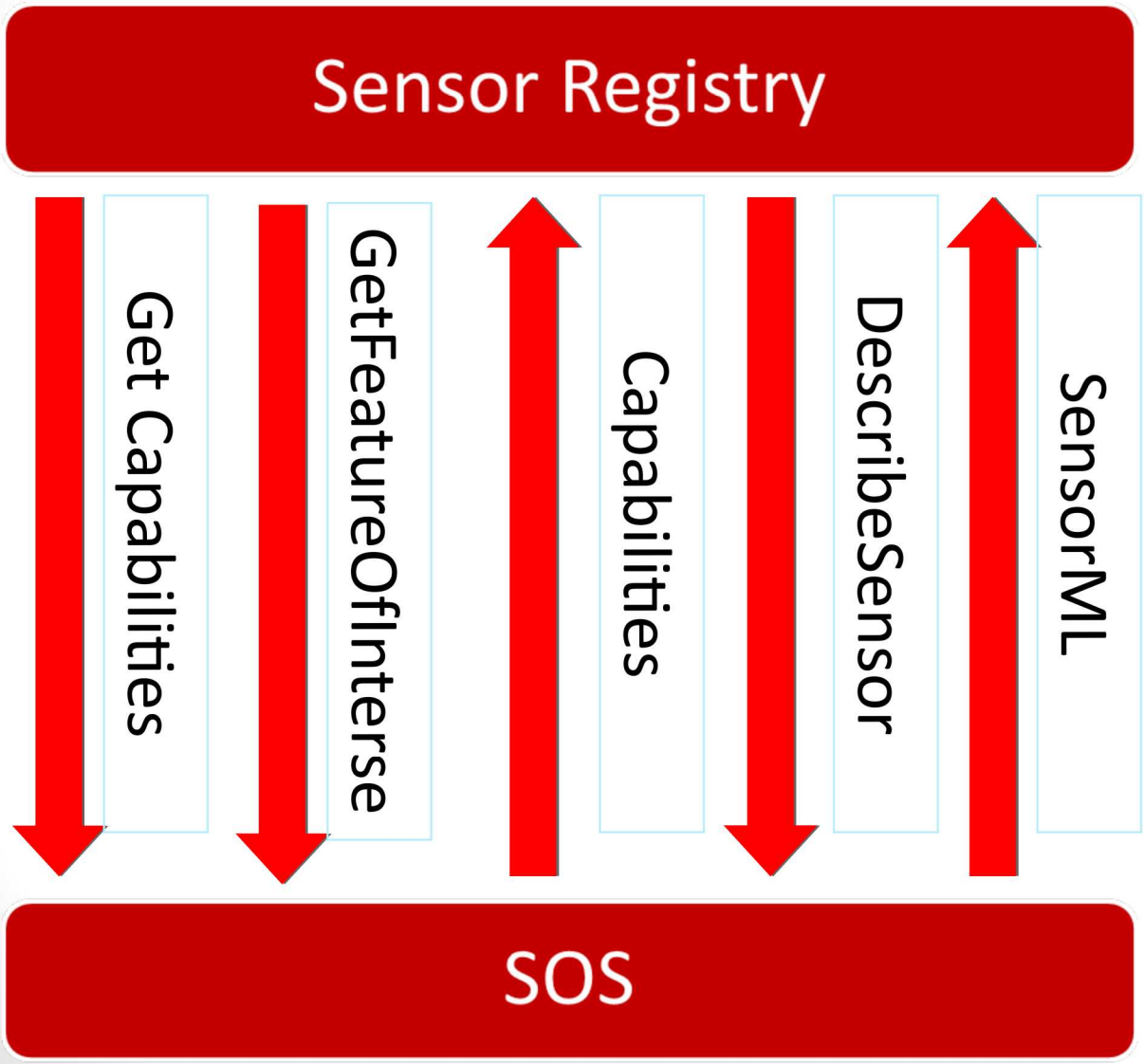
Transform heterogeneous data formats before to store them in the database, coming from different kind of instruments, with different formats (ASCII, XML, …).

Type of data The future (**O&M XML Format**)



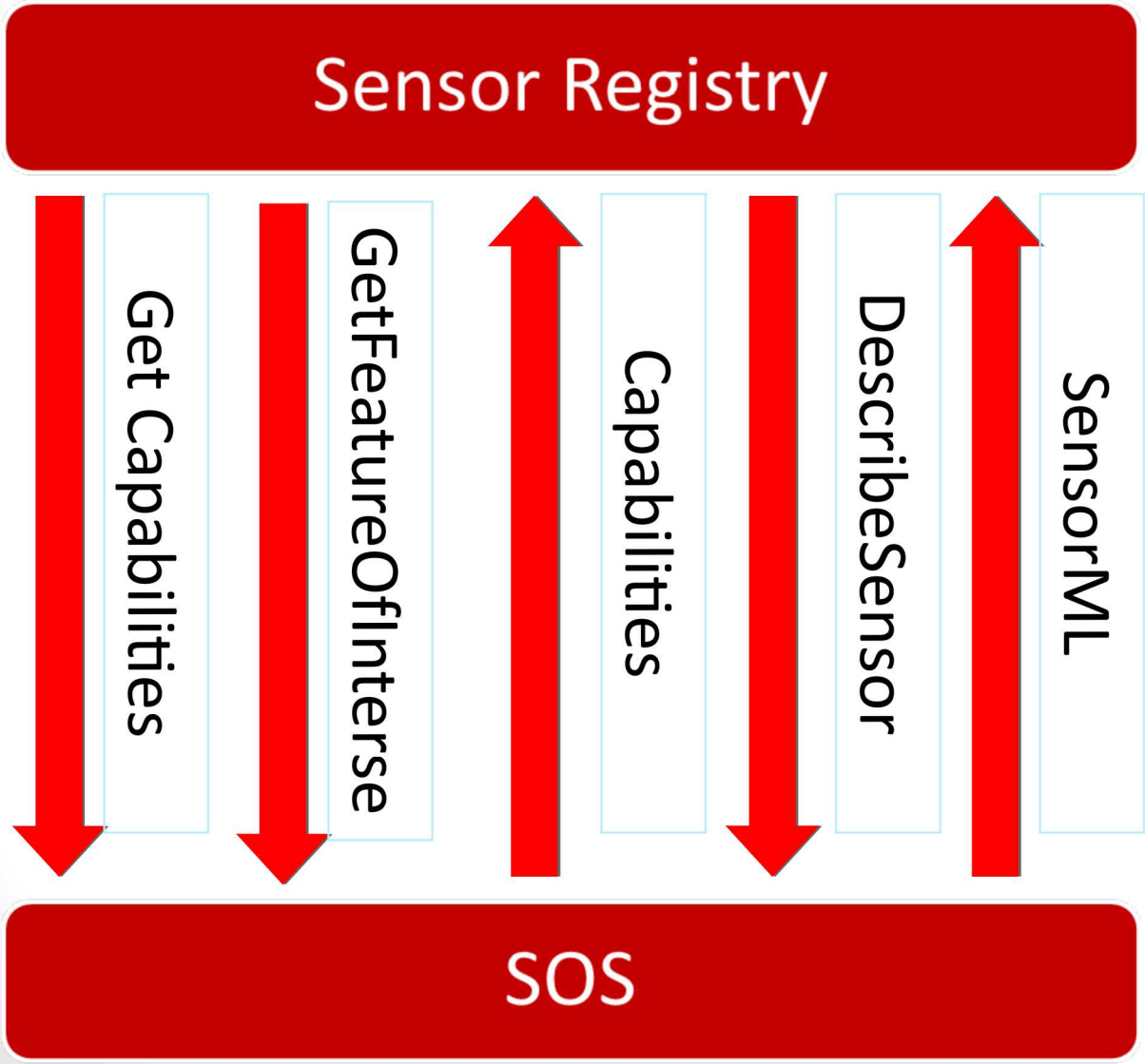
Standardized format using standardized operations.

Sensor Web Enablement (SWE)



The OGC's Sensor Web Enablement (SWE) standards enable developers to make all types of sensors discoverable, accessible and useable via the Web.

Sensor Web Enablement (SWE)



The Sensor Observation Service (SOS) is a **web service** that allows querying observations and sensor metadata.

The information are stored in a **PostgreSQL/PostGIS database** and they can be obtained by standard requests.

Real – Time Oceanographic Data Management System

LOADING DATA (*RT-LOADER*) Apache Camel

O&M

RT DB

REST - Request

DATA VALIDATION

WEB SERVICE

DATA DISTRIBUTION (NetCDF)

RT-WEB

SensorML

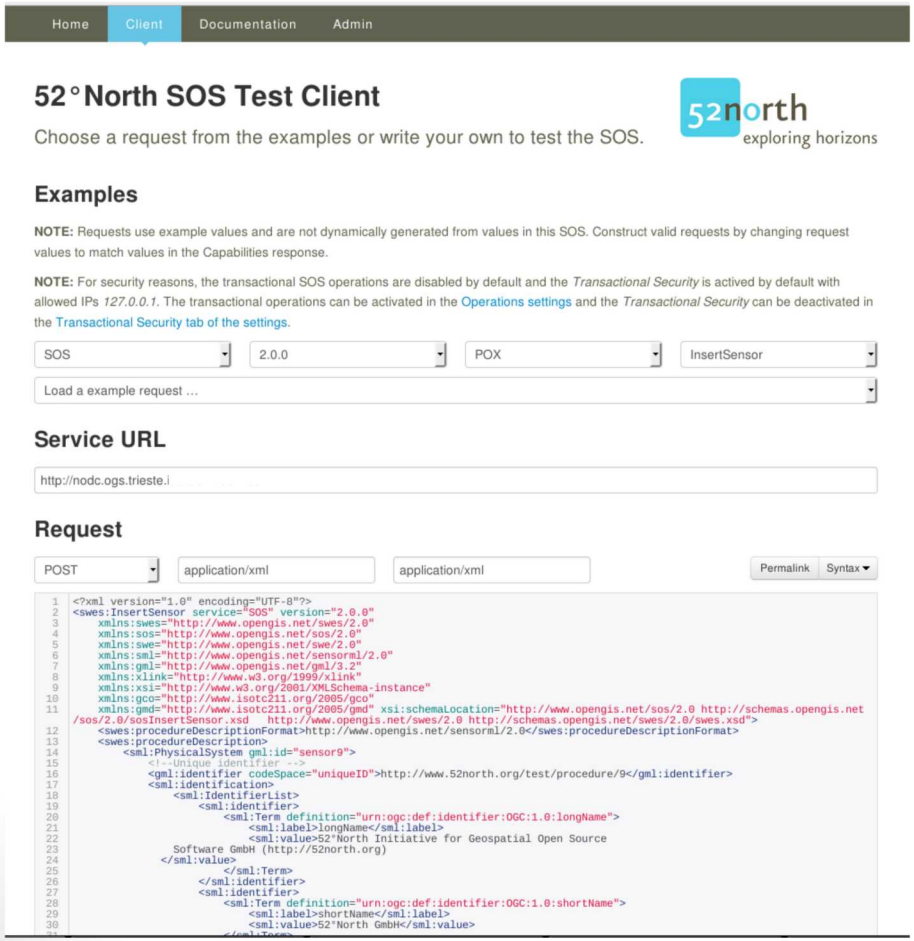
SOS Client

52n SOS

WEB CLIENT

Sensor Web Enablement (SWE): **HOW**

1. InsertSensor → SOS Client (52° North)



*"The OGC Sensor Observation Service **aggregates** readings from live, in-situ and remote sensors. The service provides an **interface** to make sensors and sensor data archives **accessible** via an interoperable web based interface. "*

Sensor Web Enablement (SWE): HOW

SensorML

1. InsertSensor → SOS Client (52° North)

```
<!-- ============================================================== -->
<!-- Created By: Elena Partescano NODC-OGS Trieste - 2015-03-25T18:00:00Z -->
<!-- ============================================================== -->

<!-- ================================================ -->
<!-- System Search Keywords -->
<!-- ================================================ -->
<sml:keywords>
  <sml:KeywordList definition="http://vocab.nerc.ac.uk/collection/P03/current/D020">
    <sml:keyword>Other physical oceanographic measurements</sml:keyword>
  </sml:KeywordList>
</sml:keywords>
<!-- ================================================ -->
<!-- System Identifiers -->
<!-- ================================================ -->
<sml:identification>
  <sml:IdentifierList>
    <sml:identifier>
      <sml:Term definition="urn:ogc:def:identifier:OGS:uniqueID">
        <sml:label></sml:label>
        <sml:value>urn:ogc:object:feature:Sensor:OGS:CT_10597_E2M3A</sml:value>
      </sml:Term>
    </sml:identifier>
    <sml:identifier>
      <sml:Term definition="description">
        <sml:label>description</sml:label>
        <sml:value>The SBE 37-SMP-ODO MicroCAT is a high-accuracy conductivity and temperature (pressure optional)
          recorder with Serial interface, internal batteries, Memory, integral Pump, and Optical Dissolved Oxygen
          sensor. Constructed of titanium and other non-corroding materials for long life with minimal maintenance,
          the MicroCAT is designed for moorings or other long duration, fixed-site deployments.
          Calibration coefficients are stored in EEPROM, allowing output of C, T, P, DO, and time in ASCII engineering
          units (decimal or XML; raw output available); salinity, sound velocity, and specific conductivity can also be output.
        </sml:value>
      </sml:Term>
    </sml:identifier>
    <sml:identifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018">
        <sml:label>Short_Name</sml:label>
        <sml:value>SBE 37-SMP MicroCAT</sml:value>
      </sml:Term>
    </sml:identifier>
    <sml:identifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/L22/current/TOOL0018">
        <sml:label>Long_Name</sml:label>
        <sml:value>Sea-Bird SBE 37-SMP MicroCAT C-T Sensor</sml:value>
      </sml:Term>
```

Sensor Model Language (SensorML) is a OGC's XML **standard** models used to describe sensors and measurement processes.

SWE: metadata -> SensorML

```
        <sml:Term definition="http://geossregistries.info/geosspub/resource_details_ns.jsp?compId=urn:geoss
          <sml:label>GEOSS_Resource_Details</sml:label>
          <sml:value>urn:geoss:csr:resource:urn:uuid:bc49af8b-573d-ea9a-ce8c-525be30a680a</sml:value>
        </sml:Term>
      </sml:identifier>
    </sml:IdentifierList>
</sml:identification>
<!-- ================================================ -->
<!-- System Classifiers -->
<!-- ================================================ -->
<sml:classification>
  <sml:ClassifierList>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/P02/current/TEMP">
        <sml:label>Intended Application1</sml:label>
        <sml:value>Temperature of the water column</sml:value>
      </sml:Term>
    </sml:classifier>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/P02/current/PSAL">
        <sml:label>Intended Application2</sml:label>
        <sml:value>Salinity of the water column</sml:value>
      </sml:Term>
    </sml:classifier>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/P02/current/AHGT">
        <sml:label>Intended Application3</sml:label>
        <sml:value>Vertical spatial coordinates</sml:value>
      </sml:Term>
    </sml:classifier>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/P02/current/DOXY">
        <sml:label>Intended Application4</sml:label>
        <sml:value>Dissolved oxygen parameters in the water column</sml:value>
      </sml:Term>
    </sml:classifier>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/L05/current/130">
        <sml:label>Sensor Type</sml:label>
        <sml:value>CTD</sml:value>
      </sml:Term>
    </sml:classifier>
    <sml:classifier>
      <sml:Term definition="http://vocab.nerc.ac.uk/collection/L19/current/SDNKG01">
        <sml:label>Deployment Role</sml:label>
        <sml:value>instrument</sml:value>
      </sml:Term>
    </sml:classifier>
```

SensorML

- **WHAT**
- **WHERE**
- **WHEN**
- **HOW**
- **WHO**

We developed a SensorML and O&M profiles using **BODC** *vocabs:* **P01, P02, P03, P06, L05, L19, L22, L23** *and connection to* **EDIOS** *catalog.*

SWE: metadata -> Observations and Measurements (O&M)

2. InsertObservations → REST – POST - request

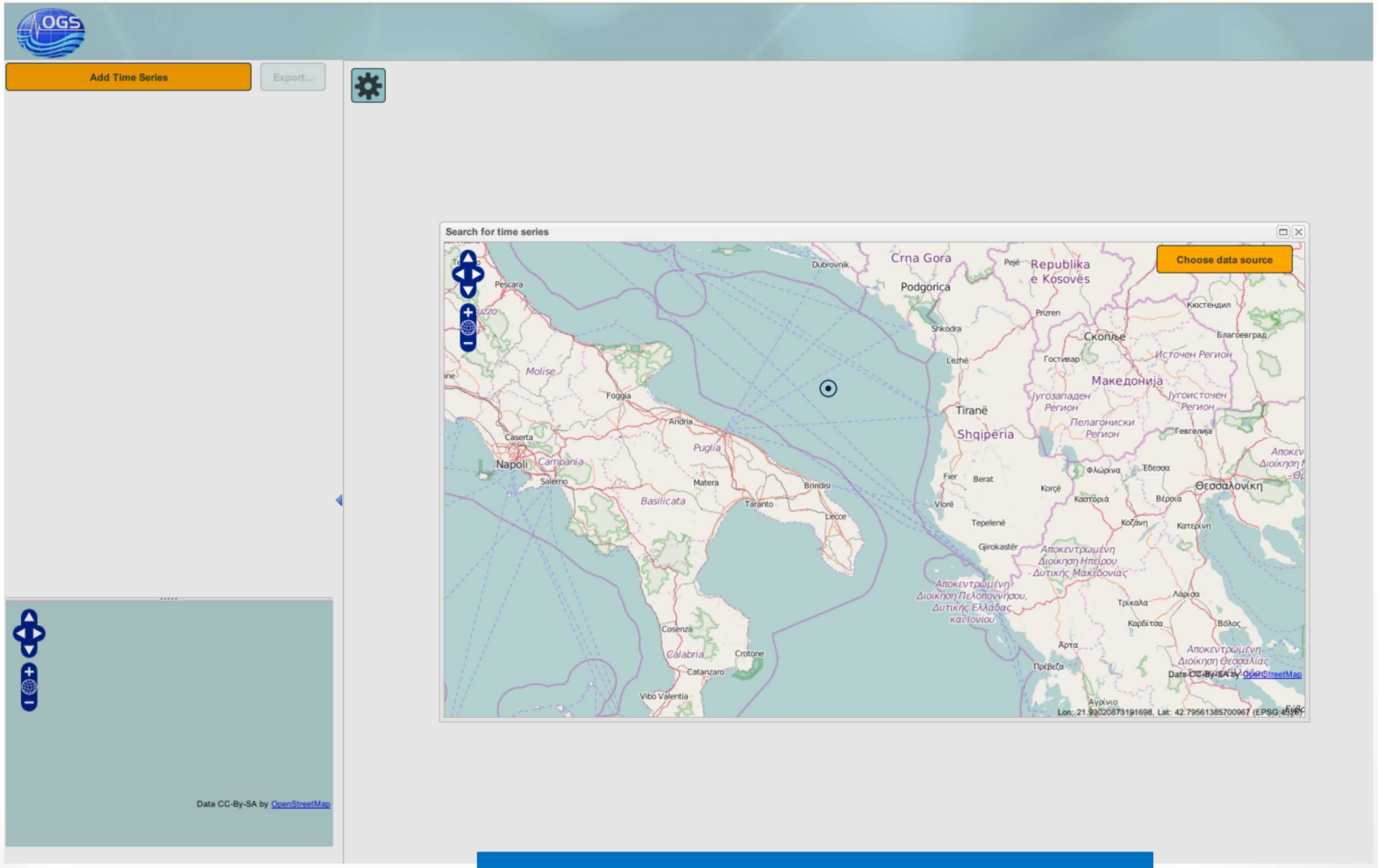
```
  </swe:Boolean>
 </swes:extension>
 <!--  multiple offerings are possible  -->
 <sos:offering>CT_E2M3A</sos:offering>
▼<sos:observation>
 ▼<om:OM_Observation gml:id="o1">
    <om:type xlink:href="http://www.opengis.net/def/observationType/OGC-OM/2.0/OM_SWEArrayObservation"/>
   ▼<om:phenomenonTime>
    ▼<gml:TimePeriod gml:id="phenomenonTime">
       <gml:beginPosition>2015-02-13T13:35:14Z</gml:beginPosition>
       <gml:endPosition>2015-07-29T07:58:08Z</gml:endPosition>
     </gml:TimePeriod>
   </om:phenomenonTime>
   <om:resultTime>
    ▼<gml:TimeInstant gml:id="resultTime">
       <gml:timePosition>2015-08-06T14:40:13Z</gml:timePosition>
     </gml:TimeInstant>
   </om:resultTime>
   <om:procedure xlink:href="urn:ogc:object:feature:Sensor:OGS:CT_10597_E2M3A"/>
   <om:observedProperty xlink:href="http://vocab.nerc.ac.uk/collection/P01/current/DOXYZZXX"/>
   <om:featureOfInterest>
    ▼<sams:SF_SpatialSamplingFeature gml:id="ssf_E2M3A">
       <gml:identifier codeSpace="">E2M3A</gml:identifier>
       <gml:name>E2M3A</gml:name>
       <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-OM/2.0/SF_SamplingPoint"/>
       <sf:sampledFeature xlink:href="E2M3A_1"/>
      ▼<sams:shape>
       ▼<gml:Point gml:id="E2M3A">
          <gml:pos srsName="http://www.opengis.net/def/crs/EPSG/0/4326">41.5225 18.0895</gml:pos>
        </gml:Point>
       </sams:shape>
     </sams:SF_SpatialSamplingFeature>
   </om:featureOfInterest>
   <om:result xsi:type="swe:DataArrayPropertyType">
    ▼<swe:DataArray>
     ▼<swe:elementCount>
      ▼<swe:Count>
         <swe:value>2828</swe:value>
       </swe:Count>
      </swe:elementCount>
     ▼<swe:elementType name="defs">
      ▼<swe:DataRecord>
       ▼<swe:field name="phenomenonTime">
        ▼<swe:Time definition="http://www.opengis.net/def/property/OGC/0/PhenomenonTime">
           <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"/>
         </swe:Time>
        </swe:field>
       ▼<swe:field name="observable_property_oxy_E2M3A">
        ▼<swe:Quantity definition="http://vocab.nerc.ac.uk/collection/P01/current/DOXYZZXX">
           <swe:uom xlink:href="http://vocab.nerc.ac.uk/collection/P06/current/UMLL" code="ml/l"/>
         </swe:Quantity>
        </swe:field>
       </swe:DataRecord>
     </swe:elementType>
    ▼<swe:encoding>
       <swe:TextEncoding tokenSeparator="#" blockSeparator="@"/>
     </swe:encoding>
    ▼<swe:values>
     2015-02-13T13:35:14Z#5.26@2015-02-13T14:35:15Z#5.2@2015-02-13T15:35:14Z#5.15@2015-02-13T16:35:14Z#5.18@2015-02-13T17:35:
```

O&M

This **standard** defines XML schemas for observations.
These provide document models for the **exchange** of information describing observation between **different** scientific and technical **communities**

Sensor Web Enablement (SWE): HOW

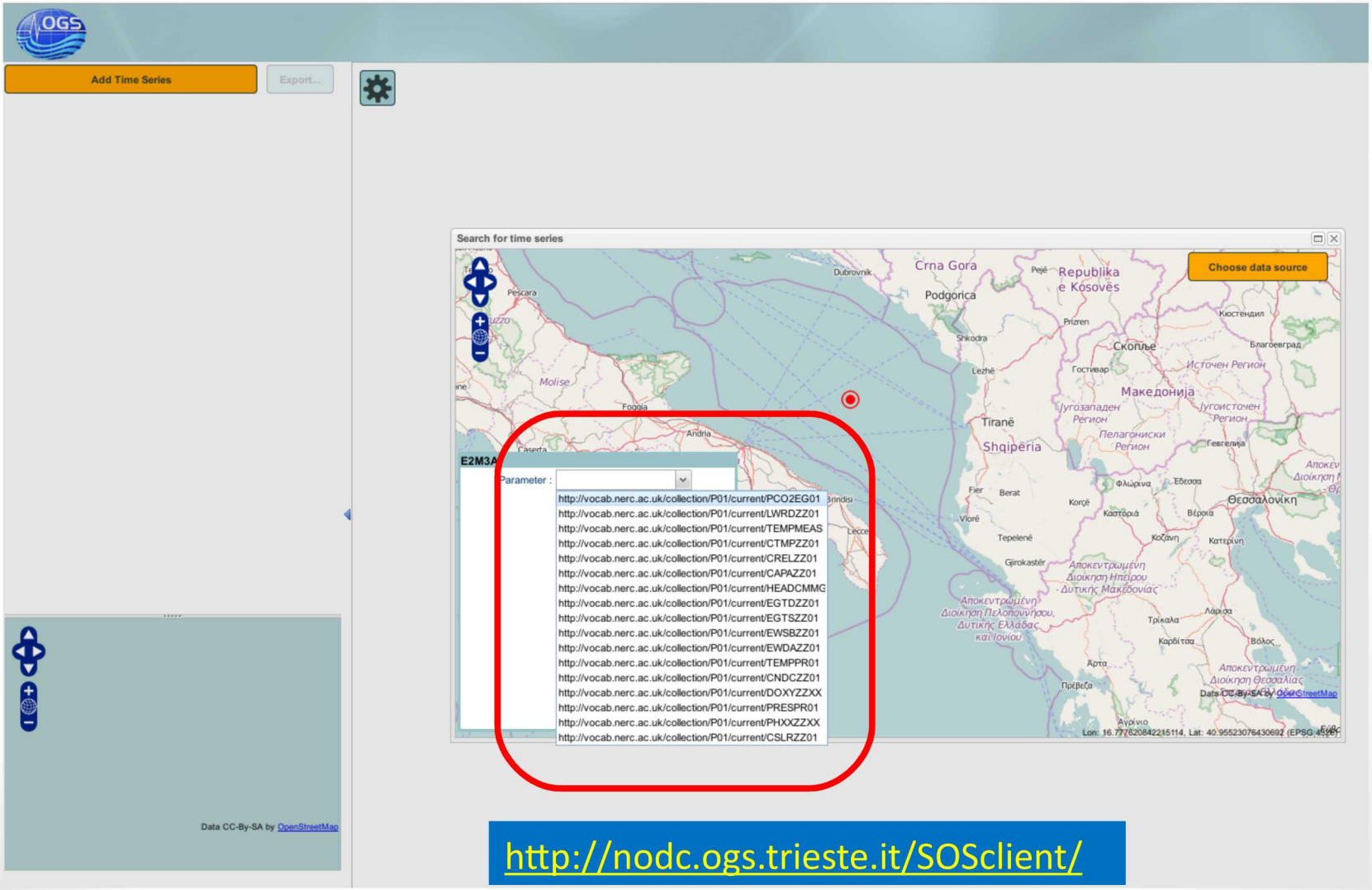
3. Data Visualization → Web Client (52° north)



http://nodc.ogs.trieste.it/SOSclient/

Sensor Web Enablement (SWE): HOW

3. Data Visualization → Web Client (52° north)



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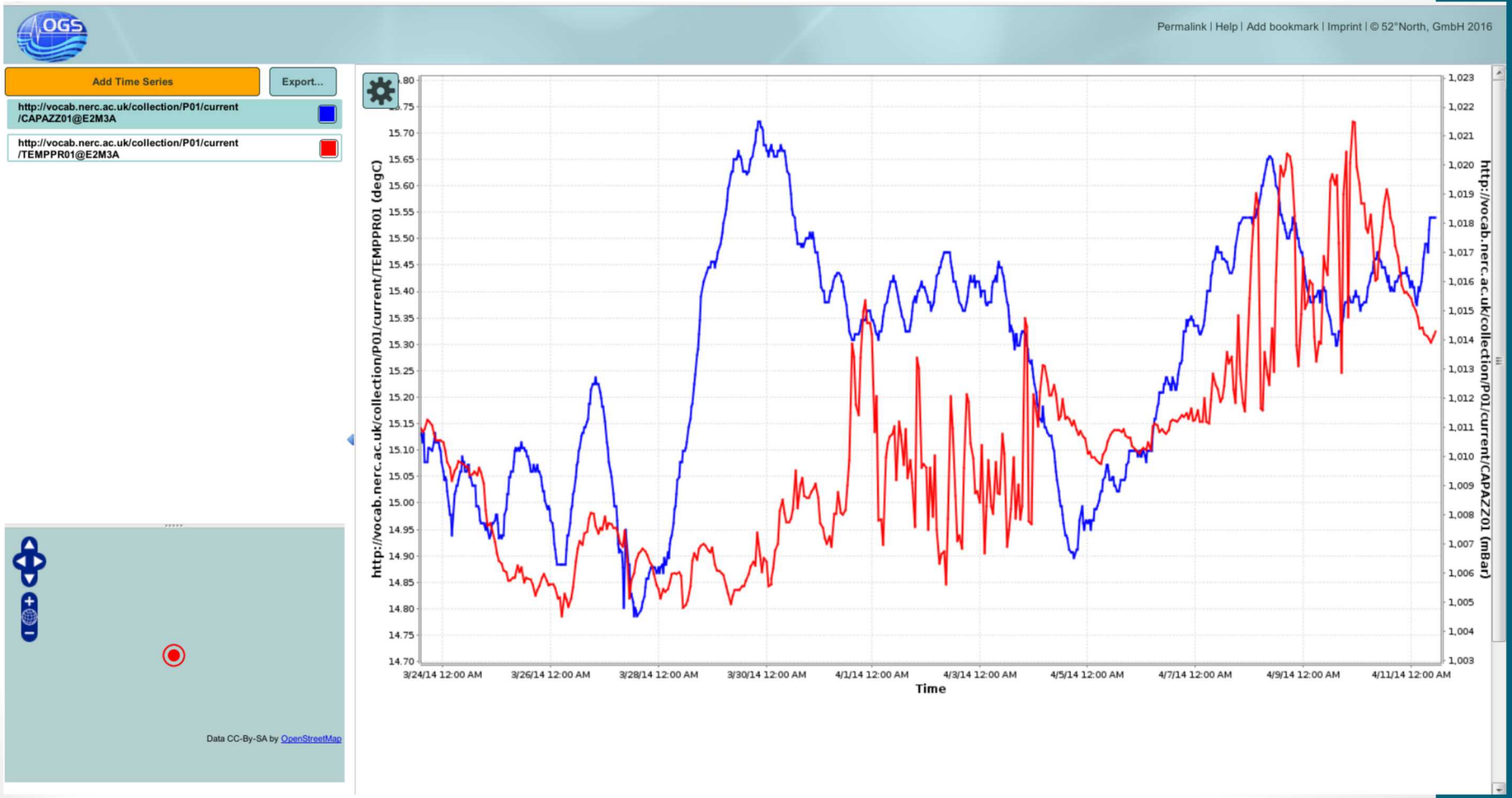

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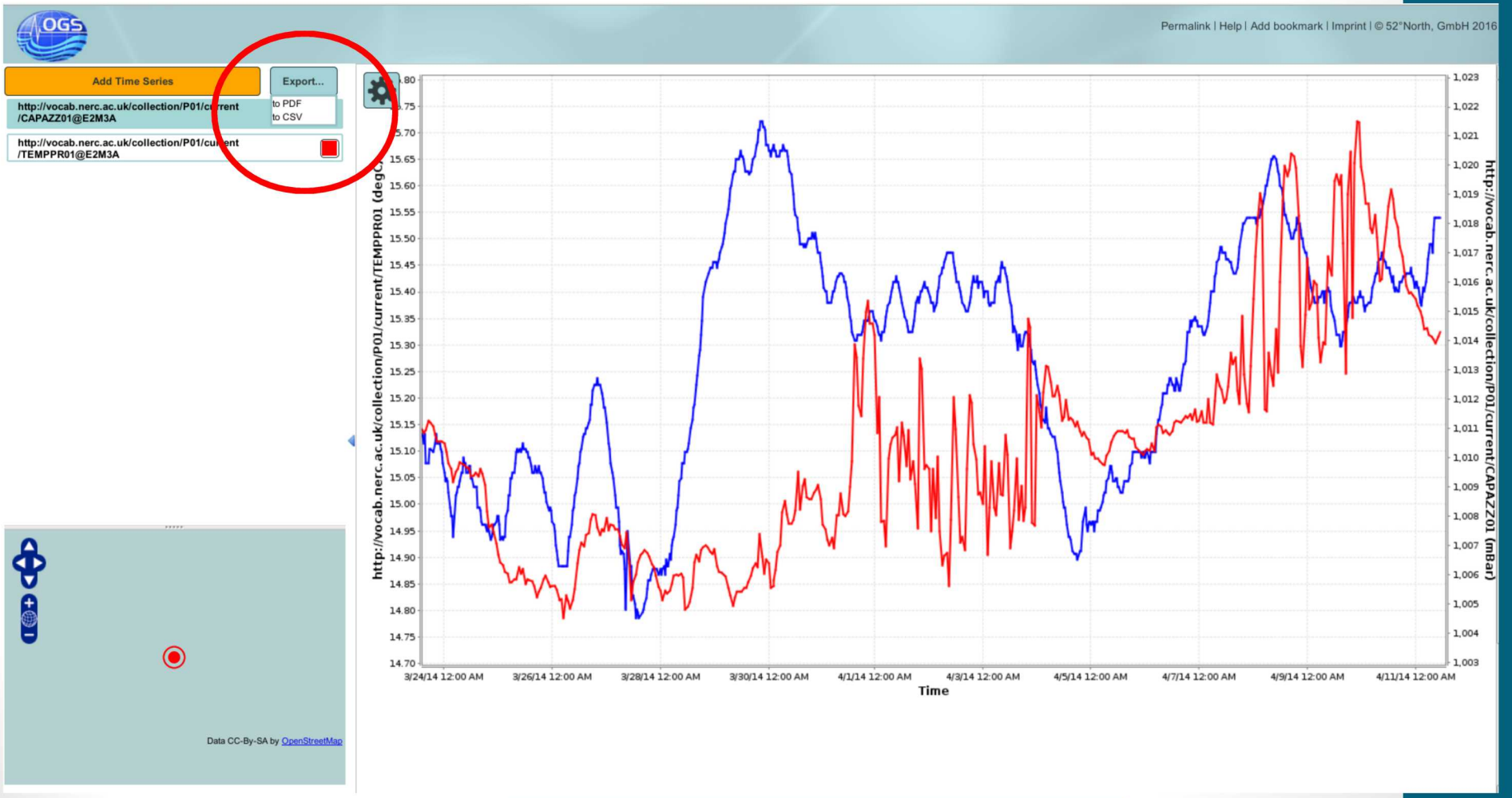

http://nodc.ogs.trieste.it/SOSclient/

Sensor Web Enablement (SWE): E2-M3A

SensorML

- AIR_METEO
- AIR_PRESS
- CT
- GPS
- pCO2
- pH
- PIR
- PSP
- WIND

O&M

- AIR_PRESS
- CT_cond
- CT_oxy
- CT_press
- CT_temp
- GPS_lat
- GPS_lon
- HUMID
- pCO2
- pH
- PIR_INFRA
- PIR_TEMP
- PSP
- TEMP_AIR
- WIND_DIR
- WIND_DIR_GUST
- WIND_ORIENTATION
- WIND_SPEED
- WIND_SPEED_GUST

Sensor Web Enablement (SWE)

In conclusion:

PROS

- Use of widely adopted standards for data, metadata and for management procedures
- Possible connection with different systems (e.g. Delayed-Mode, SeaDataNet experience)
- In a near future, will be possible a direct link to newly developed sensors speaking O&M

CONS

- Demanding adaptation of previous system
- Currently, few choices of server and client softwares and libraries
- Lack of user friendly management interface: manual metadata compilation

Thanks for the attention!