Adaptation of the Helgoland client to represent the marine monitoring network of BSH

Christoph Schreyer

Federal Maritime and Hydrographic Agency of Germany
Agenda

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  • Services and Responsibilities
  • Tasks and Products
• Marine Environmental Monitoring Network
  • MARNET
  • Arkona Basin Buoy
• Adaptation of the 52° North SOS
  • Category
• Implementation
  • BSH - Data Process
  • 52° North - Adaptation of the Helgoland Client
• Further Development
The BSH - Facts and Figures

- Federal Maritime and Hydrographic Agency of Germany
  - Maritime government research agency in the **Federal Ministry of Transport and Digital Infrastructure**
  - Total number of employees: 874 spread over 3 locations
  - 5 multi-functional ships for hydrographic surveying, wreck search, testing of navigation equipment and marine research

VWFS Atair

Headquarter: Hamburg  
Rostock  
Laboratory Sülldorf (Hamburg)
The BSH - Services and Responsibilities

• Services for maritime shipping
  • flag state tasks, general services for managing owners, funding for maritime transport
  • environmental protection in maritime transportation
  • safety of navigation
  • maritime security

• Nautical and hydrographic information
  • hydrographic surveying
  • investigation of underwater obstructions/wreck search

• Marine monitoring, maritime services
  • marine research and monitoring for utilization, climate and environment
  • forecasting and warning services
  • geospatial data information services

• Order of the seas
  • maritime spatial planning
  • approval of offshore installations

• National, international obligations to report
The BSH - Tasks and Products

- Water level forecasting and storm tide warnings
- Designing areas and licensing of offshore wind farms
- Services for maritime transport, such as law of the flag, tonnage measurement, International Ship Register
- Authorization and supervision of Radar, navigation and safety fittings
- Production and publication of nautical charts and nautical publications
- Operating a Marine Environmental Monitoring Network
- Data products and information (e.g. oceanographic)
- more on www.bsh.de
Marine Environmental Monitoring Network

- **BSH's monitoring network** consists of
  - 9 automatically measuring stations and
  - 7 wave buoys, which only measure the sea state.

**North Sea**
- Unmanned lightship Deutsche Bucht
- Unmanned lightship TW EMS
- Nordseeboje II
- Nordseeboje III

**Baltic Sea**
- Lighthouse Kiel
- Large-size buoy Fehmarn Belt
- Measuring mast Darßer Schwelle
- Large-size buoy Oder Bank
- Arkona Basin Buoy
# Marine Environmental Monitoring Network

- **The Arkona Basin Buoy**
  - 142 sensors, 14 parameter distributed over 30 depths at 1 position

<table>
<thead>
<tr>
<th>Sensors</th>
<th>2m</th>
<th>5m</th>
<th>7m</th>
<th>16m, 25m</th>
<th>33m</th>
<th>40m</th>
<th>43m</th>
<th>45m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea temperature</td>
<td>2m</td>
<td>5m</td>
<td>7m</td>
<td>16m, 25m</td>
<td>33m</td>
<td>40m</td>
<td>43m</td>
<td></td>
</tr>
<tr>
<td>Salinity</td>
<td>2m</td>
<td>5m</td>
<td>7m</td>
<td>16m, 25m</td>
<td>33m</td>
<td>40m</td>
<td>43m</td>
<td></td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td></td>
<td></td>
<td></td>
<td>7m</td>
<td></td>
<td></td>
<td></td>
<td>40m</td>
</tr>
<tr>
<td>Chlorophyll</td>
<td>2m</td>
<td>5m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opacity</td>
<td>2m</td>
<td>5m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td></td>
<td></td>
<td></td>
<td>4m - 42m (2m depth levels)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea state</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meteorology</td>
<td>0m</td>
<td>10m height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Implementation

• **Special Feature**
  • Sensors are aggregated at one point in different depths and heights
    • Different from environmental monitoring ashore, where the sensors are distributed over a large area

• **BSH – Data Process**

• **52° North - Adaptation of the 52° North Helgoland Client**
  • Data model and Sensor Web REST-API of the 52° North SOS server will be extended by a “category” element.
    • In general, categories group available time series
    • In our case the category element allows the connection of the measured values with the corresponding depth

• Tree representation of the time series, which can be sorted by phenomenon as well as by depth
Implementation - Data Process

INSIDA → Sensor Model Description → SOS Server

1. Sensor Model Description
2. Input
3. Output

InsertSensor (SML)
InsertObservation
InsertResult (O&M)

INSIDA

Series API
REST API
SOS Services (O&M)

Output

Temperature, Conductivity, Oxygen saturation...

Clients
Implementation – Station/Sensor Description

1 SensorML: Sensor System as a Physical System

- A platform consists of various sensors in different depths and heights at one position
  - Requires hierarchical modeling of the sensors/procedures and offerings
  - First, insert the platform and then the individual sensors (ordered by ObservableProperty/Phenomenon and depth/height) into the SOS
  - Build the hierarchy with the sml:attachedTo Element

- Platform/Station: Arkona Basin Buoy (no observations)
  - Station: Arkona Basin Buoy - Weather (no observations)
    - Sensor: Arkona Basin Buoy - Weather 10m Air Temperature
    - Sensor: Arkona Basin Buoy - Weather 10m Wind Speed
    - Sensor: Arkona Basin Buoy - Weather 2m Air Temperature
    - Sensor: Arkona Basin Buoy - Weather 2m Wind Speed
  - Sensor: Arkona Basin Buoy - 2m Sea Water Temperature
  - Sensor: Arkona Basin Buoy - 5m Sea Water Temperature
  - Sensor: Arkona Basin Buoy - 7m Sea Water Temperature
  - ...
Implementation – SensorML: Sensor System as a Physical System

Environmental System
- Identification
- Location: coordinates, referenceFrame
- Status: active
- Metadata: Owner, contact details, etc.

PhysicalSystem
- System Identification
- Name: Arkona Basin Buoy
- Location: coordinates, referenceFrame
- Status: active
- Metadata: Owner, contact details, etc.

PhysicalComponent
- Identification
- Name: Arkona Basin Buoy
- Location: coordinates, altitude, referenceFrame
- Status: active
- Parent element: attachedTo PhysicalSystem

Model & Configuration
- Component Identification
- Name: Arkona Basin Buoy
- Location: coordinates, altitude, referenceFrame
- Status: active
- Parent element: attachedTo PhysicalSystem

Input
- Observed property

Process

Output
- Unit of measure (uom)

Sensor 1

Sensor 2

*Code snippet*:
```xml
<PhysicalSystem>
  ...
  <Model & Configuration>
    ...
  </Model & Configuration>
</PhysicalSystem>
```
Implementation – Station/Sensor Description

1. FME – Inserting the sensor description via SensorML (PlatformParameter2SensorML.frw)
Implementation – Data Loading

2 Insert Sensor data with Category Element

- **InsertObservation** operation – Insert **one observation** per request
- **InsertResult** operation – Insert **multiple observations** per request, without having the need to provide all parameters each time.
  - **InsertResultTemplate** Operation - it is first required to define the template of the result. This template describes the structure of the values of **InsertResult** operation.
  
Once the template is defined, the raw values can simply be inserted without having the need to provide all the parameters for each request again.

```json
{  
  "request" : "InsertResultTemplate",  
  "service" : "SOS",  
  "version" : "2.0.0",  
  "identifier" : "urn:balticSea:station:arkonaBasinBuoy:-0.5:sea_water_temperature:47:insertresulttemplate",  
  "offering" : "urn:balticSea:station:arkonaBasinBuoy:-0.5:sea_water_temperature:47:offering",  
  "observationTemplate" : {  
    "type" : "http://www.opengis.net/def/observationType/OGC-OM/2.0/OM_Measurement",  
    "procedure" : "urn:balticSea:station:arkonaBasinBuoy:-0.5:sea_water_temperature:47",  
    "parameter" : [ {  
      "NamedValue" : {  
        "name" : "category",  
        "value" : {  
          "value" : "-0.5",  
          "name" : "-0.5",  
          "description" : "Sensor at -0.5m"  
        },  
        "observedProperty" : "sea_water_temperature",  
        "featureOfInterest" : {  
          "name" : "featureOfInterest",  
          "identifier" : "featureOfInterest",  
          "feature" : [  
            {  
              "name" : "depth",  
              "value" : 47  
            },  
            {  
              "name" : "temperature",  
              "value" : 10  
            }  
          ],  
          "spatialRepresentationType" : [  
            "point",  
            "line"  
          ],  
          "spatialReference" : {  
            "wkt" : "ellipsoid WGS84"  
          }  
        }  
      }  
    ] }  
}  
```

**InsertResultTemplate**: For each combination observedproperty - depth
Implementation - Data Loading

2. FME – Operation: InsertResult (Insida2SOS_Result.fmw)
Implementation - Data Loading

FME – Operation: InsertResult (Insida2SOS_Result.fmw)

1. Check if an InsertResultTemplate for a given "offering" and "observedProperty" exists (GetResultTemplate)

2. If no InsertResultTemplate exists, insert a result template for each (InsertResultTemplate)

3. Create the InsertResult JSON documents

Example: "tokenSeparator" : ",",
"blockSeparator" : "#"

```json
{
  "request" : "InsertResult",
  "service" : "SOS",
  "version" : "2.0.0",
  "templateIdentifier" : "urn:balticSea:station:arkonaBasinBuoy:10:relative_humidity::insertresulttemplate",
  "resultValues" : "2017-12-19T07:00:00+00:00,92.03%, 2017-10-13T13:00:00+00:00,91.33%, 2016-05T22:00:00+00:00,91.17%, 2017-10-13T08:00+00:00,90.83%"
}
```
Implementation – BSH Helgoland Client

3 Helgoland Client - BSH adaption: Map viewer
Implementation – BSH Helgoland Client

3 Helgoland Client - BSH adaption: Selection dialogue
Implementation – BSH Helgoland Client
Further Development

Data

- **New Data Sources**
  - Sea state, Water level, chemical oceanography, biology and fisheries, contamination…
- **New data Sources with different feature of interest**
  - Ship’s Cruise Track (e.g. FerryBoxes)
- **Searchable Sensor Metadata**
  - Link Sensor metadata (SensorML) with SDI ISO 19115 metadata

Client

- User-controlled scaling of the Y-axis
- Download further data types, e.g. netCDF
- Visualization of more than time series, e.g. profile measurements, horizontal / vertical sections, waterfall plots
Thank you very much!
Implementation – O&M Conceptual Model

Example: „Feature of Interest“ Point – Multiple Result in Time

Seawater Temperature (Sensor with sensor position)

Procedure

Observation

Result

Sampling Time

Data (Observed value)

Unit of Measurement

Degree Celsius

Feature-Of-Interest

Platform Position (Geometric feature to which the observation is associated)

Observed Property

Seawater Temperature (Phenomenon for which the observation contains data)

produce

uses

has

with

carries

estimates value of

observes

（Instrument measuring the temperature of the water column.）
Implementation – O&M Conceptual Model

Example: „Feature of Interest“ Curve – Multiple Result in Time

Thermosalinograph (TSG) \(^1\)
(Sensor with sensor position)

 Procedure

 Observation

 Result

 Sampling Time

TSG Data (Observed value)

Seawater Temperature
(Phenomenon for which the observation contains data)

Unit of Measurement

Degree Celsius

Feature-Of-Interest

Observed Property

Ship’s Cruise Track
(Geometric feature to which the observation is associated)

Observed

Observed Property

observes

carries

has

estimates value of

produce

with

to

produce

uses

\(^1\) TSG is an instrument mounted near the water intake of ships to continuously measure sea surface temperature and conductivity while the ship is in motion.