BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

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

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Agenda

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

- **The BSH**
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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

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- 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

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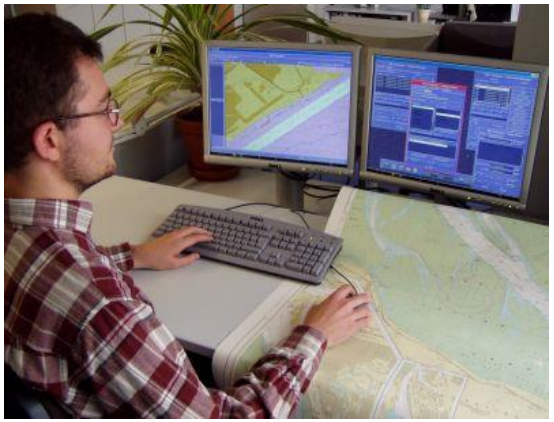
- Services for maritime shipping
  - flag state tasks, general services for managing owners, funding for maritime transport
  - environmental protection in maritime transportation
  - safety of navigation
  - maritime security
- Nautical and hydrographic information
  - hydrographic surveying
  - investigation 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

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- **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

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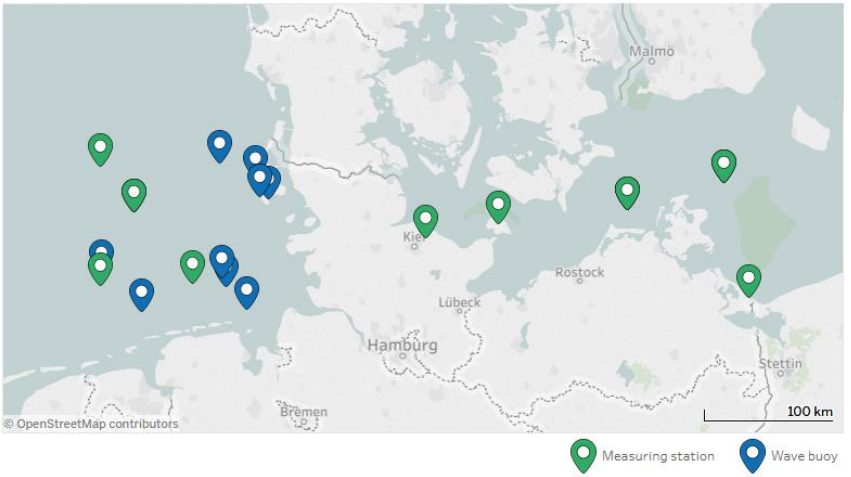
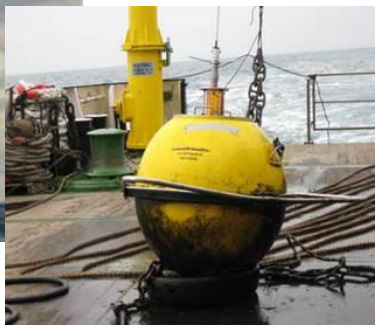
- **BSH's monitoring network** consists of
  - 9 automatically measuring stations and
  - 7 wave buoys, which only measure the sea state.
- **North Sea**
  - Unmanned lightship Deutsche Bucht
  - Unmanned lightship TW EMS
  - Nordseeboje II
  - Nordseeboje III
- **Baltic Sea**
  - Lighthouse Kiel
  - Large-size buoy Fehmarn Belt
  - Measuring mast Darßer Schwelle
  - Large-size buoy Oder Bank
  - Arkona Basin Buoy





Marine Environmental Monitoring Network

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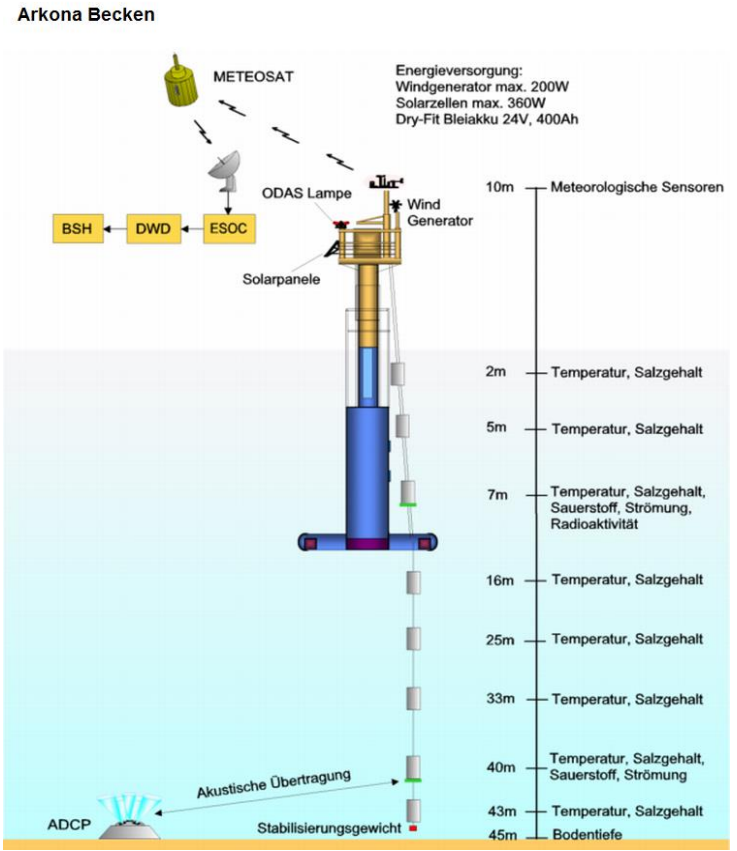
- The Arkona Basin Buoy
  - 142 sensors, 14 parameter distributed over 30 depths at 1 position

Sensors									
Sea temperature	2m	5m	7m	16m,	25m	33m	40m	43m	45m
Salinity	2m	5m	7m	16m	25m	33m	40m	43m	
Oxygen saturation			7m				40m		
Chlorophyll	2m	5m							
Opacity	2m	5m							
Current	4m - 42m (2m depth levels)								
Sea state									
Meteorology	0m, 10m height								



Implementation

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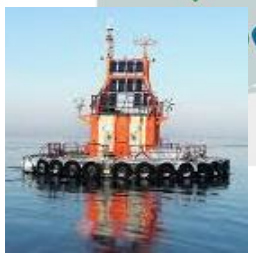
- **Special Feature**
  - Sensors are aggregated at one point in different depths and heights
    - Different from environmental monitoring ashore, where the sensors are distributed over a large area
- **BSH – Data Process**

- **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

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE



Temperature, Conductivity
Oxygen saturation…

INSIDA

1 **Sensor Model Description**

insertSensor **(SML)**

Input

insertObservation
insertResult
(O&M)

2

SOS Server

52n

Sensor Observation Service

Output

Series API
REST API

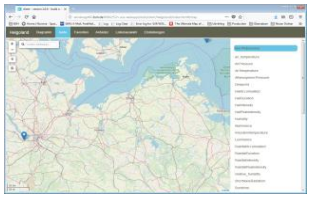
SOS Services
(O&M)

3

SOS DB

(Postgres)

Clients



Implementation – Station/Sensor Description

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

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

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Environment

PhysicalSystem

System identification
System name: Arkona Basin Buoy
System location: coordinates, referenceFrame
System status: activ
System metadata: Owner, contact details etc.

PhysicalComponent
(Sensor 1)

Input ● → **Input** Observed property → **Process** → **Output** uom

Model & Configuration
Component identification
Component offering
Component name: Arkona Basin Buoy
Component location: coordinates, altitude, refFrame
Component type: insitu
Component status: activ
Parent element: attachedTo PhysicalSystem

PhysicalComponent
(Sensor 2)

Input ● → **Input** Observed property → **Process** → **Output** uom

Model & Configuration

```
<swes:procedureDescription>
    <sml:PhysicalSystem xmlns:gml="http://www.opengis.net/gml/3.2"
        <!-- ================================================== -->
        <!--                  System Description                -->
        <!-- ================================================== -->
        <gml:description>Arkona Basin Buoy BSH/IOW - Platform</gml:description>
        <gml:identifier codeSpace="uniqueID">urn:balticSea:station:arkonaBasinBuoy</gml:identifier>
        <sml:capabilities name="offerings">
            <sml:CapabilityList>
                <sml:capability name="offeringID">
                    <swe:Text definition="urn:ogc:def:identifier:OGC:offeringID">
                        <swe:label>Arkona Basin Buoy Station Offering</swe:label>
                        <swe:value>urn:balticSea:station:arkonaBasinBuoy:offering</swe:value>
                    </swe:Text>
                </sml:capability>
            </sml:CapabilityList>
        </sml:capabilities>
<sml:PhysicalComponent
    <!-- ====================================== -->
    <!--          Component Descriptions        -->
    <!-- ====================================== -->
    <gml:identifier codeSpace="uniqueID">urn:balticSea:station:arkonaBasinBuoy:-0.5:sea_water_temperature:47</gml:identifier>
    <gml:name>Water temperature at -0.5 meter</gml:name>
    <sml:capabilities name="offerings">
        <sml:CapabilityList>
            <sml:capability name="offeringID">
                <swe:Text definition="urn:ogc:def:identifier:OGC:offeringID">
                    <swe:label>Arkona Basin Buoy Station sea_water_temperature in -0.5m</swe:label>
                    <swe:value>urn:balticSea:station:arkonaBasinBuoy:-0.5:sea_water_temperature:47:offering</swe:value>
                </swe:Text>
            </sml:capability>
        </sml:CapabilityList>
    </sml:capabilities>
    <sml:capabilities name="metadata">
        <sml:CapabilityList>
            <!-- status indicates, whether sensor is insitu (true) or remote (false) -->
            <sml:capability name="insitu">
                <swe:Boolean definition="insitu">
                    <swe:value>true</swe:value>
                </swe:Boolean>
            </sml:capability>
            <!-- status indicates, whether sensor is mobile (true) or fixed/stationary (false) -->
            <sml:capability name="mobile">
                <swe:Boolean definition="mobile">
                    <swe:value>false</swe:value>
                </swe:Boolean>
            </sml:capability>
        </sml:CapabilityList>
    </sml:capabilities>
    <sml:attachedTo xlink:title="urn:balticSea:station:arkonaBasinBuoy"></sml:attachedTo>
```

Implementation – Station/Sensor Description

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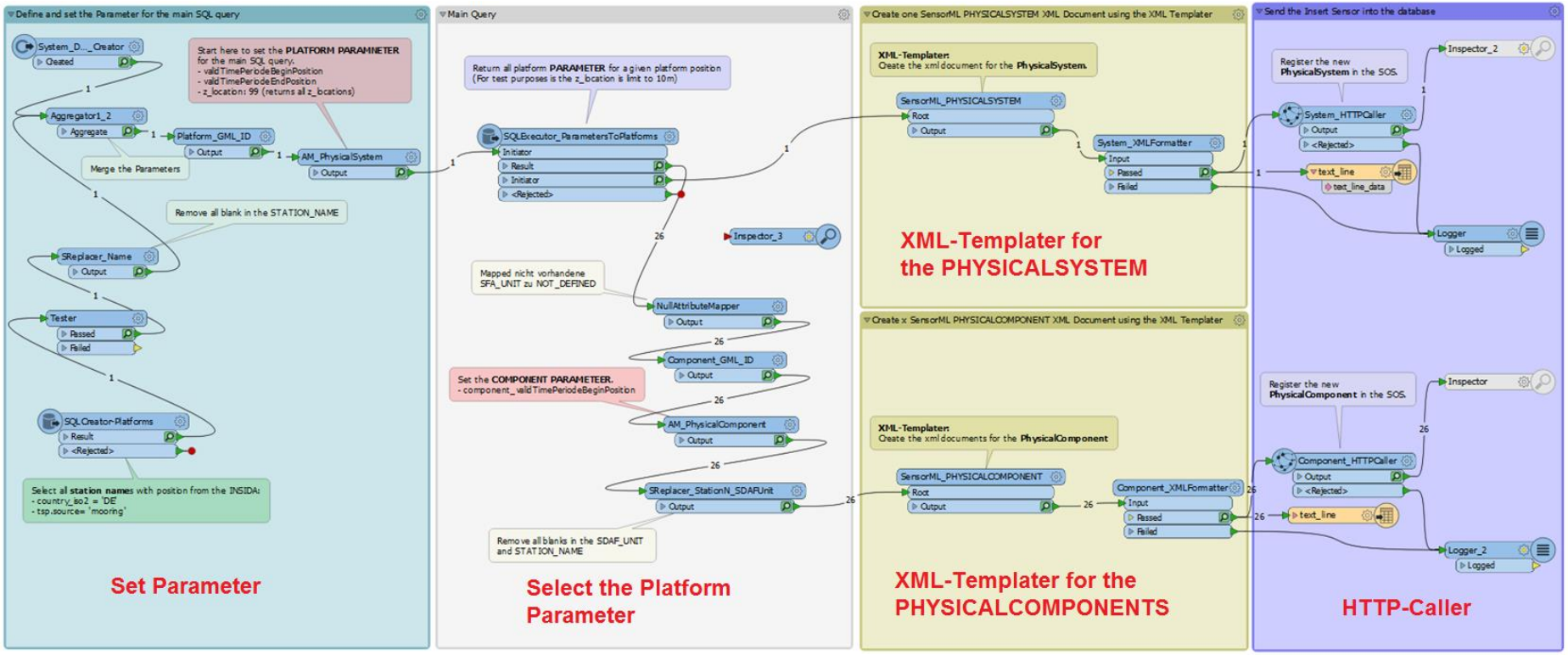
1. FME – Inserting the sensor description via SensorML (PlatformParameter2SensorML.frw)



Implementation – Data Loading

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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.

```
{
   "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" : {
```

InsertResultTemplate: For each combination observedproperty - depth

Implementation - Data Loading

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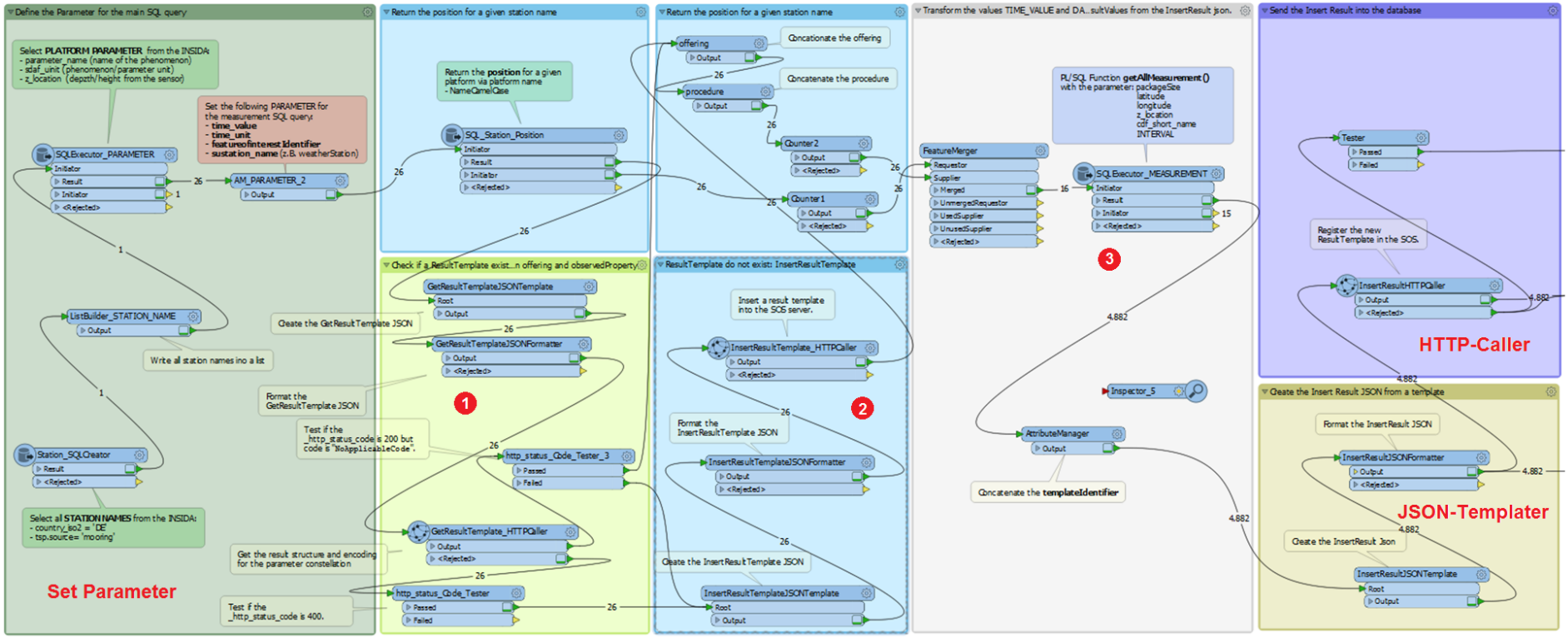
2 FME – Operation: InsertResult (Insida2SOS_Result.fmw)



Implementation - Data Loading

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

2 FME – Operation: InsertResult (Insida2SOS_Result.fmw)

1. Check if a 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" : "#"


```
{
   "request" : "InsertResult",
   "service" : "SOS",
   "version" : "2.0.0",
   "templateIdentifier" : "urn:balticSea:station:arkonaBasinBuoy:10:relative_humidity:8:insertresulttemplate",
   "resultValues" : "2017-12-19T07:00:00+00:00,92.83#2017-10-13T13:00:00+00:00,91.33#2018-06-05T22:00:00+00:00,81.17#2017-10-13T08:0
}
```

Implementation – BSH Helgoland Client

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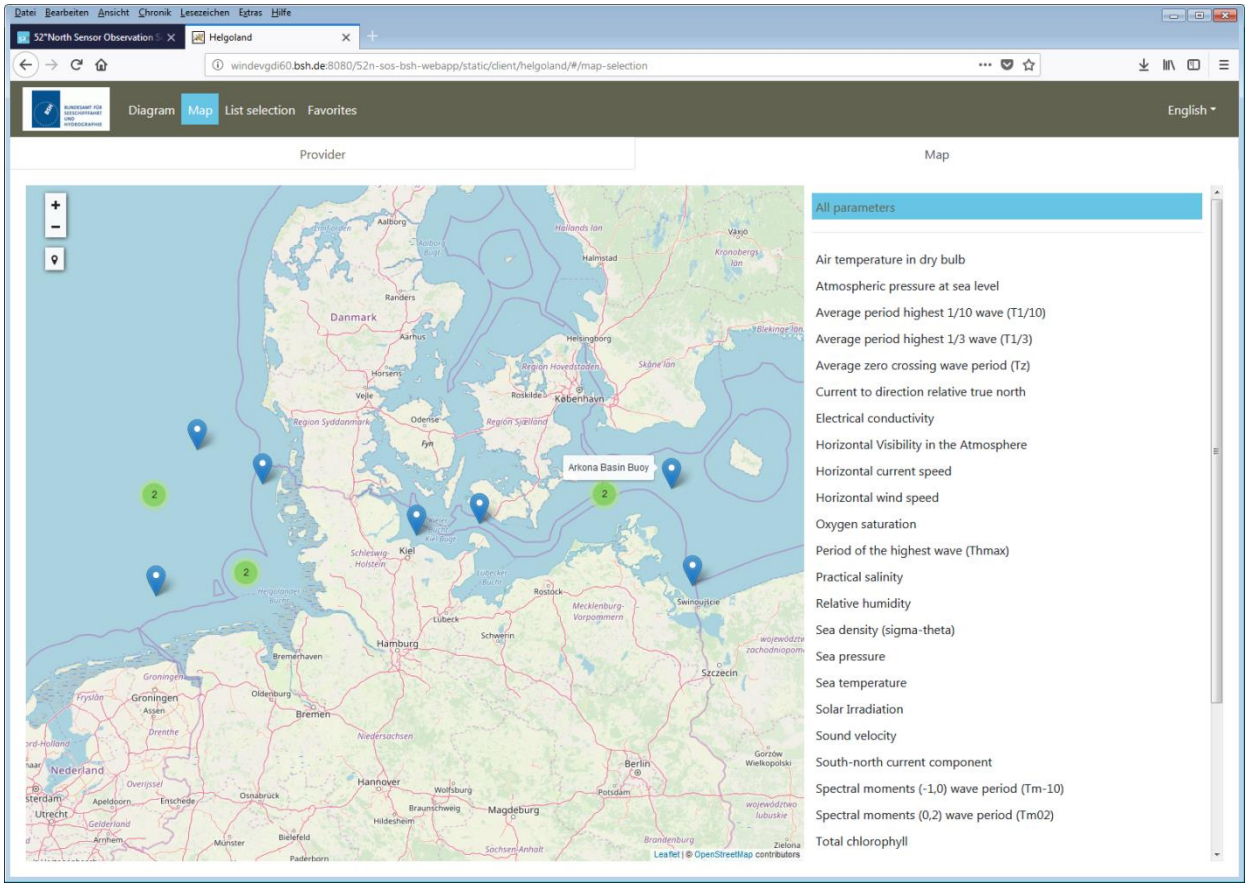
3 Helgoland Client - BSH adaption: Map viewer



Implementation – BSH Helgoland Client

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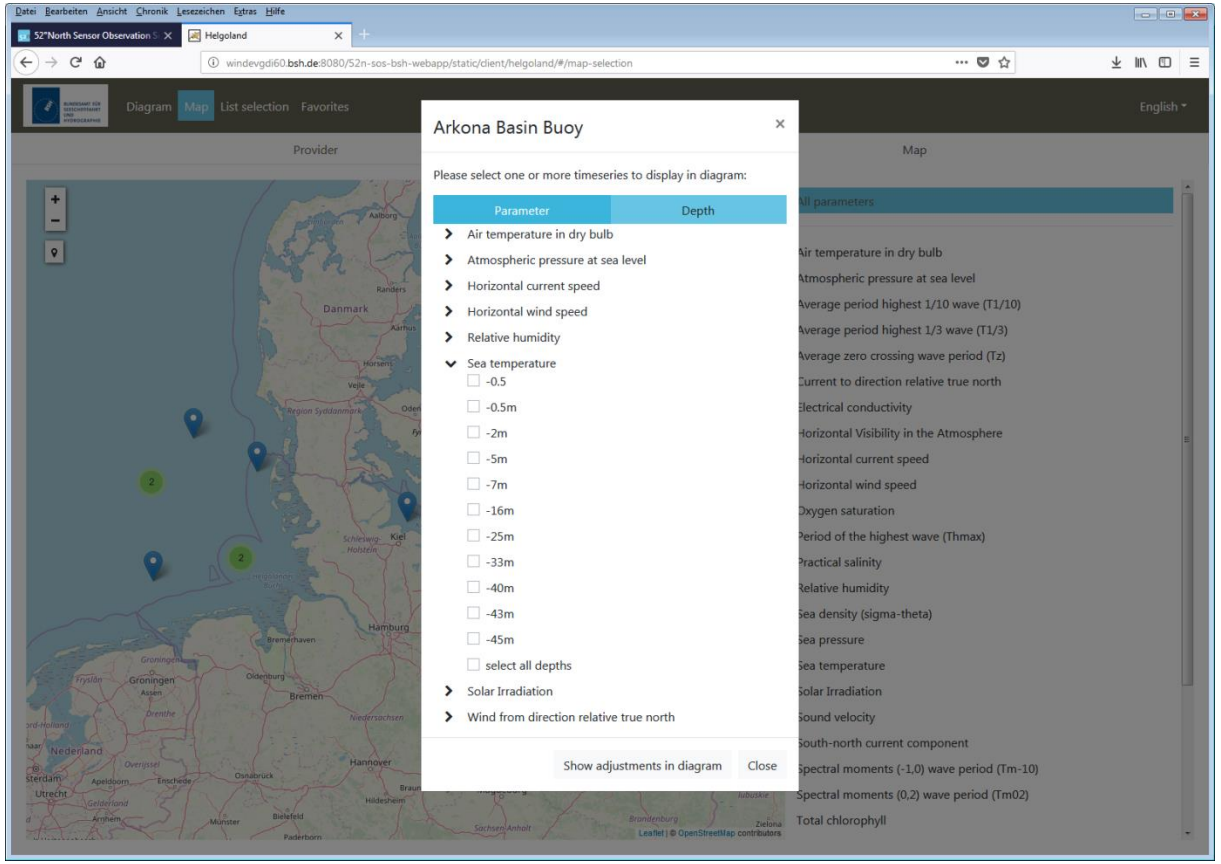
3 Helgoland Client - BSH adaption: Selection dialogue



Implementation – BSH Helgoland Client

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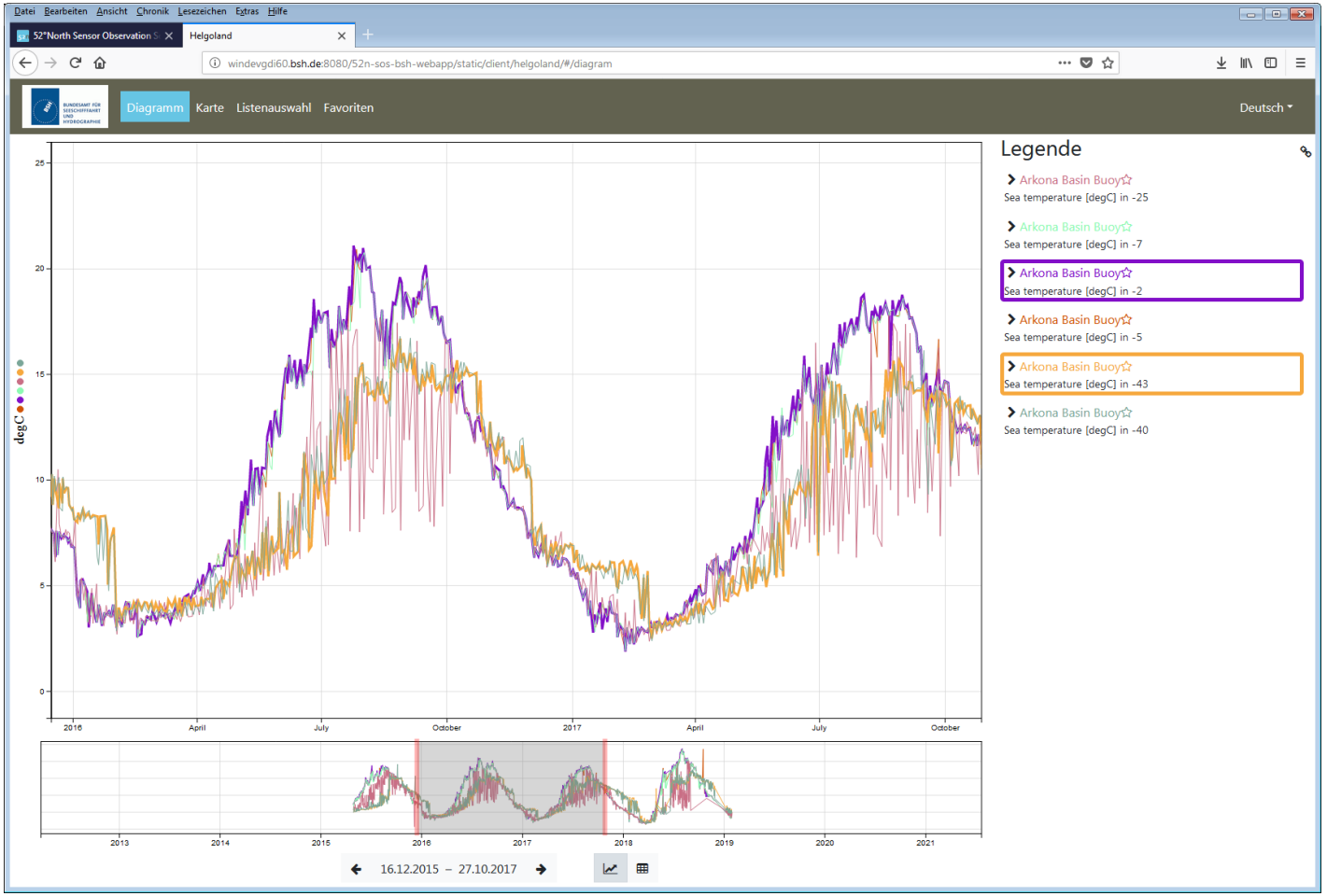


Further Development

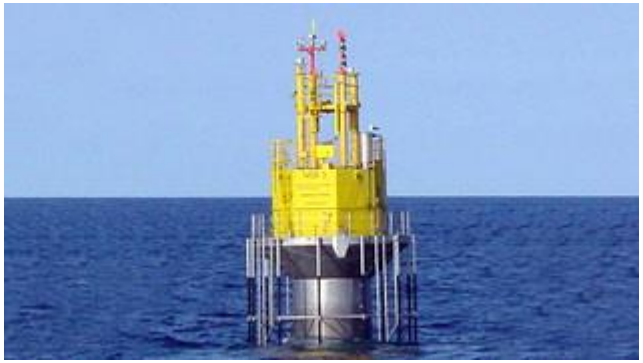
BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

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!

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Implementation – O&M Conceptual Model

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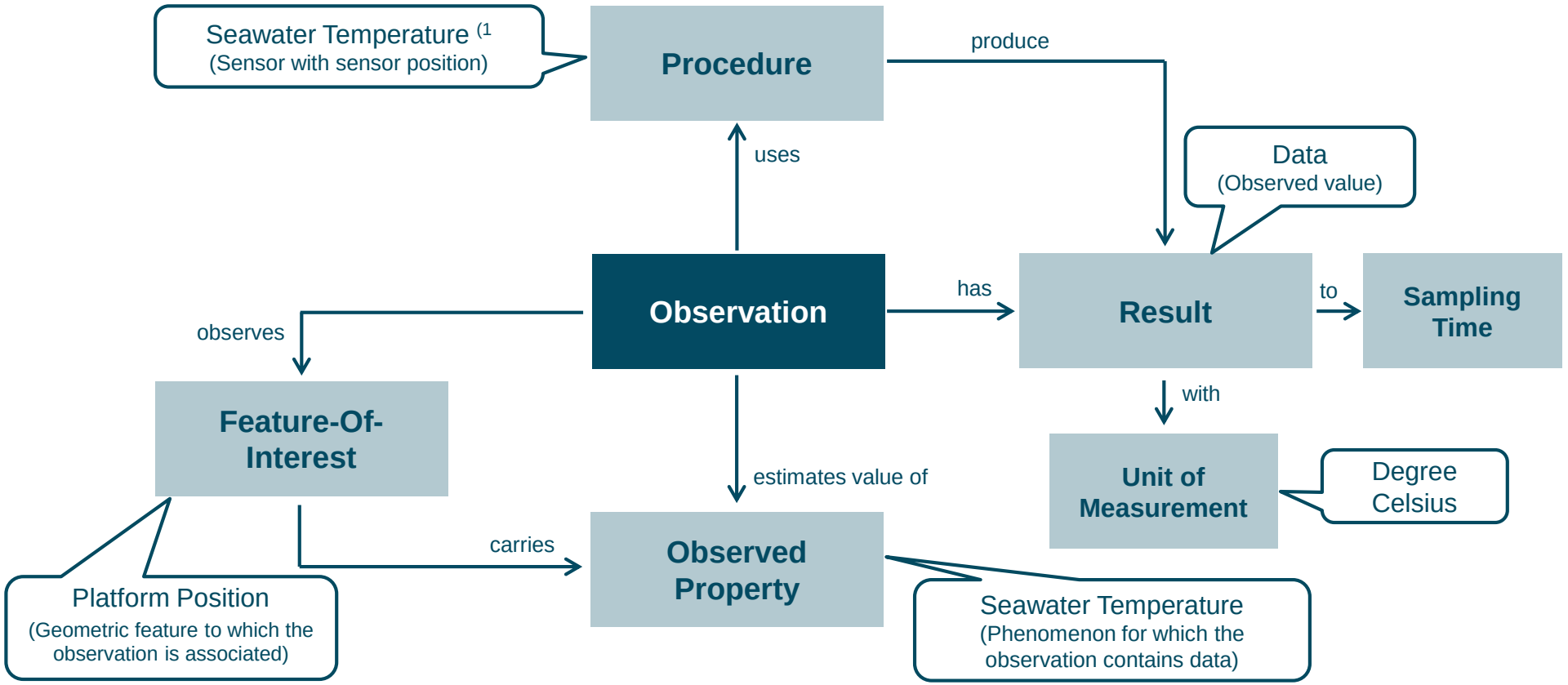
Example:
„Feature of Interest“ Point– Multiple Result in Time



(1 Instrument measuring the temperature of the water column.

Implementation – O&M Conceptual Model

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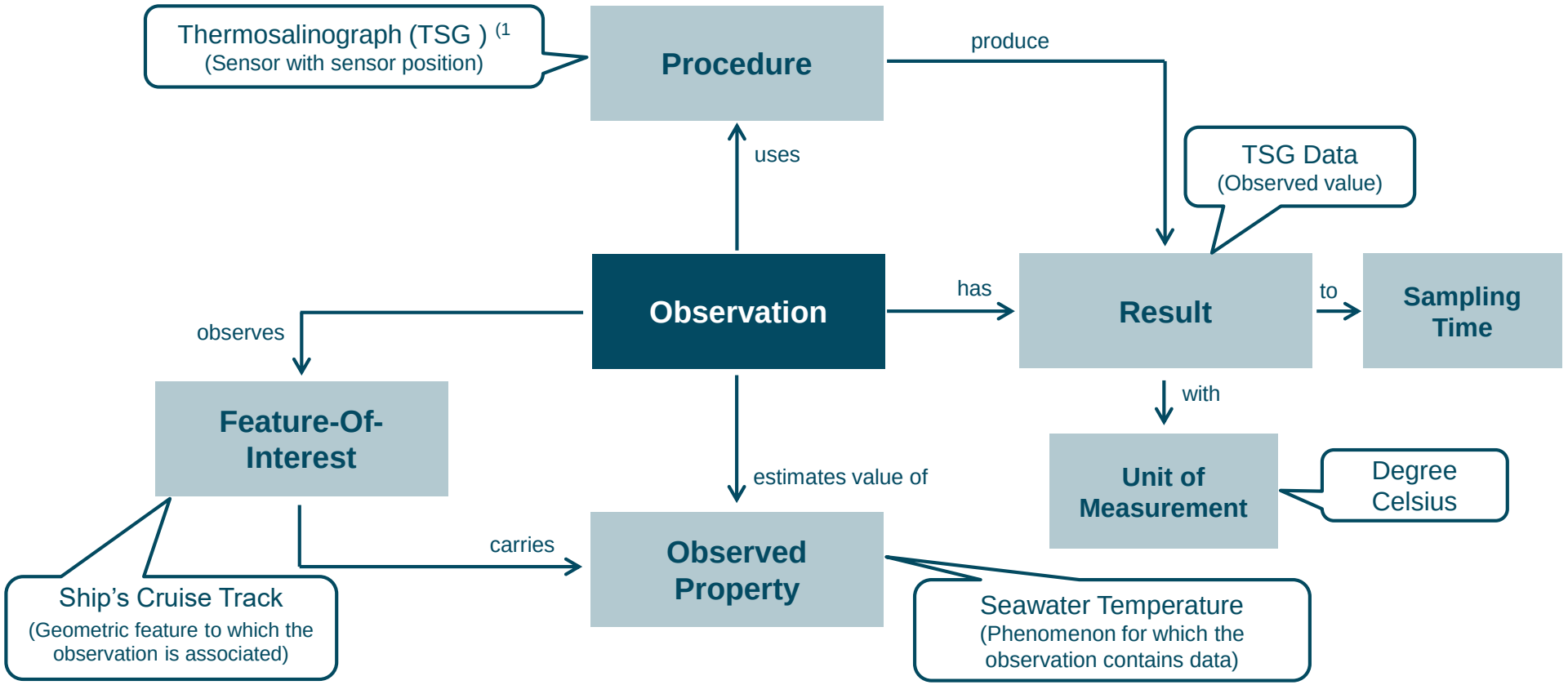
Example:
„Feature of Interest“ Curve – Multiple Result in Time



(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.