Specification of SOS Viewing Services and Development Plan

WP 10 - Deliverable D10.17

HORIZON *2020*

sdn-userdesk@seadatanet.org – www.seadatanet.org

SeaDataCloud - Further developing the pan-European infrastructure for marine and ocean data management

Grant Agreement Number: 730960

Deliverable number	Short title
D10.17	Specification of SOS Viewing Services

Long title

Specification of SOS Viewing Services and Development Plan

Short description

This deliverable specifies the SeaDataCloud SOS Viewing Service as a viewer application for data streams from operational sensors and platforms available via the SeaDataCloud infrastructure. It further provides a development plan for this component, specifying the different tasks that need to be carried out in order to fulfil the identified user requirements.

Author	Working group
Dr. Simon Jirka, Christian Autermann, Jan Schulte, Henning Bredel, Matthes Rieke	WP 10

Dissemination	Copyright terms
Public	

History

Version	Authors	Date	Comments
0.1	Dr. Simon Jirka	17/09/2018	Initial document
0.9	Dr. Simon Jirka, Christian Autermann, Jan Schulte	02/11/2018	Full version for review
1.0	Dick M.A. Schaap	13/11/2018	Reviewed and accepted as technical coordinator
1.1	M. Fichaut	13/11/2018	Final minor edits

Disclaimer

Acknowledgment

This document is a deliverable of the SeaDataCloud project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement № 730960.

Table of contents

1. Abbreviations

API	Application Programming Interface
CSV	Comma-Separated Values
GUI	Graphical User Interface
HTML	Hypertext Markup Language
ISO	International Organization for Standardization
JSON	JavaScript Object Notation
O&M	Observations and Measurements
OGC	Open Geospatial Consortium
PDF	Portable Document Format
PNG	Portable Network Graphics
REST	Representational State Transfer
SensorML	Sensor Model Language
SOS	Sensor Observation Service
SWE	Sensor Web Enablement

2. Introduction

Within the SeaDataCloud architecture, the OGC Sensor Observation Service (SOS) interface is used for sharing different types of non-validated live streams of observation data in an interoperable manner. While upstream services such as the SeaDataCloud SWE Ingestion Service enable the harvesting of sensor metadata and observation data streams, downstream services such as the SeaDataCloud SOS Viewing Service enable the user-friendly publishing and distribution of such data sources.

This deliverable specifies the SeaDataCloud SOS Viewing Service as a viewer application for data streams from operational sensors and platforms available via the SeaDataCloud infrastructure. It further provides a development plan for this component, specifying the different tasks that need to be carried out in order to fulfil the identified user requirements.

The starting point for the development of the SeaDataCloud SOS Viewing Service is the JavaScript-based 52°North Helgoland Sensor Web Viewer together with the 52°North Sensor Web REST-API. This approach allows on the one hand to re-use and extend the work from previous projects such as ODIP II and NeXOS and at the same time ensures a resource-efficient implementation.

For the SeaDataCloud project, especially the following work items are foreseen:

- Support of additional data types (observation data streams going beyond stationary and mobile in situ sensors delivering scalar values, e.g. profiles and spectral data)
- Develop improved discovery mechanisms to help users to find data streams that shall be visualised
- Development of an optimised user interface in line with other SeaDataCloud tools

The remainder of this deliverable is structured as follows: Section 3 provides and overview of identified requirements, discusses their scope, and identifies to which extend additional developments are needed. Section 4 offers an overview of the software baseline that will be used (i.e. the 52°North Sensor Web REST-API as well as the 52°North Helgoland Sensor Web Viewer. Finally, section 5 provides a development plan which maps the previously identified developments to dedicated implementation tasks in the two baseline software components.

3. Requirements

This section provides an overview of the requirements for the SeaDataCloud SOS Viewing Service. This information is provided as part of Table 2. It has to be noted that these requirements are a baseline of extensions requested by SeaDataCloud partners that were identified in different bilateral discussions. However, it is expected that after a first implementation of the described extensions, further user feedback will become available that will result in additional modifications and extensions of the developed SOS Viewing Service.

Table 1: Overview of the Requirements for the SeaDataCloud SOS Viewing Service

Require-ment ID	Title	Description	Status
001	Visualisation and download of time-series data	Users shall be able to select one or multiple time series data sets for visualisation as a diagram or table. There shall be an option to download the displayed data as CSV files.	Already supported, no extension necessary.
002	Visualisation and download of profile measurements	Users shall be able to select individual profile observations for visualisation as a diagram. There shall be an option to download the displayed data as a CSV file.	Already supported, improvements of user workflow are needed (currently the data selection workflow is rather complex and should be simplified). Download functionality is needed as enhancement of the 52°North Helgoland Sensor Web Viewer.
003	Visualisation and download of trajectory measurements	Users shall be able to select individual trajectory observations for visualisation as a diagram combined with a map. There shall be an option to download the displayed data as a CSV file.	Improvement of the current implementation necessary. Download functionality is not yet supported. Higher efficiency for the handling of trajectories along non-fixed routes is necessary (currently the client download all trajectories for data selection).

004	Visualisation and download of spectral data	Users shall be able to select individual spectral observations for visualisation as a diagram. There shall be an option to download the displayed data as a CSV file.	Not yet available, development of extensions for 52°North Sensor Web REST-API and Helgoland Sensor Web Viewer necessary.
005	Discovery and download of out-of-band observations	Users shall be able to visualise the availability of out-of-band observations (e.g. references to external NetCDF files) on a map view. If selecting one location for which observations are available, the user shall have a functionality to download the data via the link contained in the out-of-band observation.	Already supported within the 52°North Sensor Web REST-API. Not yet supported in the 52°North Helgoland Sensor Web Viewer (enhancement necessary).
006	Integration of vocabulary servers	Many marine SOS servers use dictionary entries for referencing specific observed properties, sensor types, etc. However, as the URIs pointing to these vocabulary entries are not human readable, the viewer shall resolve such URIs and show a human readable label as defined by the corresponding dictionary entry. For SeaDataCloud the NERC Vocabulary Server shall be used.	First prototype for Helgoland available as output of ODIP II; further improvements of performance and robustness are necessary
007	Free-text search	There shall be a functionality for free-text search that allows users to discover observation data streams that match to one or more user defined search terms.	Not yet available. Needs to be implemented.
008	Facet search	There shall be a complementary more sophisticated search functionality that allows users to query for live data streams based on the following properties: • Feature of interest • Observed property/parameter • Platform ID/name • Data provider • Spatial filter • Temporal filter	Not yet available, needs to be implemented.

009	Metadata visualisation	Users shall be able to view the metadata of a live observation data stream based on the SensorML description of the corresponding sensor.	Currently there is only basic functionality for showing core metadata in the legend of the 52°North Helgoland Sensor Web Viewer. More comprehensive functionality supporting SensorML-based metadata needs to be added as an enhancement.
011	General usability improvements	The client shall offer a high level of user-friendliness coupled with a dedicated SeaDataCloud user interface design.	Continuous ongoing process.
012	Improved release cycle	Provide a release of the client with subsequent release plan in order to cover the SeaDataCloud SOS Viewing Service requirements in a systematic manner.	Continuous ongoing process.

4. Software Baseline and Architecture

This section introduces the software baseline which is used for developing the SeaDataCloud SOS Viewing Service. In order to ensure a high level of efficiency, the SeaDataCloud SOS Viewing Service will not be built as a new stand-alone development. Instead, already established components will be used that will be enhanced and improved in order fulfil the requirements of the SeaDataCloud community. After the introduction of the software baseline, also the software architecture of the SeaDataCloud SOS Viewing Service will be described. The focus of this architecture description is the presentation of the different components and their interactions.

4.1. Software Baseline

The software baseline of the SeaDataCloud SOS Viewing Service comprises two elements.

On the one hand, a server-side component, the 52°North Sensor Web REST-API, enables the caching of metadata and efficient access of datasets offered by different SOS servers. In order to avoid the rather computationally expensive handling of XML-encoded responses, this REST-API offers a lightweight REST/JSON-based interface that makes the metadata (and data) of SOS instances available in a highly efficient and developer-friendly manner. This increases not only the performance of client-applications but also the efficiency of client development.

On the other hand, the 52°North Helgoland Sensor Web Viewer, a lightweight JavaScript Web application that can be executed on a broad range of devices (e.g. mobile phones, tablet computers, desktop computers), is used. This component has the role of a user frontend offering functionality for data discovery, visualisation, and download. The input data for the 52°North Helgoland Sensor Web Viewer is delivered by the 52°North Sensor Web REST-API.

4.1.1. 52°North Sensor Web REST-API

The 52°North Sensor Web REST-API provides an access layer to observation data streams via a RESTful Web binding with different output formats such as JSON, but also in form of rendered diagrams (e.g. PDF or PNG) and data files (e.g. CSV).

In addition, it offers several input and output functionalities such as

- Pre-rendering of time series data (i.e. diagrams)
- Generalization of observation data for visualisation purposes (for reducing the data volume that is transmitted to a client device)
- Overlaying of data from multiple data sets
- Conversion of raw data to other formats such as PDF, PNG, and CSV

The current version of the 52°North Sensor Web REST-API interface provides support for a broad range of different types of measurement data. This comprises

- Time-series observations measured at stationary locations
- Observations measured along a trajectory
- Profile observations measured at a fixed location
- Profile observations measured along a trajectory

- Remote observations taken at fixed locations (e.g. webcam images included as a reference in an observation)
- Out-of-band observations containing a reference to the measurement values

For facilitating the development of Sensor Web client applications, the 52°North Sensor Web REST-API offers several endpoints as a convenient entry point for developers:

- /search: simple search over the labels of all resources over all available endpoints
- /services: access to information about SOS servers encapsulated by a REST-API instance
- /datasets: access to datasets such as time series, profiles, and trajectory observations
- /phenomena: access to the parameters/properties that were observed
- /platforms: access to stations, ships, buoys, gliders, etc. to which sensors are attached
- /procedures: access to the measurement processes or sensors that were used for obtaining observation values
- /features: access to geospatial objects (so called features of interest) to which observations are associated
- /geometries: access to geometries that are associated to observations
- /categories: access to categories into which observations may be grouped
- /offerings: access to the offering metadata that are defined by underlying SOS servers

The current detailed version of the 52°North Sensor Web REST-API interface specification is available online[1].

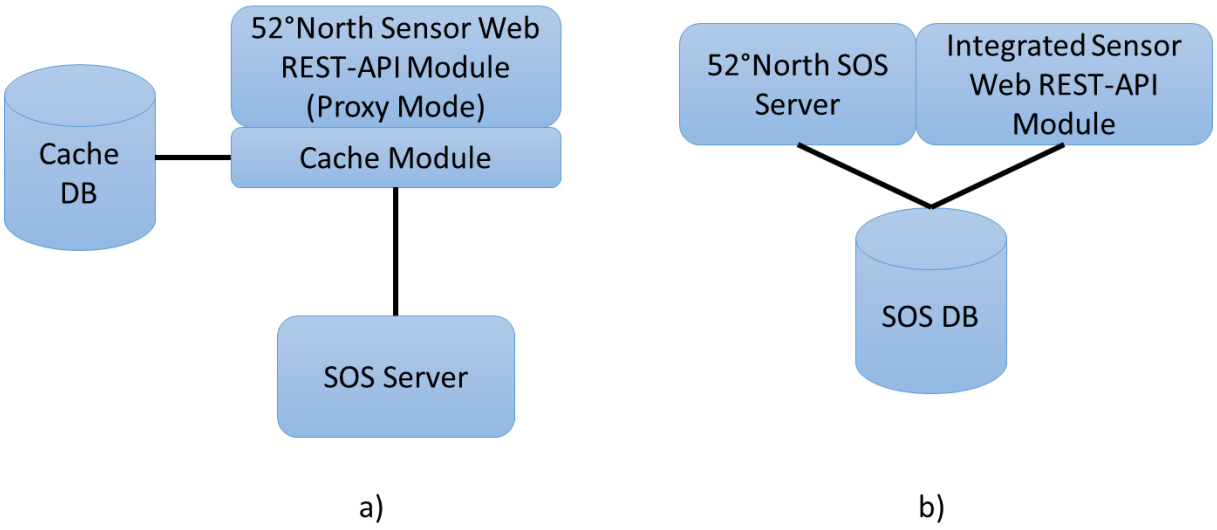

Figure 1: Deployment Modes of the 52°North Sensor Web REST-API: a) Proxy Mode, b) Integrated SOS Module

It is possible to deploy the 52°North Sensor Web REST-API in two different modes. This is shown in Figure 1. Option a) is the deployment as a proxy module that caches metadata from existing SOS

[1] http://52north.github.io/series-rest-api/develop/index.html

instances. For example, this approach avoids the repetitive download of complex, XML-encoded observation metadata, which results in a significant increase of performance when interacting with SOS servers. Option b) is a mode that is specific to the 52°North SOS implementation. In this case, the 52°North Sensor Web REST-API can be deployed as an additional module of the 52°North SOS which allows direct database access for the 52°North Sensor Web REST-API. As this approach enables a faster access to the observation data, this option has performance advantages compared to the proxy deployment. However, still the proxy deployment is highly useful for efficiently integrating those SOS servers which comply with the OGC SOS standard and that do not offer an implementation of the 52°North Sensor Web REST-API.

If the 52°North Sensor Web REST-API is deployed in the proxy mode, there are different ways how the necessary caching of SOS metadata can be achieved. In general, the approach is that different SOS operations are called in order to determine the available datasets of the SOS server and their metadata and to load the collected data into a dedicated cache database (see Figure 2). In the following, two important cases of SOS servers are described:

a) Regular SOS Server: As a first step, the GetCapabilities operation of the SOS server is called in order to determine valid parameter values for subsequent SOS operation calls. Furthermore, an overview of available datasets is determined from the Contents section of the GetCapabilities response. After that a series of DescribeSensor and GetFeatureOfInterest calls is executed for the available procedures and features in order to further enrich the SOS metadata stored in the cache.

b) INSPIRE-compliant SOS Server: In this case SOS servers offer the additional GetDataAvailability operation. After calling the GetCapabilities operation, the GetDataAvailability operation can directly be used for determining the available observation data sets. Subsequently, the GetFeatureOfInterest operation can be used for collecting geospatial references for the available observation data sets.

In both cases, the requesting of the actual observation datasets is executed on demand if a client requests a specific subset of the available data. For this purpose, the 52°North Sensor Web REST-API makes use of the GetObservation operation.

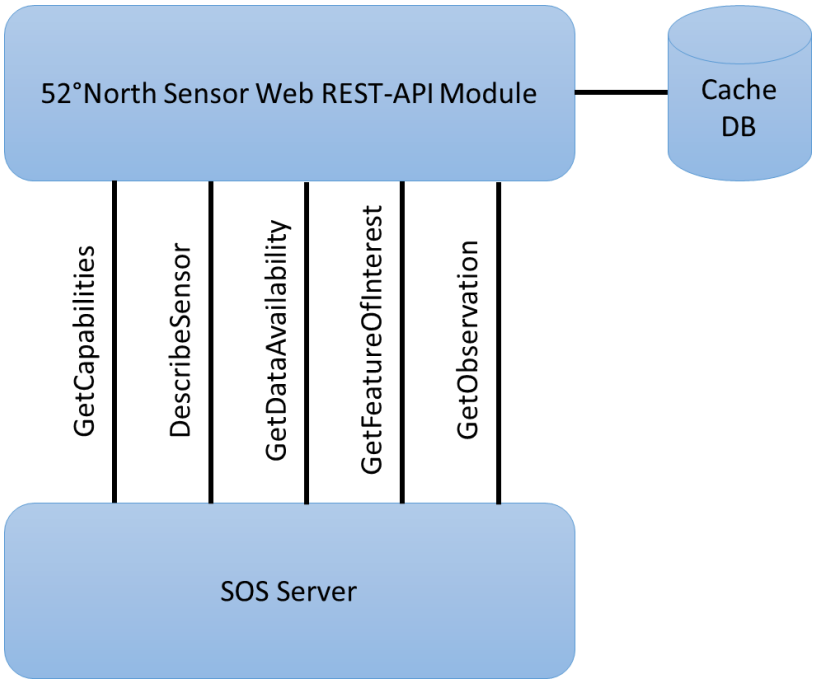

Figure 2: Interactions between 52°North Sensor Web REST API and SOS Servers

From a technological view point, the 52°North Sensor Web REST-API makes used of the following frameworks:

- Spring MVC: Basic application development framework
- JFreeChart: Diagram rendering
- Hibernate: Abstraction layer for database access

The 52°North Sensor Web REST-API has been published under the GNU General Public License v2 (GPLv2). This ensures that the 52°North Sensor Web REST-API can be re-used, customized, enhanced, and modified by all interested parties. At the same time it guarantees, that all work derived from this API will also be available to the public.

The implementation of the 52°North Sensor Web REST-API is available online via GitHub[2].

4.1.2. 52°North Helgoland Sensor Web Viewer

The 52°North Helgoland Sensor Web Viewer is a lightweight JavaScript-based Web application that enables the discovery, exploration, and visualization of Sensor Web observation data in various fields of use, e.g. hydrology, meteorology, environmental monitoring, and traffic management. Also in the marine domain the Helgoland Sensor Web Viewer has been applied and extended as part of projects such as ODIP II, NeXOS and FixO[3].

Typical functionality of the 52°North Helgoland Sensor Web Viewer comprises:

- Discovering and exploring stations or mobile sensor platforms in a map view
- Wizard-like tools (map- (see Figure 3) or menu-based) for selecting different types of observation data (currently supported: time series, trajectories, profiles)
- Different options for visualizing observation data streams
    - Map-based (e.g. latest values)
    - Table-based (e.g. time series)
    - Graph-based (e.g. time series (see Figure 4) or profiles (see Figure 5))
    - Combined map- and graph view (e.g. data measured along a trajectory (see Figure 6))
- Downloading selected data sets as CSV files

The 52°North Helgoland Sensor Web Viewer is based on HTML, JavaScript and CSS and can connect to different Sensor Web REST-API endpoints (see section 4.1.1). These Sensor Web REST-API implementations provide a thin access layer to sensor data via a RESTful Web binding with different output formats and are also able to encapsulate the business logic (e.g. XML handling) to facilitate the communication with SOS servers (see section 4.1.1).

[2] https://github.com/52North/series-rest-api

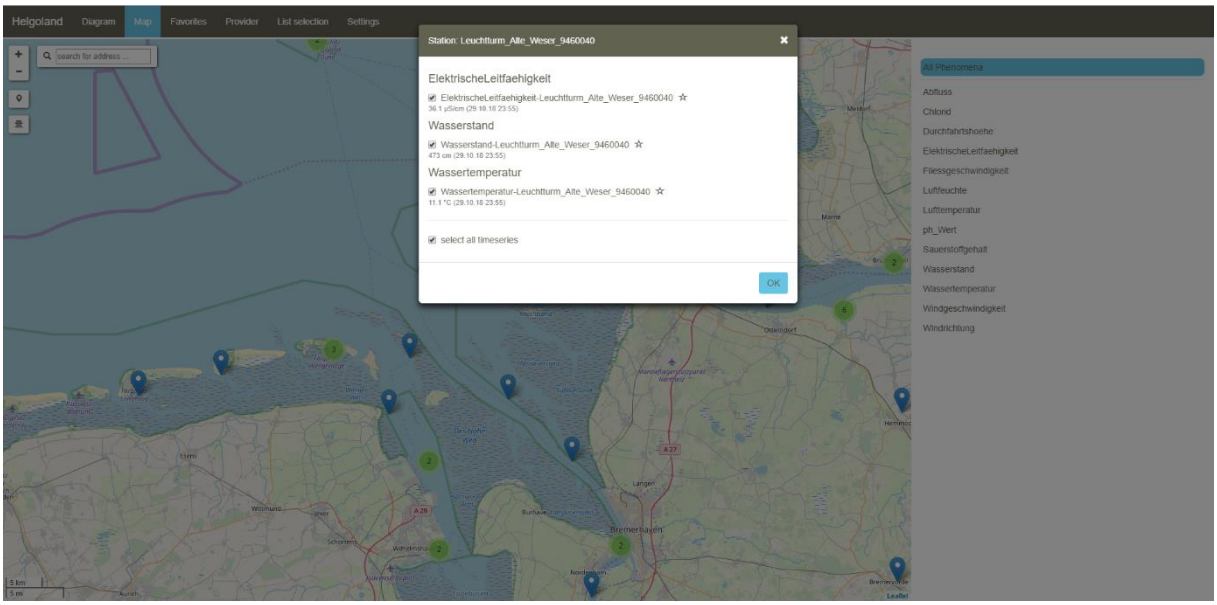

Figure 3: Map View for Data Selection in the 52°North Helgoland Sensor Web Viewer

Figure 4: Visualisation of Timeseries Data in the 52°North Helgoland Sensor Web Viewer

Figure 5: Visualisation of a Profile Measurement in the 52°North Helgoland Sensor Web Viewer

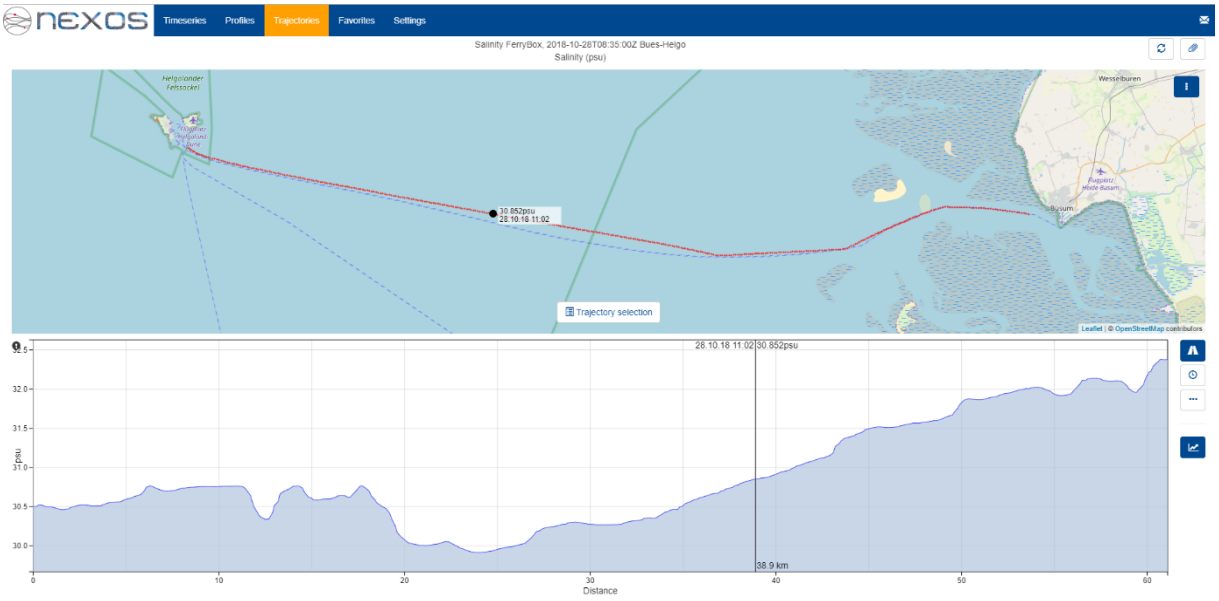

Figure 6: Trajectory Visualisation in the 52°North Helgoland Sensor Web Viewer

The technological baseline of the 52°North Helgoland Sensor Web Viewer relies on a series of established JavaScript frameworks that offer core elements of the application. This ensures an efficient re-use of existing open source developments providing basic functionality, so that the core development of the application can be focused on domain-specific extensions, enhanced functionality and usability. The basic frameworks used for the development of the 52°North Helgoland Sensor Web Viewer comprise:

- Angular[3] (front-end web application platform)

[3] https://angular.io/

- Bootstrap[4] (basic user interface elements)
- Leaflet[5] (map view)
- Moment.js[6] (time handling)
- D3.js[7] (diagram rendering)
- plotly[8] (diagram rendering)
- Flot[9] (diagram rendering)

The 52°North Helgoland Sensor Web Viewer has been published under the Apache 2.0 License. This allows the flexible re-use of the developments in many application scenarios and offers a broad range of options for further customisation, enhancement, or modification.

It is important to note, that the architecture of the 52°North Helgoland Sensor Web Viewer comprises two main elements. On the one hand, the Helgoland Toolbox provides the essential core functionalities for building Sensor Web viewing applications. On the other hand, the Helgoland frontend implementation makes use of this toolbox for providing a user interface. This approach makes it possible, that individual parts of the 52°North Helgoland Sensor Web Viewer can also be integrated into other (potentially specialized) applications without needing the full Helgoland frontend.

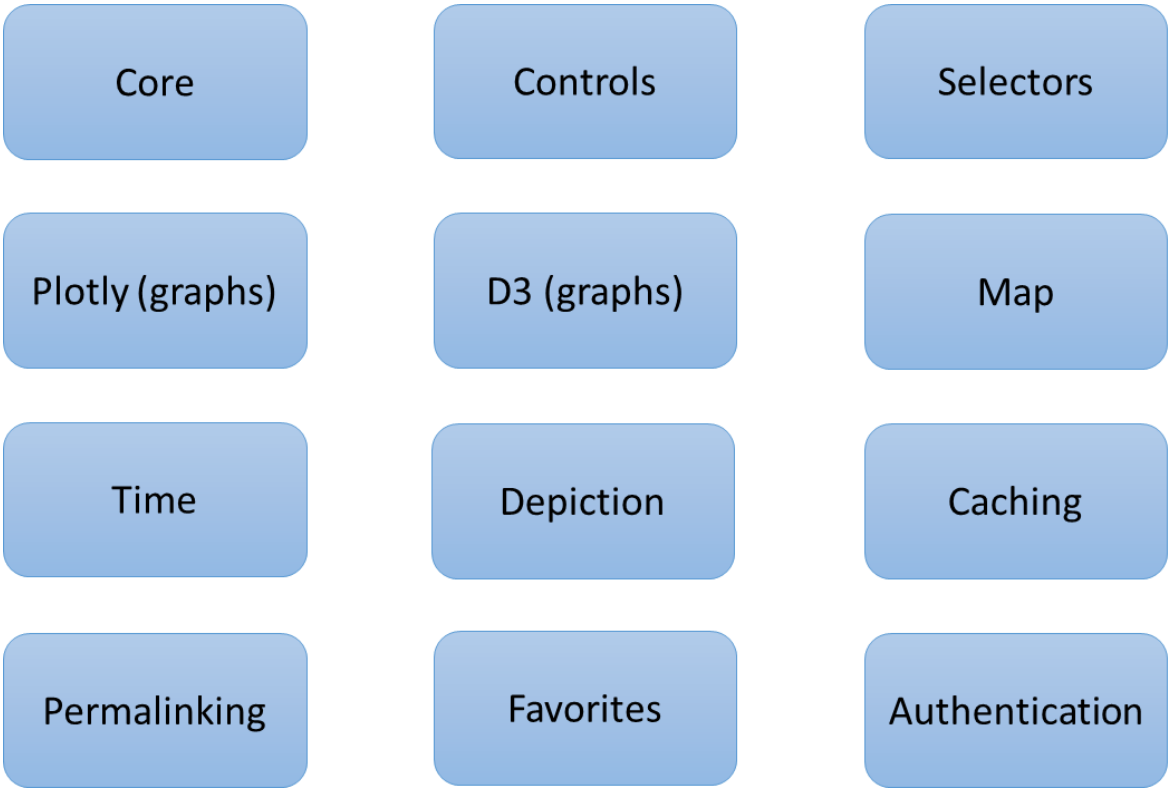

Figure 7: Modules of the Helgoland Toolbox

[4] http://getbootstrap.com/
[5] https://leafletjs.com/
[6] https://momentjs.com/
[7] https://d3js.org/
[8] https://plot.ly/
[9] https://www.flotcharts.org/

The Helgoland toolbox contains Angular based modules, components, and injectables to build all kinds of different Sensor Web client applications. It is divided in different modules to support specific needs. Currently the toolbox comprise the following modules (see Figure 7):

- Core: Communication and response model for interacting with Sensor Web REST-API instances, important services (local storage), core interfaces
- Controls: User interface controls (e.g. toggle buttons)
- Selectors: Components for dataset selection (e.g. lists and filters)
- Plotly (graphs): Graph rendering of profiles with plotly.js
- D3 (graphs): Time series and trajectory graph presentation with D3.js
- Map: Components to display Leaflet maps for view or selection, and also map controls (geo-search, locate, zoom)
- Time: Components to manipulate/select time periods or time stamps
- Depiction: Components to show data or metadata (e.g. dataset data table, time series entry, label-mapper)
- Caching: HTTP request caching for completed and running requests (e.g. avoiding that the same data is downloaded twice)
- Permalinking: Components to generate permalinks pointing to user-defined client views and service to resolve them
- Favourites: Components and services to handle datasets as favourites
- Authentication: Login functionality to protect the access to a client application (not intended for SOS access control); currently support of a basic-auth handling

4.2. Architecture of the SOS Viewing Service

Figure 8 provides an overview of the architecture pattern implemented by the SeaDataCloud SOS Viewing Service. The top layer comprises the 52°North Helgoland Sensor Web Viewer which offers a user interface and provides the user with functionality for data discovery, selection, visualisation, and download. The necessary inputs for the 52°North Helgoland Sensor Web Viewer are provided by one or more instances of the 52°North Sensor Web REST-API (the client shall be able to consume multiple endpoints of this API within one single client instance in order to enable the visualisation of data across multiple endpoints.

For the 52°North Sensor Web REST-API two modes of operation are supported. On the one hand the 52°North Sensor Web REST-API can be deployed as an additional module of the 52°North SOS server implementation. In this case, the 52°North Sensor Web REST-API makes use of a native database access implementation which further increases performance. On the other hand, the 52°North Sensor Web REST-API can be deployed in a proxy mode. In this case, the 52°North Sensor Web REST-API is capable of harvesting metadata from pre-configured SOS servers and to offer efficient data discovery and access functionality based on the collected and cached metadata.

Finally, the SeaDataCloud SWE Ingestion Service may be used for loading data into the databases of the SOS servers in order to make non-validated live observation data streams available for access through the SOS Viewing Service.

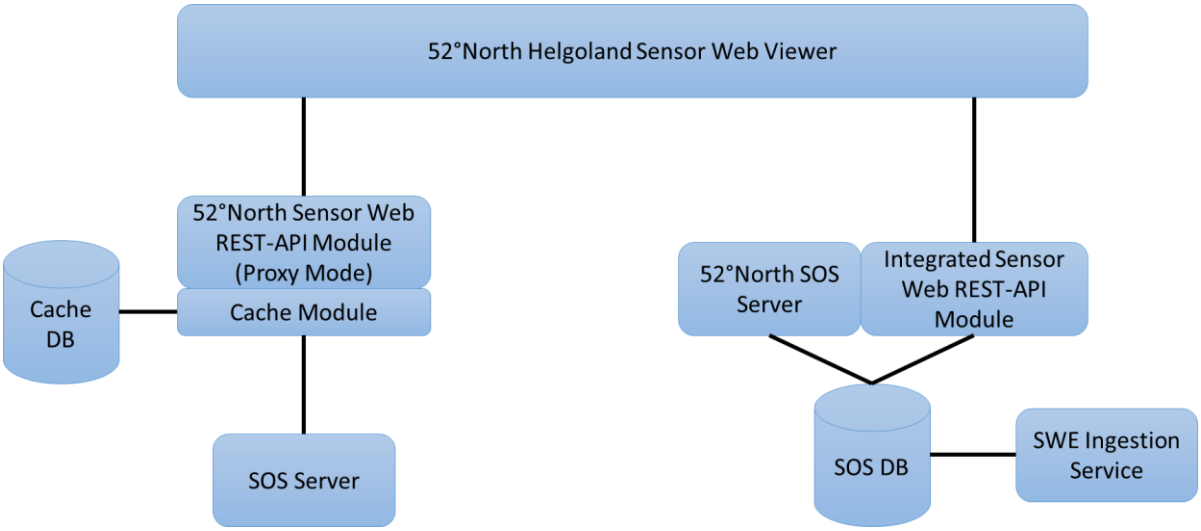

Figure 8: Architecture and Deployment Options for the SWE Viewing Service

5. Development Plan

Based on the above identified requirements (see section 3) and the existing software baseline (see section 4.1) several development tasks need to be conducted in the frame of the SeaDataCloud project. These required development tasks are described in more detail in Table 2. This table describes how the different requirements of section 3 can be solved by extending the existing components of the software baseline. Furthermore, an indicative priority of the different tasks is provided based on feedback gathered during the creation of this development plan.

Please note: These development tasks are related to the currently identified requirement. Further tasks may arise based on feedback gathered during user tests of the features outlined in the table below.

Table 2: Overview of necessary Development Tasks

Require-ment ID	Affected Component	Description	Necessary Developments	Priority
002	52°North Helgoland	Download of profile measurements	At the moment the 52°North Helgoland Sensor Web Viewer is capable of visualising profile observations as diagrams. In addition to this, a button shall be added to the user interface which allows to download the data of a currently displayed profile as CSV file.	High
003	52°North Helgoland	Improve handling of trajectory-based observations	The 52°North Helgoland Sensor Web Viewer is already able to handle trajectory-based observations. However, this functionality needs further improvement in order to increase its value for users. In detail the two following tasks are foreseen: • Harmonise the data selection workflow (at the moment different approaches for profiles measured along trajectories and at fixed points are used). This should either be aligned or split-up into two separate workflows • Develop a more efficient preview of trajectories along which profiles were measured; at the moment the complete trajectories are downloaded by the client which results in performance issues. Either a generalisation or a sub-setting approach shall be implemented.	High

005	52°North Helgoland	Support of out-of-band observations	This approach requires several modifications to the 52°North Helgoland Sensor Web Viewer
			• New data selection workflow
			  ○ User is able to specify criteria for which observations shall be accessed, e.g.
			  ▪ Data provider
			  ▪ Temporal extent
			  ▪ Observed properties
			  ○ Based on selected criteria, a corresponding map view showing the available data is opened.
			• Map view
			  ○ Display sites for which out of band observations are available
			  ○ When clicking on a site, the user sees a pop-up message showing a list of available out-of-band-observations. Each entry of this list links to a download URL through which the observation data can be downloaded.
				High

004	52°North Helgoland	Support of new observation type: spectral data	At the moment the 52°North Helgoland Sensor Web Viewer is not yet able to handle spectral observations. Thus, an extension is necessary. This includes the following development tasks: • Data selection workflow for spectral observations that also considers the case that certain data sets may contain time series of spectral data • Diagram view for spectral data • Download functionality (i.e. a button in the legend area) for downloading a currently displayed spectral observation as CSV file This implementation depends on the availability of support of spectral observations via the 52°North Sensor Web REST-API (see below).	Medium
004	52°North Sensor Web REST-API	Support of new observation type: spectral data	This task comprises the following developments for the 52°North Sensor Web REST-API: • Introduce a new observation type for spectral data • Implement a JSON-based encoding of spectral observation data • Enable temporal filtering in case of time series of spectral observations	Medium

006	52°North Helgoland	Improved support of vocabularies	As part of the ODIP II project the 52°North Helgoland Sensor Web Viewer was already extended with functionality for resolving URLs pointing to vocabulary entries. However, at the moment this functionality needs further improvements with regard to robustness and performance. In detail the following implementation tasks were identified: • Caching of previously resolved vocabulary entries in order to avoid unnecessary network traffic • Improved robustness in case of slow response time of the vocabulary server (i.e. avoid a blocking of the application if the vocabulary server responses are taking a longer time).	High

007 and 008	52°North Helgoland	Improved discovery functionality	At the moment the 52°North Helgoland Sensor Web Viewer offers different data selection workflows based on list- and map-views. However, functionality for searching specific datasets is not yet available. To close this gap, the following two tasks shall be implemented:
			• Full-text search: This functionality shall be able to deliver a list of live data streams that include a set of given keywords in their metadata
			• Facet search: Allow users to discover data sets based on the following query criteria:
			  ○ Feature of Interest (referring to geospatial objects to which observations are associated)
			  ○ Observed property/parameter
			  ○ Platform ID/name
			  ○ Data provider
			  ○ Spatial filter
			  ○ Temporal filter
			This functionality depends on a corresponding extension of the 52°North Sensor Web REST-API (see below).
				High

007 and 008	52°North Sensor Web REST API	Improved discovery functionality	In order to enable enhanced discovery functionality in the 52°North Sensor Web Viewer, the 52°North Sensor Web REST-API needs to provide corresponding search functionality. While it already offers simple search functionality across the labels of the available entities, further enhancements are needed. This comprises: • Full text search across all data and metadata fields • Advanced filtering functionality to discovery data sets based on the filter described in the previous implementation task (facet search)	High
009	52°North Helgoland	Enhanced sensor metadata visualisation	At the moment the 52°North Helgoland Sensor Web Viewer allows to display basic metadata about a data set as an entry in the legend. However, in the marine domain, often a much more comprehensive set of metadata is provided as SensorML files. Thus, the metadata displaying capabilities of the 52°North Helgoland Sensor Web Viewer shall be extended. This comprises the following aspects: • Provide access to the original SensorML files describing the sensor which has generated a data set (i.e. SensorML download for each displayed data set via a dedicated button) • Visualise dedicated SensorML properties as a pop-up window. This visualisation shall transform the rather complex SensorML content into a configurable (concerning the properties that shall be shown), and user-friendly view	High
009	52°North Sensor Web REST API	Enhanced sensor metadata access	The 52°North Sensor Web REST-API is not yet able to provide in all set-up scenarios access to the SensorML files that describe a sensor which has generated a data set (e.g. in case of certain types of SOS servers running behind the 52°North Sensor Web REST-	High

			API in proxy mode). This gap shall be closed	
010	52°North Helgoland	Optimized user interface design in line with the SeaDataCloud design guidelines	Although the 52°North Helgoland Sensor Web Viewer has been developed to offer a user-friendly user interface, the access to non-validated live observation data streams shall be enabled through a customised, SeaDataCloud-specific user interface. In order to further optimize the user experience, user testing by SeaDataCloud partners shall be performed after a first version has been completed. This will likely deliver further ideas and suggestion how to further improve the SeaDataCloud SOS Viewing Service.	High
011	52°North Helgoland	Improved release cycle	At the moment the 52°North Helgoland Sensor Web Viewer is only available as a continuous development version. After completion of the SeaDataCloud implementation tasks, it shall be published as an official release. Furthermore, a dedicated release plan for future extensions shall be developed.	High

6. References

Botts, Mike and Alexandre Robin (2014). OGC Implementation Specification: Sensor Model Language (SensorML) 2.0.0 (12-000). Wayland, MA, USA, Open Geospatial Consortium Inc.

Bröring, Arne, Christoph Stasch and Johannes Echterhoff (2012). OGC Implementation Specification: Sensor Observation Service (SOS) 2.0 (12-006). Wayland, MA, USA, Open Geospatial Consortium Inc.

Cox, Simon (2011). OGC Implementation Specification: Observations and Measurements (O&M) - XML Implementation 2.0 (10-025r1). Wayland, MA, USA, Open Geospatial Consortium Inc.

INSPIRE MIG sub-group MIWP-7a (2016a). Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE - Version 3.0. Ispra, Italy, INSPIRE Maintenance and Implementation Group (MIG).

INSPIRE MIG sub-group MIWP-7a (2016b). Technical Guidance for implementing download services using the OGC Sensor Observation Service and ISO 19143 Filter Encoding - Version 1.0. Ispra, Italy, INSPIRE Maintenance and Implementation Group (MIG).

ISO TC 211 (2011). ISO 19156:2011 - Geographic information -- Observations and measurements - International Standard. Geneva, Switzerland, International Organization for Standardization.

Kokkinaki, Alexandra, Louise Darroch, Justin Buck and Simon Jirka (2016). Semantically Enhancing SensorML with Controlled Vocabularies in the Marine Domain. GSW 2016 - Geospatial Sensor Webs Conference 2016, Münster, Germany, CEUR-WS.org.