



Project No. 249024

NETMAR

Open service network for marine environmental data

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ICT - Information and Communication Technologies Theme

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Executive Summary

NETMAR has developed a pilot European Marine Information System (EUMIS) for searching, downloading and integrating satellite, in situ and model data from ocean and coastal areas. EUMIS uses a semantic framework coupled with ontologies for identifying and accessing distributed data, such as near-real time, forecast and historical data. The semantic tools have been implemented as portal components (called portlets) and web services. Portlets for retrieval and display of geographic datasets, “smart” search and discovery, and service chain composition have been developed and integrated in the EUMIS portal. The EUMIS portal also contains a Wiki, where users can find information about products and services.

The portal Wiki provides an overview of the products and services that are offered by EUMIS, and how to use the different tools in the portal. The home page of the portal offers pointers to these resources through the main menu, as well as illustrating the underlying concepts, sample services and products offered by EUMIS. All content in the Wiki is open to everyone, and can be searched by free text search.

The GIS Viewer allows users to display on a map distributed geo-spatial resources that have been shared by means of the OGC Web Map Service (WMS) standard. It provides a user-friendly way of browsing WMS servers to see what features they have available, choosing those of interest, and seeing the resulting map. The GIS viewer allows the user to obtain multiple layers overlaid on top of one another in the same geographic map projection. If the WMS server supports it, a user can click on a feature to get additional information about it, such as the values measured by an in situ sensor. Layers can be added and removed dynamically, and their display easily turned on and off. The GIS Viewer also includes common GIS functions (e.g. zoom, pan, legends), shows the latitude-longitude location of the cursor inside a map, and facilitates printing of the currently displayed layers. Furthermore, a web processing service (WPS) can be run from within the GIS Viewer and the resulting map or graph displayed in the portal.

Smart search is the ability of a discovery engine to locate target documents that do not include either an exact or fuzzy match to a user-supplied text string or user-supplied keyword. For example, if the user initiates a search on the discipline keyword ‘Physical Oceanography’, the discovery engine will find documents marked up with terms like ‘currents’, ‘waves’, ‘water temperature’, ‘salinity’ and so on, because these are semantically linked to the search criteria. The smart search and discovery client supports three features: ontology browsing, dataset smart search, and metadata visualisation. It provides search facilities based on the *semantics* of the data, including support for multi-domain and multi-lingual search in a network of metadata catalogue services connected by a mediator tool.

The service chaining editor allows users to generate new products by specifying workflows that utilise a set of data delivery and processing services. The workflow is generated using a graphical editor where individual services are chained together to form a new process. The workflows can be saved for later use, re-opened and edited, and run within an included workflow engine. Workflow output can be viewed within the GIS viewer.

All components are realised as portlets that are deployed in the open source Liferay Community Edition portal. The portlets will run in any commonly used web browser, with Flash installed to run the search and discovery client.

The EUMIS portal is publicly available at <http://eumis.nersc.no/>, while open source EUMIS components are publicly available at <https://github.com/NETMAR/netmar>.

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1 Introduction

1.1 Background

NETMAR aims to develop a pilot European Marine Information System (EUMIS) for searching, downloading and integrating satellite, in situ and model data from ocean and coastal areas. EUMIS will use a semantic framework coupled with ontologies for identifying and accessing distributed data, such as near-real time, forecast and historical data. The semantic tools have been implemented as portal components (called portlets) and web services. Portlets for retrieval and display of geographic datasets, “smart” search and discovery, and service chain composition have now been developed and integrated in the EUMIS portal. The EUMIS portal also contains a Wiki, where users can find information about products and services. The Wiki component is realised using a built-in portlet in the Liferay Community Edition [LRv6].

1.2 Objective of this report

The purpose of this document is to describe the functionality of the EUMIS portal and the three EUMIS components that have been developed in the project: (1) the GIS map-viewer, (2) the semantic search and discovery client, and (3) the service chaining editor. This second and final version of the EUMIS portal with these components integrated will be used to demonstrate proof-of-concept of the semantic tools and the portal during autumn 2012 in interaction with user testing and evaluation.

1.3 Terminology

The Simple Knowledge Organization System (SKOS) is a W3C recommendation, and provides a scheme for the serialisation of controlled vocabularies and thesauri (see section 1.3.2 below). SKOS is based upon **concepts** that it defines as a “unit of thought”, i.e. an idea or notion such as “shoreline emergency access” or “oil spill”. Concepts may also carry other information, such as their relationships to other concepts and information about their provenance and version history.

SKOS provides the means for grouping those concepts together as either collections or schemes. A SKOS collection is a grouping of concepts which share something in common and can be conveniently grouped under a common label, for example “SeaDataNet agreed parameter groups” or “ISO19115 topic categories”. Similarly, SKOS **concept schemes** are also groupings of concepts but the relationships between the concepts are also a part of the concept scheme, making them a useful model for the publication of thesauri, for example the “ICAN coastal erosion thesaurus”.

A **concept URI** is a pre-defined URI uniquely identifying a term (i.e. concept) in a vocabulary (i.e. controlled list of terms) for a given application domain. For example, the concept URI <http://vocab.ndg.nerc.ac.uk/term/P011/current/ATEMP2MM> identifies the term “Temperature (2m) of the atmosphere by model prediction” in the BODC Parameter Usage Vocabulary P011.

A **portal** is a web site that collects input from a number of sources, and presents it in a uniform manner to the user. The portal content is perceived to come from the same source – the portal – while it typically is a combination of content from several sources, or an extract of selected content from a single external source (such as a news feed).

A **portlet** is portal component that can be deployed in a portal. A portlet can provide many types of functionality, among others, retrieve data from external sources, process and analyse data, present retrieved data on a geographic map. A portlet can also communicate with other portlets running in the same portal.

A **Uniform Resource Identifier (URI)** is “a compact string of characters for identifying an abstract or physical resource” [RFC2396]. A URI can among others identify a file or a part of an online document, which can be identified by e.g. <ftp://ftp.is.co.za/rfc/rfc1808.txt> or <http://www.w3.org/TR/2009/REC-skos-reference-20090818/#concepts>.

1.4 Organisation of this report

The remainder of this report is organised as follows. Section 2 describes the content and features of the Wiki in the EUMIS portal. Section 3-5 then goes on to explain the features of and how to use the three EUMIS components, the GIS viewer (section 3), the discovery and search client (section 4) and the service chaining editor (section 5). Finally, the features of the first version of the EUMIS portal is summarised in section 6.

2 Wiki

The portal Wiki provides an overview of what products and services are offered by the EUMIS, and how to use the different tools in the portal. The home page of the portal offers pointers to these resources through the main menu, as well as illustrating the underlying concepts, sample services and products offered by EUMIS using a slide show presentation of products from the four Pilots as well as of the developed components, i.e. the GIS viewer, search and discovery client, and service chaining editor (Figure 2-1). Currently all services and products in the EUMIS portal are open, and access does not require registration.

From the home page, the user can navigate to the EUMIS components, pilots, Wiki and Help page using the main menu shown near the top of the page. The user can also search the entire portal from the home page.

The NETMAR project aims to develop a pilot European Marine Information System (EUMIS) for searching, downloading and integrating satellite, in situ and model data from ocean and coastal areas. It will be a user-configurable system offering flexible service discovery, access and chaining facilities using OGC, OPeNDAP and W3C standards. Read more at www.netmar-project.eu

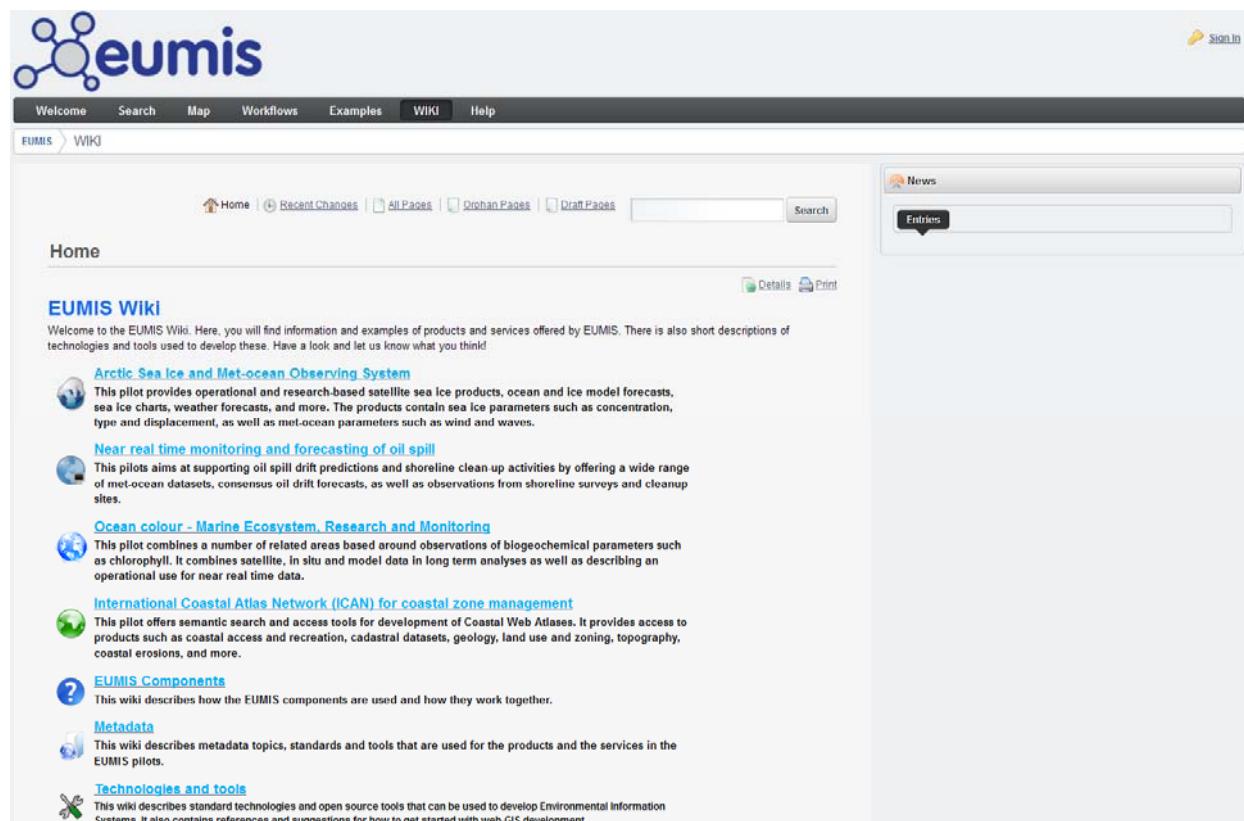
Figure 2-1 EUMIS portal home page.

2.1 Wiki content and organisation

The EUMIS Wiki homepage gives a brief overview of the topics covered, with links to separate pages (Figure 2-2). Currently, there are Wiki sections for each of the pilots, as well as for the technologies and tools used to develop the services and for the metadata provided for each product. The Wiki can also be searched by entering free text keywords in the text area near the top of the page searched by giving a free text in the text area near the top of the page. When searching for e.g. “sea ice” the portal will return a list of all Wiki pages containing this string with the most relevant pages first, as illustrated in Figure 2-3. Each page name is a link that can be clicked on to go directly to it.

Each Pilot Wiki has the same overall structure. In the top level page, the Pilot Wikis contain a short description of: (1) users, (2) products with a few examples, and (3) links to the services offered. Additional sections can be added to each Pilot Wiki as needed. All pilots may not need the same information and the Pilot Wiki is open for service providers to add new sections or children pages to fulfil their users' needs.

Figure 2-4 shows the current Pilot 1 Wiki. It contains a short description of targeted users, examples of products offered and a link to the pilot page where the latest products will be available. As the amount of information grows, the Table of Contents feature at the top of the page provides handy help to go quickly to the information of interest. Further information can also be placed in separate pages, so-called children pages, to avoid the main page becoming unmanageable.



The screenshot displays the EUMIS Wiki home page. At the top, there is a navigation menu with links for 'Welcome', 'Search', 'Map', 'Workflows', 'Examples', 'WIKI', and 'Help'. Below this, a search bar is present. The main content area is titled 'Home' and features a 'Details' and 'Print' link. The 'EUMIS Wiki' section includes a welcome message and a list of pilot projects, each with an icon and a brief description:

- Arctic Sea Ice and Met-ocean Observing System**: This pilot provides operational and research-based satellite sea ice products, ocean and ice model forecasts, sea ice charts, weather forecasts, and more. The products contain sea ice parameters such as concentration, type and displacement, as well as met-ocean parameters such as wind and waves.
- Near real time monitoring and forecasting of oil spill**: This pilot aims at supporting oil spill drift predictions and shoreline clean up activities by offering a wide range of met-ocean datasets, consensus oil drift forecasts, as well as observations from shoreline surveys and cleanup sites.
- Ocean colour - Marine Ecosystem, Research and Monitoring**: This pilot combines a number of related areas based around observations of biogeochemical parameters such as chlorophyll. It combines satellite, in situ and model data in long term analyses as well as describing an operational use for near real time data.
- International Coastal Atlas Network (ICAN) for coastal zone management**: This pilot offers semantic search and access tools for development of Coastal Web Atlases. It provides access to products such as coastal access and recreation, cadastral datasets, geology, land use and zoning, topography, coastal erosions, and more.
- EUMIS Components**: This wiki describes how the EUMIS components are used and how they work together.
- Metadata**: This wiki describes metadata topics, standards and tools that are used for the products and the services in the EUMIS pilots.
- Technologies and tools**: This wiki describes standard technologies and open source tools that can be used to develop Environmental Information Systems. It also contains references and suggestions for how to get started with web-GIS development.

On the right side, there is a 'News' section with an 'Entries' button.

Figure 2-2 EUMIS Wiki home page.

The screenshot shows the EUMIS Wiki search results for the query 'sea ice'. The page features the EUMIS logo at the top left and a navigation menu with 'Welcome', 'Search', 'Map', 'Workflows', 'Examples', 'WIKI', and 'Help'. The search bar contains 'sea ice' and a 'Search' button. Below the search bar, there is a section titled 'Create a new page on this topic.' followed by a table of search results.

#	Wiki	Page	Score
1.	Main	Arctic Sea Ice and Met-ocean Observing System	★★★★★
2.	Main	Arctic Sea Ice and Metocean Observing System	★★★★★
3.	Main	Home	★★★★★
4.	Main	Figure 3	★★★★★
5.	Main	Figure 2	★★★★★
6.	Main	Phytoplankton blooms in Gulf of Biscay and English Channel	★★★★★
7.	Main	Ocean colour - Marine Ecosystem, Research and Monitoring	★★★★★
8.	Main	International Coastal Atlas Network (ICANN) for coastal zone management	★★★★★

Showing 8 results.

Figure 2-3 Example of search result in the EUMIS Wiki.

The screenshot shows the Wiki homepage for the 'Arctic Sea Ice and Metocean Observing System'. The page includes a navigation bar with 'Home', 'Recent Changes', 'All Pages', 'Orphan Pages', and 'Draft Pages', along with a search bar. The main content area is titled 'Arctic Sea Ice and Metocean Observing System' and features a 'Table of Contents' with links to 'Users', 'Products', and 'Services'. The 'Users' section describes the user base, including representatives from offshore and shipping companies, ship and icebreaker captains, national authorities, regional environmental agencies, national ice services, and scientists. The 'Products' section provides examples of products for planning sailing routes and convoy operations in sea ice covered areas, such as Satellite Synthetic Aperture Radar (ASAR) images, SAR images classified by automatic algorithms, and ice drift predictions. Three figures are displayed: Figure 1 is a SAR image of sea ice, Figure 2 is a map showing a 'Land mask' over the Arctic region, and Figure 3 is a map showing ice drift predictions. The 'Services' section mentions that these products will be available through the Arctic Sea Ice and Metocean Observing System Pilot.

Figure 2-4 EUMIS portal: Pilot 1 Wiki homepage.

3 GIS map viewer

3.1 Purpose and features

The GIS Viewer allows users to display on a map distributed geo-spatial resources that have been shared by means of the OGC WMS standard [WMS13]. It provides a user-friendly way of browsing WMS servers to see what features they have available, choosing those of interest, and seeing the resulting map. The GIS viewer allows the user to obtain multiple layers overlaid on top of one another in the same geographic map projection. If the WMS server supports it, a user can click on a feature to get additional information about it, such as the values measured by an in situ sensor.

The GIS viewer has the following features:

- common GIS functions (e.g. zoom, pan, legends, locator map, store the context map, print the map)
- NcWMS compatibility

NcWMS is a Web Map Service for geospatial data that are stored in NetCDF files, such as model output and satellite datasets. It implements some extensions to the standard, time series and transects. The GIS viewer is compatible with NcWMS, where end users can interrogate multi-dimensional services (e.g. time and elevation), change the colour map, graph time series (Figure 3-1) and transects.

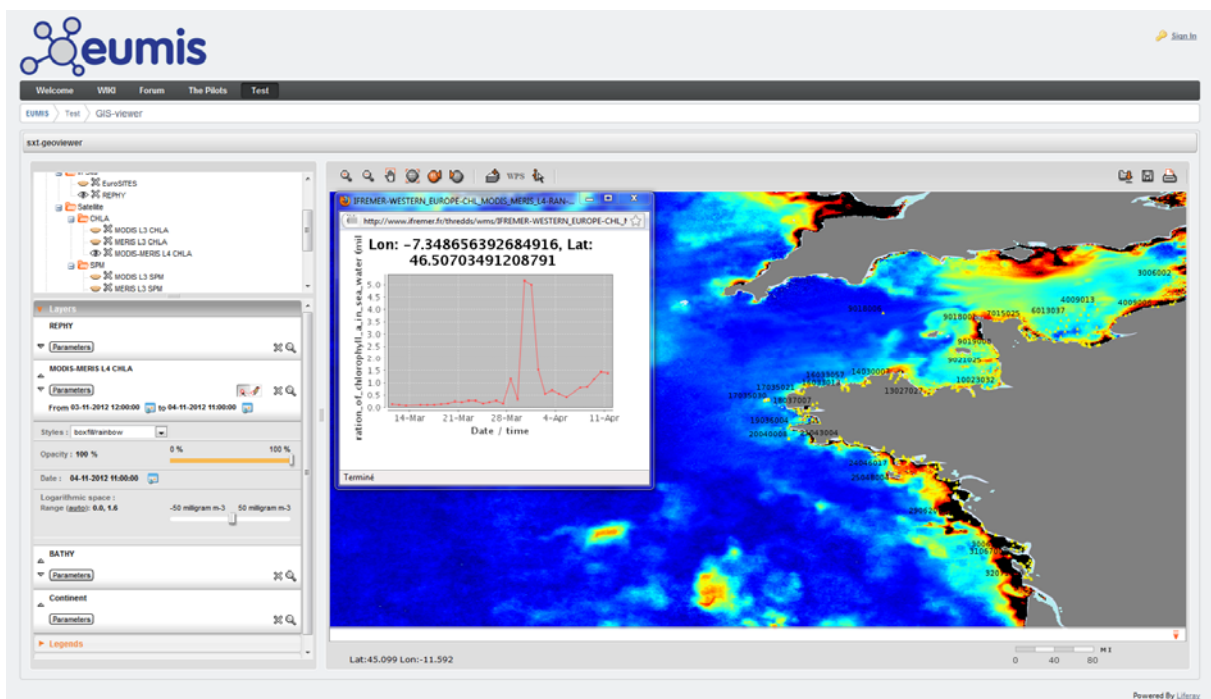


Figure 3-1 Example of time series from ncWMS.

- Multiple projections

The GIS viewer is able to display geospatial layers in several map projections. If the WMS server can respond using the same projection of the map, the client side of the GIS viewer directly displays this layer. Otherwise the server side of the GIS viewer performs a re-projection. Therefore, the pilots can use different projections. For example, Pilot 1 (Arctic Sea Ice and Met-ocean Observing System) uses the stereographic projection.

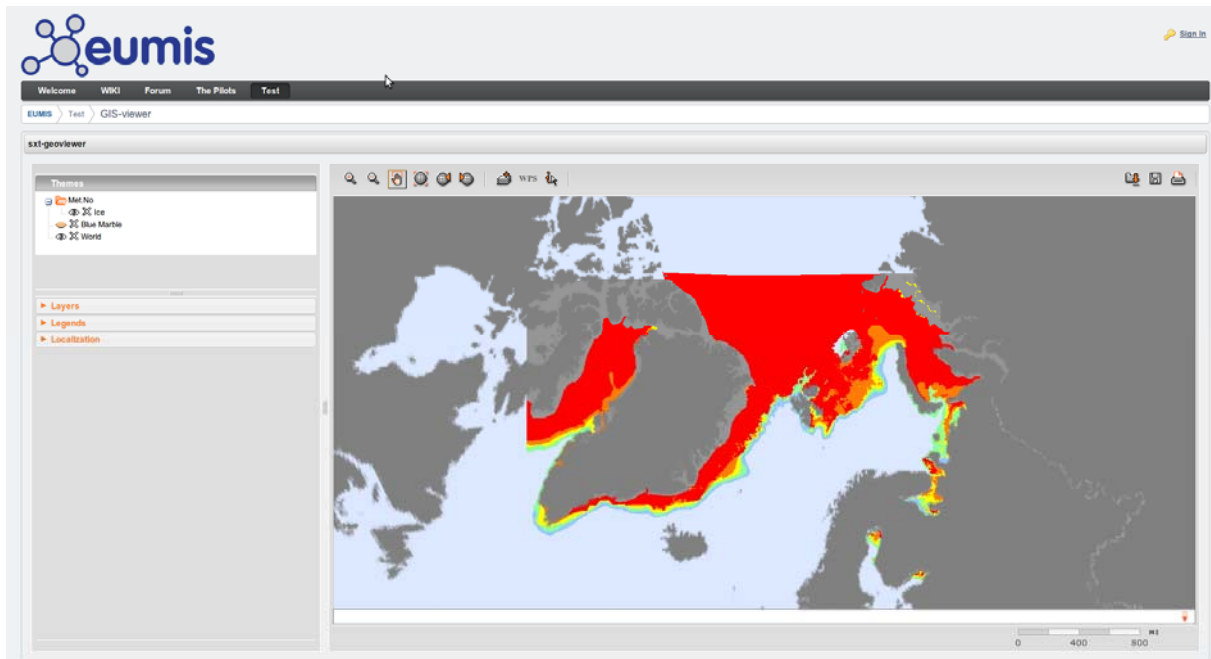


Figure 3-2 Example of ice chart in stereographic projection.

- WPS

A WPS client is implemented in the GIS Viewer. It allows to execute remote WPS server, and when the result is a geospatial dataset (e.g. GeoTIFF, GML, KML) to display it in the map. The users can select or edit WPS URL, then choose an available Process, and set the input parameters, and finally execute the process.

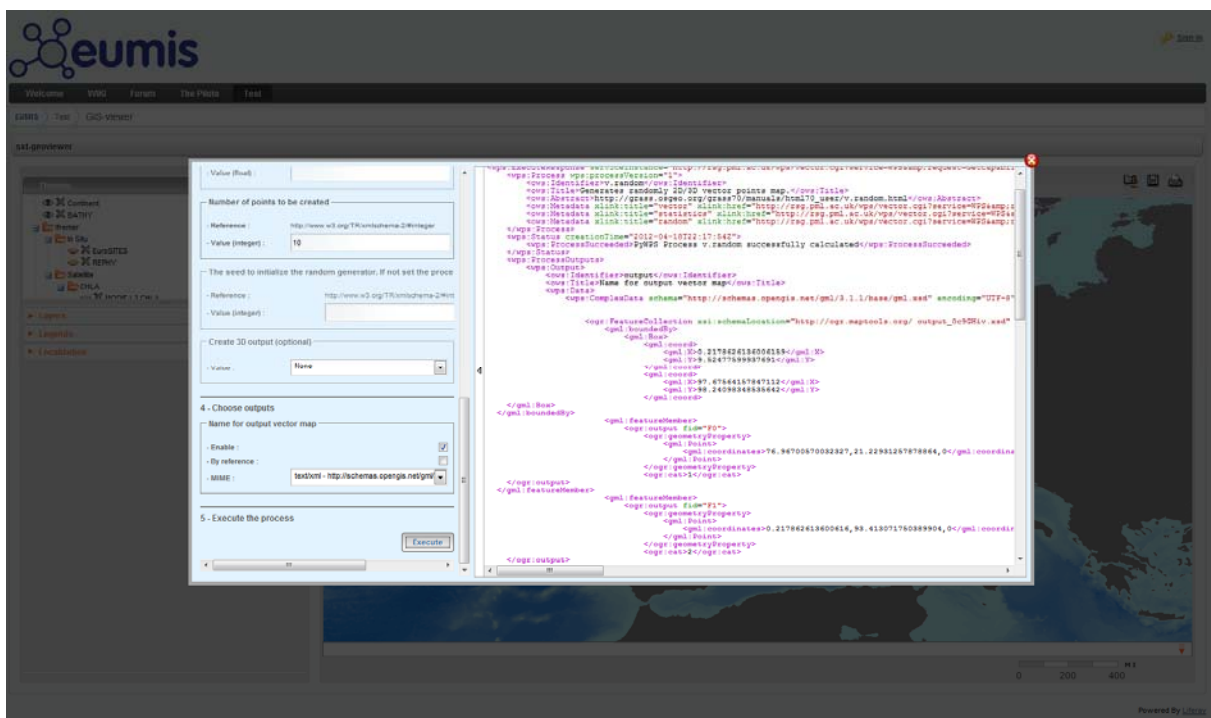


Figure 3-3 Example of WPS form (left) and response (right).

3.2 How to use it

When started for the first time, the GIS Viewer will show a coastline layer (Figure 3-4). All functions are readily available in a toolbar above the map area, and the position of the cursor (crosshair) in the map and the map scale is shown below. To the left, all current layers are listed, with operations for turning them on/off and manipulating the colours used when displaying them.

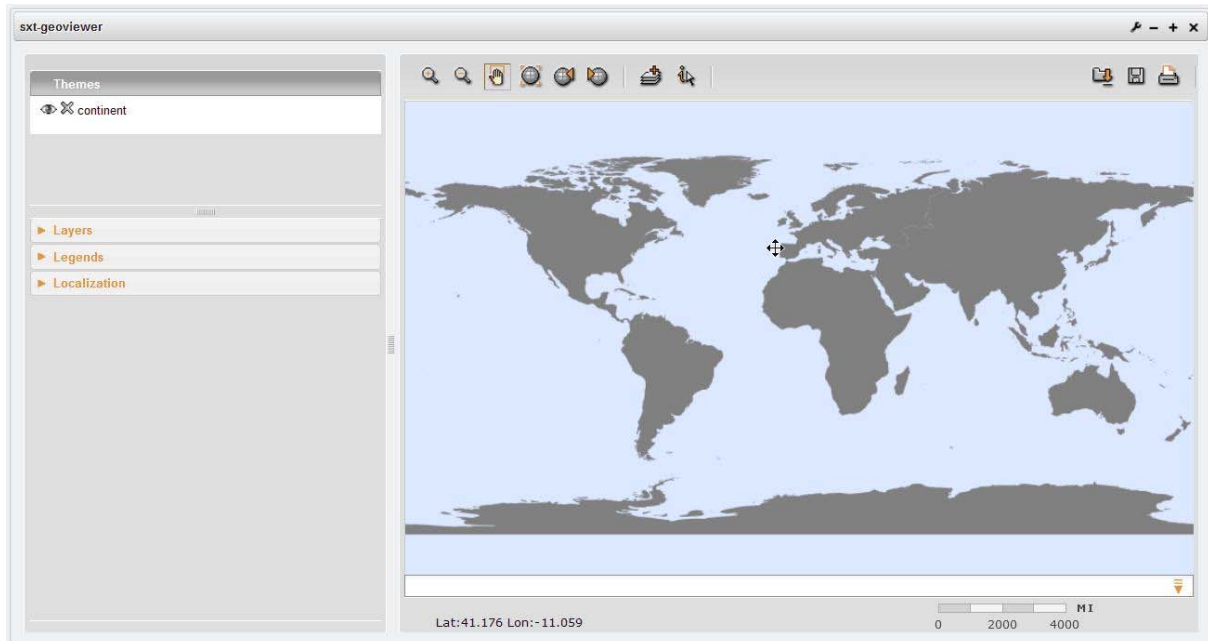





Figure 3-4 GIS Viewer: Initial map with coastline.

All buttons in the toolbar have a so-called *tooltip*, a short text explaining what function they perform. The tooltip is shown when placing the cursor over the button and resting it there for a few seconds (Figure 3-5). The three first buttons on the toolbar provide zoom in, zoom out and pan operations on the map. The three next buttons restore the map to the original extent, go back to previous zoom and go to the next zoom, respectively. The next button, , allows the user to add more WMS layers to the map, the WPS button allows the user to execute remote WPS services, while the  button allows the user to query a feature in the map. The last three buttons on the toolbar, uploads an OWS context file (holding a predefined set of WMS map layers), saves such a file, and prints the currently displayed map, respectively.

After clicking the add WMS layer button, , a dialogue box opens where the user can enter a WMS server URL, as shown in Figure 3-6. The GIS viewer obtains a list of layers available from this WMS server, and the user can then select which to add to the map. The selected layers are added to the layer list, and displayed in the map window as illustrated in Figure 3-7.



Each layer can then be manipulated using the layer menus in the left part of the screen. For instance, it is possible to zoom to the extent of a layer to focus the map (Figure 3-8). Layers can be turned on/off by clicking the eye-symbol () in front on the layer name, and be removed permanently by pressing the delete button (). To re-insert a layer, just open the add layer dialogue again, give the WMS server URL and select it again.



Figure 3-5 GIS Viewer: Tooltips for the toolbar buttons.

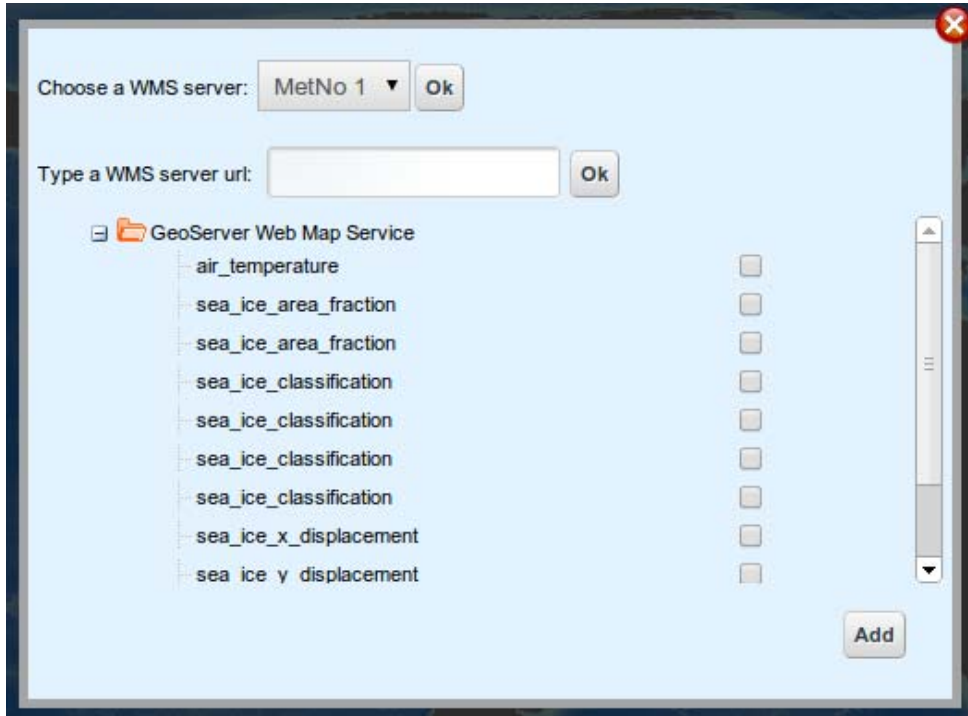


Figure 3-6 GIS Viewer: Adding more WMS layers.

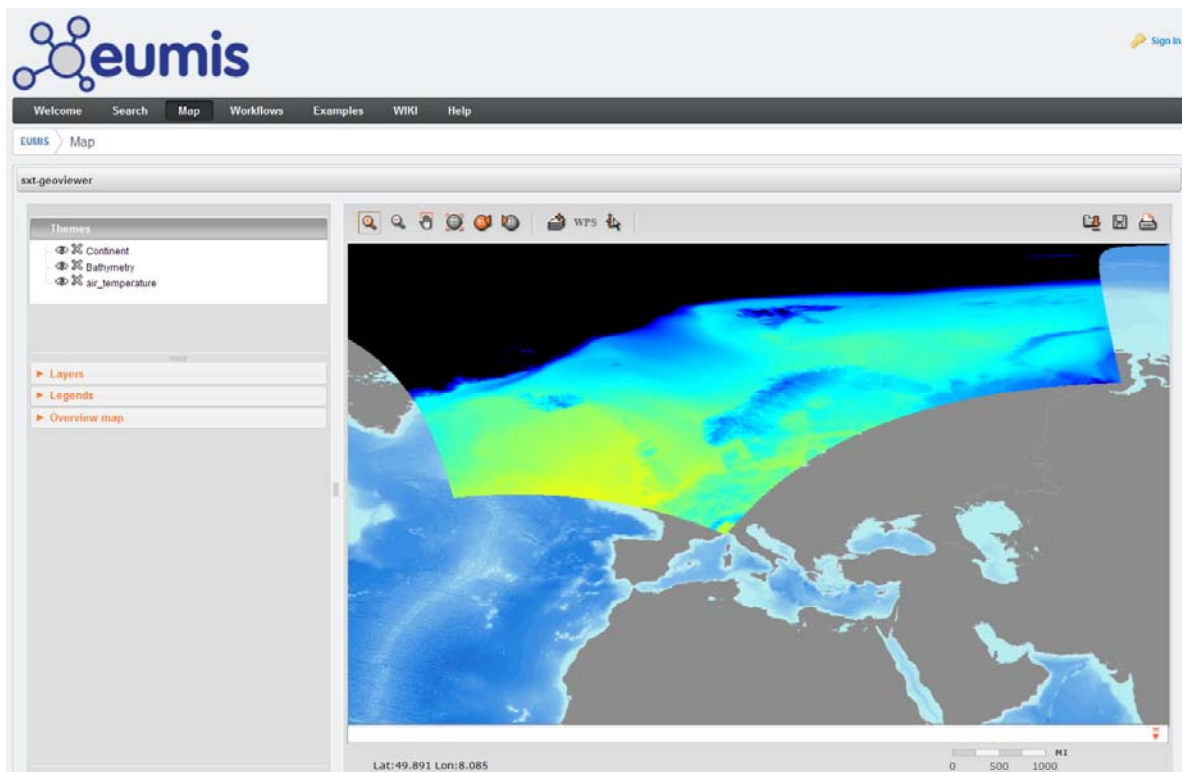


Figure 3-7 GIS Viewer: New layers added to the map.

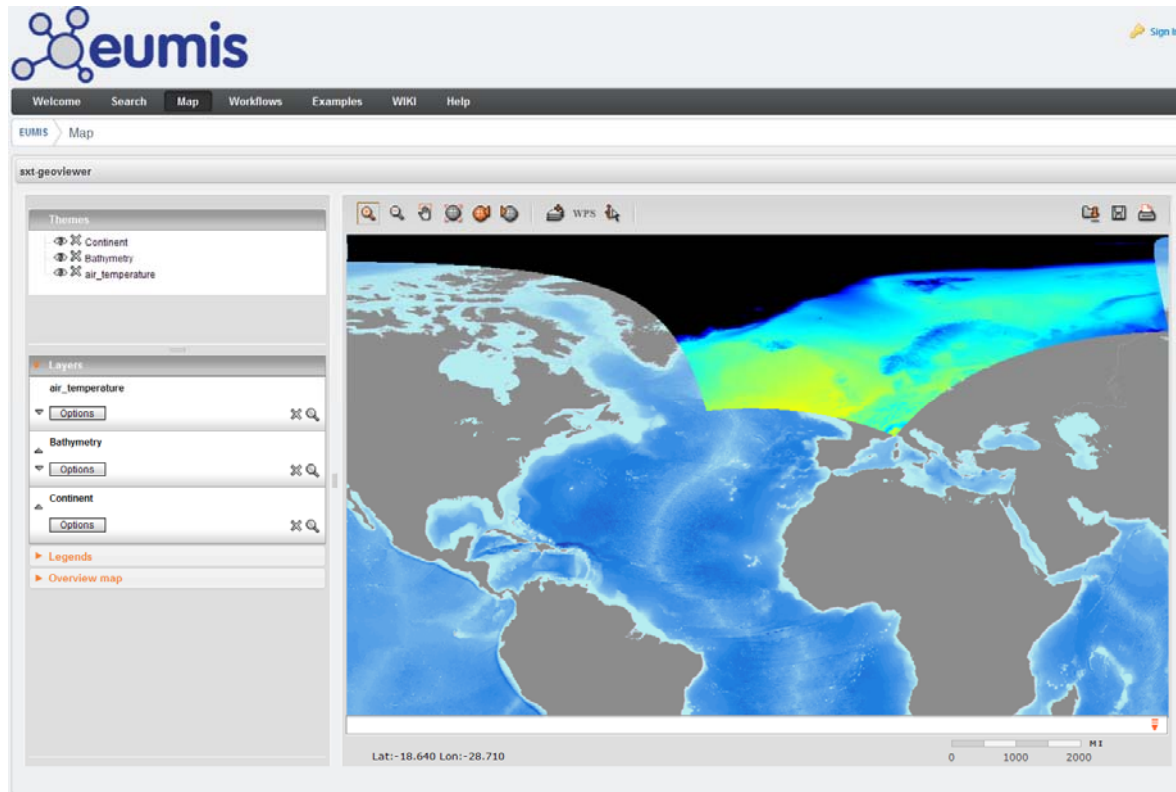


Figure 3-8 GIS Viewer: Zoom to the extent of a layer.

3.3 Implementation

The GIS Viewer is implemented using the MapFaces library [MF]. MapFaces has a modular design consisting separate Java Server Faces (JSF) components resting on a base geo-spatial library. The components rely on several JavaScript elements for user interface elements running in the browser on the client side. MapFaces uses the jQuery JavaScript library to provide elegant and powerful components in a compact, highly structured library [JQ]. MapFaces also uses a simplified version of the OpenLayers JavaScript library for displaying map data in web browsers, providing functionality like transparent layers and simple navigation panel [OL].

The GIS viewer is a portlet running inside the Liferay Community Edition (version 6.0.5) portal [LRv6]. It uses two Java libraries:

- Java Advanced Imaging (JAI) 1.1.3 [JAI].
- Java Advanced Imaging I/O (JAI Image-I/O) libraries Image I/O 1.1 [JAIIO].

These must be installed on the portal server before the portlet itself is installed.

Figure 3-9 shows a simple architecture diagram for the GIS Viewer. The client side is realised by mean of two open source libraries, OpenLayers [OL] for all GIS operations (e.g. map display, zooming and panning) and jQuery [JQ] for setting up the layer lists and panels for legends etc., in the graphical user interface (GUI). The server side is comprised of components from the MapFaces library and the GeoToolkit library [GT]. The client and server communicate via the JSF protocol.

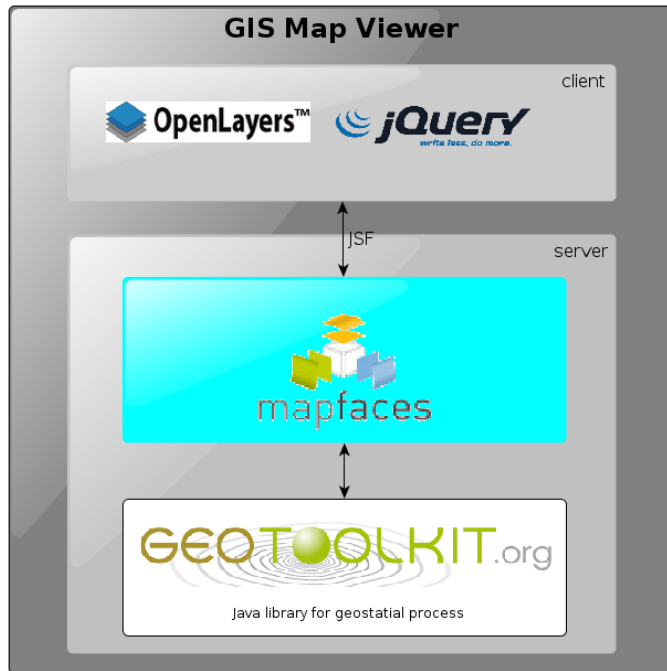


Figure 3-9 GIS Viewer: Architecture diagram.

The GIS Viewer can store the current configuration of map layers for later use. This is done in an XML (eXtensible Mark-up Language) file.

After adding the layers of interest to the GIS Viewer, each user can store a new map context file for his session. One example is found at:

<http://eumis.nersc.no/web/guest/map2?url=http://www.ifremer.fr/isi/sextant/OWC/netmar.xml>

This file contains an example of a set of layers used in NETMAR for monitoring of Phytoplankton blooms in Gulf of Biscay and English Channel. Once loaded into the GIS Viewer, the layer list will look like in Figure 3-10.

The map configuration is stored in OWS-Context files [WMC05]. The example web map context file at <http://www.ifremer.fr/isi/sextant/OWC/netmar.xml> is shown in Figure 3-11.

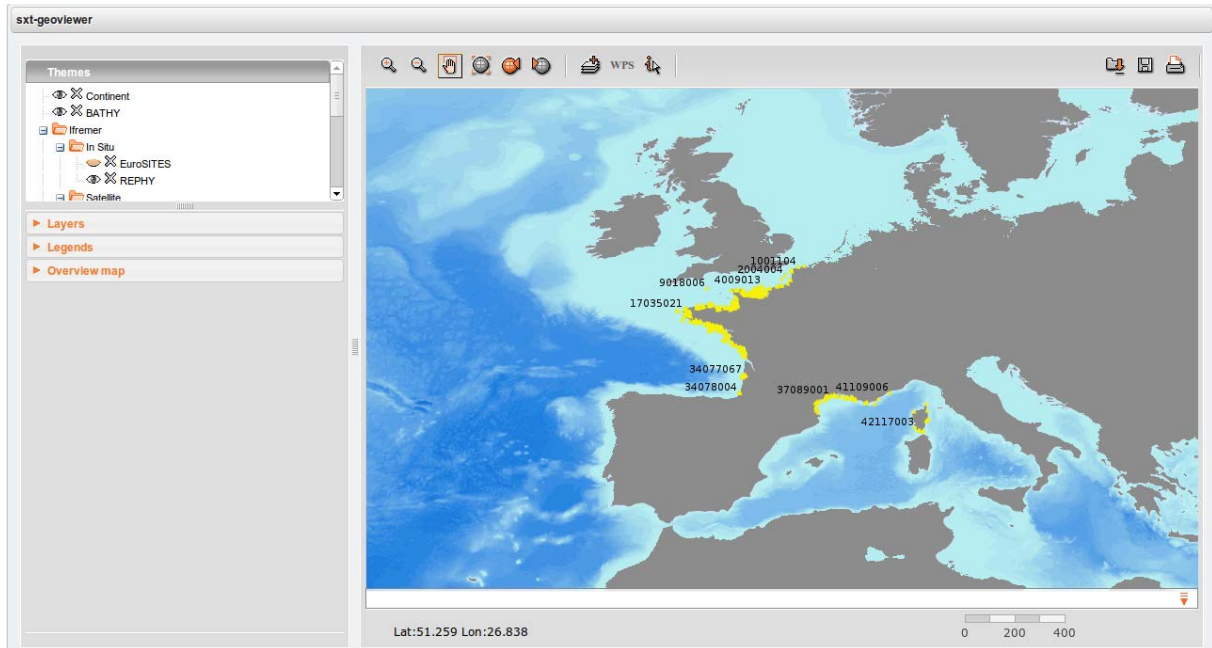


Figure 3-10 GIS Viewer: Loading a predefined set of map layers into the map viewer.

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<ows-context:OWSContext ...>
  <ows-context:General>
    <ows-context:Window height="672" width="1240"/>
    <ows:BoundingBox crs="EPSG:4326">
      <ows:LowerCorner>-90.0 -180.0</ows:LowerCorner>
      <ows:UpperCorner>90.0 180.0</ows:UpperCorner>
    </ows:BoundingBox>
    <ows:Title>BlueMarble + Google (EPSG:3857) example </ows:Title>
    <ows:Abstract/>
  </ows-context:General>
  <ows-context:ResourceList>

    <ows-context:Layer queryable="true" opacity="1" hidden="false" group="Monde"
id="8" name="basic">
      <ows:Title>Metacarta</ows:Title>
      <ows:OutputFormat>image/png</ows:OutputFormat>
      <ows-context:Server version="1.1.1" service="urn:ogc:serviceType:WMS"
default="true">
        <ows-context:OnlineResource
xlink:href="http://vmap0.tiles.osgeo.org/wms/vmap0"/>
        </ows-context:Server>
      </ows-context:Layer>

      <ows-context:Layer queryable="true" opacity="1" hidden="true"
group="Ifremer/In Situ" id="5" name="EuroSITES">
        <ows:Title>EuroSITES</ows:Title>
        <ows:OutputFormat>image/png</ows:OutputFormat>
        <ows-context:Server version="1.3.0" service="urn:ogc:serviceType:WMS"
default="true">
          <ows-context:OnlineResource
xlink:href="http://www.ifremer.fr/services/wms/swe"/>
          </ows-context:Server>
        </ows-context:Layer>
      ...

    </ows-context:ResourceList>
</ows-context:OWSContext>
```

Figure 3-11 GIS Viewer: Excerpts of an OWS Context file.

4 Semantic search and discovery client

4.1 Purpose and features

Smart search is the ability of a discovery engine to locate target documents that do not include either an exact or fuzzy match to a user-supplied text string or user-supplied keyword. For example, if the user initiates a search on the discipline keyword ‘Physical Oceanography’, the discovery engine find documents marked up with terms like ‘currents’, ‘waves’, ‘water temperature’, ‘salinity’ and so on, because these are semantically linked to the search criteria.

The smart search and discovery client allows users to search for data by *meaning* rather than by mere textual keywords. The first version of this client supports three features: ontology browsing, dataset smart search, and metadata visualisation. It provides search facilities based on the *semantics* of the data, including support for multi-domain and multi-lingual search in a network of metadata catalogue services connected by a mediator tool.

4.2 How to use it

The search and discovery client helps the user find relevant datasets by allowing him to browse the ontology terms to find suitable topics (themes, parameters, instruments, etc.). Figure 4-1 shows the discovery client with the home menu, to the left, and the ontology browser, to the right. The home menu contains three buttons for accessing the ontology browser, the data search component, and the metadata viewer. By default, the ontology browser is selected.

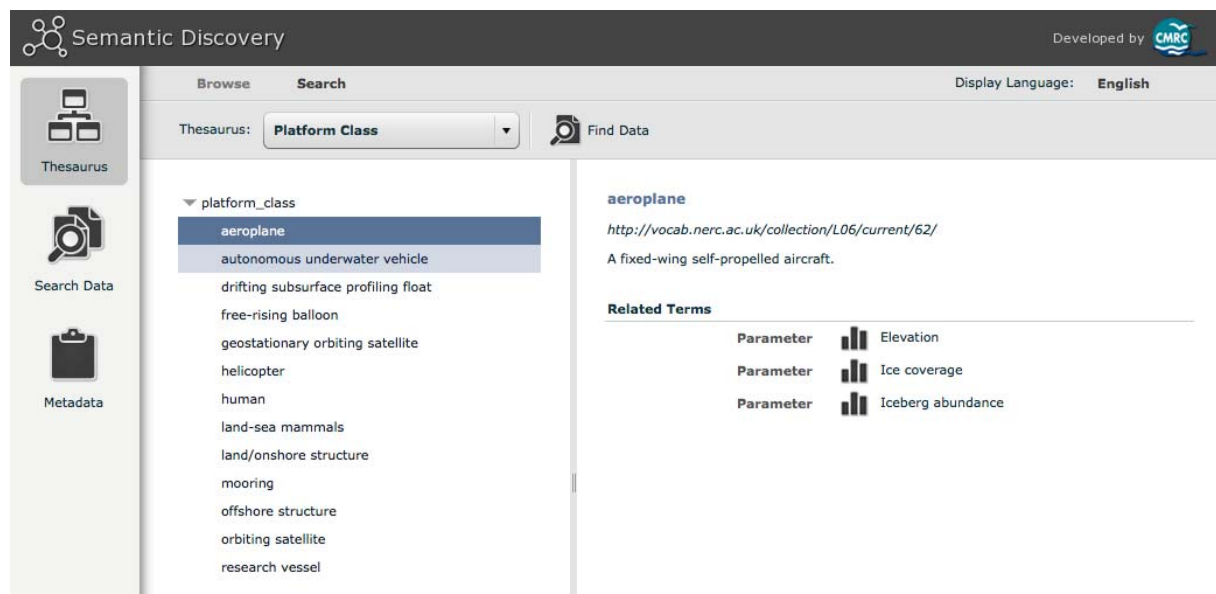


Figure 4-1 Discovery client: Start-up screen of the ontology browser.

The ontology browser displays the defined concepts of the NETMAR ontologies in a tree structure. By clicking on a concept, its definition is shown along with related terms to the right (Figure 4-1). A “Display language” button on the top right side of the ontology browser allows users to select the language of the concept definitions and labels (this works only if concept labels and definitions are available in the selected language).

A combo box on top of the concept tree (c.f., Figure 4-2) allows users to select the discovery facet (concept scheme), e.g., platform class, platform, parameter, instrument, etc. When a user selects a facet, the ontology browser loads the hierarchy of the concepts contained in the corresponding concept scheme.

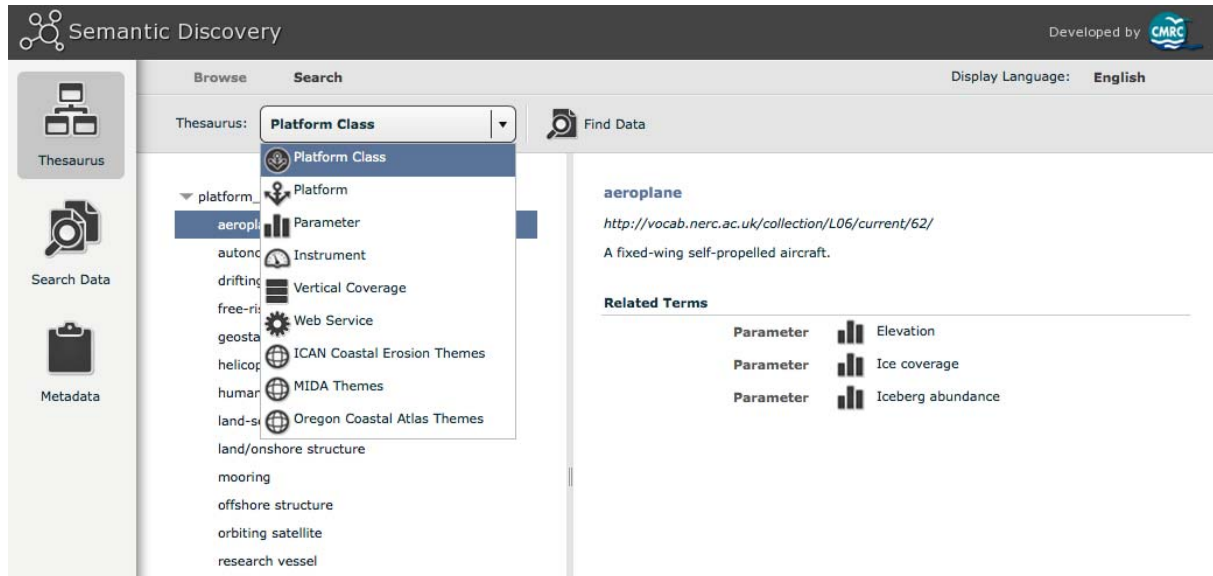


Figure 4-2 Facet Combo Box.

When a concept is selected, the user can inspect any of the related terms by clicking on it, or move on to searching by entering a keyword in the search field. Entering e.g. “ice edge” will search the ontology for any semantically related terms, and display these with definitions inside the browser (Figure 4-3). A search “Options” button allows users to restrict the search to a selected list of concept schemes (Figure 4-4) and to select whether they want to search concepts by URI or, otherwise, by label and definition. The search keyword language may be selected using the drop down list button next to the search text input.

The screenshot shows the Semantic Discovery interface with a search for 'ice edge'. The results are displayed in a table with columns for Type and Term. The search results are as follows:

Type	Term
Parameter	Ice edge <i>Definition: Unavailable</i>
Parameter	Edge (EUMETSAT OSI-SAF) of ice on the water body by classification of brightness temperature <i>Definition: Unavailable</i>
Parameter	Ice motion and related parameters <i>Definition: Parameters specifying the speed and direction of sea or land ice and the stresses associated w</i>
Parameter	Snow and ice mass, thickness and extent <i>Definition: Measurements of quantity (mass), thickness and spatial extent of snow and ice</i>
Parameter	Snow and ice physical properties and characteristics <i>Definition: Parameters related to physical properties (e.g. colour, density, in-situ temperature) or...</i>
Parameter	Coverage (by area) of ice on the water body by image analysis <i>Definition: The proportion of a given sea area covered by ice as determined from a satellite image</i>
Parameter	Coverage (by area) of ice on the water body by model prediction <i>Definition: The proportion of a given sea area covered by ice as determined from a numerical model pred</i>
Parameter	Ice displacement <i>Definition: The distance moved in a period of time by frozen water covering the Earth's surface</i>
Parameter	Ice type <i>Definition: The physical nature of frozen water on the Earth's surface</i>
Parameter	Ice speed <i>Definition: The distance moved per unit time by frozen water covering the Earth's surface</i>
Parameter	Ice temperature <i>Definition: The degree of hotness of frozen water on the Earth's surface</i>

At the bottom of the results area, it says "(Click on an item to view in Ontology Browser)" and "46 terms found".

Figure 4-3 Ontology browser: Searching in the ontologies.

The screenshot shows the Semantic Discovery interface with a search for 'Ice Edge'. An 'Options' dialog box is open, showing search settings. The dialog box contains the following options:

- Search by URI
- Select thesauri to search:
 - Platform Class
 - Platform
 - Parameter
 - Instrument
 - Vertical Coverage
 - Web Service

The dialog box has a 'Close' button at the bottom right.

Figure 4-4 Ontology Browser: Ontology Search Options.

Selecting any of the found terms, e.g., “Ice Edge” of Figure 4-3, will show the definition of this term, and its relations (c.f., Figure 4-5).

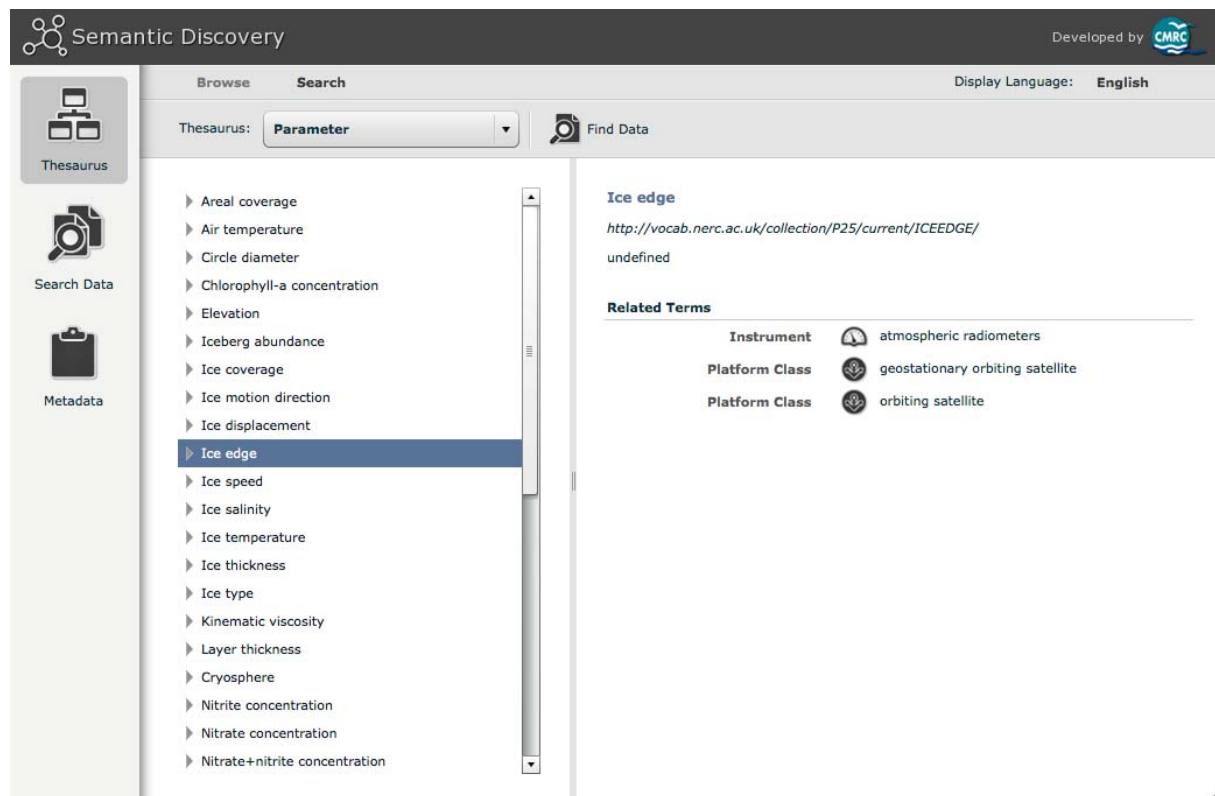


Figure 4-5 Ontology Browser: Definition of a found term and its relationships.

When a user has found a suitable search term (Ice Edge), he can select it in the ontology browser and press the “Find Data” button (Figure 4-5). This will start the data search component, and search for data matching the selected term. Alternatively, the user can type a free-text keyword in the text input (top left) of the data search interface, and, like in the ontology browser, select the keyword language.

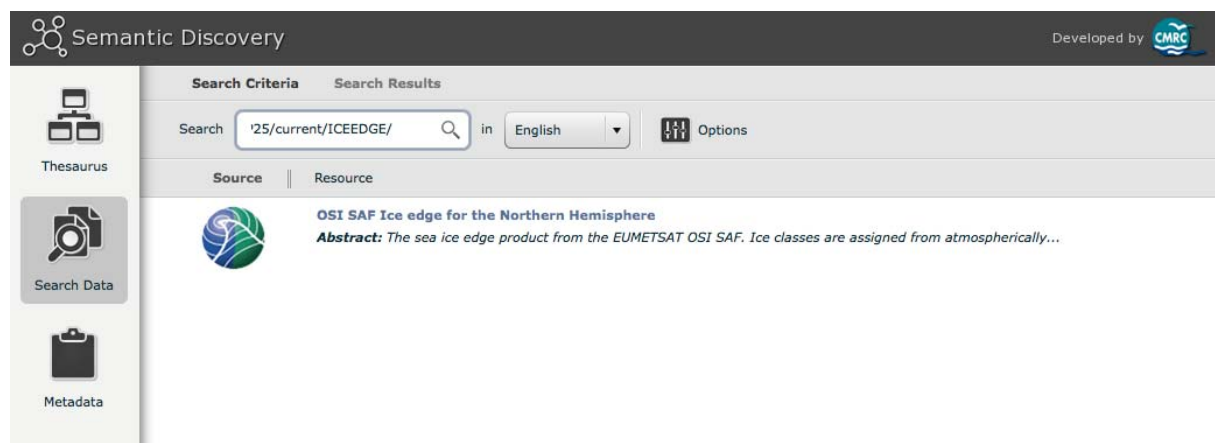


Figure 4-6 Data Search Component: Smart search for data using the term “Ice Edge”.

The user can refine the search criteria by selecting the geographic area of interest in the “Search Criteria” view of the data search component (Figure 4-7). Areas of interest may be selected by clicking on a place concept from the place ontology that is presented in the concept hierarchy at the left side of the search criteria view (e.g., North Sea), or manually by drawing a bounding box on the map (right side area).

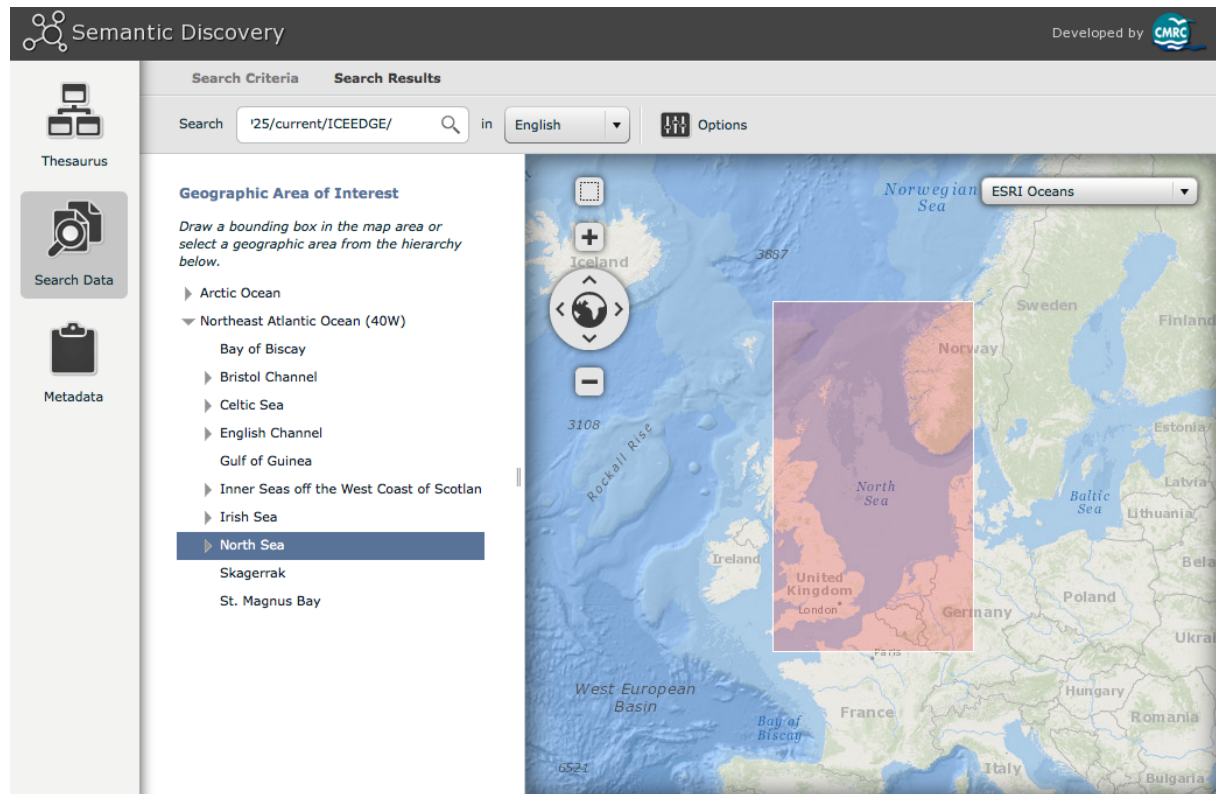


Figure 4-7 Data Search Component: Smart search for data using the term “temperature”..

A search “Options” button allows users to select search options such as whether they want to search the terms they have entered in metadata keywords, title, or abstract, and whether they are looking for datasets or services, c.f., Figure 4-8.

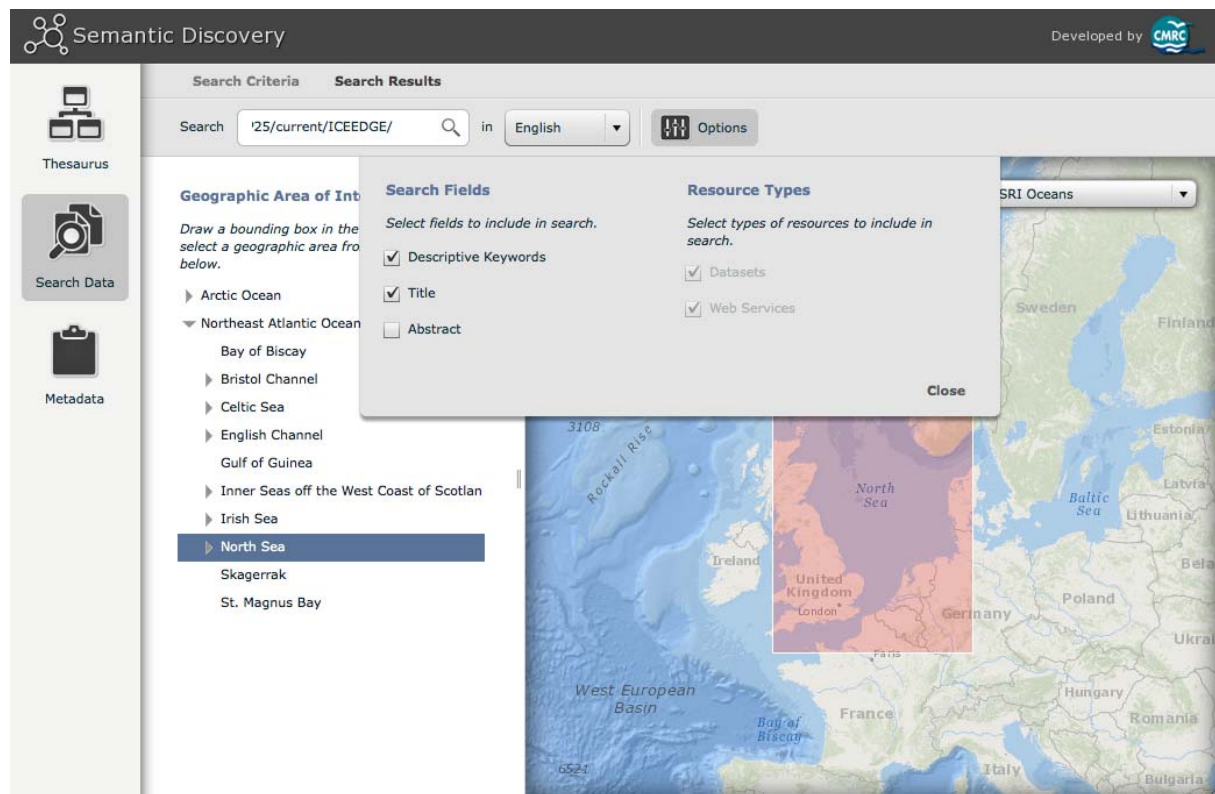


Figure 4-8 Data Search Component: Data Search Options.

The search client will present a list of all datasets matching the search criteria (Figure 4-6) and the user can then click on any of the found datasets to view its metadata (Figure 4-13).

The metadata viewer provides four ways of displaying metadata (top menu bar buttons): summary view (Figure 4-9), full view (Figure 4-10), XML view (Figure 4-11), and data download view (Figure 4-12).

The data download view contains all the online data delivery options available as described in the metadata record, with buttons to perform the appropriate actions for each download option (e.g., “view in GIS viewer” for WMS links, “download file” for download links, etc.)

The screenshot shows the 'Semantic Discovery' interface. The top navigation bar includes 'Summary', 'Full', 'XML', and 'Data Links'. The left sidebar has 'Thesaurus', 'Search Data', and 'Metadata' options. The main content area displays the following metadata for the result 'OSI SAF Ice edge for the Northern Hemisphere':

Identifier	13c3c2ff-2204-4b57-8161-e42f2cb2be1f@http://netmar.met.no/geonetwork/
Alternate Title	Ice edge
Creation Date	2009-08-21T21:37:11Z
Publication Date	2009-08-21T21:37:11Z
Revision Date	2009-08-21T21:37:11Z
Descriptive Keywords	Oceanographic geographical features, Edge (EUMETSAT OSI-SAF) of ice on the water body by classification of brightness temperature and ASCAT backscatter, Dimensionless, http://vocab.nerc.ac.uk/collection/P22/current/28 , http://vocab.nerc.ac.uk/collection/P01/current/ICEEDGEX , http://vocab.nerc.ac.uk/collection/P06/current/UUUU [Unknown keyword type]
Temporal Extent	Begin Date: 2010-01-01T12:00:00.000Z End Date: 2012-02-26T12:00:00.000Z
Geographic Bounding Box	

Figure 4-9 Data Search Component: Viewing the Summary Metadata of a data search result.

The screenshot shows the 'Semantic Discovery' interface with the 'Full' metadata view selected. The left sidebar remains the same. The main content area displays a detailed list of metadata fields:

- ▼ File Identifier
 - 13c3c2ff-2204-4b57-8161-e42f2cb2be1f@http://netmar.met.no/geonetwork/
- ▼ Language
 - Code List: http://www.loc.gov/standards/iso639-2/php/code_list.php
 - Code List Value: eng
 - English
- ▶ Character Set
- ▶ Hierarchy Level
- ▶ Contact
- ▶ Date Stamp
- ▶ Metadata Standard Name
- ▶ Metadata Standard Version
- ▶ Reference System Info
- ▶ Identification Info
- ▶ Distribution Info
- ▶ Data Quality Info
- ▶ Metadata Constraints

Figure 4-10 Data Search Component: Full Metadata View.

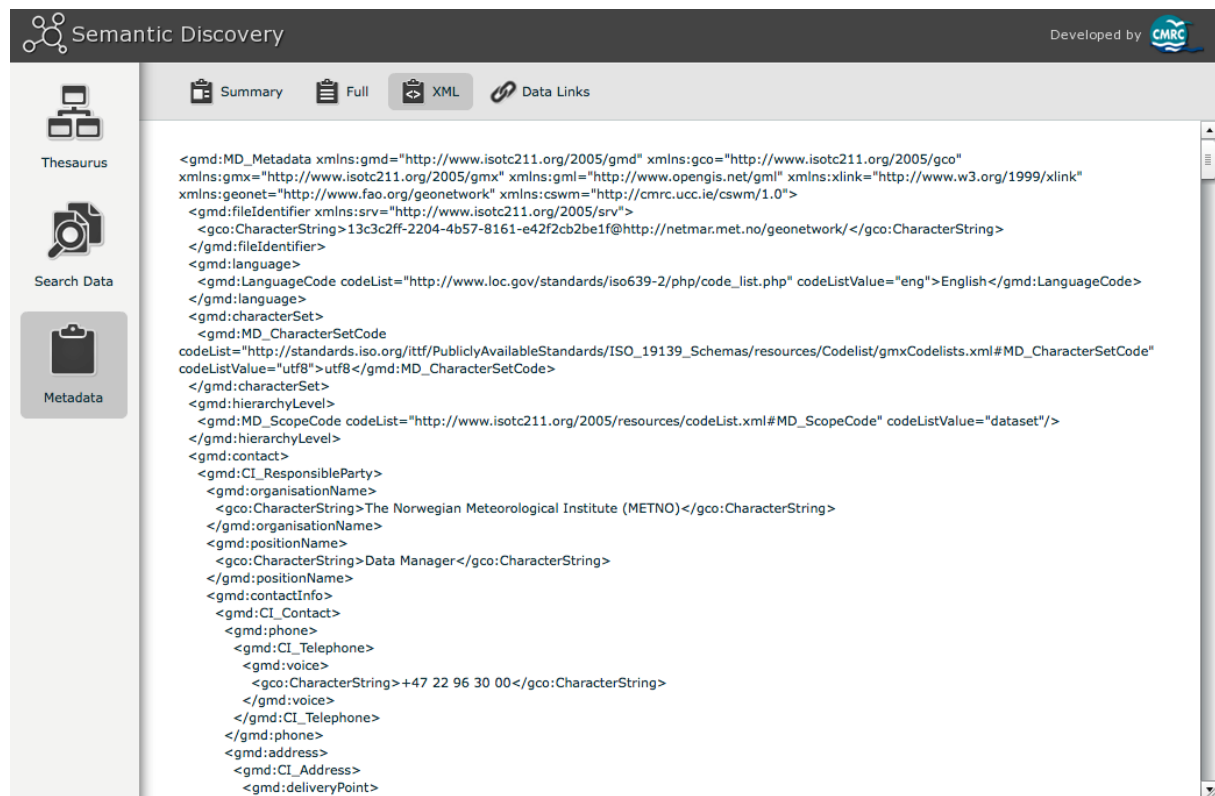


Figure 4-11 Data Search Component: XML View.

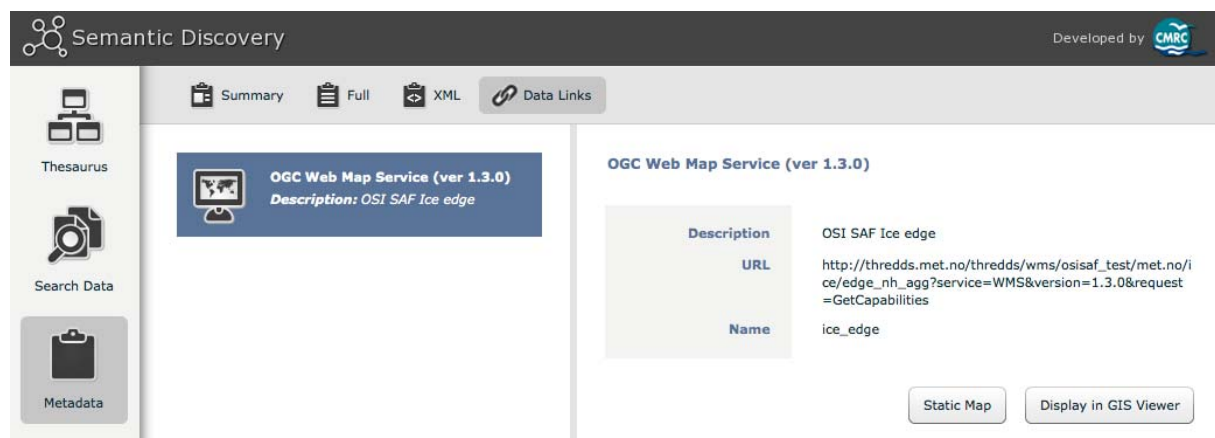


Figure 4-12 Data Search Component: Data Download View.

4.3 Implementation

The smart search and discovery client includes the following features: an ontology browser, a smart search interface (discovery GUI), and a metadata viewer. It relies on two services: a semantic web service (SWS) and a CSW (Catalogue Service for the Web) mediator (CSWM), as illustrated in Figure 4-13.

The semantic web service (SWS) provides a high-level interface for retrieving knowledge from the NETMAR ontologies. The operations supported by the SWS are high-level and easy-to-use operations oriented towards querying SKOS (Simple Knowledge Organization System) thesauri [MB09]. They constitute common operations required by most semantics-based components such as the CSW mediator, the ontology browser, and the discovery GUI

(Graphical User Interface). Examples of such operations include, *Get Concept Schemes*, *Get Concept Hierarchy*, *Get Related Concepts*, and *Search Concept*. The SWS is developed in Java, using the Jena ontology framework [Jena].

On top of the catalogue services, a CSW Mediator is responsible for handling metadata semantics and allows data discovery based on semantics. The CSWM supports distributed catalogue services, thus allowing new catalogue services to be integrated easily. The CSWM supports CSWM and CSW 2.0.2 XML requests and returns either a CSWM or a CSW 2.0.2 response (depending on the request standard) [CSW202]. It is developed in Java.

The ontology browser (OB) allows end-users to browse the ontologies with the aim of finding data types and datasets of interest. The OB allows users to better understand the meaning of the various topics (disciplines, themes, instruments, parameters, etc.) and how they relate to each other, and find in an accurate way data of relevance to their topics of interest. It allows them to search (by browsing or by keyword) concepts of interest, and from there navigate to the data discovery interface to find related datasets or services.

The smart data discovery interface allows end-users to search datasets of interest based on the “meaning of a keyword” and a geographic area of interest. The current discovery GUI includes a basic ontology browser for place keywords that hold geospatial information encoded in GML (Geography Markup Language).

The metadata viewer is used to display metadata records of interest to the user. This allows users to navigate from metadata to data and to the web GIS.

The ontology browser, the smart data discovery interface and the metadata viewer are all developed in Adobe Flex 3. To integrate these components in the EUMIS portal, this application had to be wrapped in a JSP (Java Server Pages) file, and configuration files defined to enable Liferay to recognise it as a portlet. All necessary files were compiled into a .war file, which was deployed in the portal container (Liferay).

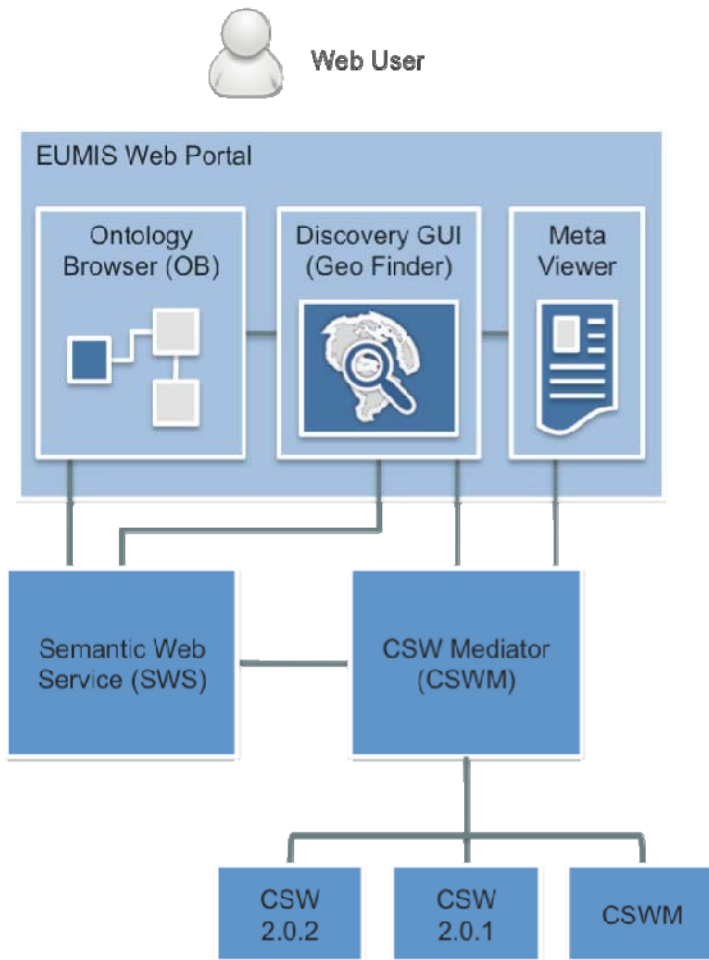


Figure 4-13 Smart search client components and services.

5 Service chaining editor

5.1 Purpose and features

One key aim of the NETMAR project is to enable non-technical users to build their own workflows using components (data and processing) provided by the project. These workflows can then be saved and reused by the user or published for use by others. The editor is available online via any commonly used web browser, as part of the EUMIS portal, and requires no special tools or plugins to be installed. The service chains (aka workflows) that are created by the editor can be executed by a web based workflow engine like Taverna Server [Tav].

The service chaining editor (SCE) has the following features:

- Access to processing services offered by the NETMAR partner (and external parties, if available) through service metadata provided online as WSDL (Web Service Definition Language) files. The WSDL can be loaded into the editor, and the services added to the Service List for easy inclusion in the user's own workflows.
- WYSIWYG (What You See Is What You Get) editing of the workflows. The services are shown graphically in the editor's work area, where the users can connect them by linking the output from one service to the input of another.
- Storing of own workflows for later execution and (if desirable) sharing with other users.
 - Workflows may be stored locally to the browser for ease of use.
 - Workflows may be exported in a standard format, allowing their execution in external workflow engines.
- Loading of own (and others') workflows, editing of these and saving as new workflows.
- Workflows may be run from within the SCE using the included workflow engine.

5.2 How to use it

The SCE is made up of an editing canvas on which the work flow is created and three control windows

- Workspace
- Service List
- Settings

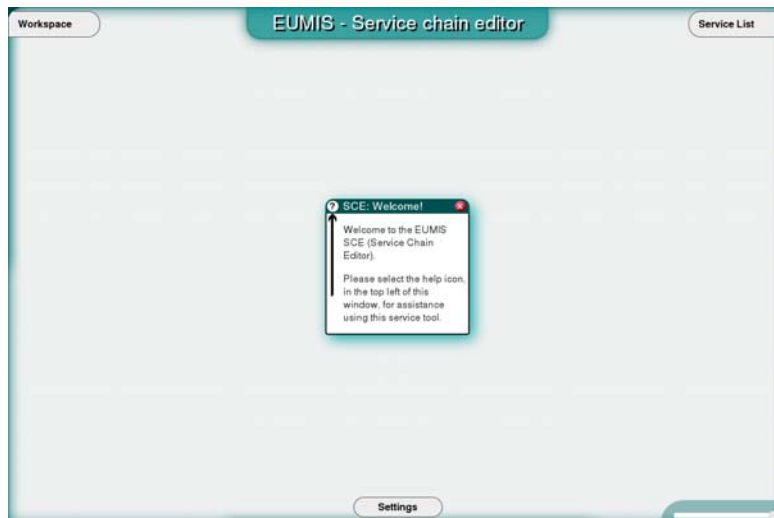


Figure 5-1 SCE startup screen.

On first start up the SCE will display a blank screen with the control windows closed (Figure 5-1), clicking on the “Service List” tab will open the Service List (Figure 5-2) from which services may be dragged on to the editing canvas. Additional WSDL files may be added to the service list by clicking on the “Load new WSDL file” button and specifying the URL.

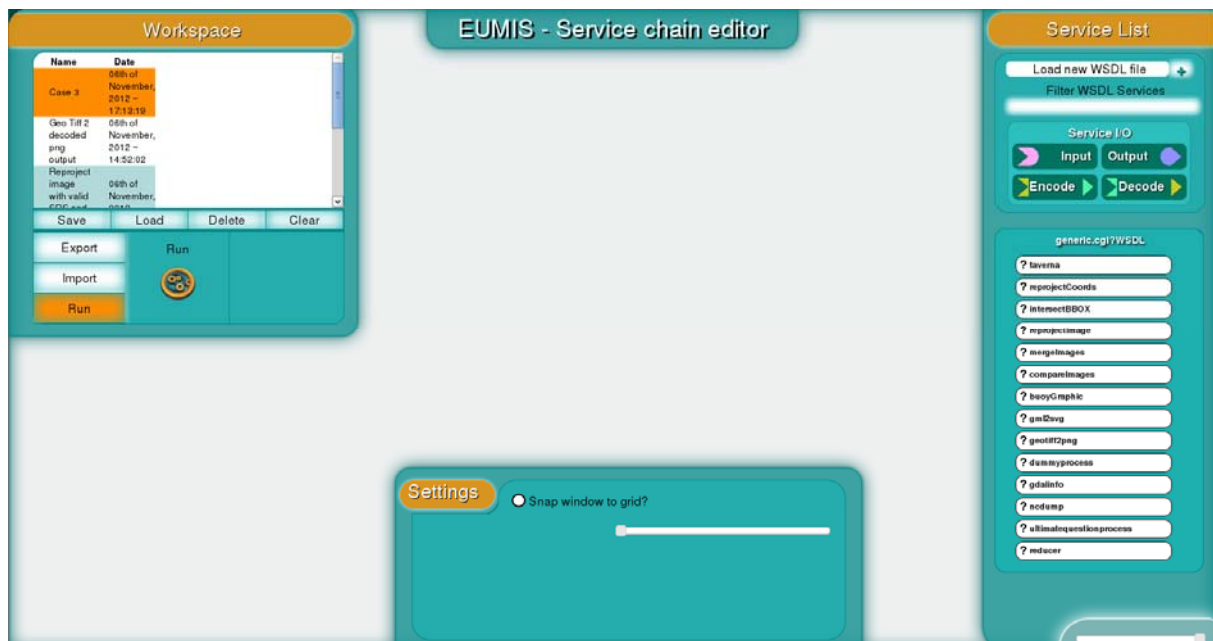


Figure 5-2 SCE showing available control windows SCE startup screen.

A workflow is created by dragging services onto the canvas and joining the inputs and outputs (Figure 5-3).

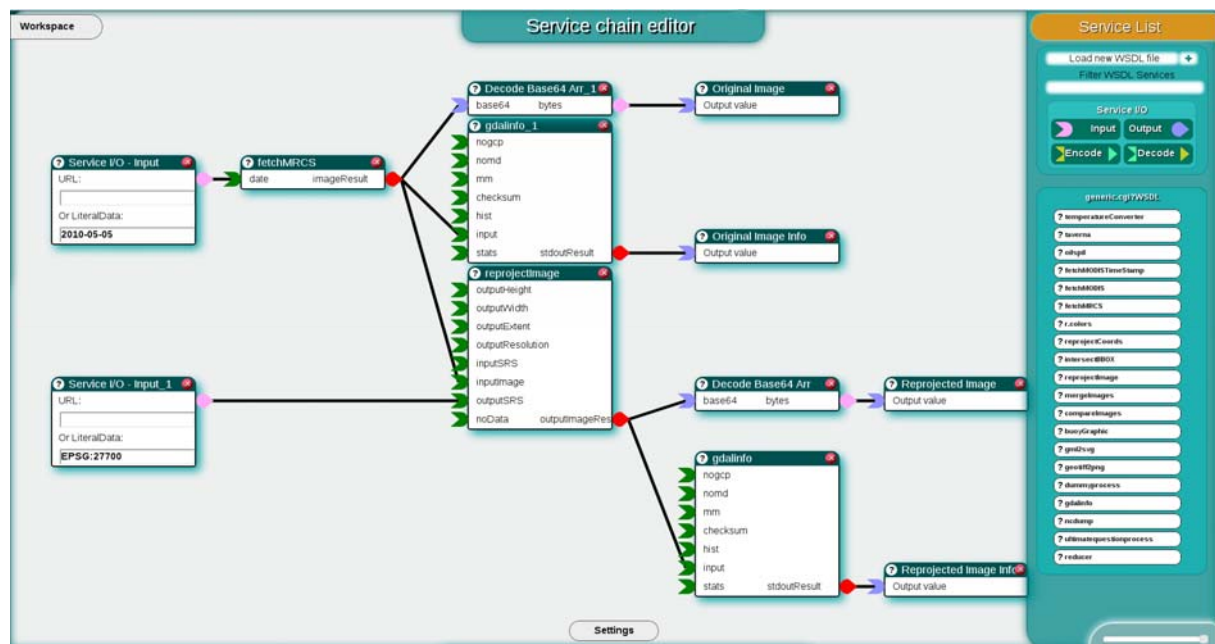


Figure 5-3 Example workflow to reproject a model image.

Once created a workflow may be saved or run from within the Workspace control window.

The help function of the service chaining editor can be invoked by clicking the help icon (?) in the upper left corner of a node or by invoking the general help function using the F1 button anywhere inside the editor. The Wiki also has information about how to use the editor at <http://eumis.nersc.no/en/wiki/-/wiki/Main/Service%20Chain%20Editor>.

5.3 Implementation

The service chaining editor is implemented using HTML and JavaScript (using the open source jQuery [JQ] library). Styling makes use of Cascading Style Sheets (CSS), which ensure that the different components of the user interface are correctly positioned on the screen.

Workflows are represented internally as JSON[JN] which can be saved for future editing in the local browser storage; they are converted to two forms of XML by a PHP[PHP] proxy layer running on the web server. The first XML format is T2FLOW [T2F], the native format for Taverna, which can then be run on the Taverna Server provided within EUMIS or on a local Taverna Workbench. The second XML format is NETMAR specific, allowing workflows to be shared between users and imported back into the SCE for further editing. These NETMAR workflows may be emailed directly from the SCE at the click of a button.

As the service chaining editor is first implemented as a standalone web application, it has to be wrapped in a JSP page before integration in the portal. A set of portlet configuration files have been created, declaring which JavaScript libraries and CSS files the editor needs.

6 Conclusions

The first version of the EUMIS portal provides products and services for the following pilots:

- Pilot 1: Arctic Sea Ice and Met-ocean Observing System
- Pilot 2: Oil spill drift forecast and Shoreline Cleanup assessment services in France
- Pilot 3: Ocean Colour – Marine Ecosystem, Research and Monitoring.
- Pilot 4: The International Coastal Atlas Network (ICAN)

The requirements for each pilot have been defined by interacting with users in the respective application domains [PTS+11] through dedicated user meetings and workshops, followed by phone and e-mail contact.

The second and final version of the EUMIS portal contains a Wiki, where users can find information about the products and services offered, as well as the tools used to develop the portal, its components and data delivery and processing services. The portal also includes three GIS components: (1) the GIS Viewer, (2) the search and discovery client, and (3) the service chaining editor. All content and services in the EUMIS portal is open to everyone, and there is no need for users to register to get access.

The GIS Viewer allows users to display on a map distributed geo-spatial resources that have been shared by means of the OGC WMS standard. The GIS viewer allows the user to obtain multiple layers overlaid on top of one another in the same geographic map projection. Layers can be added and removed dynamically, and their display easily turned on and off. The GIS map viewer also includes common GIS functions (e.g. zoom, pan, legends), shows the latitude-longitude location of the cursor inside a map, and facilitates printing of the currently displayed layers. The GIS Viewer is also capable of running a web processing service (WPS), and display the resulting image or graph.

Smart search is the ability of a discovery engine to locate target documents that do not include either an exact or fuzzy match to a user-supplied text string or user-supplied keyword. For example, if the user initiates a search on the discipline keyword 'Physical Oceanography', the discovery engine find documents marked up with terms like 'currents', 'waves', 'water temperature', 'salinity' and so on, because these are semantically linked to the search criteria. The smart search and discovery client supports three features: ontology browsing, dataset smart search, and metadata visualisation. It provides search facilities based on the *semantics* of the data, including support for multi-domain and multi-lingual search in a network of metadata catalogue services connected by a mediator tool.

The service chaining editor allows users to generate new products by specifying workflows that utilise a set of data delivery and processing services. The workflow is generated using a graphical editor where individual services are chained together to form a new process. The workflows can be saved for later use, re-opened and edited, and run within an included workflow engine. Workflow output can be viewed within the GIS viewer.

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