



Marine Microbial Biodiversity, Bioinformatics & Biotechnology



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Acronym: Micro B3

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Deliverable 3.5

Portal, supporting OGC and ISO standards, bundling the selected oceanographic services for Micro B3

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Summary

The Micro B3 project aims for a better understanding of the complexity of marine microbial communities and their role in climate change. This requires that the data sets and information on marine organisms and genes are complemented with their environmental context. Oceanographic and marine environmental data will be provided to Micro B3 by the major existing overarching oceanographic data management infrastructures, SeaDataNet and EurOBIS, that also are both driving the data management component of the EMODNet development. These oversee and give access to extensive volumes and types of data sets from existing ocean and marine data collection activities from multiple sources. Their contribution to Micro B3 will be arranged as part of WP3. Moreover data will be collected in the framework of Micro B3 via the **Ocean Sampling Day (OSD)** (WP2) and derived from the **Tara Oceans** expedition for which WP3 gives data management support.

Deliverable D3.3 gives a functional analysis of the way that the flow of data from the field via the data management infrastructures to Micro B3, MB3-IS and users might be structured and organised. This has been tuned with related WPs in Micro B3: WP2, WP4 and WP5. Furthermore D3.3 gives a technical analysis and specifications of the interoperability options, both for delivering metadata and data to MB3-IS and for the mutual exchanges between SeaDataNet (marine environmental data), EurOBIS (marine biodiversity data) and the European Nucleotide Archive (ENA) (molecular sequence data).

This Deliverable D3.5 describes the further detailing, development and actual implementation of the selected interoperability solutions for sharing metadata and data from SeaDataNet towards MB3-IS, EurOBIS and ENA. The implemented interoperability solutions concern machine-to-machine services for sharing metadata and data from SeaDataNet towards MB3-IS, and OGC WMS-WFS services as well as OpenSearch services for sharing metadata from SeaDataNet towards EurOBIS and ENA.

Further activity is planned till end 2014 between WP3 and WP4 for arranging operational 2-way functioning of the interoperability services between SeaDataNet, EurOBIS and ENA as well as between WP3 and WP5 for WP5 to integrate the WP3 machine-to-machine services into MB3-IS. Moreover the machine-to-machine services will be populated with oceanographic metadata and data from SeaDataNet for the selected oceanographic sites (following the definition in D3.4) in order to deliver D3.6. This will also take place till end 2014 in order to allow for PANGAEA to perform data management and curation for the Tara Oceans and OSD data sets and to index those via SeaDataNet.

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1.0 Introduction

The Micro B3 project aims for a better understanding of the complexity of marine microbial communities and their role in climate change. This requires that the data sets and information on marine organisms and genes are complemented with their environmental context.

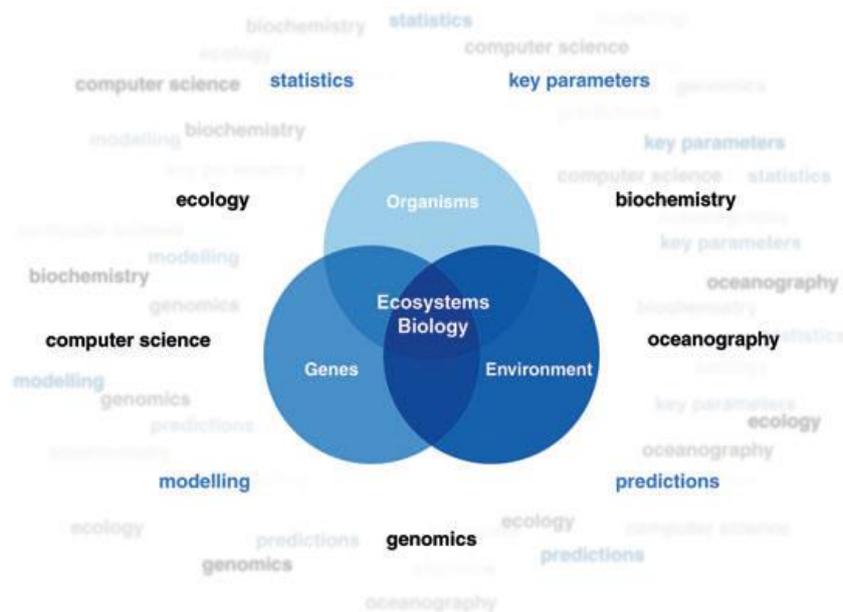


Figure: Integrating the information on the diversity of the organisms with their potential functions, reflected in their genes, and the environmental conditions surrounding them.

Deliverable D3.1 describes in detail the setup, scope and services of the leading European oceanographic data management infrastructure SeaDataNet, including its network of connected data centres such as NODCs, ICES, and PANGAEA, as well as of EurOBIS as leading European infrastructure for marine biodiversity, and their roles in the EMODNet development. SeaDataNet and EurOBIS oversee and give access to extensive volumes and types of data sets from existing ocean and marine data collection activities from multiple sources. Additional oceanographic data sets are collected in the framework of Micro B3 via the **Ocean Sampling Day (OSD)** (WP2) and derived from the **Tara Oceans** expedition. Data management and curation activities for these additional data sets are performed by partner PANGAEA as part of WP3 and these will result in extra input for SeaDataNet and the European Nucleotide Archive (ENA) (molecular sequence data).

Deliverable D3.3 gives a functional analysis of the way that the flow of data from the field via the data management infrastructures to Micro B3, MB3-IS and users might be structured

and organised. This has been tuned with related WPs in Micro B3: WP2, WP4 and WP5. Furthermore D3.3 gives a technical analysis and specifications of the interoperability options, both for delivering metadata and data to MB3-IS and for the mutual exchanges between SeaDataNet (marine environmental data), EurOBIS (marine biodiversity data) and the European Nucleotide Archive (ENA) (molecular sequence data).

Interfacing is planned between the 3 basic infrastructures, SeaDataNet, EurOBIS and ENA, for better service and a complete data provision to their internal and external users. SeaDataNet users will have direct overview of data sets as managed and provided by EurOBIS and ENA; EurOBIS users of data sets as managed and provided by SeaDataNet and ENA; and ENA users of data sets as managed and provided by SeaDataNet and EurOBIS. This "horizontal" exchange between the 3 leading European infrastructures can be achieved by the following interoperability solutions:

1. Using OGC WMS - WFS protocols to exchange metadata including URLs to further metadata and data
2. Using OpenSearch protocol to facilitate remote queries from one portal to the other portal

The discovery and delivery of data sets from SeaDataNet to MB3-IS has a focus on providing access to metadata and data sets for a number of selected oceanographic sites which have been defined in D3.4. The interfacing from SeaDataNet towards MB3-IS can take place by combining the following services:

1. Using OGC WMS - WFS protocols to exchange CDI metadata from SeaDataNet to MB3-IS
2. Using machine-to-machine services for sharing in an efficient and dynamic way metadata and data sets for the selected oceanographic sites from SeaDataNet to MB3-IS and its users.

This Deliverable D3.5 describes the further detailing, development and actual implementation of the indicated interoperability solutions from the perspective of SeaDataNet as provider.

2.0 OGC WMS – WFS services from SeaDataNet towards EurOBIS and ENA

So-called ‘horizontal’ interfacing is planned between the 3 basic infrastructures, SeaDataNet, EurOBIS and ENA, for better service and a complete data provision to their internal and external users. SeaDataNet users will have direct overview of data sets as managed and provided by EurOBIS and ENA; EurOBIS users of data sets as managed and provided by SeaDataNet and ENA; and ENA users of data sets as managed and provided by SeaDataNet and EurOBIS.

One way to achieve this horizontal exchange between the 3 leading European infrastructures is making use of the Open Geospatial Consortium (OGC) Web Map Service (WMS) and Web Feature Service (WFS) protocols to exchange metadata including URLs to further metadata and data.

WMS makes it possible to share and exchange map layers between each of the internet portals with map viewing services and WFS makes it possible to interrogate the objects on these maps by clicking on those thereby retrieving feature information. The feature info then can include URLs to the associated portal to retrieve further metadata and options to request access and delivery of the data sets.

The SeaDataNet infrastructure has a central portal with the CDI Data Discovery and Access service which gives detailed metadata of the data sets as managed by the distributed data centres. At present there are already 103 data centres from 34 countries surrounding European seas connected, giving overview and access to more than 1.5 million observation data sets as described by the CDI metadata. The CDI Data Discovery and Access service also features a data shopping mechanism to support registered users to request access and if granted, to download data sets from the distributed data centres in a common way using the Request Status Manager (RSM) facility at the SeaDataNet portal.

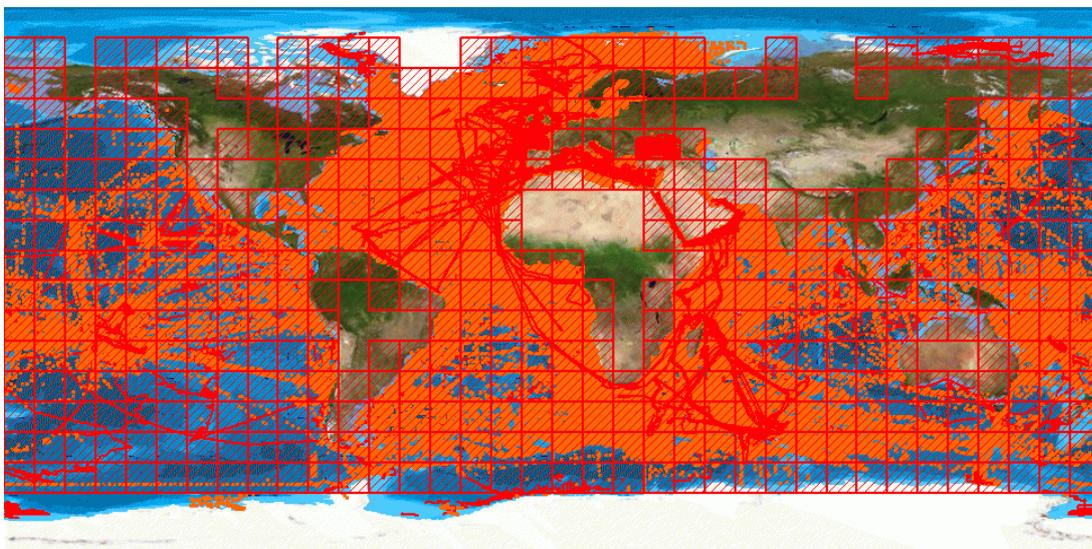


Figure: Coverage of observation data sets in SeaDataNet July 2014



Figure: Map of SeaDataNet connected data centres (103 centres per July 2014)

The WMS-WFS services make it possible to share and exchange map layers between internet portals with map viewing services and to interrogate the objects on these maps by clicking on those thereby retrieving feature information. This way SeaDataNet can provide EurOBIS and ENA as well as MB3-IS map layers with locations and metadata for all observation data sets as included and available in the SeaDataNet CDI Data Discovery and Access Service.

The WMS URL for SeaDataNet is:

http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet

The OGC protocol works with a GetCapabilities request:

http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?service=WMS&request=GetCapabilities

This will give the following XML with formulation of the capabilities:

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oceanographic services for Micro B3, 21 July 2014

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE WMT_MS_Capabilities SYSTEM "http://schemas.opengis.net/wmts/1.1.1/WMT_MS_Capabilities.dtd">
<!-- end of DOCTYPE declaration -->
- <WMT_MS_Capabilities version="1.1.1">
  <!-- MapServer version 5.0.0 OUTPUT=GIF OUTPUT=PNG OUTPUT=JPEG OUTPUT=WBMP OUTPUT=PDF OUTPUT=SWF OUTPUT=SVG SUPPORTS=PROJ SUPPORTS=AGG SUPPORTS=FREEZY
  SUPPORTS=WMS_SERVER SUPPORTS=WMS_CLIENT SUPPORTS=WFS_SERVER SUPPORTS=WFS_CLIENT SUPPORTS=WCS_SERVER SUPPORTS=SOS_SERVER SUPPORTS=FASTCGI
  SUPPORTS=THREADS SUPPORTS=GEOS INPUT=JPEG INPUT=POSTGIS INPUT=OGR INPUT=GDAL INPUT=SHAPEFILE -->
  - <Service>
    - <Name>OGC:WMS</Name>
    - <Title>MARIS WMS Server - SeaDataNet</Title>
    - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
    - <ContactInformation> </ContactInformation>
  </Service>
  - <Capability>
    - <Request>
      - <GetCapabilities>
        - <Format>application/vnd.ogc.wms_xml</Format>
        - <DCPType>
          - <HTTP>
            - <Get>
              - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Get>
            - <Post>
              - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
            </Post>
          </HTTP>
        </DCPType>
      </GetCapabilities>
    - <GetMap>
      - <Format>image/png</Format>
      - <Format>image/gif</Format>
      - <Format>image/png; mode=24bit</Format>
      - <Format>image/jpeg</Format>
      - <Format>image/wbmp</Format>
      - <Format>image/tiff</Format>
      - <Format>image/svg+xml</Format>
      - <DCPType>
        - <HTTP>
          - <Get>
            - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
          </Get>
          - <Post>
            - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
          </Post>
        </HTTP>
      </DCPType>
    </GetMap>
  </Capability>
</WMT_MS_Capabilities>
```

Figure: GetCapabilities XML of SeaDataNet WMS – part 1

```
</Post>
</HTTP>
</DCPType>
</GetMap>
- <GetFeatureInfo>
  - <Format>text/plain</Format>
  - <Format>application/vnd.ogc.gml</Format>
  - <DCPType>
    - <HTTP>
      - <Get>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Get>
      - <Post>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Post>
    </HTTP>
  </DCPType>
</GetFeatureInfo>
- <DescribeLayer>
  - <Format>text/xml</Format>
  - <DCPType>
    - <HTTP>
      - <Get>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Get>
      - <Post>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Post>
    </HTTP>
  </DCPType>
</DescribeLayer>
- <GetLegendGraphic>
  - <Format>image/png</Format>
  - <Format>image/gif</Format>
  - <Format>image/png; mode=24bit</Format>
  - <Format>image/jpeg</Format>
  - <Format>image/wbmp</Format>
  - <DCPType>
    - <HTTP>
      - <Get>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Get>
      - <Post>
        - <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
      </Post>
    </HTTP>
  </DCPType>
</GetLegendGraphic>
</DescribeLayer>
</DCPType>
</Service>
</WMT_MS_Capabilities>
```

Figure: GetCapabilities XML of SeaDataNet WMS – part 2

```

        </Post>
        </HTTP>
        </DCPType>
        </GetLegendGraphic>
        <GetStyles>
        <Format>text/xml</Format>
        <DCPType>
        <HTTP>
        <Get>
        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Get>
        <Post>
        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?" xmlns:xlink="http://www.w3.org/1999/xlink"/>
        </Post>
        </HTTP>
        </DCPType>
        </Request>
        </Exception>
        <Format>application/vnd.ogc.se_xml</Format>
        <Format>application/vnd.ogc.se_image</Format>
        <Format>application/vnd.ogc.se_blank</Format>
        </Exception>
        <VendorSpecificCapabilities/>
        <UserDefinedSymbolization RemoteWFS="0" UserStyle="1" UserLayer="0" SupportSLD="1"/>
        <Layer>
        <Name>MARIS_WMS_Server_seadatanet_seadatanet</Name>
        <Title>MARIS WMS Server - SeaDataNet</Title>
        <SRS>EPSG:4326</SRS>
        <SRS>EPSG:900913</SRS>
        <LatLonBoundingBox maxy="90" maxx="180" miny="-90" minx="-180"/>
        <BoundingBox maxy="90" maxx="180" miny="-90" minx="-180" SRS="EPSG:4326"/>
        <Layer cascaded="0" opaque="0" queryable="0">
        <Name>points</Name>
        <Title>points</Title>
        <SRS>EPSG:4326</SRS>
        <SRS>EPSG:900913</SRS>
        <LatLonBoundingBox maxy="82.941" maxx="180" miny="-76.8555" minx="-180"/>
        <BoundingBox maxy="82.941" maxx="180" miny="-76.8555" minx="-180" SRS="EPSG:4326"/>
        <Style>
        <Name>default</Name>
        <Title>default</Title>
        <LegendURL height="10" width="20">
        <Format>image/png</Format>
        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?
    
```

Figure: GetCapabilities XML of SeaDataNet WMS – part 3

```

        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?
        version=1.1.1&service=WMS&request=GetLegendGraphic&layer=points&format=image/png" xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
        </LegendURL>
        </Style>
        </Layer>
        <Layer cascaded="0" opaque="0" queryable="0">
        <Name>lines</Name>
        <Title>lines</Title>
        <SRS>EPSG:4326</SRS>
        <SRS>EPSG:900913</SRS>
        <LatLonBoundingBox maxy="81.705" maxx="180" miny="-78.193" minx="-180"/>
        <BoundingBox maxy="81.705" maxx="180" miny="-78.193" minx="-180" SRS="EPSG:4326"/>
        <Style>
        <Name>default</Name>
        <Title>default</Title>
        <LegendURL height="10" width="20">
        <Format>image/png</Format>
        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?
        version=1.1.1&service=WMS&request=GetLegendGraphic&layer=lines&format=image/png" xmlns:xlink="http://www.w3.org/1999/xlink" xlink:type="simple"/>
        </LegendURL>
        </Style>
        </Layer>
        <Layer cascaded="0" opaque="0" queryable="0">
        <Name>polygons</Name>
        <Title>polygons</Title>
        <SRS>EPSG:4326</SRS>
        <SRS>EPSG:900913</SRS>
        <LatLonBoundingBox maxy="80.0202" maxx="180" miny="-70" minx="-180"/>
        <BoundingBox maxy="80.0202" maxx="180" miny="-70" minx="-180" SRS="EPSG:4326"/>
        <Style>
        <Name>default</Name>
        <Title>default</Title>
        <LegendURL height="10" width="20">
        <Format>image/png</Format>
        <OnlineResource xlink:href="http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?
        version=1.1.1&service=WMS&request=GetLegendGraphic&layer=polygons&format=image/png" xmlns:xlink="http://www.w3.org/1999/xlink"
        xlink:type="simple"/>
        </LegendURL>
        </Style>
        </Layer>
        </Layer>
        </Capability>
    </WMT_MS_Capabilities>
    
```

Figure: GetCapabilities XML of SeaDataNet WMS – part 4

The SeaDataNet WMS service can be added to a WMS client as illustrated in the following images:

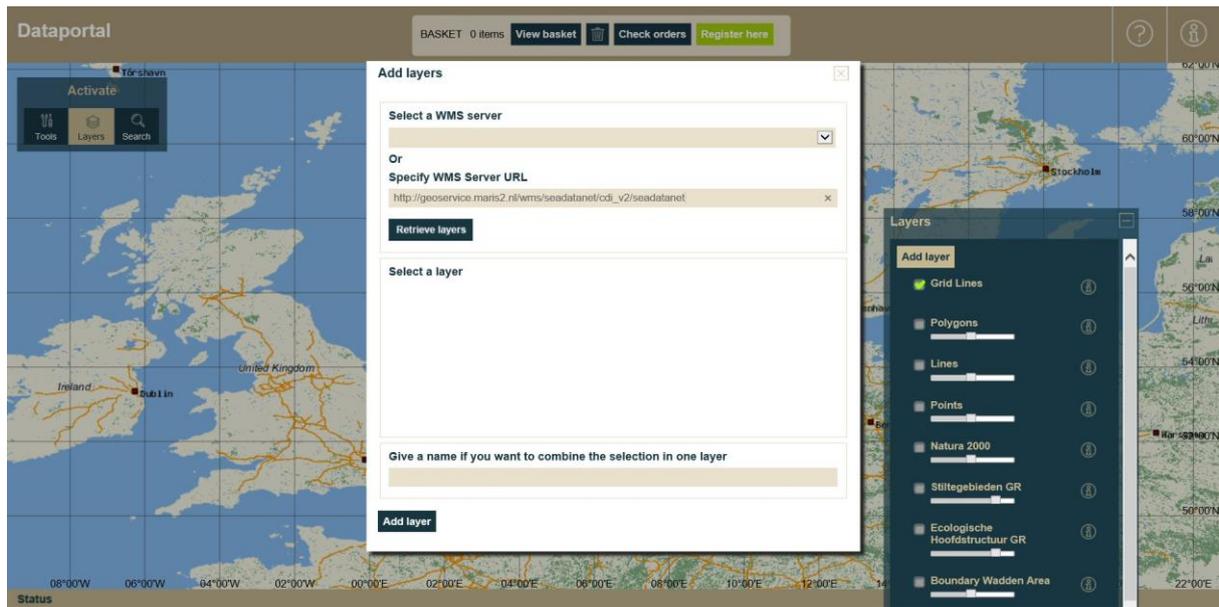


Figure: WMS client portal with Add Layers option; specify SeaDataNet WMS

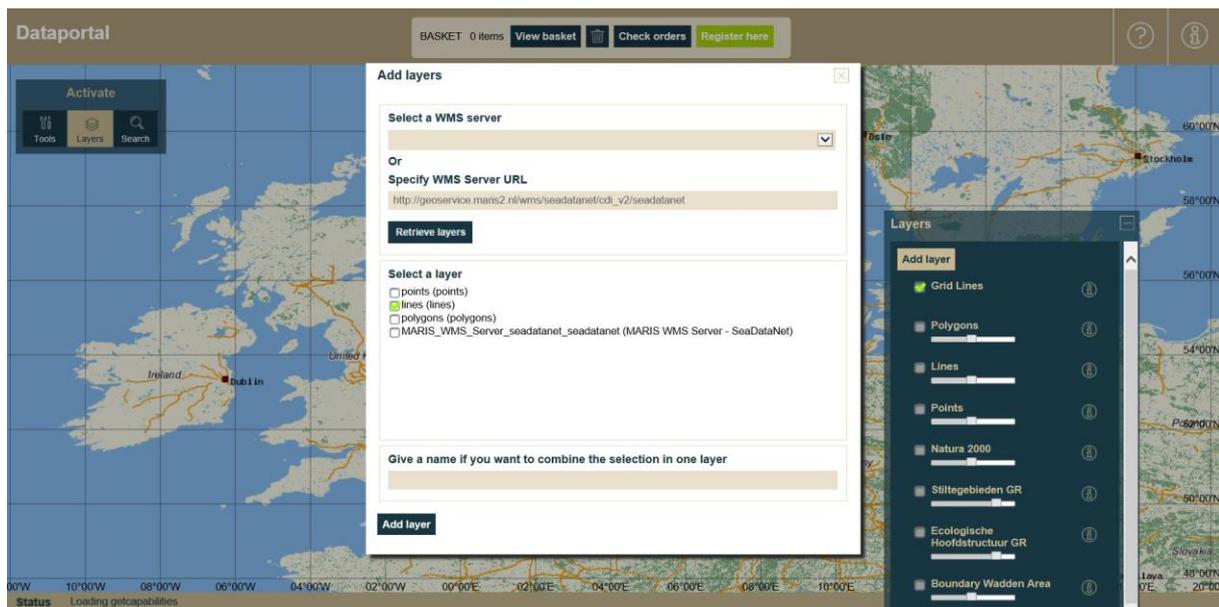


Figure: WMS client portal with Add Layers option; chose specific SeaDataNet layer(s)

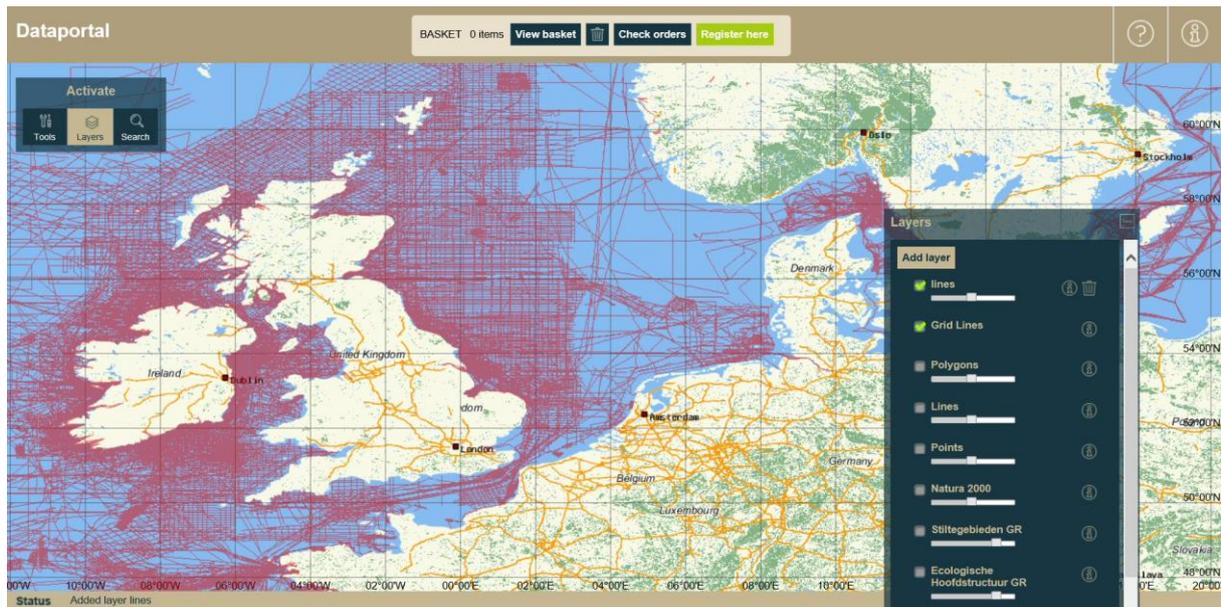


Figure: WMS client portal with added and activated SeaDataNet Lines layer

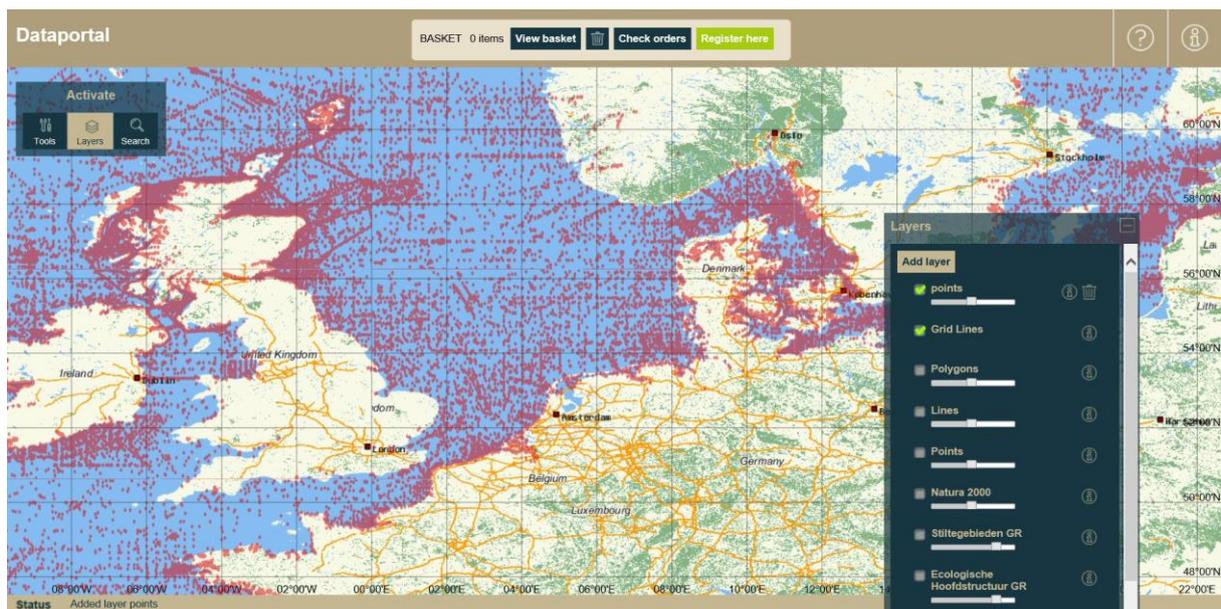


Figure: WMS client portal with added and activated SeaDataNet Points layer

An example WMS request:

http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet?styles=&format=image/png&transparent=true&request=getmap&version=1.1.1&srs=EPSG:4326&layers=lines&width=580&height=290&bbox=-180,-90,180,90

The SeaDataNet WMS GetCapabilities also specifies how the WFS can be called and integrated in another portal. However implementing WFS is depending on the client and needs programming. E.g. in an OpenLayers interface you can use the standards, but still have to program. The steps are as follows:

- Include WFS details from the GetCapabilities (URL and other options)
- Use the standard WFS protocol
- WMS layer must be active
- User can click on the map nearby or on position of point/line/polygon in the layer
- Position on the screen can be converted to co-ordinates
- Using these co-ordinates the client can compose a url

Examples of WFS request:

http://geoservice.maris2.nl/wfs/seadatanet/cdi_v2/seadatanet?service=WFS&version=1.0.0&request=getfeature&outputformat=gml3&typename=points&maxfeatures=10&bbox=0.2793103448275872,57.4448275862069,1.5206896551724127,59.244827586206895

This gives the following XML response:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<ms:msFeatureCollection xsi:schemaLocation="http://mapserver.gis.umn.edu/mapserver http://geoservice.maris2.nl/wfs/seadatanet/cdi_v2/seadatanet?
SERVICE=WFS&VERSION=1.0.0&REQUEST=DescribeFeatureType&TYPENAME=points&OUTPUTFORMAT=SFE_XMLSHEMA" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:ogc="http://www.opengis.net/ogc" xmlns:gml="http://www.opengis.net/gml" xmlns:ms="http://mapserver.gis.umn.edu/mapserver" version="1.0.0">
  <gml:boundedBy>
    <gml:Envelope srsName="EPSG:4326">
      <gml:pos>-0.279000 57.454134</gml:pos>
      <gml:pos>1.520000 59.238744</gml:pos>
    </gml:Envelope>
  </gml:boundedBy>
  <gml:featureMember>
    <ms:points gml:id="points.774062">
      <gml:boundedBy>
        <gml:Envelope srsName="EPSG:4326">
          <gml:pos>0.505700 58.635500</gml:pos>
          <gml:pos>0.505700 58.635500</gml:pos>
        </gml:Envelope>
      </gml:boundedBy>
      <ms:msGeometry>
        <gml:Point srsName="EPSG:4326">
          <gml:pos>0.505700 58.635500</gml:pos>
        </gml:Point>
      </ms:msGeometry>
      <ms:n_code>774062</ms:n_code>
      <ms:dataname>SC06/93/0126</ms:dataname>
      <ms:author>British Oceanographic Data Centre</ms:author>
      <ms:url>http://seadatanet.maris2.nl/v_cdi_v3/print_wfs.asp?n_code=774062</ms:url>
    </ms:points>
  </gml:featureMember>
  <gml:featureMember>
    <ms:points gml:id="points.774060">
      <gml:boundedBy>
        <gml:Envelope srsName="EPSG:4326">
          <gml:pos>1.004500 58.801300</gml:pos>
          <gml:pos>1.004500 58.801300</gml:pos>
        </gml:Envelope>
      </gml:boundedBy>
      <ms:msGeometry>
        <gml:Point srsName="EPSG:4326">
          <gml:pos>1.004500 58.801300</gml:pos>
        </gml:Point>
      </ms:msGeometry>
      <ms:n_code>774060</ms:n_code>
      <ms:dataname>SC06/93/0124</ms:dataname>
    </ms:points>
  </gml:featureMember>
```

Figure: 1st part of SeaDataNet WFS XML response for WFS query example

The WFS XML response in this case gives the locations of CDI entries for point observations with their data set reference, CDI data centre, and the URL to retrieve the full CDI metadata details from the SeaDataNet CDI Data Discovery & Access service, where a user can also request access to the related data. The WMS – WFS interoperability can be illustrated by the SIMORC portal (www.simorc.com) which features a SeaDataNet layer for physical oceanography data sets.

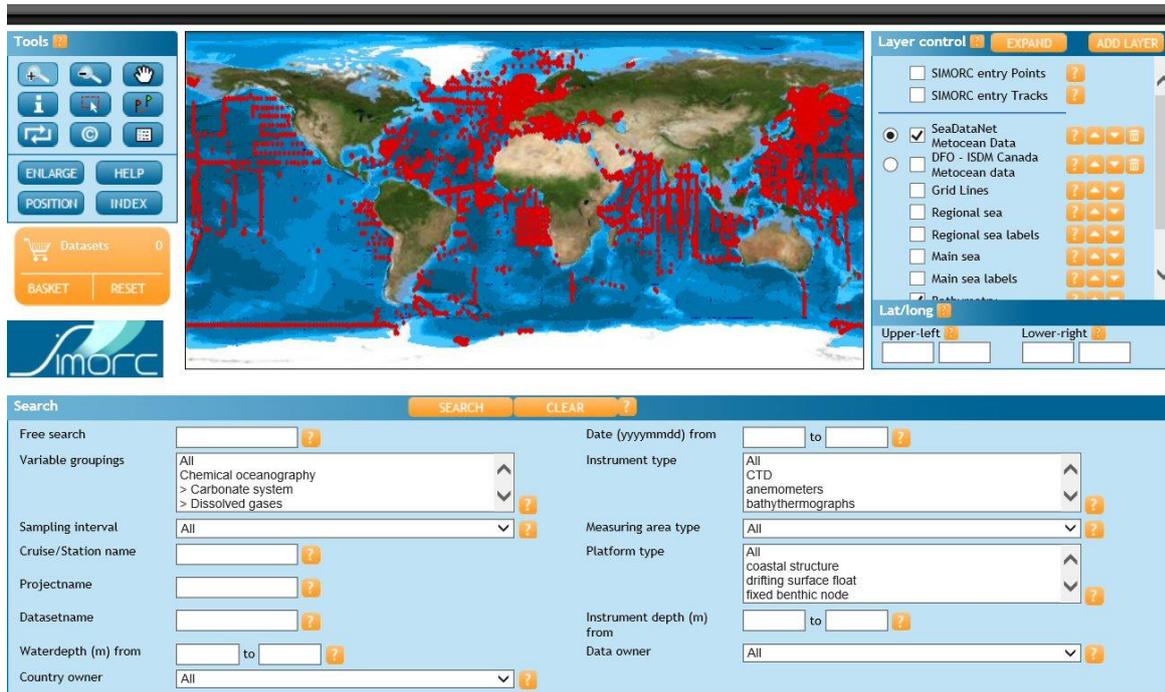


Figure: SeaDataNet Physical Oceanography WMS – WFS layer in SIMORC portal

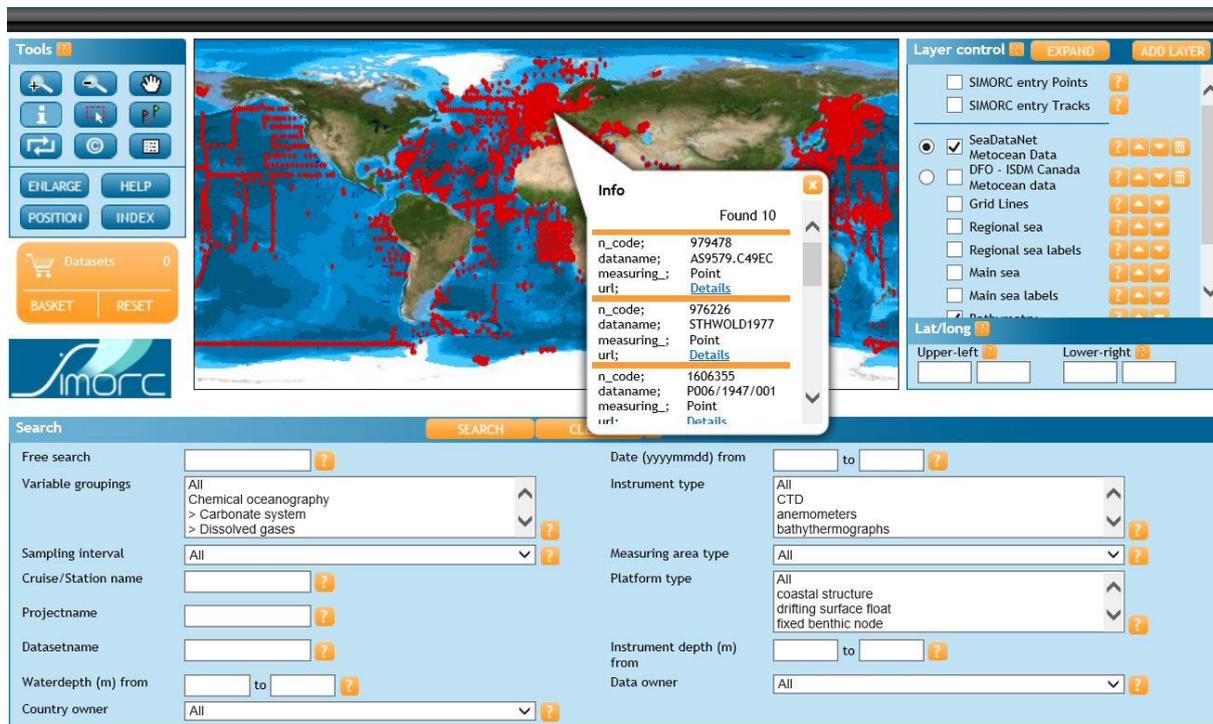


Figure: Interrogating the map by WFS gives metadata of SeaDataNet sites including URL to further details

Clicking on the URL will give a link to SeaDataNet for the selected site and data set.

The selected data set is described below with metadata. Access to the data set itself can be requested via the SeaDataNet portal that gives an overview and access to marine and ocean sets acquired and managed by European organisations. Go to: <http://www.seadatanet.org>

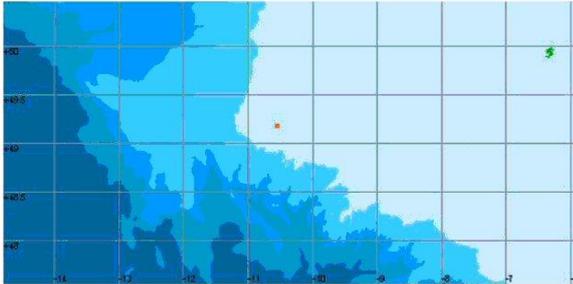
Details

WHAT?

Date_created	1/3/2010
Data set name	112161c.150
Discipline	Physical oceanography
Category	Currents
Variables measured	Water column temperature and salinity Horizontal velocity of the water column (currents) Temperature of the water column
Abstract	A single series of Currents -subsurface Eulerian data collected between 14 June 1995 14:30 and 03 September 1995 07:30.
Data format	Ocean Data View ASCII input Version 0.4
Data size	260
Data set creation date	20101118

WHERE?

Map



Latitude 1	49.1507
Longitude 1	-10.5135
Measuring area type	point
Water depth (m)	142
Depth reference	sea level
Minimum instrument depth (m)	30

Figure: SeaDataNet CDI details

For the exchange from SeaDataNet towards EurOBIS and ENA the full scope of SeaDataNet sites and observations will be included, using the SeaDataNet WMS as described:

http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/seadatanet

For the exchange from SeaDataNet towards MB3-IS also a dedicated subset will be activated, which will focus on the oceanographic sites that have been selected in Deliverable D3.4 for delivering oceanographic data sets to MB3-IS. This dedicated WMS-WFS service will be activated later this year (see also Chapter 5) and get a comparable URL:

http://geoservice.maris2.nl/wms/seadatanet/cdi_v2/micro-b3

Remarks: the SeaDataNet WMS services will be upgraded later this year from OGC version 1.1.1 to 1.3.0 while the WFS will be upgraded from OGC version 1.0.0. to 1.1.0.

3.0 OpenSearch service from SeaDataNet towards EurOBIS and ENA

OpenSearch is another interesting protocol supported by major portals such as Google, Yahoo, Twitter that will be used to facilitate the horizontal interoperability between the 3 European portals of SeaDataNet, EurOBIS and ENA. OpenSearch provides metadata about the contents along with a set of URL Templates which illustrate the parameters accepted by the service and the variety of output formats in which results can be obtained. The OpenSearch request interface is simple, consisting of a description of a HTTP GET request with a series of optional key-value parameters that can be used to constrain the search:

- Free search
- Geospatial (area or point + radius)
- Temporal (from to)

OpenSearch protocol is rather simple: No use of vocabularies, no special search fields which has a disadvantage when querying a very large collection with specific data like SeaDataNet. It is necessary to split the total metadata in many OpenSearch access points (virtual aggregations).

Format HTTP get:

```
<Url type="text/html"
template="http://example.com/?q={searchTerms?}&pw={startPage?}"/>
```

Example:

<http://www.google.com/?q=question>

<http://www.google.com/?q={searchTerms}>

SeaDataNet already had previous experience with OpenSearch through the EU FP7 Genesi-DEC project where MARIS had set up an application prototype for OpenSearch together with the European Space Agency (ESA) that coordinated Genesi-DEC. An OpenSearch communication layer had been developed on top of a subset of the SeaDataNet CDI database.

For Micro-B3 a SeaDataNet OpenSearch implementation has been developed that considers the full scope of SeaDataNet CDIs. The OpenSearch principle is that so-called OpenSearch entry points are prepared in JSON XML or RDF. Each file describes an access point as an aggregation of the marine data as available in SeaDataNet. To make the entry points not too large in number of CDIs and to provide distinctive attributes to each aggregation of CDIs it has been decided to prepare SeaDataNet entypoints as aggregations of the CDI observation discipline (code from the SeaDataNet P08 vocabulary), CDI data centre (code from the SeaDataNet EDMO directory), and geometric observation type (point / curve / area).

Applying this to the present CDI collection of > 1.5 million CDI entries results in 444 SeaDataNet OpenSearch entry points.

Querying is made possible on spatial and temporal criteria PLUS free search on the following CDI metadata attributes: parameters (from vocabularies P02), station name (free text), alternative station name (free text), cruise name (free text), and alternative cruise name (free text).

Each OpenSearch entry point is an aggregation of multiple CDI entries. Any query will take place on these multiple CDI entries while the results will be given initially as aggregation records, thereby indicating the full range of CDI in the aggregation record as well as the number of CDI entries within the aggregation record that match the query criteria. Then the aggregation record result will also contain a direct link to the SeaDataNet CDI service which allows to browse the details of the selected CDIs and to submit requests for data access.

This process is illustrated by an OpenSearch Demonstration client that has been developed by MARIS based upon the collection of 444 OpenSearch entry points (situation at 21st July 2014). See:

<http://seadatanet.maris2.nl/opensearch/client/search.php>

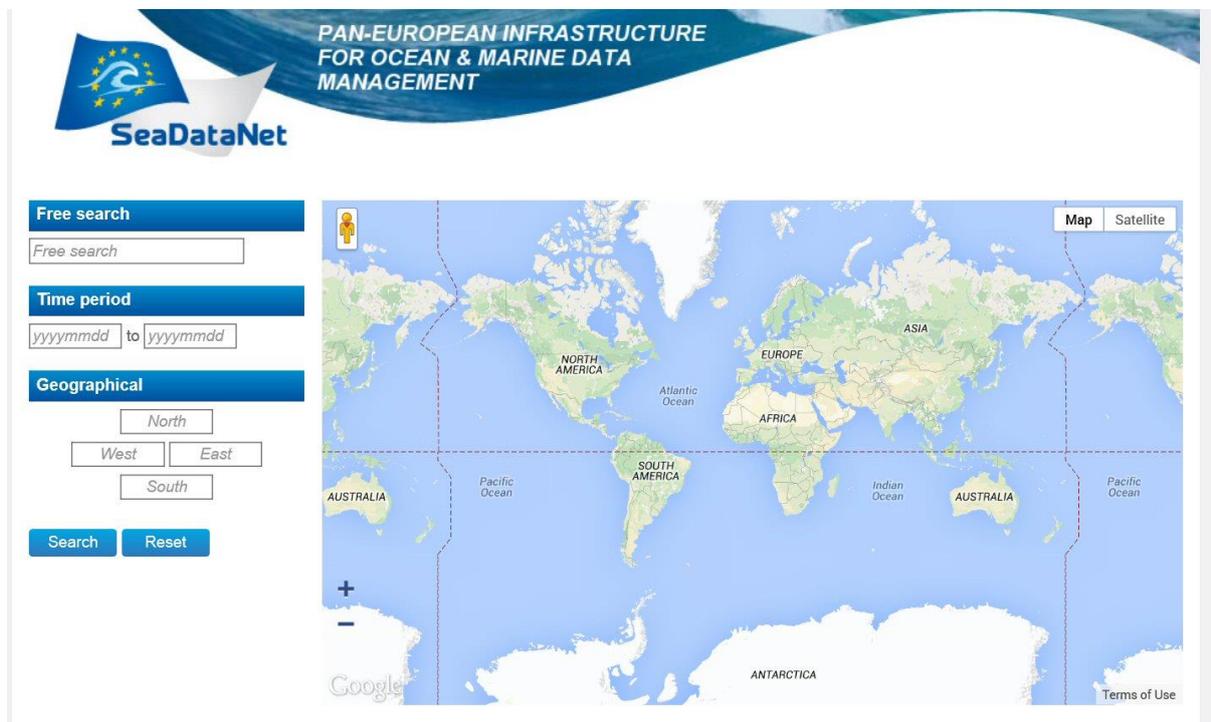


Figure: SeaDataNet OpenSearch DEMO client for SeaDataNet entry points

*Marine Microbial Biodiversity, Bioinformatics and Biotechnology.
 Deliverable No 3-5: Portal, supporting OGC and ISO standards, bundling the selected
 oceanographic services for Micro B3, 21 July 2014*

The screenshot shows the SeaDataNet OpenSearch DEMO client interface. At the top, there is a banner for 'PAN-EUROPEAN INFRASTRUCTURE FOR OCEAN & MARINE DATA MANAGEMENT' with the SeaDataNet logo. Below the banner, there are search filters: 'Free search' with a text input containing 'temperature', 'Time period' with inputs for '1900' and '2000', and 'Geographical' with several input fields (56, 2, -2, 54). A 'Search' button and a 'Reset' button are also present. The main area features a world map with a red overlay indicating search results, and a 'Map' button with a 'Satellite' option. Below the map, it says 'Found 9' and 'Show (1-9)'. A table of search results is displayed below the map.

ID	Author	Contributor	Updated	Content	From	To	Details	Hits	Link
43-DS01-3	British Oceanographic Data Centre (United Kingdom)	University of Plymouth, Institute of Marine Studies (United Kingdom) University of Wales, School of Ocean Sciences (United Kingdom) Plymouth Marine Laboratory (United Kingdom) University of Southampton Department	4/7/2014 11:54:00 AM	Variables categories: Administration and dimensions, Water column temperature and salinity Instruments: discrete water samplers	1988-12-15	1995-07-12	23	20	Link

Figure: SeaDataNet OpenSearch DEMO client: result of search

The screenshot shows the details of a search result for ID 43-DS01-4. The table below provides detailed information for this entry. Below the table, there are five blue arrows pointing upwards to specific columns in the table, with labels explaining their meaning.

43-DS01-4	British Oceanographic Data Centre (United Kingdom)	University of Cambridge Department of Earth Sciences (United Kingdom) University of East Anglia, School of Environmental Sciences (United Kingdom) University of Liverpool, Port Erin Marine Laboratory (United Kingdom) National Oceanography Centre, Southampton (United Kingdom) University of Wales, School of Ocean Sciences (United Kingdom)	3/18/2014 1:02:00 PM	Variables categories: Administration and dimensions, Water column temperature and salinity Instruments: discrete water samplers	1966-01-12	2013-02-13	24368	381	Link
-----------	--	--	----------------------	--	------------	------------	-------	-----	----------------------

↑ ↑

Entrypoint ID Data Centre

↑

Parameters - Instruments

↑ ↑ ↑

No of CDI in Entrypoint No of selected CDIs Link to SDN

Figure: SeaDataNet OpenSearch DEMO client: details and explanation of one result

Clicking on the link will lead to the SeaDataNet CDI Data Discovery & Access service, zooming in to selected CDIs. In this example the 381 CDIs from the entrypoint with 24368 CDIs.

The screenshot displays the SeaDataNet web interface. At the top, there is a banner for 'PAN-EUROPEAN INFRASTRUCTURE FOR OCEAN & MARINE DATA MANAGEMENT' with the SeaDataNet logo. Below the banner is a navigation bar with a shopping cart icon, 'Cart: 0 Dataset(s)', and buttons for 'Proceed to check out', 'Reset Basket', 'Timeseries on', 'Export', 'Store query', 'Summary', and 'Hide map'. A breadcrumb trail shows the search path: 'Reset all steps > British Oceanographic Data Centre > Biological oceanography > point > Free search: temperature > Upper-left: 2 / 56 | Lower-right: -2 / 54 > Date from: 19000101 to: 20001231'. The main content area features a map of Europe with orange dots representing CDI entry points. To the left of the map is a 'Tools' panel with icons for search, zoom, and other map functions. To the right is a 'Layer control' panel with checkboxes for 'CDI entry Points', 'CDI entry Tracks', 'CDI entry Areas', 'Grid Lines', 'Regional sea', 'Regional sea labels', 'Main sea', 'Main sea labels', 'Bathymetry', and 'Blue Marble'. Below the map is a search bar with 'SEARCH BY:' and a table of results. The table has columns for '#', 'Data set name', 'Disciplines - Parameter groups', 'Instrument / gear type', and 'Show'. Two rows are visible, both for data set 'CO11/99/72' and 'CO11/99/17'. The table also shows 'Found 381 | Show (1-20) | Previous | Next 20'.

#	Data set name	Disciplines - Parameter groups	Instrument / gear type	Show
<input type="checkbox"/>	CO11/99/72	Biological oceanography > Pigments Marine geology > Suspended particulate material Physical oceanography > Optical properties > Water column temperature and salinity	CTD, fluorometers, optical backscatter sensors, radiometers, salinity sensor, water temperature sensor	<input type="checkbox"/>
<input type="checkbox"/>	CO11/99/17	Biological oceanography > Pigments	CTD, fluorometers, optical backscatter sensors, radiometers, salinity sensor, water temperature	<input type="checkbox"/>

Figure: SeaDataNet CDI service: display of the 381 related CDI records

The SeaDataNet OpenSearch entry points are maintained dynamically at the central SeaDataNet CDI service and are updated by aggregation for each updating of existing CDI entries and new CDI entries.

The SeaDataNet OpenSearch aggregations in XML – ISO19139 (444 per 21st July 2014) can be found at the following URLs:

<http://seadatanet.maris2.nl/opensearch/seadatanet/42-DS01-4/>

<http://seadatanet.maris2.nl/opensearch/seadatanet/42-DS04-3/>

etc

The tables on the next page show all possible combinations of aggregation by CDI_data_centre (EDMO-code) – Discipline (P08 code) – Measurement_Area_Type (L02 code)

42-DS01-4	120-DS07-4	269-DS08-6	486-DS05-4	1167-DS03-4	630-DS04-3
42-DS04-3	120-DS08-4	269-DS10-4	486-DS06-4	1167-DS04-4	630-DS04-4
42-DS04-4	120-DS08-6	310-DS04-3	486-DS08-4	1167-DS08-4	630-DS07-4
42-DS08-4	120-DS10-4	310-DS04-4	486-DS02-4	1168-DS02-4	630-DS08-3
43-DS01-3	134-DS01-4	310-DS08-4	486-DS03-4	1168-DS03-4	632-DS03-6
43-DS01-4	134-DS02-4	353-DS01-3	486-DS04-3	1168-DS04-4	632-DS05-6
43-DS01-6	134-DS03-4	353-DS01-4	486-DS04-4	1169-DS01-4	632-DS07-6
43-DS02-3	134-DS04-4	353-DS02-4	486-DS07-4	1169-DS02-4	632-DS08-6
43-DS02-4	134-DS06-4	353-DS03-3	486-DS10-4	540-DS04-6	633-DS01-4
43-DS03-3	134-DS07-4	353-DS03-4	540-DS03-4	540-DS07-4	633-DS02-4
43-DS03-4	136-DS03-4	353-DS04-4	841-DS02-4	540-DS08-6	633-DS03-4
43-DS03-6	136-DS07-4	353-DS04-6	841-DS03-4	545-DS01-3	633-DS04-4
43-DS04-3	144-DS01-4	353-DS05-4	841-DS05-4	545-DS01-4	635-DS04-4
43-DS04-4	144-DS02-4	353-DS06-4	850-DS04-3	545-DS02-4	635-DS08-4
43-DS04-6	144-DS04-4	353-DS07-4	850-DS08-3	545-DS03-3	681-DS02-4
43-DS05-3	144-DS07-4	353-DS08-4	924-DS02-4	545-DS03-4	681-DS03-4
43-DS05-4	144-DS08-4	353-DS08-6	924-DS03-4	545-DS04-4	681-DS07-4
43-DS05-6	144-DS10-4	353-DS10-4	924-DS07-4	545-DS05-4	681-DS10-4
43-DS07-3	145-DS04-3	353-DS11-4	961-DS01-4	545-DS07-4	685-DS02-4
43-DS08-3	145-DS04-6	366-DS01-6	961-DS02-4	545-DS08-4	685-DS03-4
43-DS08-4	145-DS08-3	366-DS03-6	961-DS03-4	545-DS10-4	685-DS07-4
43-DS08-6	145-DS08-6	366-DS04-6	961-DS03-6	545-DS11-4	685-DS10-4
43-DS10-4	191-DS01-4	366-DS05-6	486-DS08-3	565-DS04-3	688-DS02-4
96-DS01-4	191-DS02-4	366-DS07-6	961-DS04-4	583-DS03-4	688-DS03-4
96-DS02-4	191-DS03-4	366-DS08-6	961-DS05-4	590-DS01-4	688-DS07-4
96-DS03-4	191-DS11-4	366-DS11-6	961-DS05-6	590-DS02-4	691-DS02-4
96-DS04-4	193-DS02-4	396-DS03-3	961-DS06-4	590-DS03-4	691-DS03-4
96-DS04-6	193-DS03-4	396-DS03-4	961-DS06-6	590-DS04-4	691-DS07-4
96-DS06-4	195-DS03-4	396-DS05-4	961-DS07-4	590-DS04-6	692-DS01-4
96-DS07-4	269-DS01-4	396-DS07-3	963-DS01-4	590-DS07-4	692-DS02-4
96-DS08-4	269-DS02-4	396-DS07-4	963-DS02-4	590-DS08-6	692-DS03-4
96-DS08-6	269-DS03-4	422-DS01-4	963-DS03-4	609-DS02-4	692-DS04-3
96-DS10-4	269-DS04-3	422-DS02-4	963-DS07-4	609-DS04-4	692-DS04-4
120-DS01-4	269-DS04-4	422-DS03-4	1022-DS02-4	609-DS08-4	692-DS08-3
120-DS02-4	269-DS04-6	422-DS04-4	1022-DS04-3	609-DS10-4	692-DS08-4
120-DS03-4	269-DS05-4	422-DS07-4	1022-DS04-4	612-DS01-4	693-DS01-4
120-DS04-4	269-DS06-4	486-DS01-4	1022-DS08-4	612-DS02-4	693-DS02-4
120-DS04-6	269-DS07-4	486-DS01-6	1022-DS10-4	612-DS03-4	693-DS03-4
120-DS05-4	269-DS08-3	486-DS02-6	1167-DS01-4	630-DS01-4	693-DS04-4
120-DS06-4	269-DS08-4	486-DS03-6	1167-DS02-4	630-DS03-4	693-DS05-4

Table: Possible OpenSearch aggregations – part 1 (situation 21st July 2014)

693-DS06-4	729-DS03-4	1229-DS02-4	1578-DS04-3	2228-DS04-4	3234-DS07-4
693-DS08-4	729-DS04-4	1229-DS03-4	1578-DS04-4	2228-DS08-4	3288-DS04-3
693-DS10-4	729-DS08-4	1229-DS04-4	1578-DS04-6	2230-DS04-4	3288-DS08-3
696-DS01-4	729-DS10-4	1232-DS02-4	1578-DS08-3	2230-DS08-4	3339-DS04-6
696-DS02-4	730-DS01-4	1232-DS03-4	1578-DS08-4	2231-DS02-4	
696-DS03-4	730-DS02-4	1232-DS07-4	1578-DS08-6	2231-DS03-4	
696-DS04-4	730-DS03-4	1265-DS02-4	1578-DS10-4	2231-DS06-4	
697-DS01-4	730-DS07-4	1265-DS03-4	1609-DS02-4	2231-DS07-4	
697-DS02-4	731-DS03-4	1265-DS04-4	1609-DS04-4	2231-DS10-4	
697-DS03-4	731-DS07-4	1265-DS07-4	1609-DS08-4	2239-DS01-4	
697-DS04-4	732-DS02-4	1265-DS08-4	1609-DS10-4	2239-DS02-4	
697-DS05-4	732-DS03-4	1265-DS10-4	1703-DS04-3	2239-DS04-4	
697-DS08-4	732-DS04-4	1340-DS01-6	1725-DS02-4	2239-DS08-4	
697-DS10-4	732-DS05-4	1340-DS03-6	1725-DS03-4	2239-DS10-4	
697-DS11-6	733-DS01-4	1340-DS05-6	1725-DS06-4	2276-DS04-3	
698-DS02-4	733-DS02-4	1340-DS07-6	1725-DS07-4	2276-DS04-6	
698-DS03-4	733-DS03-4	1340-DS11-6	1848-DS04-3	2276-DS08-3	
700-DS01-4	733-DS04-4	1415-DS04-3	1848-DS04-4	2276-DS08-6	
700-DS02-4	733-DS08-4	1415-DS04-4	1848-DS08-4	2432-DS02-4	
700-DS03-4	761-DS03-6	1415-DS08-4	2108-DS03-4	2432-DS03-4	
700-DS07-4	761-DS05-6	1461-DS04-6	2124-DS02-4	2432-DS07-4	
708-DS01-4	761-DS06-6	1461-DS08-6	2124-DS04-3	2489-DS03-3	
708-DS02-4	761-DS09-6	1496-DS04-3	2124-DS04-4	2489-DS04-3	
708-DS03-4	761-DS10-6	1496-DS07-3	2124-DS07-4	2489-DS08-3	
708-DS05-4	801-DS01-4	1526-DS01-4	2124-DS08-3	2543-DS04-6	
711-DS01-4	801-DS02-4	1526-DS02-4	2124-DS08-4	2543-DS08-6	
711-DS02-4	801-DS03-4	1526-DS03-4	2124-DS10-4	2607-DS04-6	
711-DS03-4	801-DS07-4	1526-DS04-4	2157-DS03-3	2607-DS08-6	
711-DS06-4	802-DS02-4	1526-DS08-4	2157-DS03-6	3009-DS01-4	
713-DS01-4	802-DS03-4	1526-DS10-4	2157-DS04-3	3009-DS02-4	
713-DS02-4	840-DS01-4	1543-DS04-4	2157-DS04-6	3009-DS03-4	
713-DS03-4	840-DS02-4	1543-DS08-4	2157-DS08-3	3009-DS07-4	
713-DS10-4	840-DS03-4	1545-DS02-4	2157-DS08-6	3092-DS04-3	
727-DS02-4	1169-DS03-4	1545-DS04-4	2172-DS04-3	3092-DS04-4	
727-DS03-4	1169-DS04-4	1545-DS08-4	2176-DS01-4	3092-DS07-4	
727-DS04-4	1169-DS05-4	1545-DS10-4	2176-DS02-4	3092-DS08-4	
727-DS08-4	1169-DS06-4	1546-DS01-4	2176-DS03-4	3234-DS01-4	
727-DS10-4	1169-DS08-4	1578-DS01-4	2227-DS01-4	3234-DS02-4	
729-DS01-4	1228-DS03-4	1578-DS02-4	2227-DS02-4	3234-DS03-4	
729-DS02-4	1229-DS01-4	1578-DS03-4	2227-DS03-4	3234-DS04-4	

Table: Possible OpenSearch aggregations – part 2 (situation 21st July 2014)

The actual OpenSearch service can be approached by:

http://seadatanet.maris2.nl/opensearch/os_description

This gives the GetCapabilities of the SeaDataNet OpenSearch service. The returned XML looks like:

*Marine Microbial Biodiversity, Bioinformatics and Biotechnology.
Deliverable No 3-5: Portal, supporting OGC and ISO standards, bundling the selected
oceanographic services for Micro B3, 21 July 2014*

```
-<OpenSearchDescription>
  <ShortName>MARIS SeaDataNet opensearch server</ShortName>
  -<LongName>
    MARIS SeaDataNet opensearch server, allowing access to data
  </LongName>
  <Tags>Marine data, SeaDataNet</Tags>
  <Contact>maris@xs4all.nl</Contact>
  <Image width="16" height="16" type="image/x-icon" uri="http://seadatanet.maris2.nl/favicon_opensearch.ico"/>
  <Image width="64" height="64" type="image/png" uri="http://seadatanet.maris2.nl/opensearch/grfx/opensearch.png"/>
  <Query role="example" geo:box="-25,30,45,70"/>
  <Url type="application/xml" indexOffset="0" pageOffset="0" template="http://seadatanet.maris2.nl/opensearch/seadatanet/os_result?count={count?}&pw={startPage?}&q={searchTerms?}&bbox={geo:box?}&dtstart={time:start?}&dtend={time:end?}"/>
  <Url type="application/atom+xml" indexOffset="0" pageOffset="0" template="http://seadatanet.maris2.nl/opensearch/seadatanet/os_result?count={count?}&pw={startPage?}&q={searchTerms?}&bbox={geo:box?}&dtstart={time:start?}&dtend={time:end?}"/>
</OpenSearchDescription>
```

Figure: SeaDataNet OpenSearch GetCapabilities in XML

The OS_description indicates that the SeaDataNet service can be queried by lat-lon box, start – end dates, and free text and that the results can be returned as a count of the number of aggregate records by using the function:

http://seadatanet.maris2.nl/opensearch/seadatanet/os_result

An example of a query URL:

http://seadatanet.maris2.nl/opensearch/seadatanet/os_result?q=salinity

This concerns a free search on salinity. The answer will be given as ATOM and indicates which aggregate records are selected including the number of CDI records within the aggregation and the number of hits of CDIs that fulfill the search criteria and a dedicated URL to the SeaDataNet CDI service to display the hits.

This information is sufficient for a programmer to develop a comparable client as the MARIS OpenSearch DEMO client on a remote server.

4.0 Machine-to-machine interfacing between SeaDataNet and Micro-B3 Information System (MB3-IS)

The Micro B3 bioinformatics analysis system is developed in WP5. This MB3-IS consists of a software platform to support analysis in three steps:

- Processing for automatic annotation of genomes and metagenomes
- Integrating the outcome of the processing results with marine environmental data such as from SeaDataNet and its underlying databases. Time and space will be the main trigger to combine the microbial data from the laboratory/analyses with the environmental data from the datacenters, but additional keys may be needed
- Visualising the results.

For interoperability of MB3-IS with other data systems 2 main components are of importance:

- The security module: as authentication OpenID has been chosen (Shibboleth is investigated). There will be no additional user management; therefore the solution is quite simple. Consequently from a user only the OpenID url is known, plus maybe the email address. SeaDataNet is making progress with investigating the use of OpenID on top of its existing CAS login. However anyway in addition an OpenID user will have to agree the first time with the SeaDataNet user license and must have a registered email address to facilitate communication with the SeaDataNet RSM service that keeps track of the processing of data requests for the user.
- MicroB3 catalogue/database: this part of MB3-IS is foreseen to be mainly a catalogue of data services and protocols which are made available using a client to harvest data. MB3-IS will not locally buffer all data. Only in some cases, e.g. for analyses software to run on selected data, the data will be temporarily cached on the MB3-IS server for that specific user.

The discovery and delivery of data sets from SeaDataNet to MB3-IS can be set-up by combining 2 services:

1. Using the OGC WMS - WFS protocols to exchange CDI metadata from SeaDataNet to MB3-IS. This is explained in the Chapter 2.0. For MB3-IS the WMS-WFS service will zoom in to the subset of metadata for the selected oceanographic sites following the definition in Deliverable D3.4.
2. Developing a machine-to-machine interoperability from MB3-IS to SeaDataNet to provide a more efficient data discovery and delivery service to MB3-IS users

The developments for the machine-to-machine interoperability have focused on extending the SeaDataNet infrastructure with modules for configuring and managing dynamic and internal central buffers of data sets at SeaDataNet fitting the Micro B3 purpose, and setting

up central SeaDataNet services for giving access to the metadata and data sets in the buffers for providing MB3-IS selected data sets.

The existing CDI infrastructure system provides a strong foundation because it connects already more than 100 data centres and gives access to a large volume of data sets as managed by these data centres. Large efforts have been undertaken to get to this point and daily efforts are spent to monitor and keep the system fully operational. Therefore for achieving interoperability it is fundamental not to alter the existing CDI system architecture but to develop and adding extra services on top of this foundation. Then the operational system can continue without interruption and a lot of the efforts can be focused on the central CDI system without having to activate all connected data centres.

The SeaDataNet CDI system is used for giving overview and access by means of a shopping mechanism to the distributed data sets that are managed by connected data centres. To deal with the requirements for Micro-B3 as well as for a number of other user communities a robot harvesting system has been developed by MARIS for automatic and more efficient discovery and harvesting of metadata and data sets that might be transferred or made accessible for applications of specific user communities. Therefore a new online SeaDataNet Buffer Content Management System (CMS) has been developed which allows to configure specific group profiles (specify group, involved users, motivation, query criteria).

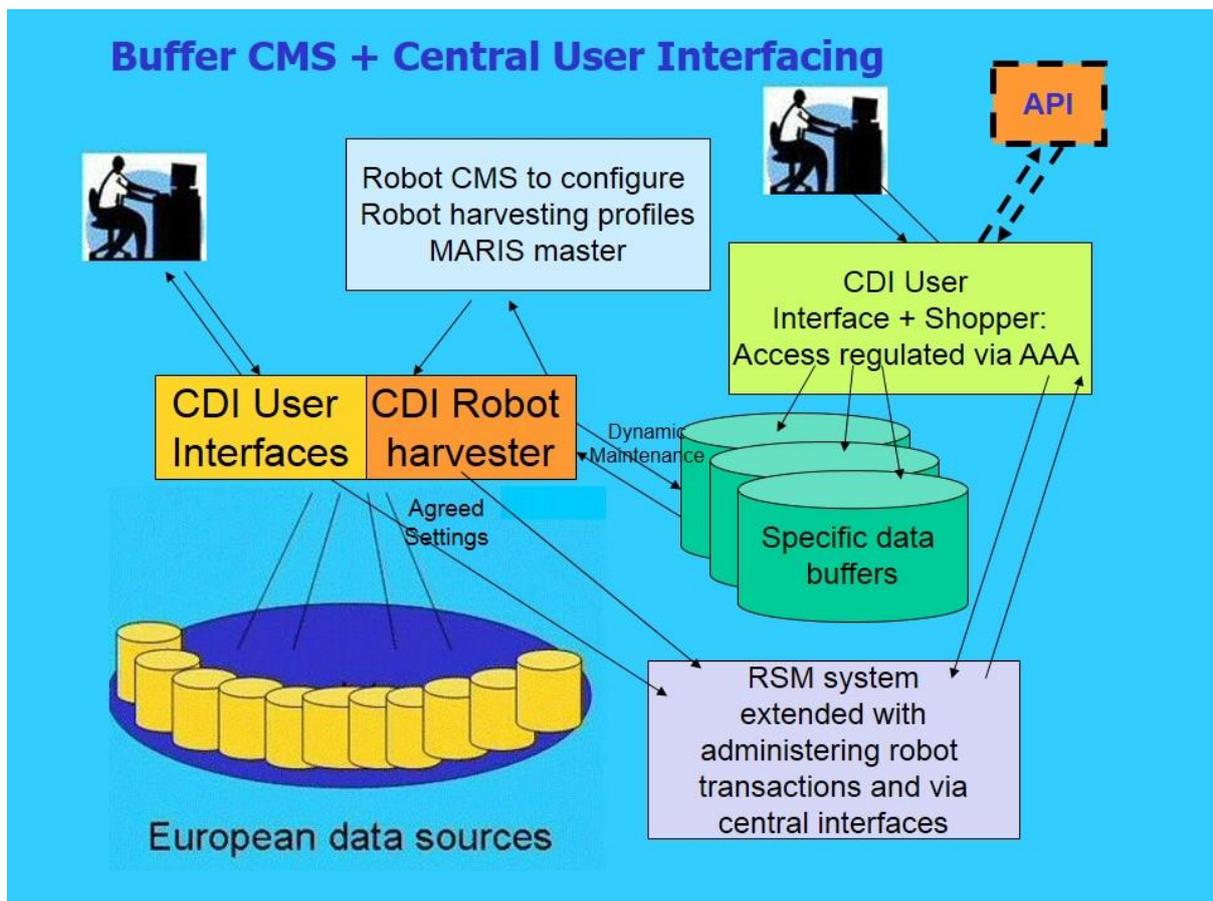


Figure: expansion of the CDI service with buffer CMS, robot harvesting and central access

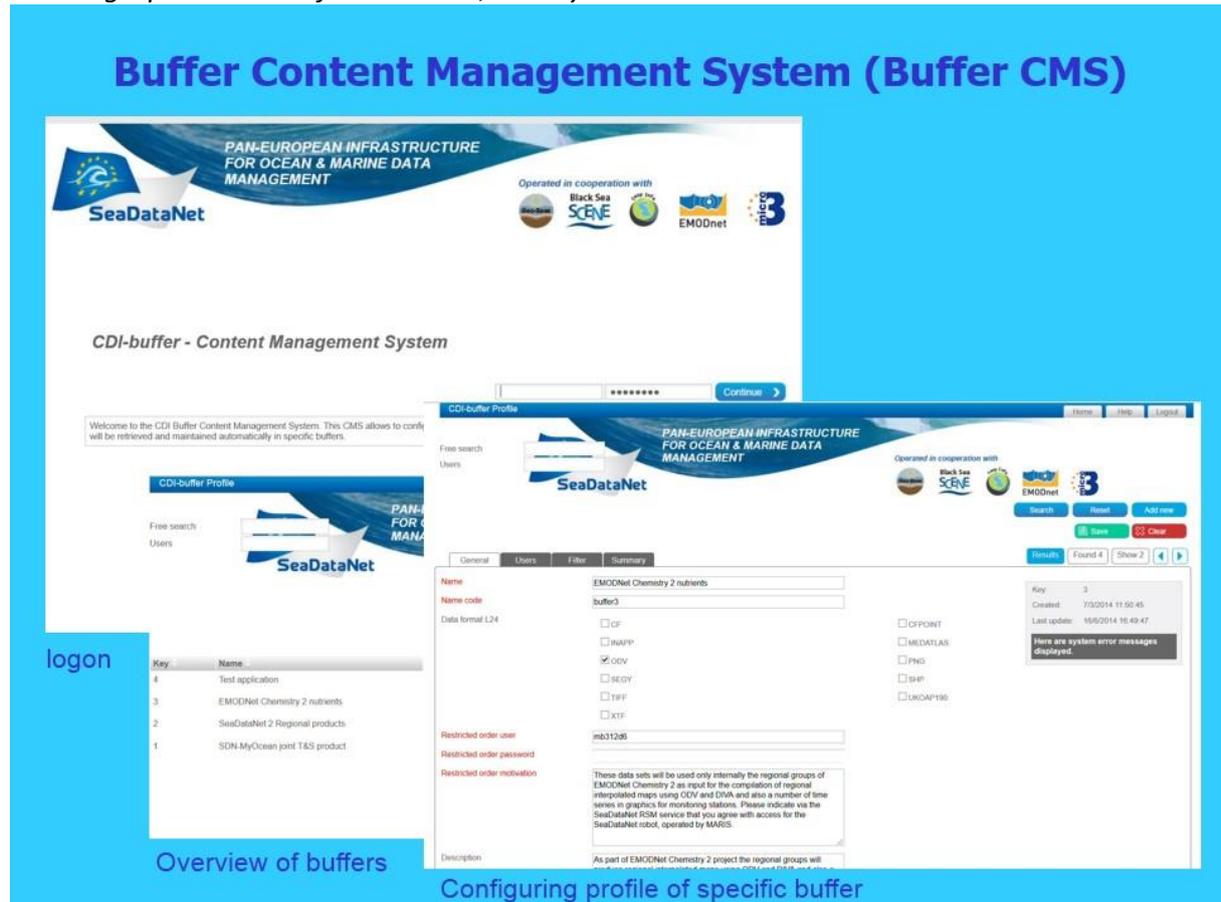


Figure: details of Buffer CMS to configure user community profiles for data harvesting

The community profile for Micro-B3 will be configured in the Buffer CMS on the basis of the selection of oceanographic locations as defined for Micro-B3 in Deliverable D3.4.

The Buffer CMS works together with the upgraded Request Status Manager (RSM) service, an existing component of the CDI shopping mechanism, to perform and administer robot shopping transactions and to store the harvested data sets in central buffers. This also includes maintenance, whereby new and updated CDI entries are identified and used to trigger additional harvesting for the central data buffers.

Furthermore the central buffers have been equipped with a Central buffer CDI User Interface including shopping mechanism, to facilitate the extraction and delivery of metadata and data sets from the central buffer databases in a regulated way. All central shopping transactions on the central buffers are administered in a new section of the RSM so that data providers can fully oversee all transactions. Remark: this buffering system is exclusive for specific applications such as MB3-IS and access is secured via the SeaDataNet AAA service only for authorised users as defined in the buffer CMS. It does not replace the distributed CDI infrastructure and its shopping process for regular users. The Buffer CMS to configure user community profiles is operated by MARIS.

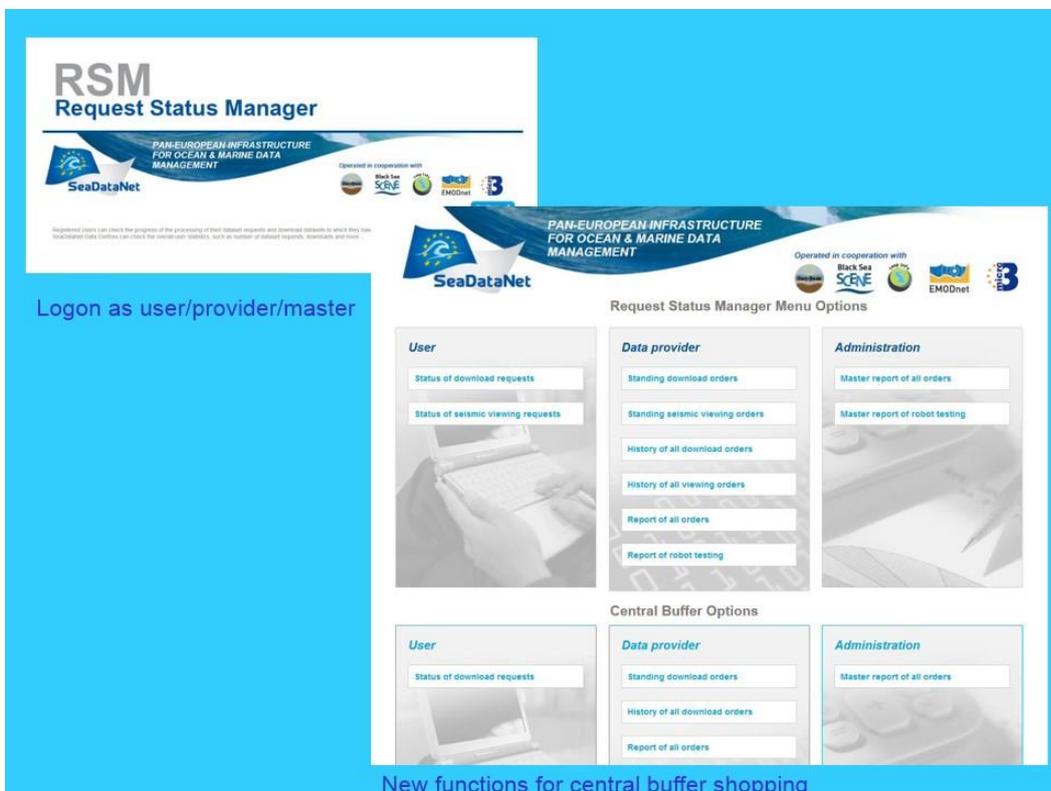
Marine Microbial Biodiversity, Bioinformatics and Biotechnology.
 Deliverable No 3-5: Portal, supporting OGC and ISO standards, bundling the selected
 oceanographic services for Micro B3, 21 July 2014



Overview of authorized buffers

Central buffer UI incl direct shopping

Figure: logon to the Central User Interface for discovery and access to authorised central buffers



New functions for central buffer shopping

Figure: logon to the Request Status Manager (RSM) with extra Central Buffer options

The central shopping mechanism has been configured to divide shopping requests to the selected Central Buffer and deliver related packages of CDI metadata and data sets of max 10,000 files each, so that a receiving user can easily handle each package. In case of the human interface the downloading of the metadata-data packages takes place via the RSM service (via User option in dashboard screen as displayed above).

In the past months next to developments also a lot of testing has taken place to assure that the robot harvesting and dynamic maintenance of the central buffers are performing in a precise way and respecting possible data access restrictions. Not all data sets in SeaDataNet are accessible under the SeaDataNet license, but might require negotiations. In those cases the robot harvester has to await and respect the decisions of the related data providers, who can oversee the robot requests as well as can indicate their decisions in the RSM service.

Next to the human operated Central Buffer User Interface also developments are well underway for an **Application Programming Interface (API)**. This API will work next to the Central Buffer User Interface and will facilitate remote and authorised machines such as MB3-IS to logon, using the SeaDataNet AAA service, and then to perform 3 functions:

- **Create_order:** enabling to configure a discovery profile for shopping in an authorised central buffer database;
- **Get_order_info:** enabling to retrieve info from the RSM about the progress of the order processing;
- **Download_order:** enabling to download the orders, when ready, as zip files with metadata and data sets.

In the following the XML is specified that must be given by the client to the API for each of these functions as well as how the client must logon:

Create order:

The XML that must be specified as a minimum:

```
<buffer_api_request>
  <user_id>the_id</user_id>
  the user id from the CAS server
  <st_ticket>st-DSLJSLFJSLFJS</st_ticket>
  the ST-ticket from the CAS-server
  <buffer_application>buffer3</buffer_application>
  the code_name of the selected and authorised central buffer
  <data_format_l24>ODV</data_format_l24>
```

the data_format from the library L24

</buffer_api_request>

This request will retrieve all CDI records from the selected central buffer. The XML that can specified as a maximum is:

```
<buffer_api_request>
  <user_id>the_id</user_id>
  the user id from the CAS server
  <st_ticket>st-DSLJSLFJSLFJS</st_ticket>
  the ST-ticket from the CAS-server
  <buffer_application>buffer3</buffer_application>
  the code_name of the selected and authorised central buffer
  <data_format_l24>ODV</data_format_l24>
  the data_format from the library L24
  <author_edmo>630</author_edmo>
  search criterium for CDI-data centre using EDMO
  <originator_edmo>41</originator_edmo>
  search criterium for Originator using EDMO
  <measuring_area_type_L02>4</measuring_area_type_L02>
  search criterium for area_type using library L02
  <start_date>20000101</start_date>
  search criterium for start date using ISO
  <end_date>20140101</end_date>
  search criterium for end date using ISO
  <bbox>
    <north>60</north>
    <east>10</east>
    <south>40</south>
    <west>-10</west>
  </bbox>
  search criterium for lat-lon box
  <matrix_date>20140601</matrix_date>
```

search criterium for retrieving all records that have been updated or newly added since this date in ISO

```
<parameters_p02>AATX</parameters_p02>
```

search criterium for discovery parameters using library P02; multiple tags possible

```
<parameters_p03>C005</parameters_p03>
```

search criterium for parameter groups using library P03; multiple tags possible

```
<parameters_p08>DS01</parameters_p08>
```

search criterium for disciplines using library P08; multiple tags possible

```
<sea_area_c19>SVX00002</sea_area_c19>
```

search criterium for sea regions using library C19; multiple tags possible

```
</buffer_api_request>
```

The request will be processed by the robot harvester in the central RSM as one shopping order with a number of sub-orders with each max. 10.000 CDI records

Possible output:

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<buffer_api_response>
```

```
  <order_number>8521</order_number>
```

main order nummer from central RSM

```
  <count>121321</count>
```

Number of ordered CDI records

```
</buffer_api_response>
```

OR

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<buffer_api_response>
```

```
  <error value="4">No record selected in this order</error>
```

```
</buffer_api_response>
```

OR

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<buffer_api_response>
```

```
  <error value="104">ST_ticket not valid</error>
```

```
</buffer_api_response>
```

More error messages are possible.

Get order info:

```
<buffer_api_request>
```

```
  <user_id>the_id</user_id>
```

the user id from the CAS server

```
  <st_ticket>st-DSLJSLFJSLFJS</st_ticket>
```

the ST-ticket from the CAS-server

```
</buffer_api_request>
```

Possible output:

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<buffer_api_response>
```

```
  <order_ready date="6/2/2014 12:23:03 PM" sub_order="5"
    main_order="52">ds1ee60_12_1.zip</order_ready>
```

```
  <order_ready date="6/2/2014 12:23:03 PM" sub_order="1"
    main_order="57">ds1ee60_12_2.zip</order_ready>
```

```
  <order_ready date="6/2/2014 12:23:03 PM" sub_order="2"
    main_order="57">ds1ee60_12_3.zip</order_ready>
```

```
</buffer_api_response>
```

OR

```
<?xml version="1.0" encoding="utf-8"?>
```

```
<buffer_api_response>
```

```
  <error value="8">No orders found</error>
```

```
</buffer_api_response>
```

Download order:

```
<buffer_api_request>
  <user_id>the_id</user_id>
  <st_ticket>st-DSLJSLFJSLFJS</st_ticket>
  <main_order>52</main_order>
  <sub_order>5</sub_order>
</buffer_api_request>
```

Possible output:

The requested zip file as download

OR

```
<?xml version="1.0" encoding="utf-8"?>
<buffer_api_response>
  <error value="9">No main_order number found</error>
</buffer_api_response>
```

OR

```
<?xml version="1.0" encoding="utf-8"?>
<buffer_api_response>
  <error value="10">No sub_order number found</error>
</buffer_api_response>
```

OR

```
<?xml version="1.0" encoding="utf-8"?>
<buffer_api_response>
  <error value="11">No zip file found </error>
</buffer_api_response>
```

CAS security for API:

The connection to the API is secured by the SeaDataNet CAS system, so that only authorised remote machines will be able to use the API and then only for the buffer databases to which they are authorised as configured in the Buffer CMS. The CAS security works as follows:

- First call to CAS-server in GET-method

https://auth.seadatanet.org/login?service=http://seadatanet.maris2.nl/return_ticket.php

Normally this calls a logon screen. However in case of the API we deal with machines and the communication is focused on getting a session ticket-number by means of string manipulation. Example of such a session ticket number:

66D6D7E6EEDA8A23C036EB0E8940348BB777434FC19189F9C8E214B9EEC8EB1C573DD6197
18C7C19D944536959BD3A1A

Also this will give a cookie, which must be forwarded each time:

JSESSIONID=3BBBA6C4D0F60852EBC1C0817FA649DF

- Second call to CAS-server in POST-method

https://auth.seadatanet.org/login?service=http://seadatanet.maris2.nl/return_ticket.php

In POST-method the following parameters must be given:

'username=[username]&password=[password]<=[session ticket number
&_eventId=submit&submit=LOGIN'

Application content must be "application/x-www-form-urlencoded"

Retrieving of the URL will return a page from the CAS-server with an automatic reference to the self given page, so in this case:

http://seadatanet.maris2.nl/return_ticket.php

This php page will only give an ST number, which is very important for the API. Such an ST number is only valid for 20 seconds and it can only be used once. So an API client must request for a new ST number for each call of the API. This implicates that an API client must take care to call the CAS server as last in his programme and then to continue towards the Central Buffer API. This API will check with the ST number whether the client is really the expected client. The API can get 2 types of answers on the following URL:

https://auth.seadatanet.org/validate?ticket=ST-9097-6EVzedZDE56nNYYI1Jdh-auth.ifremer.fr&service=http://seadatanet.maris2.nl/return_ticket.php

It can be 'no' (ticket is not correct, invalid, too late, ...). In case it is valid, then it will be 'yes' and the ID of the user will be given. Once received, the Central Buffer API can check that the client is the expected client.

5.0 Next steps

Further activity is planned till end 2014 between WP3 and WP4 for arranging operational 2-way functioning of the interoperability services between SeaDataNet, EurOBIS and ENA which will be done using the WMS-WFS services and OpenSearch.

Also there will be close cooperation between WP3 and WP5 for WP5 to integrate the dedicated WMS-WFS services for the metadata related to the selected oceanographic sites as defined in Deliverable D3.4. Furthermore, WP3 and WP5 will further arrange the configuration of the SeaDataNet Central Buffer API and the MB3-IS client to achieve machine-to-machine services.

It is also planned that the population of the Micro-B3 central buffer will take place in the coming period till end 2014. This will contain existing oceanographic metadata and data from SeaDataNet for the selected oceanographic sites following the definition in D3.4 and also new metadata and data sets for the Tara Oceans and OSD that are being managed and curated by PANGAEA and that will be indexed by PANGAEA for SeaDataNet. The harvesting process for the selected oceanographic sites will result in Deliverable D3.6 and will be undertaken in joint cooperation between MARIS and IFREMER, whereby MARIS will configure the Buffer CMS and manage the automatic harvesting, while IFREMER will contact identified SeaDataNet data centres to inform them of the Micro-B3 use and to ask for permission, where needed. Possibly for use of restricted data a written Service Level Agreement between Micro B3 and the specific SeaDataNet data providers might be required agreeing to give wider access to specific data sets for Micro B3 purposes.

Finally, as part of SeaDataNet work is ongoing for upgrading the CAS service to new software, called Marine ID, which will also make it easier to support intreroperability with OpenID. Progress will be monitored by MARIS and applied for Micro B3 when possible.

Annex A: Terminology

Term	Definition
API	Application Programming Interface
CDI	Common Data Index metadata schema as developed and operated by SeaDataNet to describe observation data sets
CMS	Content Management System
ENA	European Nucleotide Archive (ENA) operated by EMBL-EBI-EMBRC for molecular sequence data
EurOBIS	European Node of the international Ocean Biogeographic Information System (OBIS) as operated by VLIZ
ISO	International Organisation for Standardisation
MB3-IS	Micro B3 Information System
ODV	Ocean Data View ASCII format as used by SeaDataNet for data deliveries; can be imported into the Ocean Data View (ODV) data-analysis and visualisation software tool together with the CDI metadata
OGC	Open Geospatial Consortium: an international industry consortium to develop community adopted standards to “geo-enable” the Web
OpenSearch	A collection of technologies that allow publishing of search results in a format suitable for syndication and aggregation
OSD	Ocean Sampling Day
RSM	Request Status Manager, module in CDI service for administering shopping requests
SDN	SeaDataNet: EU-funded pan-European e-

	infrastructure for the management and delivery of marine and oceanographic data
WFS	Web Feature Service – OGC standard
WMS	Web Map Service – OGC standard