

# SeaDataNet: a pan-European infrastructure for marine and ocean data management

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Conference : SciDataCon 2016, 11-13 September 2016, Denver, USA

Session: [Enhancing data infrastructure services to sustain Earth Sciences researchers' needs for a robust science](#)

## Summary

The SeaDataNet infrastructure has been developed by National Oceanographic Data Centres (NODCs) and major research institutes from 34 countries. SeaDataNet works closely together with other European research and development projects and initiatives, such as the European Marine Observation and Data Network (EMODnet), providing standards, services, data centres and infrastructure for managing marine and oceanographic data, and of providing experience and expertise for joint development of new standards and services. Technical innovations in standards and services enrich the basis of SeaDataNet and are implemented in its infrastructure, where possible.

The SeaDataNet infrastructure provides harmonised discovery services and access to ocean and marine environmental data sets managed in over 100 distributed data centres, as well as a range of metadata services, tools and standards that have been widely adopted across the EU, and also more internationally: in the USA and in Australia through the cooperation with the EU funded Ocean Data Interoperability Platform (ODIP) and ODIP II projects.

The presentation will highlight the present status and achievements of the SeaDataNet infrastructure and look forward to innovations and further developments that are proposed for the coming years in the frame of the H2020 SeaDataCloud project proposal which aims at considerably advancing SeaDataNet services and increasing their usage, adopting cloud and HPC technology for better performance in cooperation with EUDAT, the network computing infrastructure developing and operating a common framework for managing scientific data across Europe.

## Introduction

The first steps for developing a pan-European infrastructure for marine and ocean data management were undertaken with support of the European Commission in the EU Sea-Search project (2002 – 2005), which was succeeded in 2006 with the 5 year SeaDataNet project and which continued in 2011 for another 4 years with the SeaDataNet II project.

Through these projects a consortium of oceanographic data centres in Europe has been actively developing the SeaDataNet pan-European infrastructure for managing, indexing and providing access to ocean and marine data sets and data products, acquired from research cruises and other observational activities in European marine waters and global oceans. The SeaDataNet consortium comprises National Oceanographic Data Centres (NODCs), and marine information services of major research institutes, from 34 coastal states bordering the European seas, and also includes expert modelling centres, IT experts, and international organisations such as the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the International Council for the Exploration of the Sea (ICES) and EU Joint Research Centre (EU-JRC) in its network. Its data centres are highly skilled and have been actively engaged in data management for many decades and have the essential capabilities and facilities for data quality control, long term stewardship, retrieval and distribution.

### **SeaDataNet Standards**

SeaDataNet has developed and maintains a set of common standards for the marine domain, collaborating with European and international experts, adopting and adapting ISO and OGC standards, and achieving INSPIRE compliance, where possible. These standards are published at the SeaDataNet portal (<http://www.seadatanet.org>) and comprise:

- INSPIRE compliant marine metadata profiles of the ISO 19115 – 19139 standard for data sets and research cruises;
- Marine metadata formats for data collections, research projects, monitoring programmes and networks and organisations;
- Controlled vocabularies for the marine domain, with international governance, user interfaces and web services. Use of common vocabularies in all metadatabases and data formats is an important prerequisite towards consistency and semantic interoperability. It follows the W3C SKOS specification for encoding data dictionaries and taxonomies served;
- Standard data exchange formats (e.g. ASCII and NetCDF) are applied for download services. These interact with other SeaDataNet standards such as the Vocabularies and Quality Flag Scale and are compliant for SeaDataNet analysis and presentation tools such as Ocean Data View (ODV) and Data-Interpolating Variational Analysis (DIVA) ;
- Standard quality control procedures for various data types, maintained together with IOC-IODE and ICES.

SeaDataNet has focused, with success, on applying these standards for interconnecting the data centres enabling the provision of integrated online access to comprehensive sets of multi-disciplinary, in situ and remote sensing marine data, metadata and products.

### **Software tools and online services**

A set of dedicated software tools and online services has been developed and is maintained by SeaDataNet, freely available from the SeaDataNet portal, to be used by each data centre for sharing metadata and data resources through the SeaDataNet infrastructure. It includes documentation and common software tools for converting local (meta)data and preparing metadata and data in the SeaDataNet formats, for populating the SeaDataNet directory

services, for statistical analysis and grid interpolation (DIVA), and a versatile software package (ODV) for data analysis, quality control and presentation.

The SeaDataNet infrastructure is able to support a wide variety of data types and to serve several sector communities. It comprises a network of interconnected data centres and a central SeaDataNet portal. The portal provides users not only background information about SeaDataNet and the various SeaDataNet standards and tools, but also a unified and transparent overview of the metadata and controlled access to the large collections of data sets, managed by the interconnected data centres.

The SeaDataNet infrastructure comprises the following services:

- Discovery
- Vocabulary services (Common vocabularies and international governance)
- Security
- Delivery
- Viewing, including product viewing
- Monitoring (system usage and performance, registration of data requests)
- Maintenance

The infrastructure has been designed to provide a coherent system of the various services. For implementation, a range of technical components have been defined. These make use of web technologies, and also comprise Java components, to provide multi-platform support and syntactic interoperability. To facilitate sharing of resources and interoperability, SeaDataNet has adopted web services for various communication tasks.

#### SeaDataNet Products

In addition, the SeaDataNet portal gives users discovery and access, including free downloading, to a number of integrated and validated data products, such as temperature and salinity climatology for all European seas. The products are described in the INSPIRE compliant SeaDataNet Sextant Catalogue service. Visualisation of spatial interpolated gridded maps at user selected water depths, including animations and horizontal transects, and associated station maps, including station profiles and time series, is provided by the OceanBrowser service. This viewer supports OGC WMS, WFS and WPS services, while the data products are managed as 4-D NetCDF (CF) files on an OPeNDAP THREDDS Data Server (TDS).

#### Future developments

Standards and services, developed so far, will be updated with new developments in informatics and instrumentation and will fulfil users' requests. SeaDataNet aims its services at a number of leading user communities which provide new challenges for upgrading and expanding the SeaDataNet standards and services. A Scientific Committee will be established, drawing on users from the research community, EMODnet, and operational oceanography, to ensure their needs are met. These are likely to include increased flexibility in access to data (using the cloud environment), greater emphasis on data products and improved linkage between real-time and delayed-mode data flows. The infrastructure is focusing on continuously improving the service quality by increasing data and data type, by adding new instruments

(gliders, etc) and platforms. Furthermore, technical improvements and new developments are foreseen including:

- Sensor Web Enablement (SWE) for operational oceanography (real-time data delivery) and transfer of data from research vessels (including links to other EU funded projects, e.g. JERICO, EUROFLEETS 1 and 2)
- Data product development, access and visualisation (e.g. EMODNet Chemistry, Copernicus Marine Environmental Monitoring Service)
- Further development of Ocean Data View (ODV) visualisation and QC software (also to include marine biological data)
- Machine-to-machine interfacing

These and other innovations and developments are part of the EU Horizon 2020 SeaDataCloud proposal which aims to advance SeaDataNet services and increase their usage, adopting cloud and HPC technology for better performance in cooperation with EUDAT, the network computing infrastructure developing and operating a common framework for managing scientific data across Europe.

## Acknowledgements

The author would like to thank the SeaDataNet partners for their contributions.

## Competing Interests

The authors declare that they have no competing interests.

## References

**Beckers, J-M, Barth, A, Troupin, C, and Alvera Azcarate, A** 2014 Approximate and Efficient Methods to Assess Error Fields in Spatial Gridding with Data Interpolating Variational Analysis (DIVA). *Journal of Atmospheric & Oceanic Technology*, 31(2), 515-530.

**Bruin, T F de, and Schaap, D** 2014 Connecting Hundreds of Oceanographic Data Sources from Countries in and around Europe into a Big Data Network. American Geophysical Union Fall Meeting, San Francisco, United States, 15-19 December.

**Fichaut, M, Schaap D M A, and Maudire G** 2013 SeaDataNet – Second phase achievements and technical highlights. *Bolletino di Geofisica teorica ed applicata*, 54(suppl.), 15-17.

**Leadbetter, A** 2015 Linked Ocean Data. In *The Semantic Web in Earth and Space Science. Current Status and Future Directions*, Chapter: 2, Publisher: IOS Press, Editors: Tom Narock, Peter Fox, pp.11-31

**Leadbetter, A, Arko, R, Chandler, C, Shepherd, A and Lowry, R** 2013 Linked Data: An Oceanographic Perspective. *Journal of Ocean Technology*. 8(3): 7-12.

**Loubrieu T, and Maudire G** 2015 SeaDataNet: Key challenges in reconciling needs and requirements of data providers and data systems versus those of users. EMODnet Partner Jamboree. 21 - 22 October 2015, Oostende, Belgium.

**Lowry, R, Leadbetter, A, and Vinci, M** 2013 Semantically-enhanced Aggregation of SeaDataNet Data. *Boll. Geof. Teor. Appl.*, 54 (supplement), 49-51.

**Lykiardopoulos, A, Balopoulou, S, Vavilis, P, Pantazi, M and Iona, A** 2014 SeaDataNet network monitoring: Definition and Implementation of service availability index. *Geophysical Research Abstracts*, Vol. 16, EGU2014-12469, 2014, EGU General Assembly 2014.

**Schlitzer, R** 2016 Ocean Data View – Software and Data Collections, <https://odv.awi.de>.