Uniting marine data management expertise

Experts leading **SeaDataNet** and **Geo-Seas** discuss their adoption and reveal how, by building international relationships, the projects are changing the face of Europe's marine and oceanographic domain


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Can you offer an insight into the background of SeaDataNet?

Michèle Fichaut: SeaDataNet is the leading network actively operating and further developing a Pan-European infrastructure for managing, indexing and providing access to ocean and marine datasets and data products, acquired from research cruises and other observational activities in European marine waters and global oceans. It connects the National Oceanographic Data Centres (NODCs) and marine information services of major research institutes from 35 coastal states bordering the European seas, and includes IOC-IODE, ICES and EU-JRC in its network. The SeaDataNet data centres are highly skilled and have been actively engaged in marine data management for many decades. Consequently, they have the essential capabilities and facilities for data quality control, long-term stewardship, retrieval and distribution of marine and ocean data. They are departments of the key marine research institutes and marine management organisations in Europe. Moreover, they maintain national networks involving other organisations managing marine and ocean data. Together they are very active from the shore to the deep ocean, in marine research and environmental monitoring, including research activities in different themes (eg. climate change, marine hydrology and chemistry, hydrodynamics, geology, marine living resources, biodiversity and habitats).

What services and support are these professional data centres offering users?

MF: SeaDataNet maintains and operates several discovery services with overviews of marine organisations in Europe and their engagement in marine research projects, managing large datasets and data acquisition by research vessels and monitoring programmes for the European seas and global ocean. These include the European Directory of Marine Organisations (EDMO), the European Directory of Marine Environmental Data (EDMED), the European Directory of Marine Environmental Research Projects (EDMERP), the Cruise Summary Reports (CSR) and the European Directory of the Ocean Observing Systems (EDIOS). SeaDataNet provides unified access to distributed datasets via its portal website to the vast resources of marine and ocean datasets, managed by the distributed data centres. The Common Data Index (CDI) is the key discovery and delivery service. It gives users a highly detailed insight into the geographical coverage and other metadata features of data across the different data centres. Users can request access to identified datasets in a harmonised way using a shopping basket. They can follow the processing of requests via an online transaction register and can download datasets in the SeaDataNet standard formats. At present the CDI service provides metadata and access to more than 1 million datasets originating from more than 300 organisations in Europe. These cover physical, geological, chemical, biological and geophysical data acquired in European waters and global oceans. SeaDataNet also maintains and operates Common Vocabulary Web services, covering a broad spectrum of ocean and marine disciplines. The common terms are used to mark up data, metadata and data products in a consistent and coherent way. Governance is regulated by an international board. At present the Vocabulary Services comprise more than 120,000 terms in over 100 lists. In addition, SeaDataNet provides documentation and common software tools for metadata and data formatting, Quality Control/Quality Assurance, statistical analysis and a versatile software package for data analysis and presentation. These tools can be downloaded from the SeaDataNet portal without any restriction.

Can you explain how SeaDataNet and EMODnet are connected?

Dick M A Schaap: Implementation of the Marine Strategy Framework Directive (MSFD) will be aided by an overarching European Marine Observation and Data Network (EMODNet). This will be a network of existing and developing European observation systems, linked by a data management structure covering all European coastal waters, shelf seas and surrounding ocean basins. It must facilitate long-term and sustainable access to the high-quality data necessary to understand the biological, chemical and physical behaviour of seas and oceans. EMODNet will underpin and provide data to WISE-Marine, the marine component of the EEA's Shared Environmental

Information System (SEIS). WISE-Marine is intended to fulfil the reporting obligations of the Marine Strategy Framework Directive and to inform the European public on indicators for Good Environmental Status of sea basins. EMODNet is coordinated at EU-level with the other European directives (INSPIRE) and large-scale framework programmes on European and global scales (GMES and GEOSS), that urge access to, and exchange of, environmental data and information. The SeaDataNet infrastructure and standards have been adopted as core elements of the EMODNet data management component. Partnerships from the SeaDataNet consortium successfully bid to develop a number of the EMODNet preparatory actions, for example, the chemical, hydrography and physics lots. These pilots make use of the SeaDataNet standards and basic infrastructure for powering their portals.

What opportunities does EMODnet offer to broaden SeaDataNet's standards and infrastructure?

DS: The EMODnet projects provide an excellent opportunity to engage and reach out to other external institutes that receive training in the application of SeaDataNet practices, thus extending the infrastructure, and in particular the data coverage in both data types and volumes. Moreover, these MSFD-related projects provide an opportunity to discuss and design plans together with policy and decision makers from EU and Member States for the future sustainability of the SeaDataNet infrastructure as a core element in the EMODNet data management infrastructure.

Can you discuss the targets of Upgrade Black Sea SCENE programme?

DS: The Seventh Framework Programme (FP7) Upgrade Black Sea SCENE (UBSS) project was preceded by the FP6 Black Sea SCENE project that established a Black Sea Scientific Network of leading environmental and socioeconomic research institutes, universities and NGOs from the countries around the Black Sea and developed a first phase of a distributed marine data and information infrastructure. The UBSS project builds upon these achievements to strengthen, expand and further populate the Black Sea marine data management infrastructure as a satellite network within the SeaDataNet infrastructure. The NODCs from the six Black Sea countries are members and national nodes in SeaDataNet. In the UBSS project activities are undertaken to establish national NODC networks by training an extra 35 local institutes in marine data management and in populating the common data and metadata services procedures, and by connecting these institutes to the SeaDataNet infrastructure. Furthermore, extra attention is given to adopting standardised methodologies for data quality, checking to ensure the quality, compatibility and coherence of the data issuing from so many sources. The UBSS project is undertaken by 51 partners of whom 43 are located in the Black Sea countries.

How does the Geo-Seas project relate to the work of SeaDataNet?

Helen Glaves: Geo-Seas is a project aiming at giving an overview of, and access to, marine geological and geophysical data and data products. Geo-Seas has adopted and is adapting the SeaDataNet standards and tools by making these fit for marine geological and geophysical purposes. Geo-Seas is implementing an e-INFRASTRUCTURE of over 20 marine geological and geophysical data centres building upon and expanding the SeaDataNet infrastructure. Users are able to identify, locate and access pan-European, harmonised and federated marine geological and geophysical datasets and derived data products held by the data centres through a dedicated Geo-Seas portal as well as through the common SeaDataNet data portal. In the majority of cases, these datasets complement those held by the NODCs participating in SeaDataNet. This will create a joint infrastructure covering both oceanographic and marine geoscientific data.

In what capacity are SeaDataNet's technologies and expertise adopted and adapted by other marine-based projects?

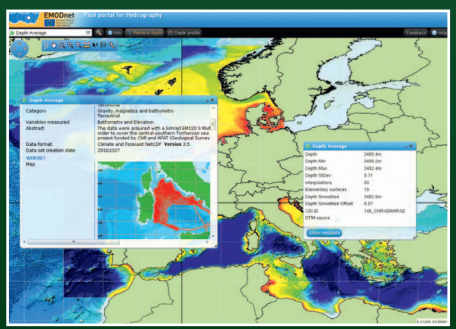
MF: The SeaDataNet infrastructure is expanded and enriched by the adoption of SeaDataNet standards and approaches in related data management projects, for example, the FP7 projects Geo-Seas, Upgrade Black Sea SCENE, EUROFLEETS and CaspInfo. This is facilitated by a few SeaDataNet partners joining these projects to transfer knowledge and act as liaison. Furthermore, SeaDataNet has established a close cooperation with EuroGOOS – the association of national governmental agencies and research organisations committed to European-scale operational oceanography within the context of the intergovernmental Global Ocean Observing System – and the MyOcean consortium, that is actively implementing the GMES Marine Core Service, aiming at deploying pan-European capacity for Ocean Monitoring and Forecasting. The cooperation focuses on improving the availability of high quality and harmonised physical oceanography datasets in real-time and delayed mode, as long-term archives, in support of operational oceanography. This has resulted in a joint development of the EMODNet Physics pilot project by SeaDataNet together with EuroGOOS and MyOcean.

Leading a **wave of change** in oceans management

A collaboration known as **SeaDataNet** is driving future standards, protocols and the technical basis of pan-European infrastructure for marine and ocean data management – fostering global knowledge transfer

WITH SO MANY state borders in such close proximity, Europe's seas have traditionally been jumbled with marine research efforts vying for space both with fishing activity and one another. As with European research more generally, great efforts have been made in recent decades to improve communication and data sharing amongst all stakeholders. Against this context, the highly successful SeaDataNet project is now moving into its next phase with a focus on upgrading the present SeaDataNet infrastructure into an operationally robust and state-of-the-art Pan-European infrastructure for marine and ocean management. The FP6 SeaDataNet project (2006-11) was preceded by the FP5 Sea-Search project (2002-05) and has now progressed into the FP7 SeaDataNet II project (2011-15). The main goal of SeaDataNet II is to deliver up-to-date and high quality access to ocean and marine metadata, data and data products which originate from data acquisition activities by all engaged coastal states across Europe. This is achieved by setting, adopting and promoting common data management standards and by realising technical and semantic interoperability with other relevant data management systems, as well as encouraging initiatives on behalf of science, environmental management, economic management and policy making.

Essentially, SeaDataNet sets the ocean and marine standards and principles which are then adopted and adapted by many other projects, thereby expanding the number of data centre nodes in the infrastructure and the data coverage. The Geo-Seas project for geology and geophysics and the Upgrade Black Sea SCENE (UBSS) project for the Black Sea region are two examples of other projects adopting SeaDataNet. SeaDataNet also acts as the core data management component of the EMODnet infrastructure; it has a Memorandum of Understanding with the GMES marine core service MyOcean, and closely cooperates with EuroGOOS and its regions. All of these partnerships and collaborations provide an excellent opportunity to spread the SeaDataNet standards and infrastructure to a wider group of data centres and to assure operational sustainability of the infrastructure beyond 2014.



EMODNET-HYDROGRAPHY PORTAL

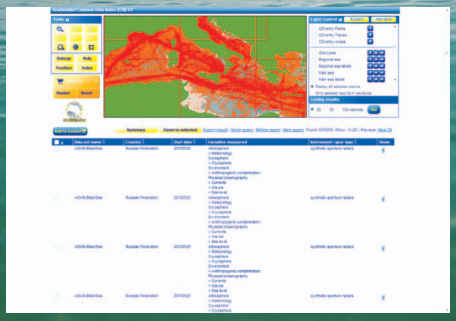
THE VALUE OF CREATING A MULTIDISCIPLINARY SYSTEM

The magnitude of the challenge facing SeaDataNet in terms of managing such fragmented and large datasets could be overwhelming, but for Project Coordinator Michèle Fichaut and Technical Coordinator Dick M A Schaap it is one they are confident they can successfully manage. Oceanographic and marine data includes a very wide range of measurements and variables covering a broad, multidisciplinary spectrum of projects and programmes, which is collected by over 1,000 research institutes, governmental organisations and private companies in all the countries bordering European seas. Various heterogeneous observing sensors are installed on research vessels, submarines, aircraft, moorings, drifting buoys and satellites to gather all of this data and these sensors measure physical, chemical, biological, geological and geophysical parameters, with further data resulting from the analysis of water and sediment samples for a wide variety of parameters. Fichaut explains that in order to make the best use of such a vast amount of data, a robust operational infrastructure, based on European and internationally agreed standards, is necessary and that this must cover data quality and long-term stewardship, as well as technical and semantic aspects of interoperability: "This project must overcome fragmented standards, formats and nomenclature, lack of information on precision and accuracy as well as insufficient temporal or spatial resolution, all of which are seen as major barriers for wider use and exploitation".

In order to create an efficient well-distributed Pan-European Marine Data Management Infrastructure for managing these large and diverse datasets, the SeaDataNet project has focused on establishing common standards and on applying those standards for interconnecting the data centres, enabling the provision of integrated online access to comprehensive sets of multidisciplinary, in situ and remote sensing marine data, metadata and products. The SeaDataNet architecture has been designed as a multidisciplinary system from its inception and it is able to support a wide variety of data types and serve several sector communities. SeaDataNet is also actively sharing its technologies and expertise, spreading and expanding its approach, and building bridges to other well-established infrastructures in the marine domain. This has resulted in an active role for a number of SeaDataNet partners in related data management projects, for example, the FP7 project EUROFLEETS. These projects have adopted the SeaDataNet approach, thereby adapting SeaDataNet standards to make them fit for their purpose. From Schaap's perspective this enriches the overall SeaDataNet standards and the capabilities of the SeaDataNet infrastructure for handling a wide range of data types from various marine disciplines.

A CENTRAL PORTAL SUPPORTING UNIFIED DATA CENTRES

The SeaDataNet portal provides users not only background information about SeaDataNet and the various standards and tools, but also a unified



CDI SCREEN SHOT

and transparent overview of the metadata and controlled access to the large collections of datasets, managed by the interconnected data centres. SeaDataNet has developed and applied a number of standards, including common metadata standards and XML schemas, based on ISO 19115, standard data transport formats ODV ASCII, MEDATLAS and NetCDF, SOAP Web services for various communication tasks and OGC services for viewing services of data products. In SeaDataNet II further activities are being undertaken to achieve full INSPIRE compliance, including a further refinement of the SeaDataNet Common Data Index (CDI) metadata profile to ISO 19139.

SeaDataNet specifically aims its integrated databases at serving users from the science, environmental management, policy making and economical sectors. This is an important point, as Fichaut explains: "Better integrated data systems are vital to enable the users of SeaDataNet to achieve improved scientific research and results, ultimately resulting in successful marine environmental and integrated coastal zone management". It is also important to achieve the establishment of indicators of Good Environmental Status for sea basins, and to support offshore industry developments, shipping, fisheries, and other economic activities. In addition, directives, policies and science programmes require reporting of the state of the seas and oceans in an integrated pan-European manner; of particular note are INSPIRE, MSFD, WISE-Marine and GMES Marine Core Service.

HARMONISING GLOBAL OCEANS DATA

Although SeaDataNet has developed the foundations of a well-structured infrastructure, Schaap says it is not yet ready and sustainable. There are many challenges and recent innovations which need further development, implementation and operation. This will be taken forwards in the SeaDataNet II project and the various related EU and EMODNet projects. An important step forwards will be achieving data access and data products services that will realise the requirements of end-users and intermediate user communities, such as GMES Marine Core Service (eg. MyOcean), WISE-Marine and regional marine conventions (eg. OSPAR, HELCOM, Black Sea Commission and Barcelona Convention), establishing SeaDataNet as the core data management component of the EMODNet infrastructure and contributing on behalf of Europe to global portal initiatives, such as the IOC-IODE – Ocean Data Portal, and GEOSS. In Fichaut's opinion another major advance forwards will be "achieving an improved capability for handling marine biological data and interoperability with the emerging biodiversity data infrastructure in close cooperation with actors in the EurOBIS, MarBEF and LifeWatch initiatives". A key issue for the SeaDataNet collaboration is achieving interoperability and exchange with other relevant data management systems in Europe, thereby promoting, fine-tuning and implementing the SeaDataNet standards, also taking into account active tuning and harmonising on an international scale. The good news is that SeaDataNet is going from strength to strength and will continue to guide the way that standards and technical protocols for marine and oceans data is managed throughout Europe and the rest of the world.

SeaDataNet

SEADATANET – A PAN-EUROPEAN INFRASTRUCTURE FOR OCEAN AND MARINE DATA MANAGEMENT

OBJECTIVES

To federate distributed digital repositories via a unique virtual portal to manage, access and share data, information, products and knowledge originating from observations by oceanographic fleets and automatic observation systems, by standardising formats for metadata, data, and products, quality control procedures, vocabularies, tools and services for ocean and marine data management and adopting new communication and information technology for developing and providing services.

PARTNERS

For a full list of partners, please visit the portal at **www.seadatanet.org**

FUNDING

EU Seventh Framework Programme (FP7) – contract no. 283607

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MICHÈLE FICHAUT received a PhD in computer engineering in 1986. She was deeply involved in the definition of ISO-19115 description of Metadata and in the development of data management tools (NEMO, MIKADO) during the 1st phase of SeaDataNet. She is presently the coordinator of the SeaDataNet II project.

DICK M A SCHAAP received an MSc in coastal engineering in 1980 (Technical University of Delft, The Netherlands). At present he is Technical Coordinator for the FP7 SeaDataNet II and FP7 Geo-Seas projects and Technical Harmoniser for EMODNet. He has held the role of Managing Director of MARIS since 1989.

Building European cooperation in geological and geophysical standards

By expanding the SeaDataNet e-Infrastructure to include the marine-based data held by **Geo-Seas** partners, the project is assuring the long-term stewardship and provision of geological and geophysical data

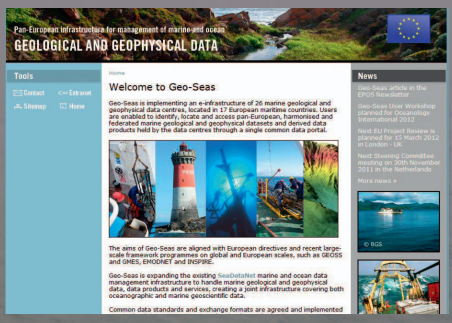
THE SEABED AND the coastal zone throughout Europe is the focus of many oceanographic, biological and sedimentary processes and the interactions between these mechanisms are complex. Knowledge of marine ecosystems, seafloor resources and pathways of pollutants is important to support management decisions as seabed data supports the ability to forecast the impacts of anthropogenic factors, such as pollution in the marine ecosystem. These datasets are also of direct relevance to the study of global climate change and natural hazards. In addition, many economic activities require high-quality data and data products. The requirement for information on the sea shelves is particularly important, as the geology is more varied than in the ocean and this zone is now used for many different purposes.

The Geo-Seas project is focused on supporting Europe's capacity to locate and access data rapidly from multiple data centres, in common formats, to Europe-wide standards and with the minimum of effort. Based at the British Geological Survey NERC, Project Coordinator Helen Glaves sees this work as providing a major boost to competitiveness in all relevant sectors throughout the EU: "Geo-Seas is adopting and adapting SeaDataNet standards which are then integrated into the overall SeaDataNet standards and infrastructure," she explains. An example of this is the expansion of the SeaDataNet common vocabularies to include specific terms for geology and geophysics.

GEO-SEAS PORTAL

The partners of Geo-Seas come from all corners of Europe. There are 30 organisations represented in total, of which 26 are data centres and four are from user communities and product development organisations. The British Geological Survey is responsible for coordinating Geo-Seas and MARIS is taking care of the technical coordination. All members of the Geo-Seas project are also participants in the global initiatives as well as European projects on harmonising data and developing common data exchange formats and methods. Being closely involved with industry and knowledgeable about all of the industry standards and all national and local initiatives is critical to the success of this project. "In taking this approach," explains Glaves, "the participants in Geo-Seas are maintaining a dialogue with data centres and organisations at the global, national and local level to ensure that the maximum commonality of standards is achieved, and that newly developed standards arising from Geo-Seas are promoted to the entire community within and outside the geoscience domain."

Each country is largely responsible for the management of the data within its own sea areas. Historically, there has been little to no coordination of geological and geophysical marine data management, data access or data products between countries, and sometimes even within countries. Therefore locating data, gaining access to data and data interoperability has proved to be a major problem for researchers, industry and policy makers. Establishing a coordinated European infrastructure and network of data centres through Geo-Seas is imperative to encourage greater cooperation between data centres throughout Europe. This is also compatible with the INSPIRE Directive to create a European spatial information infrastructure that delivers integrated spatial information to users. The European approach also means that the Geo-Seas project can make the best use of the already established SeaDataNet infrastructure, in order to ensure rapid progress on developing the pan-European infrastructure for geological and geophysical data. Through this work the Geo-Seas partnership is protecting data for re-use by new applications in many fields, thus preserving the availability of unique observational data which can be difficult or impossible to recreate.



GEO-SEAS WEBSITE SCREEN SHOT

Geo-Seas

PAN-EUROPEAN INFRASTRUCTURE FOR MANAGEMENT OF MARINE AND OCEAN GEOLOGICAL AND GEOPHYSICAL DATA

OBJECTIVES

To effect a major and significant improvement in the overview and access to marine geological and geophysical data and data products from national geological surveys and research institutes in Europe by upgrading and interconnecting their present infrastructures.

PARTNERS

For a full list of partners, please visit the portal at **www.geo-seas.eu**

FUNDING

EU Seventh Framework Programme (FP7) – contract no. RI-238952

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HELEN GLAVES holds degrees in Geology and Information Technology. She is a senior marine data manager with 22 years experience at the British Geological Survey (NERC) in both marine geosciences and data management roles. She is currently coordinator for the Geo-Seas project and a work package leader for the European Marine Observations Data Network (EMODNET) Geology lot.

Harmonising Black Sea marine data practices

Building and extending the existing **Black Sea SCENE** research infrastructure offers project partners an opportunity to expand data coverage – ultimately improving the region's marine management standards and capacity

THE AIM OF THE Upgrade Black Seas SCENE (UBSS) project is to build national networks of institutes around the SeaDataNet National Oceanographic Data Centres in each of the six Black Sea countries. This is achieved by upgrading the existing Black Sea SCENE infrastructure through the adoption of the latest SeaDataNet standards and components and then having all institutes learning and populating the metadata services, using the appropriate tools as well as setting up and populating the data access services. There are 51 partners in UBSS, of which 43 are located within the Black Sea countries. Regular six monthly meetings are organised with all partners to monitor progress and to discuss problems. Project Coordinator Dick M A Schaap explains that this allows for positive team building and also creates a 'social pressure' for all institutes to undertake action. One specific UBSS work package is dedicated to Quality Control procedures, which can be quite different from those for other European sea regions due to the specific character of the Black Sea environment. As part of this work package, dedicated Quality Assurance and Quality Control manuals have been compiled that are adopted by the Black Sea Commission. In addition, several SeaDataNet services have been outfitted with Black Sea user interfaces, developed and managed by operators from the region, using the SeaDataNet infrastructure as a backbone.

There are many benefits to be realised from the UBSS project, both in the short term and over a longer timeframe. The project has already played a major role in the implementation of the EMODNet Chemistry pilot, bringing together chemical datasets and generating chemical data products for the Black Sea region, involving UBSS partner institutes and the Black Sea Commission. The UBSS portal now gives access to a large volume of Black Sea datasets from many disciplines and institutes; still a further population is required, especially for more recent datasets. Sustaining the UBSS infrastructure as an integral component of SeaDataNet and EMODNet is a major target for the coming period. This will be progressed through discussions and lobbying with the EU (DG Environment and EEA) and the Black Sea Commission. In particular, the Black Sea Commission will be encouraged to adopt the UBSS infrastructure as an integral regional network underlying and supporting the Black Sea Information System which is, at present, mainly focusing on monitoring data: "Combining both scientific and monitoring data will provide better opportunities for good environmental management as well as science," Schaap states.

It is important for the SeaDataNet project that it continues to retain its relevance and impact and the UBSS project provides an opportunity to gain a strong foothold in the Black Sea region and among its major research and monitoring institutes, as well as a robust cooperation with the Black Sea Commission. At present, SeaDataNet together with the EEA and EU DG Environment, is exploring just how EMODNet and its SeaDataNet engine should be customised to serve WISE-Marine, which will play a major role in the reporting on the Good Environmental Status. This process is also very challenging for the Black Sea countries that have aspirations for complying with the MSFD. Schaap believes that consequently, the Black Sea experience of SeaDataNet through UBSS and the EMODNet Chemistry pilot, which had a specific focus on the Black Sea, is very valuable for the further development of their SeaDataNet work.

BLACK SEA PORTAL

UBSS

UPGRADE BLACK SEA SCENE

OBJECTIVES

To further improve the Black Sea SCENE research infrastructure's ability to: stimulate scientific cooperation; exchange knowledge and expertise; strengthen regional capacity and performance of marine environmental data and information management; underpin harmonisation with European marine data quality control/assessment procedures; adopt international metadata standards and data-management practices; and provide improved data and information delivery services for the Black Sea region at a European level.

PARTNERS

For a full list of partners, please visit the portal at **www.blackseascene.net**

FUNDING

EU Seventh Framework Programme (FP7) – contract no. 226592

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Black Sea SCENE