

Coast Map News

Managing marine and coastal data and information

Issue 7/Summer 2004

Coastal and Marine Resources Atlas for National Contingency Planning



Introduction

The UK Maritime and Coastguard Agency (MCA) are currently leading a project to revise the hardcopy Nature Conservancy Council (NCC) 'Atlas of nature conservation sites in Great Britain sensitive to coastal oil pollution' published in the 1990s, and develop an interactive digital atlas. The work is being carried out by Oakwood Environmental in association with Geowise Ltd. Phase I involved clarifying the current availability, format, and licensing arrangements for the key data layers of the digital coastal map atlas. Outcomes of the consultations provided options for the presentation and capture of key data layers during Phase II, and the management and dissemination of information amongst the final users of the contingency planning tool. The priority business areas have been identified as audit and planning, and operational response at time of spill.

Phase II, now in progress, is an exciting collaboration of stakeholders holding maritime environmental datasets.



Beach clean-up activities after an oil spill

Oakwood will collate the datasets and work with GeoWise to develop a central datastore to be maintained within Defra's on-line and searchable MAGIC facility. To meet operational needs when internet access is problematic, a CD/DVD based interactive atlas, a snapshot of the website, will also be developed.

MCA are funding partners with (in alphabetical order); Department for Environment, Food and Rural Affairs (Defra), Department of Trade and Industry (DTI), English Nature, Energy Institute, Environment Agency, Anglian Region, Essex County Council, Hampshire County Council, Joint Nature Conservation Committee, Kent

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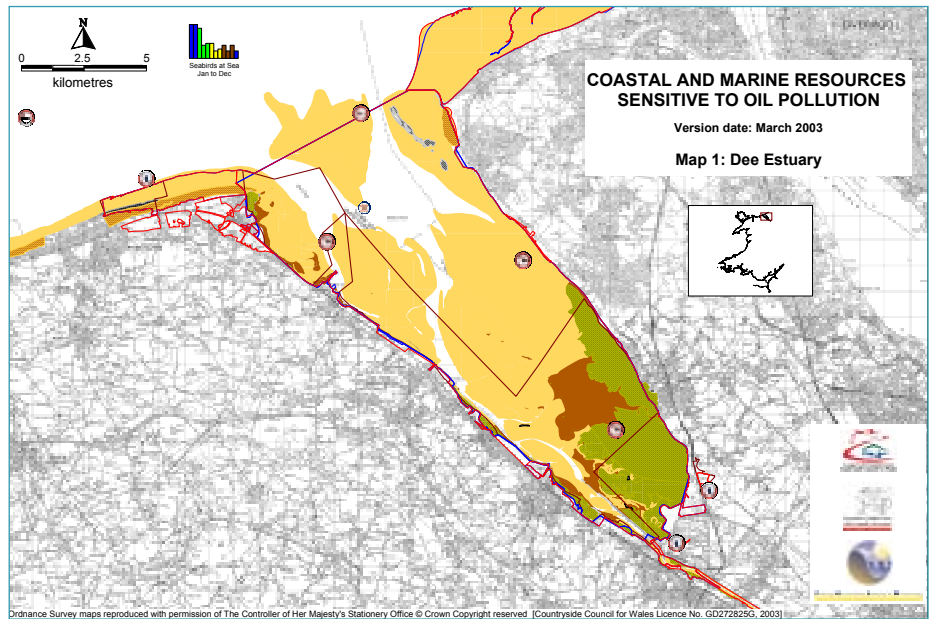
County Council, Scottish Executive, and Scottish Natural Heritage. Other organisations are supplying in-kind contributions by supplying data without charge; these include British Trust for Ornithology, CEFAS, Countryside Council for Wales, Scottish Environmental Protection Agency, and SeaWatch Foundation.

The mapping will comprise coastal and marine resources but not incorporate sensitivity analysis of the resources to potential oil pollution. For the purposes of this contract, the geographical coverage will include England, Wales and Scotland out to the Pollution Control Zone, excluding the Channel Islands, Isle of Man, and Northern Ireland.

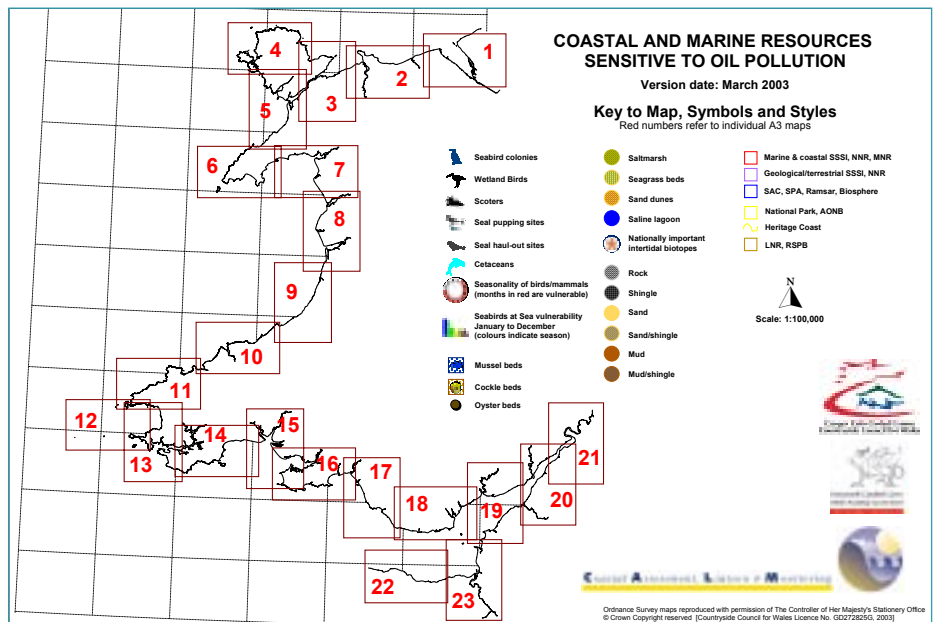
Consensus has been reached on the information requirements for data layers to be held in the datastore. The layers include; OS terrestrial basemapping at 1:50,000 and 1:25,000, bathymetry, littoral geology, coastal habitats, cetaceans, seals, wildfowl and waders, seabirds, sensitive fish areas, shellfish beds, conservation designations, bathing waters, aquaculture sites, dispersant use limits, and infrastructure such as windfarms, oil and gas facilities, and power stations.

Basemapping

A digital dataset of the littoral sediment classification of England and Wales has been produced as part of the FutureCoast project and is held by British Geological Survey (BGS). Intertidal substrates shown in the BGS data are classified under 11 classes that are closely comparable with those used in the 1990 NCC atlas, CCW and DOE NI recent coastal mapping work. Oakwood will collate the existing 'habitats' polygons for England and Scotland, and CCW intertidal substrate & coastal habitat data sets for Wales. Whilst resources have been allocated under a separate contract between Defra and BGS, to update the existing coverage of the data to include the littoral zone within the estuaries of England and the coastline of Scotland.



Screenshot from CCW's 2003 atlas of 'Coastal and Marine Resources Sensitive to Oil Pollution' for Wales



Key to the maps, symbols and styles from CCW's 2003 atlas of 'Coastal and Marine Resources Sensitive to Oil Pollution' for Wales

The attribute information is likely to include parameters such as; periods of high sensitivity for seabirds, sensitive species and habitats present, extents of conservation sites, features of high conservation value, and other information of importance to the UK Standing Environment Groups. Oakwood is in discussions with the statutory conservation agencies to define the level of detail required by users of the digital atlas.

Data providers are requested to provide associated metadata using a standard form based on UK Discovery standards (soon to be amended to ISO 19115), determining key features of the datasets. This will ensure that the final database will provide common and comprehensive metadata for all UK coastal regions and allow ease of reference for future review. Metadata may include; data management format, data quality information, data coverage, frequency of

update, availability of new versions, and data owner and contact details.

Data management

Centralised Datastore & Data Management Plan

The process of data and metadata collation from suppliers will be documented in the Data Management Plan (DMP). The DMP will provide a clear procedural ‘flow’ guide, to updating and maintaining the data sets held on the GIS database to ensure that the system is sustainable.

A central datastore will be constructed to adopt, wherever possible, processes in terms of sourcing, quality assurance and data processing that are simple and repeatable. The Defra GI Team already provides a centralised datastore capability covering England which includes supporting the MAGIC facility (see www.magic.gov.uk). The team has significant expertise and can provide technical infrastructure which offers a suitable platform for supporting this application, ensuring its sustainability and delivering ‘best value’. A distinct ‘Topic’ will be created within MAGIC, which will provide access to a web-based application for searching metadata, visualising specific datasets and selective download capabilities.

Data delivery

The single centralised datastore will deliver the relevant content through two delivery channels that are appropriate to the specific business needs of audit and planning, and operational response at time of spill;

- CD/DVD based interactive atlas,
- Web-based internet application including the ability to download specific datasets.

CD/DVD delivery channel

A CD/DVD Atlas will be developed using core datasets, built as a multi-layer interactive mapping application with basic metadata available. The Atlas will use Scalable Vector Graphics (SVG) as a means of delivering data and functionality. The CD/DVD Atlas will provide easy access to mapping that is ‘always on’. It means operational staff can use the CD/DVD in remote conditions – critical for operational use in the event of a spill. It is a data centric approach and is not intended to produce high quality maps from the CD/DVD.

Website delivery channel

A distinct ‘topic’ (e.g. Coastal and Marine Resources Atlas) will be created within the MAGIC web site. Discussions are ongoing relating to whether the web application will be publicly

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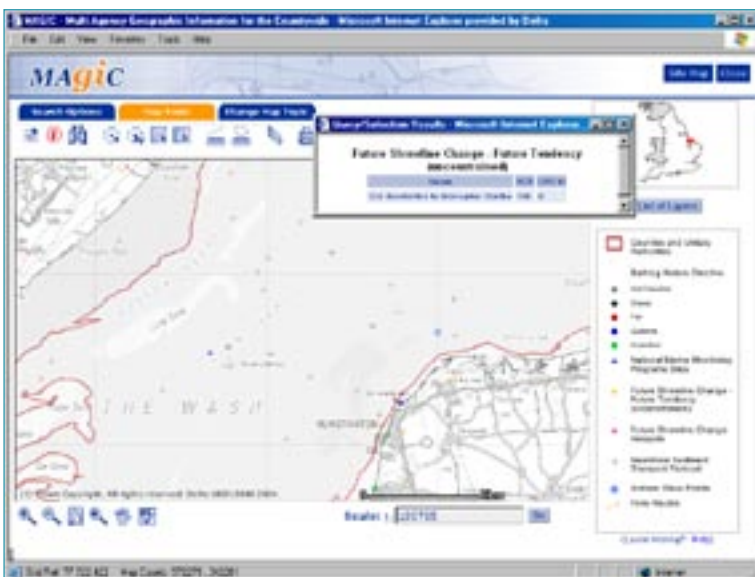
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Screenshot of proposed output from MAGIC’s marine sub-topic

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accessible and will seek reciprocal links with related sites like UK DEAL. It will deliver both general textual content to introduce the project and an interactive map viewer. In terms of functionality, the site will offer capabilities such as:-

- Ability to view and search metadata using Defra spatial metadata standards
- Ability to make specific datasets downloadable from the site (in ESRI SHP format)
- Ability to view (including switch on and off) spatial data sets, grouped into hierarchical themes, through an interactive map
- Standard map navigation tools
- Standard information tools for selection of features and reporting
- Standard tools for outputting reports and maps including appropriate map plots

Conclusion

Through the link with the MAGIC GI Team at Defra, a sustainable approach to maritime data management will be developed, a factor that has been over-looked by a number of similar projects in the past. The project also seeks to build on data-sharing and collaborative initiatives currently underway within the marine and coastal community. Through this solution, Defra will take on an important role in supporting management and delivery of information relevant to coastal and marine environmental resources– we hope they will be actively supported on an on-going basis by the many other organisations that have a role, not only in oil spill contingency planning and response, but in all aspects of maritime resources management.

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Welcome to the 7th issue of Coast Map News

You will have noticed, no doubt, that once again we have produced a particularly large issue...this reflects the level of interest in marine data collection and management at the moment and an increasing number of new initiatives about to begin or which have recently started. What is becoming apparent, albeit slowly, is the encouraging evidence of greater communication between stakeholders and some nice examples of interoperability within certain sectors. One of the most important developments to be reported in this issue is, in my opinion, the start of the MCA led initiative to update the resource atlas for emergency oil spill response and contingency planning. For the past 13 years or so, agencies and responsible organisations have had to rely on paper maps which are, at best, cumbersome and potentially outdated. The new project, to digitise these maps and populate with up to date information from a number of data providers, will allow easy access to reliable information not only for the necessary users but also, it is hoped, for a wider audience via the internet. The

data are to be added as layers to the Multi Agency Geographic Information for the Countryside (MAGIC) website (see issue 6), following agreement earlier this year that the geographical extent of the system will be extended to include the marine environment. This has been the result of negotiations within the Defra family, and those involved should be congratulated, as this is a significant step forward in the drive to improve access to marine 'static' or 'areas' data.

Another important development is the introduction of SPIRE (the Spatial Information Repository), within Defra and its family. This three year project aims to harmonise geographical information management through the development of a virtual data repository, and was officially launched at the Defra GI Conference in Nottingham in May. A full description of this initiative can be found on page 7.

Also included in this issue are reports on the EU data interoperability programme INSPIRE, and articles highlighting

the work of two of the UK's largest data management organisations the British Atmospheric (BADc) and British Oceanographic (BODC) Data Centres. I am also pleased to bring you the latest instalment in Keiran and John's 10 Questions series...this time covering the topics of 'Metadata' and 'Ontologies'... we'd be glad to receive any comments, or suggestions for future topics. Happy reading!



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The INSPIRE Directive – Environmental Information in the Geospatial Age

Introduction

Good environmental policy and regulation depends on high quality information and informed public participation. Policymakers have recognised that environment policy needs to be based on sound knowledge and informed participation. A new approach is therefore needed for how we carry out data management and information delivery across the different levels of government. Policies need to be introduced to reduce duplicated data collection and to assist and promote the harmonisation, broad dissemination and use of data. Such policies should result in increased efficiency, the benefits of which can be reinvested in improving the availability and quality of information. In turn, the increased availability of information will stimulate innovation among information providers in the commercial sector.

The European Commission recently submitted to the European Parliament and the Council of the European Union a draft directive to make interoperable spatial information readily available, in support of both national and Community policy and to enable the public to have access to this information. This is known as the INSPIRE (Infrastructure for Spatial Information in Europe) Directive. Figures 1 and 2 give an indication of the scope and technical details of the Spatial Data Infrastructure.

Overview of the Proposal

A key objective of INSPIRE is to make more and better spatial data available for monitoring and improving the state of the environment, including air, water, soil and the natural landscape. Much of this information needs to be underpinned by “multi-purpose” spatial data. INSPIRE will not set off an extensive programme of new spatial data collection in the Member States. Instead, it is designed to optimise the scope for exploiting the data that are already available, by requiring the documentation of existing spatial data, the implementation of services aimed

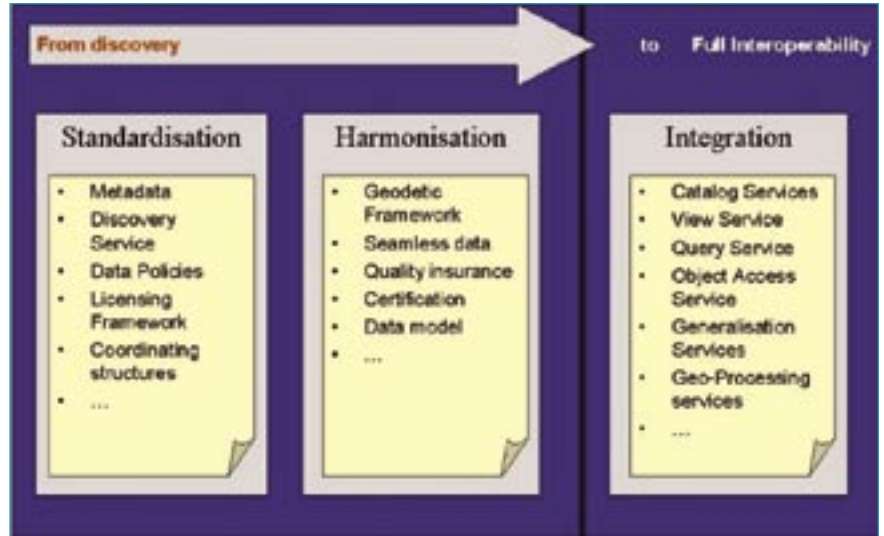


Figure 1. Towards an Infrastructure for Spatial Information

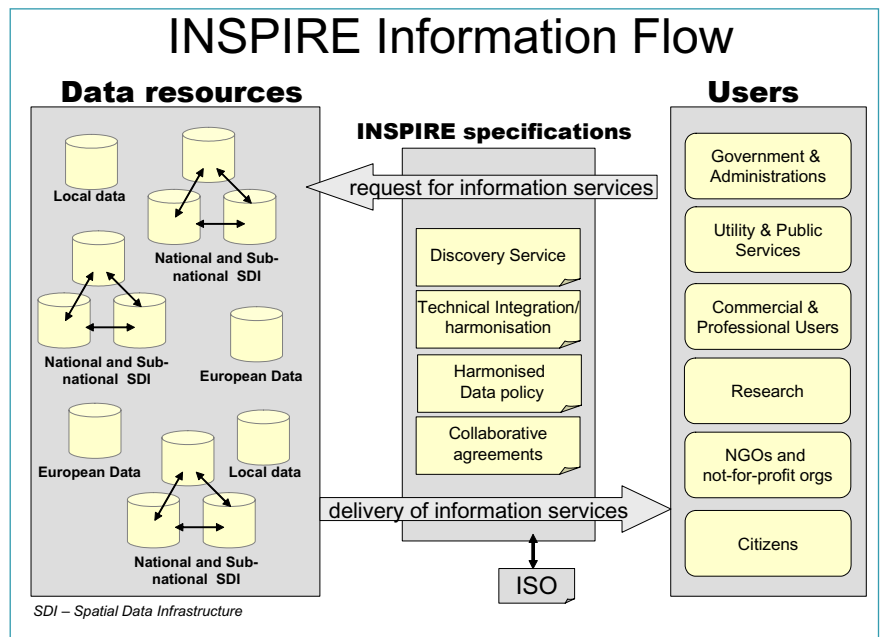


Figure 2. INSPIRE Generic Architecture Reference Model

at rendering the spatial data more accessible and interoperable and by dealing with obstacles to the use of the spatial data. INSPIRE will pave the way for a progressive harmonisation of spatial data in EU Member States.

The main beneficiaries of this proposal will be those involved in the formulation, implementation, monitoring and evaluation of environmental policies – at the

European, national and local level. These are public authorities, legislators and citizens and their organisations. However, other user groups are also expected to benefit, including the private sector, universities, researchers and the media. The proposal will support the formulation and implementation of a wide range of environmental and other policies.

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The need for community intervention

Detailed spatial information is available in Europe to support a broad range of policies. Indeed, map-based information is used in many reporting, analysis, evaluation and forecasting tools and activities. In addition, the emergence of the Internet has allowed widespread and low-cost distribution of this type of information and could contribute to better public understanding and awareness of various policy issues.

Despite these many initiatives, widespread access to and use of spatial information is still a problem in Europe. The main problems relate to data gaps, missing documentation, incompatible spatial data sets and services, due for example to varying standards, and barriers to the sharing and reuse of spatial data.

Fortunately, awareness is growing at national and EU level that quality geo-referenced information is needed in order to understand the complexity of ever-increasing human activity in the EU and to contain its adverse impact, and many regional and national initiatives are being taken. Furthermore, new instruments such as the GALILEO navigation system will improve precision and reliability in elaborating spatial information. Yet even in these circumstances, action at Community level is necessary because:

- Few Member States have developed a framework for establishing a national infrastructure for spatial information that addresses operational, organisational and legal issues. Where steps have been taken, they have often been restricted to specific regions or specific sectors.
- In most Member States where a framework has been adopted, not all problems have been addressed or initiatives are not compatible.
- Without a harmonised framework at Community level, the formulation, implementation, monitoring and evaluation of national and

Community policies that directly or indirectly affect the environment will be hindered by the barriers to exploiting the cross-border spatial data needed for policies which address problems with a cross-border spatial dimension.

Extended Impact Assessment

In June 2002, the Commission introduced a new integrated procedure for impact assessment to improve the quality and coherence of the policy development process. INSPIRE was one of the first to be subject to this need to carry out an extended impact assessment of economic, social and environmental impacts. The extended impact assessment considered six policy options and recommended a preferred option of introducing INSPIRE via a framework directive.

The required investment of the preferred option – a focused framework backed by an EU framework Directive – will to a large extent be borne by the public sector and is estimated at an average of €3.6 – 5.4 million per annum per EU Member State (EU25). This would represent only 1% of the total expenditure on spatial information.

The benefits include environmental gains, wider social benefits and gains by the private sector. Only the environmental benefits have been quantified. The average annual benefits per Member State (EU25) amount to €27 – 42 million. Knowing that these elements only represent a partial view of the whole picture, the conclusion was that the benefits outweigh the investment requirements by a considerable amount.

Subsidiarity and proportionality

The subsidiarity principle is intended to ensure that decisions are taken as closely as possible to the citizen and that constant checks are made as to whether action at European level is justified in the light of the options available at national, regional or local level.

The proposed Directive does not go beyond what is needed to achieve

its objectives. It is designed to build upon the variety of existing information systems already in place in the Member States and provides the overall framework for them to be able to work in synergy with each other, forming part of the Infrastructure for Spatial Information in the European Community. INSPIRE will also build upon existing organisations already involved in spatial data use and production and provide, as far as organisational issues are concerned, only the overall co-ordination mechanisms needed for the infrastructure to operate at the European level. As regards harmonisation, INSPIRE will address only those aspects needed to achieve cross-level and cross-thematic consistency of spatial data and to make them available to support Community policies. For instance, INSPIRE does not require Member States to change the format of their spatial data holdings; instead, Member States can provide interfaces that transform heterogeneous data to a uniform model.

The present proposal takes the form of a framework Directive in order to leave the Member States ample room to ensure that the requisite measures for achieving the prescribed objectives are tailored to their specific situations. Implementing rules of a technical and more prescriptive nature are to be adopted through the committee procedure. These are necessary to ensure the overall coherence the Infrastructure for Spatial Information in Europe needs in order to meet the objective of supporting Community policies. Use of the committee procedure also ensures sufficient flexibility to adapt the Infrastructure for Spatial Information in Europe to technological progress and to emerging policy priorities.

The proposal tackles only those aspects that need to be regulated at EU level to ensure that the objectives of the EC Treaty are met. Most of the measures allow the Member States to continue to operate their existing systems and organisational set-up, by requiring only those measures needed

to make existing systems interoperable or eliminate existing barriers. Furthermore, specific limitations have been introduced in order to prevent any disproportionate additional administrative burden on Member States and the proposal also introduces safeguards to ensure that it does not

stifle innovation, by guaranteeing openness to private sector participation.

The author is a member of the European Commission's INSPIRE Expert Group and has chaired its Data Policy and Legal Issues Group and the Extended Impact Assessment Group.

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Spatial Information Repository (SPIRE) Programme

Introduction

The aim of the Spatial Information Repository (SPIRE) Programme is to enable the use of consistent, concise and up-to-date geographic information to support the objectives of Defra, its Executive Agencies and Non-Departmental Public Bodies by developing a culture of active data management and the provision of appropriate information technology. Defra's strategic objectives demand access to a cohesive and consistent pool of information, including spatial or geographic information. The importance of geographic information was clearly highlighted during the 2001 Foot and Mouth Outbreak. More recently, the Haskins report on the review of rural delivery arrangements, published at the end of 2003, recognised the importance of geographic information to Defra, one of its recommendations being that Defra should develop an integrated rural database. Hence, there are clear drivers to join up the use of geographic information across the 'Defra family'*.

Purpose of the programme

SPIRE is a three year programme that will implement a corporate Spatial Information Repository consistent with the principles laid out in Defra's IT Strategy and Geographic Information Strategy. It will promote the use of geographic information as a corporate resource and support the Department's strategic sustainable development objectives for land, coastal and marine

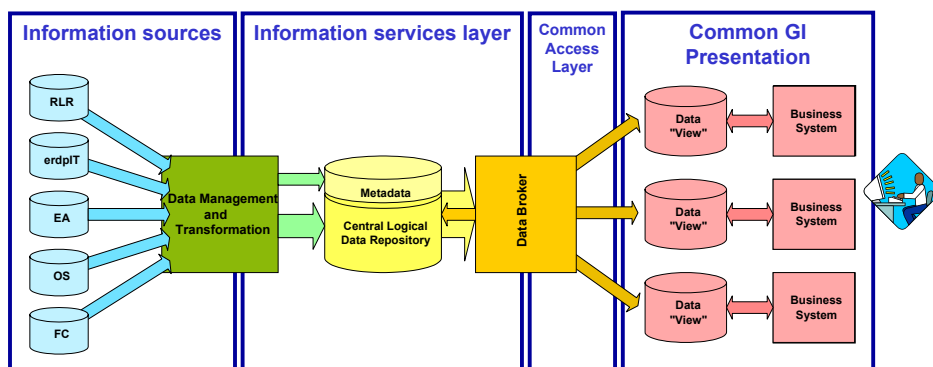


Figure 1. Proposed SPIRE architecture

environments. The Programme's focus is wider than just the terrestrial environment, recognising the fact that Defra has considerable marine interests. SPIRE will seek to meet the needs of the marine community through the provision of required data sets, e.g. UK Hydrographic Office data.

The key Programme objectives are:

- To make core geographic information layers available to Defra by December 2005 and to Defra's delivery partners by December 2006;
- To provide robust contextual data, for example OS MasterMap, against which other geographic information can be viewed by March 2005;
- To secure the necessary technical infrastructure from Defra's new IT supplier, IBM, by March 2005 and;
- To have robust geographic information management arrangements in place by March 2005.

Proposed architecture

In terms of storing data SPIRE proposes a 'federated' approach, whereby some geographic information will be held in a central repository with the rest distributed. Hence, those areas of the Defra family that currently hold and manage spatial data sets locally will continue to do so, should they wish, making them available to the SPIRE system. SPIRE will be a single virtual, or logical, repository. Figure 1 provides a conceptual overview of the proposed SPIRE architecture.

Programme structure

The programme is currently split into 2 work streams: the Data Project and the System Project.

The main focus for the System Project is the development of a Proof of Concept

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* The Defra family is defined as the core Department, its Executive Agencies and Non-Departmental Public Bodies.

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Table 1. Phasing of the SPIRE Programme

PHASE	OBJECTIVE	STAKEHOLDER INCLUSION	DATE
Mobilisation	Programme mobilised	✓ Programme team and Support Office mobilised and operational	Sept – Dec '03
Phase 0	Evolve understanding of SPIRE concept to inform detailed Work Package request submitted to e-nabling supplier	<ul style="list-style-type: none"> ✓ Development and appraisal of SPIRE Proof of Concept and MasterMap implemented ✓ Work package submission to e-nabling supplier ✓ White Space requirements gathered and onwards approach proposed ✓ SPIRE requirements gathered, interim data standard complete and data quality assessed 	Jan – Jul '04
Phase 1	Release 1 of SPIRE to support:	<ul style="list-style-type: none"> ✓ Rural Land Register systems (RITA) ✓ erdpIT systems (GENESIS) 	Aug – Mar '05
Phase 2	Release 2 of SPIRE extended to support:	<ul style="list-style-type: none"> ✓ Animal and customer repository programmes ✓ Core Defra users including SVS and RDS ✓ RADAR ✓ MAGIC 	Apr – Dec '05
Phase 3	Release 3 of SPIRE extended to support (as required and appropriate):	<ul style="list-style-type: none"> ✓ The remainder of Defra's Executive Agencies ✓ Environment Agency ✓ English Nature ✓ Countryside Agency ✓ Forestry Commission 	Jan – Sept '06
Later phases	Potential extension of SPIRE to wider Defra delivery partners as appropriate:	<ul style="list-style-type: none"> ✓ Local authorities ✓ Government Offices for the Regions ✓ Other government departments ✓ Non-government organisations 	Sept 2006 onwards

to test whether it is possible to develop an architecture to support the goals of the overall project that is in line with the overall IT strategy. The Data Project has provided a number of data sets for input to the Proof of Concept to test certain issues, for example, to assess how the system handles data sets with different projections (e.g. OSGB and WGS84): data sets provided by CEFAS were used for this purpose. Lessons learnt from this work will be captured and will inform the development of the operational SPIRE system.

The aim of the data project is to provide fit for purpose geographic information to populate SPIRE in support of the Defra aim of sustainable development and the strategic aims of customer focus, e-service delivery and evidence-based policy making. Later phases will provide fit for purpose geographic information to meet wider national, European and global information requirements.

Data Project activities can be grouped into three broad areas:

1. Identifying users' data requirements – to date this has focused on the needs of Defra, but will be expanded, in due course to include Executive Agencies and Non-Departmental Public Bodies (see Table 1 above). This has included consultation with Defra's Marine and Waterways Division;
2. Developing a SPIRE data standard – with increased sharing of geographic information it is important that data sets adhere to a common standard. The Data Project has been working closely with the wider Defra family in developing this standard and;
3. Assessing the quality of geographic information and devising migration plans to enable their use within SPIRE.

In order to deliver these activities it is vital that the business and the SPIRE Programme work closely with each

other. To help facilitate this a SPIRE Data Working Group was established. It provides a steer to the Programme and includes representatives from the Programme team, Defra, its Agencies and Non-Departmental Public Bodies.

Further details can be obtained by emailing the SPIRE Programme office, details below.



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Marine Overlays on Topography for Annex II Valuation and Exploitation - MOTIIVE

The objective of **MOTIIVE**, which is due to start in October 2004, is to examine the cost benefit of using non-proprietary data standards.

MOTIIVE addresses the harmonisation requirements between the INSPIRE core data component 'elevation' (terrestrial, bathymetric and coastal) and INSPIRE marine thematic data for 'sea regions', 'oceanic spatial features' and 'coastal zone management areas'. The proposal stresses analysis of the cost-benefit implied by strong harmonisation between 'core' and 'thematic' INSPIRE data, while fulfilling the infrastructure requirements of the GMES 'Ocean and Marine Applications' theme, already being determined by GMES Service Element (GSE) pilot projects. The aims of the project are to produce application instances of a series of OpenGIS specifications and use this to support a fully qualified business case for creating a formal OGC Working Group for Marine Data.

The EC's INSPIRE initiative proposed harmonised 'Annex 1' core spatial data and will underpin the harmonisation of 'Annex 2' thematic data. The existence of Open GIS Consortium (OGC) and International Organization for Standardisation (ISO) TC 211 non-proprietary spatial data standards and interoperability tools is expected to help foster data integration at lower cost than previously experienced when using multiple data sources in integrated data projects. A key objective of this proposal is to examine this expectation for a selected set of core and thematic data, while fully documenting the processes, procedures, barriers and resource requirements involved in creating, then using, non-proprietary spatial data geographic information standards and new interoperability tools to aid such data harmonisation. The cost-benefit analysis included in **MOTIIVE** explores the implications of harmonisation across core and thematic data areas as well as within thematic data groups.

The Aeronautics and Space priority in FP6 includes GMES - Global Monitoring for Environment and Security, a pillar of the Space programme, with six priority thematic areas, including 'Ocean and Marine Applications'. Concurrent with GMES implementation is the EC INSPIRE initiative, Infrastructure for Spatial Information in Europe, which identified core and thematic data elements for the European Spatial Data Infrastructure (ESDI). In the FP6 work programme, the GMES component of the Space priority is to develop synergies between existing information services and technologies, including interoperability of data processing and delivery systems, the focus of the current call for data harmonisation support actions. Measurable objectives of **MOTIIVE** include:

- Providing a documented methodology for implementing and monitoring data harmonisation activities between INSPIRE 'Annex I' (core - elevation) and 'Annex II' (thematic - marine/coastal) datasets. This follows the steps required in the Open GIS Consortium (OGC) Reference Model for interoperability, application of ISO 19xxx series of spatial standards and CEN/TC 287 standards profiles for ISO 19xxx, with associated Feature Type Catalogues and marine ontologies.
- Using the open standards and tools developed in early stages of the project, demonstrate this methodology applied to the data integration requirements of those GMES (Global Monitoring for Environment and Security) Service Element (GSE) pilot projects. These projects have a marine/coastal focus in which **MOTIIVE** partners already participate, underpinned by INSPIRE core (elevation) and thematic data.
- Providing a cost-benefit assessment for using OGC interoperability

specifications to harmonise INSPIRE Annex I (elevation) and Annex II (marine, coastal management) spatial data. This assessment includes analysis of two existing marine information services created without using open source standards (proprietary code, no GML schema, no agreed ontology, no standard feature catalogues, etc.) and one or two 'post-standardisation' marine information services created using the tools developed in the early stages of the project.

- Building on the pre-standardisation work of the EC MarineXML project, establish a marine data standards registry under the auspices of the Intergovernmental Oceanographic Commission (IOC and International Hydrographic Organization (IHO).
- Producing a fully qualified business case for the establishment of an official OGC Working Group on Marine Data, based on marine data related deliverables from the project, i.e. a marine ontology, a UML marine data model, review and recommendation of marine terminology thesauri, OGC feature type catalogue and GML application schema.



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The British Oceanographic Data Centre: the UK's main centre for storing and distributing data about the marine environment



The British Oceanographic Data Centre (BODC) is a national facility for stewardship and dissemination of data about the marine environment. Our sole responsibility is to operate as a data centre for the marine community and provide a resource for science, education and industry, as well as the wider public. Nearly 200 organisations have contributed data to our databases; hence we are committed to a strategy that will allow free and open access whenever possible. In addition, BODC hosts the Inter-Agency Committee on Marine Science and Technology (IACMST) National Marine Environmental Data Coordinator.

As well as our national role, we have an international responsibility as part of the Intergovernmental Oceanographic Commission's network of data centres and representation at the International Council for the Exploration of the Sea (ICES). We are also one of the lead partners in the EU-funded Sea-Search project which has developed a pan-European network for ocean and marine data and information management.

BODC deals with biological, chemical, physical and geophysical data, and its databases contain measurements of nearly 10,000 different variables. Many of the staff are scientists with direct experience of marine data collection and analysis. They work alongside information technology specialists to ensure that data are documented and stored for current and future use.

One of the challenges of data management is to ensure that data collected now can still be used in the future without reference to the originator. We store data in formats that should be unaffected by changes in technology. Included is information detailing how the data were collected, analysed and processed so that users can understand the quality of that data. As well as present day projects, BODC

is also involved in 'data archaeology' exercises, collating data sets that are in danger of being lost.

Pioneering approach

BODC is at the forefront of developments in marine data management. It was one of the first data centres to work alongside scientists during multidisciplinary research projects to provide a service during the life of the project as well as in the future.

For example, one of our present data management responsibilities concerns the long-term stewardship of marine environmental datasets arising from the NERC Marine and Freshwater Microbial Biodiversity (M&FMB) thematic programme. Here, our primary role is to ensure the quality and completeness of data collected during the main oceanographic fieldwork, and to assemble a fully integrated, quality controlled and documented dataset. During the fieldwork, aquatic microbes (viruses, bacteria, microalgae and microzooplankton) were sampled and analysed using new molecular techniques and approaches as well as more traditional methods (Figure 1). A comprehensive suite of underpinning measurements of environmental variables and biogeochemical processes were also made. BODC also provides information management support to the programme by collating information related to other data collection activities (e.g. freshwater, molecular) being carried out within the frame of the M&FMB programme.

A further example is the POL Coastal Observatory (<http://cobs.pol.ac.uk/>), which has been operational since 2002 and has an extensive field programme, with the main study area in Liverpool Bay (Figure 2). Measurements include: regular (approximately monthly), spatial survey cruises

along a grid of 35 stations that also service moorings; the Birkenhead-Belfast ferry, currently instrumented to collect near surface temperature, salinity, turbidity, chlorophyll and, eventually, nutrients; shore-based HF radar measuring waves and surface currents out to a range of 50 km. A CEFAS SmartBuoy, coastal tide gauges and meteorological stations and satellites provide further observations.

BODC provides general data management for the Coastal Observatory by maintaining an inventory of cruises/fieldwork and data sets, and by collating, archiving and banking data sets. An important additional service is the processing, calibration and quality control of the raw CTD and ship's underway data. This removes a significant burden from the project participants, leaving them more time to focus on their science. The worked-up data, complete with detailed documentation are returned to the Coastal Observatory scientists, where they are made available to registered users via the project's web pages. In the longer term, BODC's efforts will ensure that this valuable high frequency time series dataset is safeguarded, maintained and available for future use.

BODC also produces innovative marine data products and digital atlases. For example, in 2003, we published The Centenary Edition of the GEBCO Digital Atlas. The General Bathymetric Chart of



Figure 1. Zooplankton

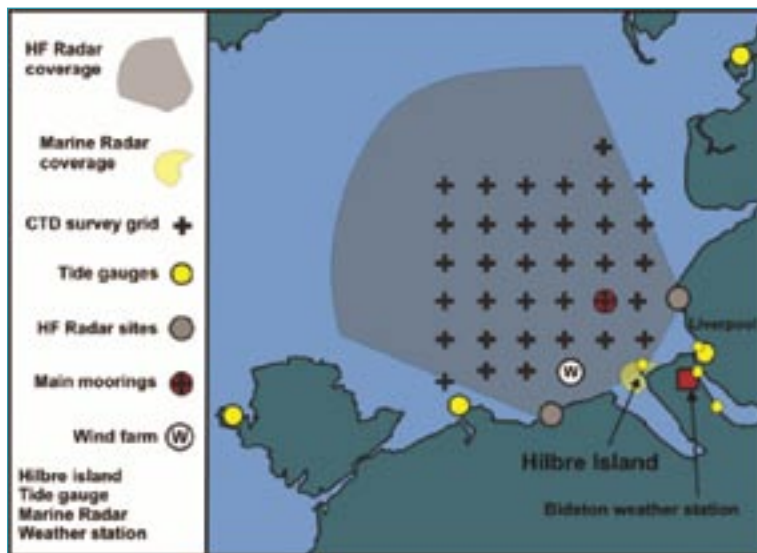


Figure 2. Coastal Observatory – Liverpool Bay measurement scheme

the Oceans (GEBCO) is an international reference map of the sea floor depth of the world's oceans. It is produced under the joint auspices of the International Hydrographic Organisation and the Intergovernmental Oceanographic Commission.

This latest version includes much-improved bathymetry for the Arctic Ocean, the Indian Ocean, the north-east and central eastern Atlantic, the Caribbean Sea and Gulf of Mexico, the Weddell Sea and the waters around

New Zealand. For the first time, the Atlas gives a depth estimate of the world's oceans at one minute intervals of latitude and longitude (Figure 3a). The digital atlas is distributed on CD-ROM and comes with software, written by BODC software engineers, for viewing the data sets (Figure 3b) and exporting the data for use in users' own programmes.

BODC is also involved in real-time data management and initiatives intended to increase the accessibility of

environmental data. We operate the UK Argo Data Centre and provide near-real-time access to the data collected by UK floats. Argo is an international project that aims to maintain a global array of 3,000 free-drifting floats. Each year, 100,000 profiles of temperature and salinity from the top 2 kilometres of the ocean are reported. For its contribution, the UK aims to deploy approximately 50 floats per year, maintaining about 150-200 in the water at any time. Data are received at BODC within 24 hours of a float surfacing. We process the data and perform real-time quality control checks before forwarding the data to the two Global Data Centres. The UK Argo Data web-site, operated by BODC, includes an interactive map that provides information about each UK float and, in addition, gives access to the data.

Developing technologies

Best value from data can only be achieved if they are easily accessible. BODC is committed to technological development to improve the process of searching for data and their delivery in a form required by the user. Central to this is the assembly of an internationally agreed dictionary and the adoption of the latest e-Science techniques to

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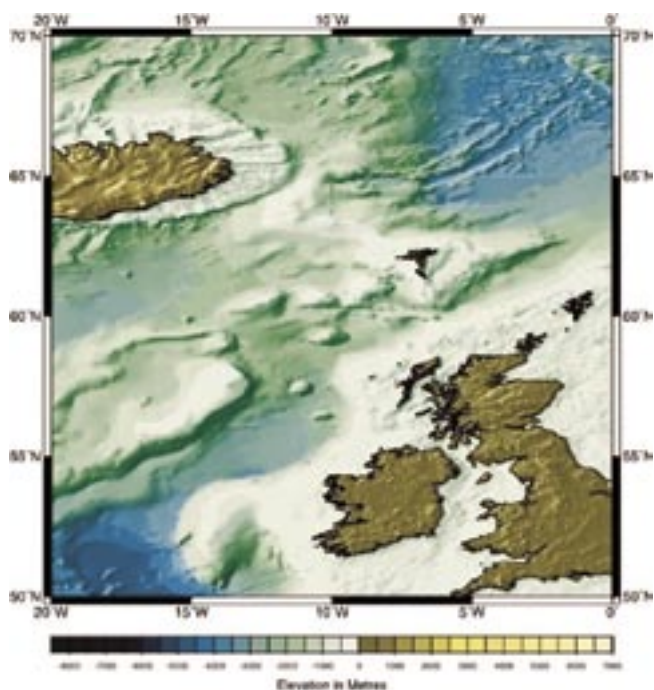


Figure 3a. Reproduced from the GEBCO One Minute Grid www.bodc.ac.uk/gebc

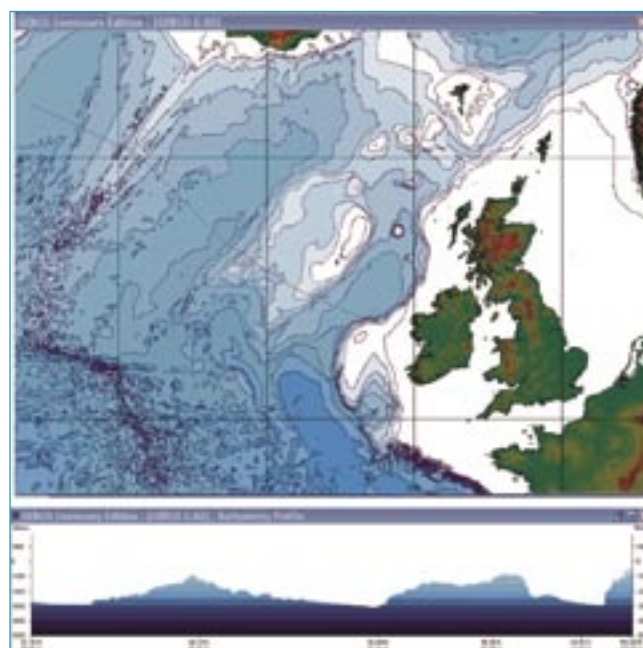


Figure 3b. Sample map and transect from the GEBCO Digital Atlas

(continued from page 11)

join together distributed data (see "Introducing the NERC DataGrid" in this issue of Coast Map News).

Alongside the NERC DataGrid, the Enabling Parameter Discovery (EnParDis) project aims to enhance the BODC Parameter Dictionary into an international standard vocabulary; to develop interoperability between the BODC Parameter Dictionary and other organisations' dictionaries, and to examine the potential of semantic and ontological tools for dictionary management and parameter discovery. The BODC Parameter Dictionary currently contains over 15,000 parameters. Work is well advanced in mapping biological entities in the dictionary to the Integrated Taxonomic Information System (ITIS) and keyword mappings to the NASA Global Change Master Directory are under development. EnParDis will exploit technologies such as the eXtensible Markup Language (XML) and is being offered for use to the EU Marine XML project.

Maximising the use of marine data

BODC is committed to making high quality oceanographic data, information and knowledge readily available to research scientists in academia, government and industry, as well as to the public. A crucial part of BODC's data management is the provision of web-based access to a variety of marine data catalogues. These are designed so that users can search, select and request data that meet their requirements. They also provide information about BODC's data holdings, and include information about data holdings managed by UK and European colleagues and collaborators. At present, most requests for data are submitted via the web-site and processed by BODC staff. However, we are moving towards greater accessibility of data through the web-

site, thus enhancing data delivery. The first phase, a redesigned web-site, will go live in late September.

Currently, directly available from the web-site are data collected by the National Tide Gauge Network (Figure 4). This Network, part of the National Tidal and Sea Level Facility, is funded by the Department for Environment, Food and Rural Affairs (Defra), operated by the Tide Gauge Inspectorate based at the Proudman Oceanographic Laboratory, and comprises 44 tide gauges related through the national levelling network to Ordnance Datum Newlyn.

BODC has a special responsibility for the remote monitoring and retrieval of quarter hourly sea level data from the Network. Daily checks are kept on the performance of the gauges and the data are downloaded weekly.

Data are processed, quality controlled and banked centrally to provide long time series of reliable and accurate sea levels. The data are used for tidal analysis and prediction, oceanographic research, coastal defence, storm surge warning systems, educational establishments and the general public.

Data from January 1980 onwards are currently freely available for download, whilst the remainder of the historic data will be online by August 2005. As new data are collected they are made available, with a three month lag to allow for quality control.



Figure 4. The National Tide Gauge Network

National and international collaboration with a range of Public Bodies, Universities, Industry, Intergovernmental organisations and other national oceanographic data centres means that, if BODC does not itself hold data, it is generally able to provide assistance in sourcing it elsewhere.

For further information about BODC, its catalogues, data holdings, CD-ROM products, data management expertise and collaborative ventures, visit the web-site at www.bodc.ac.uk

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Introducing the NERC DataGrid

Nearly every different scientific community has their own way of managing their data resources. People have different vocabularies that define their data, different file formats and databases, and different concepts of what constitutes a dataset. Some communities have excellent tools for finding data, but poor tools for using it, and some have no community tools at all. The NERC DataGrid is a research project that has the ambitious aim of eventually contributing some generic tools that can be used to build intercommunity networks for the environmental sciences. However, the early evolution of the NERC DataGrid (hereafter NDG) is built around a solution for data discovery and usage in the atmospheric and oceanic sciences, and the existing archives at the British Atmospheric and Oceanographic Data Centres.

Right now, it seems that everyone providing data access is frantically building "portals", which are super-web-sites providing access to their data. The NDG has taken the alternative approach that rather than building a portal, the NDG would provide the infrastructure upon which such portals could be built.

The design philosophy started with two basic premises: that it is very difficult to get anyone to start doing something new, and that whatever NDG does, someone else will have a better idea for doing some part of it. With those two concepts in mind, there was only one possible architecture for the NDG: what the computing world calls a "service-orientated architecture". In practice what that means is that the NDG is being built around some small bricks (services) which "data-providers" can choose to deploy with their existing tools, and which could be replaced at a later date. Where possible NDG has, and will, use pre-existing services.



As an example of how the service orientated architecture works, we can consider how discovery works in the NDG world. The basic concept is the same as how document discovery works on the Internet: users go to a search engine to find the website of interest. In the NDG, data providers run discovery clients that use a library metadata harvesting protocol (called the Open Access Initiative, or OAI) to make metadata about their data holdings available for "harvesters". Anyone can run a harvester, and then build a "data search engine" based on OAI harvesting to obtain the metadata and build a dedicated portal to data held in the NDG. (The NDG design allows free and open access to discovery metadata, but specialised metadata and the data itself can be protected by authentication controls and authorisation policies). The key point here is that any community can build their own portals based on metadata (and data) of interest to them. At any time in the future, we will be able to change how the discovery works simply by changing the discovery metadata format (provided it can be described in the eXtensible Markup Language, XML), or by changing the harvesting protocol. The data providers can use their existing metadata structures (if they have them) and/or scripts to generate the discovery metadata (which will be in the

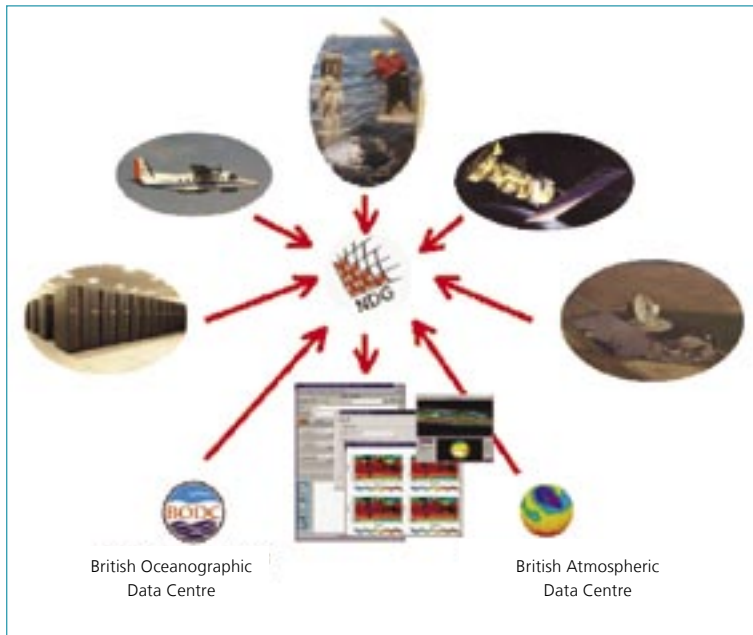
International Standards Organisation metadata format known as ISO19115). Of course, those without any metadata at all will have a big job to do before they can join in ...

Standards are important to the NDG, not only for the discovery but also throughout. Another key component of the NDG is the underlying schema that is used to describe the data so that services that manipulate the data can be built. Because Geographical Information Systems (or GIS) are important to many users of environmental data, the NDG has spent considerable time investigating how GIS can be connected to large and complex atmospheric and oceanographic datasets. Initial work has centred around the use of the Geographical Markup Language (GML) used by the OpenGIS consortium (or OGC*) and this forms the core of a new environmental data modelling language which NDG will deploy. Once the development of this new language is complete, it should be possible to layer oceanographic and atmospheric observations on top of both existing GIS layers and data layers from complex numerical models. New analysis tools will also be possible.

(continued on page 14)

* Regrettably the data manipulation world is rife with acronyms that are rarely explained. However, fortunately most of their translations can be ignored, and the reader can just treat them as nouns!

(continued from page 13)



The current status of the NDG project is that prototypes of most of the pieces are in place, and the discovery portal is up and working on limited datasets from BODC and BADC. In future many

more datasets will be added both from the data centres and from other NERC institutes and collaborative centres. However, while the initial deployment of NDG is to help locate and find data

at the Natural Environment Research Council institutes and university facilities, the NDG technology is completely open much as is the Internet. Extensions to other disciplines, outside NERC, and internationally are all underway and so at some point, the NDG name will change to reflect wider applicability.

*Bryan Lawrence and Roy Lowry
(on behalf of a team from
the British Atmospheric and
Oceanographic Data Centres
and the CCLRC e-Science centre)
<http://ndg.badc.rl.ac.uk/>*

RAP- Registry of Aquatic Pathology

The ability to accurately diagnose previously unrecognised disease conditions is dependent on familiarity with a wide range of pathogens, or potential pathogens, infecting hosts from a variety of sources. The capacity to refer to archive material including histological slides and images, as well as complete specimens of affected tissues and parasites, can further facilitate this. As a result, scientists in the Pathology and Parasitology team at CEFAS, Weymouth have been busy developing an exclusive database and specimen archive.

The Registry of Aquatic Pathology (RAP) has been developed to provide access to a large number of pathological specimens accumulated from a variety of sources around the world. It is a unique reference collection of pathological conditions caused by a

variety of agents including viruses, bacteria and parasites, as well as environmentally induced pathologies. With a database at its core consisting of over 800 accessions dating back to 1977, the RAP includes examples of

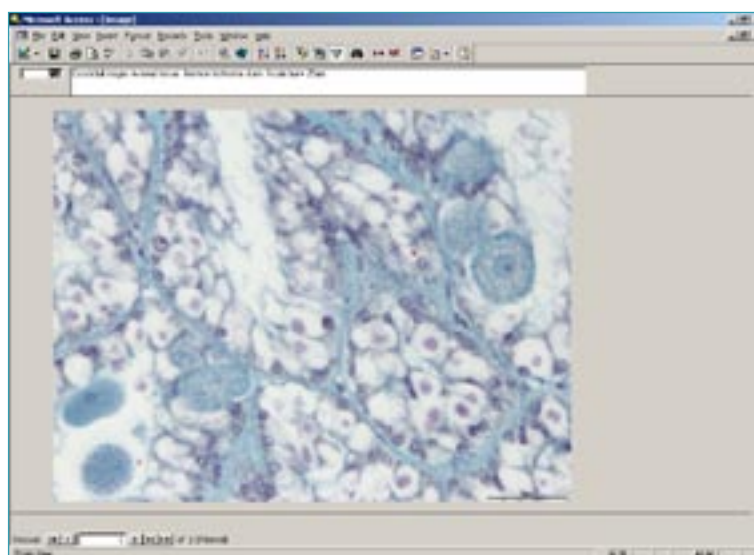
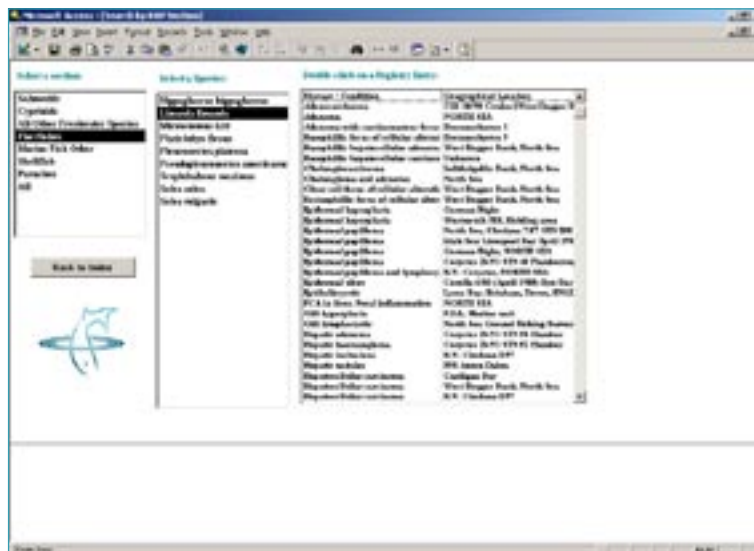
disease conditions and parasites from aquarium, cultured and wild fish and shellfish from freshwater and marine environments around the world. New accessions are continually being added.



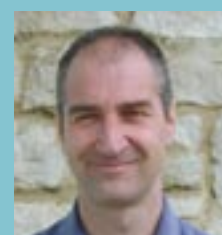
The RAP is arranged into seven sections incorporating salmonids, cyprinids, freshwater (other), flatfish, marine (other), shellfish and parasites. Each database entry contains information relating to that accession, including common and Latin species names, the disease/condition, aetiology, geographical origin, diagnostic techniques applied and a detailed description of the pathological features present. In addition, many accessions contain images of gross pathological lesions as well as those taken at the microscopic level. All related preserved material and specimens are stored in tissue banks and are available for additional examination or for future assessment using 'new' techniques that become available. In addition to wax blocks and histological slides, this material may consist of frozen tissues, transmission electron microscopy (TEM) plastic embedded blocks and scanning electron microscopy (SEM) stubs and parasites.

As part of ongoing development, work is currently underway to make the RAP database more accessible to CEFAS staff and the wider scientific community by placing it on the Internet. It is anticipated that individuals will be able to register and log on to a "user area" enabling them to browse and search the database via a web interface. This will help to increase awareness of areas of science that CEFAS is currently involved in and establish the RAP as an internationally recognised resource and repository for pathological specimens and parasites. It is planned that this phase will be completed by the end of March 2005. Once complete Coast Map News will certainly let you know!

If you have any comments or would like to learn a little bit more about the RAP, then please do not hesitate in contacting us.



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Atlas of UK Marine Renewable Energy Resources

Background

In September 2003, the Department of Trade and Industry (DTI) commissioned a consortium led by ABP Marine Environmental Research Ltd (ABPmer) to produce the Atlas of UK Marine Renewable Energy Resources. The Atlas provides spatial quantification of the wave, tidal and wind resources within the limits of the UK Continental Shelf (UKCS) (Figure 1). DTI will now use the Atlas to assist decisions on future rounds of licensing for large-scale deployment of marine renewable technologies.

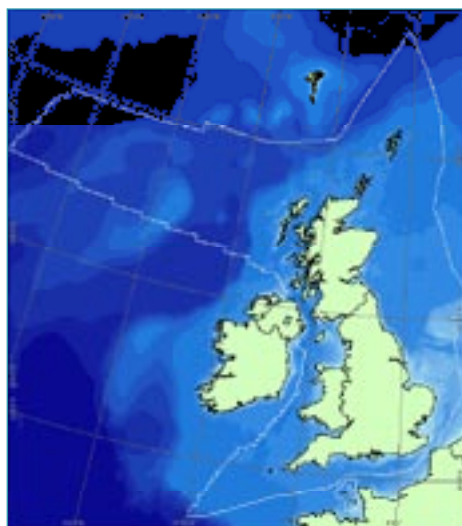


Figure 1. Study area, the UKCS, of the Atlas is shown enclosed by the white line

This work falls within DTI's Strategic Environmental Assessment (SEA) combined programme covering Oil & Gas and Marine Renewable agendas, a programme that Geotek and Hartley Anderson are jointly managing on behalf of DTI. For further information on the SEA programme please refer to www.offshore-sea.org.uk

The Consortium

The project team who delivered the Atlas brought together the UK's foremost companies in marine science and offshore wind energy, namely ABPmer, Garrad Hassan & Partners Ltd, Met Office and Proudman Oceanographic Laboratory (POL).

This consortium comprises the national centres for marine data, the technical

understanding and awareness of the marine renewable issues and provides established links with the rapidly developing marine renewable industry.

Inputs

The Atlas uses the best sources of strategic level information presently available, including input from models operated by the Met Office (Global, European and UK Waters Wave Models) and POL (the High Resolution Continental Shelf model (3D UK Waters model)). These provide, at the finest scale, a spatial resolution of 12 km and 1.8 km respectively over the majority of the UKCS, with extremities covered with a coarser grid size. (Figure 2). An important stage in the project included industry consultation as provided by numerous developers in the marine renewables industry.

Outputs

Examples of the renewable energy resources that are presented in the Atlas include:

1. Waves: significant wave height, period, power;
2. Tides: range, current speed, power; and
3. Wind: speed, power.

These are provided for a range of spatial scales i.e. spring and neap, annual and seasonal, depending upon the resource of interest.

The information provided for each resource covers the entire UKCS and the final output provided to DTI comprises :

1. a technical report;
2. an Atlas of wave, tidal and wind resources; and
3. a comprehensive GIS database of resource themes with data query tools.

The work undertaken for the Atlas is based on a large number of data points covering the entire UKCS with each data point provided with an associated large number of resource parameters. A geographical information system (GIS) was used to organise, manage, map and preserve a database of this information. It is hoped that as improved models are available and archives of wind and wave data develop the database will be updated.

The database is available for use by a standard application of ESRI ArcGIS 8.3 which can facilitate user defined spatial mapping of the main resource



Figure 2a. The location of the wave and wind model grids, as used in the Met Office Global and UK Models. These have a spatial resolution of 60 km and 12 km respectively

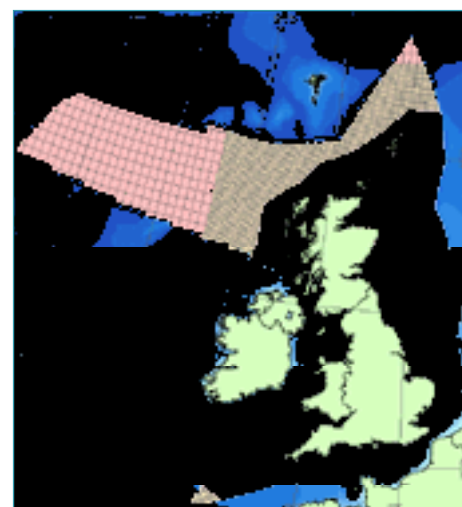


Figure 2b. The location of the tidal model grids, as used in the POL NEA, CS3 and HRCS Models. These have a spatial resolution of 35 km, 12 km and 1.8 km respectively

parameters. These data can be tested against a limited number of basic criteria such as water depth and distance offshore to identify and assess resource areas. In addition, a number of bespoke tools assist further resource assessments. Query functions using these tools extract information from the database and use MS Excel for graphical and tabular presentation.

Prior to an assessment of a resource, it is important that any other environmental constraints are taken into consideration, for example water depth. This constraint is important to different technologies for various reasons, for example the nature of the wave resource is depth-dependant with those waves in shallower water being more susceptible to breaking. The bathymetric information held within the Atlas can therefore be interrogated for selected areas where depths are between a user specified range. The selected depth range can be interrogated further through the request for a selection of a pre-defined range of, for example tidal power. As an example, locations in the depth range 40 to 150 m whose wave power is within the range 10 to 20 kW/m have been selected, as shown in Figure 3. It can be observed that these wave powers are restricted to the north North Sea, south-west and the north-west.

Data more suited to graphical presentation are items illustrating temporal and spatial variation.

Examples are :

1. Spring and neap current speed through depth. In this example it can be seen that the velocity profile through the water column is similar on the spring and neap tide, with the greatest current speed for both predicted in the upper 50% of the water column.
2. Significant wave height. This can be presented in both monthly and seasonal graphs for a maximum of ten locations per graph. In this example it can be seen that the wave heights at all locations are greatest in February and smallest in July.

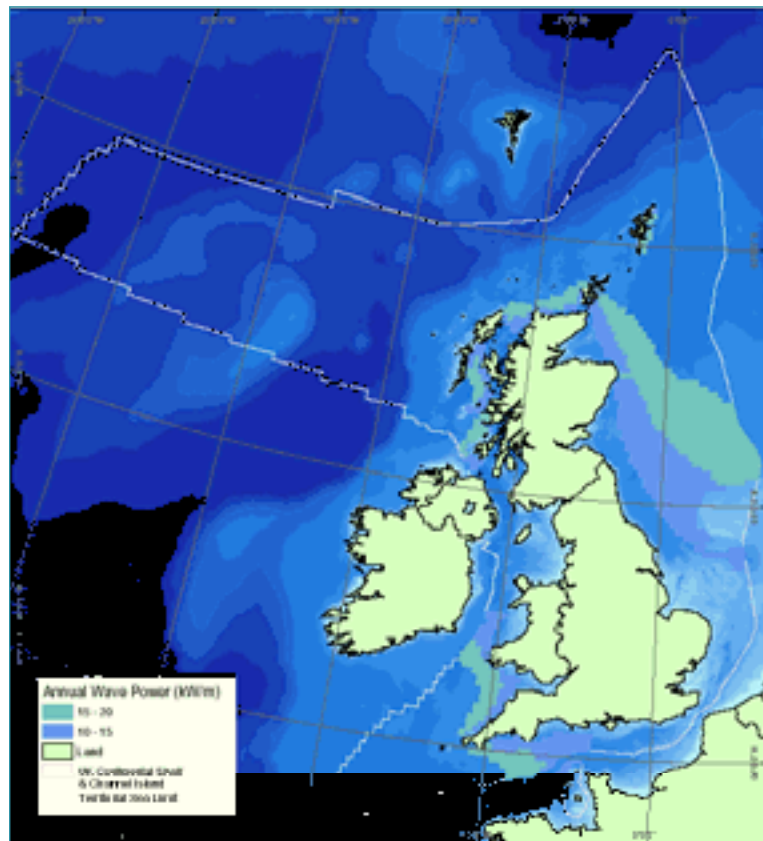
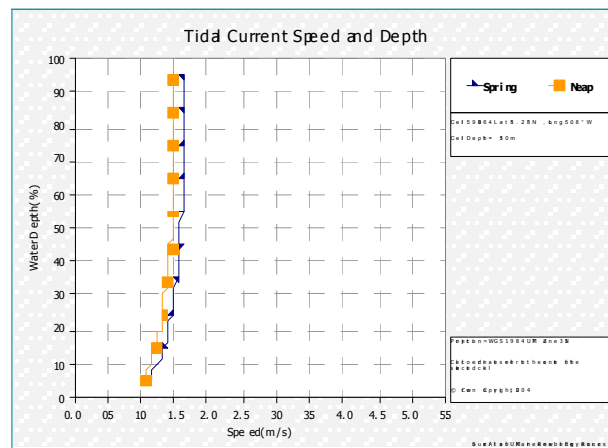
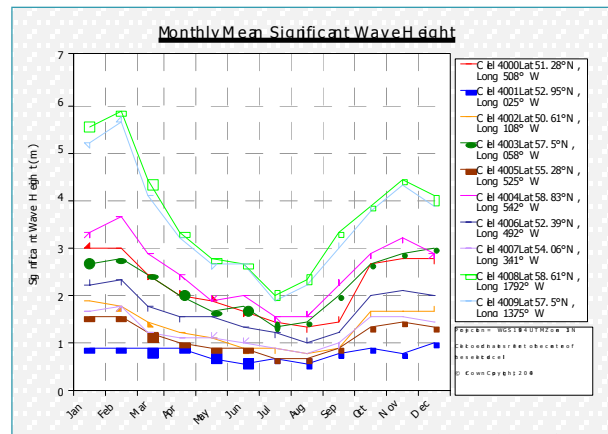


Figure 3. Resource interrogation : bathymetry between 40 and 150 m combined with wave power between 10 to 20 kW/m

(1)



(2)



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The Coastal Inventory could be a new GIS dataset for:

Water Framework Directive Managers:

- Spatial Planners
- Port Authorities
- Coastal Developers
- Boat Owners
- Tourist Authorities
- Coastal Engineers

Supplying Information on:

- Shoreline Type e.g. Revetments, sea walls, beaches, docks, rocky shores
- Shoreline Features e.g. Jetties, piers, pontoon, steps, ladders
- Shoreline Vulnerability e.g. State of repair, conditions, erosion
- Adjacent Land use e.g. Agriculture, industry, residential, amenity

An Essential Tool for the Water Framework Directive?

A main objective of the Water Framework Directive is to establish an integrated monitoring and management system for all waters. The Coastal Inventory dataset could become an essential tool for the monitoring and management of coastal, estuarine and riparian waters.

It is a homogeneous, comprehensive and updateable spatial database offering high-resolution information on shoreline type, shoreline features, adjacent land use and shoreline vulnerability. This dataset can be easily imported to any GIS system.

Accessing the Data

The Coastal Inventory Databank is comprised of a number of datasets:

1. *Shoreline Type*; 2. *Shoreline Features*; 3. *Shoreline Vulnerability*; 4. *Adjacent Land Use*.

The construction of the final datasets is dependent on the requirements of the end user. Examples given here are relevant to a number of applications including coastal engineering, spatial planning and development and shoreline maintenance.

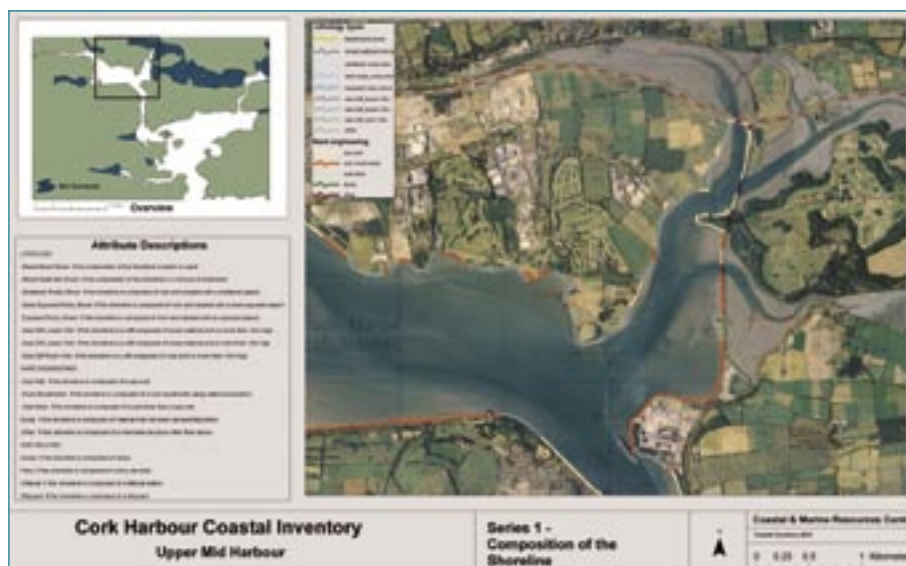


Figure 1. Coastal inventory showing main map, overlay map and legend

(1) *Shoreline Type Dataset*

- Natural shoreline, such as beach, rock shore, cliff
- Reinforced shoreline, such as sea wall, revetments
- Maritime shoreline, such as docks, lifeboat stations

(2) *Shoreline Features Dataset*

- Jetty, pier, pontoon, steps, ladder etc

This dataset is especially useful for those requiring access to and from the land such as emergency services, boat owners and tourism agencies.

Once the shoreline type/feature has been recorded then a number of characteristics are ascribed to the attribute (these characteristics are dependent on the particular shoreline type/feature).

Firstly the condition of the shoreline type/feature is graded, e.g.:

- Sea wall - good condition
- Rock revetments – require repair work
- Beach – accreting
- Jetty – require repair work
- Slipway – not in use, derelict
- Ladder – unusable

The characteristics that were ascribed in the Shoreline Type/Feature datasets are used to create the 3rd dataset.

(3) *Shoreline Vulnerability Dataset*

This dataset uses information gathered in relation to the state of repair, the working condition, the extent of erosion of all of the shoreline types and shoreline features.

From the Shoreline Type dataset the land behind the shoreline is classed for usage, e.g. agriculture, residential, industrial.

A 4th dataset is then extracted.

(4) *Adjacent Land Use*

This dataset gives an overall impression of the usage and management at the interface between land and water.

This dataset is especially useful for planners and those interested in conservation corridors. It can help in the identification of pollution problems in relation to point source contamination. It also provides an overall impression of features that define the coastal zone.

Numerous other combinations of data can be extracted depending on end user requirements.

Visualising the Data

There are a number of choices available when visualising the data. Information is collected using sophisticated Global

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Positioning System technology and all of the post processing is carried out, in house, by the Coastal and Marine Resources Centre, thereby allowing flexibility in individual survey design, data processing and visualisation 'end user' output.

A few suggestions for visualising the data are given below.

1. Use a Free GIS Viewer

Install a free GIS Viewer e.g. ArcReader/MapInfo ProViewer, onto your computer and view a customised GIS which can be interrogated.

Directly access the datasets in a free user-friendly programme. All of the preprocessing has been carried out so even the non-GIS expert can easily operate the Coastal Inventory with ease. Zoom to areas of interest, turn on and off data, overlay data layers on aerial photographs, query the datasets and print to ready made templates.

2. Use Proprietary Software

If you have other types of software, then the GIS can be customised to suit your needs.

If you already have ArcMap software installed, a tailor made GIS can be created in this ESRI program. If you use MapInfo then the data can be made available in this format. If you prefer to use 'open GIS' server technologies then your GIS can be displayed over the internet/intranet using free software.

3. Print-Ready Maps

If you require quick and easy maps without having to use a GIS then PDF maps can be supplied for your area of interest. These maps can either be digital and ready to print or they can be supplied as a hardcopy Coastal Inventory Atlas.

The PDF maps contain all four main areas of interest (although maps can be tailored to suit your specific



requirements). The main areas of interest are:

Shoreline Type;
Shoreline Features;
Adjacent Land Use;
Shoreline Vulnerability.

The maps are designed to suit end user requirements. Figure 1 illustrates a main map, an overview map, attribute information and a legend.

The digital PDF maps are navigated by using pre-inserted hyperlinks to allow you to move backwards and forwards between the individual maps.

4. Extract Your Own GIS Data

Use directly or export GIS files to be used in your own GIS software package.

Use the data in whatever way you like. You can decide what data to extract depending on what data needs you or your end users have.

Data Commissioning

If you are interested in gaining access to Coastal Inventory data, or commissioning the collection of new data, or if you would just like more information on the datasets available, please contact the CMRC.



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<http://cmrc.ucc.ie>

Future Directions for Operational Marine Information Systems

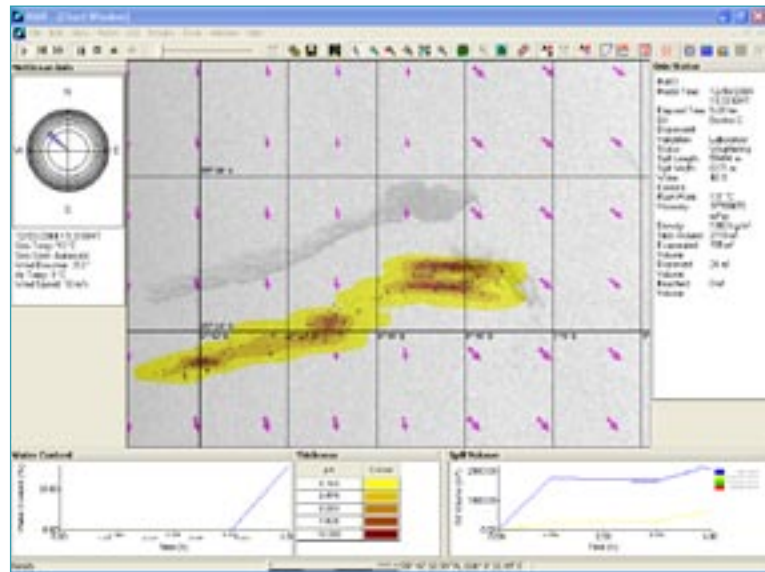


Computer-based models to predict the dispersion of pollutants at sea have existed for several decades. Until the late 1980s, they were often based within hydrodynamic models hosted on large mainframe computers. Simulations could take several hours to run and the results would require additional processing in order to be interpreted and presented in reports.

By the early 1990s, advances in desktop computing power, graphical user interfaces and the introduction of Geographical Information Systems gave rise to the development of a new generation of PC-based dispersion modelling applications. Often termed 'Marine Information Systems', the new applications were designed to be quick to set up and run, and to display model results instantaneously in a form that could be easily interpreted or presented.

Early developments

One of the earliest of these systems was an oil spill trajectory and weathering model, OSIS (the Oil Spill Information System, released in 1992), developed by BMT Ceemaid and Warren Spring Laboratory (now BMT Cordah and AEA Technology, respectively). Designed as a standalone application on the Microsoft Windows™ platform, the system made use of a GIS-based interface, through which operators could both configure the model and view its results. The configuration was kept as simple as possible by limiting input data to that which operators could reasonably be expected to have to hand in an emergency spill response situation; for example, spill rate, oil type and weather information. The underlying oil spill dispersion calculations were independent of hydrodynamic calculations and could be driven using stored data, such as tidal current harmonics (which allow prediction of tidal currents for any period). As a result, typical scenarios could be run within a few minutes. Model outputs interacted with the GIS



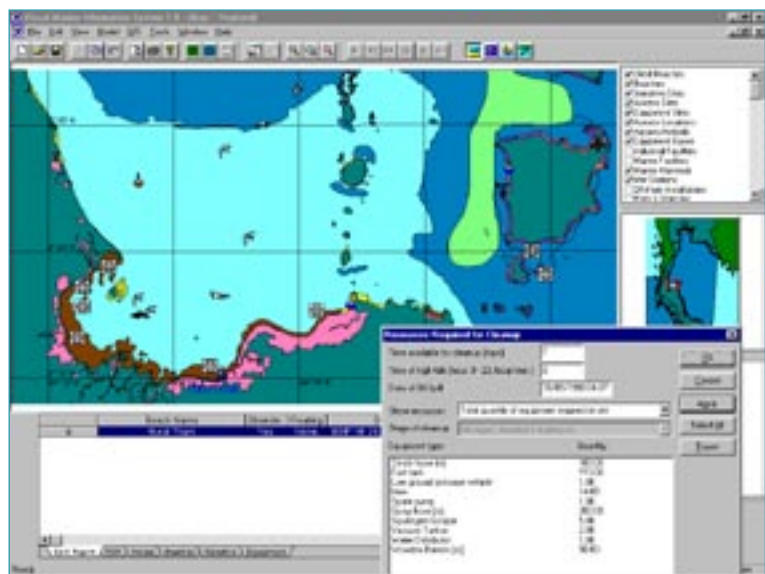
The latest versions of OSIS include satellite data imports and remote hydrodynamic data links

as the model ran, allowing operators to instantaneously view predicted shoreline oiling against maps of environmental sensitivities.

The GIS functionality within the models gave them potential for integration with emergency response contingency plans and environmental management systems. In 1995, SOCRATES, a sister application to OSIS, was developed

to act as a 'decision support tool' during oil spill cleanup operations. The SOCRATES system, developed for the UK Government Marine Pollution Control Unit (now Maritime and Coastguard Agency), allowed local authorities to transfer contingency plan data traditionally kept in paper files into electronic formats, such as GIS

(continued on page 22)



SOCRATES Version 2.0 includes spill response logging databases. This information can be used in subsequent compensation claims

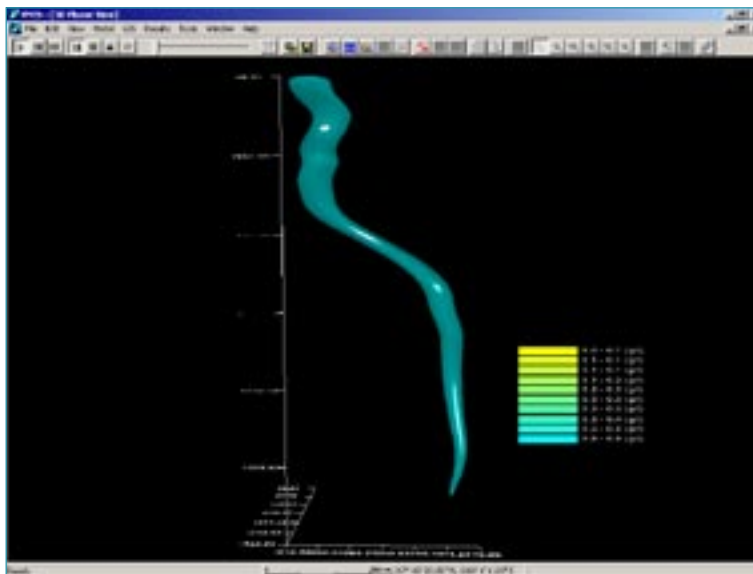
(continued from page 21)

maps with file links. This included data such as local shoreline characteristics and access points, oil containment and cleanup equipment storage details and the location of sites sensitive to pollution. In the event of shoreline oiling, SOCRATES could use this data to suggest the resources required to respond to the cleanup.

Where previous models had been operated by physicists or oceanographers, the new systems were designed for use by experts and non-experts alike. They were quickly taken up by environmental managers in sectors such as the oil and chemical industries, and by local and national authorities responsible for pollution prevention and response. The speed of the models enabled several scenarios to be considered within a short space of time and they were ideal for use in preparation of pollution spill contingency plans or evaluation of routine discharges, as well as response to emergency situations.

Systems' implementation

A marine information system configured for one of BMT Cordah's SE Asian clients in 2001 illustrates a typical implementation. The client was supplied with a combined OSIS-SOCRATES package configured with environmental sensitivity maps displaying sites such as coral reefs, mangrove forests and turtle nesting areas. Much of the coastline was remote and accessible only by boat for any potential shoreline cleanup. Helicopter-borne video footage at sites over 1,400 km of coastline was taken and embedded in the GIS to allow rapid cleanup assessment in these areas. The footage was also used to configure the SOCRATES shoreline characteristics' database. Suitable hydrodynamic model data was not available for the region and current data was extracted from the client's own current meter records data and processed for use within the oil spill trajectory and weathering model. The system was supplied as part of a larger package, which included oil spill response training, equipment reviews and quick reference guides for pollution cleanup in different habitats.



The sub-sea oil release system: designed to model deepsea blowouts and pipeline leaks (BMT Cordah/AEA Technology)

The OSIS and SOCRATES systems were used for emergency response during the *Sea Empress* oil spill incident. In February 1996, the *Sea Empress* ran aground in the entrance to Milford Haven (South Wales). Over 6 days, approximately 72,000 tonnes of crude oil were released, stranding on beaches across approximately 200 km of shoreline. Within a few hours of the grounding, the OSIS

model was implemented on behalf of the UK Marine Pollution Control Unit to forecast the path the oil would take. As oil continued to leak, the OSIS weathering model was used to determine the timeframes within which chemical dispersants could be sprayed on the slick: The success of dispersants is dependent on a number of factors including the level of oil-water emulsification within the slick, which OSIS can predict. Dispersant application was successfully employed to reduce the water surface slick volume during this incident.



During the first days of the incident, SOCRATES was configured with shoreline and equipment data derived from local records and set up in the incident's Joint Response Centre.



Pictures of *Sea Empress* oil spill clean-up courtesy of Oil Spill Response Limited

Here it was used initially to provide information for the shoreline cleanup, and subsequently as a tool to collate the vast quantity of data generated during the response operation. This information was later released on user-interactive CD-ROM as part of a post-cleanup information dissemination programme.

Current developments

Marine information systems are now available to support a range of maritime activities from port operations to search and rescue missions and deep sea oil exploration. Many systems now support industry standard GIS formats (e.g. ESRI or MapInfo), as well as ENC formats such as S57 or ARCS. Whilst new models continue to be developed, notably in areas such as offshore decommissioning and sub-sea acoustics, many have now advanced to a point where further enhancements are producing only minimal returns. The focus of systems' development is switching towards the data underlying the models.

The models can only be as accurate as the oceanographic and meteorological data that drives them. In order to maintain speed, systems have often used data based upon a combination of tidal current predictions and typical seasonal current patterns. In regions such as the North Sea, where predictable tidal currents predominate, this is generally a suitable approach. However, in areas where current patterns are less predictable, the systems have sometimes required input from hydrodynamic and meteorological forecast models to maintain accuracy.

In the past, this could add significantly to the time required to get results from the systems. However, availability of online metocean model output, together with today's increasing bandwidths, has allowed near real-time (NRT) oceanographic forecasts to be incorporated more rapidly. For registered users, agencies such as the UK Met Office now make forecasts from, for example, their global Forecasting Ocean Assimilation Model (FOAM) or their European Waters

Shelf-seas forecast model available for download over the Internet. Systems have recently been produced for coastguards and navies that utilise links to such data sources.

An initiative being promoted by the UK Met Office, the Maritime and Coastguard Agency, the Environmental Systems Science Centre (Reading University) and BMT Cordah aims to make a wider range of global marine environmental data available through an Internet data brokering system. Supported by the Southeast England Development Agency, the initiative will bring together data providers, systems' infrastructure developers and maritime industry end users to build up proposals for online data delivery channels. As well as addressing requirements for NRT forecast data, such a broker will provide end users with an opportunity to configure their marine models with data for new areas, and provide a wider market for data suppliers. For further details about this initiative, please see www.envdatacluster.net.

Other developments in marine information systems focus on the integration of existing technologies or techniques. For example, recent projects have aimed to combine pollution spill models, metocean forecast models and satellite imagery. Computer-aided approaches to identifying pollution such as oil slicks from satellite images have been developed and are being improved. The eventual aim of such integration, which is being developed through projects such as the European Commission co-funded CLEOPATRA project, is to be able to identify oil (and other) spills and predict their trajectory within an hour or so of a satellite pass, to allow rapid initiation of the appropriate response. An additional application is 'backtracking' spills to help in identifying candidate sources (perhaps through integration with ship mounted Automatic Identification Systems which are being mandated through the International Maritime Organisation).

The future

In order to meet future customers' requirements and expectations, marine information systems will have to become more flexible. Whilst such systems will continue to be used in environments where standalone versions are the most practical option, the focus is expected to increasingly move to centrally hosted systems that end users will access through local 'thin client' programs or web browsers. This will have a range of benefits to system operators: they will be able to choose from a wide range of remotely stored data and won't be limited to the datasets within their tailored standalone systems; they will not have to worry whether they have installed the latest maintenance patch; their upfront costs will be cheaper and they won't be restricted to only the models they've purchased; they will have access to other web services such as chart and map servers and a range of different metocean data providers and finally, of course, they will be able to run the models almost anywhere. Additionally on-line services can offer a full audit trail to be used during post incident analysis in helping assess the effectiveness and appropriateness of the response. With advances in wireless communication technologies, the future lies in giving operators the flexibility to access their modelling tools for emergency pollution response, search and rescue missions, or simply routine operations, both at their desks and on site.

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Go wild on the web with English Nature's new website, Nature on the Map

In December of last year English Nature launched its new interactive mapping website, Nature on the Map (<http://www.natureonthemap.org.uk>). Plenty of these mapping websites have emerged on the internet over the last few years, and several of those on offer in the UK are environment or biodiversity-related (Multi-Agency Geographic Information for the Countryside (MAGIC), National Biodiversity Network (NBN) Gateway, What's In My Back Yard (WIMBY)). Nature on the Map's niche, however, is in providing the general public with a simple and intuitive system for finding protected wildlife areas in their neighbourhood or elsewhere, whilst offering more for those who care to dig a bit deeper.



Figure 1. Nature on the Map welcome page

The user can choose from five themed maps (Nature Reserves, Sites of Special Scientific Interest (SSSIs), International Sites, Biodiversity Action Plan Priority Habitats, or Geological Sites), and an Advanced Map which offers a more flexible pick'n'mix approach to designing map content. They have access to all the basic navigation functions you would expect from such a website (a zoom-in/zoom-out 'ladder', pan arrows, searching on postcodes, places, sites and administrative areas). They can also use a large map or a small one (to suit internet connection speeds), print maps they create or email them to others.



Figure 2. The main map page, showing the Wash SSSI and BAP Priority Habitats such as extensive mudflats

Another powerful facility is the ability to identify protected sites that fall partly or wholly within counties or other administrative areas, or those that fall within a radius of a postcode or place. The user simply clicks through a very simple wizard to generate a table of the results, with links to take them from any listed feature straight to a map of a protected site falling within their area of interest.

Users who want to discover more about the features they are interested in will find that links to further information

are available for some map layers. New report pages about SSSIs and the condition of their constituent units has been recently made available on our main website. Nature on the Map also links directly from SSSIs to reports about species records from the NBN Gateway. Other links point to pages about Natural Areas, National Nature Reserves, our Area Teams and

Special Areas for Conservation on the Joint Nature Conservation Committee website. This aspect of the site will continue to provide one of its most useful features, and will expand wherever appropriate links to new web resources about the map features emerge.

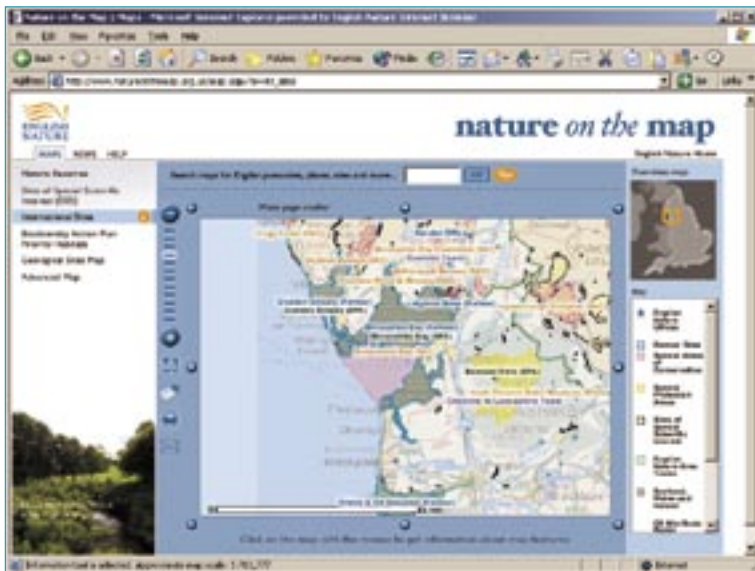


Figure 3. International sites in Lancashire around Morecambe Bay

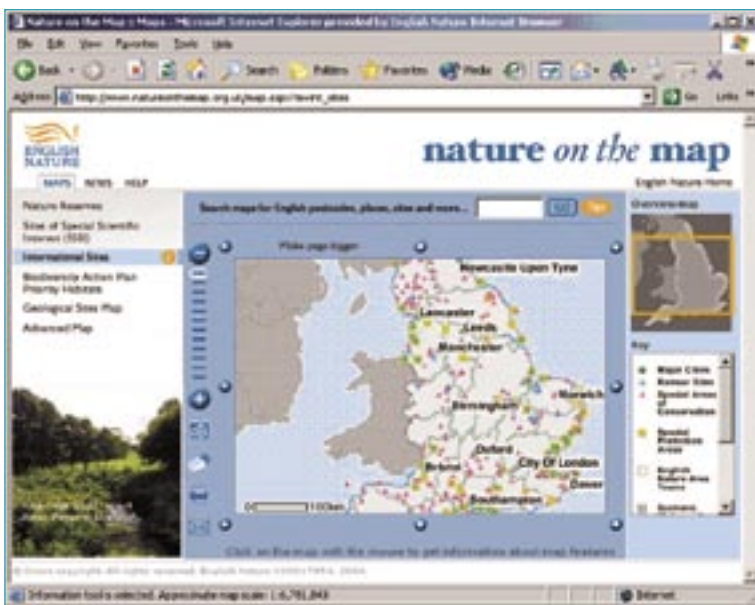


Figure 4. International sites represented for clarity as points at small scales

So what's in it for Coastal and Marine professionals? At present the system offers limited coastal and marine information – coastal designated site boundaries are of course to be found in the system (as described above), and several of the BAP Priority Habitats are obviously coastal (Mudflats, Coastal Vegetated Shingle, Coastal and Floodplain Grazing Marsh, Maritime Cliff and Slope, Saline Lagoons, and Coastal Sand Dunes), and these are set against OS mapping (up to 1:10,000 scale black

and white mapping) for context. The system was designed, however, to be adaptable and expandable, so there is great potential to add new maps or more layers to existing maps - perhaps in future we shall develop a new map, with a coastal or marine theme including seabed habitats, biodiversity 'hotspots' and so on.

Current plans for the future do not immediately point seawards though. We have already moved on a little

from the public user base to provide an 'Advanced Map' that is geared more to providing biodiversity planners and professionals with information and guidance on how their local patch rates for its allocation of different BAP Priority Habitats. We are now looking at a range of enhancement projects, for example to assist farm advisers in targeting new agri-environment scheme applications.

We have had an excellent start, with user numbers climbing steadily since December. The site has met with very favourable reviews not just from our own staff but, perhaps more importantly, from users who can feedback via a form on the website.

Nature on the Map can be found at <http://www.natureonthemap.org.uk> or via link from the home page of our main website at <http://www.english-nature.org.uk>



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Ten Questions on....Metadata

Q1: Metadata...what is it and why is it important?

The standard and rather broad definition that everyone references is "data about data". So, metadata for seabed bathymetry could describe who carried out the survey, the coverage area, when it was done, to what degree of accuracy, how this data should be portrayed, who has permission to access it etc. In effect, metadata should allow anyone to 'discover', 'explore' and 'exploit' information.

Metadata can describe a whole range of 'objects' from documents to data to images to people and their activities. A fuller description of geospatial metadata is given on <http://www.gigateway.org.uk> .

Q2: Are there different types of metadata?

Yes, metadata is often classified under the following categories:-

- a) 'administrative' which provides a wide variety of information related to the display, use, management and interpretation of objects eg. access rights;*
- b) 'structural' which provides information on the physical structure of an object such as the file format of a specific dataset; and*
- c) 'descriptive' (often termed 'discovery' metadata) which describes the object so as to facilitate the search and identification eg. through key word descriptors or an abstract.*

To date, much of the focus in terms of standardisation work has been on descriptive metadata at the discovery level.

Q3: But it's a pretty boring subject at the end of the day isn't it - why is it so important?

Actually, when you get into the 'domain' it becomes much more interesting (and complex) - considerable expertise has been drawn from the world of library-based cataloguing to try and make knowledge sharing a reality. It is absolutely critical if we are going to avoid all the past, and indeed current, problems associated with finding information and making good use of it.

Organisations across the UK are now expected to make their data available for re-use so it is vital that there are appropriate repositories that can be searched effectively. There are also international efforts to improve data discovery and use, for example see the Marine Environmental Data Inventory at <http://ioc.unesco.org/medi/search.html>.

Q4: Won't metadata management increase data management costs?

Projects can cut corners through a lack of consideration of metadata and information re-use – in effect, treating the exercise as a complete one-off and effectively throwing away the data at the end. However this approach is now widely discredited. Anyone commissioning such work should consider how information collected during the project is going to be published and managed. Expectations for metadata should be clearly spelt out. Organisations must build in processes that allow others, particularly from outside, to find that information easily, assess its value to them and then potentially make use of it.

So, yes it probably will add cost but these overheads should not have been avoided in the first place.

There remain issues about the level of detail at which metadata is captured. Potentially the more detail captured, the easier it is to find and the more value can be added to it. That must be balanced by what are the highest priorities for potential users and what is reasonable in terms of cost. Defining minimum acceptable standards is, therefore, of great value.

Q5: Even if it is considered, in my experience it is rarely done properly - what can be done to ensure it is?

Firstly, an organisation needs to accept strategically that it is going to manage and publish information effectively. Once that's accepted they need to put this into action with procedures across-the-board to ensure any data capture exercises are done properly. Best practice suggests that metadata capture should not be an after-thought - it should be an integral part of the data capture and processing phase. It may require multiple data experts to complete metadata records particularly if datasets go through a series of processes in stages before being published.

Q6: There are loads of national and international standards that keep being mentioned - where do you start?

This is a complex area frequented by different and not always complimentary interest groups. There are a broad range of standards at international (ISO), European (CEN) and national (BS) levels, many of which have some impact on organisations looking to publish resources relevant to spatial information. To answer this properly would take many pages.

Suffice to say there are a few critical ones. There is an international generic metadata standard commonly applied to documents called Dublin Core (see <http://www.dublincore.org>) - this is a 'discovery level' model and only contains about 15 key fields. It is not specific to geospatial information in any way although it can be used in a limited way. This standard is the basis for the UK eGMS (eGovernment Metadata Standard).

The GI/Geomatics International Technical Programme TC211 is responsible for ISO 19115 and 19139, both of which apply specifically to geospatial metadata, the latter being the definition of the XML schema for the former. ISO 19115 has been published although it cannot be put into practice until 19139 has also been published which is now likely to be at the end of 2004. The UK Glgateway is committed to making its tools and nodes compliant with ISO 19115.

ISO 19115 includes both high level 'discovery' metadata and also lower level, detailed metadata. As such, it will allow full discovery, exploration and exploitation capabilities. However, it may go beyond what many organisations consider to be critical. The discovery level sub-set is likely to be defined through the work of the UK Glgateway as a minimum standard. While this will make information easier to find, in order to explore and fully exploit it requires all the 'administrative' and 'structural' detail in ISO 19115.

If you want to get into the nitty gritty of geospatial metadata standards try <http://metadata.dgiwg.org/>.

Q7: So, as a UK organisation how do I get started?

Before you do anything you really need to decide what the needs are for this metadata – who is going to

use it and for what? There is little point in producing metadata to an infinite level of detail if all you want to do is help people to find it and contact you for further information. Requirements for managing and delivering metadata will vary between organisations, so you need to consider what these are before jumping in at the deep end. Bear in mind that different organisations can implement the same metadata standard in many different ways!

If your organisation is already committed to effective metadata management then you can get specific advice on geospatial metadata management and publication through the Glgateway team (<http://www.glgateway.org.uk>).

We would suggest you think about managing your own metadata and, if you want to share it with the outside world, you have two options – you can use an existing metadata node or you can set yourself up as a new node. Organisations such as British Geological Survey and the British Atmospheric Data Centre have done this. There are now ISO 19115 compliant, commercial software tools available off-the-shelf that can significantly speed up the process of creating a new geospatial metadata node using specifications from the Open GIS Consortium to facilitate distributed searching and querying.

Q8: What standards should I follow?

If you want to start now then you can work with the existing UK standards, notably the NGDF Standard (National Geospatial Data Framework), also known as the Glgateway Discovery Metadata Specification (see <http://www.glgateway.org.uk/metadata/metadataspecs.html>). This specification is likely to closely resemble those being developed through a Glgateway led project

called UK Gemini (Geo-Spatial Metadata Interoperability Initiative).

The Gemini Project is currently working on the creation of a UK profile for ISO 19115. It should report by the end of 2004. It will define a set of elements that will allow for ISO compliancy and also 'mapping' with the eGMS (a UK eGovernment guideline on metadata based on Dublin Core), so that organisations will only need to create one set of metadata to comply with international and national standards. The UK Gemini profile is due to be published this Autumn, but again will rely on ISO 19139 for implementation.

There is a range of tools available from the Glgateway to help you. MetaGenie v 1.0, available as a free download, will create and validate records to NGDF standard. If you begin to create NGDF compliant metadata now, MetaGenie v 2.0 (coming soon) will provide a translation tool to convert your NGDF records to be ISO compliant with minimal intervention.

Q9: How can I maximize the likelihood that people will 'discover' my information?

There are several approaches to organizing metadata so it can be searched effectively. We are all used to Internet search engines like Google, designed to offer highly effective ways of searching the web. However, these engines are not designed for searching dedicated information networks. It is widely accepted that specialist search tools can be configured to optimise search and retrieval much more effectively.

Uncontrolled keywords associated with metadata objects, while easy to apply, provide a lack of

(continued on page 28)

consistency in choice of words, with different spelling and forms of words, all of which can compromise searching by subject. Rather than allowing metadata compilers to enter any key words they feel are appropriate, a set of pre-defined and consistent keywords can be defined through what is known as a 'controlled vocabulary'.

An example is the Glgateway DataLocator service that uses a defined set of subject key words to facilitate searching.

This can be taken further by grouping metadata objects (datasets, documents etc) into a hierarchy of relevant 'subjects'. This creates what is known as a taxonomy (after zoological and botanical classification systems). An example is the UK DEAL site (<http://www.ukdeal.co.uk/scripts/find.cfm>) where objects are grouped under higher level subject areas such as Well Data, 2D Seismic Surveys, 3D Seismic Surveys etc.

Taxonomies can be further extended by Thesauri – these are more powerful as they can better describe the world by not enforcing a rigid hierarchy. Subjects such as "2D Seismic Surveys" can be associated with other synonymous terms or related terms. For example, if I searched for "seabed acoustic surveys" I would find the "2D Seismic Surveys" and "3D Seismic Surveys". A non-coastal example is <http://www.nla.gov.au/apais/thesaurus/>.

Thesauri can be further extended to model the real world in a more complex manner using ontologies which classify subjects into types and associate properties and relationship types. For more information see 10 Questions on Ontologies below.

Q10: So what's the future?

Here's a scenario - I want to find spatially referenced datasets on cod stocks in the UK.

So I go to the UK Marine Data online Information Gateway and type "cod" into the search engine. This goes away and searches multiple 'nodes' (or information repositories) across the Internet, locates all resources tagged as "cod" (cod being an element of an agreed vocabulary), returns them, glues them together, prioritises them, and displays them categorised under "datasets", "documents", "organisations" and "people". I select the datasets category and find several time-series datasets on cod stocks. I can explore each one further by drilling down to a more detailed level. I am offered a 'visualise' tool which will display any, or all, of my datasets spatially and/or temporally. I am also offered a 'download' tool as these datasets are public domain. I then decide to have a quick look at the "documents" option where I find a very useful CEFAS report on the state of cod stocks, including a regional atlas of maps. Finally, I go into the spatial search tool to

explore whether there are other related datasets covering the same areas as my cod datasets. Great - just what I wanted!

The above scenario would appear to be very much on the radar if not all possible just yet. If you're looking for an example of something that gets close then you could type "cod" into the Resource Discovery Network at <http://www.rdn.ac.uk/> and see which bits are missing. Another non-coastal example is at <http://www.eastofenglandobservatory.org.uk> which uses the Dublin Core generic metadata standard to search multiple nodes for different types of information resource.

Finally, if you really want to dive in at the deep end then I would refer you to the Web Catalogue specifications on www.opengis.org and the work of the UK DataGrid Project at <http://www.e-science.clrc.ac.uk/web/projects/nercdatagrid>.



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Ten Questions on....Ontologies

Q1: Ontologies....I have heard it a lot recently when people talk about managing data -I don't really know what it means though.

In a nutshell it means 'lets understand how and why things are related'.

Q2: Can you give me an example?

Suppose I was interested in 'measuring wave heights'. There are many 'things' related to this, such as 'measures of wave height - HRMS, HMAX etc.', 'techniques to measure wave heights - buoys, ships, satellites, models', 'forms of wave height - spectra, timeseries, statistics', or 'organisations that measure wave height'. If the relationship between these 'things' are known it makes data management more effective.

Q3: In what way?

A good example would be searching for data. At one level, if we know that 'organisation A measured wave data' we could contact them directly to ask about their data. At a web-search engine level, if a search engine found 'spectra data' on the website of 'organisation A' then it could infer that this is likely to be 'wave data'.

Q4: Is this just about getting data?

No, it helps in planning too - for example, if Organisation B was looking to commission a survey to collect wave data, it would be useful for them to know that Organisation C was already collecting wave data at the same site.

Q5: So this seems like capturing knowledge and understanding - isn't this all just common sense?

Yes it is. However a lot of this 'common sense' can be subjective or tacit and this makes it difficult to manage data. The ontology makes explicit the knowledge and understanding we have in a given domain or subject area. This can also highlight where differences of opinion lie.

Q6: Are ontologies the same as metadata then?

No, but there is a relationship. Metadata is a standardised way of describing 'things' and this does help managing data immensely, but even if we had two 'things' described using the same metadata standard we may not know how they are related.

Q7: Could I have another example please?

Ok, suppose 'metadata A' described 'wave height information collected by CEFAS' and 'metadata B' described 'wave period information collected by Channel Coast Observatory'. A search on the metadata only would not help provide answers to the question 'find me wave data collection funded by Defra'. An ontology, however, can capture the fact that both 'wave height' and 'wave period' are types of 'wave data' and 'CEFAS and Channel Coast Observatory' are funded by Defra.

Q8: Why is there excitement about ontologies at present?

Largely because developments in the Web have realised a number

of tools to enable ontologies to be easily developed and deployed. In particular OWL, or Web Ontology Language, that is built on XML's ability to define customised tagging schemes for a given community.

Q9: You told me about XML in the last issue...so will OWL replace XML?

No. Firstly, because OWL is built on XML so they are not 'competitors'. Secondly, OWL differs from an XML schema in that OWL is a tool for knowledge representation and XML is a tool for a message format. Think of the differences that exist between 'ontologies' and 'metadata' mentioned above.

Q10: Thank-you. Finally, why are they called ontologies?

'Ontology' is a long established term that the Web community borrowed from philosophy. It refers to the science of describing what exists in the world and how they are related.



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Interoperability – a success story

Joint Defra/EA Flood and Coastal Erosion Risk Management R&D Programme

Defra and the Environment Agency sponsor strategic flood and coastal erosion risk management research jointly as part of a user-oriented R&D programme. The joint programme has many mutual benefits to both the organisations and to the user, so joining up the two organisations information sources is seen as an important factor in presenting the results of research in a comprehensive manner. This is a response to recommendations made by the user community and demonstrates what is possible.

A single webpage www.defra.gov.uk/enviro/fcd/research (Figure 1) is now used to host all information about the Joint Programme (previously held separately within Defra and the Environment Agency's respective websites).



Figure 1. Joint R&D Programme Home Page

The significant breakthrough which has been made, is providing a single access point to project information and publications held in separate databases. Thus information about all projects in the joint programme is now available and accessible via a 'Defra/EA projects' link on the Project information and publications page of the Joint Programme website.

The search tool, illustrated below (Figure 2), makes the search for project information easier and quicker. Publications that are hosted by the site are available to download 'free of charge'.

Allowing access to both databases from a single website is an example of

the use of Government Interoperability (e-GIF) criteria, and without repeating material from the previous edition of Coast Map News, the project has addressed (and will need to continue to review) many of the issues outlined in the two earlier articles about Interoperability.

Changes to the data will be refreshed on a weekly basis, this automatic refresh commencing at the beginning of August. If you have any queries about what is contained within the pages, and/or about the tool itself then please utilise the 'contact us' page on the website.

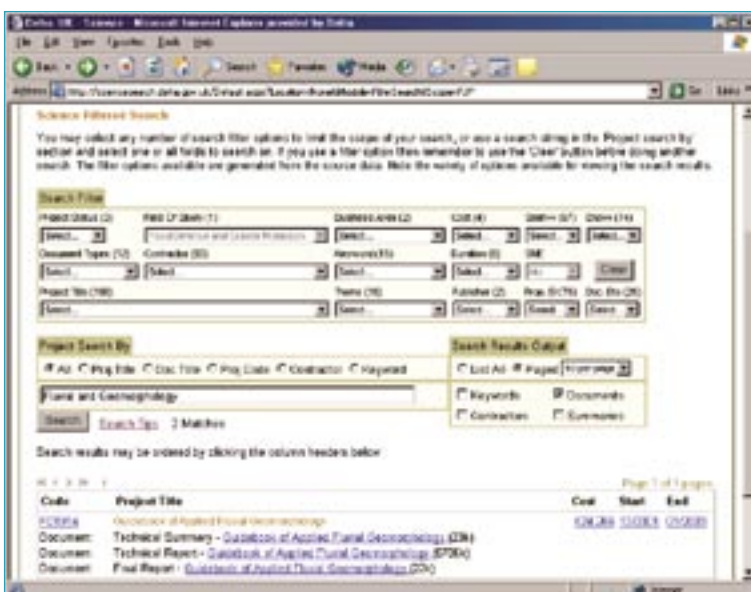


Figure 2. Search Tool Home Page

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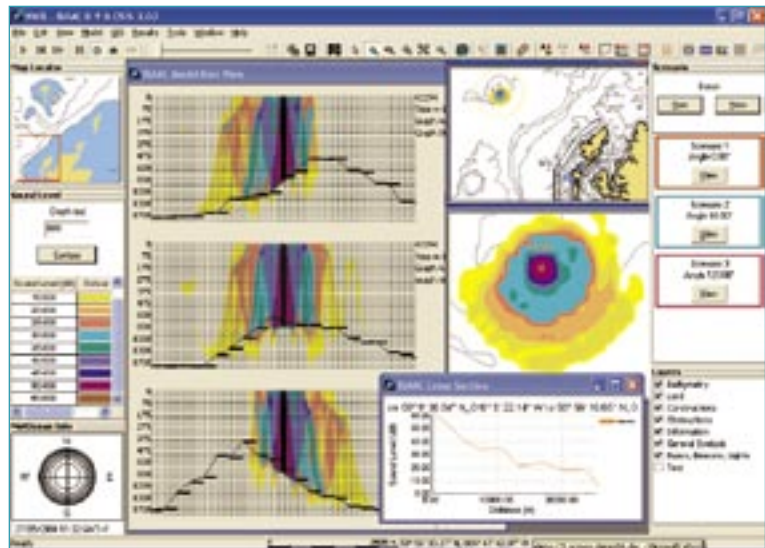
New subsea acoustics model from BMT

A new subsea acoustic information system, called ISAAC, has been launched by BMT Cordah Ltd, a subsidiary of British Maritime Technology Ltd (BMT) to help assess the impact of underwater noise on marine species. ISAAC is the culmination of a two year research and development project and has been designed to be intuitive to use by both non-experts and specialists.

Underwater noise can originate from many different offshore operations, including oil and gas exploration, pipeline laying, dredging, ocean surveying equipment and wind farm development. Recent evidence suggests noise can adversely affect marine mammal populations by disrupting normal feeding and breeding behaviour and causing physiological damage.

ISAAC uses a Gaussian ray tracing approach to determine the way acoustic ray paths travel between source and target position including those reflected from the sea surface and sea bed. The ray paths may refract with changes in water density, salinity, temperature and sea bed type. Users of the system are able to determine the spatial extent of noise propagation and whether noise generated from subsea activities exceeds sensitivity levels for various species such as whales and dolphins. The new information system uses BMT's existing Visual Marine Information System for GIS mapping and data interrogation. ISAAC allows sensitive marine areas such as marine mammal locations, migratory routes and fisheries to be displayed in the GIS alongside acoustic propagation results. Noise impacts on individual species can be assessed by comparing the sound pressure levels generated from anthropogenic activities with sensitivity thresholds to perform environmental risk assessment.

ISAAC is also compatible with existing BMT software systems under the Visual Marine Information System framework which is used for pollution control and search and rescue applications.



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A 'countryside map' for the sea (CMap)

The recent Irish Sea Pilot (Vincent *et al.*, 2004), to test a regional seas approach to marine conservation management, investigated the concept of 'marine landscapes' (coastal, seabed and water column) and their ecological relevance (Golding *et al.*, 2004). The seabed landscapes (Figure 1) were derived from integrating a number of geophysical attributes including bathymetry, sediments, bedforms, maximum bed stress and other data. The water column landscapes (Figure 2) were based on two 'model derived', gridded datasets for salinity and stratification (both supplied by Proudman Oceanographic Laboratory). The ecological relevance of the derived landscapes was tested by assessing the correlation with different biological communities, e.g. biotope complexes for the seabed landscapes, to determine the degree to which a particular landscape can be used as a surrogate for particular communities. In general the seabed landscapes were found to be ecologically valid.

Based on the successful 'proof of concept' in the Irish Sea, we are now proposing to extend this approach to the rest of UK waters to produce a 'countryside map for the sea'. As such, the proposal represents a key opportunity for a rapid and cost effective measure to support and accelerate the implementation of a broad range of measures covered by Defra's Marine Stewardship process. The output would provide a fundamental spatial information layer to support more effective management of marine resources, better management of associated knowledge, and implementation of existing international commitments and targets. The CMap project is intimately linked with a wider habitat mapping initiative 'Mapping European Seabed Habitats' (MESH) (see Coast Map News 6) but for various reasons has kept a separate identity.

The proposal is supported by a range of bodies including the UK conservation agencies who made the initial proposal, Defra, the Scottish Executive, a number

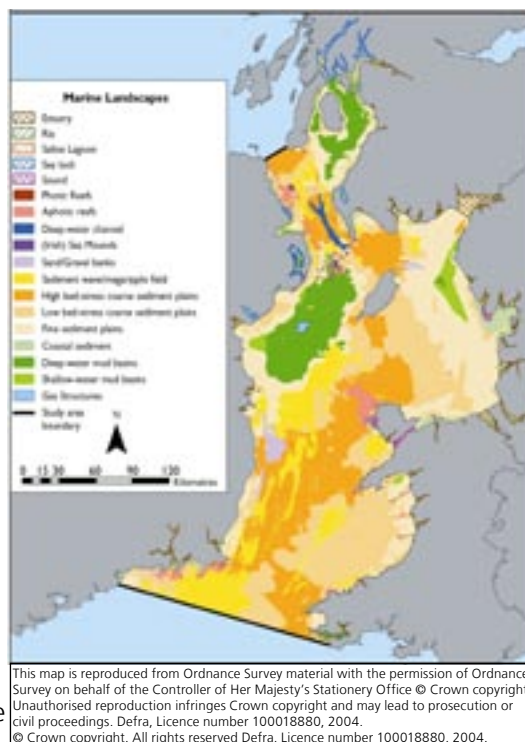


Figure 1. Irish Sea Pilot - marine landscapes (The Irish Sea Pilot was funded by Defra)

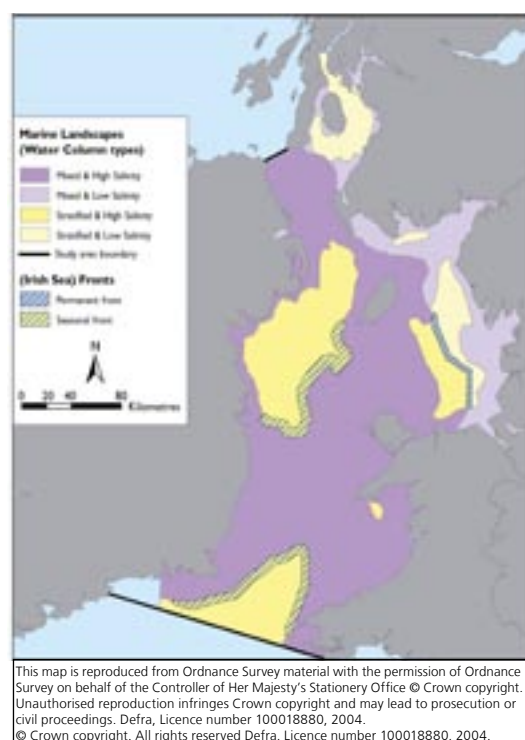


Figure 2. Irish Sea Pilot - water column types (The Irish Sea Pilot was funded by Defra)

of agencies such as CEFAS, research institutes and NGOs; some of the funding required has been identified. We are currently refining the methodology before the project can start including

agreeing the list of geophysical parameters to be analysed, (we may add turbidity and wave base to those used in the Irish Sea exercise), which available datasets to use, (there are choices for bathymetry), and the different 'classes' within each parameter. We are also in the process of identifying the best structure and approach to manage the project given the potential partners involved. Both management and data issues will be discussed further at a project start up meeting in mid August with a view to starting work by the autumn. It is anticipated that work would be completed within a year to eighteen months.

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SPI-ing on the seafloor....

One of the biggest challenges facing benthic ecologists has been how to study seafloor organisms and processes that cannot be directly observed. Historically they have relied on destructive tools (e.g. grabs, corers and dredges) to quantify benthic fauna (macrofauna and meiofauna) and its associated sediments. However, recent improvements in technology have enabled them to observe these communities and processes *in situ*.

The use of REMOTS ("Remote Ecological Monitoring of the Seafloor") or SPI camera (Sediment Profile Imagery), is helping benthic researchers to explore and describe changes in marine habitats through high quality images. This technology was developed in the early 1970s by a group of US scientists, led by Dr Don Rhoads, for applications in paleoecology and sedimentation. It was subsequently used to provide better understanding of organism-sediment relationships. REMOTS started to be widely applied for benthic sampling and monitoring in the U.S.A during the early 1980s. This provided valuable information for regulatory authorities, also enabling them to solve issues of the escalating cost of monitoring exercises for some types of activity where camera work was effective (i.e. dredged material disposal sites). Dr Rhoads saw the potential for further developing this technique to be used as a teaching tool for better understanding the theory of disturbance/re-colonisation and the biogenic modification of sediments in marine habitats.

SPI technology is now employed throughout the world, enabling scientists to visually collect cost-effective data in an image format of the seafloor. It is also an excellent means of communicating ecological data in a simple format to non-specialists. These images have been collected in marine and fresh water areas, mainly focusing on habitats affected by man-made activities (i.e. dredged material disposal sites, sewage sludge grounds, wood wastes, fish farms, anoxia, bioturbation processes and capping exercises). To date, increasing demands for studying

and monitoring benthic communities has encouraged the development of SPI technology in the UK through a combination of research projects. CEFAS employed this technology last year to ground-truth areas of known habitat heterogeneity (for more details see Coast News issue 6/Spring 2004).

The SPI camera works "like an inverted periscope", taking cross-sectional images of the upper 20 cm of the seafloor. The resulting images look like views through the side of an aquarium.

The camera possesses a wedge-shaped prism with a plexiglass faceplate and an internal light provided by a flash strobe. The back of the prism has a mirror mounted at a 45° angle which reflects the image of the sediment-water interface at the faceplate up to the camera. An inner frame supports the camera and prism assembly, which is controlled by a 'passive' hydraulic piston (Figure 1). The wedge-shaped prism enters the bottom and is driven into the sediment by its weight (Figure 2). The piston ensures that the prism enters the

(continued on page 34)

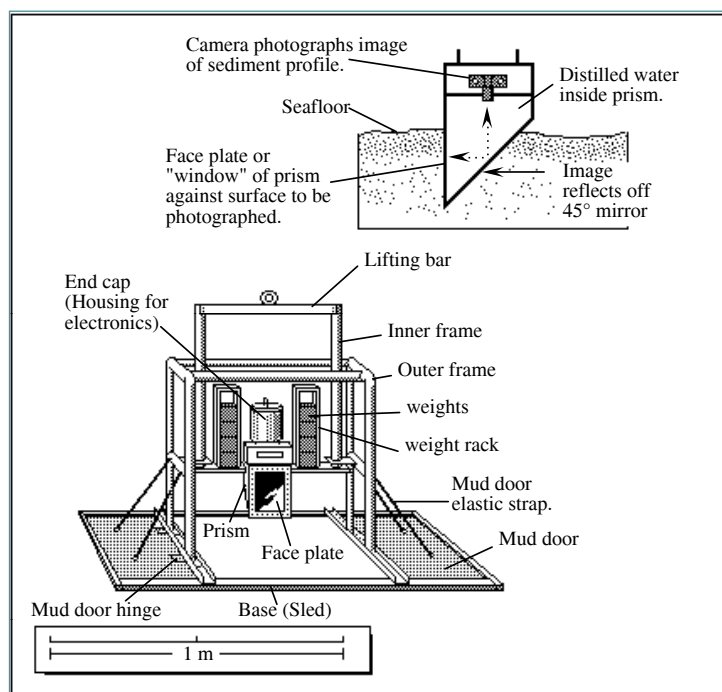


Figure 1. Diagram of a Sediment Profile imagery (SPI) camera

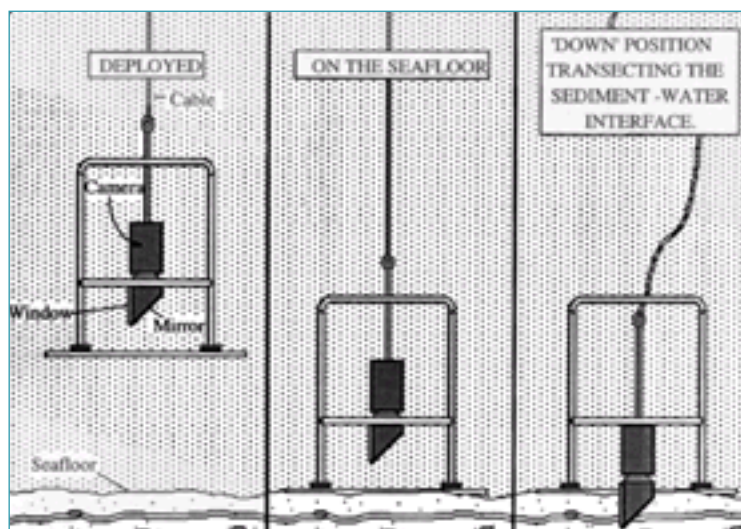


Figure 2. Sediment Profile imagery (SPI) camera deployment on the seafloor

(continued from page 33)

bottom slowly and does not disturb the sediment-water interface. On impact with the bottom, a trigger activates a time delay on the camera shutter release and a photograph is taken when the prism comes to rest. A series of images can be obtained at any time on a sampling site.

Two examples of SPI images are shown. The first is taken at a dredged material disposal site (Figure 3-A) and the second image is from a sewage sludge disposal site (Figure 3-B). The quality of these images makes possible a rapid assessment of the status of an area based on the calculation of the following biological and physical parameters: 1) sediment type (measured from the upper 5 cm sediment layer); 2) prism penetration depth (gives an indication of relative sediment compaction); 3) sediment boundary roughness (indicates the degree of

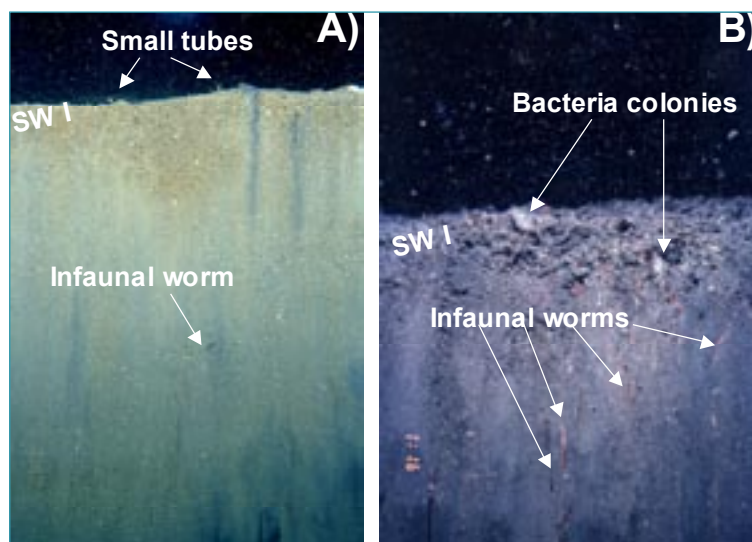


Figure 3. Examples of Sediment profile images. Images are about 15 cm wide. Image A is from Dredged material disposal site and has a few small tubes at the Sediment Water Interface (SWI) and one small infaunal worm about the center of the image. Image B is from Sewage sludge disposal site and has colonies of bacteria (white filaments) at the SWI and many polychaetes (horizontal red lines)

physical disturbance or biotic activity at the sediment water boundary); 4) sediment Apparent Redox Potential Discontinuity Depth (ARPD) (is the cline in reflectance between paler oxidized surficial sediments and darker reduced sediment at depth); 5) infaunal successional status (qualifies the type of animals living in the bottom); 6) calculation of a mean organism sediment index -OSI value (integrates the information gained from the other parameters measured into a single index which is indicative of the health status of the area).

In April, there was a SPICE (Sediment Profile Imagery Colloquium of Experts) Conference held at the Martin Ryan Institute, National University of Ireland, Galway. This event brought a wide range of expert users of SPI technology together to present ongoing research projects and highlight new applications. Of particular interest was a session focusing on the revision of existing indices, for example the OSI (Rhoads & Germano, 1986) and also the Benthic Habitat Quality index-BHQ (Nilsson and Rosenberg, 1997) based on the successional stages to monitor coastal habitats. This approach has been modified for use in the Water

Framework Directive (WFD) as a key tool for monitoring benthic systems in the coastal zone. For further information on the SPI technology workshop visit the conference web site at: <http://mri.nuigalway.ie/spice/spice/spiceindex.htm>

Fascinating new avenues for research using SPI technology continue to be explored. SPI can help to complement traditional monitoring tools and also to facilitate *in situ* observations for better understanding of organism-sediment processes in marine environments. This technology would further our existing knowledge and also would increase the challenge for scientists to extend our research paths.



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