



## THE NERC MARINE CENTRES' STRATEGIC RESEARCH PROGRAMME 2007-2012

# National Facility 1: British Oceanographic Data Centre (BODC)

Marine data are expensive to collect – and careful stewardship is required in order to obtain the benefits of that investment for environmental science and evidence-based policy in a changing world. BODC is an NERC Designated Data Centre that directly supports other parts of the Oceans 2025 programme, as well as providing high quality oceanographic data management services on a national and international basis.

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- Main activities:
- Development and coordination of core functions
  - Data management services for NERC Marine Centres
  - Role as the National Oceanographic Data Centre
  - Role as national focus for marine data management
  - Customer requests service
  - Support for international activities
  - Long-term management and maintenance of databases
  - Development and maintenance of supporting software

The text that follows is based on that submitted to NERC. For details on science Themes and other National Facilities, see [www.oceans2025.org](http://www.oceans2025.org). This information is made public by the Oceans 2025 Directors to facilitate engagement of the wider community in the programme; permission is required for other uses. This text does not include information on resource requirements, and is limited to fully- or partly-funded activities within the Oceans 2025 programme. Since not all the programme is fully-funded, there may be changes to some objectives and deliverables (to be identified in the Implementation Plan).

# National Facility 1: British Oceanographic Data Centre

## Strategic context

Basic data from measurement programmes are irreplaceable assets that are both expensive to collect and uniquely document the changing Earth system. Combined with past and future data, they form the necessary foundation to assess the impact of environmental change and, through modelling, to predict future conditions. Environmental data also serve as the basis from which policy makers and regulators formulate and implement evidence-based policy concerning human interactions with natural systems, including the social and economic perspective (e.g. Defra, 2002, 2005; SCF, 2004; CEC, 2005).

For these reasons it is essential that future generations of scientists and research users are able to access environmental data that has been properly managed and preserved, to known standards and formats, together with basic background information on how the data were collected and analysed (metadata). Moreover, insurance is required against accidental loss and technological redundancy through changes in storage media. Delivering this requires a dedicated infrastructure of complex relational databases and staff that understand the data and their use as well as information technology. Effective organisation, management and dissemination of NERC's scientific data and information generated through public investment helps to ensure the long-term sustainability of the UK science base. Meeting data requests from the private sector and government contributes to knowledge transfer and national economic competitiveness.

NERC's present strategy (NERC, 2002) places 'Using Knowledge' through the supply of data and information as one of Council's strategic goals. It includes the following statements:

- NERC's environmental datasets generated from public investment are a valuable national asset, providing a long term baseline contributing to UK and international monitoring, forecasting and modelling needs
- Provision of data and information to policy makers and regulators to underpin evidence-based policy are essential exploitation and dissemination activities.
- NERC will continue to foster increased collaboration with other UK and international data networks and centres.
- NERC will ensure that its scientists have access to high-performance computing facilities and e-Science investments so that they can access, manipulate and assimilate data from diverse sources.
- Sustained improvements in NERC data/information management are needed to deliver the objectives of the 'Knowledge' priority.

This framework is reinforced through NERC's Science and Information Strategy, which emphasises that NERC promotes access to, and inter-operability of, its data and information to maximise scientific exploitation and knowledge transfer. The aim is to enhance innovative basic, strategic and applied research and development, and training, across and between individuals, institutions, government agencies and industry, in the UK and overseas. It also takes regard of NERC's legal responsibilities to provide access to results and basic data arising from its publicly funded activities.

BODC has been the UK national data centre for marine science since 1969. It is part of NERC's environmental data centre network, with Designated Data Centre responsibility for NERC's oceanographic data, and acts on behalf of the entire UK marine community. It plays a role in coordinating marine data holdings of Government departments; leads for the UK as part of the international network of data centres of the Intergovernmental Oceanographic Commission (IOC); and represents the UK on data management issues at the International Council for the Exploration of the Sea (ICES). BODC's portfolio of activity involves not only laboratory and community wide research programmes, but also international science programmes and activities.

NERC's 2004 Science Management Audit of BODC considered it an essential national service operating at high quality, fully aligned to NERC's highest priorities and offering excellent value for money. BODC was given an overall rating of  $\alpha 4$ , with elements of  $\alpha 5$  (the highest possible grade, representing international excellence) for science programme support, such as directed mode and consortium programmes, *Argo* and the adoption of e-Science techniques.

### Overall aims and purpose

BODC's over-arching 'well-found data centre' activities cover:

- BODC's role as NERC's Designated Data Centre for oceanographic data
- infrastructure development required to manage, maintain and disseminate data
- national and international commitments to data management curation and exchange
- activities where NERC, on behalf of the national or international science community, has tasked BODC to provide data management services to specific high profile activities.

These core activities provide the infrastructure necessary to undertake a portfolio of additionally funded activities beyond the strategic programmes of NERC's research and collaborative centres. Such additional activities provide ~55% of BODC income, and encompass a range of shorter-term directed mode, consortium and responsive mode grants, and complementary national and international work. They benefit NERC's science programmes and cement BODC's role as the UK national marine data centre. This national role is exemplified by the high (~60%) proportion of non-NERC data in our holdings of certain fundamental oceanographic data types and benefits NERC funded researchers through provision of ready and easy access to a much wider pool of data.

This National Facility proposal relates to the dedicated data management services and facilities to support ~220 FTEs and associated postgraduate students identified within *Oceans 2025*. Taking account of other funding sources and partnerships, the combined programmes of the NERC marine Centres support more than 800 researchers and 900 postgraduate and undergraduate students. More widely, the Inter-Agency Committee on Marine Science and Technology recently estimated that there are more than 2,200 researchers engaged in marine science and technology in UK higher education establishments (IACMST, 2002). In addition, more than 1100 staff work in government marine laboratories (Cefas, FRS Aberdeen and DARDNI) plus the marine activities of such bodies as the Met Office, UKHO, EA, SEPA, Crown Estates and DTI. The total size of the community is higher still: the Institute of Marine Engineering Science and Technology has more than 16,000 members. As the National Marine Data Centre, BODC serves all these individuals, bodies and organisations, in both the public and private sectors.

BODC aims to provide easily-discovered, consistently formatted, quality assured data that may be used without consultation with any of the multiple originators. Data submission is made as simple as possible through flexibility in the way we accept information and the provision of an advice service. Data assets are managed according to international best practices, many of which have been developed by BODC. Modern, efficient and easy to use access is delivered by a sophisticated information technology infrastructure developed by a skilled workforce with specialist IT and scientific training, who, when the occasion requires, assist in data collection and analysis. A key feature is that we act as an 'honest broker': individuals and organisations have confidence that 'their' data are safe with BODC with no risk of exploitation against their scientific or commercial interests. Consequently, the interpretation and manipulation of basic data and subsequent value added resale activities are the province of others, whether NERC, Government or commercial.

Collection of oceanographic data is frequently non-systematic and often centred around multi-disciplinary research cruises under difficult conditions. The resulting data sets are highly heterogeneous

and collected for many different purposes. For example, one CTD cast may take 24 water bottle samples with each discrete sample being analysed for more than a hundred different biological and chemical parameters. The data rarely conform to common standards and measurement techniques and strategies are continually evolving. Such diverse and complex data requires specialised data management skills and software systems in which BODC has developed considerable expertise. Data collection by long-term observatories and operational systems is more systematic, but equally requires specialist techniques to ensure its integrity. The marshalling and delivery of such information, has little to do with ensuring storage volume, but relies on rigorous assembly of information and implementation of sophisticated relational databases that must appear simple to the user to interrogate.

NERC Designated Data Centres are the means by which NERC (and those it funds) discharge their legal responsibilities under the Environmental Information Regulations (EIRs) (2005). Any individual or organisation worldwide has a right, ultimately enforceable in law, to request and view all data in a calibrated form. Whilst this conforms to NERC's mission 'to provide advice on, disseminate knowledge of, and engage society in, the environmental sciences' it places an extra driver to ensure that NERC and those it funds from the public purse really do make all information readily available.

### **Description of activity and work**

The existing five year programme (2002-07) gave BODC its first clearly-defined funding and independence that enabled us to focus on core data management functions. We have remedied a period of underinvestment in essential infrastructure maintenance and development during the 1990s and have firmly re-established our role as a national data centre. Our approaches to data acquisition, storage and supply equal the very best international standards. In 2007-12, we intend to reinforce our reputation as a world centre of excellence for marine data management and ensure that our data delivery service enables customers to locate, view and download online our entire data holdings, together with those from other NERC data centres. BODC strategic activities can be grouped into 8 categories:

#### **1. Development and coordination of core functions**

This activity covers: BODC's core management functions as a national data centre; the strategic development and implementation of the present and future work programmes; high level engagement and leadership within the NERC and the wider UK and International community; and an element of group administration support. In addition to its core activities, BODC is involved in approximately 25 projects. Sound management is required to ensure that BODC meets its project commitments, responds effectively to its longer term responsibilities and maintains its infrastructure development. Clear strategic thinking is essential to ensure that BODC's IT policy is kept up-to-date and that BODC can grasp new opportunities offered by advancing technology. BODC's approach also needs to keep pace with advances field data collection technology and the evolving needs of the scientific community. Close liaison is required with the scientific community at all levels within NERC, the universities, and Government and commercial sectors so as to understand their requirements and to promote BODC's activities and services. Opportunities need to be identified for BODC involvement and initiatives are required to maintain BODC's position as one of the world's pre-eminent oceanographic data centres.

#### **2. Data management services for NERC marine Centres and Collaborative Centres**

A key role for BODC is to ensure that NERC and those it funds fulfil their responsibilities in respect of data management. There is little financial and practical sense in each NERC-supported marine Centre maintaining its own separate infrastructure and database expertise. Each would require a similar hardware and IT overhead, their approaches would inevitably diverge and it would be confusing and tedious for users to obtain data from multiple sources. Also, despite the best intentions of the Centres, rigorous data management inevitably assumes a lesser importance than the primary scientific mission.

BODC takes a pro-active role in leading and providing data management support to the National

Oceanography Centre, Southampton (NOC), Plymouth Marine Laboratory (PML), Proudman Oceanographic Laboratory (POL) and the Scottish Association for Marine Science (SAMS) to:

- i) Provide a dedicated and skilled independent resource and associated infrastructure (hardware, software and delivery mechanisms) to enable the centres to secure and access their data.
- ii) Ensure data resulting from the centres activities are managed and secured for long-term use.
- iii) Remove the burden from individual scientists in having to respond to requests and information.
- iv) Meet NERC's and the centres legal obligations under the EIRs.

Since 2001, there has been a dedicated Laboratory Liaison Officer (LLO) for each of the above-named Centres. Their responsibility is to provide skilled data management expertise to assist and guide the process of data management at BODC. These posts are filled by determined, resilient and proactive individuals with good management skills who understand data collection, can communicate with scientists on equal terms and can take an overview of the data quality for ingestion into the national archives. The primary role of the LLOs is not to analyse the data, but to ensure the data management cycle is effectively closed.

Although there is currently no formal responsibility for BODC management of data from the Sea Mammal Research Unit (SMRU), appropriate arrangements are being developed in the Oceans 2025 framework, through the LLO model. SMRU does not itself have the necessary infrastructure (IT and database) nor expertise to fully meet NERC's policy requirements for high quality data management.

Similarly, there is no designated responsibility for the marine data collected by the British Antarctic Survey (BAS). Such data are not currently managed to uniform standards and are arguably largely invisible to the wider community. Both BODC and BAS consider that the LLO model using existing infrastructure will provide an integrated, NERC-wide approach to oceanographic data management.

### **3. Role as National Oceanographic Data Centre**

Since its formation in 1989, BODC has assembled and maintained national archives of key oceanographic data sets, providing data-related support to university researchers and the wider marine community. This endeavour is challenging due to the extensive scope of the responsibilities and the relatively weak culture of data management in the wider community, requiring frequent reinvigoration. We also offer training of graduate and postgraduate students in data management and analysis techniques. The Strategic Ocean Funding Initiative (SOFI) is likely to increase demand for such services, aligned to the Oceans 2025 Themes and part-supported by LLO activities [(2) above].

The activity includes the provision of the following national services:

*"Data Discovery" inventories and catalogues.* The UK Directory of Marine Environmental Data Sets is an online searchable database which provides a comprehensive reference to ~700 marine data sets and collections held by 130 UK organisations and data holding centres. The Directory forms the UK component of the European Directory of Marine Environmental Data Sets, developed by BODC, and established as a European standard for indexing and searching data sets relating to the marine environment. BODC also supports an online cruise inventory containing information on more than 6,000 UK related cruises on 654 ships and with more than 3,700 cruise reports accessible on-line. This facility enables NERC to meet its international obligation when working in the EEZ jurisdictions of other nations.

*National data archives.* BODC has built up large holdings of fundamental oceanographic data types primarily collected by UK organisations. These include temperature, salinity, currents and sea level. The earliest data (sea level) dates back to the nineteenth century, but most data are from the 1970s onwards. Data are supplied by over 100 organisations and include almost 50000 temperature and salinity profiles, 5700 current meter records and 8000 tide gauge records.

#### **4. Role as national focus for marine data management**

BODC data not only originate from NERC-supported research, but also from UK or EU commissions and from data donated by UK government departments and agencies, and commercial companies.

In 1996, the post of the IACMST National Coordinator for the Marine Environmental Data Network was established at BODC and is funded within BODC's core programme. The remit of the post is to take a national lead at a senior level in the development and support of an inter-agency approach to the management and exchange of marine data within the UK. The BODC Deputy Director provides leadership for the activity with support from a BODC data scientist. Prime activities include the development and implementation of guidelines for data management; the development and maintenance of national data inventories (e.g. largely designed by BODC); the improvement of mechanisms for the subsequent exchange of data; representation at international level and submission of UK data to the World Data Centre system; identification of opportunities for extending and improving the national archives.

BODC is supported in this by the IACMST Marine Environmental Data Action Group, which contains representatives of all UK public sector organisations involved in marine data. A number of these organisations (Defra, UKHO, EA, Met Office and FRS/SEERAD ) provide funds for this activity through annual subscriptions. With the support of the Action Group, BODC also represents the UK in a number of international groups concerned with the management and dissemination of oceanographic data, particularly in the framework of IOC (e.g Working Committee on International Oceanographic Data and Information Exchange) and ICES. The UK MED Coordinator reports annually to IACMST, and BODC hosts OceanNET ([www.oceannet.org](http://www.oceannet.org)), the portal for the MED and GOOS action groups operated by IACMST.

BODC also hosts the Marine Data Information Partnership (MDIP) manager, a parallel 2.5 yr initiative with the mission to harmonise stewardship of and access to marine data and information across the UK, in the particular context of improved management of UK seas.

#### **5. Customer requests service**

Demand for BODC data and data products has greatly expanded in recent years and we intend this to continue. Our goal is for all data to be available online and we have progressively improved our delivery, with 98% of 38,021 requests in 2004/05 coming via the web as compared to 79% of 4932 requests in 2000/01. However, improvement in this basic performance metric masks the fact that requests requiring written (e-mail and letter) and phone communication are consistently ~ 1000 pa. Many of these (typically 35%) come from school, undergraduate and postgraduate university students. Often they are not straightforward, requiring significant staff time to service. Although web presence is vitally important, direct customer contact greatly influences peoples' perception of an organisation and represents the front line in dealing with Freedom of Information and Environmental Information Regulation obligations.

#### **6. Support for international activities**

Core funding underpins BODC's (and NERC's) commitments as the National Marine Data Centre to the following international activities, that attract additional non-NERC funding:

BODC hosts the Manager for the *General Bathymetric Chart of the Oceans (GEBCO) Digital Atlas* to help IOC and IHO generate and disseminate the most authoritative bathymetric data set for the world's oceans. The Manager is responsible for: receiving and quality controlling new data; updating the Digital Atlas bathymetry; providing user support and answering enquiries about the data; ensuring delivery and appropriate licensing of the data via CD-ROM and the web; securing the definitive master copy of the entire bathymetry and making subsequent additions; and providing feedback to the GEBCO

community on user's comments. The activity is joint with the post of Bathymetric Editor at NOC (see Theme 5, WP 5.6) and NOC hosting of the GEBCO Permanent Secretary, Professor Bob Whitmarsh.

An accurate estimate of bathymetry forms the basis for research and utilisation of the global ocean and is a prerequisite for developing a predictive capability for basin scale processes influencing environmental and ecosystem change. In 2003 BODC published a CD-ROM atlas of global digital bathymetry at 1 min resolution with bathymetric contours and trackline control data. To date, 2,190 copies have been distributed in more than 100 countries. This information is also now available on-line. Increasing data submission and sophisticated data collection techniques means that there is real impetus and opportunity to improve areas of very poor bathymetry coverage.

BODC provides long-term support for the *WCRP Climate Variability and Predictability project (CLIVAR)*, managing both the Moored Instrument and Delayed-mode Sea Level Data Assembly Centres (DACs). These responsibilities complement those of the International CLIVAR Project Office at NOC led by Dr Howard Cattle. Our mandate is to acquire, quality control, assemble metadata and documentation for data collected during CLIVAR and collaborate with the other seven DACs to build an integrated multidisciplinary dataset. This extends the high quality moored instrument and sea level data sets collected during WOCE (World Ocean Circulation Experiment). For both data types BODC have long established track records and internationally recognised expertise. We ensure the long-term stewardship of the data which will be made available online. The sea level activity operates alongside BODC's role as a Sea Level Archiving Centre for the *IOC Global Sea Level Observing System (GLOSS)* and BODC development of the GLOSS Station Handbook – an information resource relating to the GLOSS Core Network of tide gauges. These tasks complement NERC's contribution to GLOSS as outlined in the proposal for National Facility 2 (PSMSL) and SO 7 of Theme 10.

Linking with SO 5 of Theme 10, BODC operates the *UK Argo Data Centre* and leads the development of the *Argo Southern Ocean Regional Data Centre* (with CSIRO, Australia). The UK Centre processes all UK profiling floats, regardless of location. Data are delivered to internationally agreed standards. During Oceans 2025, BODC will sustain automatically quality controlled near-real-time data delivery, the assembly of metadata, and scientific calibration of the data acquired by UK floats. The Southern Ocean Regional Data Centre will assist in publishing a reference data set for float salinity calibration, determine the internal consistency of Southern Ocean Argo data and deliver products using float data.

### **7. Long-term management and maintenance of databases**

BODC's diverse data holdings encompass: national collections of specific types of data; integrated, multidisciplinary, data sets from large scale projects; and *ad hoc* data sets submitted to BODC for safe keeping and dissemination. These have to be properly backed up and maintained on modern media in modern formats. Their integrity needs to be regularly checked and wherever practical they need to be integrated into common systems. Despite the inherent heterogeneous nature of its data, BODC adopts a generic approach for data management so that common systems may be used to the maximum extent possible. This approach is crucial in the move to distribution of data via the internet and the adoption of e-Science techniques to ensure comprehensive and seamless delivery to customers. Many of BODC's data are stored either within relational tables under Oracle, or as files in standard formats such as NetCDF indexed by Oracle Metadata. Data structures range from isolated spot values to complex multi-dimensional series and all data are accompanied by supporting documentation and meta-data. BODC holds data on more than 10,000 parameters in some 100,000 individual data series.

### **8. Development and maintenance of supporting software**

BODC's customers expect data to be convenient to use, with readily-gauged quality and supporting information on how data were collected and processed. These attributes are achieved by sophisticated and powerful data handling systems, developed by BODC and exploiting state-of-the-art computing

technologies. BODC was the first marine data centre worldwide to publish data sets on CD-ROM, the first to develop a generalised approach for formatting data, the first to develop interactive systems for screening and flagging data, and one of the first to deliver PC-based data products.

Although some momentum was lost in the mid to late 1990s, BODC is currently investing around seven person years of effort annually into maintaining, restructuring and updating data handling infrastructure and data delivery systems. This is being achieved through: baseline core funded staff (3); temporarily diverting labour from direct data management; directed studentships; casual labour; external experts; and additional funding in open competition to develop new e-Science approaches. The latter refers to the NERC DataGrid project, to build the infrastructure necessary for seamless access to distributed data. Following a period of research and development (end Sept 2007), this is expected to become part of the basic data centre responsibilities.

In the period 2007-12, BODC aims to achieve the following advances in data handling capabilities:

- Make visible via the web BODC's entire portfolio of data. Historical expediency means that ~ 50% of BODC data, including most biological and chemical data and all surface ship measurements, are held in a database not readily searchable by external users. Considerable effort is needed in order that the information detailing how the data were collected, analysed and processed is compatible across the data holdings, enabling discovery and delivery through one interface.
- Deploy innovative e-Science techniques and technologies to enable data discovery and utilisation in a standards compliant manner, using web services and grid-services (when suitable standards are agreed for the latter). Currently, users have much to do in requesting, assembling and manipulating data from different disciplines (e.g. oceanographic and atmospheric) before they can be utilised. The DataGrid approach will remove much of this burden. After discovery and browsing, the system will take over, merging individual elements of data to create a 'designer dataset' to the user's specification. Online services will then enable users to visualise data, both as individual time series or profiles, and contoured renderings of data aggregations.
- Continue to define and promote international standards for data terminology. Marine data cover an unusually wide range of physical, chemical, biological and geological data types, and scientists often use different words to describe the same type of data or the same words to describe different data. To avoid errors and misunderstandings (particularly for internet searches and access), BODC is at the forefront of work to establish a dictionary of terms for international adoption as the standard vocabulary. It will map directly to dictionaries used by other leading international data management organisations. The BODC data dictionary currently contains more than 18,000 terms and is used by many international organisations (e.g. ICES, NIOZ, RIKZ).
- Make data searchable through a geographical (GIS) interface. No matter how robust internal data management procedures, the true worth of data will only be realised by making information available through attractive and easily useable interfaces. We have determined the approach, but now need to implement it.
- Increase automation and depth to BODC's visual screening and error-checking software. A key deliverable for a data centre is quality assured data that does not require each user to individually assess the data's reliability. This is particularly important for marine data where sampling is expensive, and temporally and geographically sparse. If intercomparisons are to be made, whether in time or space, it must be possible for users to have confidence in data quality.

### **Links to other parts of Oceans 2025**

BODC's role as the Designated Data Centre for marine science will provide underpinning data management support for the research-based Oceans 2025 Themes (1-6, 8 and 9) and all the sustained

observations of Theme 10 (SO 1 – 15, with particularly close links to SO5 and SO7 as noted above). In addition, BODC will support data management relating to other National Facilities, particularly NF2 (PSMSL) via BODC's CLIVAR/GLOSS activities, and to SOFI-funded work.

### Key deliverables

As the UK national marine Data Centre, BODC will:

- Deliver a comprehensive and integrated national data management service to the highest international standards
- Aim to ensure that all data generated from NERC funded marine science are secured to known standards for long-term use without requiring reference to the originators
- Access data through modern, efficient and sustainable interfaces that enable users to perform comprehensive searches of our and other data centre holdings via a geographical interface
- Facilitate open access to high quality marine data resulting from publicly funded work, thereby fulfilling NERC's mission to disseminate knowledge and meeting its legal obligations.
- Provide the national lead and focus for marine data management in the UK
- Represent the UK in the international exchange and management of marine data, including the development and implementation of best practice and fulfil the UK's obligations in respect of international exchange of marine data
- Raise the profile of BODC (and NERC) data holdings and management in the UK and internationally.

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### Acronyms

BAS	British Antarctic Survey	IHO	International Hydrographic Organisation
BODC	British Oceanographic Data Centre	IOC	Intergovernmental Oceanographic Commission
CD-ROM	Compact Disk Read Only Memory	IT	Information Technology
CEC	Commission of the European Communities	LLO	Laboratory Liaison Officer
Cefas	Centre for Environment, Fisheries & Aquaculture Science	MDIP	Marine Data Information Partnership
CLIVAR	Climate Variability and Predictability	MED	Marine Environmental Data
CSIRO	Commonwealth Scientific and Industrial Research Organisation	NERC	Natural Environment Research Council
CTD	Conductivity Temperature Depth	NetCDF	Network Common Data Format
DAC	Data Assembly Centres	NIOZ	Nederlands Instituut voor Onderzoek der Zee (Netherlands Institute for Sea Research)
DARDNI	Dept for Agriculture & Rural Development Northern Ireland	NOC	National Oceanography Centre, Southampton
Defra	Department of Environment, Food and Rural Affairs	PML	Plymouth Marine Laboratory
DTI	Department of Trade and Industry	POL	Proudman Oceanographic Laboratory
EA	Environment Agency	PSMSL	Permanent Service for Mean Sea Level
EEZ	Exclusive Economic Zone	RIKZ	Rijks Instituut voor Kust en Zee (Nat Inst for Coastal & Marine Management)
EIR	Environmental Information Regulations	SAMS	Scottish Association for Marine Science
EU	European Union	SCF	Scottish Coastal Forum
FRS	Fisheries Research Services	SEERAD	Scottish Executive Environment & Rural Affairs Dept
FTE	Full Time Equivalent	SEPA	Scottish Environmental Protection Agency
GEBCO	General Bathymetric Chart of the Oceans	SMRU	Sea Mammal Research Unit
GIS	Geographic Information System	SOFI	Strategic Ocean Funding Initiative
GLOSS	Global Sea Level Observing System	UKHO	United Kingdom Hydrographic Office
GOOS	Global Ocean Observing System	WCRP	World Climate Research Programme
IACMST	Inter-Agency Committee on Marine Science & Technology	WOCE	World Ocean Circulation Experiment
ICES	International Council for the Exploration of the Sea		