

The UK-Integrated Marine Observing Network UK-IMON

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There is pressure to reduce the cost of marine data collection, currently estimated at around £80 million per year in the UK. At the same time, new data-intensive observing systems and models are driving a 'data deluge' that challenges our capability to fully realise the benefits. In addition there are many players using diverse observing systems, but very limited 'common language'. So far attempts to coordinate across the different UK ocean observing communities have had partial success. However, more remains to be done to ensure all marine data, whatever the purpose of its collection, are put to good use and are available to meet future critical information needs. Against this background a workshop held in November 2011 brought together the key UK marine policy, science and operational organisations as well as industry representatives who agreed to form the UK Integrated Marine Observing Network (UK-IMON).

It was agreed that UK-IMON should 'serve societal needs by providing reliable marine data and information, for a better understanding of marine systems, improving safety, enhancing our economy and protecting the environment'. UK-IMON will build on the existing UK marine observing infrastructure.

This poster will provide an overview of partner observing programmes as a step towards the type of information required to identify overlap and opportunities for greater synergy in the future. A list of core variables will be shown that could form the basis of a shared vision of the common measurements to be made across all future UK-IMON partner programmes. An approach is described that will make best use of the existing UK data management and dissemination infrastructure to streamline the process of transforming ecological data into useable information. New web based technologies use this information to provide better evidence and new knowledge of ecosystem structure, function and status.

SEPA National Marine Monitoring Buoy Network

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The SEPA National Marine Monitoring Buoy Network provides high frequency environmental data from strategic locations around the coast as part of SEPA's obligations to monitoring the marine environment. Continuous monitoring equipment gathers dissolved oxygen, water temperature, salinity and chlorophyll-a data at regular intervals. The data is used to assess the state of the marine environment at representative locations and strict quality control measures are in place to ensure robust and trustworthy datasets. Graphs of the results are regularly updated and available to the public via SEPA's website.

Biological regimes in the Bay of Biscay and English Channel

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During the final year of the Pride of Bilbao (PoB) ferry route between Portsmouth, UK and Bilbao, Spain a comprehensive phytoplankton data set was collected based on pigments and taxonomy measurements. The work was in support of the EU project ProTool that aims to develop an automated system for measuring primary productivity from ships of opportunity. Our remit was to provide both biological and physical data for algorithm development. The data suggests that conditions in the region are relatively stable with minor yearly variations in the timing, succession and extent of the phytoplankton blooms. The small variations that are observed are likely due to variations in fresh water input and wind patterns influencing nutrient availability.

EMECO Datatool

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The EMECO Datatool (EDT) is part of the European Marine Ecosystem Observatory (EMECO – www.emecodata.net) initiative and is a web-based tool that enables rapid integration and visualisation of multi-platform, multi-parameter, and multi-national data. It has been developed to help meet the reporting and assessment requirements of European policy drivers and OSPAR. Initial developments were specifically focussed on the assessment of eutrophication in the North Sea but they are currently being extended to meet the requirements of the Marine Strategy Framework Directive (MSFD).

Seasonal cycle of dissolved organic nitrogen from Cefas SmartBuoy water samples

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The high-temporal resolution autonomous water samplers deployed on Cefas Smartbuoys provide a unique opportunity to study biogeochemical dynamics, where temporal coverage by cruise programmes cannot succeed. We present two years of dissolved organic nitrogen determinations (sampling frequency between 3 and 5 days) from the Dowsing SmartBuoy (53°31'N, 01°3'E) demonstrating complex dynamics which would simply look like random noise with e.g. monthly sampling by ship. Tidal cycles appear to complicate the signal and supporting data (in-situ measurements and remote sensing) are essential in interpreting the DON measurements.

‘Strategic long-term passive acoustic monitoring: The Scottish Acoustic Marine Mammal Observatory’

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We are deploying an array of 3 underwater listening buoys, using the Pambuoy(tm) system, to measure noise and detect marine mammals along the East coast of Scotland. This array will provide strategic impact assessment and monitoring around proposed coastal wind farm sites. The solar-powered buoys carry calibrated hydrophones and a computer system capable of processing acoustic data onboard, and of sending data over the UK 3G network. The buoys return summary outputs from multiple onboard detection algorithms, optimised to detect and identify a variety of marine mammal species from their acoustic output, as well as measurements of underwater noise levels. The buoys also make scheduled direct hydrophone recordings, with some also returned immediately and most stored onboard for download during maintenance checks every 3-6 months.

DASSH – The UK Archive for Marine Species and Habitats Data

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Since 2005 the Marine Biological Association of the United Kingdom (MBA) has hosted DASSH, the Marine and Environmental Data and Information Network (MEDIN) accredited national Data Archive Centre (DAC) for marine species and habitats data. DASSH provides a focal point for access to marine biodiversity data within the UK. DASSH delivers MEDIN and Government data requirements and associated services for the biodiversity community. The centralization of data holdings simplifies the process of data acquisition for users of marine data, greatly reducing the time taken to identify and access relevant datasets. In addition DASSH provides a service to the data providers, acting as a custodian and ensuring data are archived in line with international best practice and current standards. The data held within DASSH is critical in supporting Marine Spatial Planning, Environmental Impact Assessments and to provide the evidence base to achieve Good Environmental Status (GES) under the Marine Strategy Framework Directive (MSFD). In addition DASSH assists in meeting the reporting requirements of UK Marine Monitoring and Assessment Strategy, which in turn addresses the reporting for more than 40 national and international obligations including OSPAR, Water Framework Directive (WFD) and other marine environmental directives. Potential future sustainable development of our oceans requires access to all available data.

Developing an undersea cabled observatory – MeDON

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In June 2012 a demonstration pilot-project of an undersea cabled observatory was installed in the challenging coastal waters off the Island of Molene, western Brittany. The MeDON project delivered new and innovative technologies to meet these challenges including: underwater mateable connections; Ethernet and power requirements; a shore station to handle real-time data feeds; HD cameras; acoustics together with automated algorithms for the detection of cetaceans and other marine life; currents and other environmental parameters.

pCO₂ variability in the northeast Atlantic Ocean

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The northeast Atlantic is a net CO₂ sink although recent work suggests year to year variability in CO₂ uptake in this region due to changes in wintertime mixing and stratification (1-3 mol C m⁻² yr⁻¹). We compare various time series studies to investigate inter-annual variability in the water partial pressure of CO₂ (pCO₂). A full-depth mooring has been in place at the Porcupine Abyssal Plain (PAP) Sustained Observatory (49°N, 16.5°W; 4800m) since 2002, with autonomous sensor measurements of temperature, salinity, chlorophyll a fluorescence, nitrate, and pCO₂. The seawater pCO₂ showed a persistent under-saturation resulting in significantly larger oceanic sink than at subtropical time series sites such as ESTOC. We investigate the effects of various processes and time scales (from diurnal to inter annual) on the pCO₂ variations. We use ancillary data to elucidate both physical and biological processes controlling seasonal variability, which will ultimately affect the annual flux estimates. Due to recent collaboration with the UK Met Office we can also investigate the effect of the relatively high wind measurements in the area.

Marine Scotland Science Ecosystem Monitoring Programme

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Marine Scotland Science operates an offshore and coastal monitoring programme which collects baseline data to support an assessment of the state of the ecosystem as well as for a variety of scientific and advice applications. The offshore programme has monitored the temperature and salinity of the water in the Faroe-Shetland channel for over a hundred years and the characteristics of the waters flowing into the northern North Sea for more than 30 years. The coastal ecosystem monitoring programme monitors a combination of variables (temperature, salinity, nutrients, alkalinity, biotoxins, phytoplankton and zooplankton) at a variety of stations around the Scottish coast. Data from these programmes contribute towards fulfilling the requirements of monitoring directives such as the Water Framework Directive and the Marine Strategy Framework Directive.

These data have shown how the temperature and salinity of water originating in the North Atlantic has become much warmer and saltier since the mid-1990's as a combined result of climate change and natural changes in the circulation of the North Atlantic. Over the last decade, conditions have been variable in coastal regions, with cool and fresh conditions in 2001, record high annual mean temperatures observed in 2003 and some recent cold winters (2009/2010 and 2010/2011). Changes in the plankton community have also been observed over the last 10 years at the coastal sites. These include a decrease in the abundance of the dinoflagellate *Ceratium* and an extension of the growing period of *Calanus helgolandicus* over the summer months. Data from these programmes have contributed to assessment documents such as Charting Progress 2, Scotland's Marine Atlas, Marine Climate Change Impact Programme - Annual Report Cards, the ICES Report on Ocean Climate and the ICES Zooplankton and Phytoplankton Status Reports.

The Western Channel Observatory – a cascade of timescales

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Observations have been made in the western English Channel (WEC) for over a century. During that period there have been tremendous changes in measurement types and techniques, fuelled in part by technological advances. Each distinct dataset is able to inform scientist, stakeholder or policy-maker about different aspects of the biological, chemical and physical variability of the WEC.

Long-term monitoring in the marine environment: the Marine Environmental Change Network (MECN).

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There is a long history of marine surveys and observations in European seas. Unfortunately, by the 1980s long-term marine time-series were falling out of fashion and it is estimated that 40% of European time-series had funding withdrawn at this time. However, it wasn't long before their value was recognised in relation to observing climate effects. In the UK, a 2002 report "Review of Current Marine Observations in relation to present and future needs" identified the need for the continuation, restoration and enhancement of long-term marine observations in UK waters, and the establishment of a network of parties involved in this work. The Defra funded Marine Environmental Change Network (MECN) was established in response to these needs.

The MECN has two main elements: a science programme and a knowledge transfer programme. The science programme was established in Phase 1 and has looked at issues such as how multiple datasets can be analysed to show changes over long-term time-scales ("MECN Long-term Datasets Analysis"; report to Defra, 2009; Spencer et al. 2010, Marine Ecology). Long-term changes in biodiversity in relation to drivers such as climate change and fishing have also been examined using some of the individual time-series. A key aim of the MECN established in Phase 2 is to "ensure that information from the network is provided to policy makers and other end-users to enable them to produce more accurate assessments of ecosystem state and gain a clearer understanding of factors influencing change in marine ecosystems". The knowledge transfer programme is therefore aimed at providing evidence to support policy through mechanisms such as the Marine Climate Change Impacts Partnership and the United Kingdom Marine Monitoring and Assessment Framework (UKMMAS).

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Operational evaluation of a hydrodynamic-ecosystem model

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Oceanographic Operational models are not routinely validated beyond the most simple skill assessments even though critical evaluation on a daily to monthly scales is required to gain the largest societal impact. Numerical models can diverge in time and can produce erroneous outputs due to errors in the forcing or to their simplified representation of the natural ecosystem. An early warning system of operational models is therefore required to maintain a quantitative consistency through the systems life cycle. We suggest here a methodology to assess the quality of the models operationally. The methodology consists in building a climatology of relevant model skill metrics (Shutler et al. [2011]) using a long time series of model hindcasts the satellite data (AVHRR Sea Surface Temperature (SS) and MODIS chlorophyll-a). On cumulative timescales ranging from one week to months, the same metrics are computed operationally and compared to the climatology. This method enables the operational assessment of the state of a model hence providing an early warning system capable of identifying the degradation in quality of operational model systems. The examples presented here are for simulations of the Western Channel domain of POLCOMSERSEM model (Allen et al. [2001], Blackford et al. [2004]).

Providing the big picture

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Research Highlights from the North Atlantic CPR survey