

e-Science potential

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e-Science has the potential to enable researchers to gain new insights from once unfathomable amounts of data. UK government has invested more than GBE200 million to support development of e-Science since 2000. The marine and energy industries are, for example, likely to benefit from the availability of sophisticated meteorological and oceanographic data in a user-friendly format to enable them to make predictions about the environments in which they operate.

E-Science is a new term in the framework of information society technologies (IST) defined by the UK Government as “science increasingly done through distributed global collaborations enabled by the internet, using very large data collections, tera-scale computing resources and high-performance visualisation”. The definition can be more widely interpreted, to include computational and data ‘grid’ applications, middleware developments and essential hardware procurement. In the

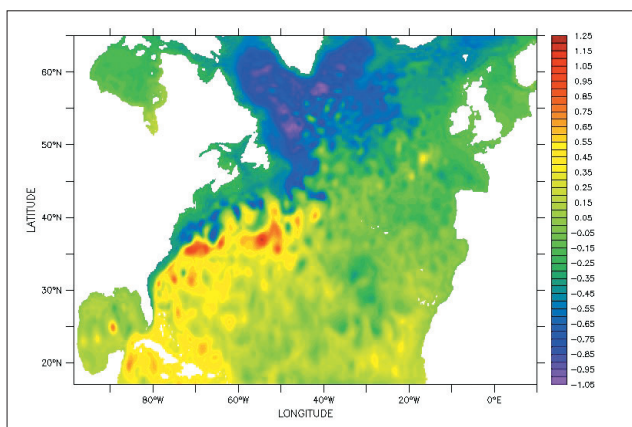
UK, much of e-Science funding goes in support of developing advanced informatics techniques that help researchers access, process and visualise the vast amounts of data increasingly produced throughout the world. This includes grid systems which draw upon the unused power of computers distributed at multiple sites and are now enabling large-scale data challenges to be tackled in a fast and cost effective way.

The drivers for e-Science are based in advances in computing, communications, remote sensing and modelling, framed by the desire to improve understanding of our environment and our ability to monitor and forecast the governing physical processes. These drivers are captured under GMES (Global Monitoring of Environment and Security), a joint European Commission (EC) and European Space Agency (ESA) initiative barely five years old that is now driving the focus for EC Research Framework Programmes 6/7 into the next decade. In parallel, through EC initiatives such as the ESDP (European Spatial Development Perspective 1999) and INSPIRE (Infrastructure for Spatial Information in Europe 2003/4) we also have the emergence of ‘geo-information’ as an important enabling framework for integrating and harmonising geo-spatial data and information across national borders and regional boundaries.

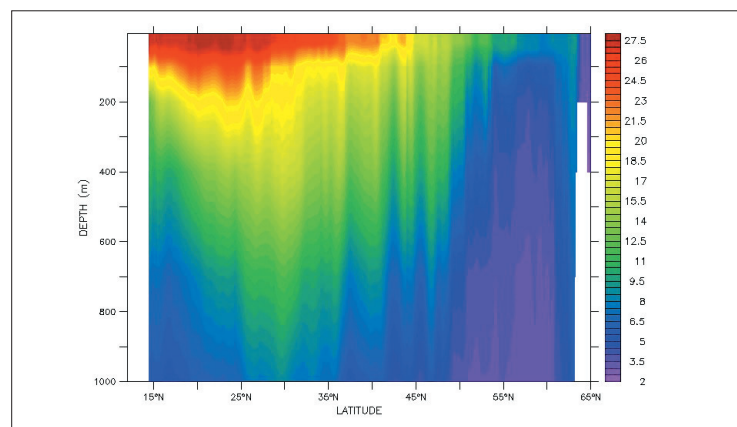
BMT has been tracking GMES and e-

Science for a number of years from the viewpoint of applications potential. As BMT’s director of environment systems, I sit as a member of several national e-Science steering committees in the UK. BMT is involved in a number of high profile e-Science projects in the marine sector. These include the GODIVA (Grid for Ocean Diagnostics, Interactive Visualisation and Analysis) project, sponsored by the Natural Environment Research Council (NERC). The aim is to make existing meteorological and maritime data generated operationally by the UK Meteorological Office available in a user-friendly format for a variety of applications across the UK research community. Co-ordinated by Professor Keith Haines at Reading University, who holds the BMT chair in marine informatics, the project involves partners from the Southampton Oceanography Centre (SOC), Imperial College, the Rutherford Appleton Laboratory (RAL) and Manchester Computing Services.

GODIVA products and infrastructure include data services, visualisation services, grid computing facilities and ocean science results and demonstrators. The data services include the data delivery web service GADS, which serves more than 1Tb of ocean model data from NERC models and the UK Met Office daily ocean forecast products. Some of the data held by GODIVA can be accessed through an open web portal

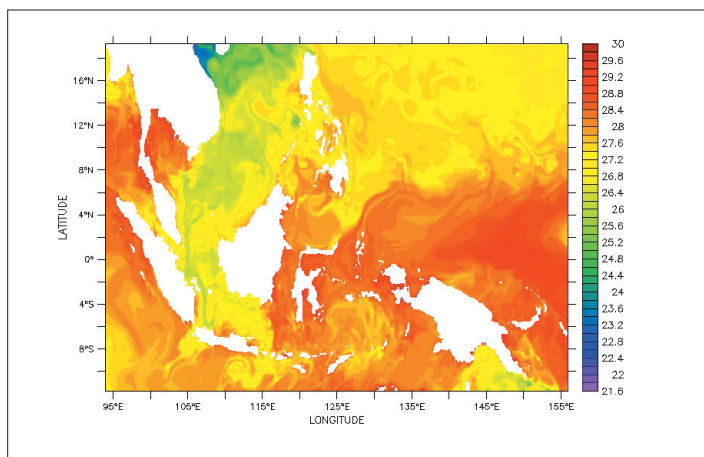


Sea surface height in metres over the North Atlantic from the UK Met Office FOAM model on 30 September 2004. This analysis reflects all of the assimilated satellite and in situ ocean data that were available at the time.

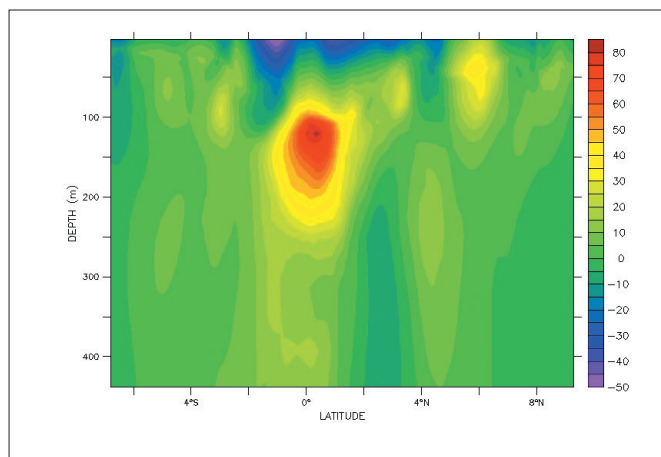


A North-South temperature section at 39°W for the upper 1000 metres of the North Atlantic from the same UK Met Office FOAM model for 30 September 2004. The warm/cold waters of the subtropical/subpolar gyres can be clearly seen. The undulations of the isotherms indicate the position of mesoscale eddies.

in the ocean data environment



Sea surface temperature map from the NERC OCCAM 1/12-degree global model over Indonesia. This illustrates the detail that is available from the highest resolution global models and shows that the ESSC data server can cut and handle very large data sets to produce figures such as this in a few seconds.



A North-South section across the Equator in the Pacific (140W) of the eastward current from the NERC OCCAM model. The strong eastward current right on the Equator is the equatorial undercurrent and its correct representation is critical for modelling the El Niño phenomenon.

(www.nerc-essc.ac.uk/godiva) which allows remote clients to construct their own movies of the evolving ocean circulation on their browsers. Within the project itself considerably more advanced visualisation prototypes are available including a steerable 4D perspective viewer for exploring data remotely, and remapping capabilities to compare different ocean parameters with each other.

Another project that involves Professor Haines' e-Science team is MERSEA (Marine Environment and Security for the European Area), an EU FP6 Integrated Project engaging 40 research partners across Europe. The project (<http://www.mersea.eu.org>) aims to develop a unified European system for operational monitoring and forecasting on global and regional scales of the ocean physics, bio-geochemistry and ecosystems. The project officially started in April 2004 as the ocean component of GMES. The foundation is based on four existing operational models that have been assessed and inter-compared, namely FOAM (Meteorological Office, UK), Mercator (Mercator-Océan, France), MFS (INGV, Italy) and Topaz (NERSC, Norway). The outcome is envisaged to be an operational network that will: collect and validate data from space-borne sensors and in situ measurement networks; assimilate and merge ocean data into global scale ocean circulation and region-

al high-resolution ecosystem models; and validate and deliver the model information to many user categories. The concept and objectives are challenging and lend themselves to the full scope of e-Science resource applications.

The GODIVA work in particular has direct application for re-engineering metocean data delivery within BMT marine information systems such as SARIS (Search & Rescue Information System) and OSIS (Oil Spill Information System) and developing new types of network based services that address broader community markets. Exploratory work in this area, funded by the South East England Development Agency (SEEDA), provides an online interactive data portal that demonstrates how operational meteorological forecast data sets can be browsed and selectively downloaded for integration with these BMT marine information products.

On a broader front, e-Science is seen as a core element in the development of suitably comprehensive regional marine information services and their subsequent globalisation, something that is increasingly required in European seas and elsewhere. A case in point is the regional marine information system info@SEA currently being implemented by BMT in Singapore in collaboration with the Maritime Port Authority of Singapore (MPA) and DHI Water &

Environment, Singapore. info@SEA hosts high-resolution operational forecasts of regional current fields computed by DHI, and is based on an enterprise-scale e-data warehouse concept that enables the integration of diverse data and provision of different types of marine information service to different end-users. info@SEA provides the facility for accessing remote databases and combining data within a geo-spatial environment to create information products that can be disseminated using optional thick/thin client web service methodology. It offers a framework for integrating Earth observation (EO) data into operational services concerned with maritime surveillance and security and anticipates the growing need for such systems to address multinational cross-border issues concerned with integrity and health of the maritime environment.

Many applications for the 'maritime data warehouse' concept are likely to come to light following discussions with industry facilitated by BMT. Since EO data are expensive and it is prohibitive to deploy dedicated satellites, it makes sense for the existing data to be 're-purposed' for commercial applications. It is one of the many ways in which public service organisations and academics engaged in 'pure science' can partner with industry in a sustainable way to the benefit of society at large. ■