

# ncWMS: A Web Map Service for multidimensional gridded environmental data

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http://ncwms.sf.net



## Introduction

A Web Map Service (WMS [1]) is a means for a Geographic Information System (GIS) to access tailored georeferenced map imagery over the Web. Imagery from different WMS services can be combined and overlain precisely in order to compare different sources of information.

Historically it has been very difficult to ingest data from the atmospheric, oceanic and climate sciences into GIS tools. Such data are commonly large and multidimensional, concerning the evolution in time of complex three-dimensional features such as storms, fronts and ocean eddies. These data are typically not encoded in standard GIS formats.

ncWMS is a free and open source WMS implementation for multidimensional gridded data. It bridges the gap between the environmental science and GIS communities, and provides a means for scientists to explore large datasets interactively.

## Interoperability

ncWMS is compatible with versions 1.1.1 and 1.3.0 of the WMS standard. It implements some extensions to the standard for efficient control over image styling and the production of "non-map" plots. Sensible defaults are implemented for tools that do not understand these extensions.

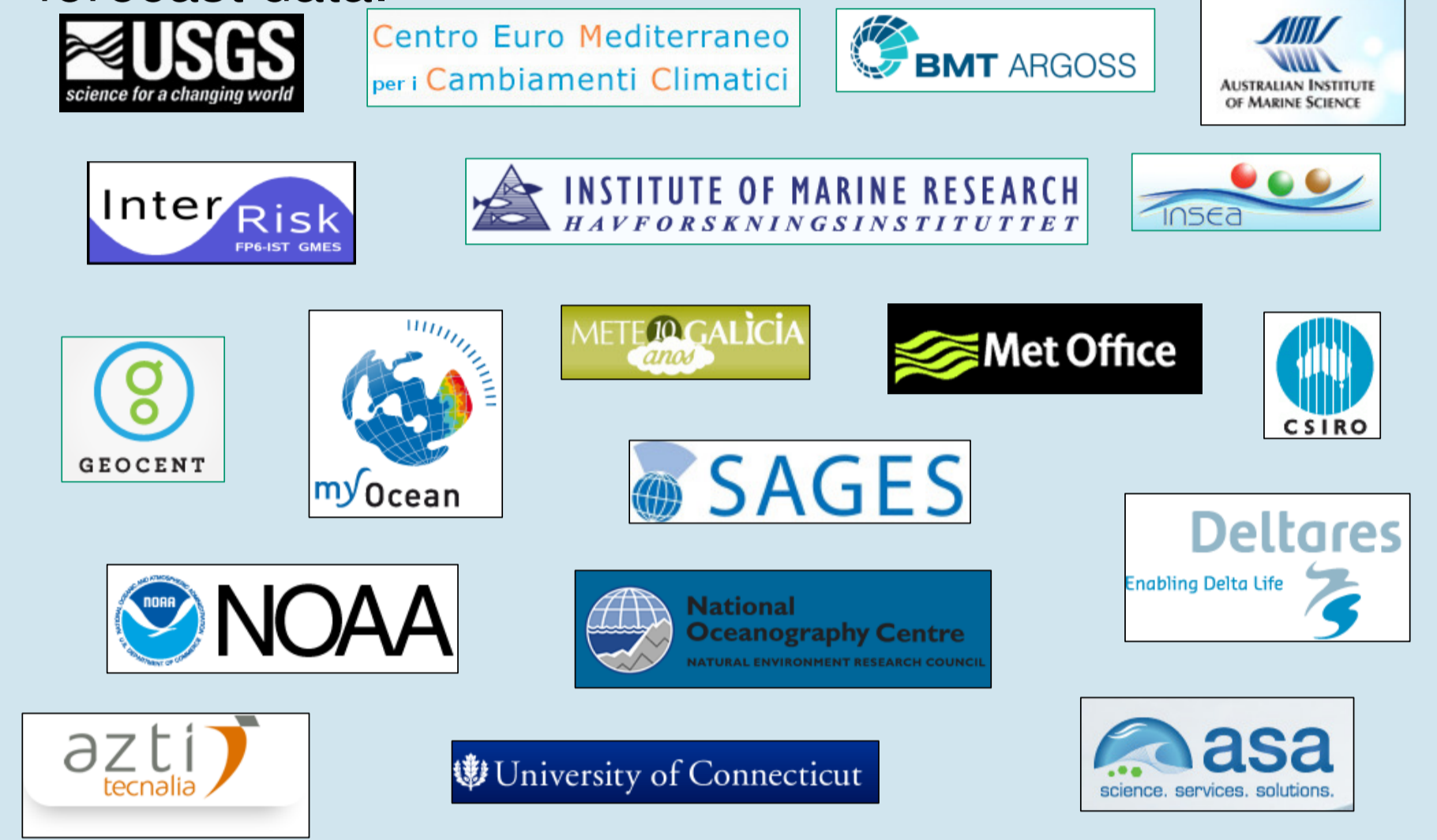
ncWMS implements the TIME and ELEVATION dimensions for handling 4D data, in accordance with the standard. Unfortunately most current GIS clients do not support these dimensions, although this situation is improving.

Data can be read from many standard file formats including CF-compliant NetCDF [2], HDF, HDF5 and GRIB. Accurate metadata are important to ensure correct behaviour.

## Adoption

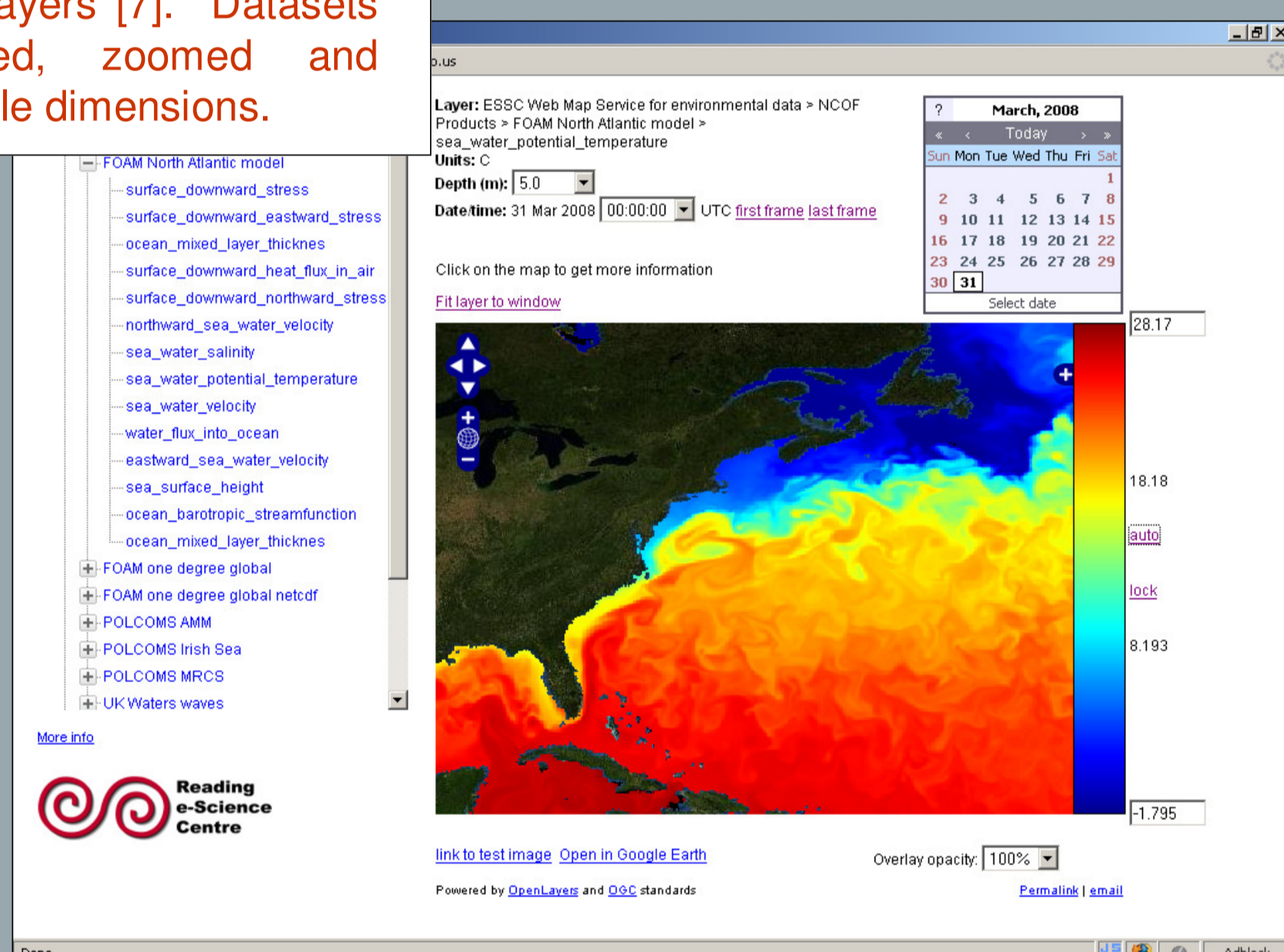
ncWMS is used by many data providers, research groups, teaching groups, private companies and international programmes.

It has been integrated with the THREDDS data server [3]. THREDDS will form a key component of MyOcean [4], the European Marine Core Service, providing WMS and OPeNDAP [5] access to ocean forecast data.



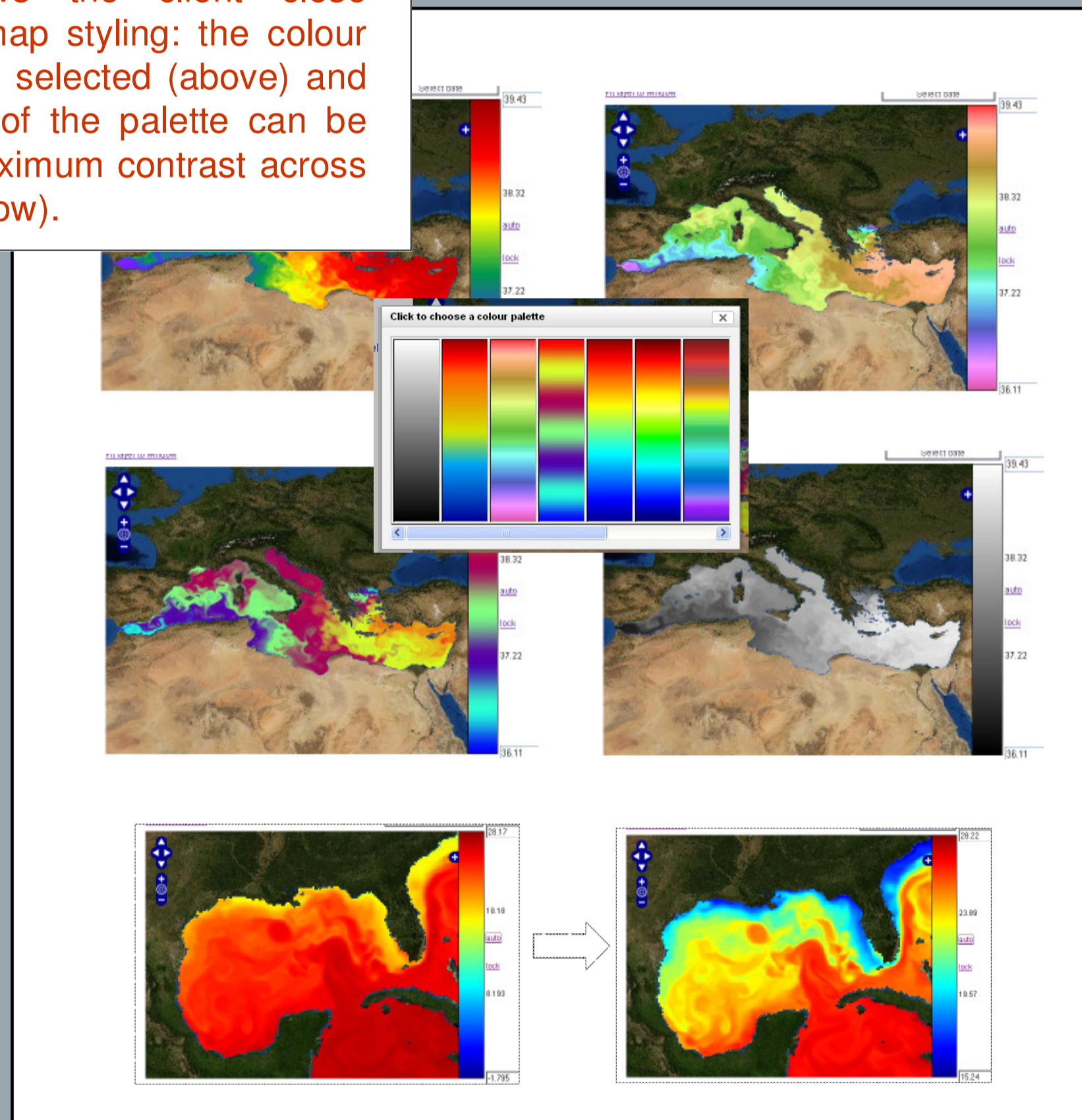
## Built-in interactive website

ncWMS is packaged with Godiva2 [6], a web-based data exploration tool based on OpenLayers [7]. Datasets can be panned, zoomed and explored in multiple dimensions.



## Control over map styling

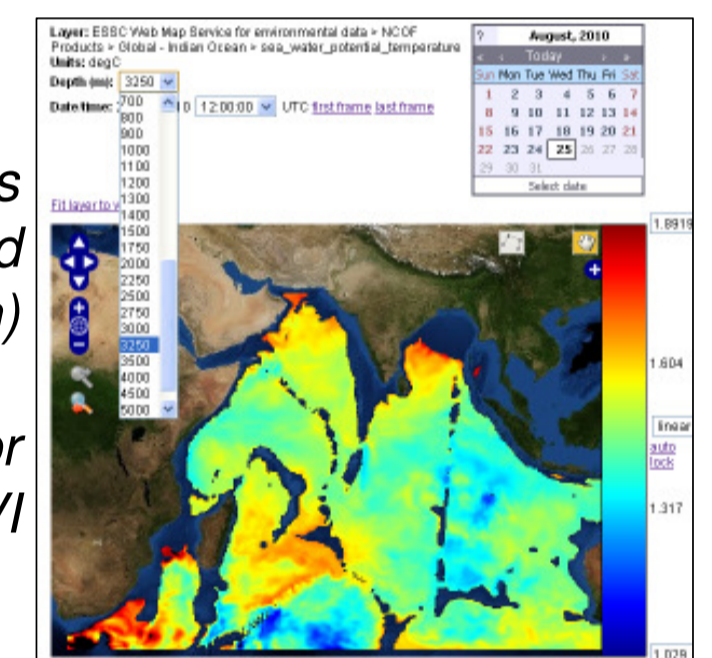
ncWMS allows the client close control over map styling: the colour palette can be selected (above) and the extremes of the palette can be set to give maximum contrast across the scene (below).



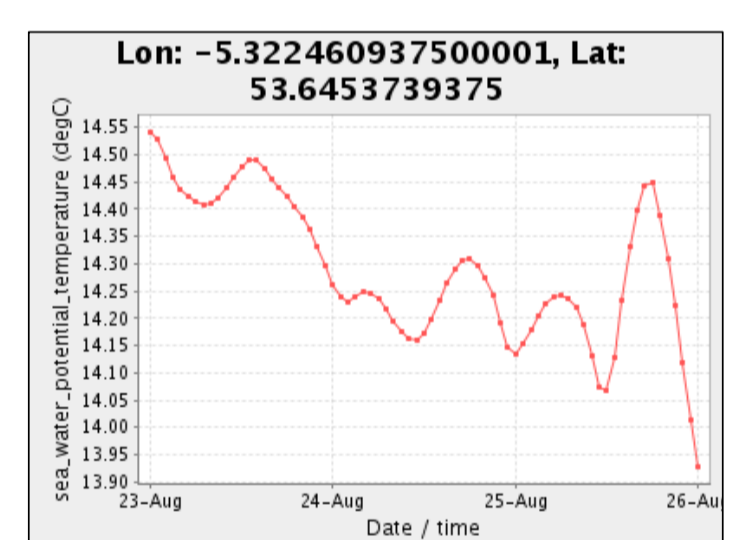
## Multidimensional data plotting

ncWMS allows the visualization of data in various slices through 4D space.

Maps at various times and elevations (standard GetMap operation)

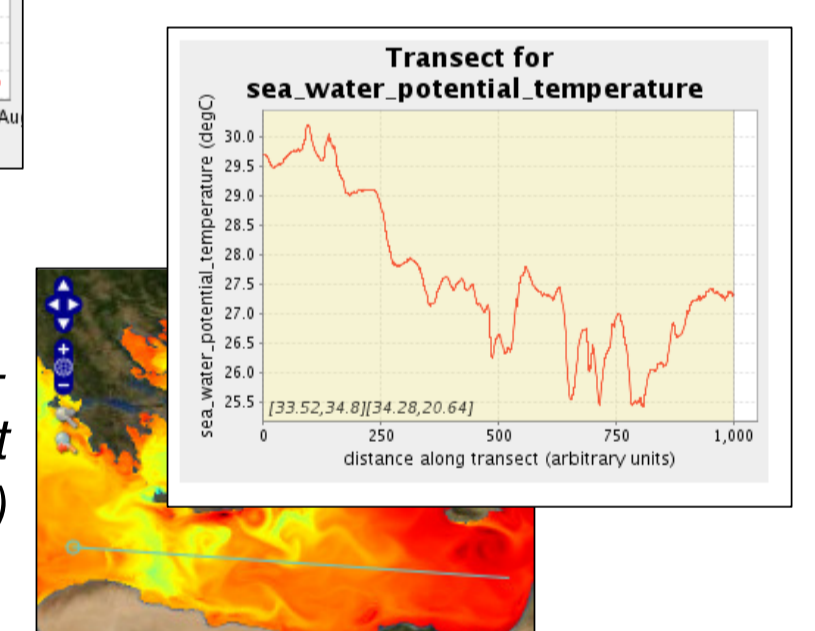


Animations as GIF or AVI



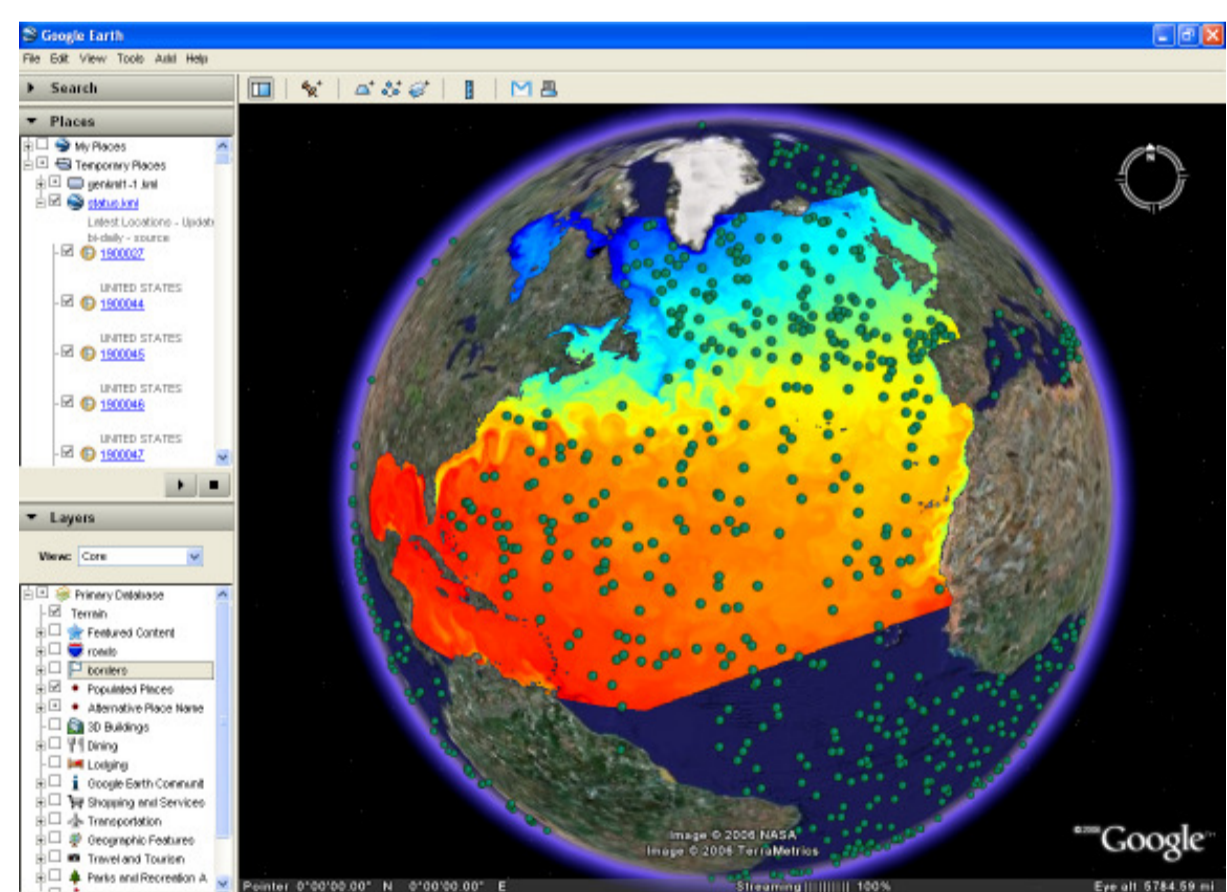
Timeseries graphs (GetFeatureInfo operation)

Transects (non-standard GetTransect operation)



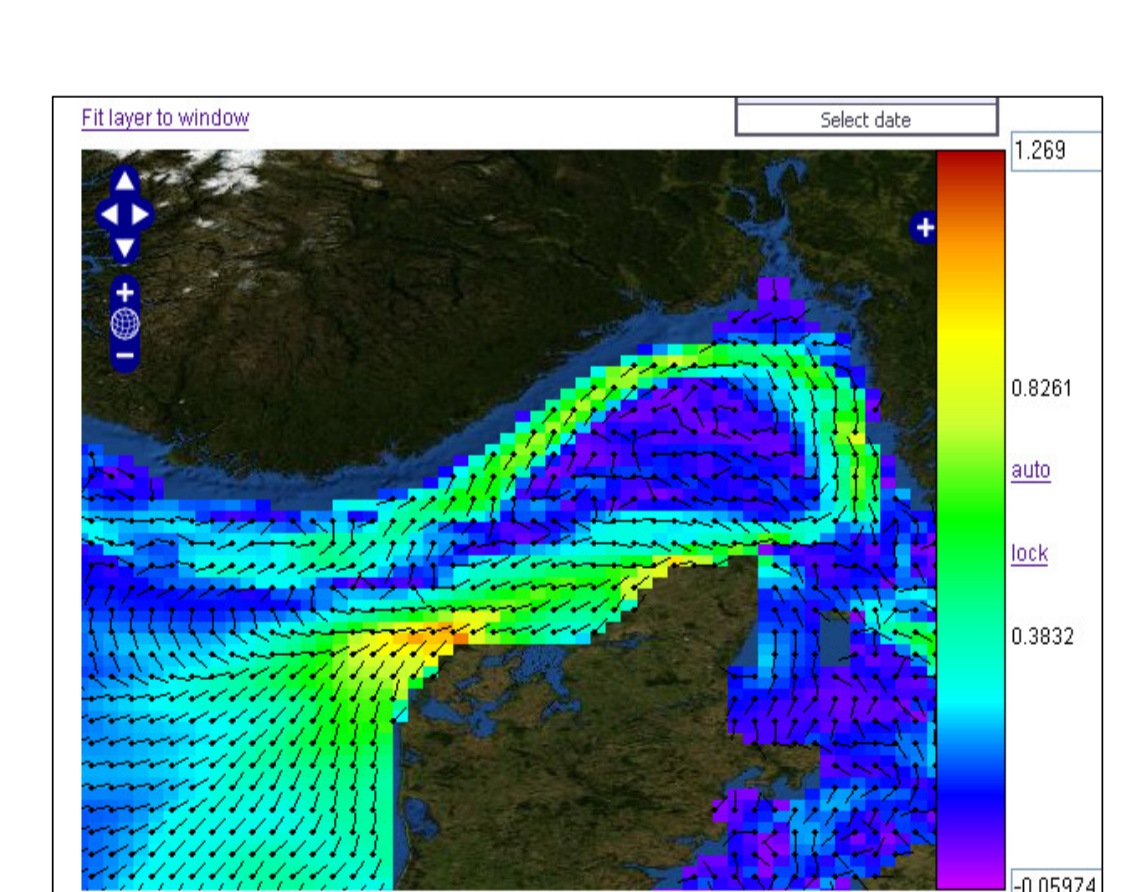
## Export to Google Earth

ncWMS can produce output in KML [8] for display in Google Earth. Here we show the numerical model data from ncWMS being viewed alongside the locations of Argo floats [9].



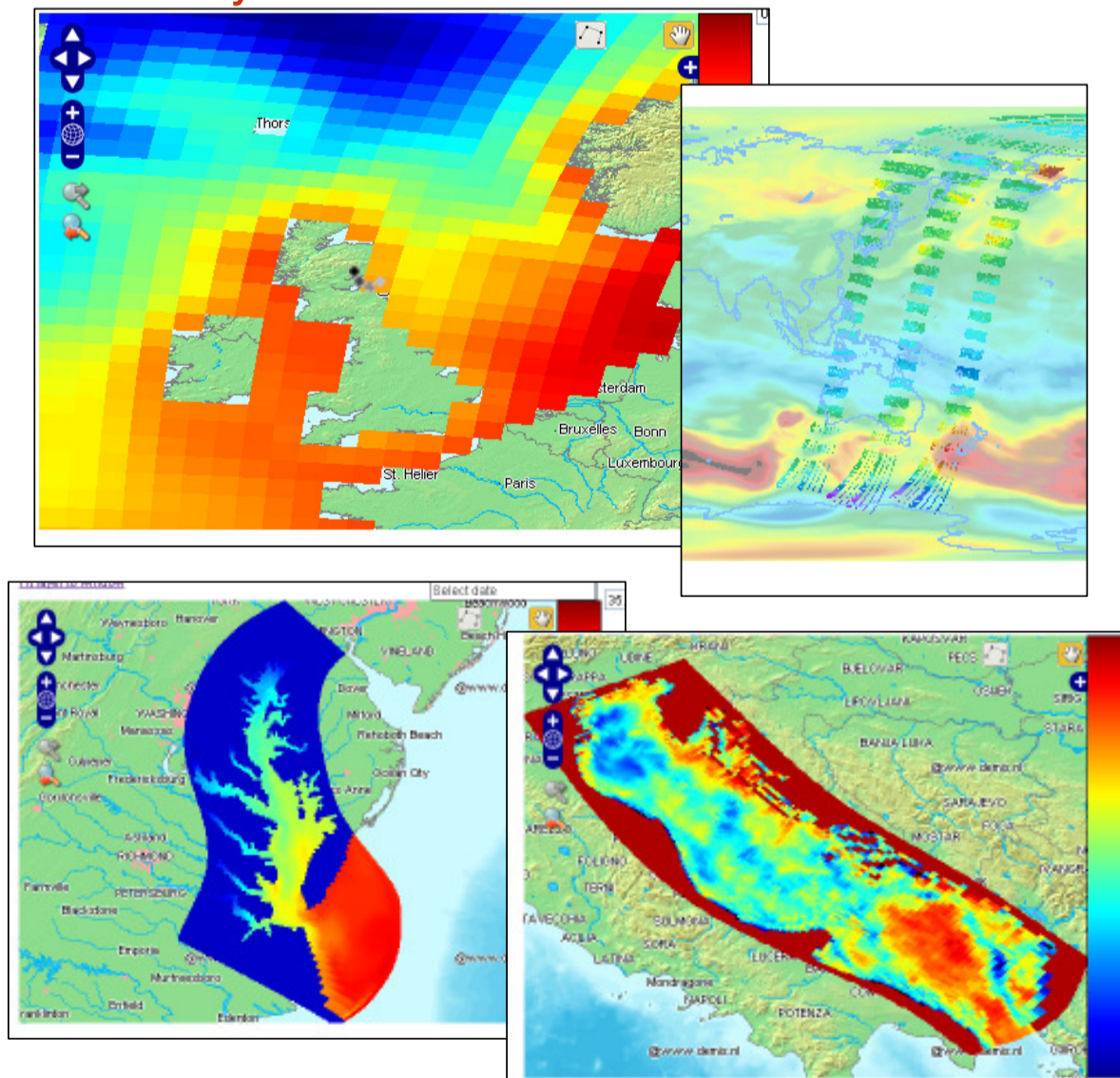
## Vector fields

Vector fields such as sea water velocity can be automatically displayed as arrows superimposed on top of the magnitude of the velocity field.



## Handling of complex grids

Many datasets from coastal- and global-ocean modelling and Earth Observation employ complex grids in order to follow coastlines, avoid polar singularities or follow a satellite orbit. ncWMS handles these efficiently.



## Technical details

ncWMS is a Java web application. Installation is a simple matter of copying the WAR file into any standards-compliant servlet engine, such as Tomcat. The application is configured through a simple web interface.

ncWMS uses the Java NetCDF libraries [10] to read data from any data format that conforms with the Unidata Common Data Model, including NetCDF, HDF, HDF5 and GRIB.

Geotoolkit [11] is used to perform coordinate transformations, allowing ncWMS to output imagery in all of the standard EPSG map projections.

## References and definitions

- [1] http://www.openeospatial.org/standards/wms
- [2] http://www.cfconventions.org/
- [3] http://www.unidata.ucar.edu/projects/THREDDS/tech/TDS.html
- [4] http://www.myocean.eu/
- [5] http://opendap.org
- [6] http://www.reading.ac.uk/godiva2
- [7] http://openlayers.org
- [8] http://www.openeospatial.org/standards/kml/
- [9] http://w3.jcommops.org/FTPRoot/Argo/Status/status.kml
- [10] http://www.unidata.ucar.edu/software/netcdf-java/
- [11] http://www.geotoolkit.org/
- [12] http://www.openeospatial.org/projects/groups/meteodwg

## Performance

Much effort has been devoted to ensuring that imagery is generated as quickly as possible. Actual performance is dependent on many factors including disk speed, data compression, map projection and disk caching within the operating system. Typically a 256x256 image can be generated in 0.5-1s.



## Future plans

**Extension to non-gridded data**, such as in situ observations.

**More "non-map" plots**, such as profiles, vertical sections, Hovmuller diagrams and animations thereof.

**Establishment of MetOcean WMS "profile"**, in collaboration with the OGC MetOcean Domain Working Group [12]. Further standardization of many aspects of WMS is needed to ensure interoperability for MetOcean applications, e.g. Generation of "non-map" plots, handling of different vertical and temporal coordinate systems, harmonization of styling.