

## 1. Abstract

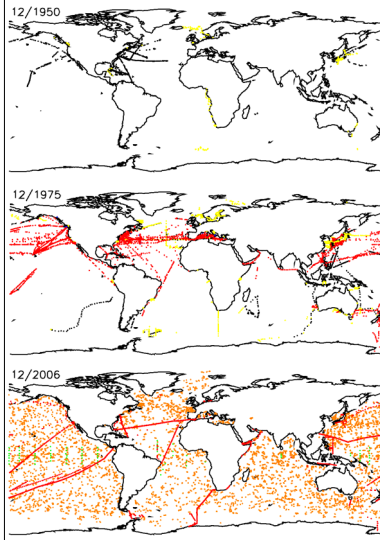
EN3 is a global dataset containing measurements of subsurface ocean temperature and salinity that have been quality controlled using a comprehensive set of objective tests. Data are output in NetCDF format and are available for the years 1950-2006 inclusive from the Met Office Hadley Centre web pages at [www.metoffice.gov.uk/hadobs](http://www.metoffice.gov.uk/hadobs). EN3 will soon include near real-time updates, as occurs for other Met Office datasets (e.g. HadISST).

In this poster the EN3 quality control system and some example applications of its output are described.

## 2. Introduction

Subsurface ocean data have many important uses such as for estimating oceanic heat uptake and for initialising decadal climate predictions (Smith *et al.*, 2007). For successful use of the data in these applications it is important that the observations are of good quality. For example, if erroneous data are incorporated into a model run, the errors will propagate through the simulation and spurious results could be produced. Therefore, quality control of the data is essential.

The Met Office quality control system was developed under the EU ENACT and ENSEMBLES projects. The system has been applied to data from 1950-2006 to create the EN3 dataset. A detailed description of the quality control system can be found in Ingleby and Huddleston (2007).

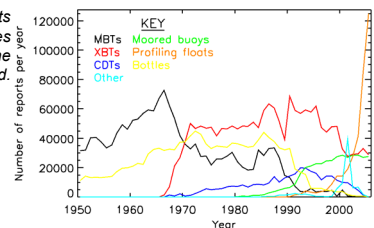


## 3. Data

The principal source of the data included in EN3 is the World Ocean Database 2005 (WOD05). These data are supplemented with profiles obtained from the Global Temperature-Salinity Profile Program (GTSP) from 1990 and Argo data from 1999. See below for references for these datasets.

Observations processed by the system include those from mechanical (MBT) and expendable (XBT) bathythermographs, conductivity-temperature-depth (CTD) profiles, moored buoys and profiling floats. The proportion of the data from each type of instrument changes over the years, as shown in Figure 1. Particularly noticeable is the growth in the number of profiling floats due to the Argo project. Coverage of the oceans also changes, with relatively sparse coverage in the early years of the dataset improving to almost global coverage after the introduction of the Argo floats. This is illustrated in Figure 2, which shows the positions at which observations occurred in December 1950, 1975 and 2006.

**Figure 1:** The number of reports from various instrument types excluding those reports where the entire profile was rejected.

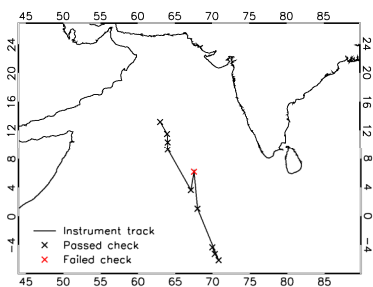


**Figure 2:** Change in the number and coverage of observations during the period of the dataset. See Figure 1 for the key to the colours used.

## 4. The quality control system

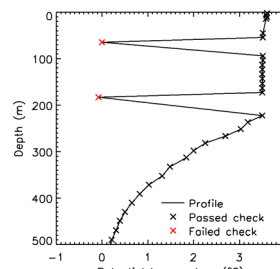
The main steps incorporated in the system are as follows:

- Vertical thinning: the profiles are thinned vertically if necessary to reduce the number of levels to a maximum of 150.
- XBT depth corrections: corrections are applied to the depths recorded for XBTs in order to compensate for the difference between the expected fall rate of the instruments and that which occurs in reality. The correction used depends on the XBT type and, for the most common type of XBT, a reduced correction is applied in cooler water where the viscosity is higher.
- Prior rejects: profiles that are known to be suspect are rejected. These were defined using the Argo grey list and by visual inspection of the data.
- Instrument track check: Figure 3 shows an example of a profile rejected by this check.



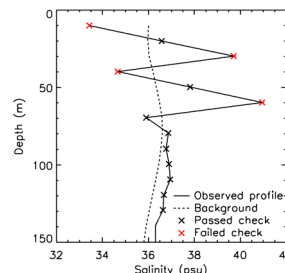
**Figure 3:** Track of a series of XBT measurements made in June 1980. The instrument track check has been passed by the profiles recorded at positions marked with black crosses; the profile at the position marked in red was rejected.

- The profiles are checked for constant values over a number of levels and for spikes and steps. Figure 4 shows an instance where spikes have been detected in a profile.
- Duplicate check and thinning of reports within 0.2° latitude/longitude and 1 hour of each other; this thinning reflects the design of the system to support data assimilation.
- The profiles are checked for density inversions.



**Figure 4:** An Argo profile from January 2006 showing the levels that passed (black crosses) and failed (red) the check for spikes.

- Bayesian background check: this check compares the observations to a background. For EN3 this background is a damped anomaly persistence forecast. Figure 5 gives an example of where levels in a profile have been flagged by the background check.
- Buddy check: compares nearby observations to each other.
- Output: the data are output in a uniform format for the entire record. Quality control flags are supplied with the data to show if an entire profile or individual levels were rejected.



**Figure 5:** An Argo profile from June 2004 showing the levels that passed (black crosses) and failed (red) the background check.

## 6. Obtaining the EN3 dataset

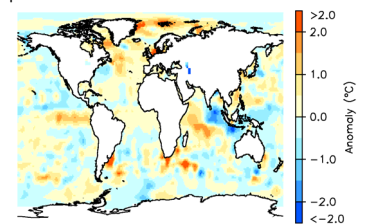
The EN3 dataset can be downloaded from the Met Office Hadley Centre website at [www.metoffice.gov.uk/hadobs](http://www.metoffice.gov.uk/hadobs). The files are available free of charge for private study and scientific research. Monthly data for each year are stored together in tar files. Within these are two files for each month; the first contains the quality controlled profiles stored in NetCDF format; the second contains a listing of statistics produced by the quality control software.

The quality control system will be further developed and improved on an ongoing basis. To help with this it would be extremely useful to hear about how you are using the dataset and about any comments or suggestions for improvements that you have. There are links on the website for registering as a user and for leaving feedback. Alternatively, please use the email address at the bottom of the poster. This can also be used to ask questions about the dataset.

## 5. Applications of the data

The results produced by the quality control system have been used in many applications. A number of these are described below:

- The quality controlled observations have been used to generate the HadGOA dataset (Palmer *et al.*, 2007). This analysis of historical ocean heat content uses the novel approach of integrating between the surface and a fixed isotherm to filter out effects such as circulation changes from the record. More information about the dataset can be found at [www.metoffice.gov.uk/hadobs](http://www.metoffice.gov.uk/hadobs).
- A by-product of the EN3 system is a model-independent objective analysis formed from the data for each month. Applications of these analyses include using them to create plots of the state of the oceans, which, for example, are of interest to seasonal forecasters. Figure 6 shows an example of the type of plot that can be produced.



**Figure 6:** Mean 0-300 m temperature anomalies relative to a 1971-2000 climatology for December 2006.

- A variant of the software is incorporated within the operational systems at the Met Office that are used for short-range ocean forecasts and for seasonal forecasting.

## 7. References/acknowledgements

Argo: These data were collected and made freely available by the International Argo Project and the national programs that contribute to it. (<http://www.argo.ucsd.edu>, <http://argo.jcom.mopps.org>). Argo is a pilot program of the Global Ocean Observing System.

GTSP: Operational Oceanography Group; Global Temperature-Salinity Profile Program. June 2006. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Oceanographic Data Center, Silver Spring, Maryland, 20910. <http://www.nodc.noaa.gov/GTSP/>

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