REPROCESSING THE GLOBAL HISTORIC HYDROGRAPHYC DATA

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1. PROJECT

There is a general need in the oceanographic community for a historic hydrographic data product providing quality-controlled temperature and salinity profiles as long backwards in time as possible. Such a data base will be important for many different applications in the oceanographic community since it will provide a description of the two most important characteristics of sea water. Applications will include water mass analysis, ocean modeling but especially also ocean syntheses estimating the time-varying ocean circulation by combining all available ocean data with ocean models.

In a cooperative effort between the KlimaCampus of the University of Hamburg, the German Oceanographic Data Centre (DOD, Hamburg), the Publishing Network for Geoscientific & Environmental Data (PANGEA) and the Alfred Wegener Institut für Polarforschung (AWI), we reprocess all available historic hydrographic data for climate purposes.

This work includes to

- combine all available global historic hydrographic data
- enhance the available data base by historic data sets not publicly available
- remove duplicates
- quality control them in the context of ocean state estimation
- infer climate variability from the resulting data base
- use them as input for ocean syntheses

2. APPROACH

Starting from existing hydrographic data base available at NODC, we search archives at DOD, PANGEA, as well as ICES and other for new profiles not yet included in the data base. We will go back as far as 1900 or earlier attempting to create a climate quality historic data set. We will check the consistency and quality and document the differences between the data obtained by different oceanographic measurements.

The current version of the NODC World Ocean Database (WOD2005) provides the

major data source for the project and each profile in the final product will be linked to the NODC original profile via a unique NODC profile ID#. However, the data product will be different from the NODC data presentation in several ways. All profiles will be interpolated in the vertical on a 1-meter (CTD) or 5-meter (Bottle data) grid to derive a uniformly interpolated data product with sufficient vertical resolution. The *interpolated data* will be always accompanied by the *data on observed levels* to provide a possibility for the user to access simultaneously both data types.

3. DATA TYPES

Our first step is to create an up to date ***hydrographic data product***, which includes temperature and salinity measurements, obtained by means of the old Nansen hydrographic casts and by the modern Conductivity/Temperature/Depth (CTD) instruments. These two kinds of data are by far the most accurate compared to other instrument types. In addition to CTD and bottle data quality controlled and bias corrected temperature profiles obtained by means of mechanical and expendable bathythermographs will be also available. The metadata, most important for the quality assessment of the temperature and salinity data, will be available along with profile data.

4. QUALITY CONTROL PROCEDURES

We extend the quality control procedure of the World Ocean Database 2005 in several ways. The T and S quality checks will be conducted in the T/S-space and inter-cruise offsets will be calculated wherever possible. As shown by Johnson et al. [1] and by Gouretski and Jancke [2] systematic offsets between the cruises exist even for the data of the highest available quality (e.g. WOCE data set). Such inter-cruise offsets will be determined and documented on a cruise by cruise basis. Data processing methods developed during the initial stage of the project will be used for the analysis of other types of hydrographic subsurface data, such as those from mechanical and expendable bathythermographs and profiling floats. The hydrographic cast data will be used as a reference for the quality assessment of data from other instruments. Recently, a new correction method for bathythermograph data has been developed (Gouretski and Reseghetti [3], submitted) and applied to the original bathythermograph profiles. Using bias decomposition into depth error independent part and purely thermal part the new correction method effectively eliminates total temperature bias thus permitting the use of the bathythermograph data for climate application. An example of temperature and depth correction for shallow type of XBT probes is shown in Fig. 1.

5. APPLICATIONS AND ALTERNATIVE APPROACHES

One of the key applications of quality controlled hydrographic observations is their integration into an ocean or coupled climate model synthesis to obtain a consistent description of the changing circulation. One of such synthesis is the ECCO/GECCO adjoint synthesis (Estimation of Circulation and Climate of the Ocean/German Part) in which an adjoint model is used to calculate corrections of the control parameters of an ocean circulation model. In GECCO covering the period from 1951-2001 the solution is brought close to the data mainly by adjusting the surface forcing. Although GECCO was

constrained by the WOD2001 that is known to be biased, the estimated heat contain changes (Köhl and Stammer [4]) are in better agreement with recent estimates based on bias corrected XBT data than previous estimates

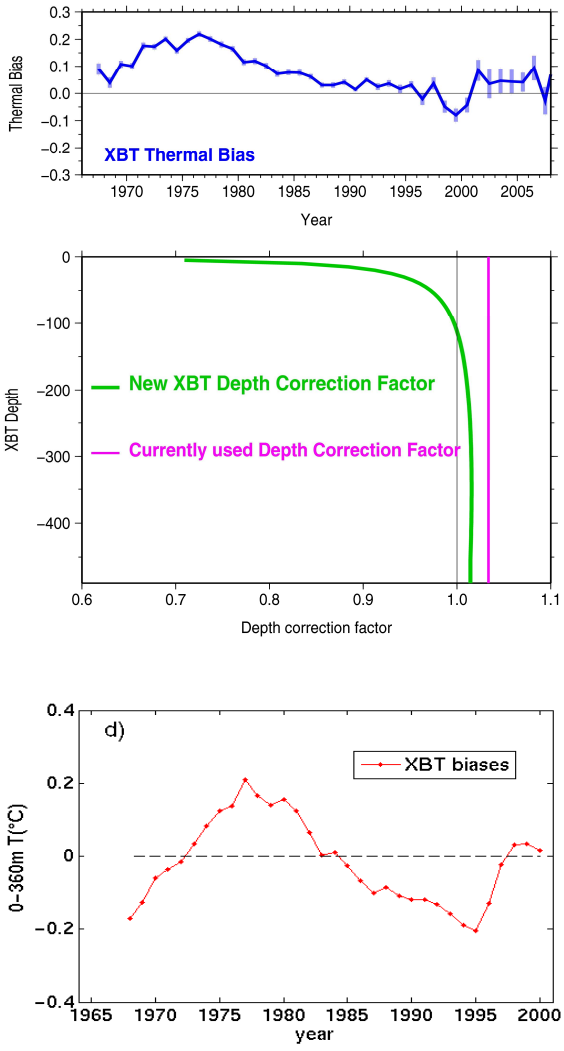

Figure 1. Temperature (top) and depth (middle) corrections for XBT data (T-4 and T-6 XBT types, [3]) and anomalies (bottom) of the depth-averaged XBT bias for the range 0-360m from a comparison to the GECCO synthesis [6]

based on simpler synthesis methods (Stammer et al. [5]). The dynamical constraint of the method apparently filters artificial heat content changes due to time variant instrument biases that can not be represented by physical processes. By comparing the synthesis to the original XBT observations, an estimate of the time variant part of this bias could be obtained (Liu [6]) which shows a similar temporal evolution as the estimate from the XBT correction method (Fig.1).

6. DATA ADDITIONS

Efforts are spent to include many German data sets not included in the historic data archives before, as well as other data obtained in the past over the global ocean. Since the beginning of the project about 7,500 historical hydrographic profiles from the German Federal Maritime and Hydrographic Agency (BSH) archives available earlier only in a printed or hand-written form have been digitized (Fig. 2).

7. DATA PRODUCTS AND AVAILABILITY

Data products will be world-wide available on the KlimaCampus data server www.klimacampus.de

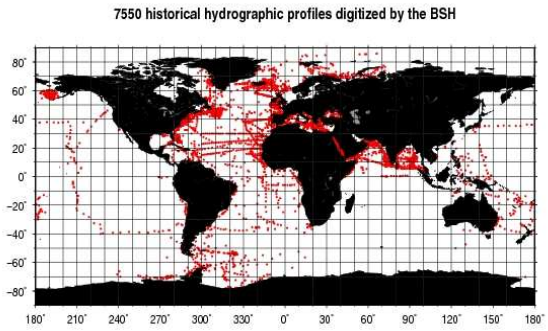

Figure 2. Historical profiles from BSH archives absent in the WOD2005

8. REFERENCES

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