ARGO requirements for more rapid and easier access to CTD data

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1. ARGO CONTEXT

Argo is the most visible and innovative new element of the sustained observing system for the open ocean. Since mid-2004 it has become the most abundant source of profile data from the ocean and that abundance will continue to increase as the array grows to its target of 3000 floats that will deliver 100,000 CTD profiles per year by 2007.

Paradoxically, the existence of Argo has highlighted the importance of research ship-based CTD observations. Argo floats are expendable, consequently there is no opportunity to do laboratory calibrations to check sensor drift. A method has been devised to estimate sensor drift by making comparisons with nearby (in space and time) CTD profiles collected by research ships and by comparing new and old floats. This method is described in: Wong, A.P.S., Johnson, G.C. Owens, W.B., 2003. Delayed-Mode Calibration of Autonomous CTD Profiling Float Salinity Data by Theta-S Climatology. Journal of Atmospheric and Oceanic Technology, 20, 308-318. Böhme, Lars and Uwe Send, 2005: Objective analyses of hydrographic data for referencing profiling float salinities in highly variable environments. Deep-Sea Research II, 52/3-4, 651-664.

The estimation of float sensor drift requires a regular supply of ship-board CTD profiles to depths of at least 1000m in water depths of 2000m or more. Unfortunately, most of these data are not easily available to Argo community, and those that are available arrive after unacceptably long delays. IODE & the NODCs are asked to assist in making these data more easily and rapidly available to Argo.

Rather schematically, one can distinguish data that are used in delayed mode (the study of ocean processes, surveys to assess low-frequency variability, building up climatology), from those used in real time (or near real time) for assimilation into ocean circulation models for operational purposes. The calibration of Argo profiles falls in both categories: validation as soon as possible after deployment, and delayed mode quality control.
2. AVAILABLE SOURCES FOR ARGO CTD REFERENCE DATABASE

*World Ocean Data Base from USA/NODC:* Periodically US-NODC issues a new version of this database compiled from the different datasets provided by the IODE National Data Centres. This database is updated every five years or so and distributed as a complete dataset. Update dataset from the previous issue is available and as well as monthly updates both on WWW and FTP sites. Nevertheless there isn't, to our knowledge, periodical updates with new CTD received since the WOD release.

*CLIVAR Global Hydrography and Carbon Hydrographic Data Office* (CCHDO at Scripps - http://cchdo.ucsd.edu/). This centre is a follow-on to the WOCE Hydrographic Program and is dedicated to CLIVAR purposes. Cruise data should normally be sent to CCHDO via a national NODCs but the specific direction of the dataflow is not as important as is the timely delivery of this information. Moreover, one of CLIVAR’s more challenging tasks has been to compile information on cruises on which CLIVAR-relevant observations have been made and would significantly benefit from improvements in the availability of cruise plans. This could be easily be achieved if the inventories of cruises maintained and regularly updated were made available and could include, in particular, information on the planned/acquired positions of CTD observations.

3. ARGO REQUIREMENTS

The ability of Argo to monitor decadal-scale change in ocean salinity (crucial to study of global scale precipitation changes and impacts on the thermohaline circulation) requires a well-calibrated CTD data set for the global ocean for temperature and salinity parameters. The initial version of the reference database used for Argo delayed mode QC will use the WOD2005 provided by US-NODC. Argo will need an annual update of this database. The CCHDO has volunteered to play a central role in the coordination and delivery of the reference CTD data sets to Argo. The CCHDO must rely on the contributions from national data centres. Without these contributions and the corresponding improvements in international data exchange, it will be very difficult to perform post-deployment sensor calibration and delayed mode quality control.

*What quality assurance level is needed?*

Argo requires data in which the calibrations of temperature pressure and particularly salinity are well documented. This means that, typically, the CTD instrument should have been calibrated shortly before the cruise (accuracy preferred: 0.002°C for temperature and 0.01 PSU for salinity). Thus if preliminary data were submitted to the CCHDO, the data should be resubmitted when the final calibration of salinity values (for example with bottle samples) has been completed. The complete data set should be delivered with the *shortest delay* to the appropriate national data centres, and to the CLIVAR and Carbon Hydrographic Data Office (CCHDO), the official CLIVAR repository for CLIVAR CTD and related bottle sample data. We note that the need for data originators to co-forward CTD data to both their national data center and the CCHDO can be simplified to the appropriate national data centre, for those nations where agreements can be reached to routinely correspond with the CCHDO regarding new CTD data files they receive, and to provide those of interest to CLIVAR directly (promptly, verbatim) to the CCHDO.\(^1\)

\(^1\) Moreover, it is recommended that the data be also transmitted *in real time* to data centres (e.g. AOML, MEDS, JMA, and CORIOLIS). For the real time, decimated data sets are acceptable and useful (every 10 or 20 db), even if uncalibrated, provided that they include the necessary meta-data. Information on the recommended data exchange formats can be obtained at the data centres.
Timescale of data usefulness

Data should be sent as soon as possible after a cruise is completed, however, data are still of significant value if delivered to CCHDO up to 1 year after cruise completion.

Data policy issue

To date there is no well-defined international data policy, however, open data sharing between countries and agencies would a boon to the oceanographic community in general and Argo in particular. One of the many obstacles to any open data policy is the PI’s right to a period of proprietary use. Argo and the CCHDO fully understand the importance of safeguarding these proprietary rights and pledge to use these early release data only for sensor calibration and assimilation into real-time ocean models. These activities will not limit these scientists’ data use privileges, including later detailed analysis. Use of these data by Argo and CCHDO will be solely for the statistical correction of float data, unless a more general release of the data is approved by the PI.

4. RECOMMENDED ACTIONS

1- National oceanographic data centers ("NODCs") to reduce delay in CTD provision by their national PIs. NODCs to encourage provision in near-realtime of cruise calibrated CTD for validation and assimilation in operational models

2- National NODCs to transmit to NODC/USA and CCHDO with short delay the calibrated CTD they get from their PIs

3- US-NODC to coordinate with CCHDO in order to provide to Argo an annual update of recent CTD collected via NODCs