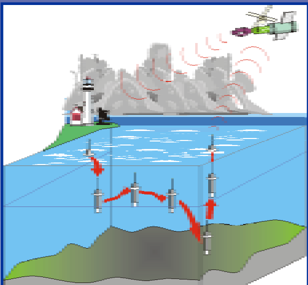
Delayed Mode Quality Control on ARGO floats at the Coriolis Data Center

Christine Coatanoan*, Philippe Galaup and Virginie Thierry, Coriolis Data Center
* IFREMER DOP/DCB/IDM/SISMER Centre de Brest - BP 70 , France Christine.Coatanoan@ifremer.fr



Moving of a profiler in the ocean

Introduction on Delayed Mode QC:

Recalibration is generally not possible due to the no recoverable nature of floats, so float datasets are usually check to an indirect way. Here we present the application of a method based on mapping a set of calibrated data by objective analyzing to the float profile position. The method applied at the Coriolis Data Center is the method of Annie Wong et al (2003) [1] adapted to North Atlantic environment by Lars Böhme [2] to produce the delayed mode data for Gyroscope project in a first time.

Recalibration is set up to correct sensor drifts by using historical hydrographic data. The used objective mapping method takes into account the high spatial and temporal variabilities of the North Atlantic [2]. Assuming that a conductivity offset changes slowly over time, the float measurements are fitted linearly to the mapped salinities in potential conductivity space by weighted least-squares. The result is a set of calibrated salinity data with corresponding uncertainties.

Floats of the Gyroscope project

Overview of the Delayed Mode QC method:

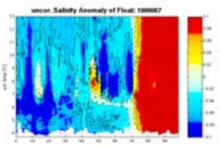
The method uses the two main state variables temperature θ and salinity S. Mean θ-S relationships can be used to estimate salinity from measurements of temperature and pressure. The CTD measurements (WOD01 and others) are interpolated on 2 dbar levels to store all information but reducing the amount of data. To provide an acceptable vertical coverage the deepest measurement of each station must be below 1000m.

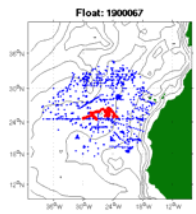
The horizontal data selection is based on a spatial distance D and fractional distance in potential vorticity F. The vertical data selection selects 10 float measurements for each profile (top and bottom measurements (525-2000 dbar), minimun and maximum of T and S, two with tightest P-T definition and two with highest P-S definition). A temporal distance t is also taken into account.

The final objective estimate at the float profile location is the sum of two stages of mapping: the first calculates the basin-wide mean, in the second the residuals are mapped to the float profile location using a covariance function of the temporal and small spatial separation. All measurements are converted to potential conductivity to eliminate differences in pressures between historical and float data. Then the potential conductivities of the float are fitted to the mapped potential conductivities.

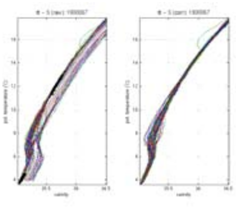
DMQC - Analysis on ARGO float:

Some diagnostic plots allow to follow the behavior of the float and to understand the correction computed from the DMQC method for the calibration.

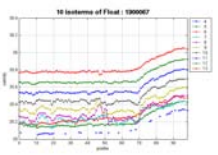




This figure shows the used reference dataset; the red points are the cycles of the studied float; the blue points are the selected data from the reference database to run the objective mapping.



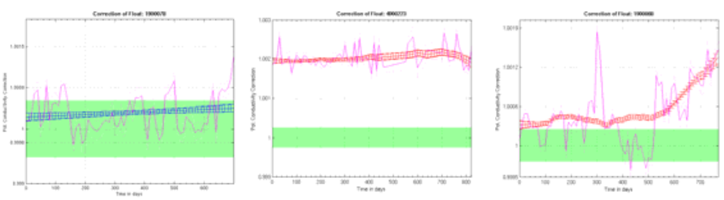
Θ-S diagrams before and after the correction : in this case, the results of the recalibration allow to correct the observed drift.



Salinity anomalies on isotherms allow to detect if a physical or technical event is the cause of the detected drift/offset of the sensor. This example shows a drift at the end of the float time-series.

Results of the calibration:

- When the correction is inside the green-box, the correction is not significant;
- When offset is observed, it has been showed that using the tank error, this offset was reduced;
- A positive drift is consistent with a fooling of the conductivity cell.

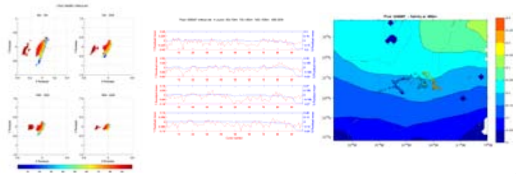


Weighted least-squares fit is done for a time-varying slope of the correction term to smooth out outliers. The green box corresponds to accuracy of ± 0.01 psu.

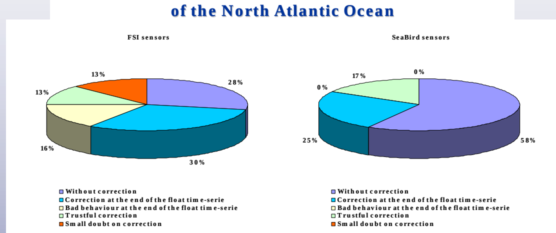
The individual corrections are in magenta and the smoothed corrections (with a sliding window of ± 6 months) are in blue or red depending of the location in or out the green box.

Complementary tools:

In parallel, a data analysis system based on optimal estimation methods has been developed and implemented at the Coriolis data center. The residual values allows to follow for some levels possible drifts or offsets. The salinity and temperature fields are used to compare the value of the float salinity with the climatology.



Ratio of corrections applied to the floats of the North Atlantic Ocean



Conclusions

Due to the drift and offset observed on the salinity sensor, it is necessary to recalibrate float data in delayed mode.

Offsets and drifts are detectable in the floats of the North Atlantic and a corresponding correction is supplied using objective mapping method.

The results have shown that Seabird sensors were more stable than FSI sensors.

Historical hydrographic dataset using to select 'best' profiles for the mapping to the float profile is sometimes insufficient in some oceanic areas and need to be updated with the recent cruise data.

To help to determine the correction, complementary tools have been developed, using the residuals and fields of an objective analysis taken into account all type of data available in the Coriolis database (profilers, xbt, ctd, moorings).

References :

1. **Wong, A. P. S., Johnson, G. C., Owens, W. B.**, February 2003. Delayed-Mode Calibration of Autonomous CTD Profiling Float Salinity Data by -S Climatology. Journal of Atmospheric and Oceanic Technology 20, 308-318.

2. **Böhme, L. and U. Send, 2005,** Objective analysis of hydrographic data for referencing profiling float salinities in highly variable environment.s. *Deep Sea Research Part II*, Vol 52/3-4, pp 651--664