Use of the analysis system for monitoring the ARGO-sensors drifts.

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In the previous letter, we briefly presented the analysis system operational at the Coriolis datacenter. This system both synthetises data sets by producing temperature and salinity gridded fields and checks for quality the data from the Coriolis database in real time. We will focus here on this latter application of the system. We will discuss of the use of the analysis tool to perform the real time and delayed mode quality control (QC), particularly of the ARGO profilers. Those two modes of QC are fundamentally different. Real time QC are meant to flag the data according to pre-defined quality levels, these tests must not slow down the data flow, they are therefore only qualitative. The delayed mode QC has to be quantitative, one wish to detect and evaluate any possible bias or drift in the sensors involved in the measurement, a particular vehicle is studied at once, and followed over its life time. Several methods based on similar techniques whose method recommended by ARGO have been proposed. Our general analysis tool is formally equivalent to this latter but also offers a wide set of possible uses.

1 Method

In the previous letter the objective analysis formalism used to produce estimations has been recalled:

$$x^a = x^f + C_{ao}\left(C_o + R\right)^{-1} d$$

We call «analysis residuals » the misfit between observations and analysis at measurement points:

$$\delta = y^0 - R(C_o + R)^{-1} d$$

Residuals are obtained at the same time as the field estimation.

2 Identification of sensor errors in the analysis residuals

In order to better identify a possible drift on any of P, T, C sensors, a set of simulations of errors on the measured parameters has been realized and the impact on the final data output and on the analysis residuals have been evaluated. One of the sensitivity test studied consisted in the simulation of a constant bias in salinity (-0.04 psu) on time series of profiles from an ARGO float considered without any suspect behaviour. Analysis using the original and the perturbed float have been independently performed, and the results of this twin experiment have been looked at. We expected to retrieve in the residuals, inconsistencies with neighbouring data, due to measurement errors or small scales not resolved by the analysis, but also from oceanic structures not resolved by the data or inconsistent with the a priori statistics. The results presented figure 1 show that the study of residual time series allows to retrieve a percentage (depending on the configuration) of the anomaly introduced.

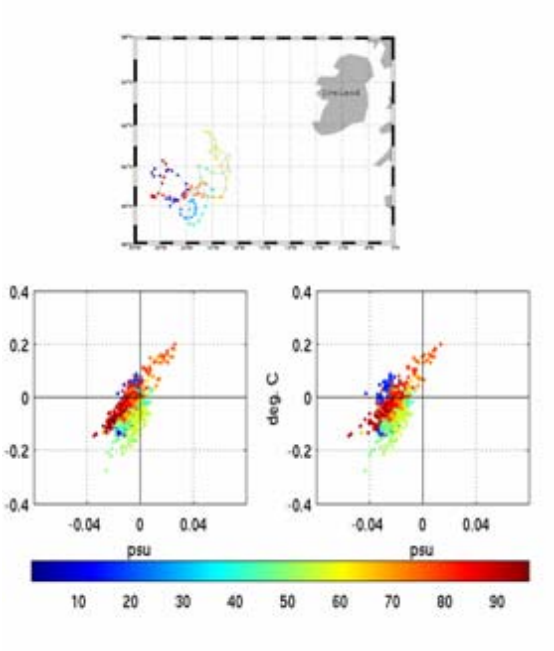

Figure 1: Sensitivity test. Top: trajectory of the ARGO profiler used in the test. Bottom: diagram of the temperature and salinity residuals at ???? m, left: unperturbed float, right: float perturbed with a constant -0.04 PSU offset.

The process has been iterated by introducing the correction given by the averaged residuals. In this example, the best result is obtained after 2 iterations (Figure 2)

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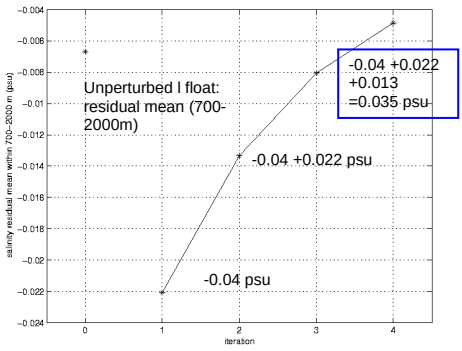

Figure 2: Error retrieved by iterations

3 Global diagnostic

A global diagnostic of the ARGO profilers fleet over the Atlantic has been realised from the reanalysis 2000-2004 (CORA-ATL-01). We selected

the floats with QC 1 or 2 and more than 16 T and S profiles and ended with 482 floats. The space distribution of the corresponding profile is shown figure 3.

Each time series of residuals has been looked at using the graphic tools presented on figure 4. The anomalous behaviours have been sorted out in 3 categories: bias, drift and the combination bias + drift. The table summarizes the result of our screening. It appears that despite the sensors problems that occurred on some floats during the early ARGO years, the fleet has behaved well with nearly 85% of good floats.

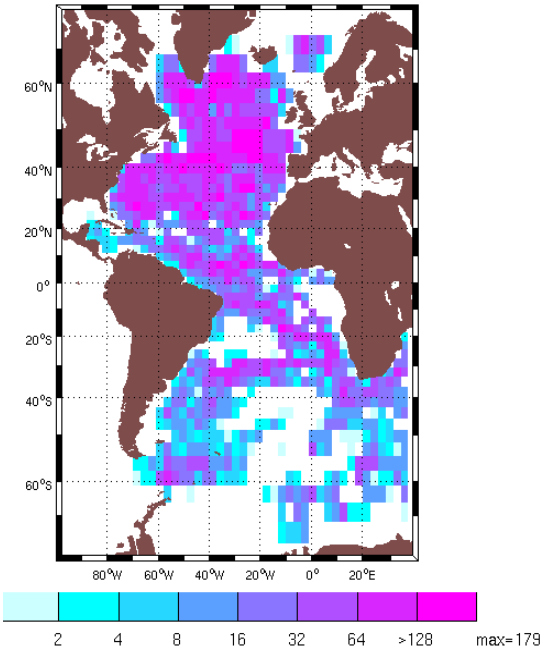

Figure 3: Number of profiles in each 3 degrees square area over the 2000-2004 period

	Number of profilers	% over 482 profilers
Offset	28	5.9
Drift	29	6.1
Offset + drift	17	3.6

Table 1: Statistics of sensors offset and drift for the 482 ARGO profilers.

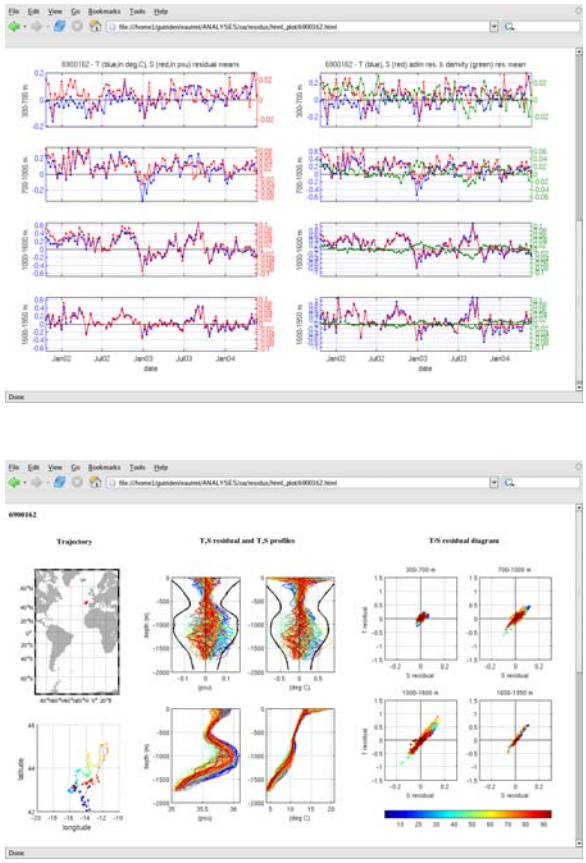

Figure 4: Graphic tools used for screening the ARGO profilers residuals over their lifetime.

4 References

Boehme, L. and U. Send, (2005), Objective analysis of hydrographic data for referencing profiling float salinities in highly variable environments, *Deep Sea Res. II*, 52, 651-664.

Coatanoan, C., L. Petit De La Villeon, (2005), Coriolis quality control manual, www.coriolis.eu.org/cdc/quality_control.htm.

Durand, F. and G. Reverdin, (2005), A statistical method for correcting salinity observations from autonomous profiling floats: An ARGO perspective, *J. Atmos. Oceanic Technol*, 22, 292-301.

Wong, A. P. S., G. C. Johnson and B. W. Owens, (2003), Delayed mode calibration of autonomous CTD profiling floats salinity data by θ-S climatology, *J. Atmos. Oceanic Technol*, 20, 308-318.