

Quality Control of Pre-Argo World Ocean Circulation Experiment Profiling Float Data

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ABSTRACT

Profiling floats were deployed in the Atlantic, Pacific and Indian Oceans as a component of the World Ocean Circulation Experiment (WOCE). WOCE float data were collected north of 6°S in the Atlantic Ocean, throughout the Indian Ocean, in all 3 ocean basins south of 30°S, and in the Northeast Pacific Ocean from 1994 to 2001. The majority of the floats were deployed in the Atlantic Ocean as part of the Atlantic Circulation and Climate Experiment (ACCE). The internationally coordinated Argo project has developed a uniform quality control procedure for the profiling float data collected during this more recent experiment. The WOCE data were edited using the Argo protocols to provide a uniformly edited data-set of profiling floats beginning in 1994 and continuing to the present. The 44,037 WOCE profiles were first reviewed using the 10 automatic quality control (QC) tests developed for Argo. There were 38,132 (87%) profiles which passed and 5,905 (13%) profiles that failed the automatic tests. The next step in the Argo quality control procedure is to have an operator inspect those profiles that failed an automatic test. There were 829 (1.9%) profiles that passed the visual quality control. Thirty five percent (15,474) of the float observations included both temperature and salinity profiles. Of these floats, 11,108 profiles were suitable for the final step in the quality control applied. This step involves using a statistical comparison of the salinity profiles to other hydrographic data to correct for any drift in the measurements.

METHODS USED:

1) Real-time QC using ARGO methodology.

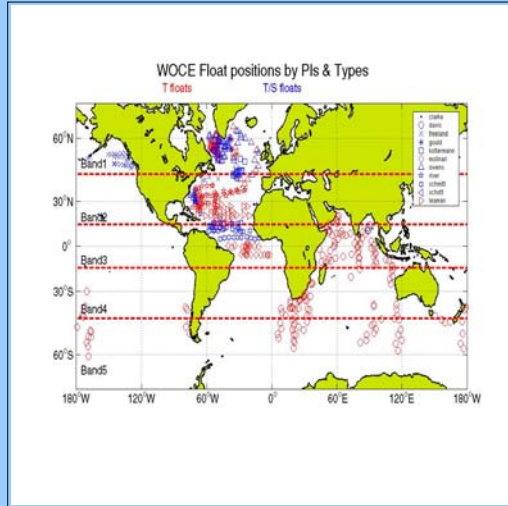
http://www.meds-sdmf-mpo-gpo.ca/ALPHAPRO/ctsp/cqmans/MG22/guide22_e.htm

2) Application of Wong et al. methodology.

(Delayed-Mode Calibration of Autonomous CTD Profiling Float Salinity Data by 6-S Climatology by Annie Wong, Gregory Johnson, Brechner Owens)

3) Final Reviews.

44,037 Profiles; 525 Floats
 T Floats: 341; T/S Floats: 184



INTRODUCTION

A total of 44,037 profiles were collected by autonomous profiling floats in the Atlantic, Pacific and Indian Oceans as part of the World Ocean Circulation Experiment (WOCE). Eleven investigators (PIs) (Clarke, Davis, Freeland, Gould, Koltermann, Molinari, Owens, Riser, Schmitt, Schott, and Leaman) deployed the floats. Only temperature data were provided by 341 of the floats, both temperature and salinity data were provided by 184 of the floats.

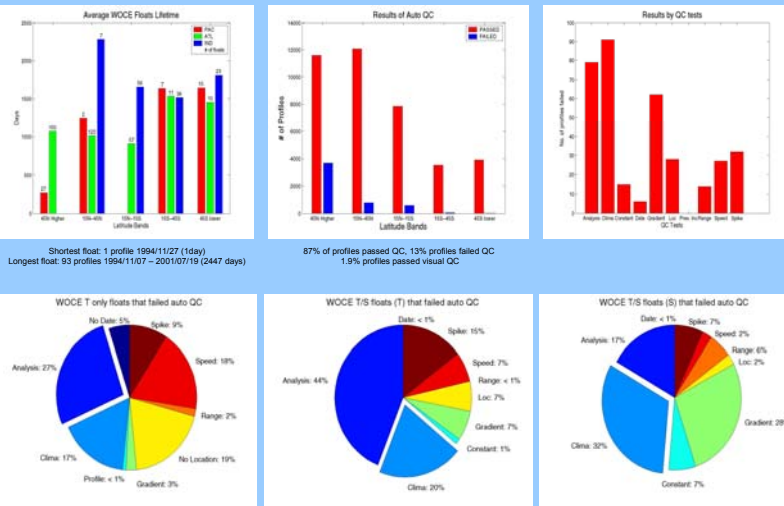
The object of this project is to quality control the WOCE profiling float data using the same procedures developed for the Argo experiment (http://www.meds-sdmf-mpo-gpo.ca/ALPHAPRO/ctsp/cqmans/MG22/guide22_e.htm). Using the same procedures on the WOCE data will generate a consistently edited data-set that extends from 1994 through Argo. Following the Argo procedures, the following methods are used to quality control the WOCE data.

- 1) Real-time Argo quality control tests: There are presently 18 real time Argo quality control tests that are applied automatically to profiles prior to international distribution. However, insufficient data are attached to the WOCE profiles to apply all 18 tests and only 10 are used (impossible date, impossible location, location on land, unrealistic speed, global range, pressure not monotonically increasing with depth, constant value, spike, vertical gradient/density gradient, climatology/NCEP's analysis). Profiles that failed one or more of the automatic tests were reviewed by an operator. Of these, profiles that failed because of one or two bad points were edited and included in the data set.
- 2) Application of Wong A., G. Johnson and B. Owens (2003, Delayed-Mode Calibration of Autonomous CTD Profiling Float Salinity Data by 6-S Climatology) method: The editing routine of Wong et al. (2003) was applied to the salinity profiles, assuming that the temperature and depth values were correct. This routine estimates the drift in the salinity sensor using a statistical method that compares float salinity values with surrounding values from historical and recent CTD data. The drift is estimated as a constant value with respect to depth. If estimated corrections are less than 0.01, the assumed accuracy of the salinity sensors, no editing is applied.
- 3) Final Reviews: We are in the process of verifying the results from the Wong et al. (2003) approach by comparing time series of temperature (i.e. verifying the assumption of no temperature errors) and corrected salinity values from the floats at depths greater than 400 m (to avoid the more variable surface layers) to similar values from concurrent and neighboring XBT, CTD and other floats (i.e., the buddies).

RESULTS: 1) Real-Time QC - Completed

QC Tests used:

- 1) Date/Time: 1994=Year, 11=Month, 1=hour, 5=minute, 12=day in range expected for month, hour 9-20, minute 0-59, sec 0-59
- 2) Location: -180=lon=180 (0=lon=0)
- 3) Position on land (ETOPO5/TerrainBase)
- 4) Global Range test: Temperature in range: -2.5 to 40 degrees C, Salinity in range: 0.0 to 41.0 PSU
- 5) Pressure monotonically increasing
- 6) Spike: Test value=(v_i+v_{i+1})/2, V₂>0 degrees C for pressure <500 db or V₂>0 PSU for pressure <500 db or V₂>3 PSU for pressure <500 db
- 7) Vertical Density Gradient: Test value=(v_i+v_{i+1})/2, V₂>0 degrees C for pressure <500db or V₂>0 PSU for pressure <500db or V₂>1 PSU for pressure <500db or V₂>1.5 PSU for pressure <500db
- 8) Speed between the profiles <=3.0 m/s
- 9) Constant values
- 10) Analysis/Climatology: Comparison to NCEP's analysis +/-0.10 Comparison to Levitus climatology +/-0.10



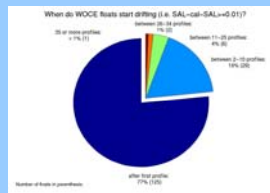
CONCLUSION

Automatic real-time quality control (qc) procedures developed under the International ARGO project have been applied to all pre-ARGO floats. The auto qc results showed that the average lifespan for the floats deployed in the Atlantic, Indian, Pacific Oceans is 1194.8, 1453.3, 1202.2 days. The overall average lifespan is 1202 days (about 3 years). This real-time qc eliminated the large and obvious errors from the pre-ARGO profiles. Overall 13 % of the profiles failed one or more tests and needed to be visually examined. This visual qc recovers 2% of the failed profiles. The tests that caused the most failures are comparisons to an NCEP model analysis and the Levitus climatology. The third most failed mode for T only floats and T/S floats was the vertical temperature or density gradient test.

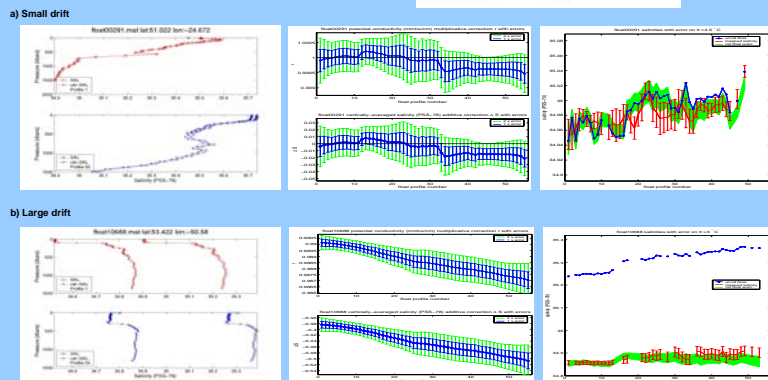
The Wong et al. (2003) delayed mode method to correct any salinity sensor drift over time was then applied to the pre-ARGO data. There were only 165 floats out of 525 floats that collected salinities. Only 1% (3) salinity floats showed a small drift (<=0.01 psu) after a year of operation.

The last part of this pre-ARGO qc is a final review. We will compare the time-series of corrected salinity values from neighboring CTD, XBT and other ARGO floats (i.e. buddies) at depths greater than 400 m. This work is on going.

RESULTS: 2) Wong et al. Method - Completed



Examples of results from Wong et al.



RESULTS: 3) Final Reviews - Work in progress

