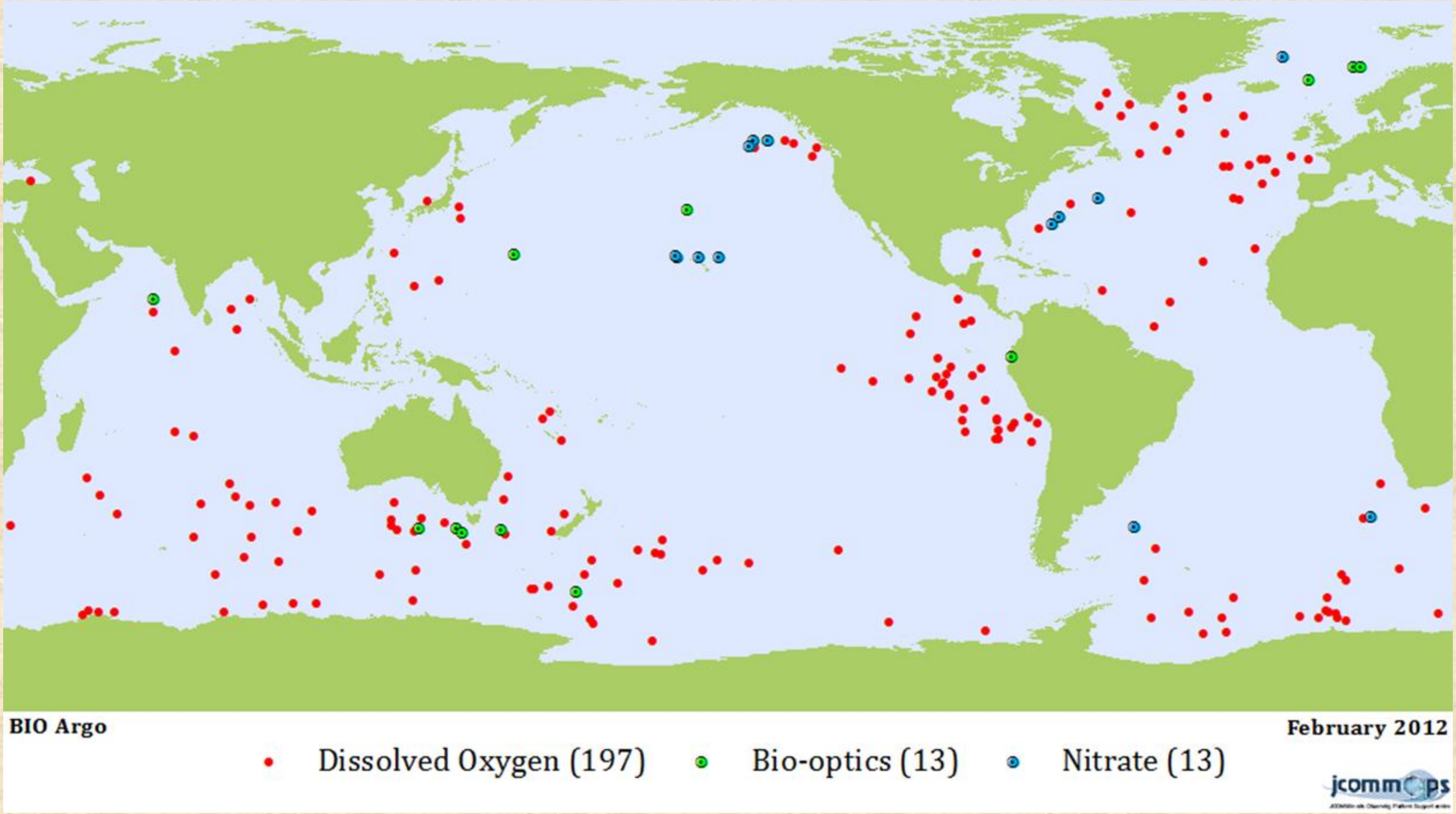
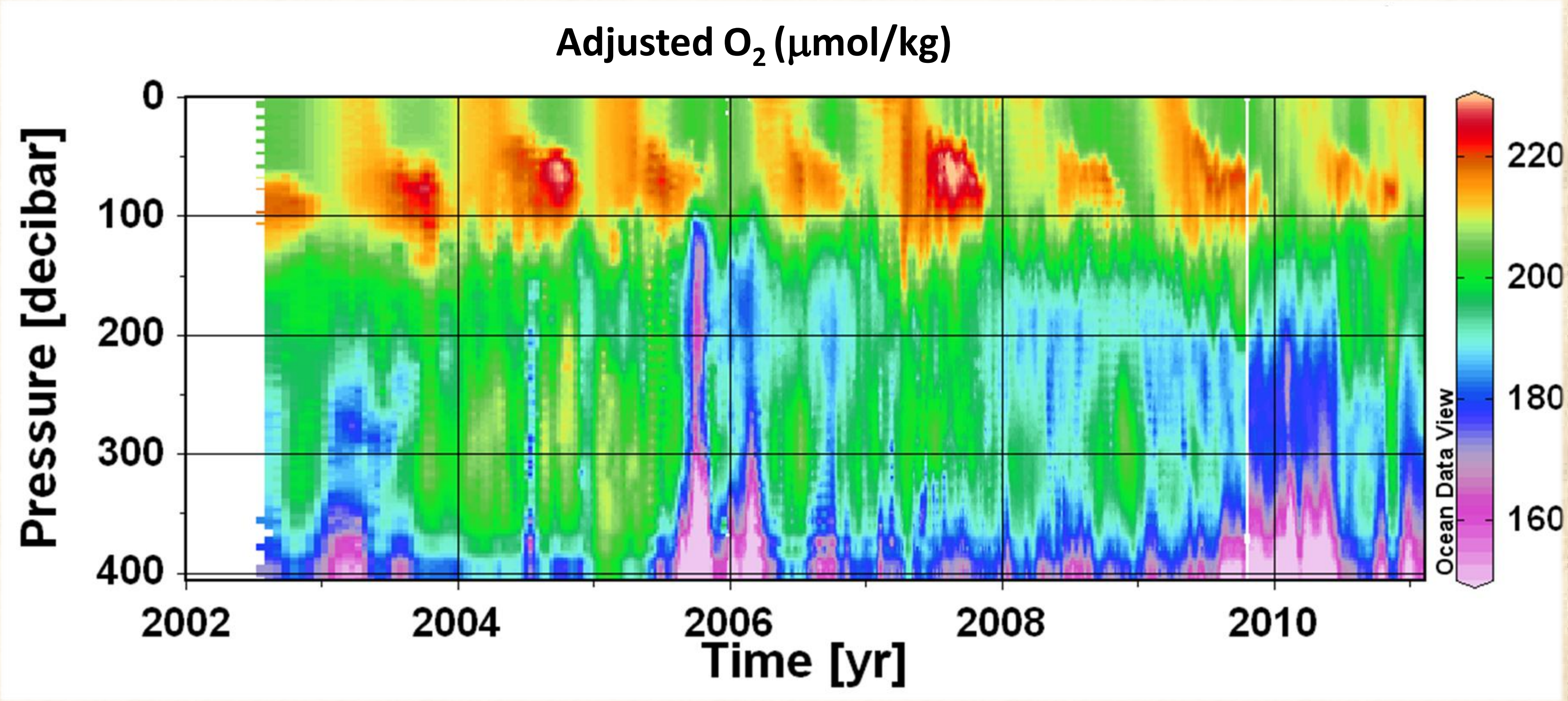
An Update on Quality Control of Oxygen Data from Profiling Floats

S. Riser, University of Washington
V. Thierry, IFREMER
D. Gilbert, Fisheries and Oceans Canada

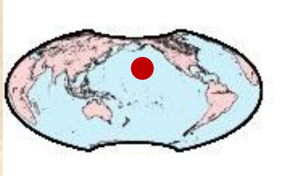
AST-13
March 20-23 2012
Paris



There are now more than 200 oxygen sensors deployed on Argo floats. There are several new programs in various planning stages that will propose to greatly increase this number. How do we use the data from these sensors? What are the inherent errors? What QC procedures need to be developed? These issues were addressed in Brest at an Argo/Oxygen Workshop in May of 2011.

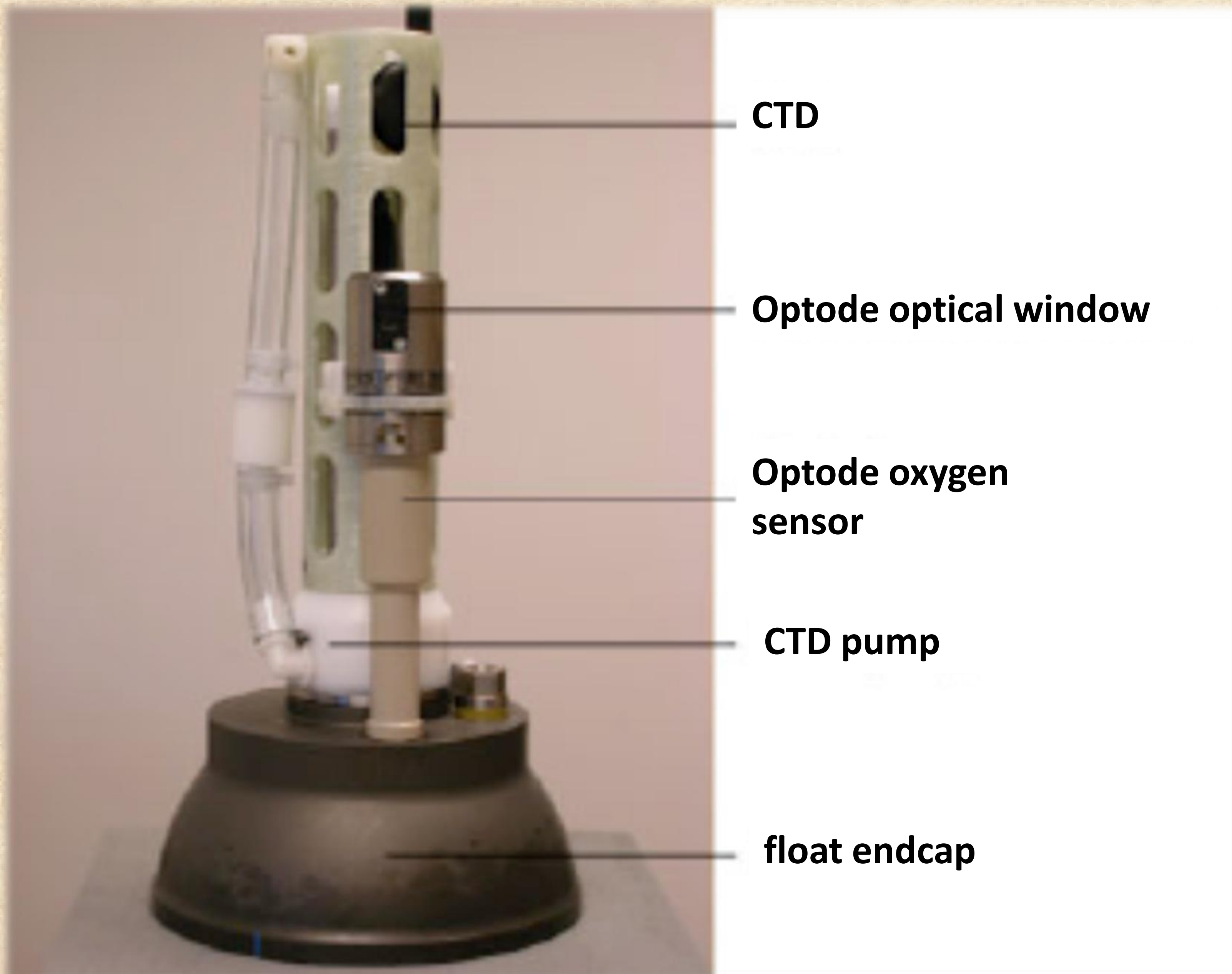


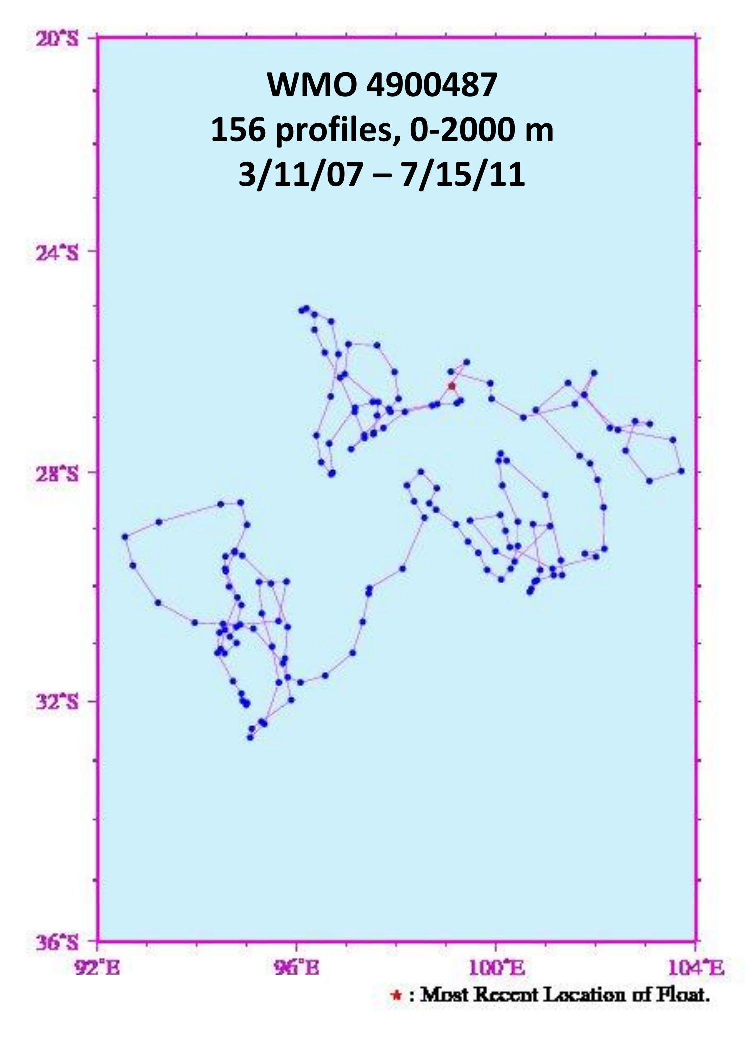
9 years of float-based O_2 data from the HOT site show a consistent seasonal cycle, demonstrating the utility of float-based O_2 measurements (from K. Johnson).

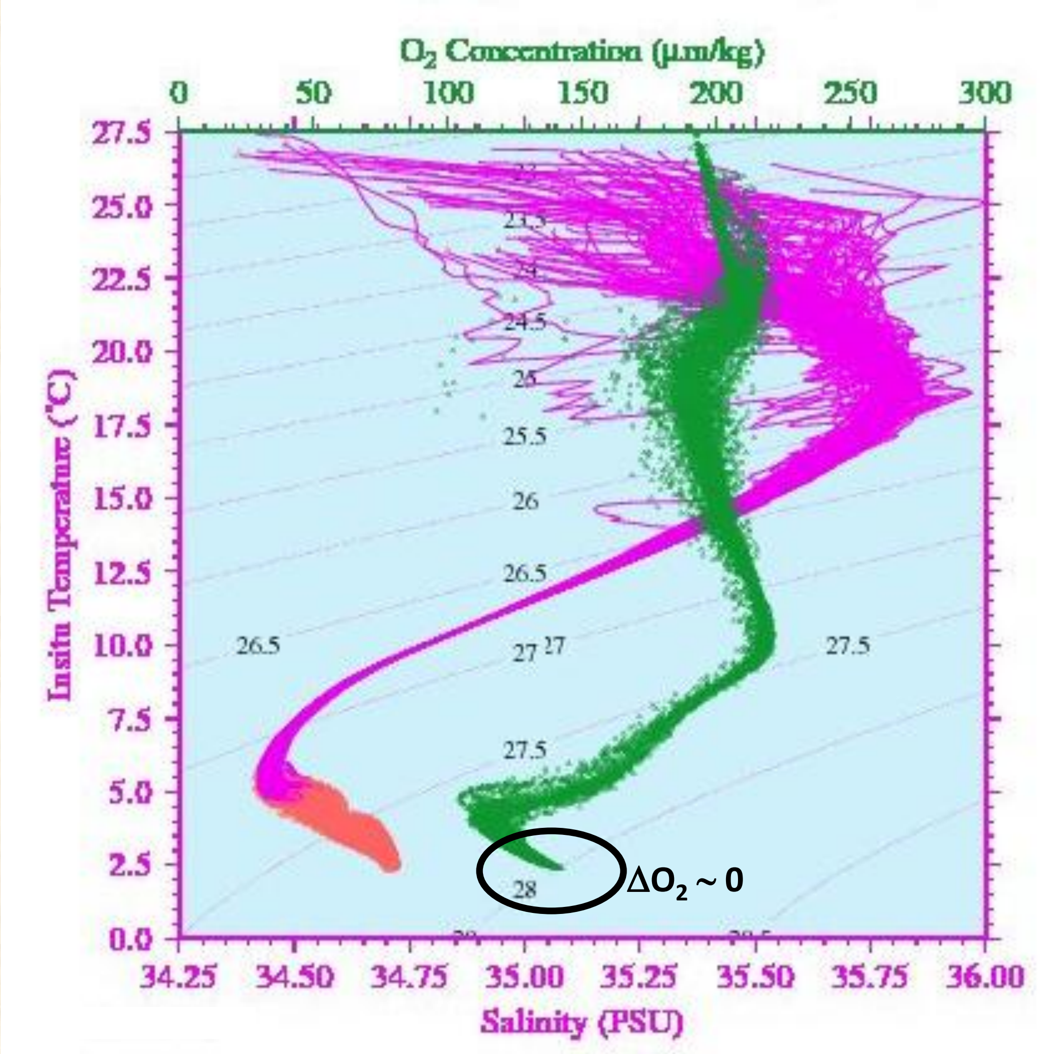


Sensor	Response Time	Accuracy	Precision	Stability
SBE 43-IDO	< 1 sec	2% of sat.	1 μmol/kg	2%/1000 hr
Optode 3830	< 25 sec	<8 μmol/kg	< 1μmol/kg	Good
Optode 4330	8-25 sec	<8 μmol/kg	< 1μmol/kg	Good
Rinko	1 sec	2%	0.1%	??
SBE 63-IDO	< 10 sec ?	1 μmol/kg ?	??	Good?

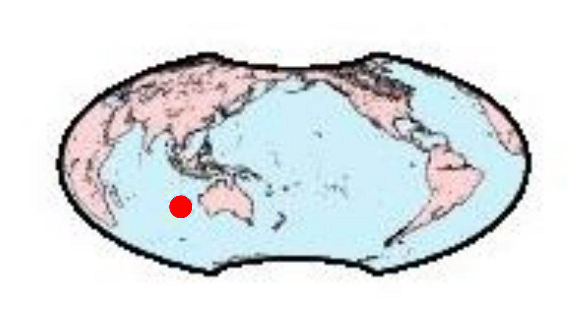
A summary of the manufacturer's stated specifications of present O_2 sensors suitable for use on profiling floats

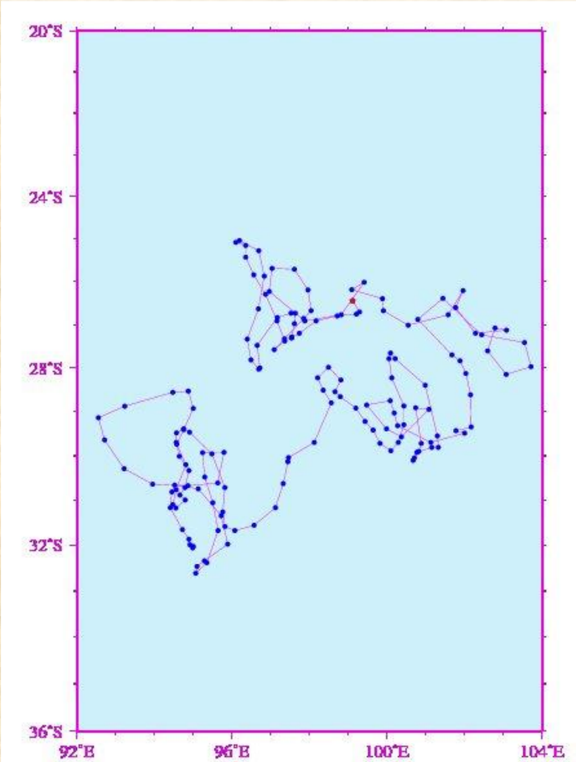

CTD
Optode optical window
Optode oxygen sensor
CTD pump
float endcap



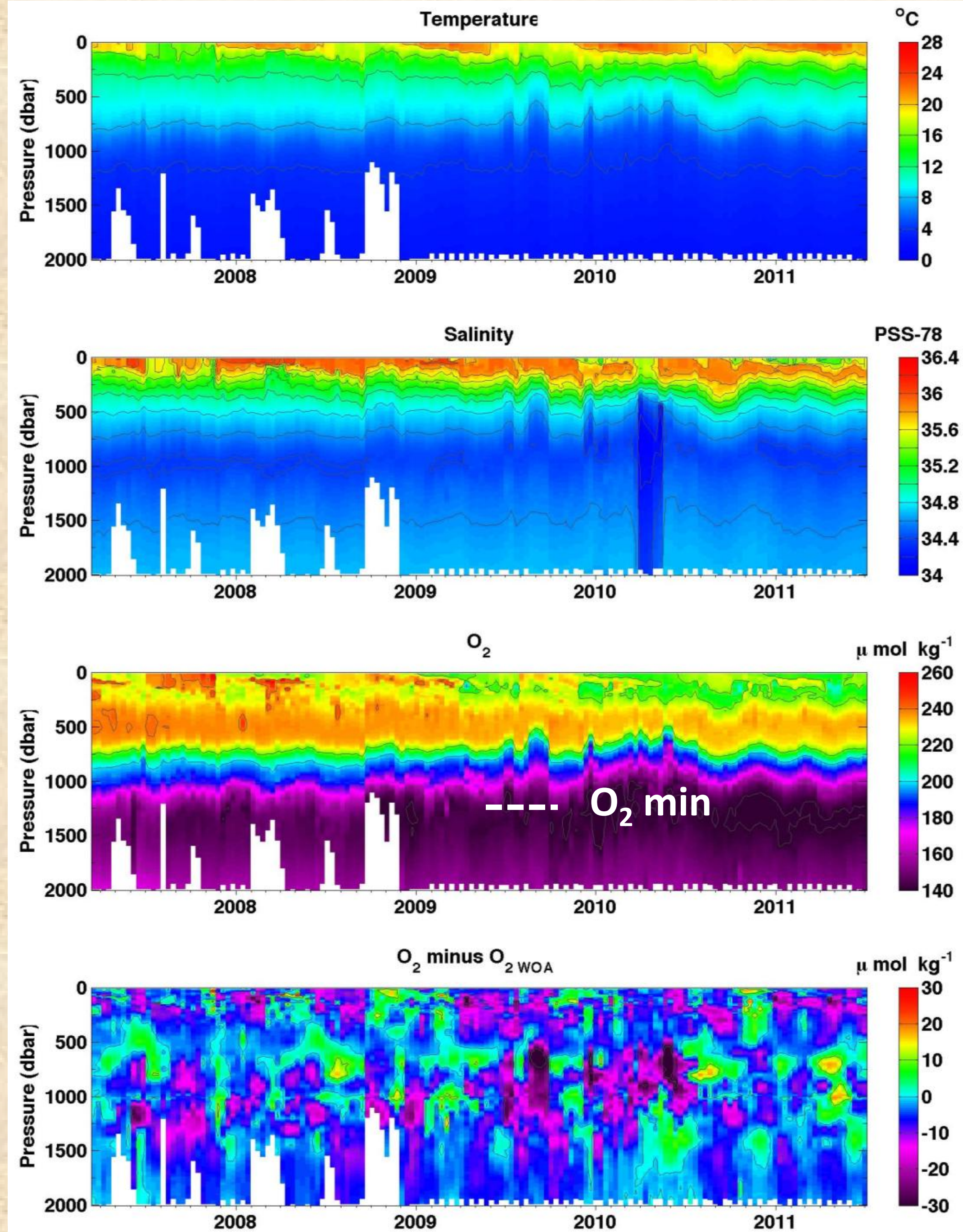


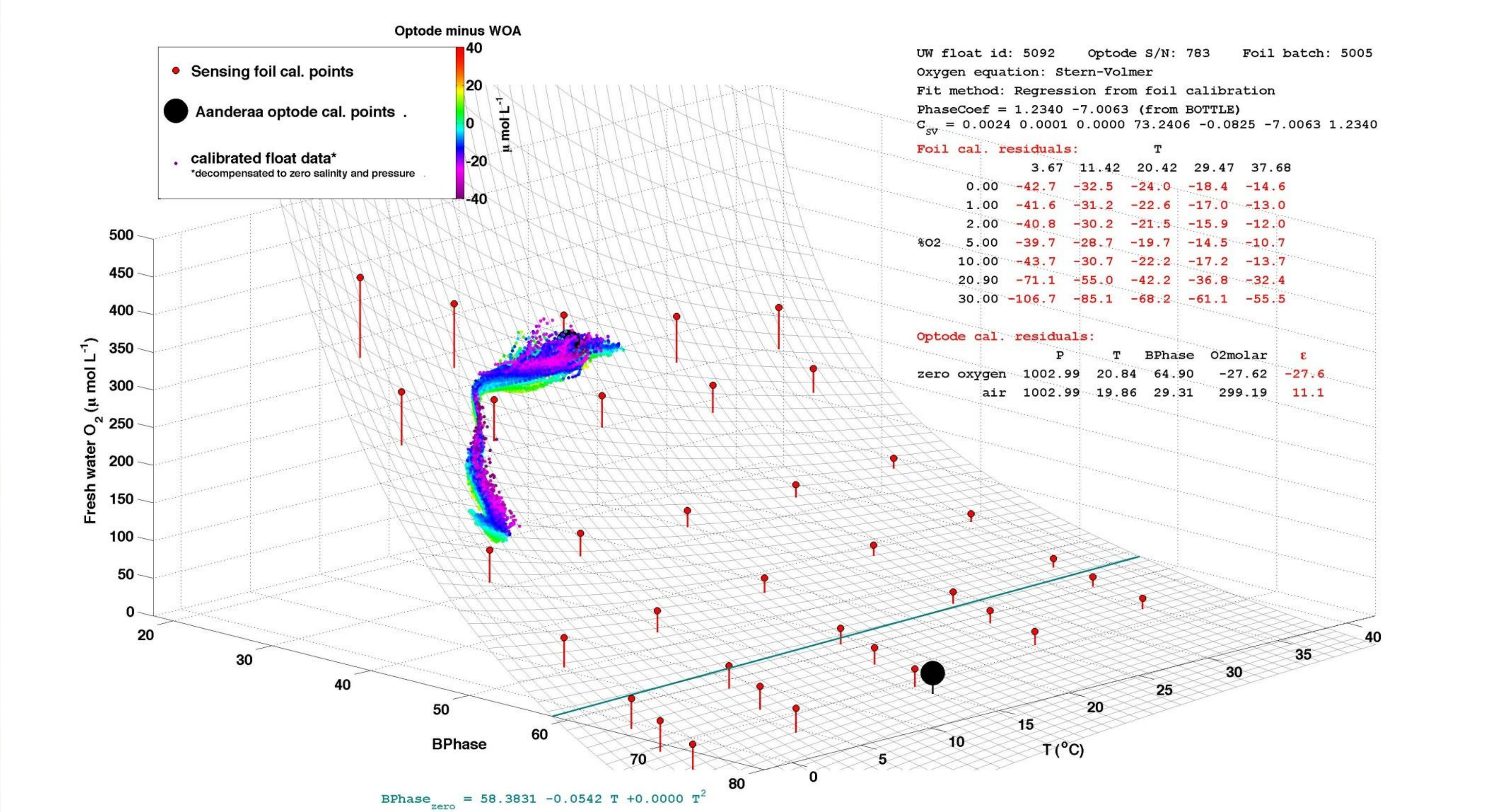
UW float 5092 shows stability typical of Optode sensors, with negligible drift over > 4 years.





UW float 5092
156 profiles, 0-2000 m
3/11/07 – 7/15/11





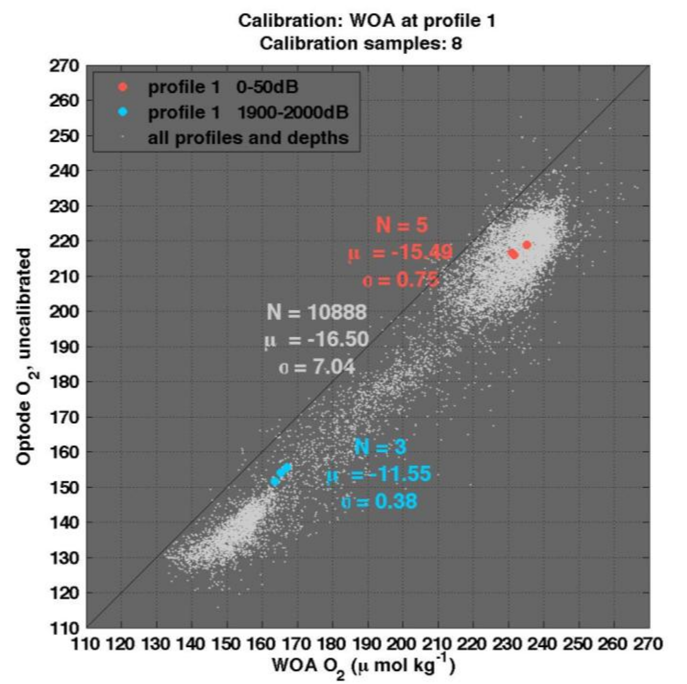
$$O_2 = \frac{\left(\frac{P_o}{P_c}\right) - 1}{K_{SV}}$$

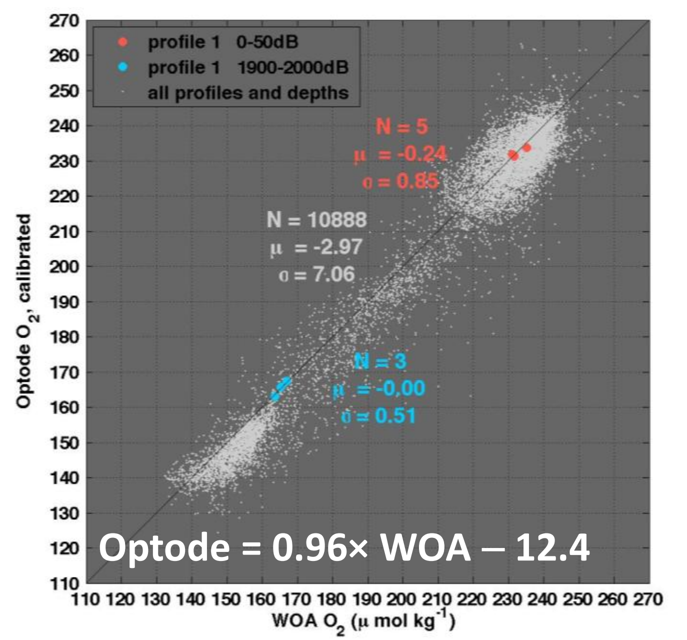
$$K_{SV} = C_1 + C_2 T + C_3 T^2$$

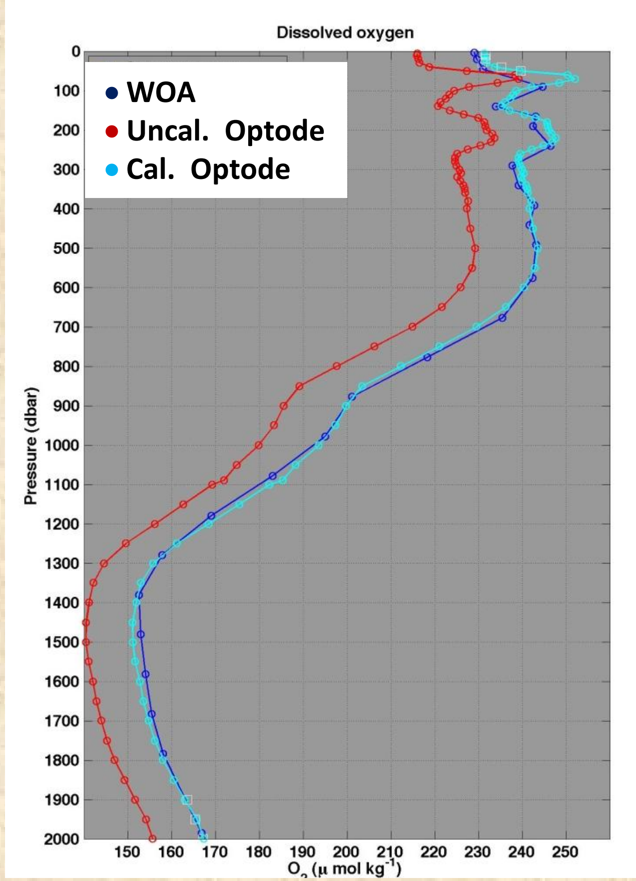
$$P_o = C_4 + C_5 T$$

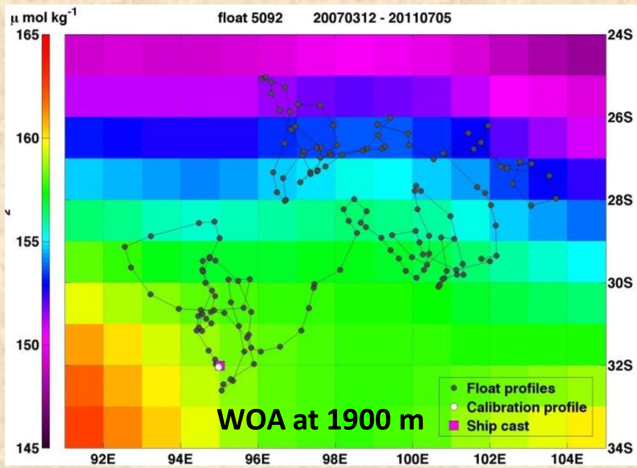
$$P_C = C_6 + C_7 \phi$$

The Stern-Volmer Equation (see Uchida et al., 2008)





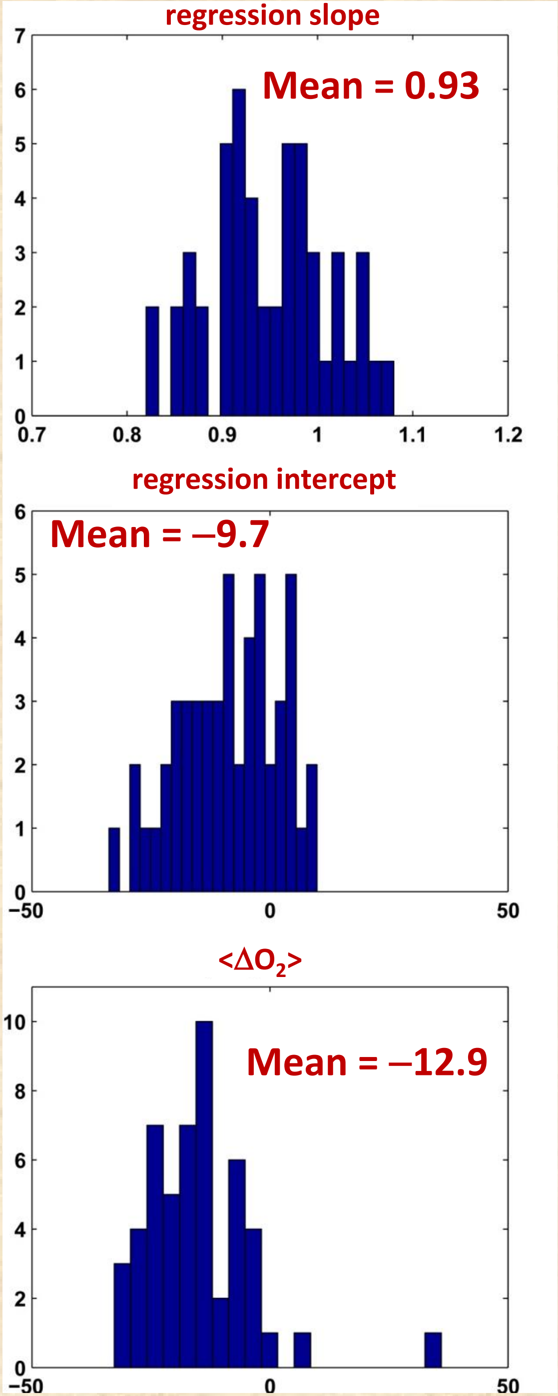


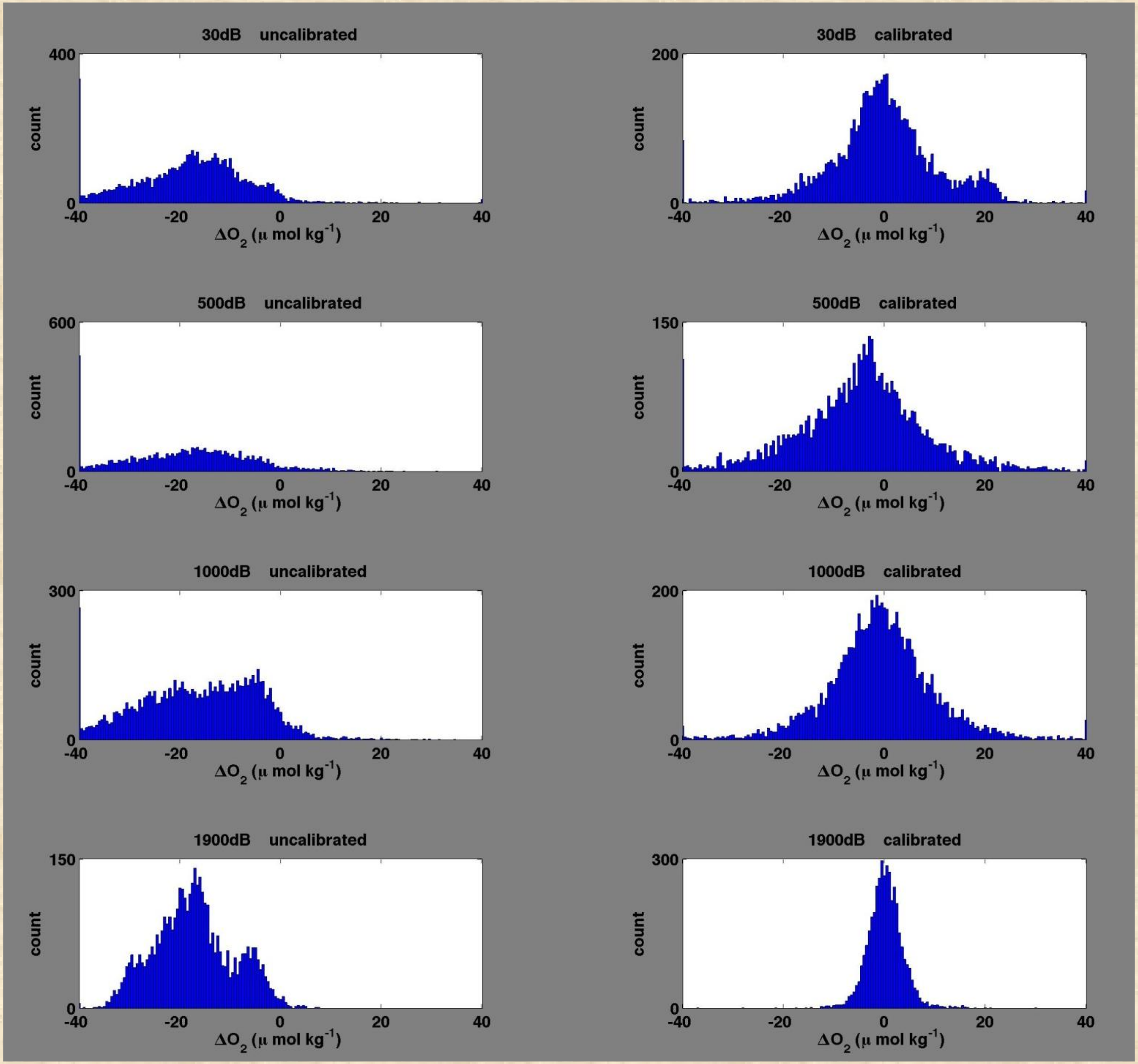


2-point calibration adjustment of O_2 data from UW float 5092 using WOA O_2 data in the eastern Indian Ocean

Combined results for 47 UW Optodes

$\text{Optode} = \text{slope} \times \text{WOA} + \text{intercept}$

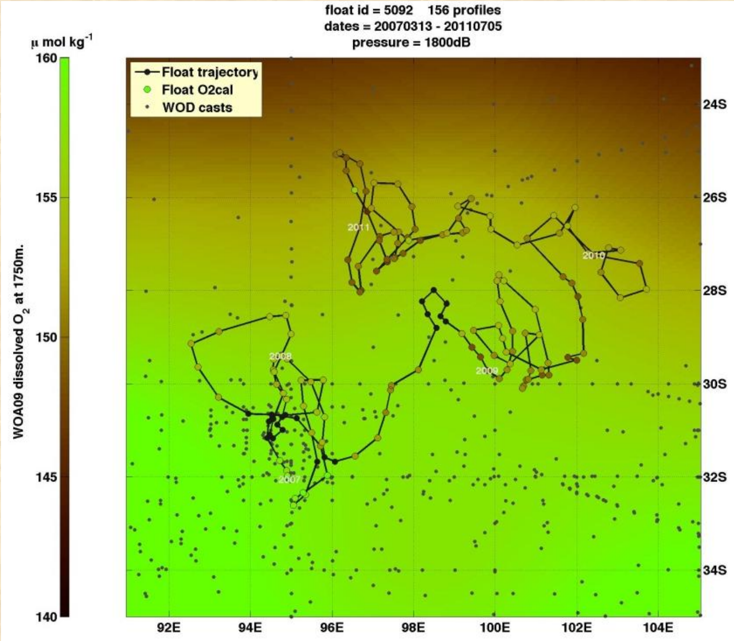




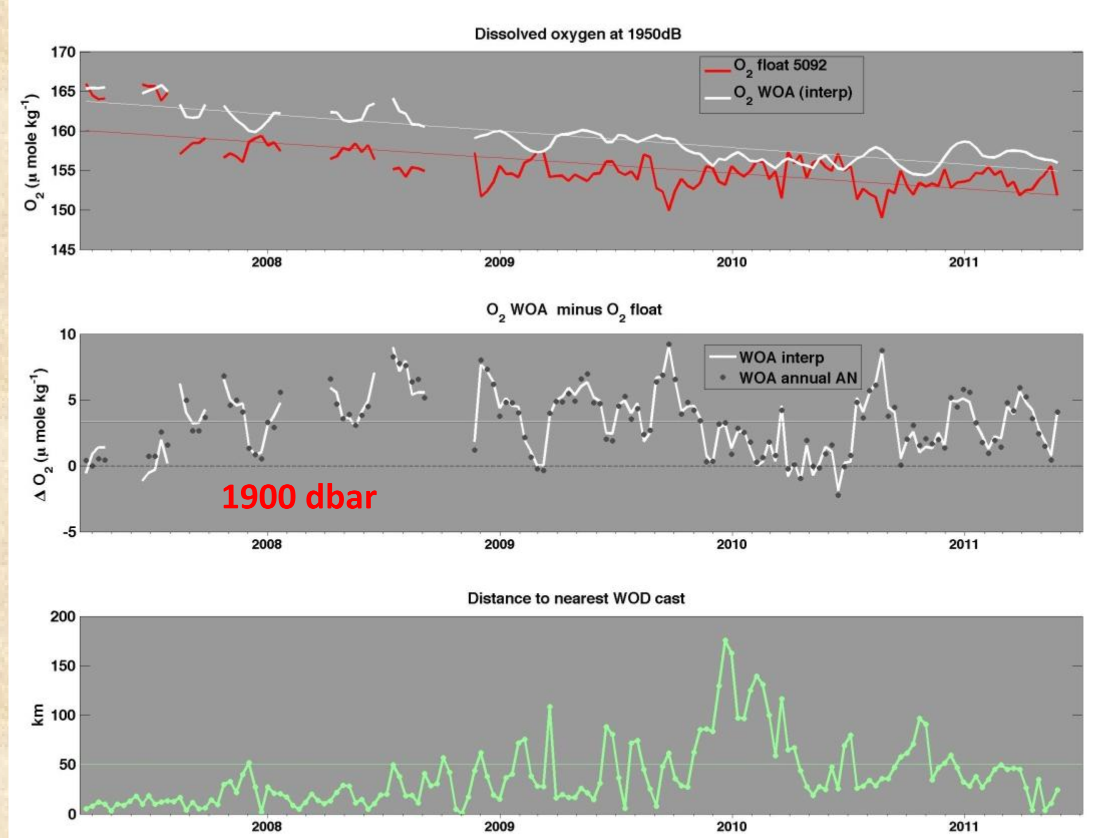
(uncalibrated)

(calibrated to WOA)

Calibration/adjustment histograms for 47 UW Optode floats



UW float 5092
156 profiles, 0-2000 m
3/11/07 – 7/15/11



In many parts of the world ocean the WOA O_2 database is sparse and the quality of the data is questionable. As a result, the calibration/adjustment can appear to vary over time, indicating that the initial adjustment was flawed. This problem can be generally eliminated if a high-quality shipboard Winkler cast can be obtained at the time of float deployment.

Summary

- There is a growing O_2 database from profiling floats. The quality of the data is getting better, and important scientific papers have already been published using these data.

- The Aanderaa Optode sensor is presently the preferred sensor for use on floats due to its long-term stability. However, the factory calibration of this sensor is unsuitable for most open ocean work. Pre-deployment calibration in a suitable laboratory is suggested whenever this is possible.

- Important progress has been made by converting the raw phase information measured by the Optode into O_2 units with the Stern-Volmer equation, and in post-calibrating the float O_2 data to WOA climatology after deployment. This is necessary because most Argo floats are deployed from ships of opportunity where no high quality shipboard O_2 data are collected.

- It appears to be possible to correct Optode sensors to an accuracy of 1-2 µmol/kg if high-quality Winkler data are collected near the float at the time of deployment, and in the future this should be done whenever possible.