Degradation of SBE41 Stability

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Summary

- At the Seattle Tech workshop a few DMQC operators noted an increase in frequency of SBE conductivity sensors drifting high and quickly
- we have attempted a ‘salinity drift’ audit using two Argo-based global climatologies.
- This reveals runs of serial numbers of SBE CTDs that do indeed express different rates of drift, with some cohorts where over 50% drift high by more than 0.01 psu by profile 60.
- There has clearly been a degradation of the stability of CTDs being deployed in Argo
- The implications are:

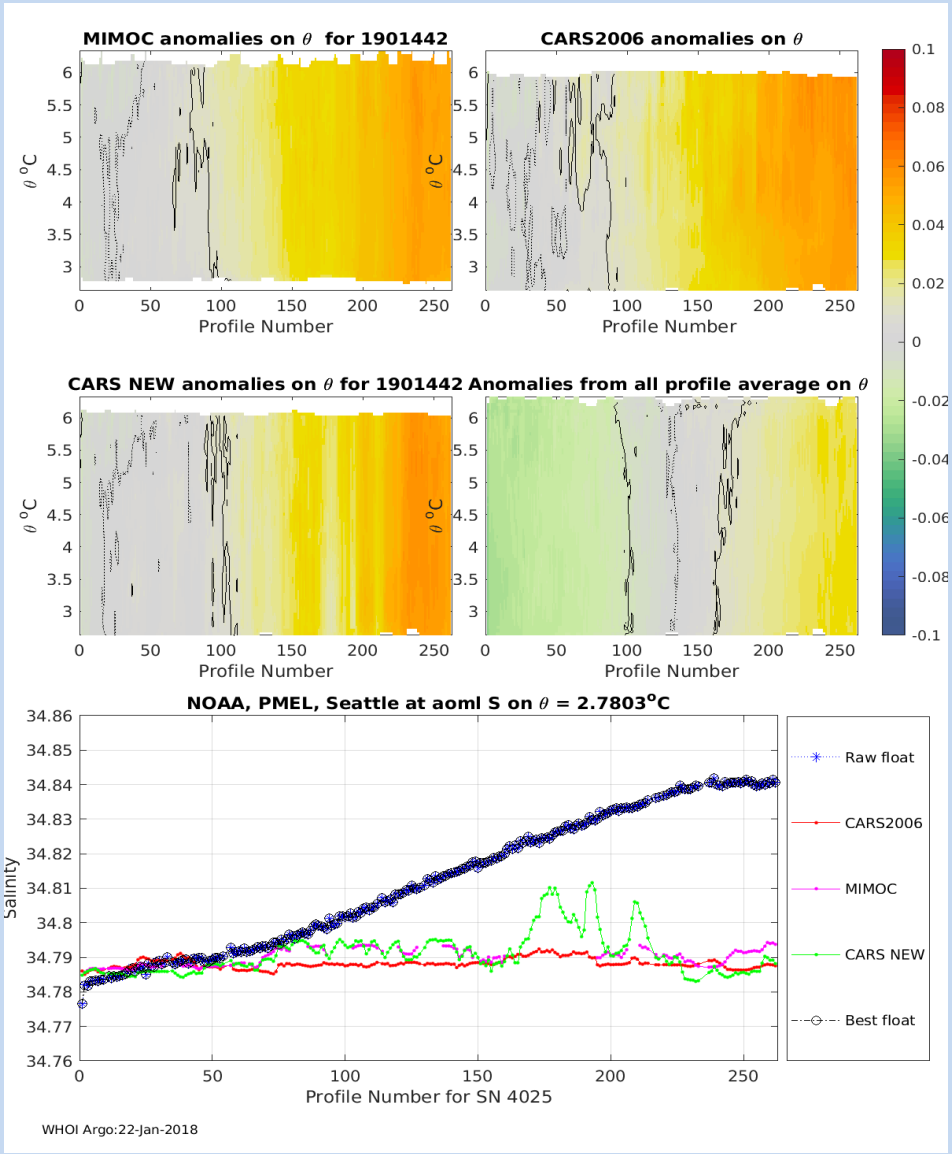
1) Increased workload for DMQC teams

2) Produce a possible high salinity bias into the global data set

3) Likely to shorten the C sensors useful life -> degrade S coverage

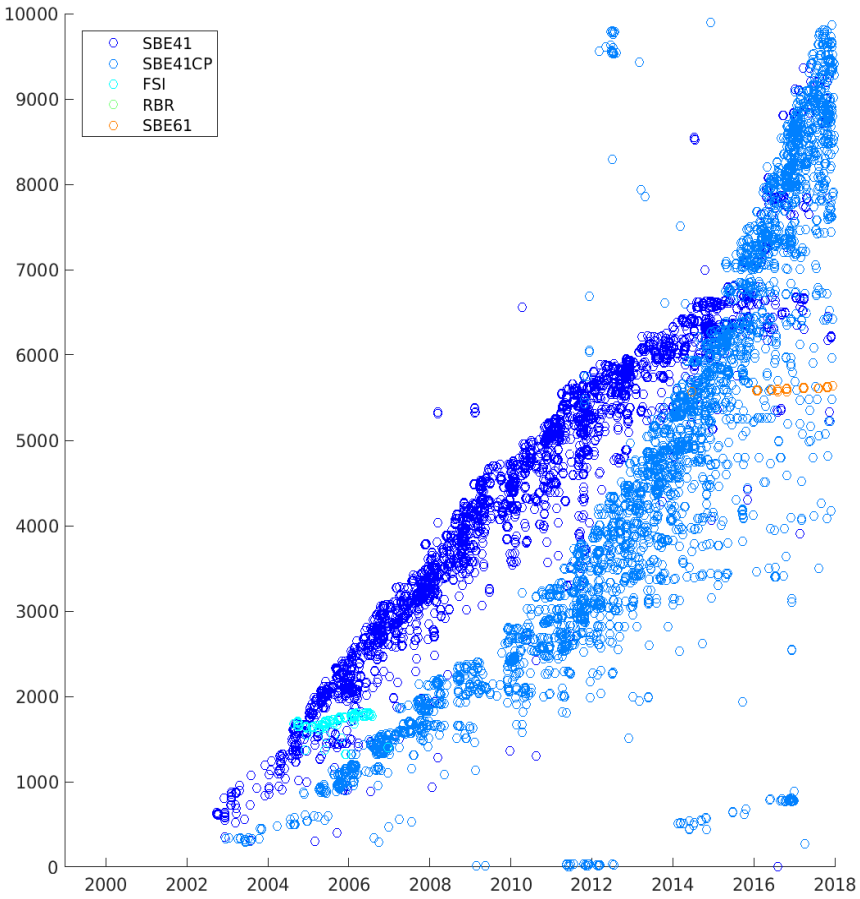
- We are working on better understanding the issue with SBE to bound the problem and eliminate it from future deployments.

Method



- Salinity offsets diagnosed as S_{raw}-S_{clim} on $\boldsymbol{\theta}$ surfaces
- S_{clim} is from 3 Argo based climatologies
- Large sensor drifts are obvious where ocean variability is low
- Floats in regions where $\boldsymbol{\theta}$-S is unstable are not assessed e.g. polar NA,SO
- S_{offset} (n_cycle) found

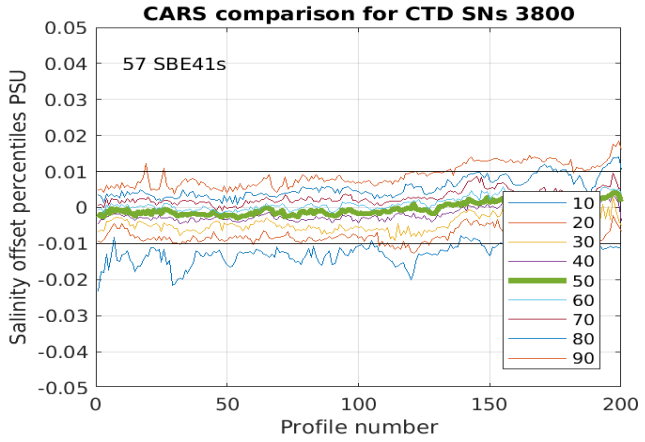
Assignment of SN, CTD type to WMO

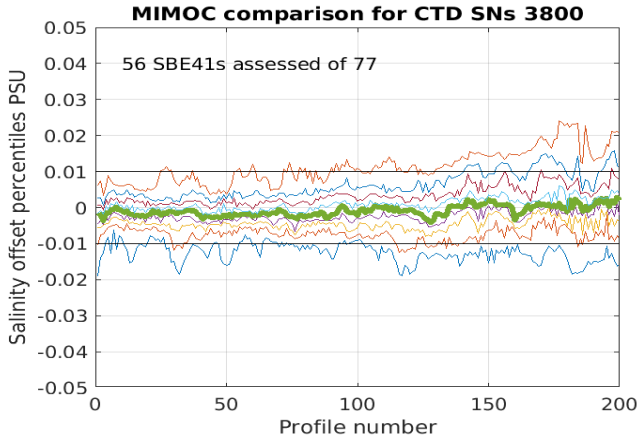


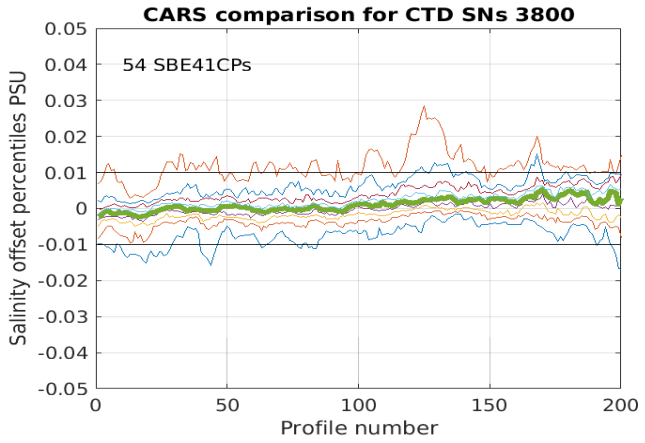
- extracted from the float meta files
- checked and augmented with information directly from the DACs (errors found).
- SeaBird had two separate series of SNs for the SBE41 (spot sampler) and the SBE41CP (continuous sampler) until SN=7000, when the series were merged

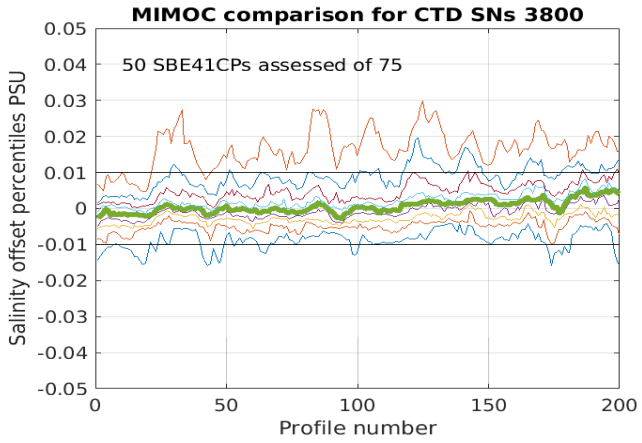
THANKS TO ARGO DATA TEAMS FOR DOING SUCH A GOOD JOB WITH THE SBE META DATA. WE COULD NOT HAVE THIS RESULT TO QUICKLY WITHOUT THEIR EFFORT!

Performance of SN 3800-3899 cohort



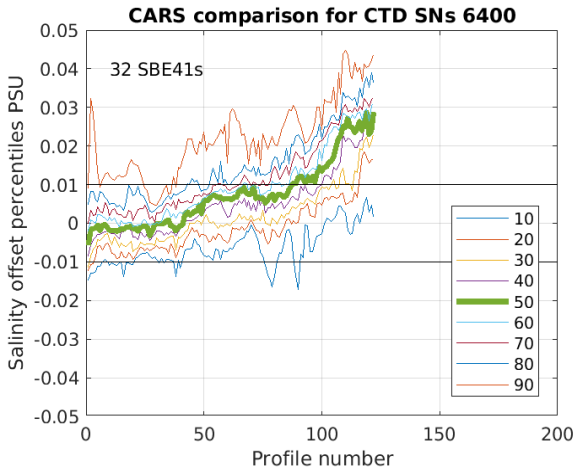


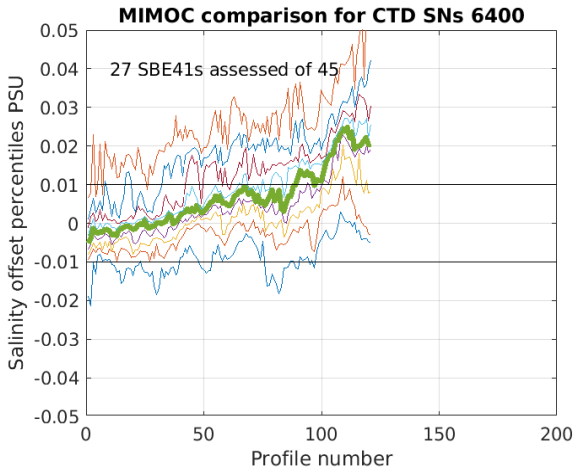


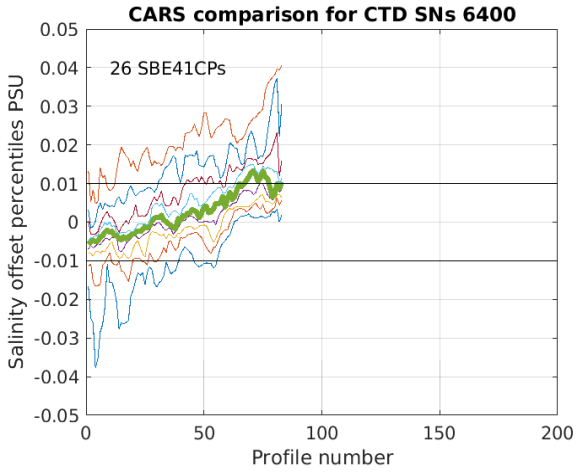


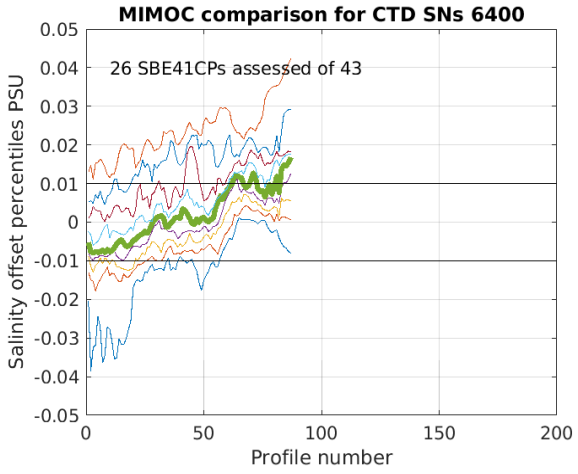
This excellent stability is what we are used to

Performance of SN 6400-6499 cohort

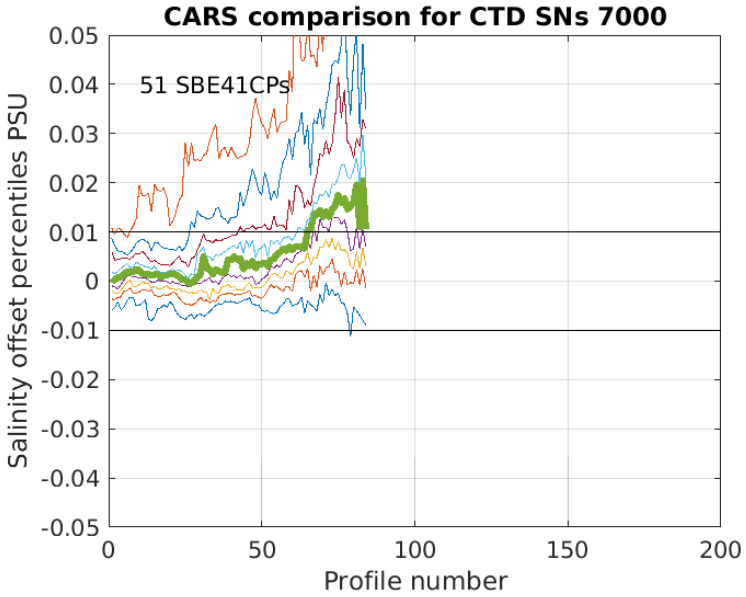


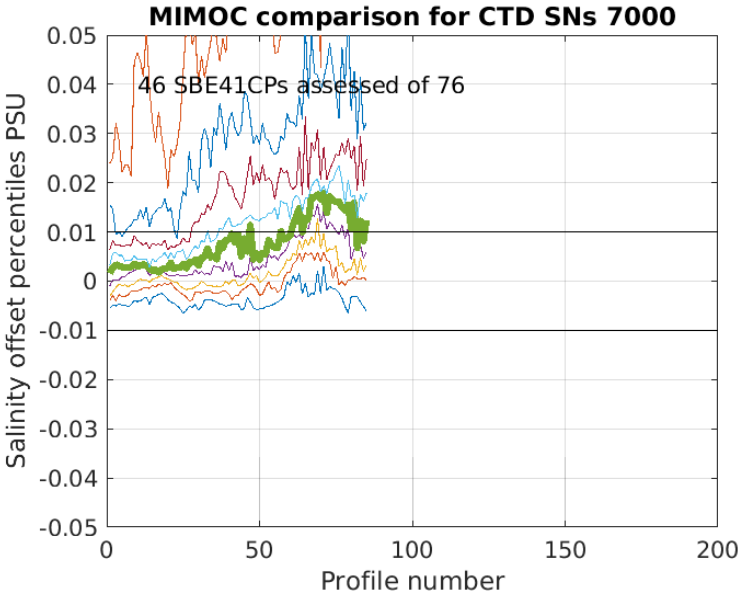




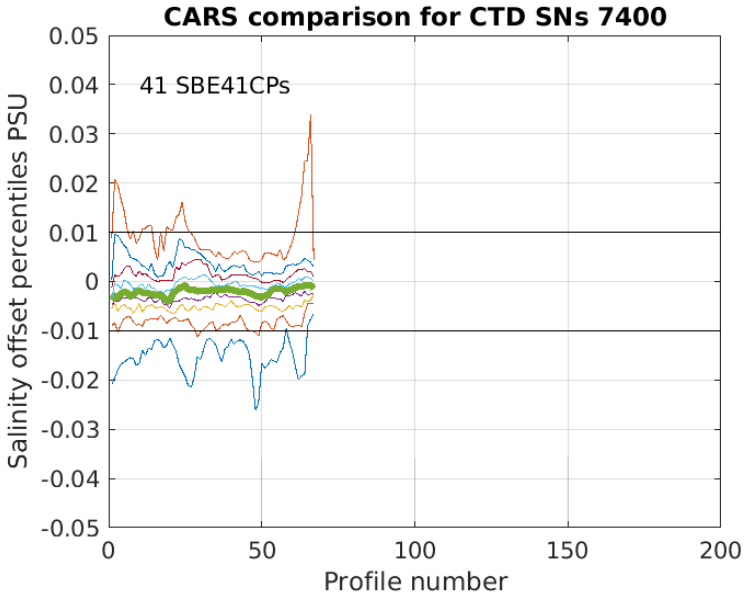


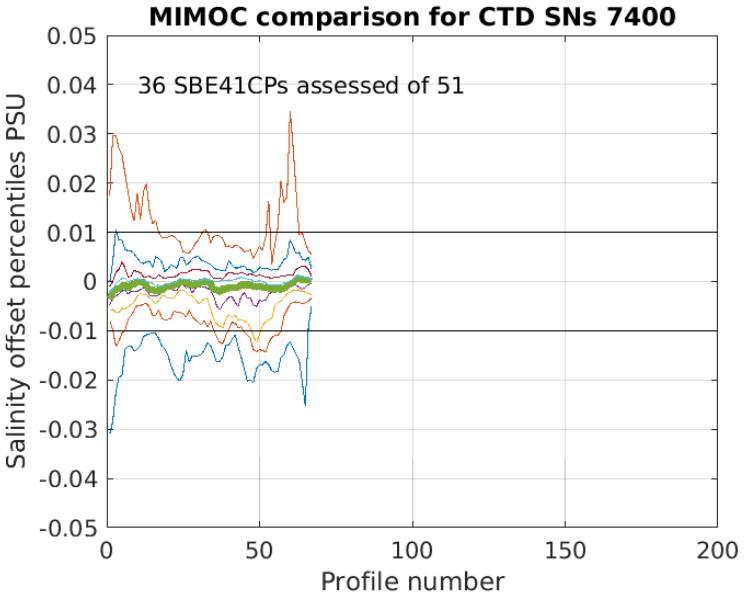
>50% have drifted > 0.01 by profile ~60

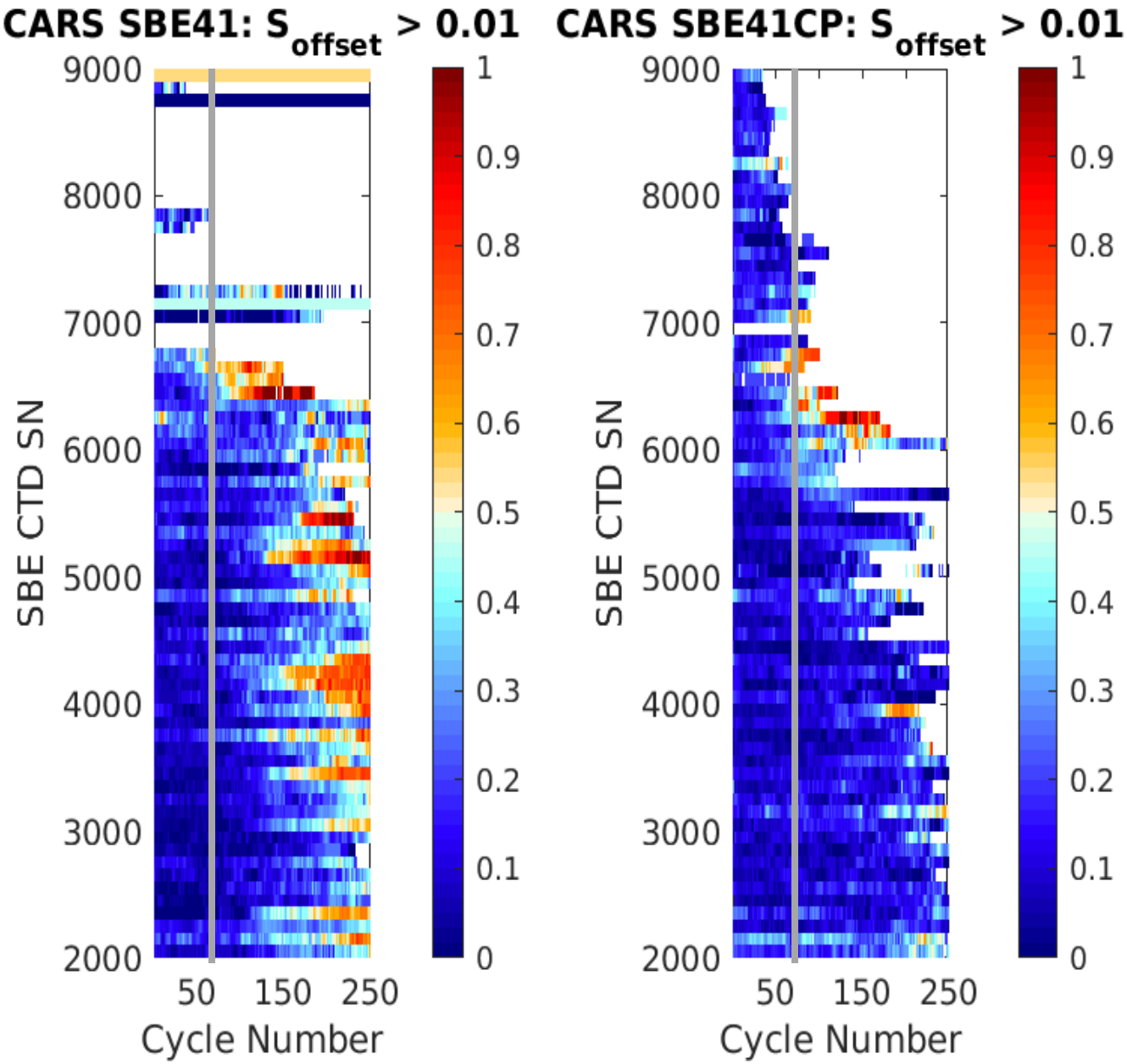




Possible improvement by mid-7000's






CARS SBE41: S offset > 0.01
CARS SBE41CP: S offset > 0.01
SBE CTD SN
9000
8000
7000
6000
5000
4000
3000
2000
50
150
250
Cycle Number
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

Summary and Actions

We have diagnosed a concerning degradation in stability of the SBE CTDs being used in Argo. The cost of removing this drift in delayed mode is high, and large numbers of sensors drifting in one direction compromises the quality of the Argo data set via introducing a bias.

Suggested actions are:

1. To engage the manufacturer in discussing these results to see if the source of this drift can be found and engineered out of the sensor production. ***This is now underway. The reason for this drift is known and will be discussed on Friday***

2. Alert Argo DMQC teams about this error – ***yet to be done***

3. Alert Argo users that a larger percentage of real-time data are likely biased high in salinity ***– yet to be done.***

4. See if we can determine if the salinity offset remains constant in pressure and temperature as the degradation gets worse. ***How correctable is the bias and for how long?***