

# Current status of Argo S profile quality

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# What is 'FSD'?

- In recent years, the SBE41/41CP manufactured by SeaBird Scientific has shown an increased frequency of fast salty drift.
- Term "FSD" is used for floats which show unusually large salinity drift in their life with  $\Delta S > 0.05$  psu.
- This issue has been identified since 2016.
- This issue has been identified to the most prevalent in SBE SN ranges 6000-7100, 8000-9500, and 10000s.
- Once suffering from FSD, the sensor cannot be restored.
- Wong et al. (2020) said that "at the time of this writing, about 25% of real-time profiles might be subject to this salinity error."

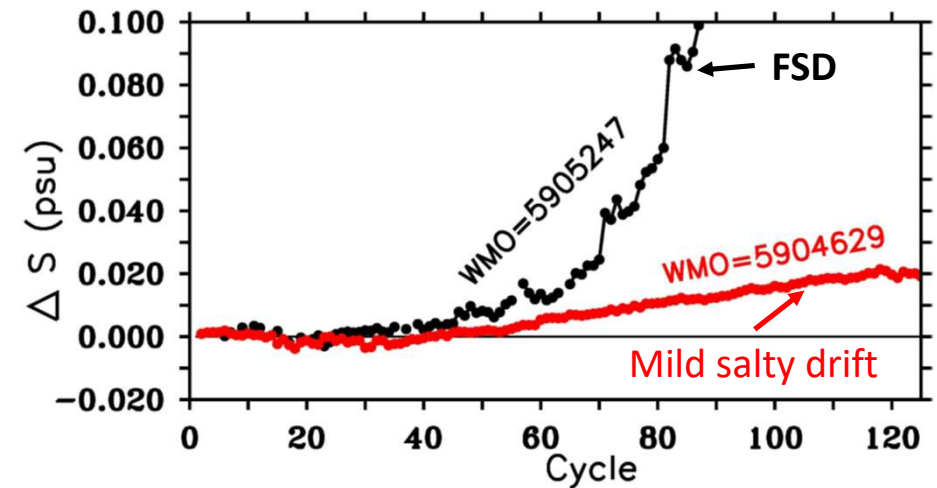


Fig.1: Two examples of SBE CTDs that showed salty sensor drift: a "slow" drift (WMO ID 5904629, in red), and a "fast" drift (WMO ID 5905247, in black). (Fig.11 in Wong et al. 2020)

# What is 'FSD'?

## Two types of FSD

### Abrupt Salty Drift

- Rate of drift is  $> 0.01$  psu/profile.
- S starts to drift rapidly in the 30~80 cycle.
- SEA-BIRD SCIENTIFIC said that they found the root cause, and that this issue has been fixed in October 2018 (SBE41CP SN11253~).

### Progressive Salty Drift

- Rate of drift is  $> 0.005$  psu/profile. ( $>0.05$  psu/2years)
- S drifts positive continually.
- SEA-BIRD SCIENTIFIC have not found the root cause yet.

# QC and data distribution of profiles with FSD

Each DAC and/or DM operator makes a judge on FSD.

As a general, when S drifts larger than 0.05 psu, it is judged as FSD.

## [Real Time QC procedure]

- When each DAC and/or DM operator makes a judge on FSD,
  - each DAC add 'bad' flag to the S data of all layers, including S data to be measured from now on.
  - the information of the float judged as FSD will be put on the greylist.

⇒ S profile data with FSD cannot be distributed to GTS.

Note:

- It is difficult to judge whether or not FSD has occurred at the timing of sending the R file to GDAC, and there is a lag.

# QC and data distribution of profiles with FSD

## [Delayed mode QC procedure]

- Anomalous Argo PSAL  $> +0.05$  psu should be strongly questioned and marked 'bad' flag within DMQC, without solid evidence to the continued validity of the data. S data with  $\Delta S > +0.05$  psu cannot be adjusted. The S data of all layers is marked 'bad' flag.
- Because threshold of drift, '+0.05', is not only indication of FSD, DMQC and adjustment should be done carefully.

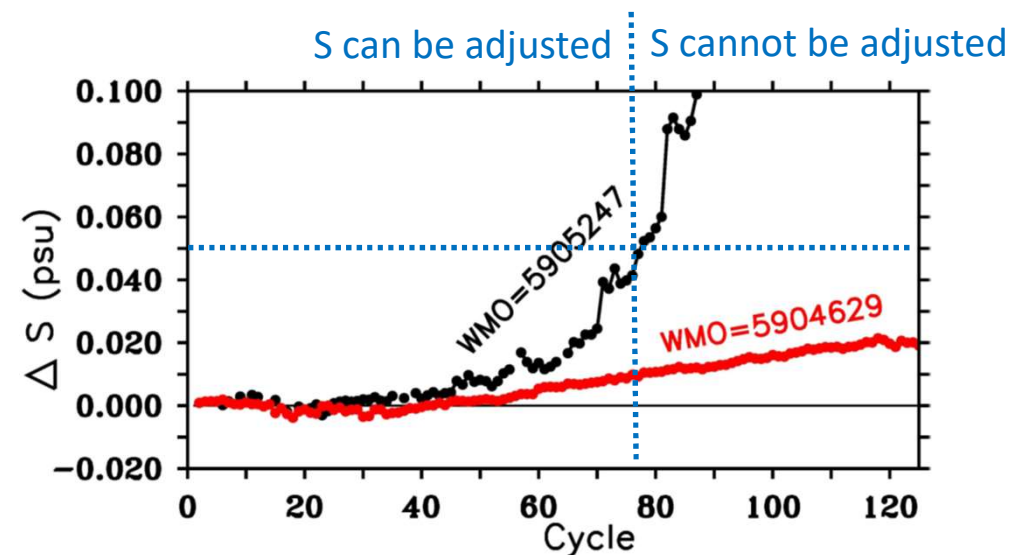


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**DQC quality data rarely suffer from FSD issue.**

## Current status of Argo S profiles' quality

- When each DAC and/or DM operator finds large errors of S data, not just FSD, each DAC add 'bad' flag to the S data of all layers in real-time QC.
- In order to confirm the current status of Argo S profiles' quality, I checked the recent ratio of the number of S profiles with the 'bad' flag to all layers to the number of global Argo S profiles.

# Current status of Argo S profiles' quality

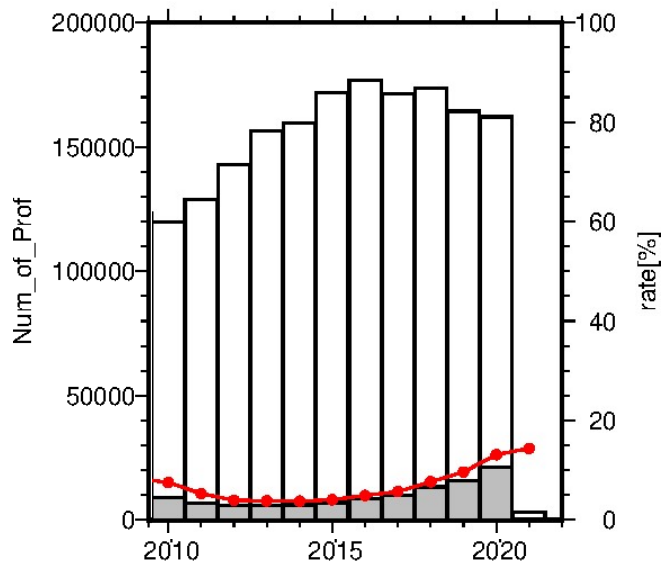


Fig.2: (bar) histogram of num of S profile; gray means num of S profile with 'bad' flag to all years, and white means num of S profile other than that. (red line) time series of ratio of the number of S profile with the 'bad' flag to all layers to the num of global S profiles.

- The ratio is about 5% in 2014. It has increased by about 15% in 2020.
  - It means that 24,000 S-profiles were lost in 2020.
  - More than 90% of floats launched after 2010 are equipped with SBE41 or SBE41CP.
- ⇒ S data errors that occurred after 2010 are problems with SBE41 or SBE41CP.
- ⇒ Based on Wong et al. (2020), it is high possible that FSD is the cause of the ratio increase.



# Current status of Argo S profiles' quality

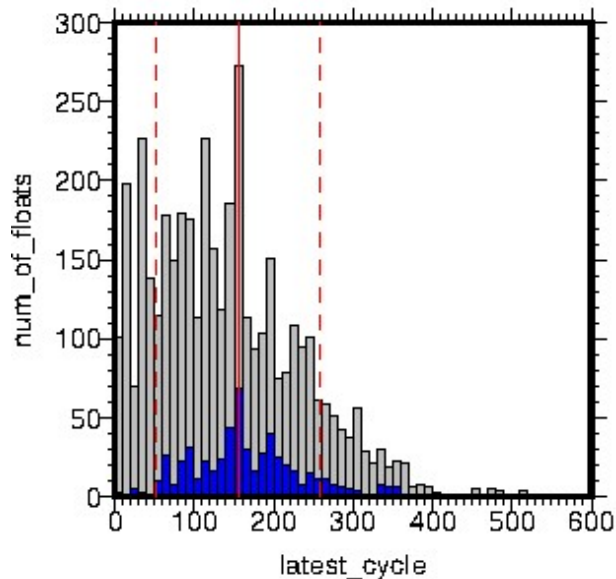


Fig.3: histogram of num of active floats equipped with SBE41 or SBE41CP as of January 2021 by the latest cycle number; blue means the number of active floats suspected of suffering from FSD, and gray means the number of active floats other than that. Red solid (dashed) line means average (standard deviation) cycle number, based on the information of inactive floats.

- Floats with the latest S profile flagged as 'bad' for all layers are regarded as suspected of FSD.
- Floats with suspected FSD account for about 14% of active floats with SBE41 and SBE41CP.
- They are most common in cycles 150-160, which corresponds to the average cycle number.
- About 48% of them have been operating shorter than the average cycle number.
- The new floats can suffer from FSD.

⇒ The situation where there are many S profile with the 'bad' flag for all layers is likely to continue for some time in the future.

**Continued monitoring of S drift and further analysis are required.**

# Impact of FSD on Argo Products

- It is difficult to judge whether or not FSD has occurred at the timing of sending the R file to GDAC, and there is a lag.  
⇒ Argo products that mainly use real-time QC Argo data are considered to be affected by FSD.
- JAMSTEC's Argo Products, MOAA-GPV, uses mainly real-time QC Argo data.

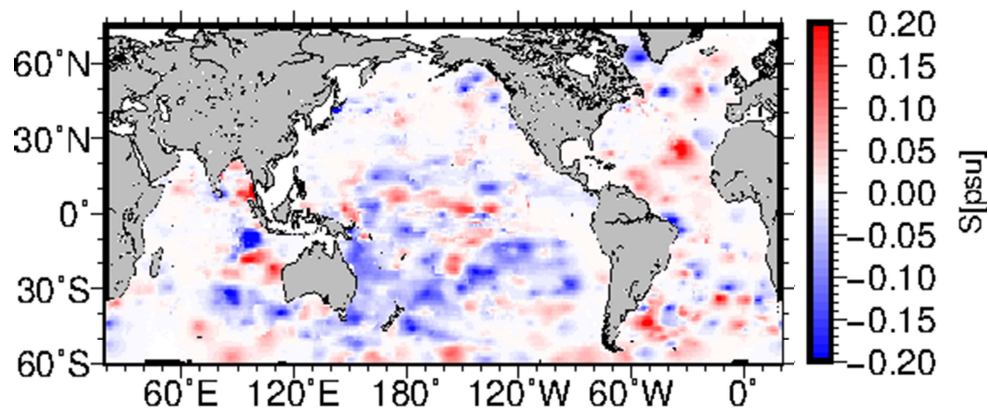


Fig.4:map of  $\Delta S$  (revised-S minus previous-S) in December 2016 at 100-dbar.(Tentative result)

We are now revising MOAA-GPV without FSD data and provide a new product ASAP.

In addition, another MOAA-GPV based on DMQC data will be released in the near future.

Tentative test case shows a subtle impact...  
We are checking it now.