DOXY

1. Sneak-peek at the Sea-Bird Scientific SBE83 optode under development
2. Optode time-response correction: data management & implementation

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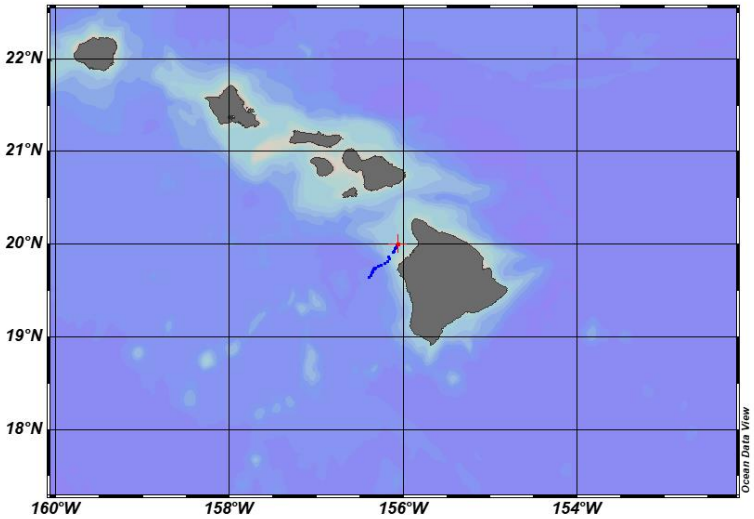
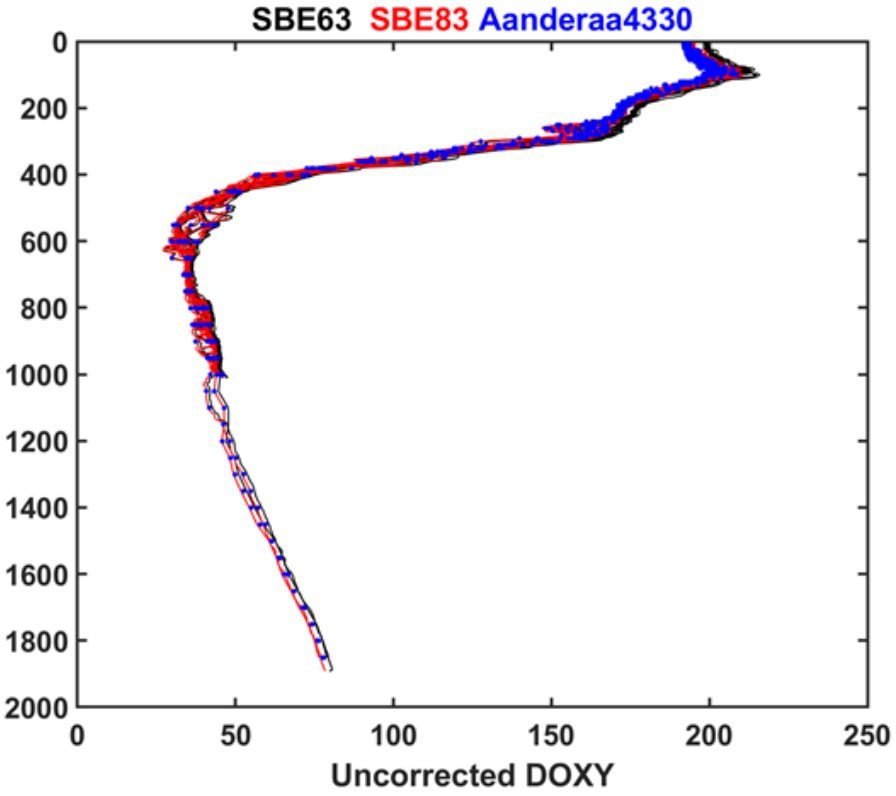
Virtual

Sneak-peek at the new Sea-Bird Scientific SBE83 Oxygen Sensor for profiling floats

- Recent test deployment off Hawaii of SBE83 optode capable of in-air gain
- Daily cycling to 1000m
- Float deployed with 3 oxygen sensors:
  1. *SBE63*: within the pumped CTD flow stream
  2. *Aanderaa 4330*: exposed, on a stalk
  3. *SBE83*: outside the direct fluid circuit but within path of CTD outflow





SEA·BIRD SCIENTIFIC

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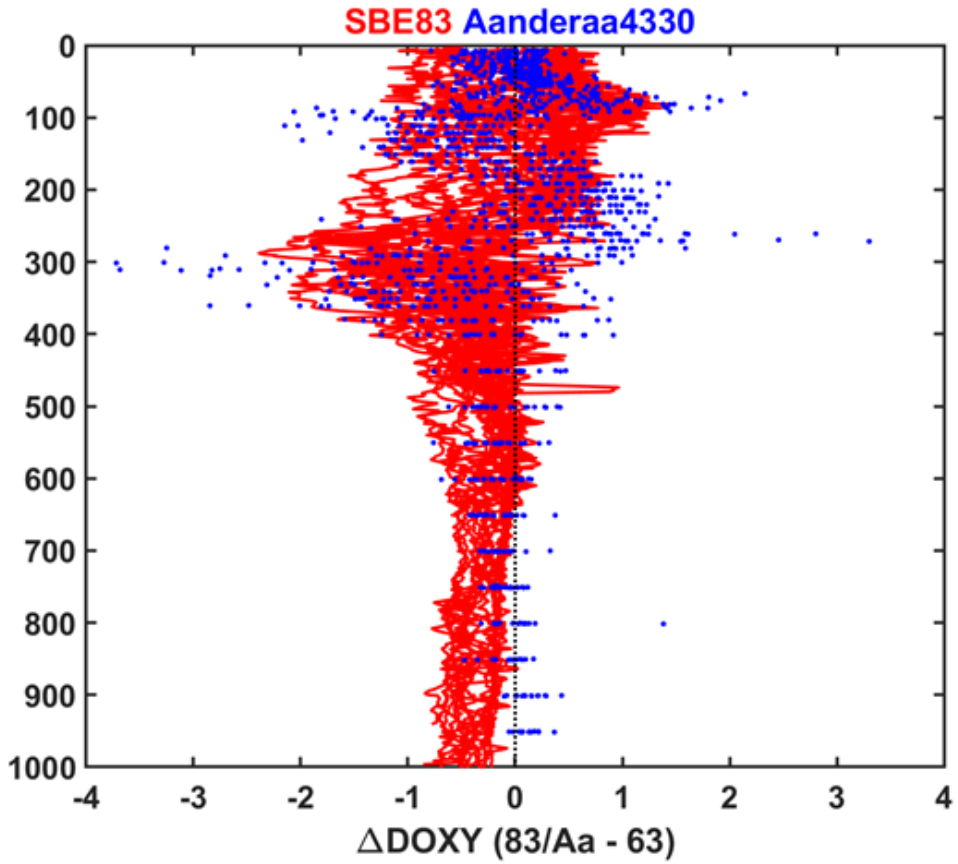
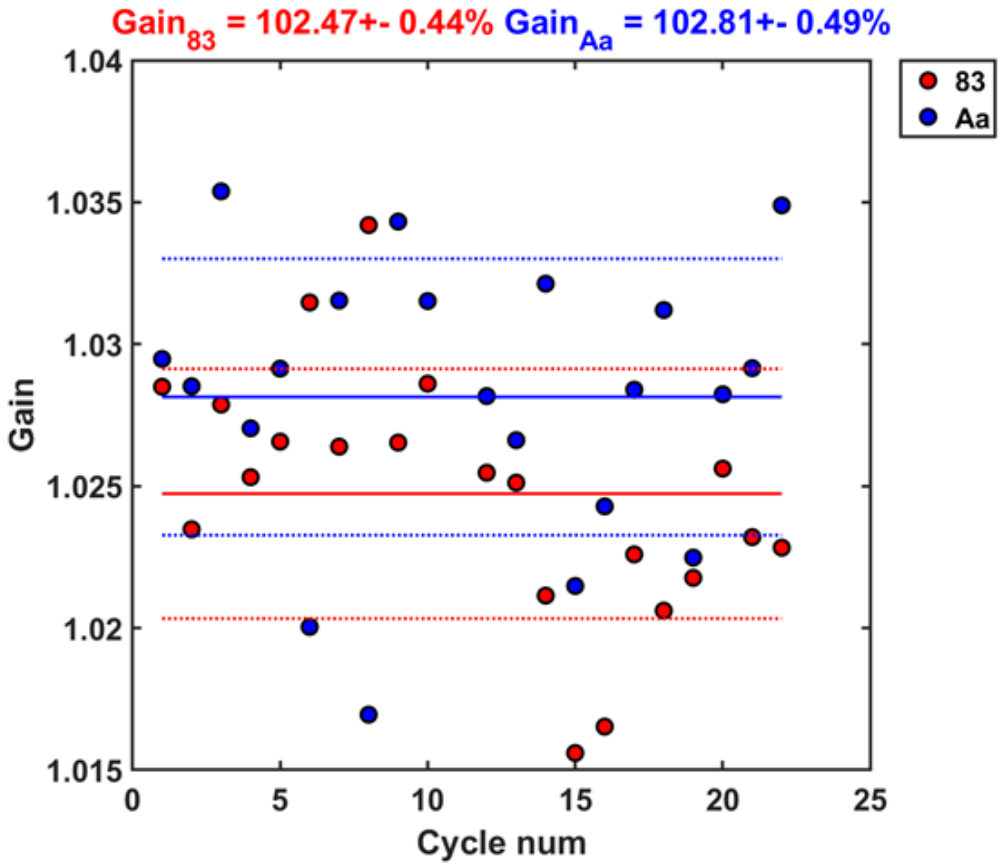
SBE83 Oxygen Sensor: preliminary data!

- Excellent agreement (red) between SBE83 and SBE63 (within 1 umol/kg throughout much of the water column)
- Good agreement (blue) between SBE83 and Aa4330, spikes due to longer response-time of the Aa4330



- Optode gain reproducibility (1σ of the gains) is similar between SBE83 (0.44%) and Aanderaa (0.49%)
- Better per-cycle precision of in-air measurements observed on SBE83 than Aa4330



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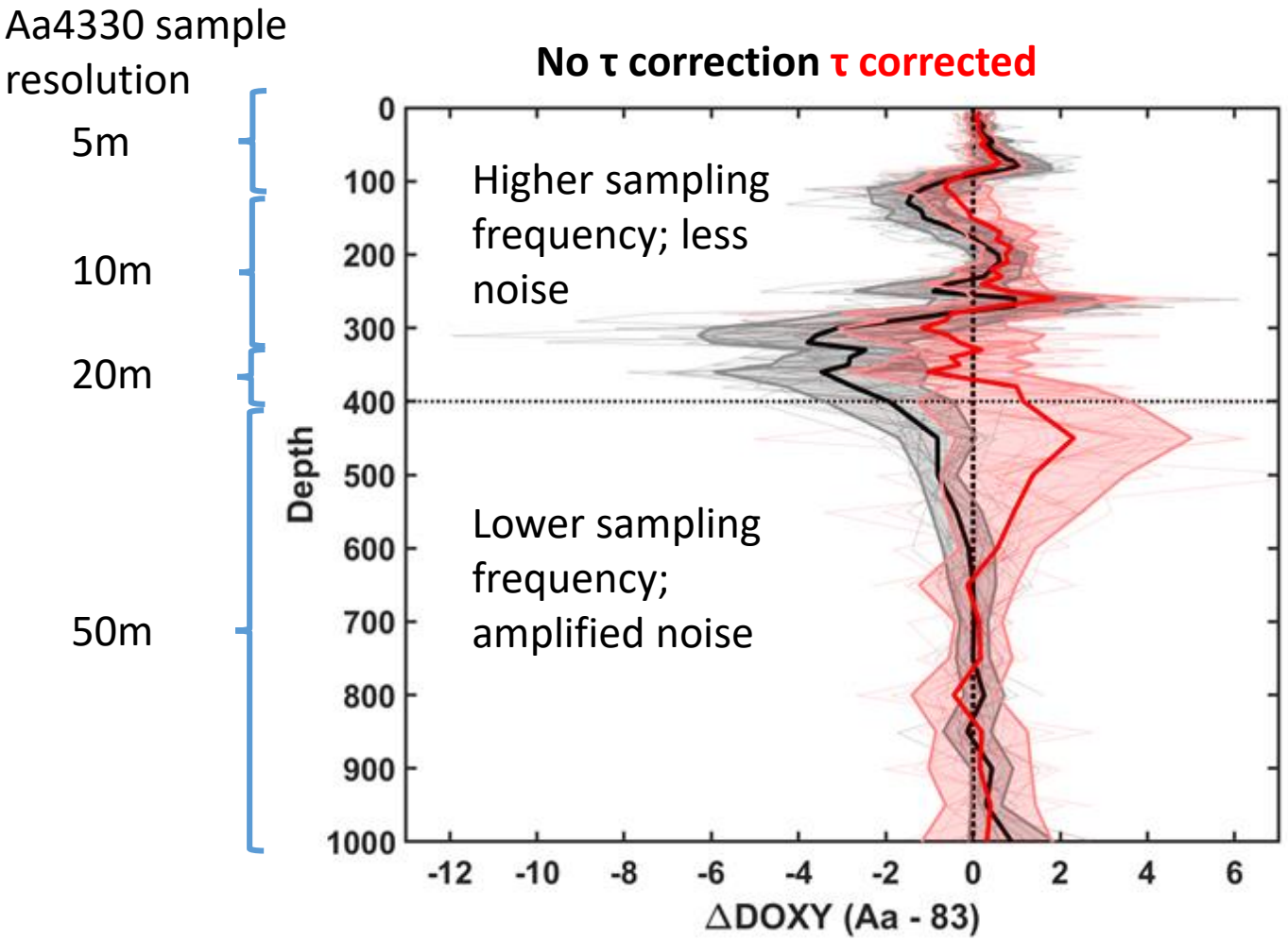
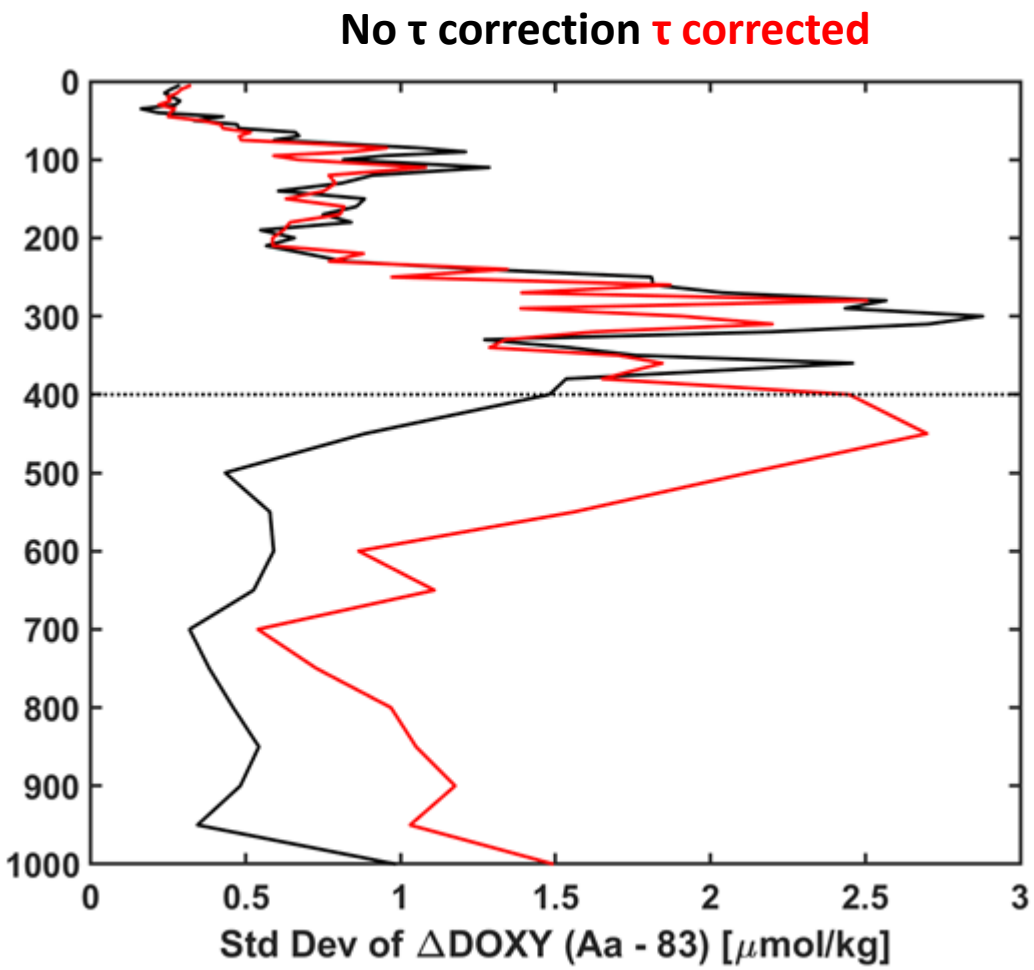
Figures by Yui Takeshita

SBE83 Oxygen Sensor: preliminary data!

- Correcting data for response-time (τ) lag following Bittig et al (2014) (red) improves the agreement between Aa4330 and SBE83 above 400m
- Multi-sensor comparison highlights the effect of sample resolution on the correction uncertainty (increased noise below 400m; overcorrection around 500m)





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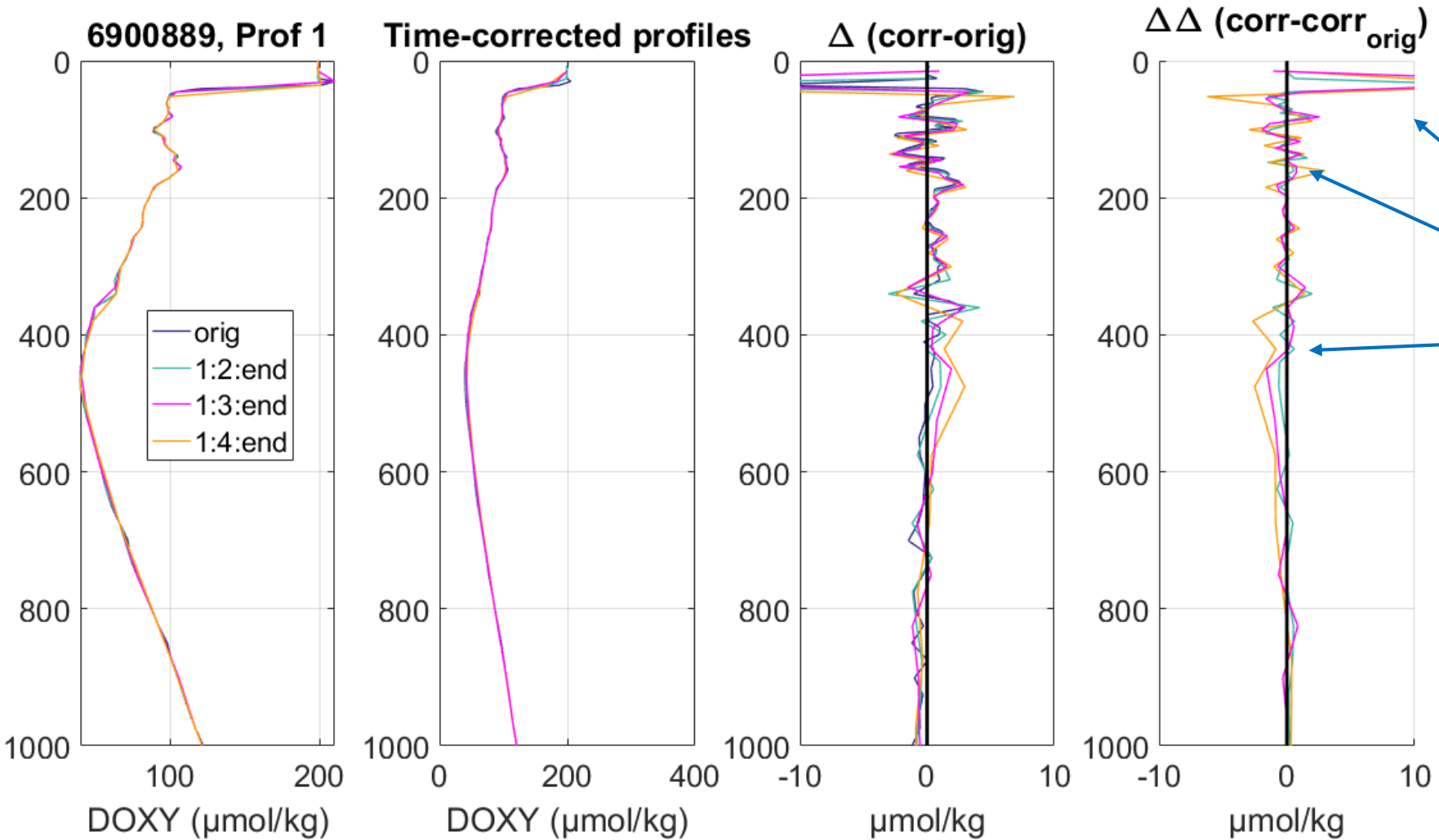
Figures by Yui Takeshita

Optode response-time correction: sample resolution

- Effect of sample resolution on inverse filter results (& reconstruction of corrected profile) has been seen before (Bittig et al, 2014; Gordon et al, 2020; Takeshita et al, submitted)
- Can be an issue when resolution too high, or too low!
- Argo data management: Bittig et al 2014 method is an advanced correction – understand the uncertainties for your sensor/platform prior to implementing



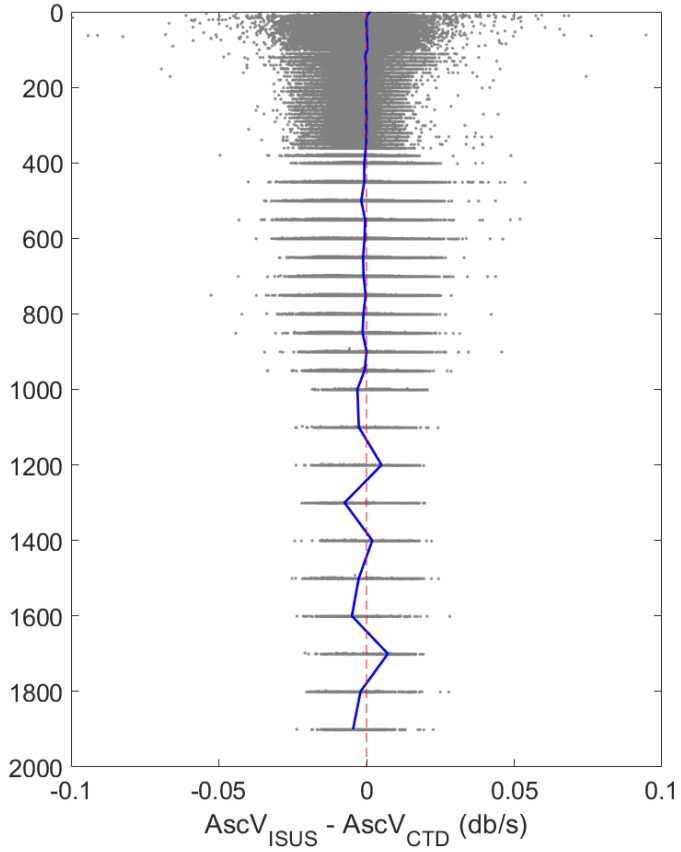
Downsampling of Coriolis Navis float.

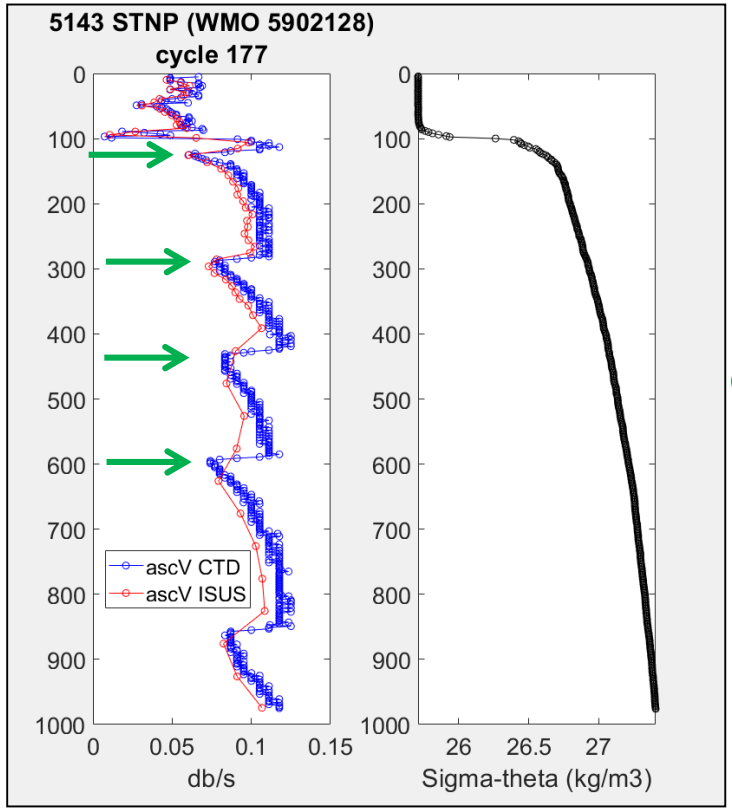
Change in sample res affects magnitude of correction most in regions of steep gradient & enhanced structure

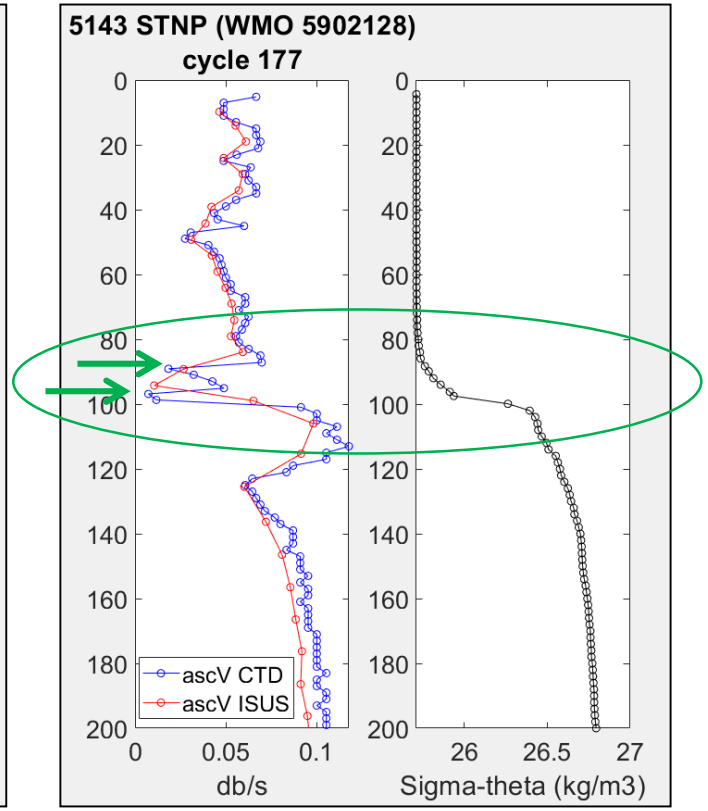
Optode response-time correction: measurement times

- For optode time-response correction, measurement times are needed!
  - MTIME is now an optional parameter in Bfiles for sensors reporting measurement times
  - Time vector can also be reconstructed from CTD bin count, to be stored in NB_SAMPLE_CTD (proposal to expand NB_SAMPLE to NB_SAMPLE_<short_sensor_name> recently circulated by Henry Bittig et al). CTD sample resolution must be known!

ISUS-based versus CTD-based velocities







- Sharp increases in ascent rate are due to buoyancy changes induced by the float's ascent control algorithm (**ie arrow locations (LEFT, RIGHT)**)
- Sharp pycnocline can cause a significant drop in float ascent rate (**RIGHT, circled**), buoyancy nudges not captured by lower-frequency ISUS data (red line)

Optode response-time correction: measurement times

But…

- For CTDs onboard UW/MBARI APEX floats, bin counts returned as 2-digit hex (0xff), **saturation occurs at bin count 255**.
- ~30% of MBARI APEX profiles have bin-saturation occurrences
- When time step > τ, sample should not require correction, but cannot be fully resolved by filter method and final interpolation

Bounding time-points required,
Time-series of *consecutive* means returned

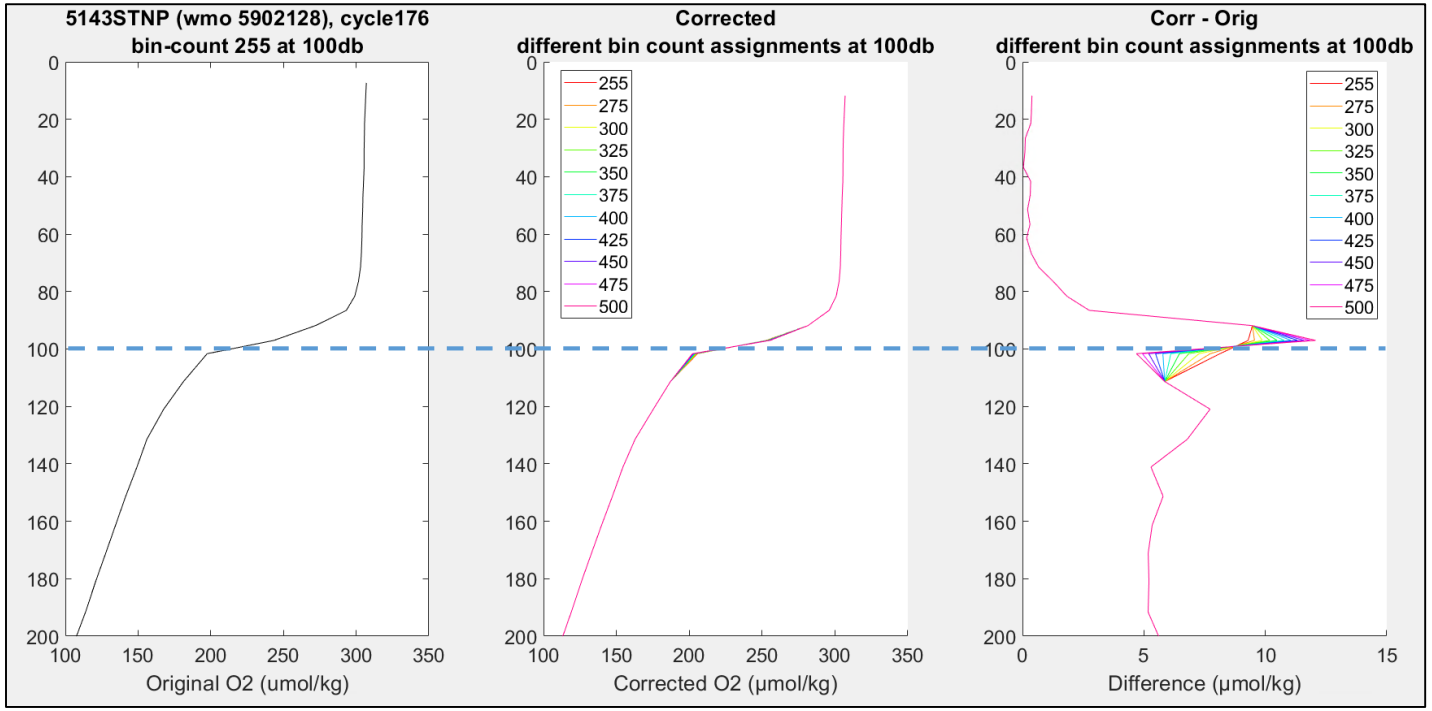
$$\frac{c^{\text{in-situ}}(t_{i+1}) + c^{\text{in-situ}}(t_i)}{2} = \frac{1}{2b} \cdot \left(c^{\text{obs}}(t_{i+1}) - a \cdot c^{\text{obs}}(t_i)\right),$$

$$a = 1 - 2b, \quad b = \left(1 + 2\frac{\tau}{t_{i+1} - t_i}\right)^{-1}; \qquad \text{(A3)}$$

Bittig et al, 2017, App-A

How to implement?

a) Leave profiles with bin saturation uncorrected
b) Leave affected points uncorrected
c) Complete correction, mark affected points QC “2”, “3”?



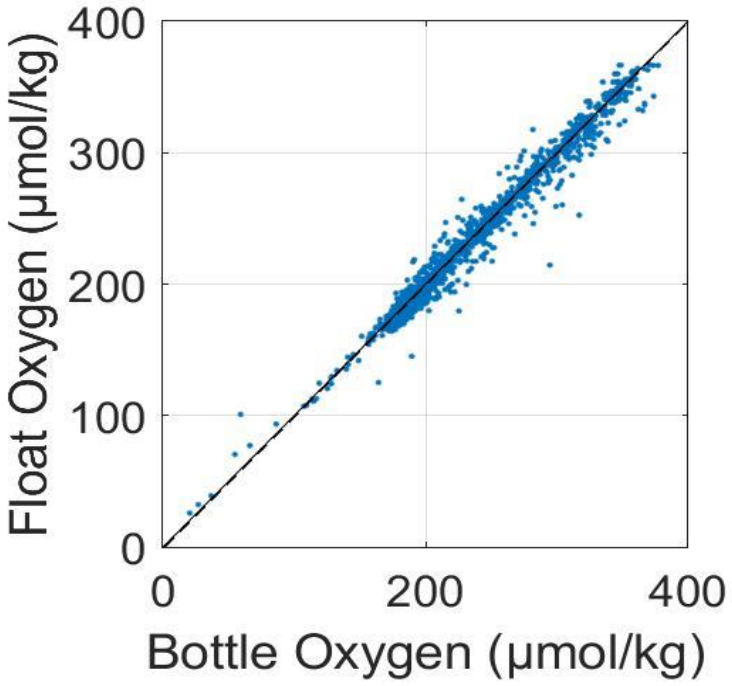
Optode response-time correction: data management & implementation

Summary:

- Bittig et al, 2014 time-response correction can improve accuracy in regions of steep gradient
- Sample resolution can affect the uncertainty in the correction
- CTD bin count info can be used to reconstruct a time vector, but bin saturation is a source of error

Implementation:

- Remaining issues (sample resolution, source of the time vector) to be addressed at the DAC-level (?)
- Adding another dimension to N_CALIB (& SCIENTIFIC_CALIB_*) likely the best way to record application & technicalities of the correction
- Info to include:
  - Reference for correction method (ie Bittig et al, 2014)
  - Assignment, parameterization of τ
  - Source of measurement times
  - Sample resolution of CTD (if NB_SAMPLE_CTD used)
  - Descriptive comments explaining any approach to remaining issues (ie, “Correction was applied to upper 400m only due to increased uncertainty in the correction at low sample resolution.”)



Remember: we are working on second-order corrections, here!