

FROM THE DEEP SEA TO THE ATMOSPHERE

Using ICOS and ARGO infrastructure for Ocean Observations

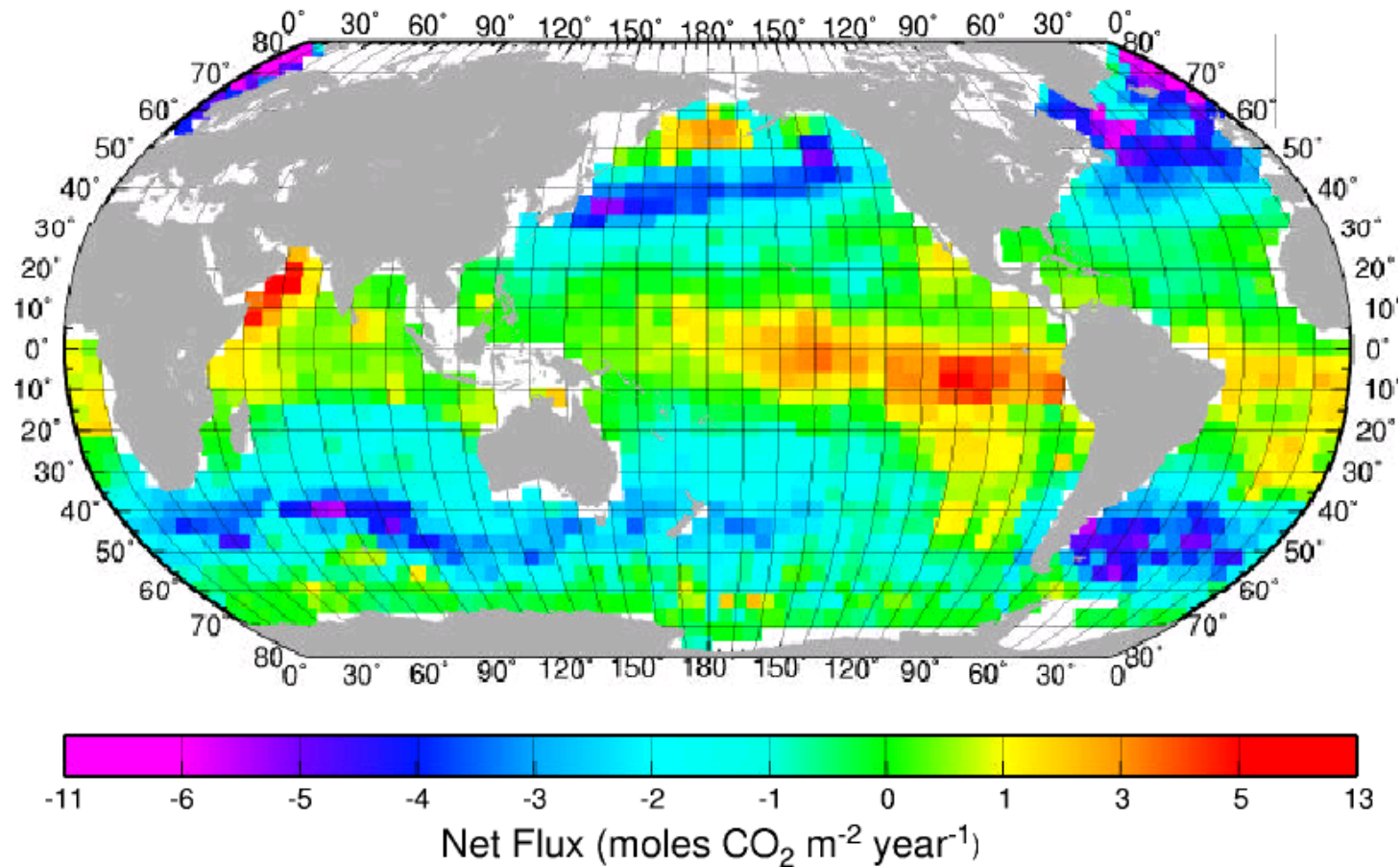
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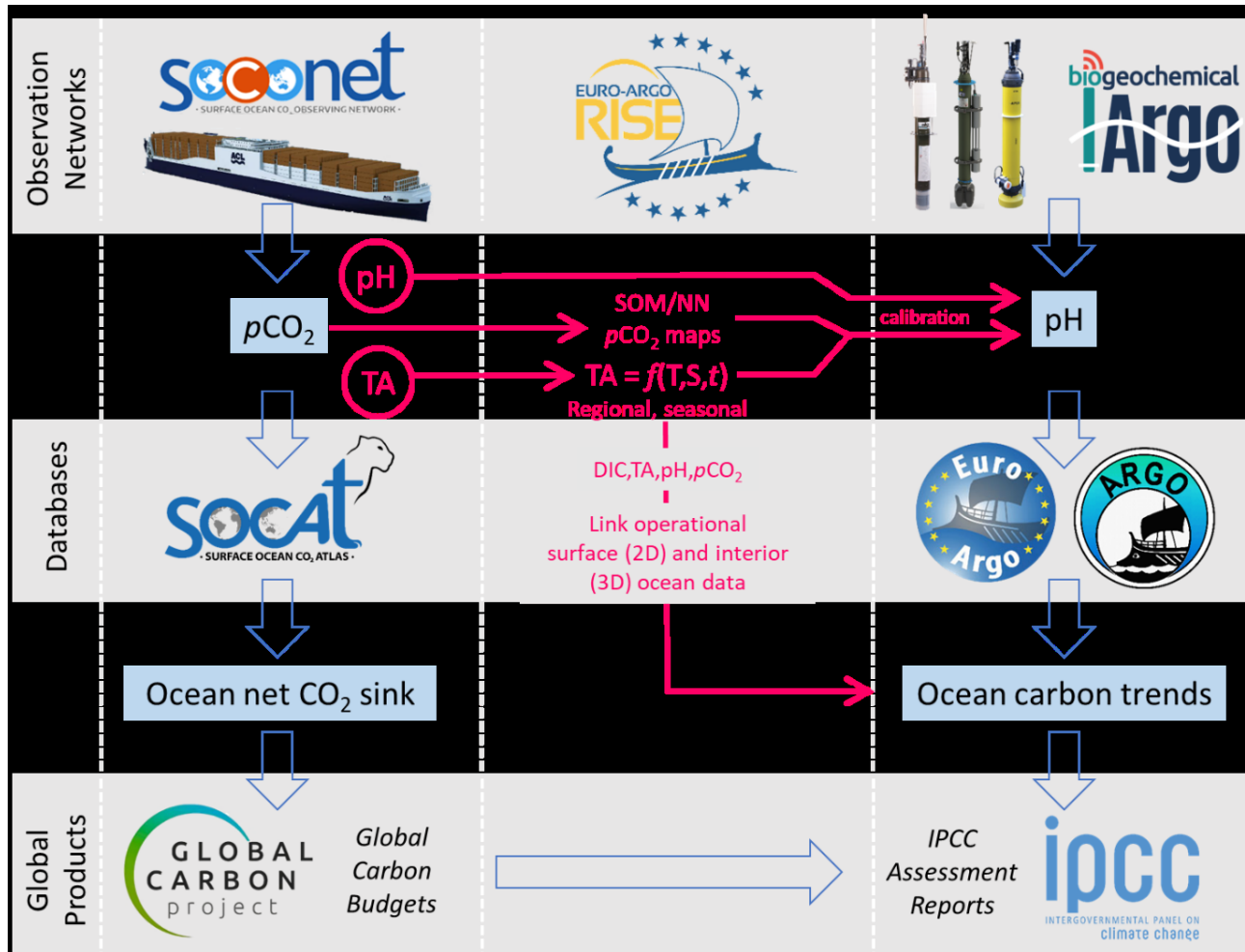


HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

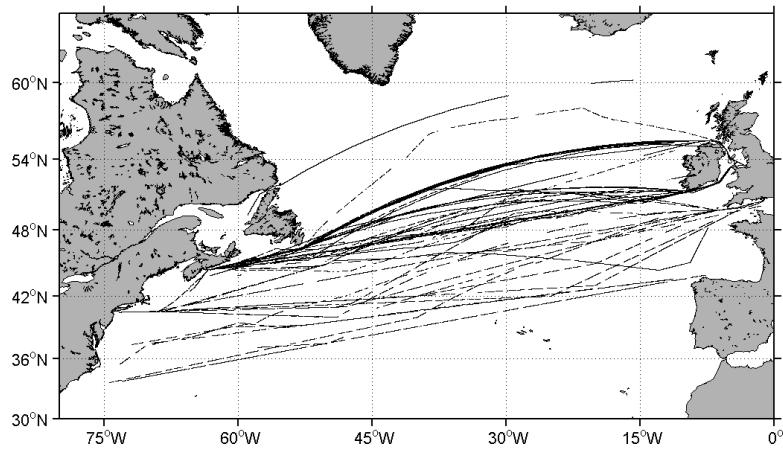


Takahashi et al., 2009

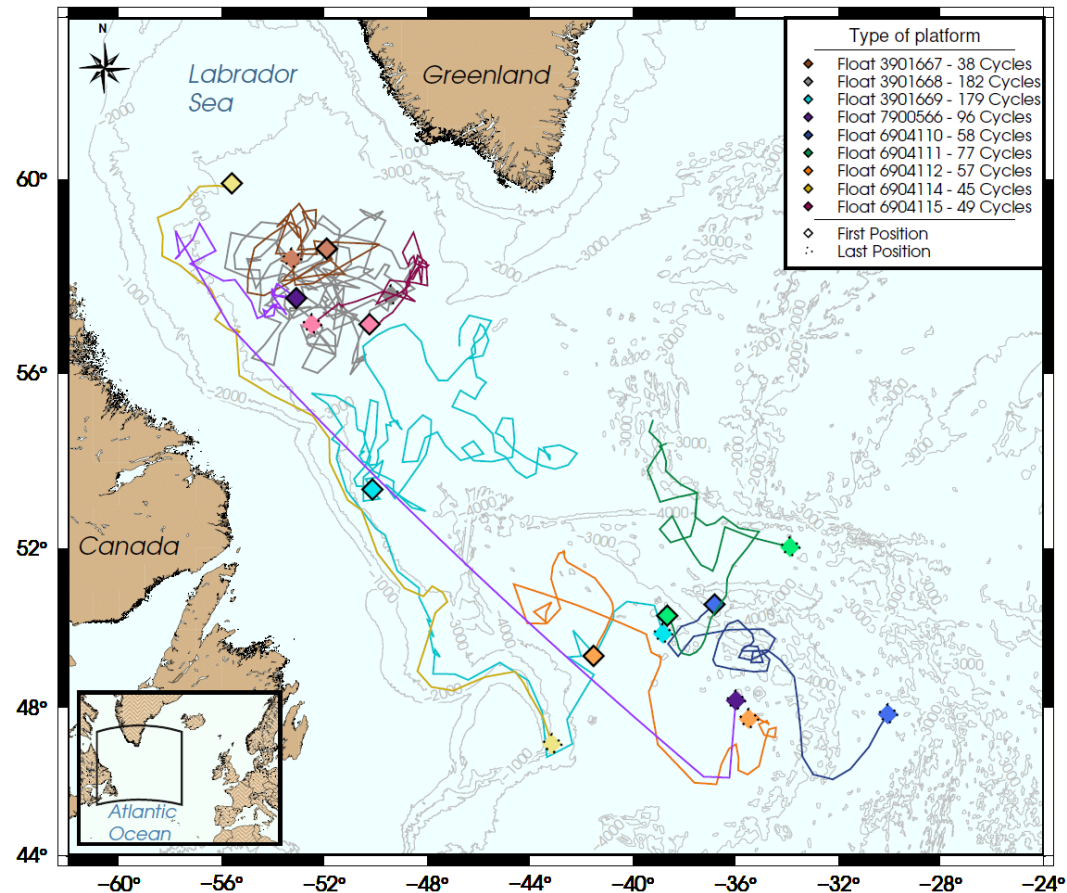
Ocean Carbon observations

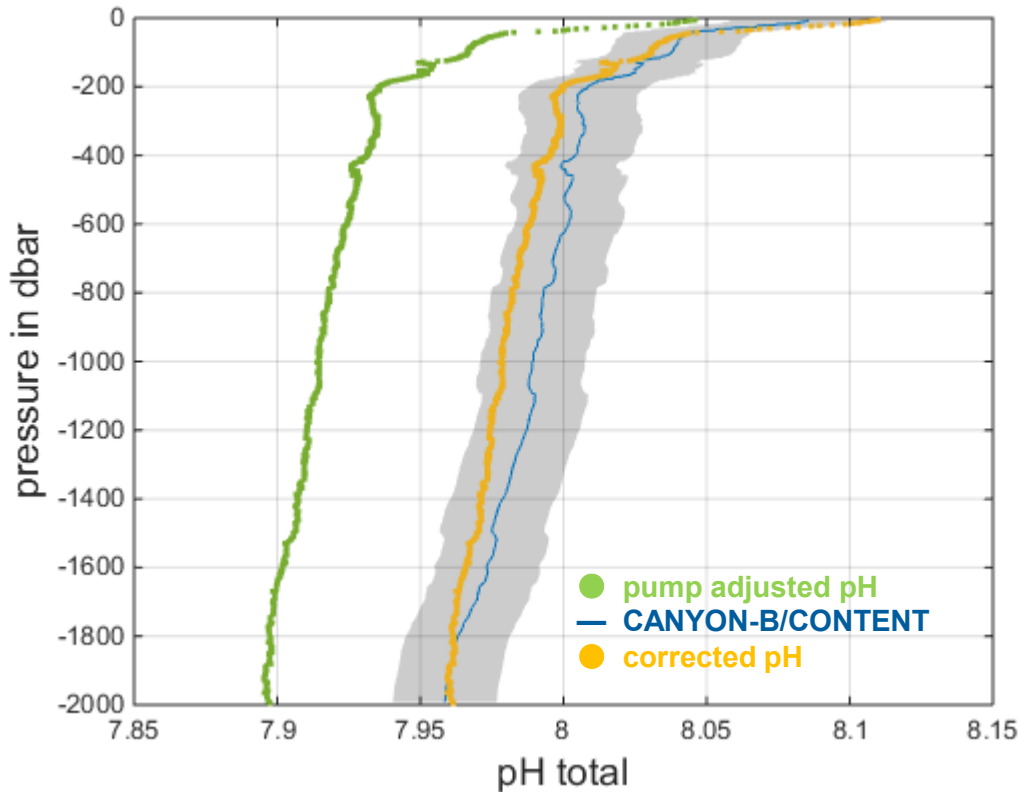


SOOP data



Float data

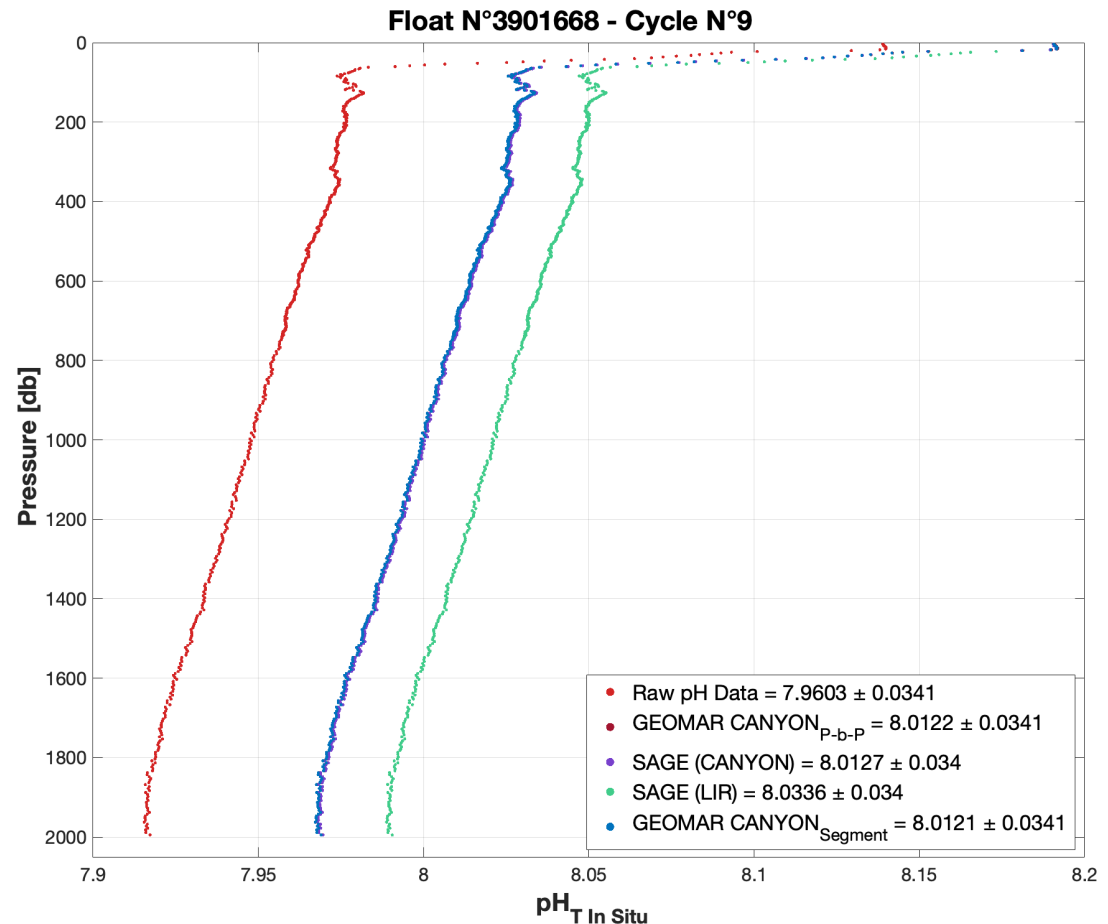




- Correcting for pump offset (if necessary)
- Adjusting to an alternative pH estimate in the deep ocean (GLODAP, CANYON-B, LIR)
- CANYON-B is a Bayesian neural network mapping that accurately reproduces GLODAPv2 based on temperature, salinity, oxygen measurements
- CONTENT combines and refines the four carbonate system variables to be consistent with carbonate chemistry

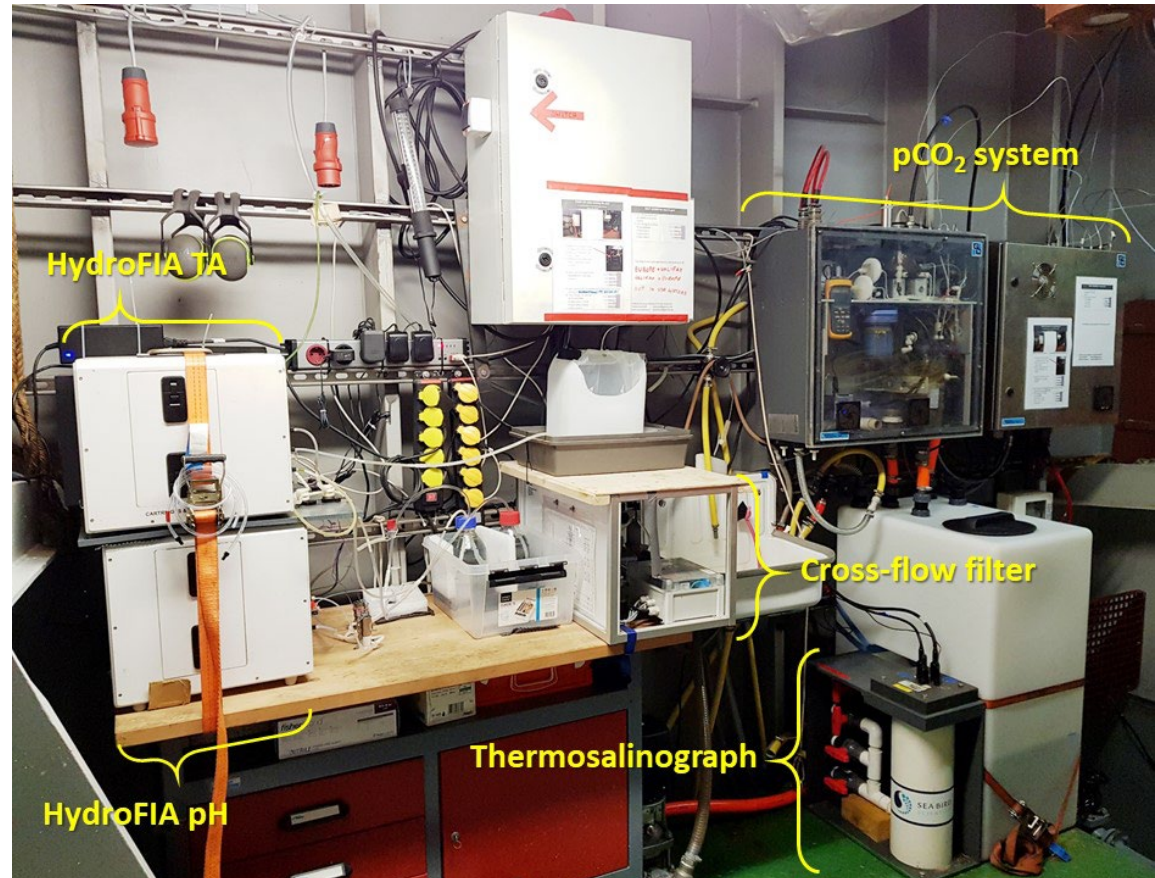
Data processing of float-pH

- We tested our own Matlab against the SAGE GUI provided by MBARI and found very good agreement (difference < 0.001)
- Corrections were calculated in two ways: **profile-by-profile** and **segment method** (where the difference between profiles in situ at the same depth is calculated by linear regression)
- SAGE Corrections were compared against the Linear Interpolated Regression; and the CANYON-B reference

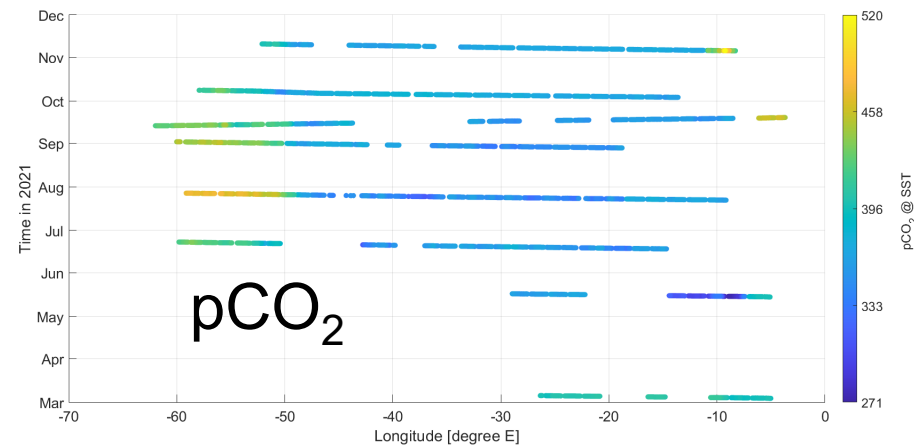
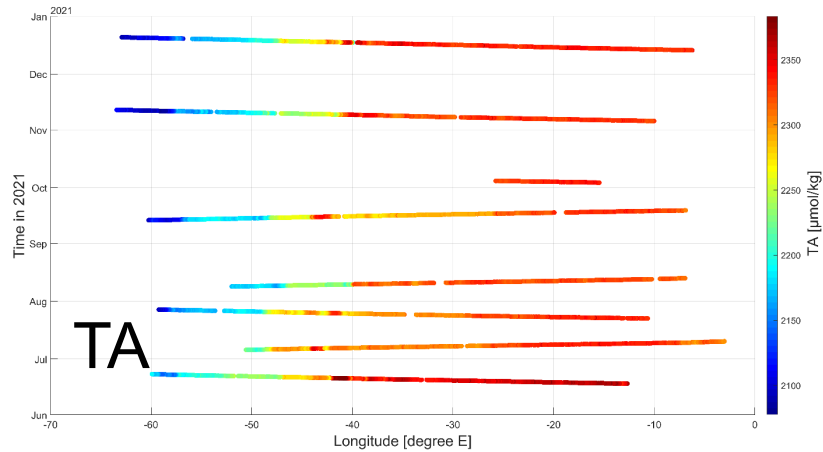


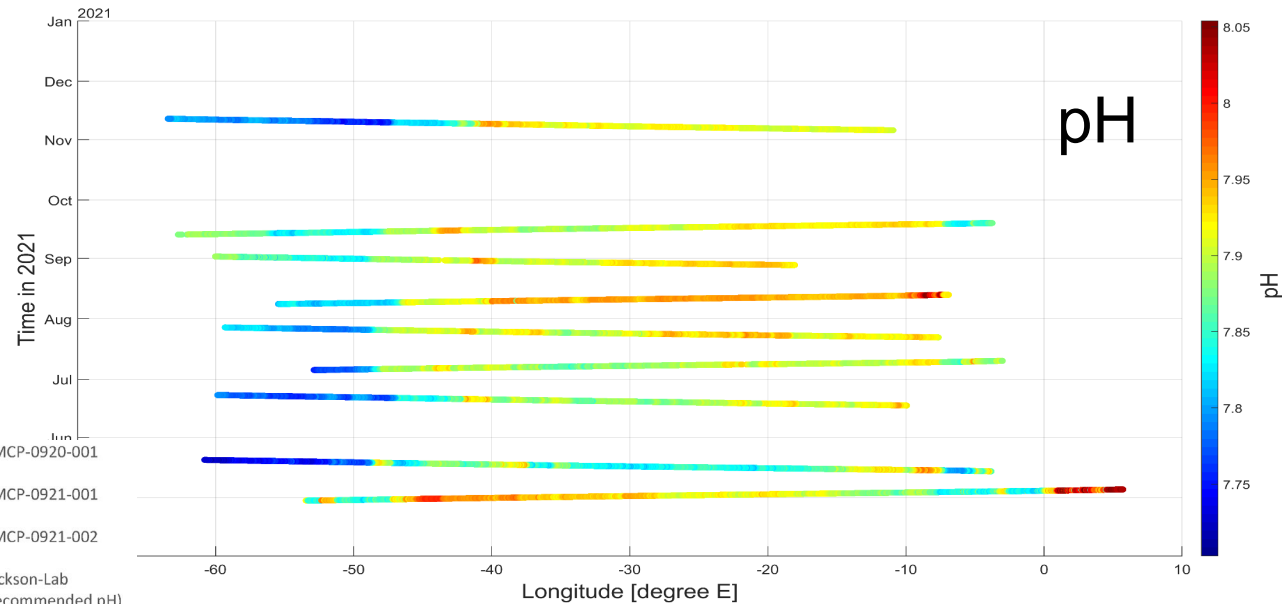
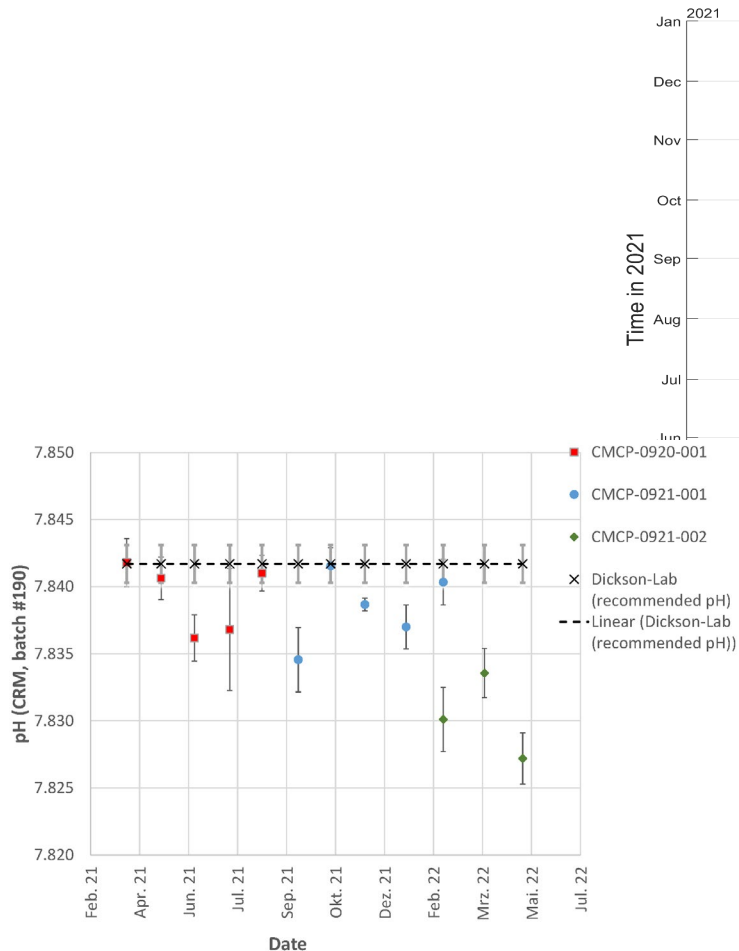
North Atlantic SOOP Line:

- Autonomous $p\text{CO}_2$ observations since 2003
- Autonomous alkalinity (TA) observations since 2019
- **Newly established autonomous pH observations since 05/2021 (at-sea pH precision ± 0.003)**



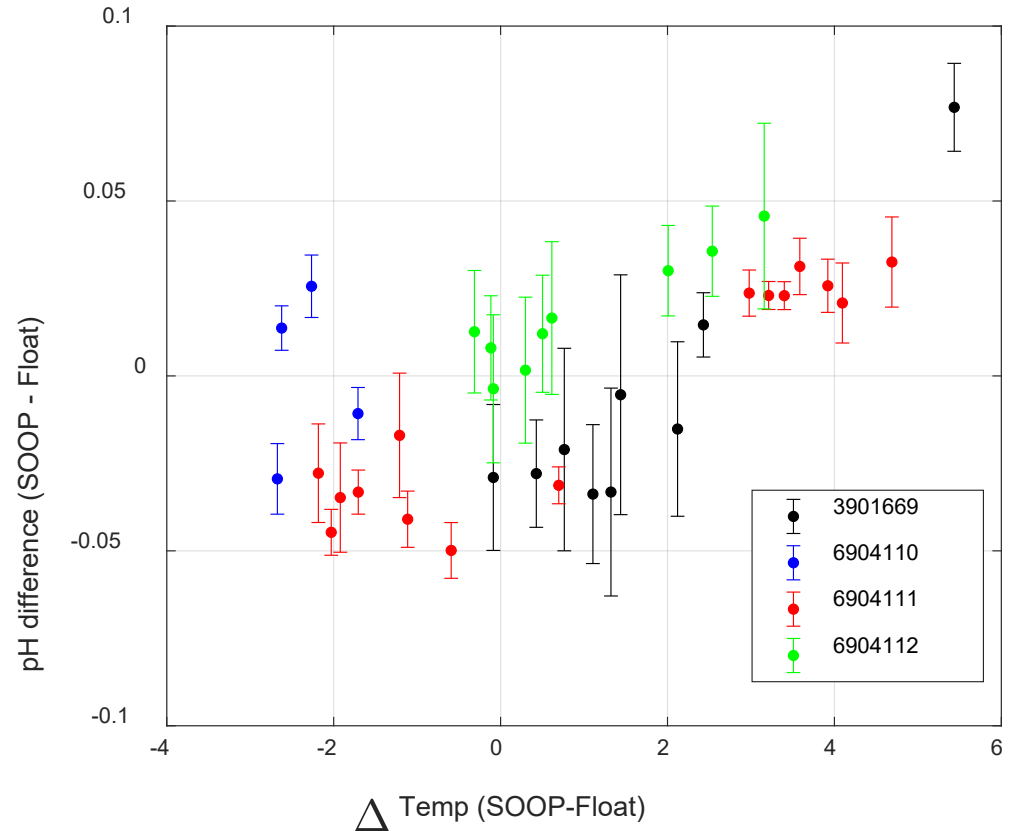
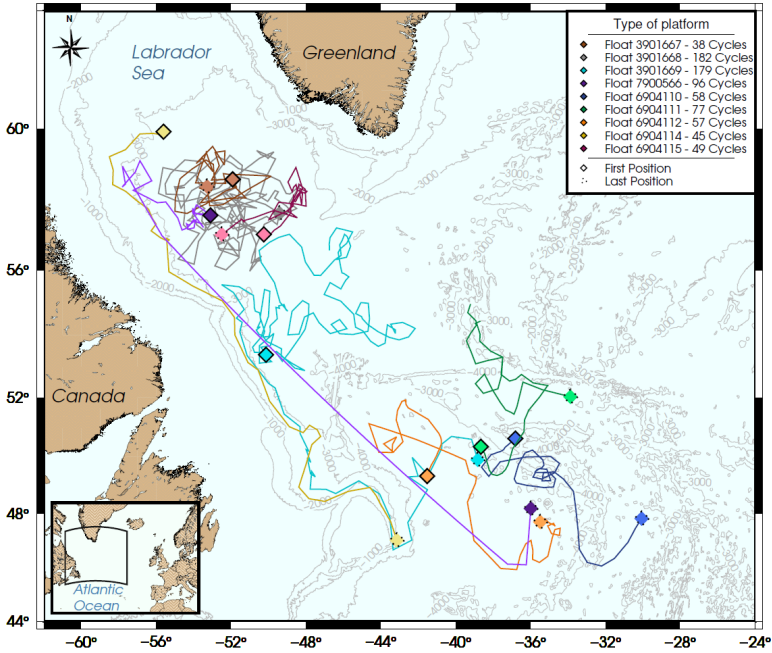
BSH/GEOMAR BGC Argo floats – pH correction





- At-sea precision (= reproducibility) of SOOP-pH is about 0.002
- SOOP-pH is regularly referenced (pre- and post-cruise) against Certified Reference Material for marine CO₂ system (CRM, Dickson Lab, SIO) which has a nominal accuracy of 0.0014
- CRM-corrected at-sea SOOP-pH is expected to reach an overall accuracy of about 0.003 – 0.004

BSH/GEOMAR BGC Argo floats – pH correction



- Need agreement how to correct float pH
 - Different approaches for different regions?
- Pressure/temperature dependent corrections
- ICOS and BGC-ARGO have a great potential to observe the ocean in three dimensions on an operational basis

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Thank you!

Questions/comments welcome!

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