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A pan-Arctic algorithm for DOC concentrations from CDOM spectra

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Motivation

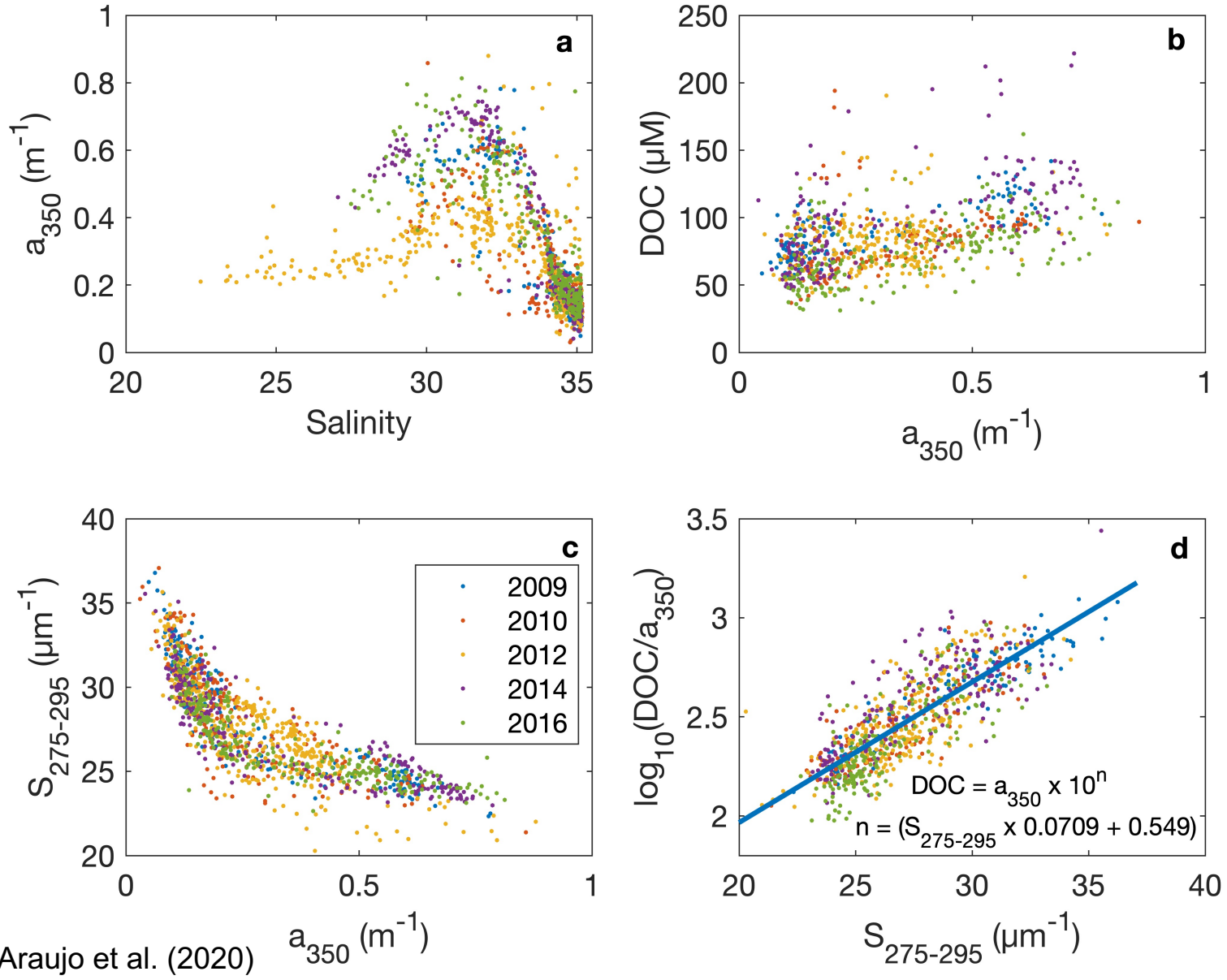
- DOC measurements are restrict to measurements of discrete samples
  - Limited coverage: synoptic snapshots of relatively small areas

- Close to rivers, CDOM (a_{350}) often correlates linearly with DOC concentrations (e.g., Gonçalves-Araujo et al., 2015; Spencer et al., 2012; Vodacek et al., 1997)
  - The use of coefficients that describe spectral absorption of CDOM have improved prediction of DOC using two end-members (e.g., Fichot & Bennet, 2011)
  - CDOM absorption is a relatively easy-to-measure parameter and can be continuously monitored with in situ optical sensors, allowing for increased sampling coverage across both spatial and temporal scales.

- However, in regions with two or more end-members of comparable DOC concentrations (shelf and oceanic waters) these relationships are difficult to derive
  - There might be two pools of similar concentration/intensity but different ratio of absorption to DOC (carbon specific absorption coefficient, a*)

Motivation

- A recent algorithm to retrieve DOC from CDOM spectral features in the Fram Strait (Gonçalves-Araujo et al., 2020) showed a potential for application to the entire Arctic



Gonçalves-Araujo et al. (2020)

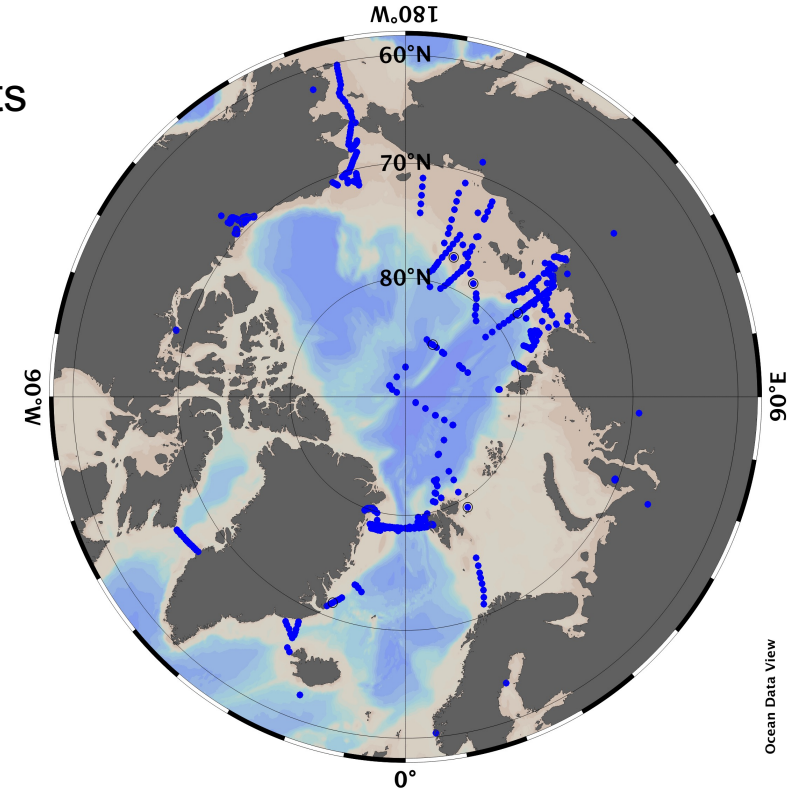
Objective and hypothesis

- The main objective was to test whether the relationships observed in the contrasting waters in Fram Strait could be efficiently employed to derive DOC across several Arctic environments

  – We hypothesized that, as one can observe strong gradients across the Fram Strait representing DOM-pools from multiple end-members, the relationships observed there would remain representative when taking the entire Arctic basin into consideration

Dataset

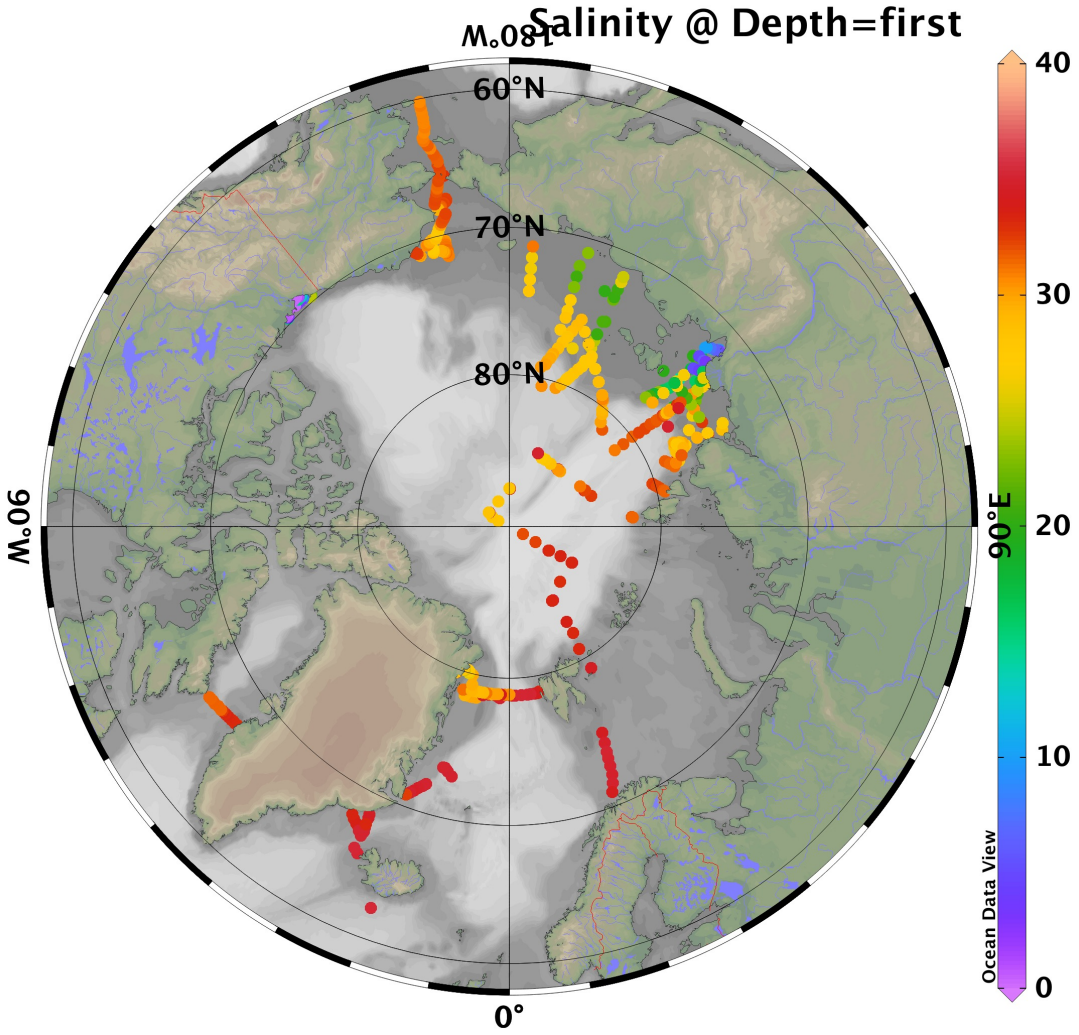
- We compiled a Pan-Arctic dataset with 3377 samples (being currently expanded)
- Data from multi-year/season campaigns, including continuous monitoring program data
- Dataset encompasses various Arctic environments
  - Surface and water column
  - Pelagic waters
  - Coastal and shelf waters
  - Estuaries
  - Rivers



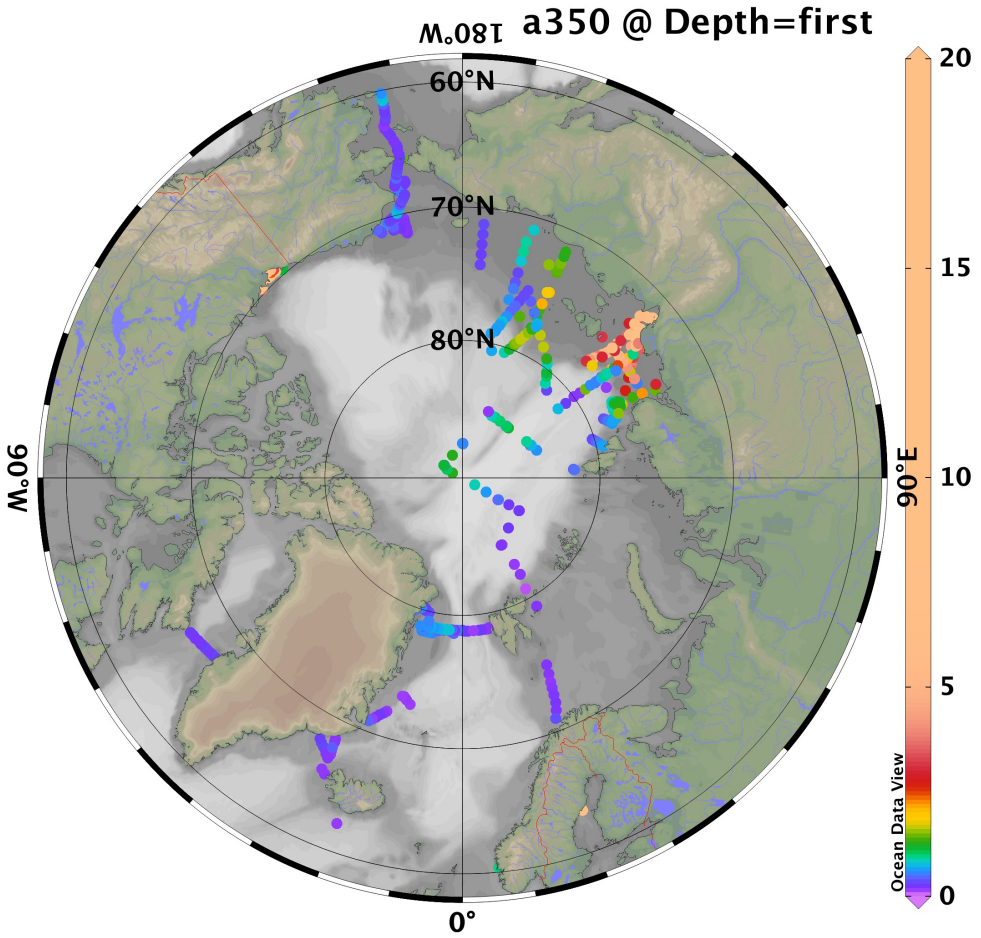
Results – Ranges for each parameter

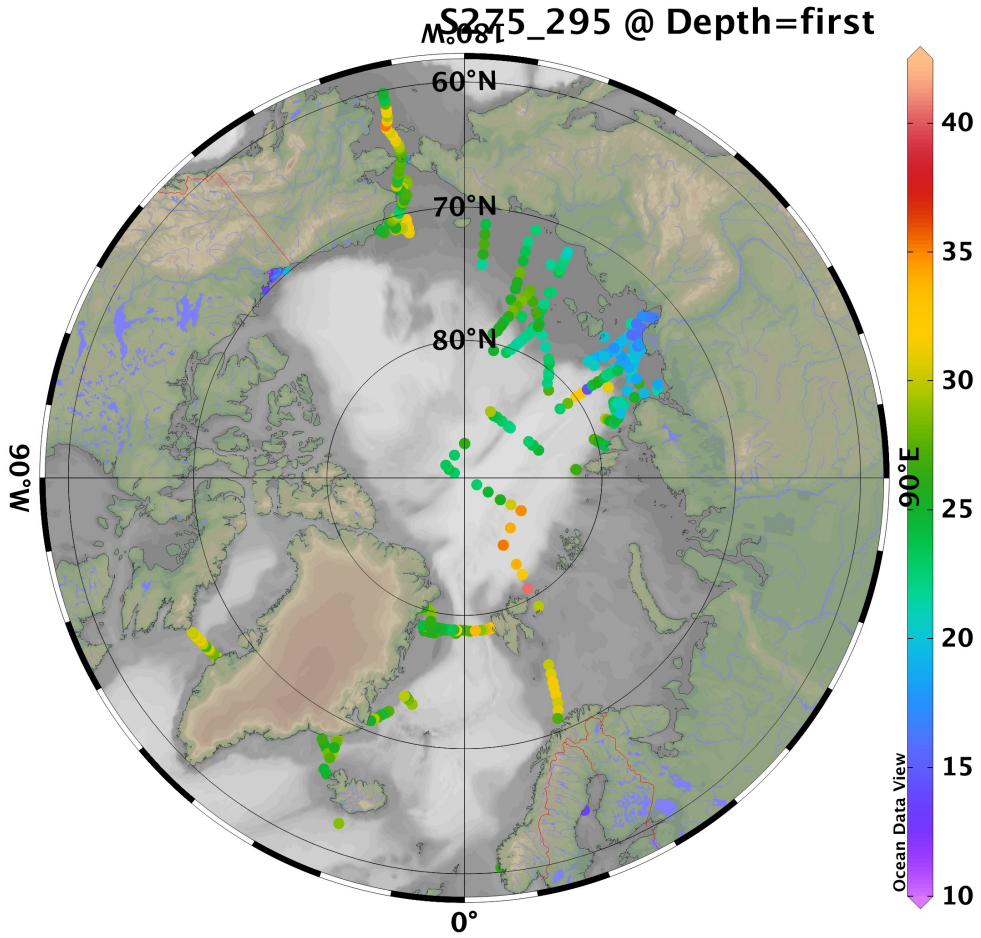
- Results are still preliminary → there is more data to be integrated
- **Salinity:** 0–35.3
- **DOC:** 29–1958 µM
- **a_{350}:** 0.01–43.03 m^{-1}
- **$S_{275-295}$**: 10.13–40.39 μm^{-1}

Results – Surface Salinity

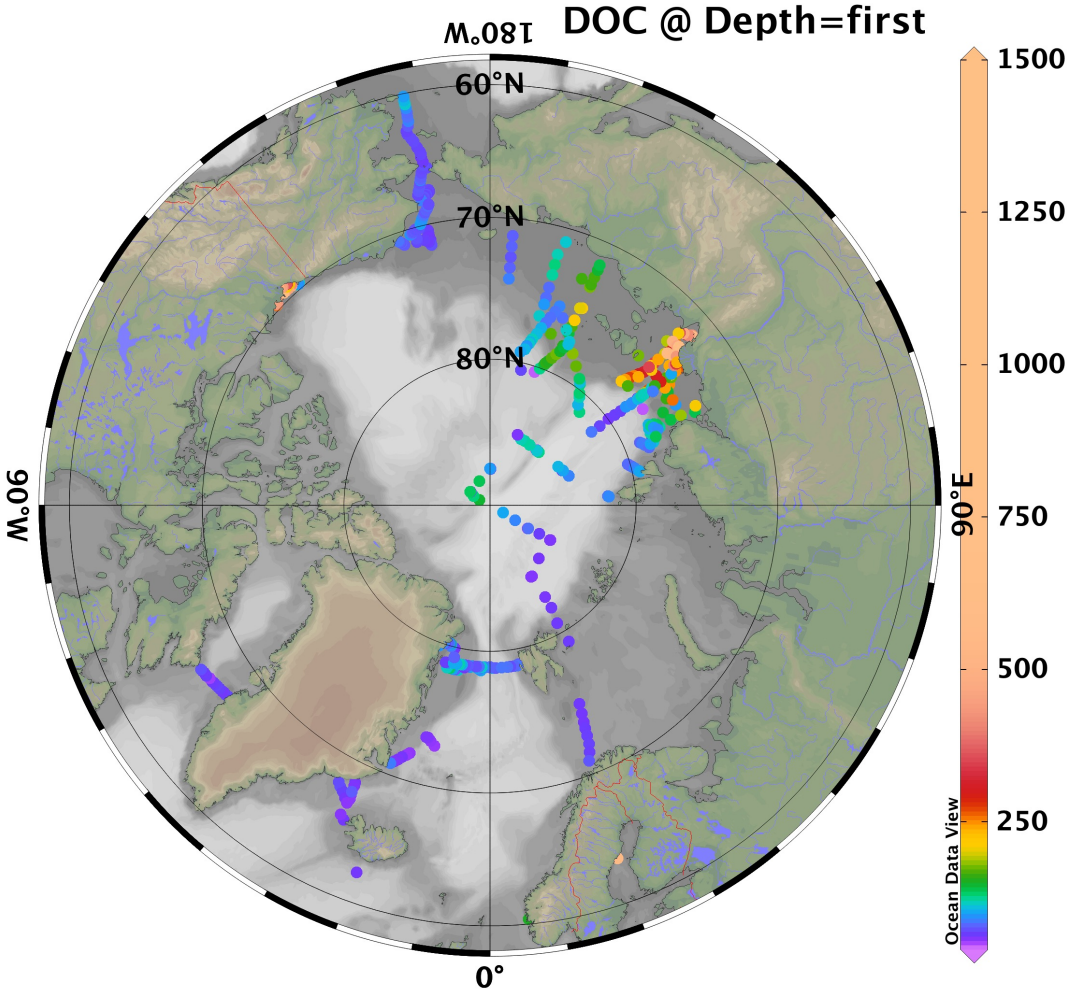


Results – Surface CDOM



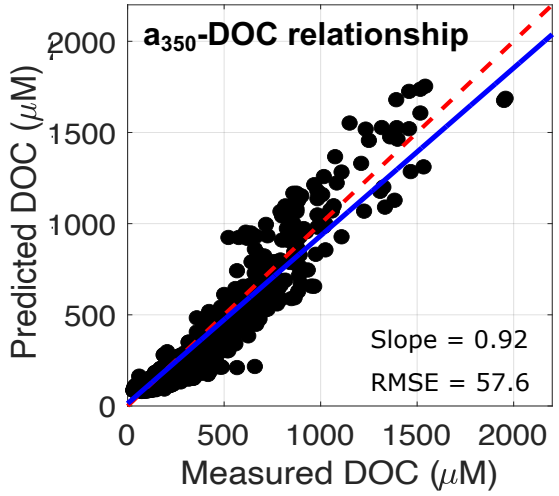


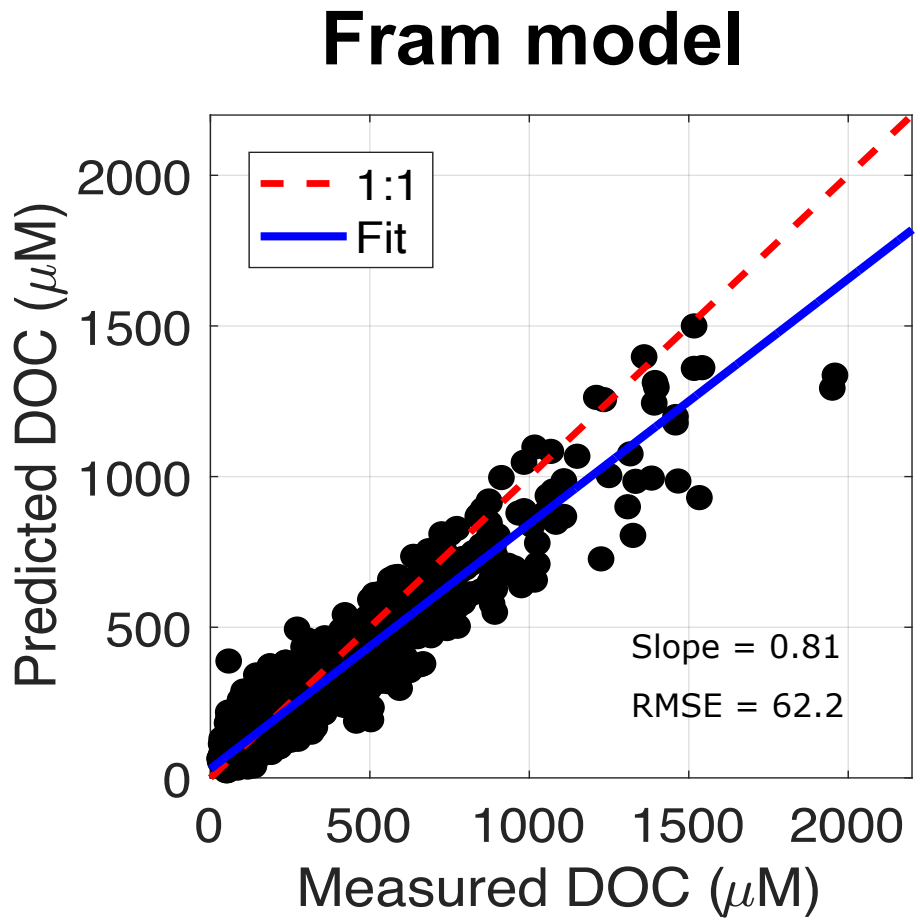
Results – Surface DOC



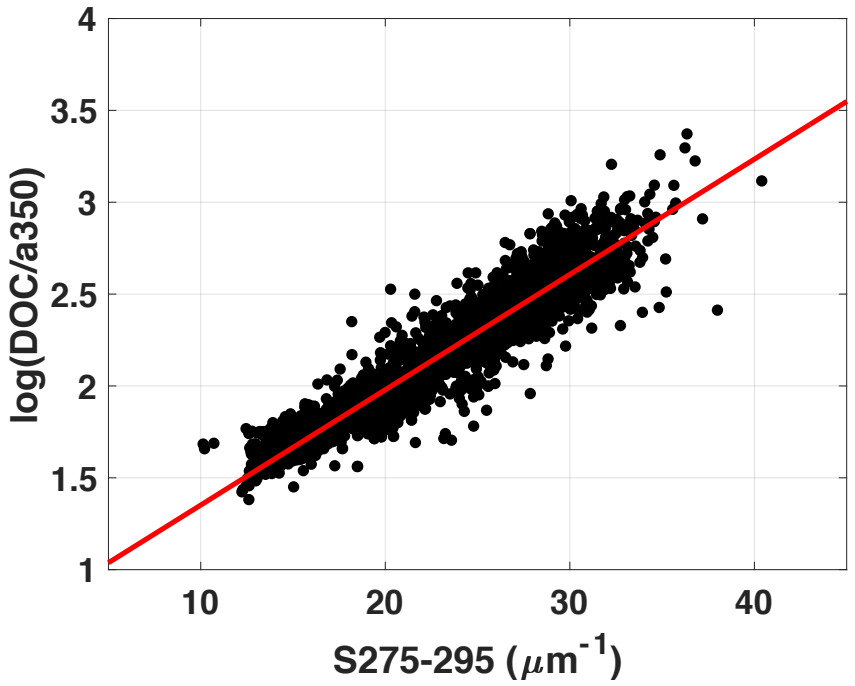
Results – Fram model performance

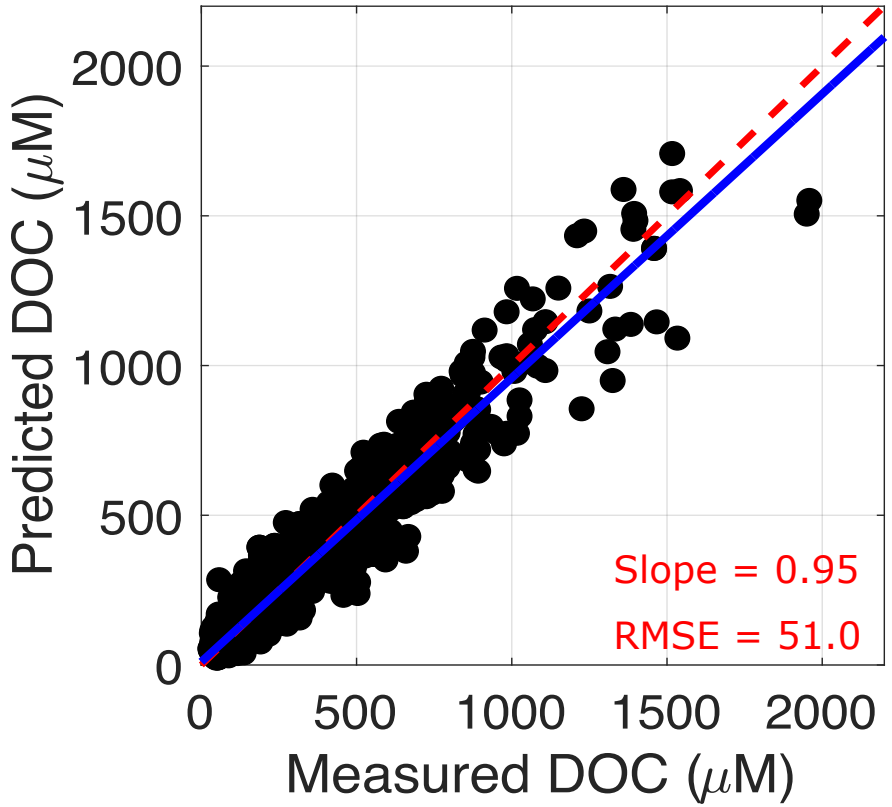
- Acceptable performance
  - DOC and pDOC correlated ($p<0.01$)
- Slope differs from 1:1 line ($p>0.05$)
- pDOC derived from linear a_{350} vs DOC relationship provide better estimates



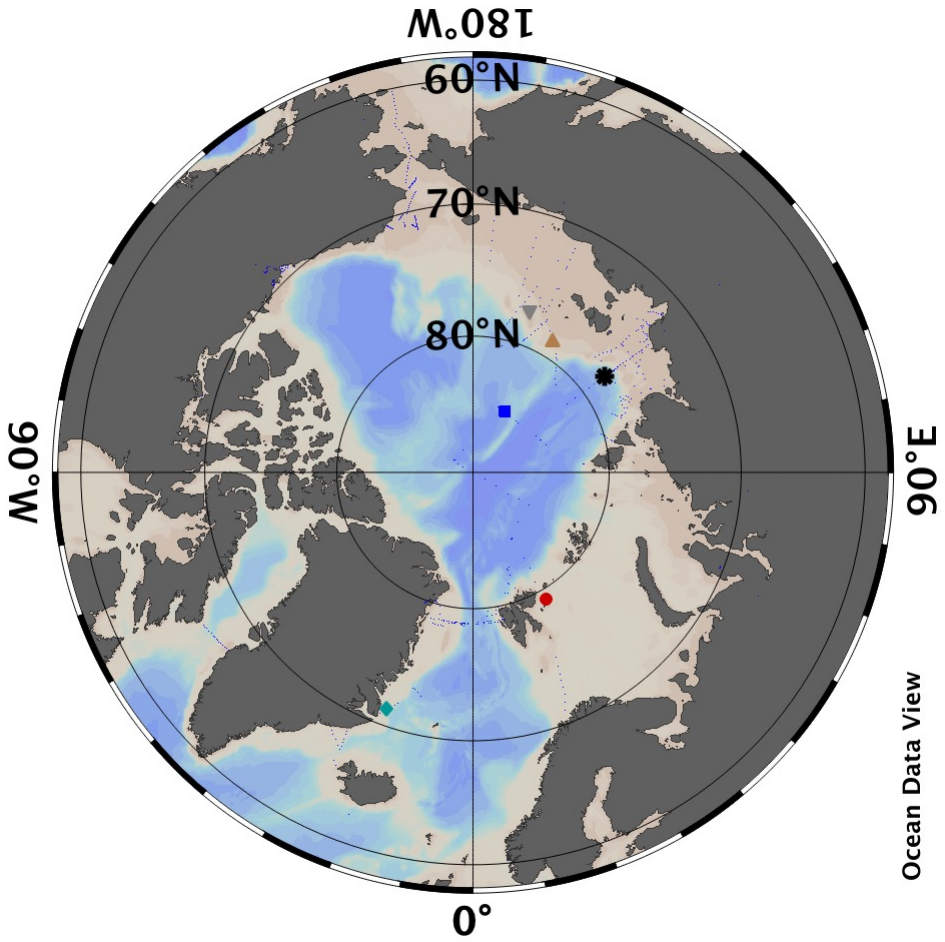


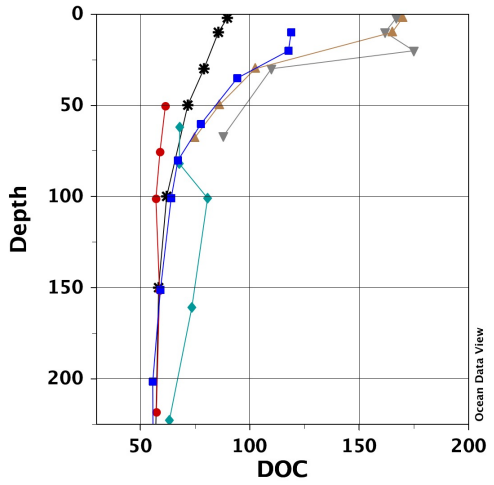
Developing a Pan-Arctic DOC algorithm

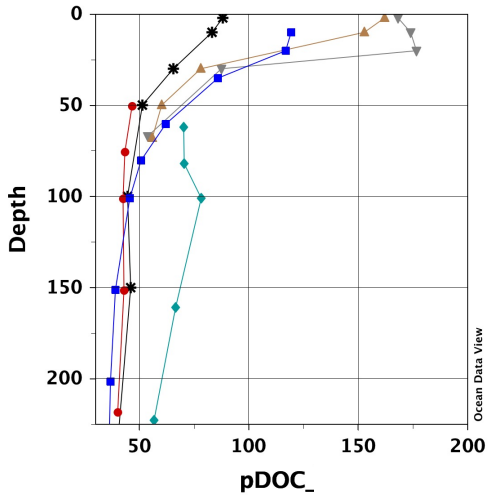


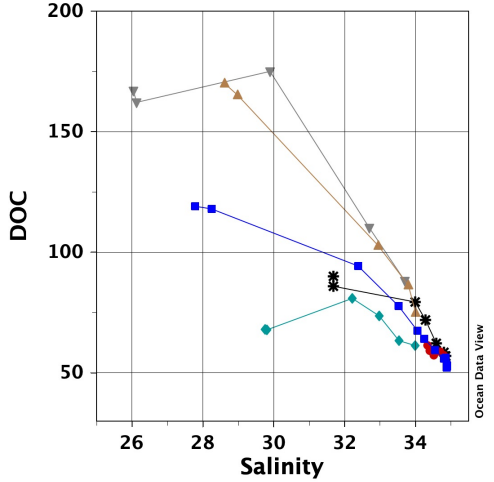


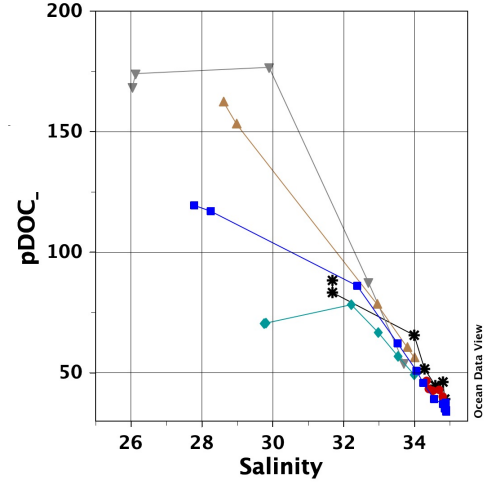
DOC vs pDOC comparisons – Low DOC sites



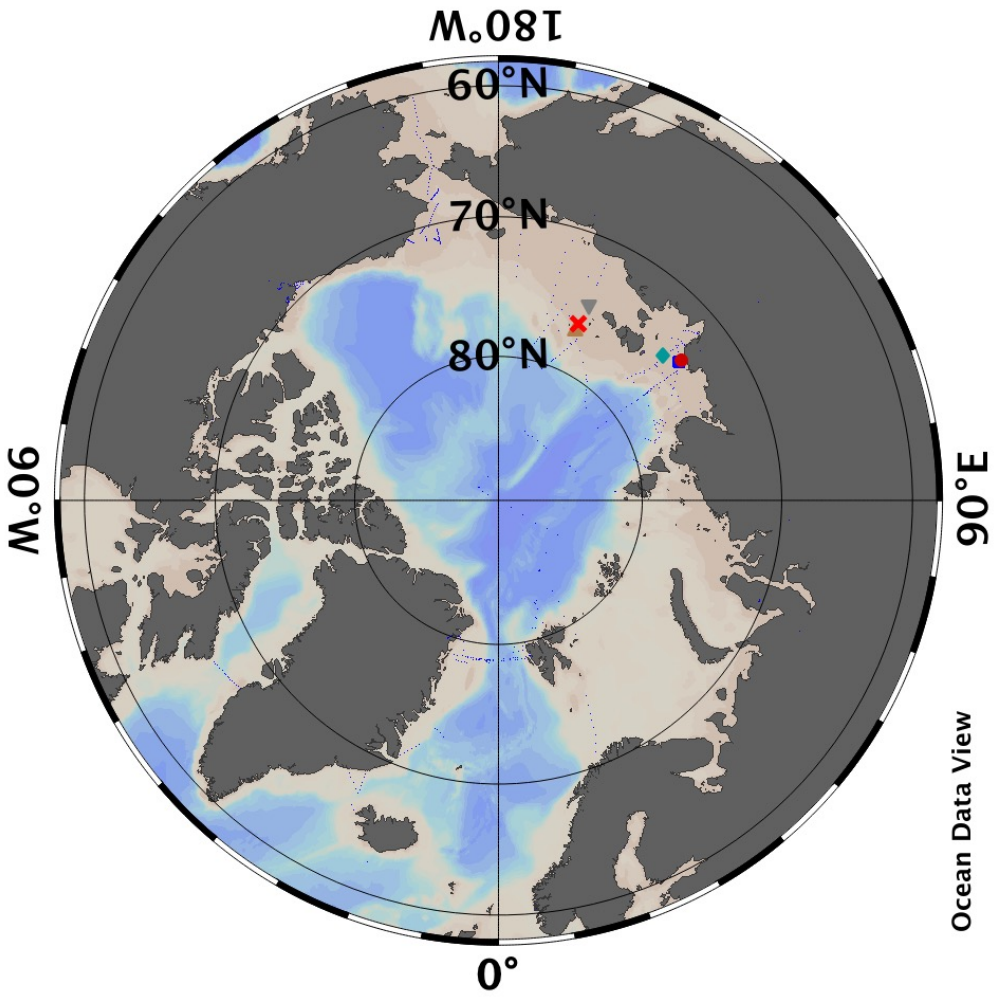


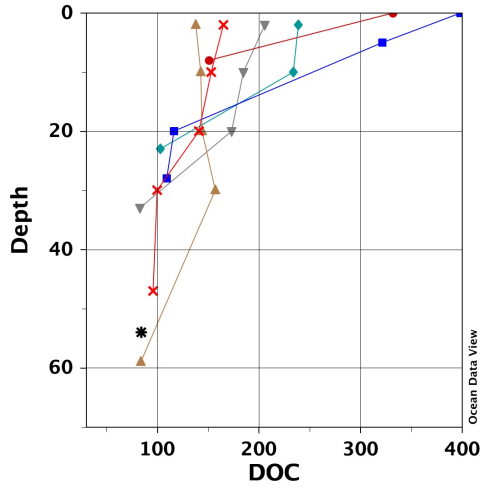


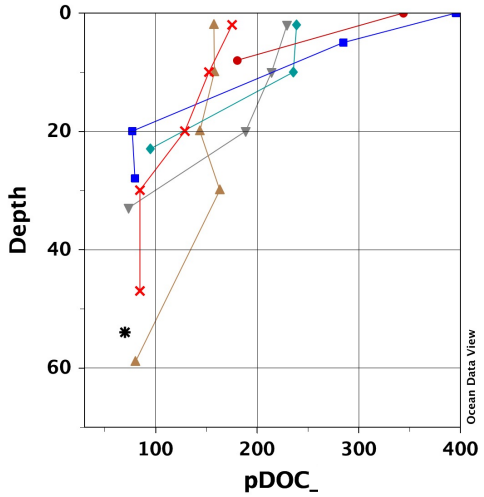


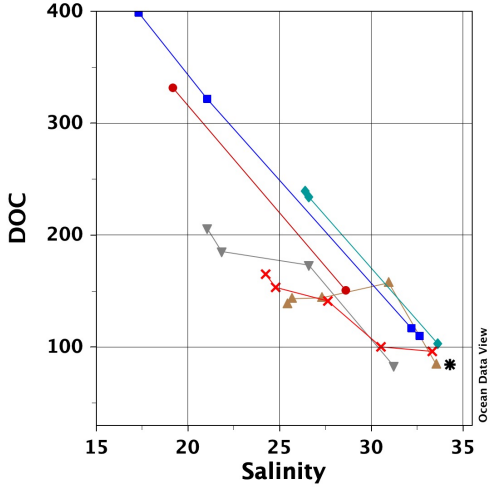


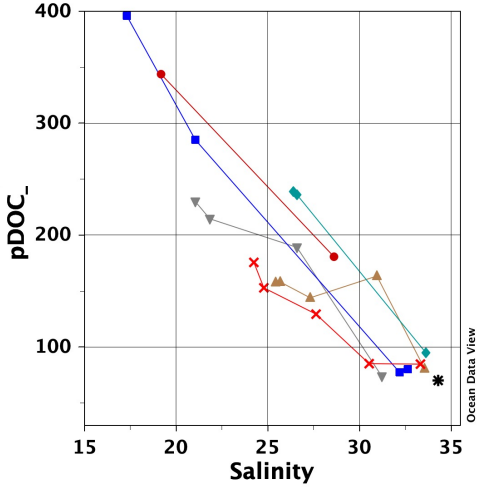
DOC vs pDOC comparisons – High DOC sites











Outlook

- Work in progress
- Expand dataset, including data from Hansell et al. (2021)
- Refine algorithm

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