Autonomous measurements of dissolved organic matter (DOM) fluorescence provide insight into origins and distributions of halocline waters in the Eurasian Basin.

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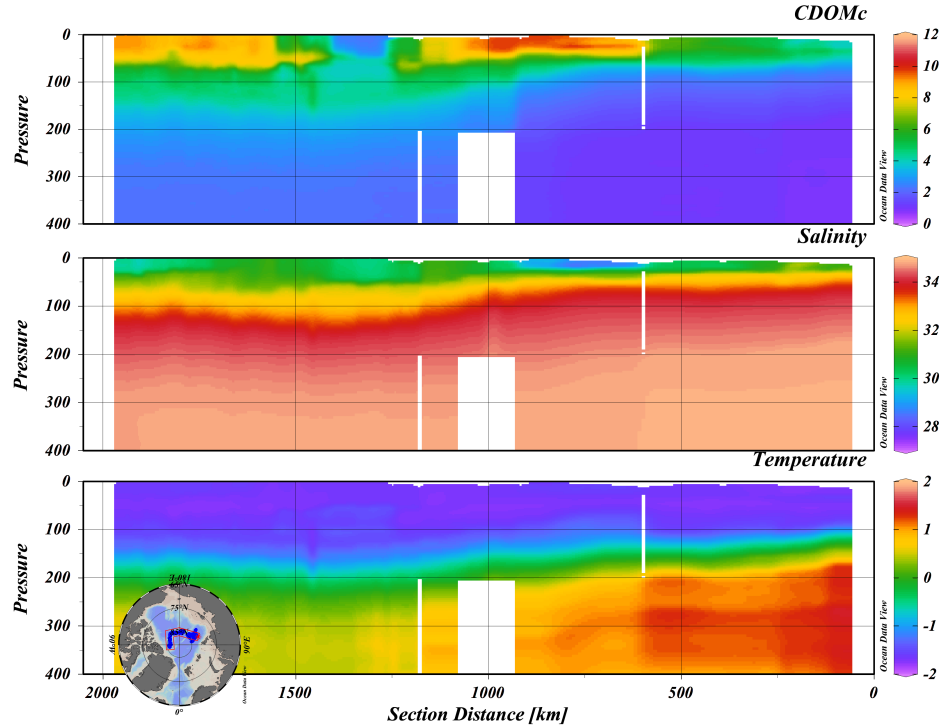
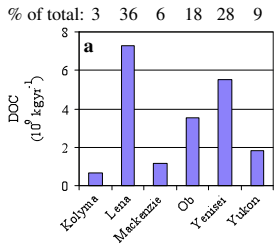
DTU Aqua
National Institute of Aquatic Resources

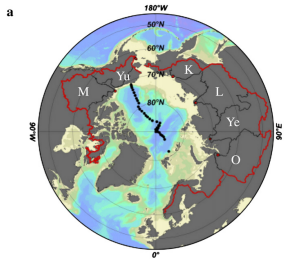


DOM in the Arctic

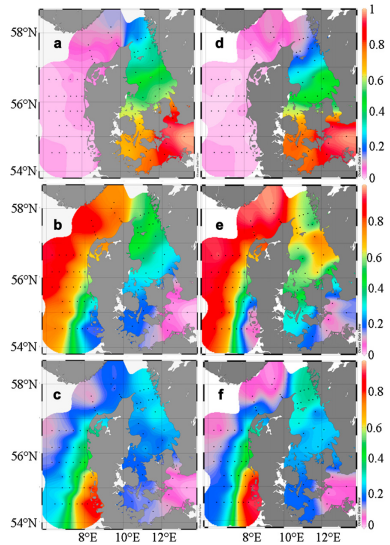
- Complex mixture of organic compounds = life's leftovers

- Dominant endmembers in the Arctic
  - Rivers (high intensity, persistent, terrestrial)
  - Atlantic water (low intensity oceanic background, persistent)
  - Planktonic and sea ice production (variable, but low for the Arctic)
  - Chukchi shelf/ "Pacific water" (high intensity, persistent, marine)





Stedmon et al 2011

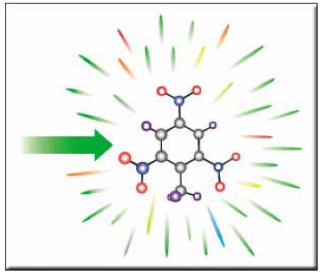


Stedmon et al 2010

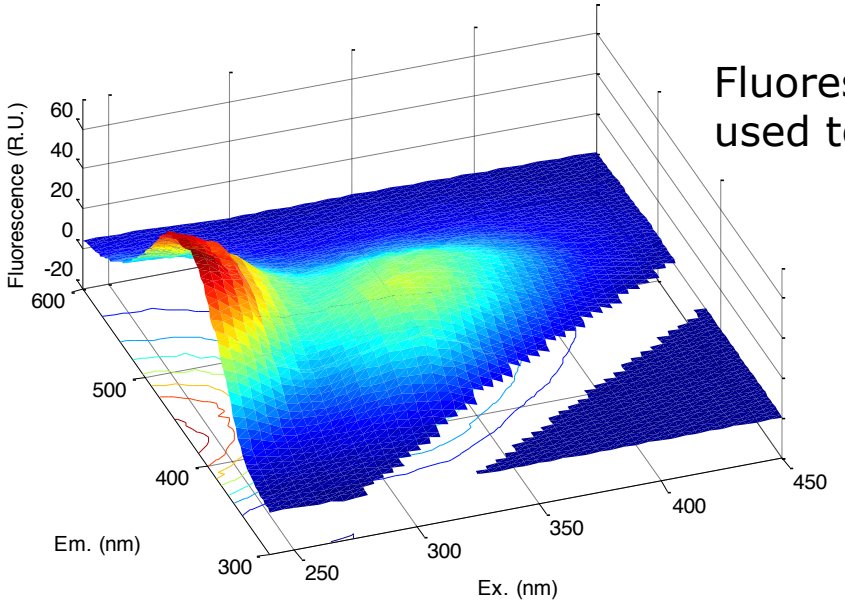
- Quasi conservative behavior
  - depends on mixing times relative to production/removal
  - Can be used as a water mass tracer

DOM Fluorescence

When a molecule absorbs light (energy) this energy can be dissipated as either heat, light (fluorescence) or a chemical reaction (photochemistry).

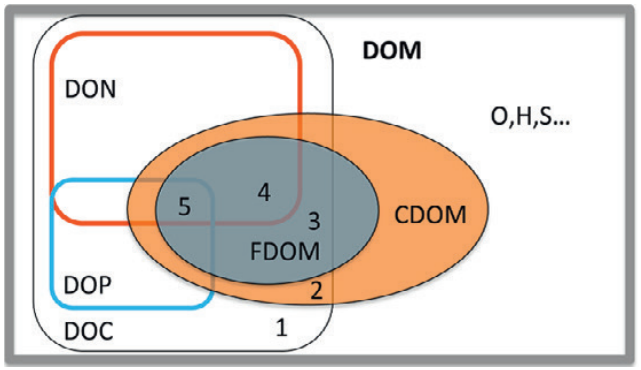


http://biochem.umn.edu



Fluorescence measurements can be used to characterise the DOM.

Proxy for total DOM



1 = No color, N and P absent (e.g., carbohydrates)
2 = Colored but N and P absent (e.g., carotenoids)
3 = Fluorescent but N and P absent (e.g., vanillic acid)
4 = Fluorescent and contains N (e.g., tyrosine)
5 = Fluorescent and contains both N and P (e.g., NADH)

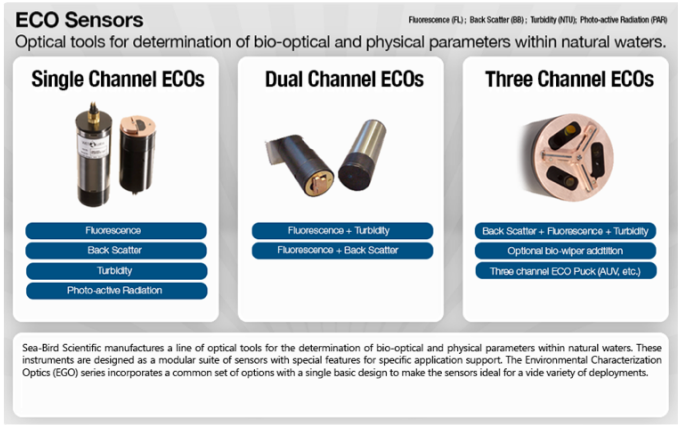
Stedmon & Nelson 2015

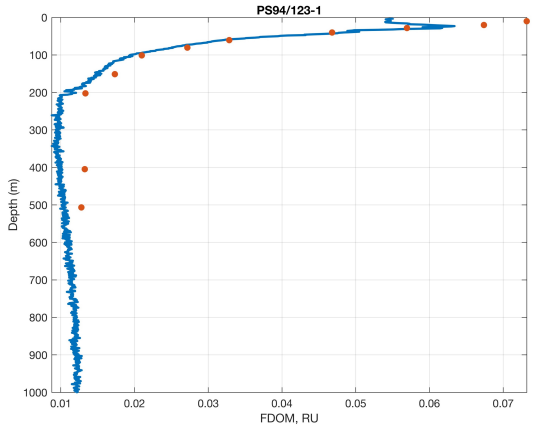
FDOM sensors

- Series of sensors available
  - Wetlabs/Seabird ECO
  - Turner Cyclops
  - Dr Haardt BackScat
  - Seapoint

- Provide high resolution profiles

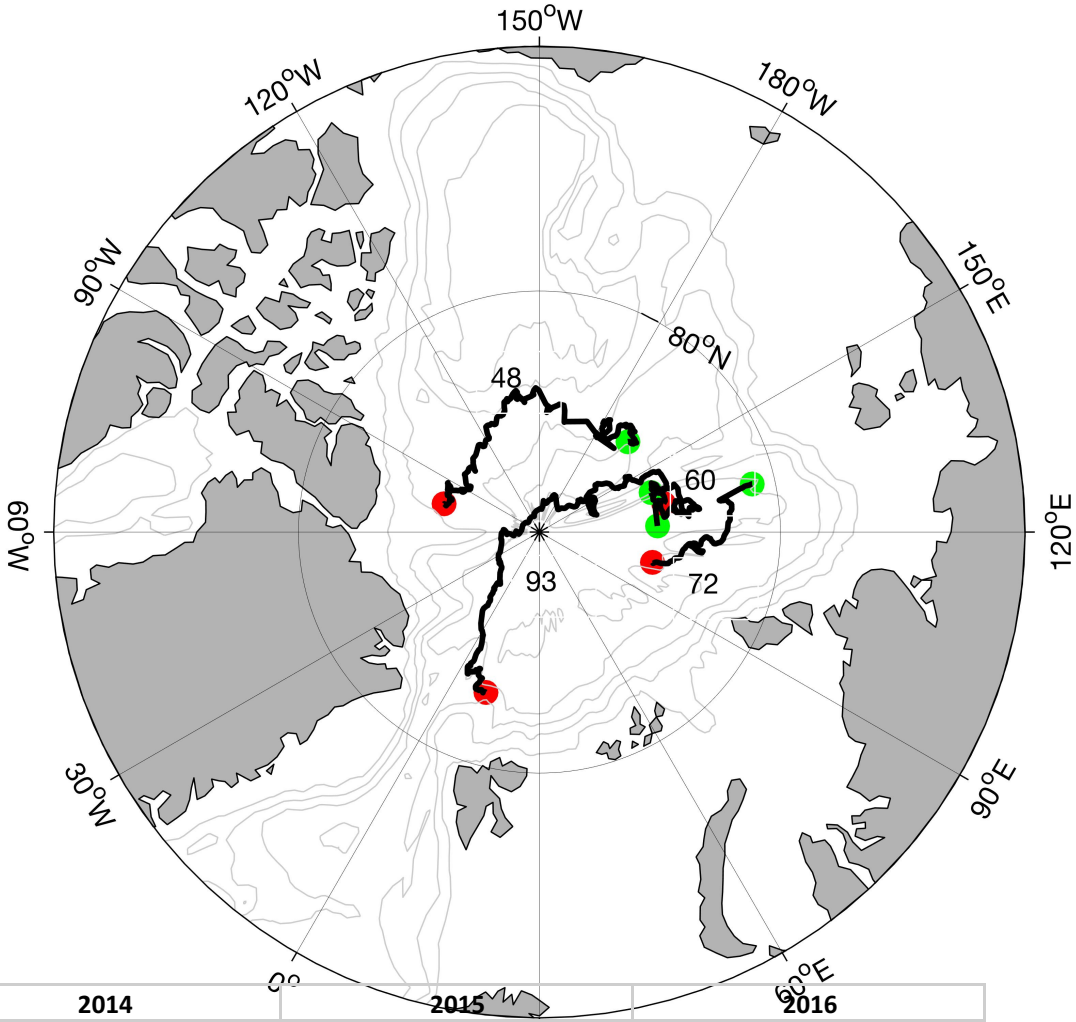
- Measures specific wavelength pairs.
  - Ex 350 Em 450 (can vary)
  - Often termed “humic fluorescence”

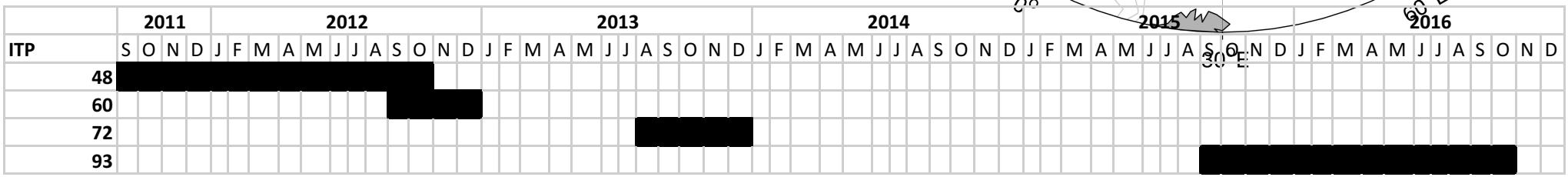




ITP-CDOM data available

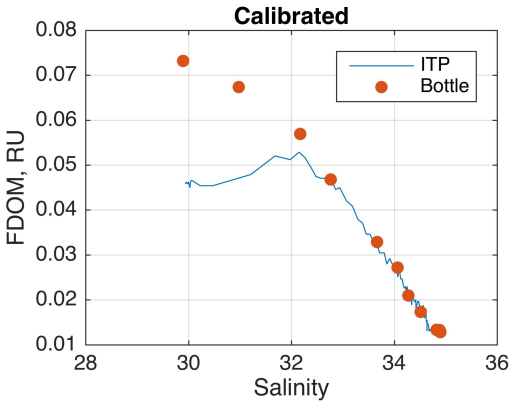
ITP	Start	Stop	nProfiles
48	10Sep2011	29Oct2012	1236
60	08Sep2012	22Dec2012	130
72	31Aug2013	16Dec2013	221
93	24Sep2015	10Oct2016	1164

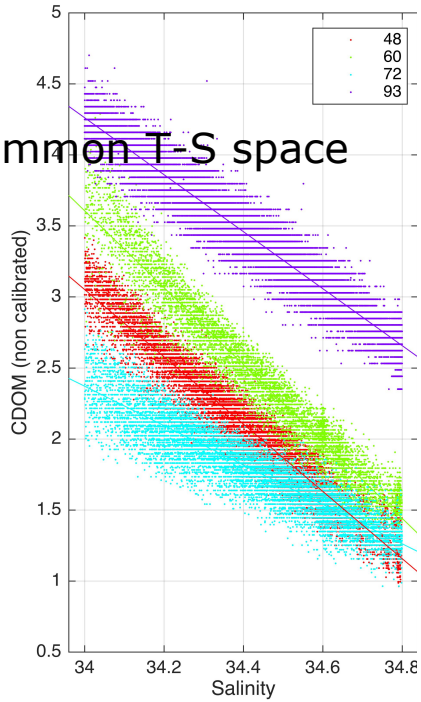


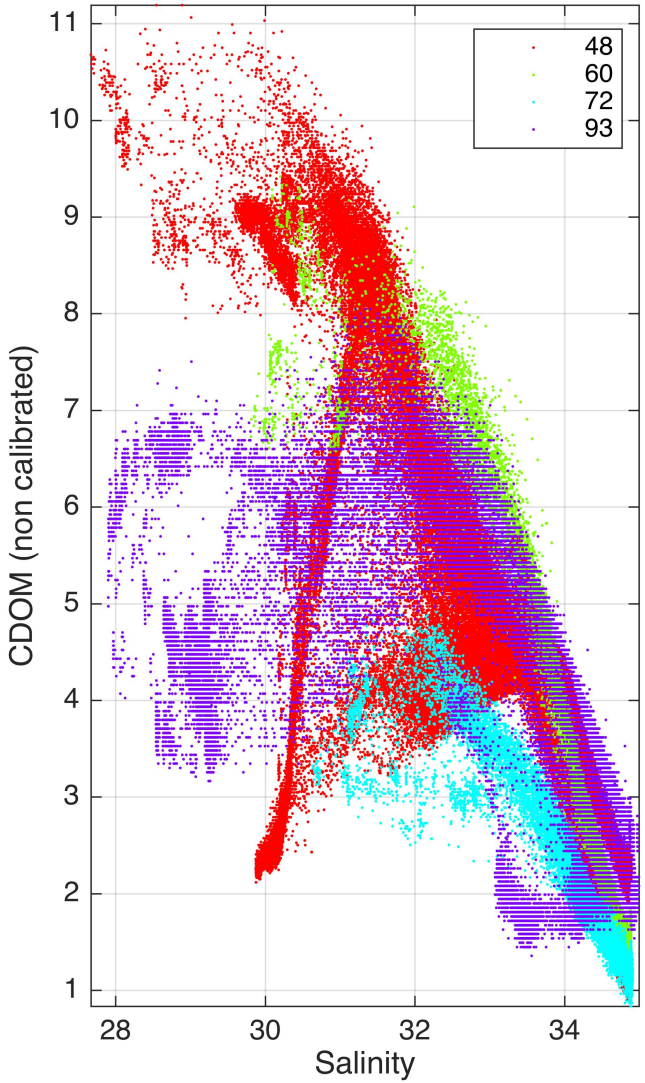


Inter-calibration

- Only have water sample lab measurements for one ITP (93)
- Factory calibration dubious
  - ITP72 lower response.
  - ITP93 higher offset
- Approach:
  - Calibrate ITP93 data to water samples
  - Identification profiles that sampled of common T-S space
  - Linear regression for FDOM vs salinities
  - Transformed to Raman Units (lab).





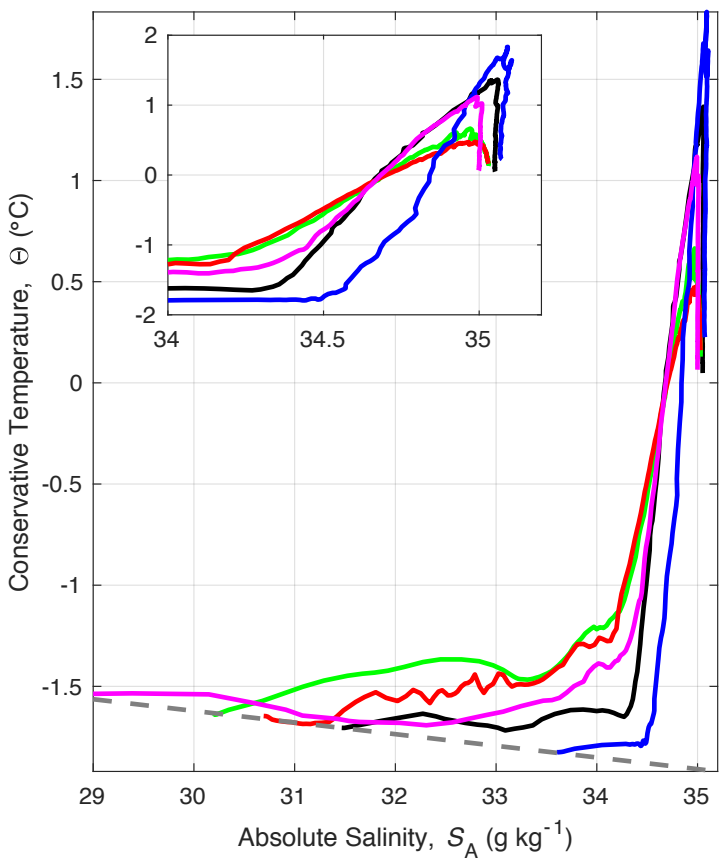


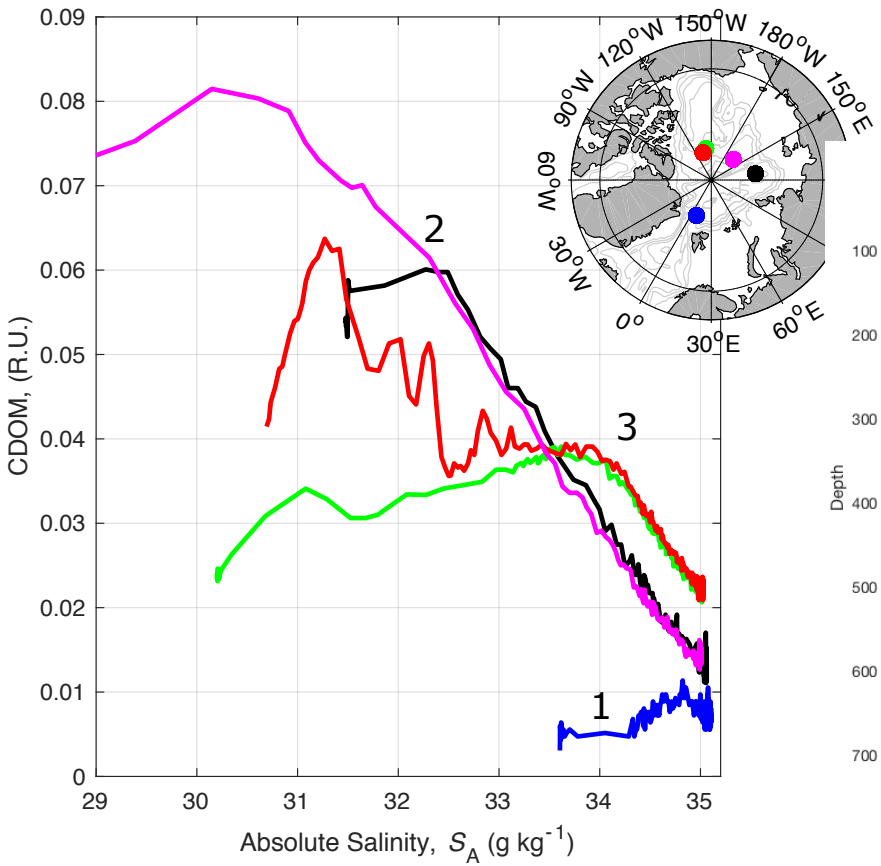
Typical profiles

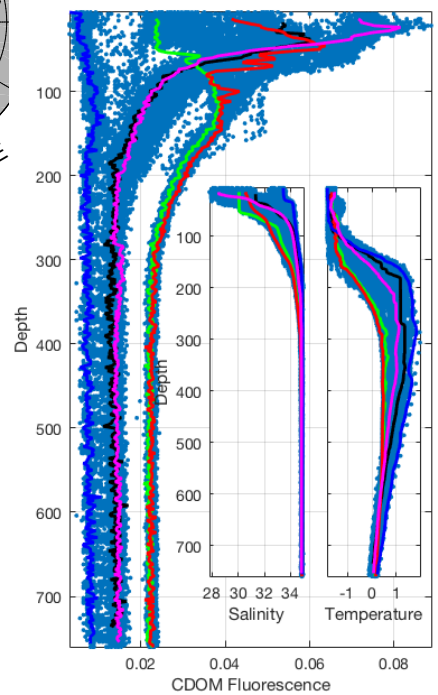
Lomonosov

48, 48, 48, 72,93

Makarov AMOR+ Nansen

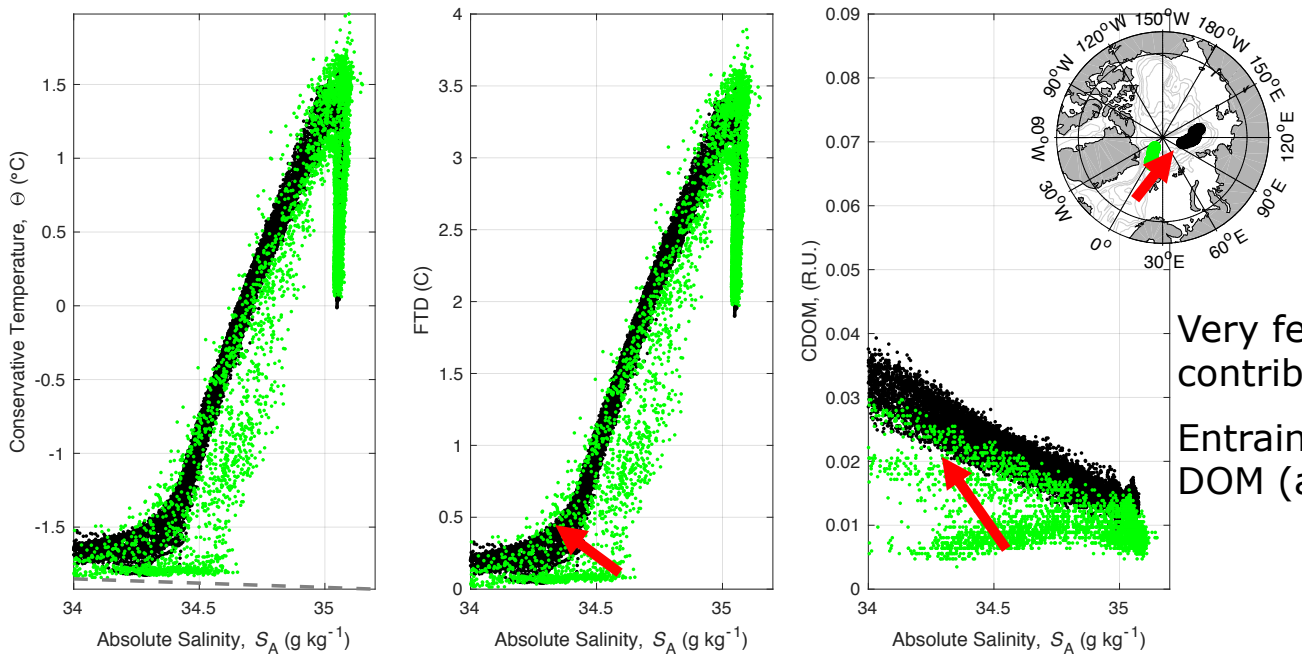






Lower Halocline Water (S>34)

- Freezing Temperature Departure (FTD)
  - Convective formation evident as FTD < 0.2C at 34.1 (Kikuchi et al 2004)
- Convective LHW contribution apparent with no CDOM
- Transition over to advective LHW contribution with linear CDOM mixing



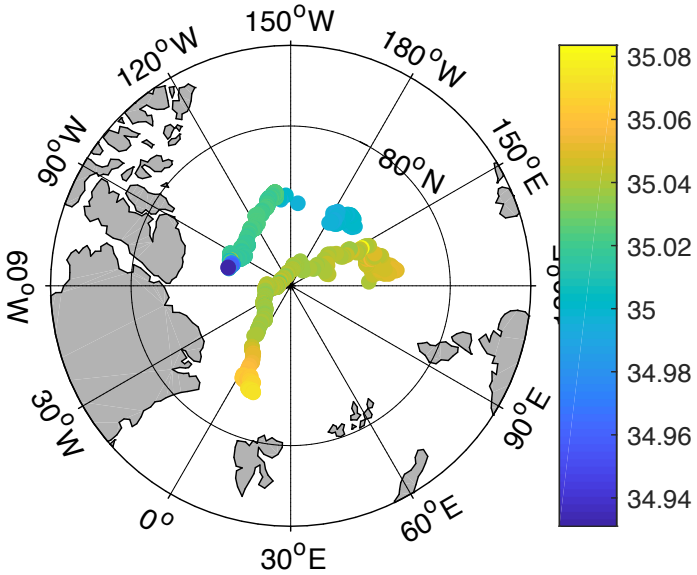
Very few profiles with cLHW contribution

Entrainment of shelf FW and DOM (advective) dominates

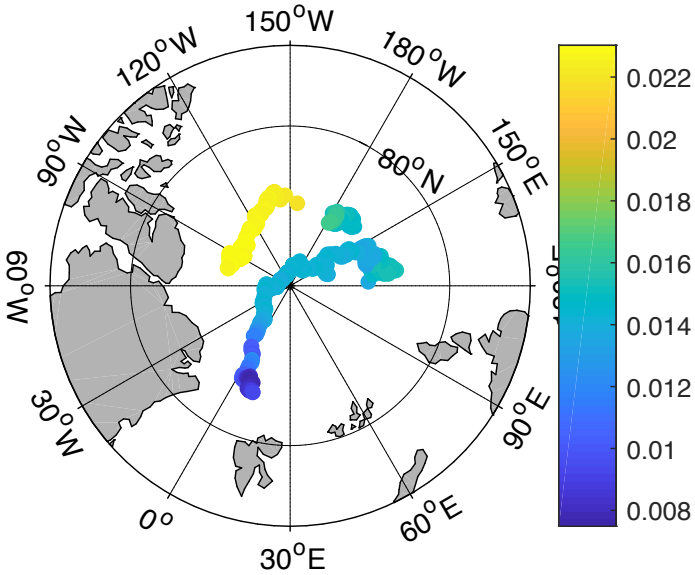
Deep water (>600m)

- Weak freshening of AW
- Small increase in CDOM in deepwaters with transit.
- Similar to that seen in Baffin Bay
  - 0.02 RU production for 150µM AOU. (20-80 years)

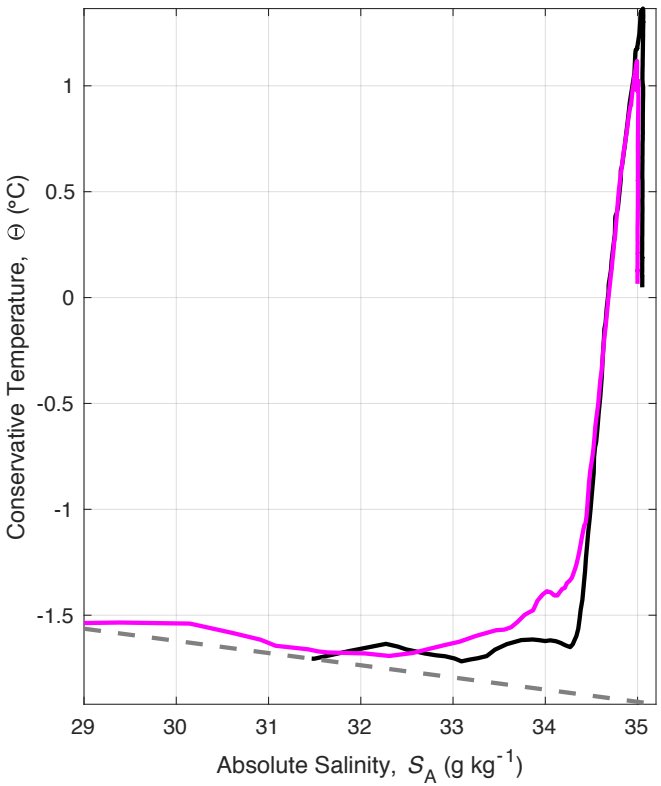
Salinity

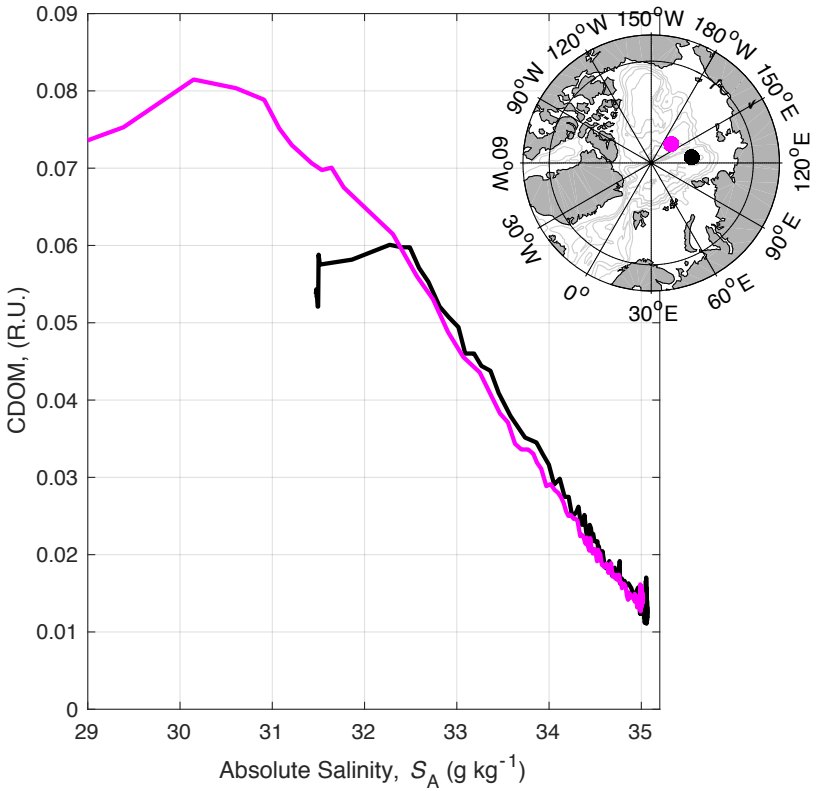


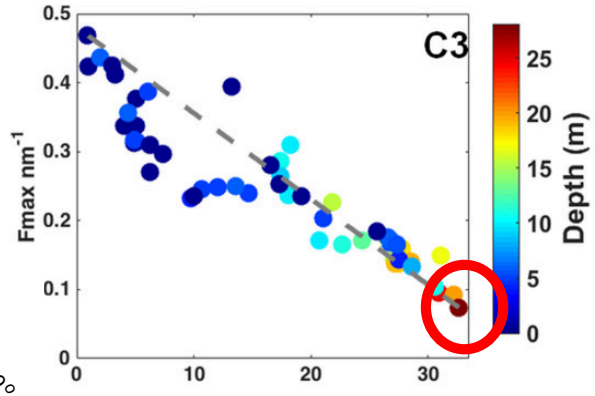
CDOM



Conservative mixing of DOM in CAO



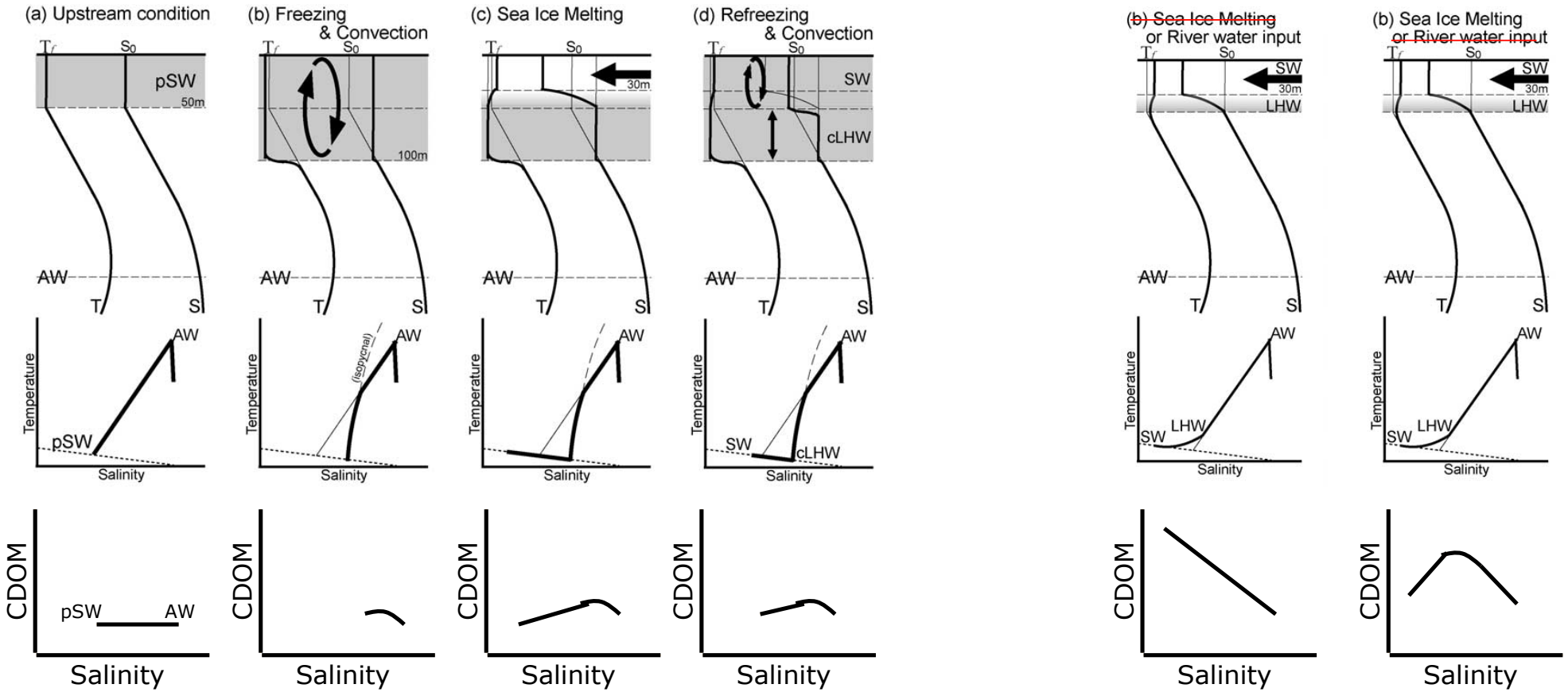




Gonçalves-Araujo et al 2015

Lena delta and Laptev Sea

Kikuchi et al 2004 + CDOM



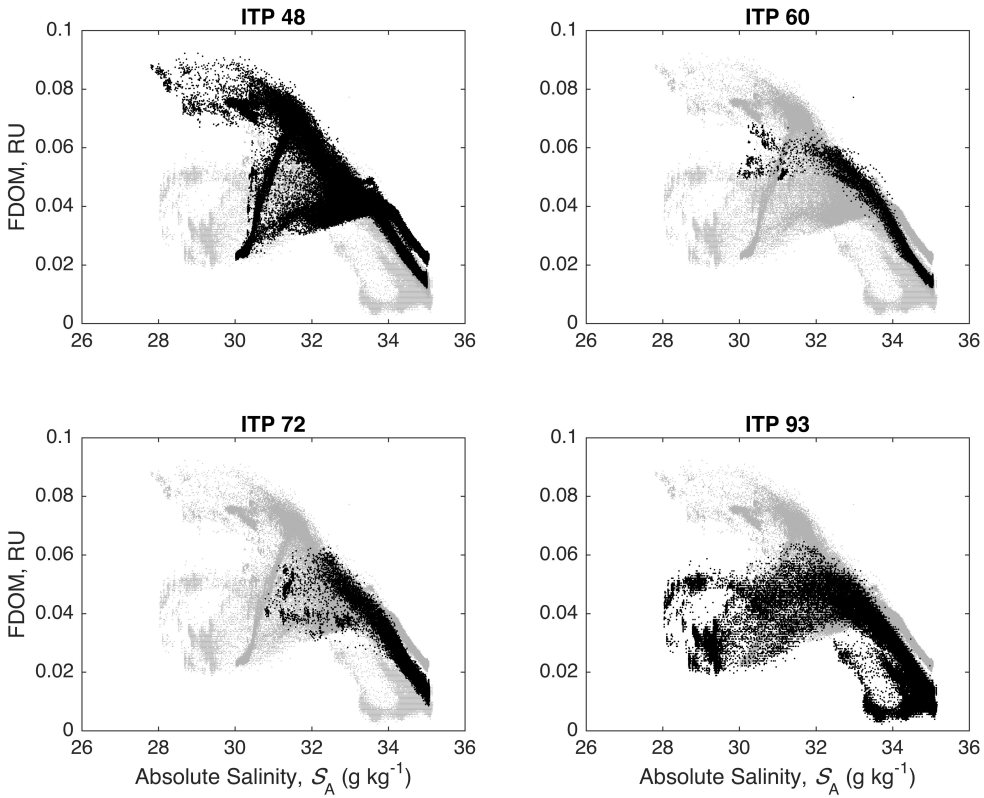
Concluding points

- Work in progress… but there is promise

- Intercalibration routine required…

- TRANSARC II data work up in conjunction with suite of other geochemical tracers from water samples (Rainer Amon, Heather Reader, Dorothea Bauch).

- Compare deepwater FDOM production with oxygen utilisation.


ITP 48
ITP 60
ITP 72
ITP 93
FDOM, RU
Absolute Salinity, S_A (g kg^{-1})
0.1
0.08
0.06
0.04
0.02
0
26
28
30
32
34
36

- Thanks to Laura and Paul and Rainer