´FLUORESCENT DISSOLVED ORGANIC MATTER AS A BIOGEOCHEMICAL TRACER IN THE DAVIS STRAIT´

Rafa Gonçalves-Araujo
Mats A. Granskog
Astrid Bracher
Kumiko Azetsu-Scott
Paul A. Dodd
Colin A. Stedmon

SCIENTIFIC REPORTS
nature

YOUMARES 7 – Hamburg
12. 09. 2016

DYNAMICS OF THE ARCTIC OCEAN

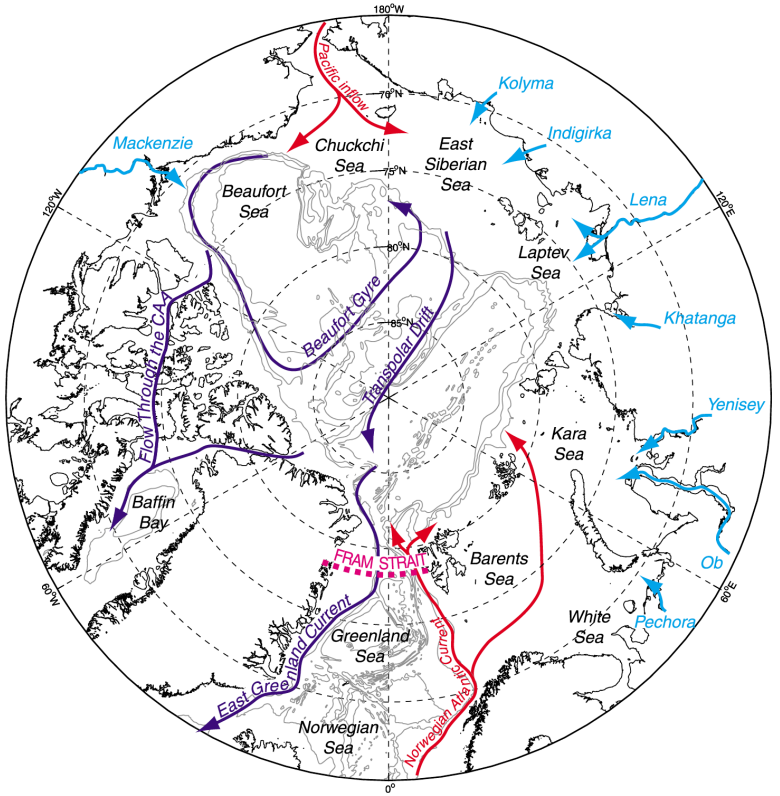
- **Fresh water supply → Arctic Rivers**

  (Aagaard & Carmack, 1989)

- **Exported through the Fram & Davis Straits**

  (Rabe et al 2009, Dodd et al 2012)

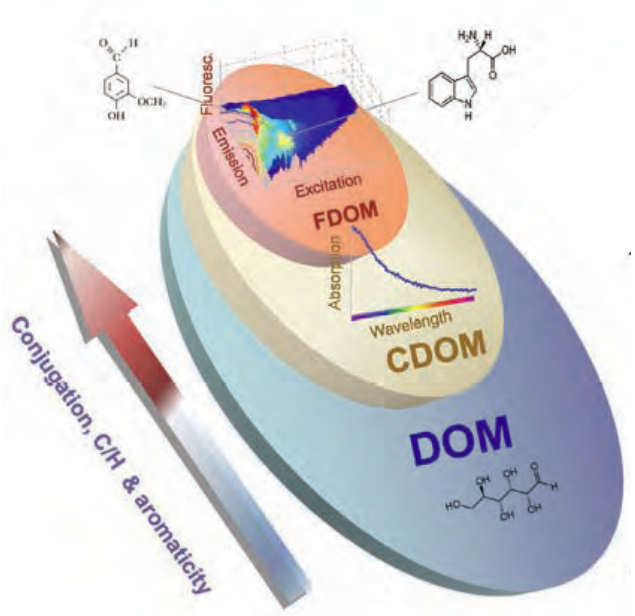
- **Global warming effects**
  - Permafrost thaw (Schuur et al 2008, 2013)
  - Fresh water export (Frey & McClelland 2009)
  - Transport of riverine material to shelf seas (Vonk et al 2012)



Dodd et al 2012 (JGR)

DISSOLVED ORGANIC MATTER

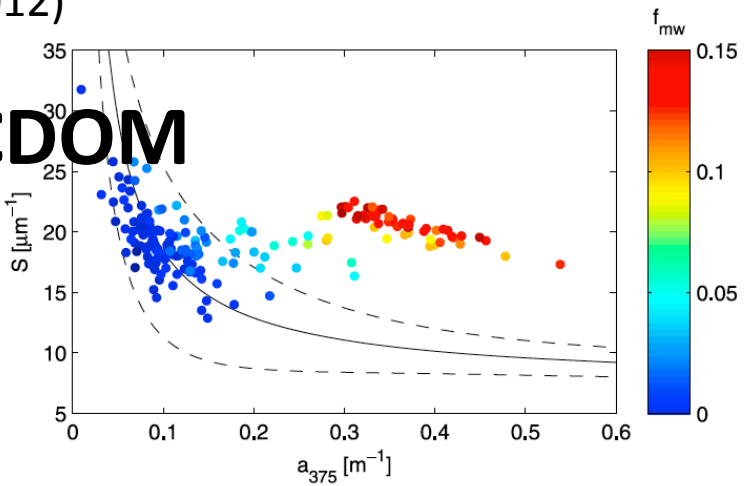
- **Spectroscopic approach**



Stedmon & Álvarez-Salgado, 2011

DOM IN THE ARCTIC

- **Main source: Arctic Rivers** (Walker et al 2013, Mann et al 2016)
  - **Humic-like compounds** (Walker et al 2013, Gonçalves-Araujo et al 2015)
- **CDOM is strongly, inversely correlated to salinity**
  (Stedmon et al 2011; Gonçalves-Araujo et al 2015)
- **CDOM correlated to fresh water fraction**
  (Stedmon et al. 2011, 2015, Granskog et al 2012)
- **FDOM more sensitive than CDOM**
  (Blough & Del Vecchio 2002)



Granskog et al 2012

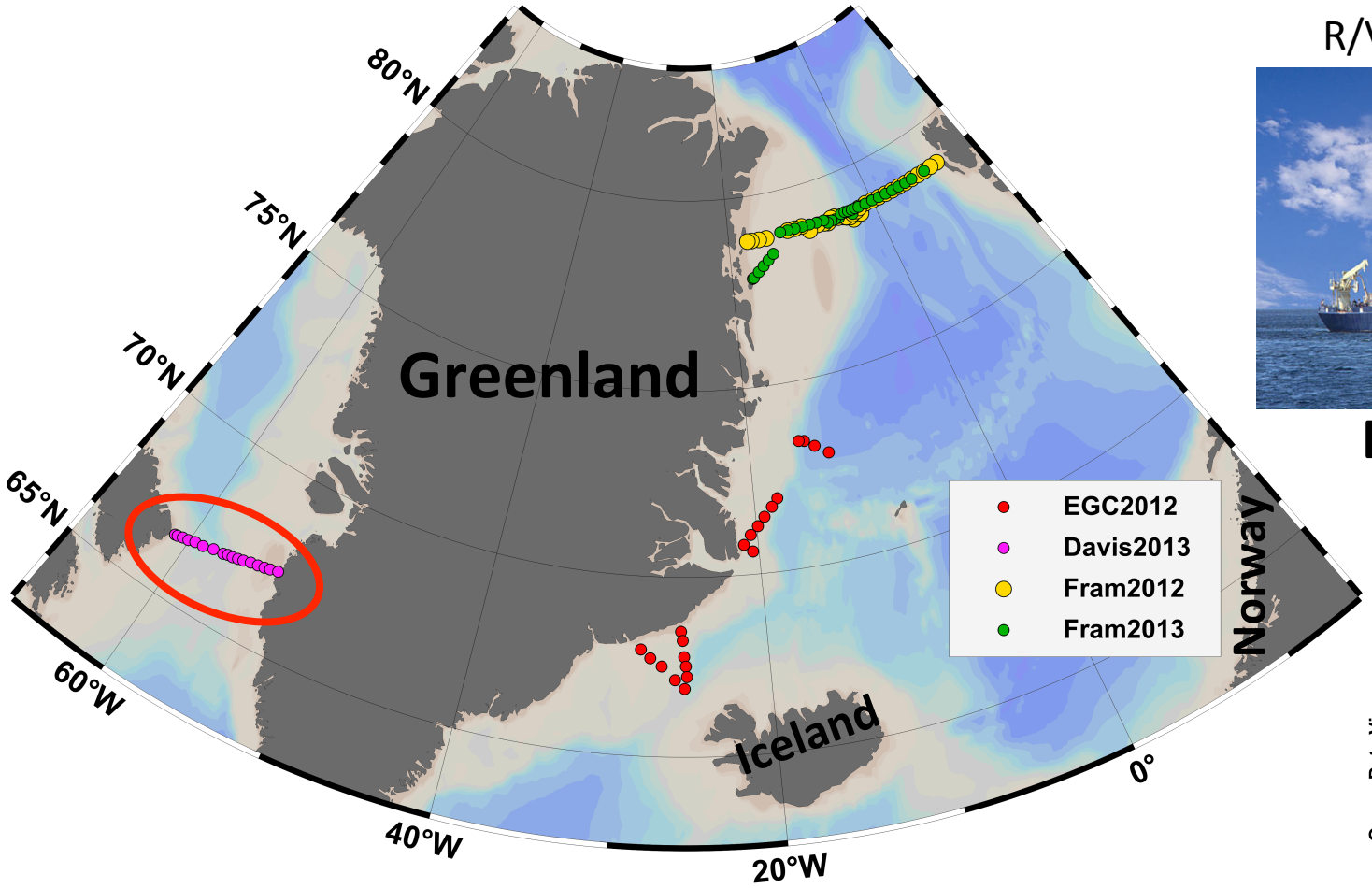
OBJECTIVE - QUESTION

Is **fluorescent** dissolved organic matter (FDOM) a reliable tracer of fresh water signal along the Arctic Ocean (Davis Strait)???

→ Hypothesis

- » VIS-FDOM (humic, terrestrial) → fresh water tracer
- » UV-FDOM (protein, marine) → local production tracer

METHODS - EXPEDITIONS



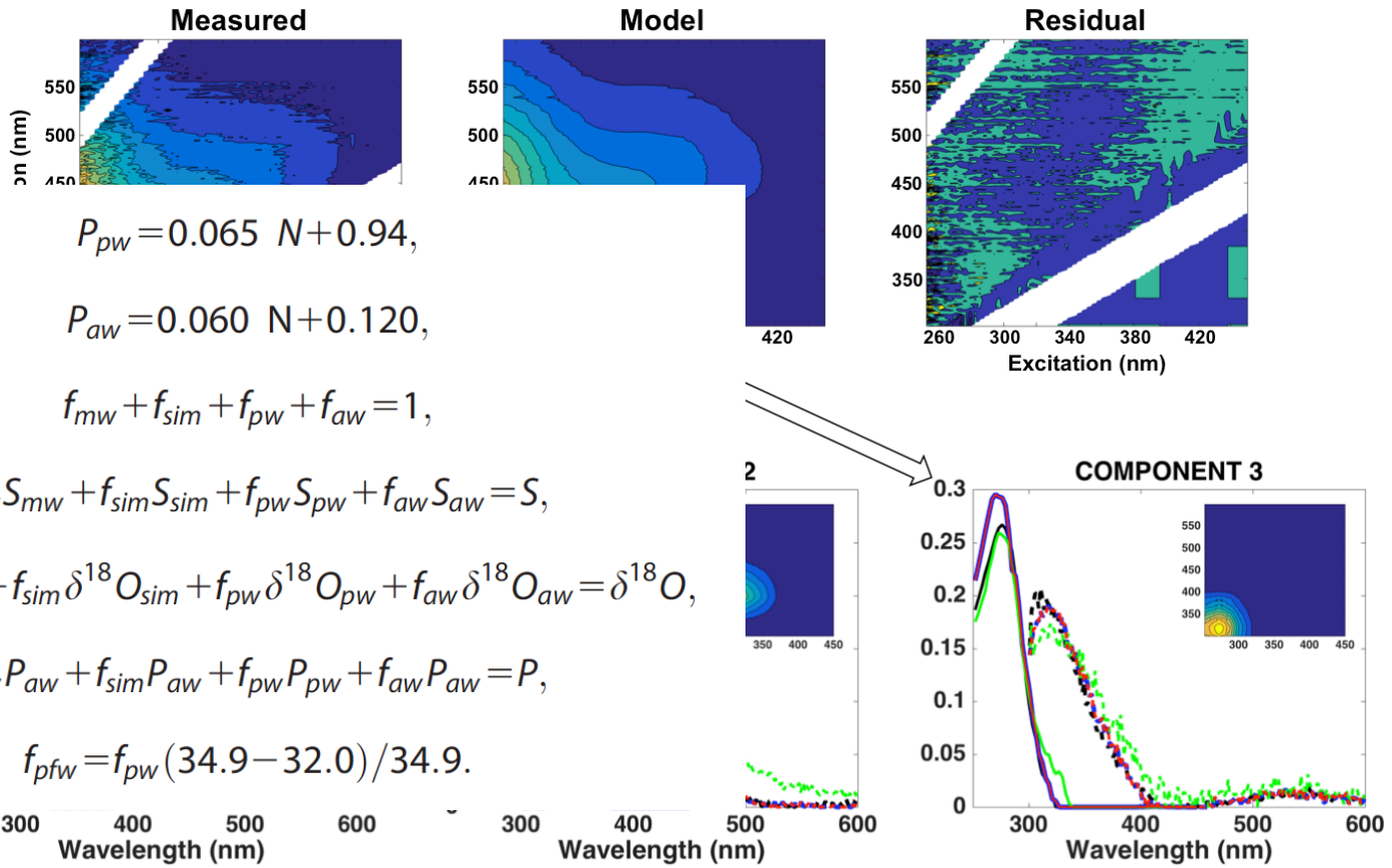
R/V Knorr - WHOI

Davis Strait
Sep 2013

- **HYDROGRAPHY:** CTD casts
- **WATER SAMPLES:** FDOM, nutrients, DO and $\delta^{18}O$

METHODS – DATA ANALYSIS

- **FDOM → EEM – PARAFAC** (Stedmon & Bro 2008)
  - DrEEM toolbox for MATLAB (Murphy et al, 2013)
- **W**



$$P_{pw} = 0.065\ N + 0.94,$$

$$P_{aw} = 0.060\ \mathrm{N} + 0.120,$$

$$f_{mw} + f_{sim} + f_{pw} + f_{aw} = 1,$$

$$f_{mw}S_{mw} + f_{sim}S_{sim} + f_{pw}S_{pw} + f_{aw}S_{aw} = S,$$

$$f_{mw}\delta^{18}O_{mw} + f_{sim}\delta^{18}O_{sim} + f_{pw}\delta^{18}O_{pw} + f_{aw}\delta^{18}O_{aw} = \delta^{18}O,$$

$$f_{mw}P_{aw} + f_{sim}P_{aw} + f_{pw}P_{pw} + f_{aw}P_{aw} = P,$$

$$f_{pfw} = f_{pw}(34.9 - 32.0)/34.9.$$

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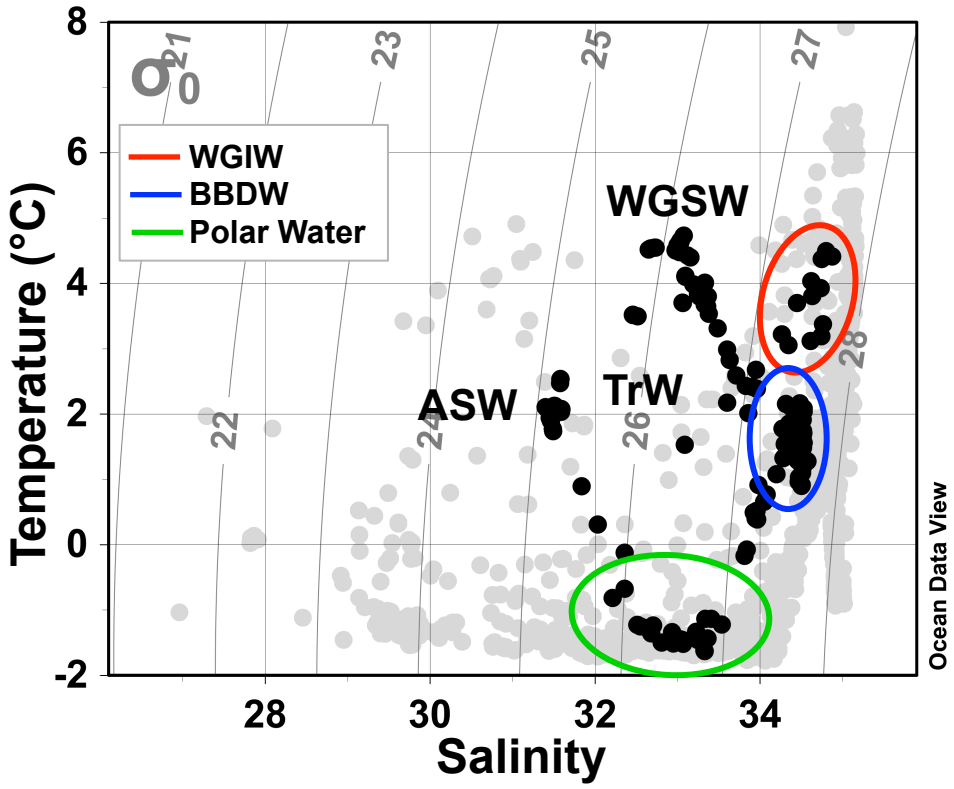
RESULTS – HYDROGRAPHY

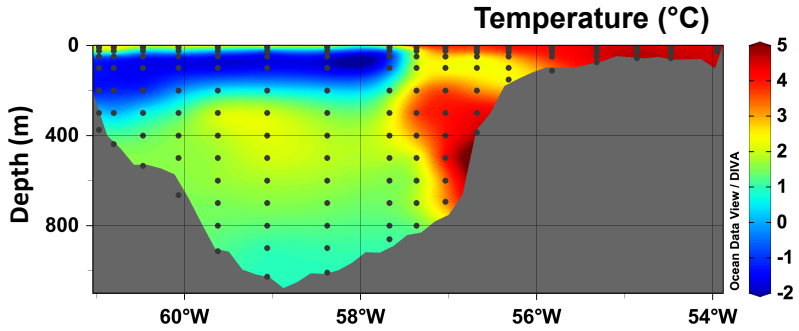


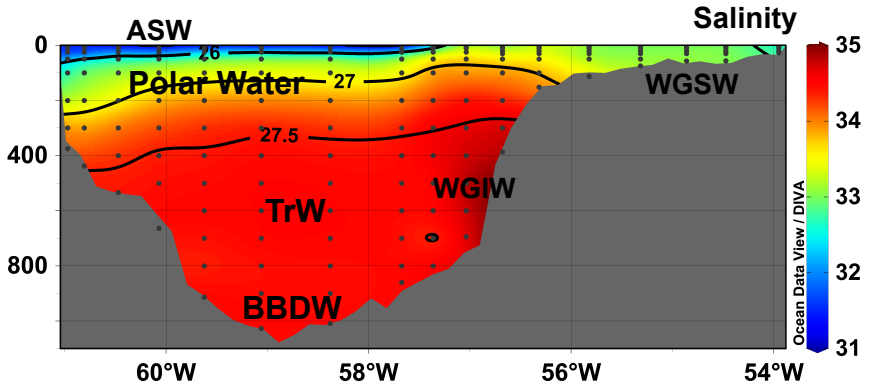
WATER MASSES

(Tang et al. 2004, Azetsu-Scott et al. 2012, Curry et al. 2014)

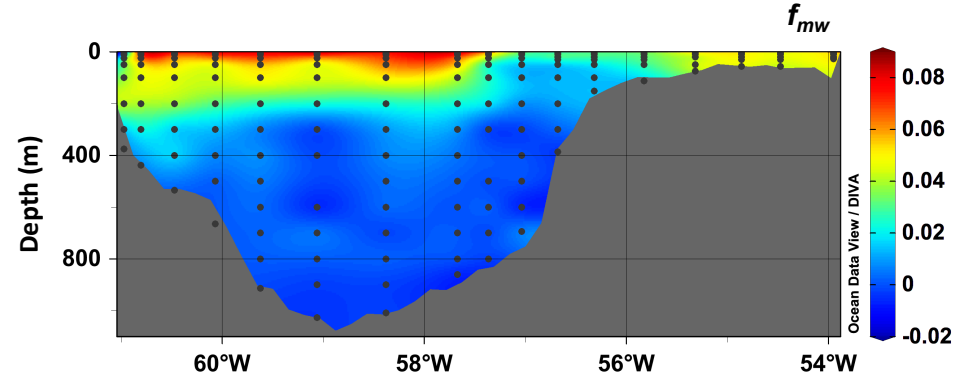
Surface layer:
- **ASW** → Arctic Surface Water
- **PW** → Polar Water
- **WGSW** → West Greenland Shelf Water

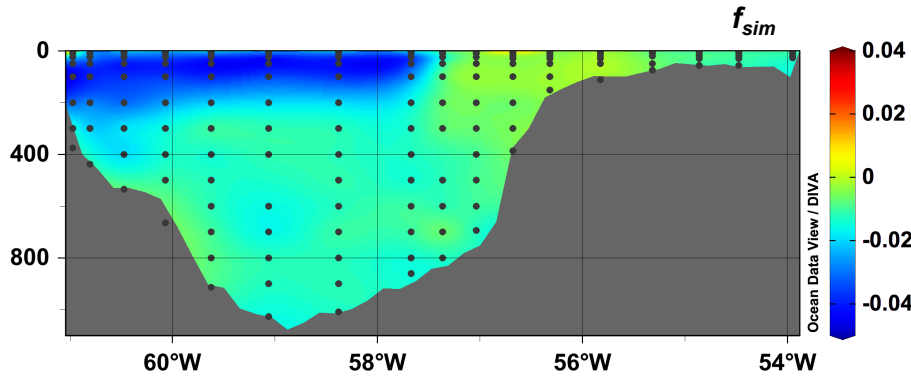
- **WGIW** → West Greenland Irminger Water
- **TrW** → Transitional Water
- **BBDW** → Baffin Bay Deep Water

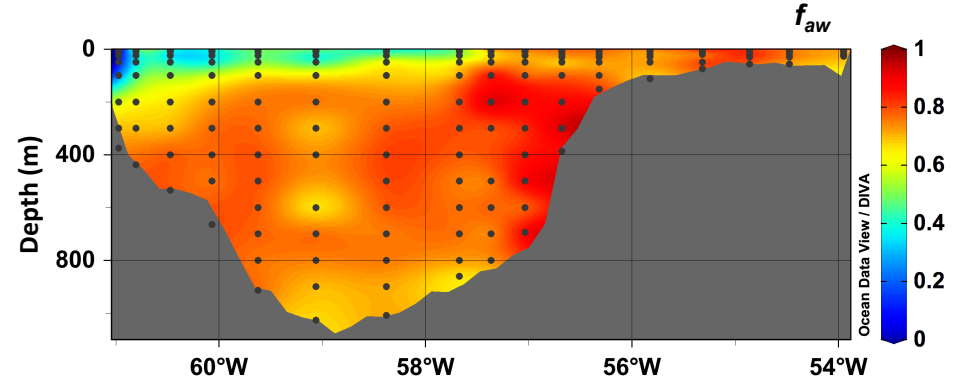


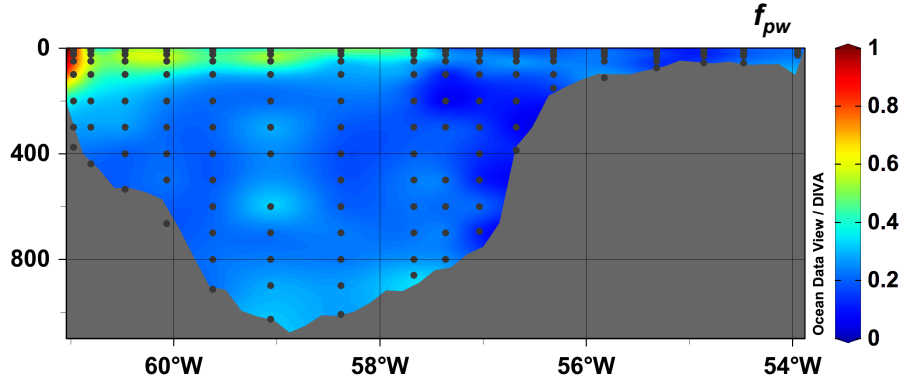


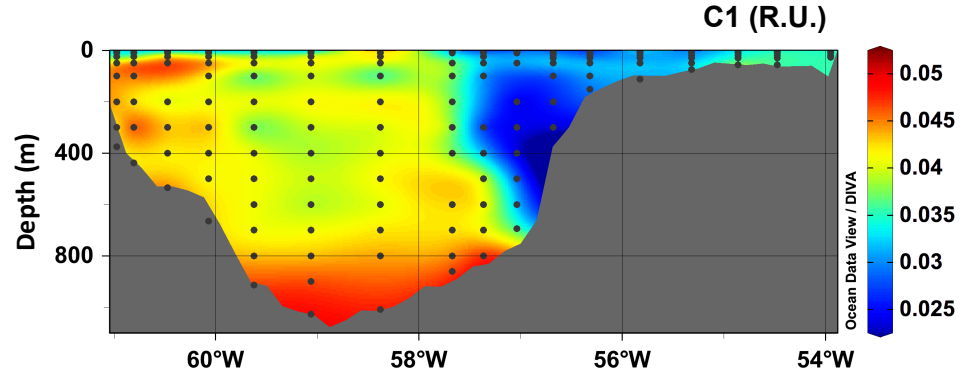
RESULTS – SPATIAL DISTRIBUTION

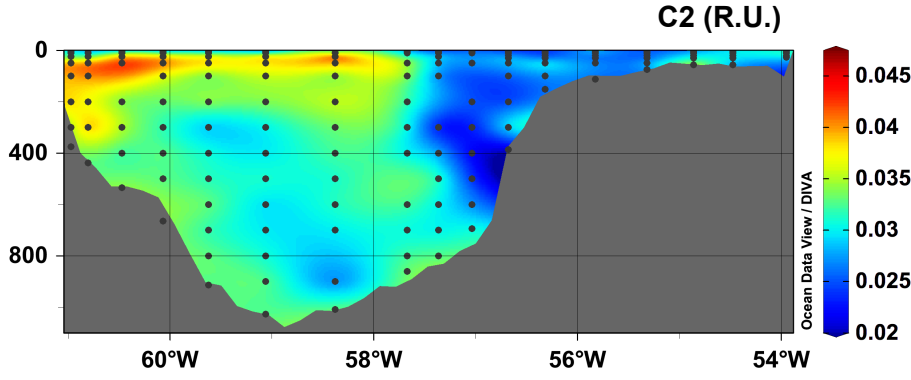






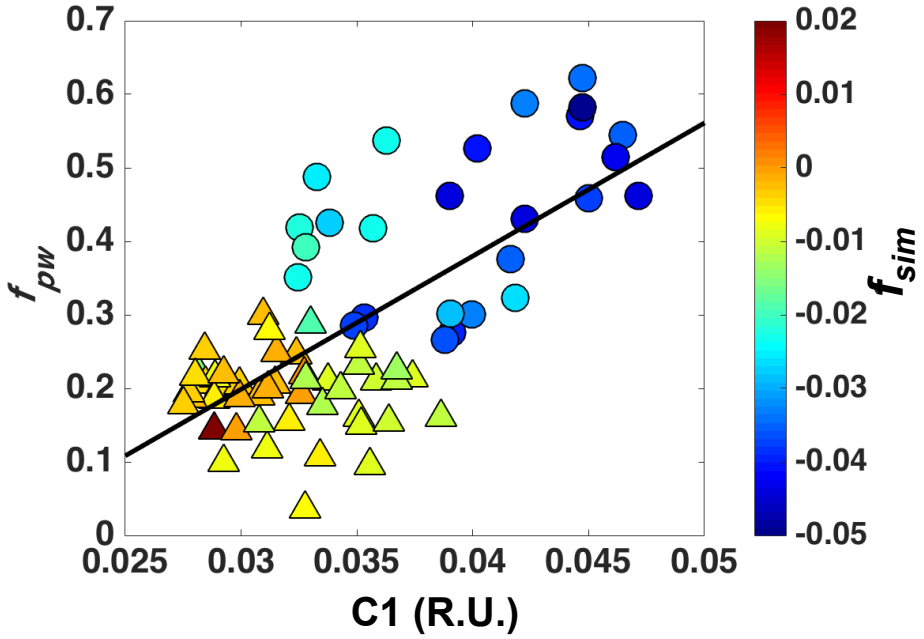


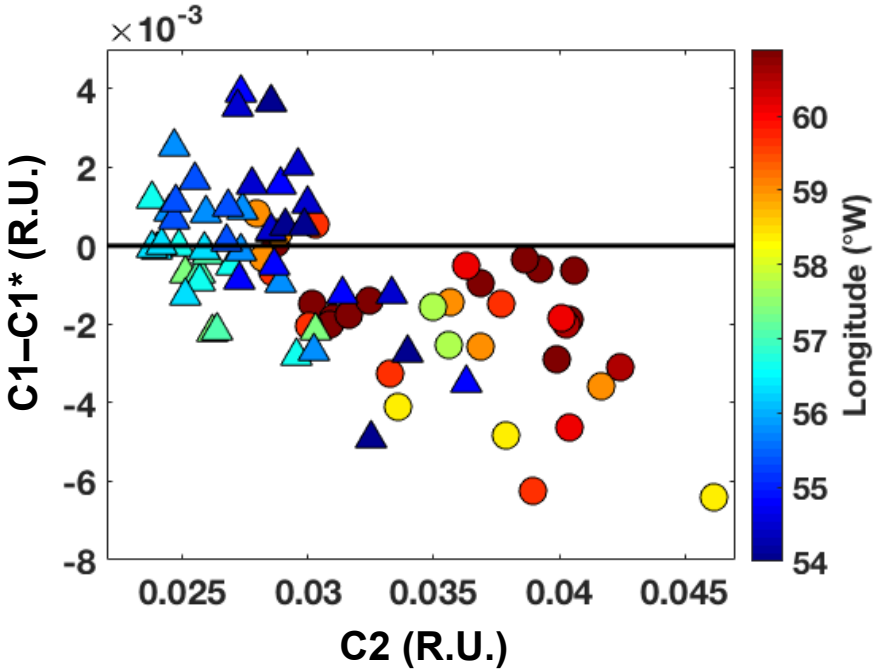


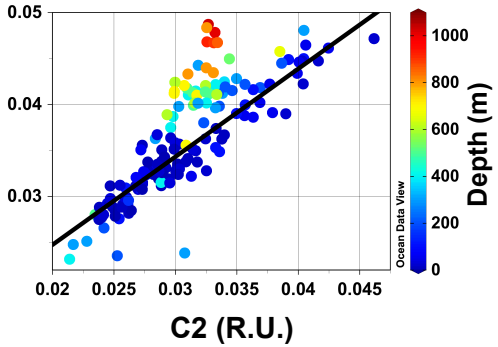


RESULTS – FDOM AS TRACER

- **Waters coming from the western Arctic → main DOM source**
- **Ratio between components → Fingerprint**

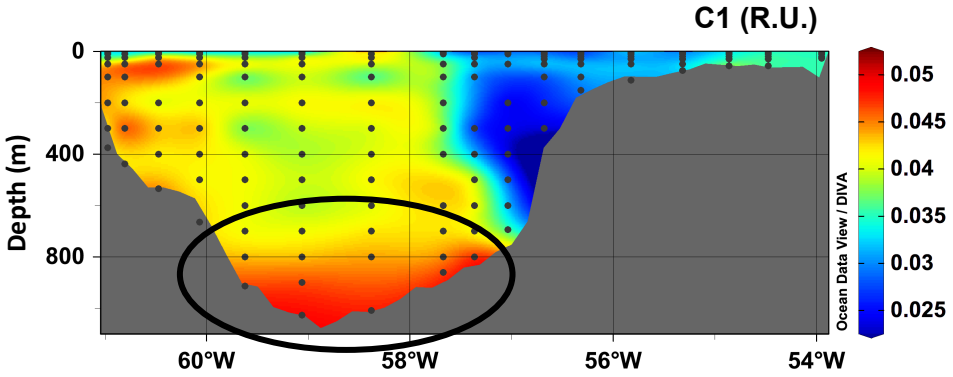


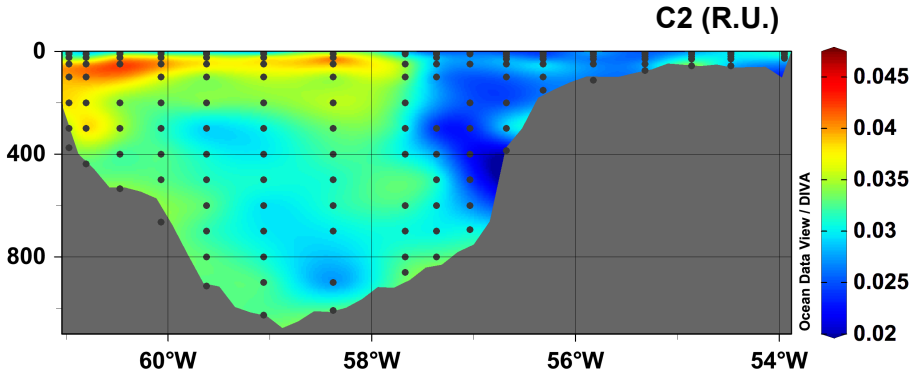


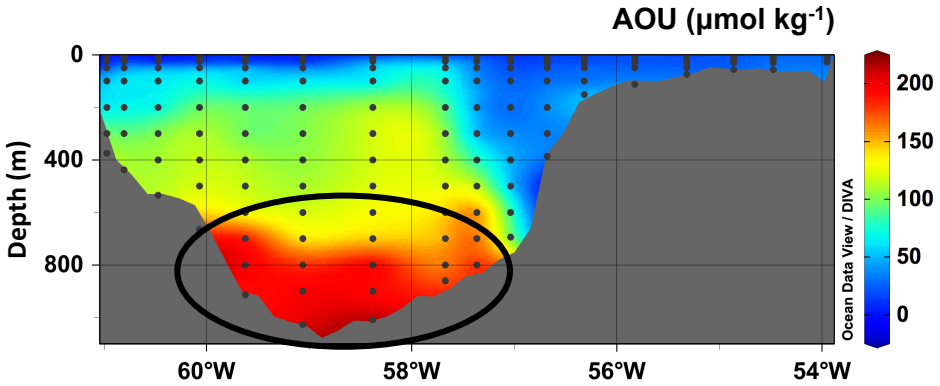


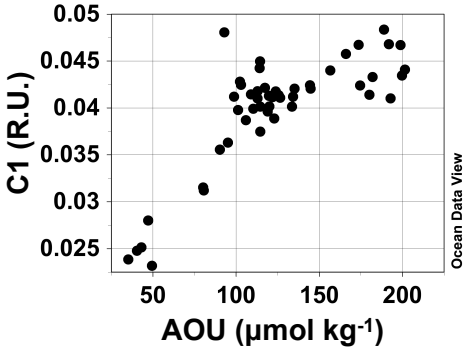
RESULTS – DOM TURNOVER

- **Increased C1 in deep waters → not visible in C2**
- **Very high AOU in deep waters → high residence time** (Jørgensen et al., 2011)
- **Microbial production of VIS-FDOM in dark ocean** (Catalá et al., 2016)









CONCLUSIONS

Is fluorescent dissolved organic matter (FDOM) a reliable tracer of fresh water signal along the Arctic Ocean (Fram Strait)??

- **VIS-FDOM correlated with fraction of Pacific Water**
- **Tracer of fresh water exiting the Arctic (ratio between C1 and C2 → fingerprints)**
- **Reliable biogeochemical tracer**
  - **DOM turnover in deep waters**

OUTLOOK

- indication of which wavelength regions for DOM fluorescence carry information on DOM source and mixing
    - Evaluation of longer time series to propose a refined model

- design of new multi-channel fluorometers for different platforms
    - Lower cost → does not require water sampling/lab analysis
    - Improve spatial/temporal resolution

rafael.goncalves.araujo@awi.de