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# USING FLUORESCENT DISSOLVED ORGANIC MATTER TO TRACE ARCTIC FRESH WATER

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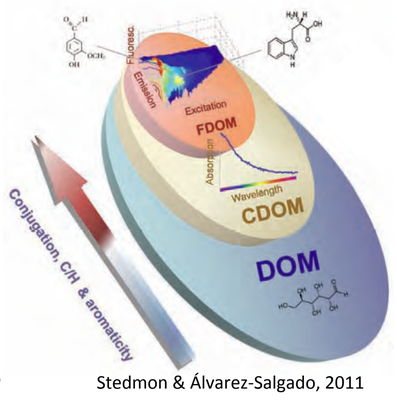
## MOTIVATION

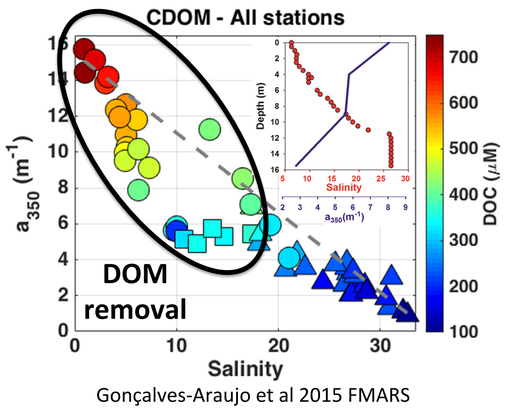
- operationally: 0.45, 0.7 and 0.2 µm filter

*Proteins* DOM Tyrosine
Amino Acids CDOM *Aliphatics*
DISSOLVED ORGANIC MATTER
FULVIC ACIDS *Tryptophan*
Phenols fDOM Lignin
*Aromatics* DOC Dissolved Molecules
Humic acids



Stedmon & Álvarez-Salgado, 2011

**ARCTIC:** 18–26 Tg C year$^{-1}$ DOC

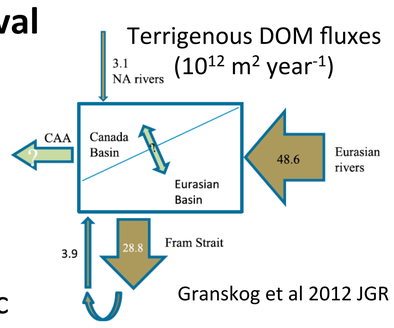


Gonçalves-Araujo et al 2015 FMARS

**Strong DOM removal**
- Shelf region
- Low salinity
- Up to 50%

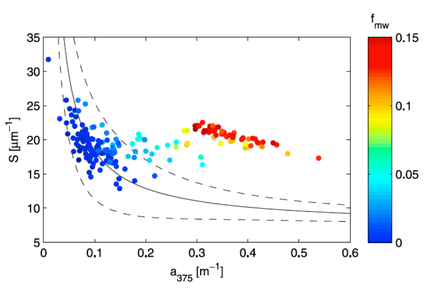
Alling et al 2010 GBC

Ca. 50% of tDOM Exported to Atlantic
Granskog et al 2012 JGR

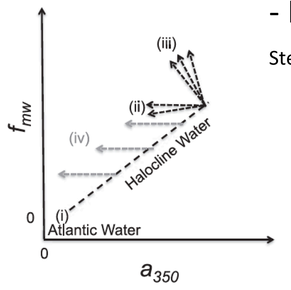


Granskog et al 2012 JGR

**CDOM as a water mass tracer**



Granskog et al 2012 JGR

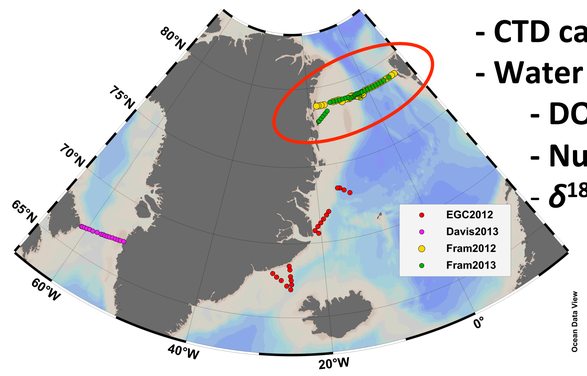


Stedmon et al 2015 JGR

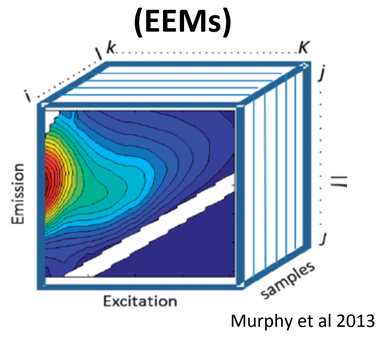
- CDOM highly correlated to DOC
  - Abs measurements good proxy
- Higher CDOM in Eurasian Basin

Stedmon et al 2011 MarChem; Matsuoka et al 2014 BG

## METHODS

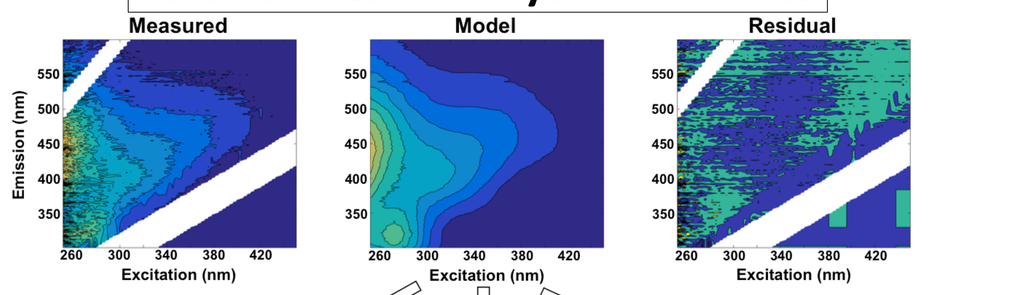


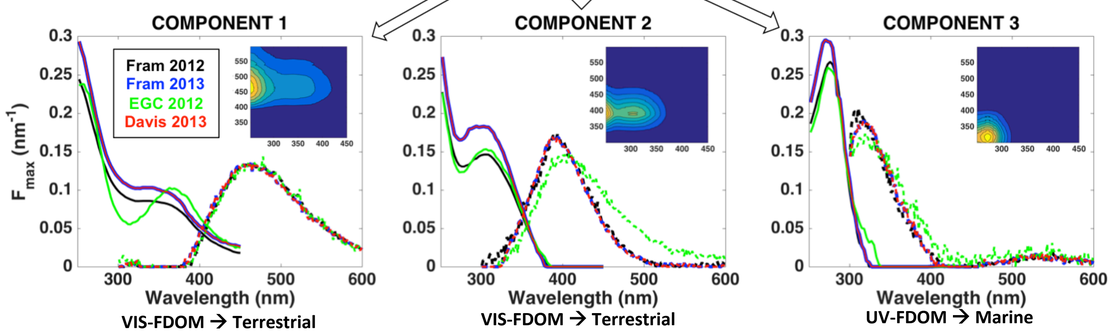

- CTD casts
- Water samples
  - DOM
  - Nutrients
  - $\delta^{18}O$



Murphy et al 2013

**Parallel Factor Analysis - PARAFAC**

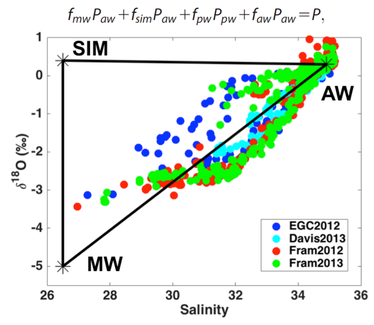


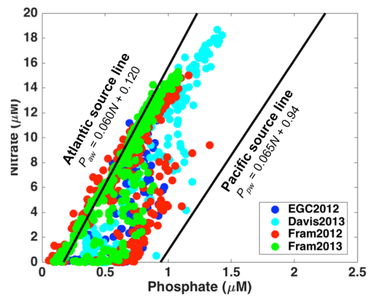




**Water Fractionation**

$$P_{pw} = 0.065\ N + 0.94,$$
$$P_{aw} = 0.060\ N + 0.120,$$
$$f_{mw} + f_{sim} + f_{pw} + f_{aw} = 1,$$
$$f_{mw}S_{mw} + f_{sim}S_{sim} + f_{pw}S_{pw} + f_{aw}S_{aw} = S,$$
$$f_{mw}\delta^{18}O_{mw} + f_{sim}\delta^{18}O_{sim} + f_{pw}\delta^{18}O_{pw} + f_{aw}\delta^{18}O_{aw} = \delta^{18}O,$$
$$f_{mw}P_{aw} + f_{sim}P_{aw} + f_{pw}P_{pw} + f_{aw}P_{aw} = P,$$

- $f_{mw}$ → meteoric water
- $f_{sim}$ → sea-ice melt
- $f_{aw}$ → Atlantic water
- $f_{pw}$ → Pacific water




## CONCLUSIONS

- indication of which wavelength regions for DOM fluorescence carry information on DOM source and mixing
- VIS-FDOM is a reliable tracer of Arctic fresh water
  - -Evaluation of longer time series to develop a refined model
- VIS-FDOM also allow distinguishing the origin of Arctic surface waters as being from the Eurasian or Canadian basins
  - -Not detected in classical analysis of T-S diagram
- design of new multi-channel fluorometers for different platforms (ITPs, gliders, AUVs)
  - -Cost effective → does not require water sampling/lab analysis
  - -Improve spatial/temporal resolution
  - -Complement current hydrographic measurements monitoring freshwater fluxes and circulation

## RESEARCH QUESTION

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

→ VIS-FDOM as proxy for lignin and humic acids, terrestrial
→ UV-FDOM: local production, proteins and amino acids

## RESULTS

### Fram 2012

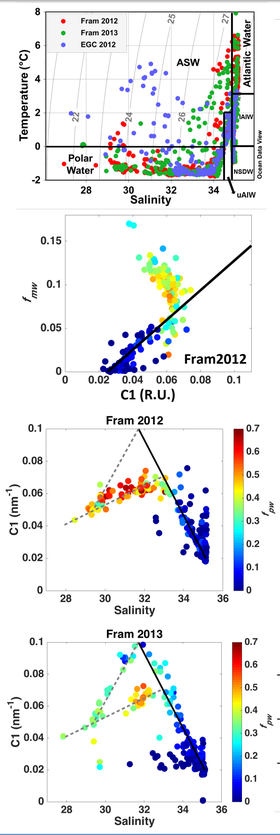


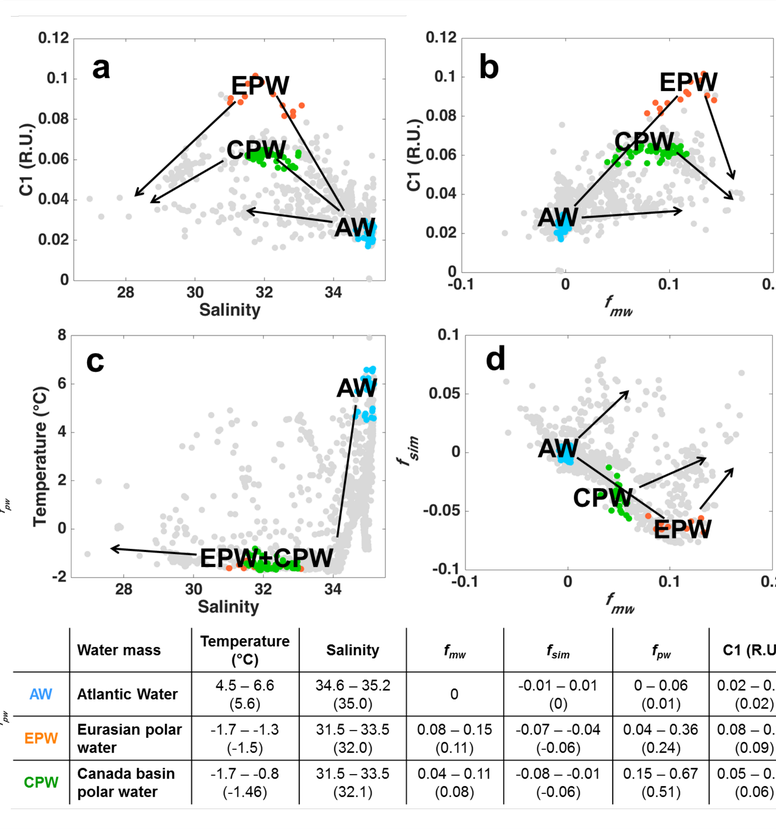
Higher $f_{pw}$ → Canada Basin

### Fram 2013



Lower $f_{pw}$ → Eurasian Basin (Siberian rivers)




| | Water mass | Temperature (°C) | Salinity | $f_{mw}$ | $f_{sim}$ | $f_{pw}$ | C1 (R.U.) |
|---|---|---|---|---|---|---|---|
| AW | Atlantic Water | 4.5 – 6.6 (5.6) | 34.6 – 35.2 (35.0) | 0 | -0.01 – 0.01 (0) | 0 – 0.06 (0.01) | 0.02 – 0.03 (0.02) |
| EPW | Eurasian polar water | -1.7 – -1.3 (-1.5) | 31.5 – 33.5 (32.0) | 0.08 – 0.15 (0.11) | -0.07 – -0.04 (-0.06) | 0.04 – 0.36 (0.24) | 0.08 – 0.10 (0.09) |
| CPW | Canada basin polar water | -1.7 – -0.8 (-1.46) | 31.5 – 33.5 (32.1) | 0.04 – 0.11 (0.08) | -0.08 – -0.01 (-0.06) | 0.15 – 0.67 (0.51) | 0.05 – 0.06 (0.06) |

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