‘TRACING THE COMPOSITION OF DOM IN THE ARCTIC OCEAN WITH FLUORESCENCE SPECTROSCOPY’

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THE ARCTIC OCEAN

- Large DOM-pool
- Terrigenous material: more than 10% of global oceans (Benner et al 2004)
- Transpolar drift $\rightarrow$ Fram Strait (Rabe et al. 2013)

- Soils and peatlands $\rightarrow$ Rivers $\rightarrow$ Ocean (Opsahl et al 1999)

DOM in the Arctic Ocean
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Dodd et al. 2012

Granskog et al. (2012)
• One of the largest rivers in the world
  – ~20% total fresh water in the Arctic Ocean (Cauwet & Sidorov, 1996)
  – The greatest discharge of organic matter in the Arctic Ocean
    – Stedmon et al. (2011)
  – CDOM varies from ~12 to 36m\(^{-1}\) - dominance of humic signal
    – Walker et al. (2013)

MERIS 1\(^{st}\) attenuation depth (04. 08. 2010)
Heim et al. (2014)
DOM IN THE LENA DELTA REGION

- Conservative mixing of DOM
- Non-conservative mixing (Alling et al. 2010)

Cauwet & Sidorov, 1996

Kattner et al. 1999

Removal of ~20%

DOM in the Arctic Ocean
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OBJECTIVES

– to characterize the DOM by means of its optical properties
  • Lena Delta region
  • Fram Strait (preliminary results)

– to investigate the processes modulating the distribution and transformation of DOM within the Lena delta region
MATERIAL AND METHODS

• THE EXPEDITIONS

→ LENA DELTA
– 1-7 September 2013
– R/V “Dalniye Zelentsy”
– 4 transects → 18 Stn → 60 Samples

→ FRAM STRAIT
– 6 Jun – 2 Jul 2014
– R/V Polarstern
– 12 Stations → 66 samples
MATERIAL AND METHODS

• DATA SET – DATA ANALYSIS
  – CTD → UMLD, water column stratification ($E$)
  – DOC
  – Aqualog Fluorescence spectrometer
    • CDOM absorption @ 350nm
    • Excitation-Emission-Matrices (EEMs)
  – PARAFAC model
    • Stedmon & Bro, 2008; Murphy et al., 2013
  – Optical indices of DOM modification
    • $S_{\text{CDOM}}$, SUVA, FI, $S_{\text{ratio}}$, HIX and BIX

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FDOM COMPONENTS

- **LENA DELTA REGION**

  - Walker et al., 2013
  - Walker et al., 2013

- **FRAM STRAIT**

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LENA DELTA REGION
Hydrography and water column structure – Lena 2013

- Salinity range: 0.9 – 32.6
- Northward propagation of the Lena Plume (Sal<10)
- Strong thermohaline gradients (especially vertical)
  - Shallow UML (<10m)
DOM TRANSFORMATION

DOM in the Arctic Ocean

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DOMINANCE OF HUMIC-LIKE SIGNAL
- Different mixing patterns
  - Above/Below pycnocline
- Indication of removal at the surface layer
- Decrease in DOM with salinity
  - Lena River $\rightarrow$ major DOM source
DOM IN THE LENA DELTA

Cauwet & Sidorov 1996

Lena outflow

DOM concentration
Humic contribution

Low

Higher

Salinity

High

Lower

Flocculation processes

Entrainment

Photodegradation processes

POC (mg L⁻¹)

Salinity
SUMMARY – LENA DELTA

• 6 fluorescent components characterized by PARAFAC model
  – 4 humic-like
  – 1 marine-humic-like
  – 1 protein-like

• Strongly humified region

• Reactivity of DOM varies with salinity

• Indication of removal at the surface layer
• What happens to DOM through the Arctic until it reaches the Atlantic basin via Fram Strait?
  – $a_{350}$ ranging from $\sim0.5-0.8\text{m}^{-1}$
  – Dominance of humic-like signal (>70%)

• Look at the optical indices of DOM
  – Degree of reactivity

• Relate with water masses fractions