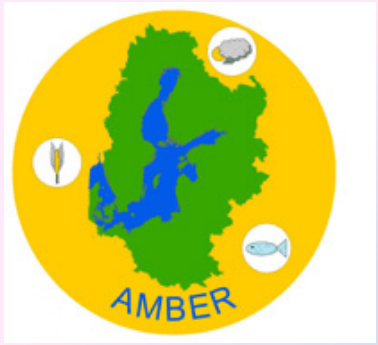

Tracing inputs of terrestrial dissolved organic matter within the Baltic Sea Ecosystem

(WP B.2 DOM input and transformation in Baltic Sea estuaries)

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Why DOM?

- DOM plays an important role in the aquatic cycles of carbon, nitrogen, and phosphorous.
- It serves as energy source (DOC) and as nutrient (DON,DOP) for bacteria, microzooplankton, phytoplankton and algae and contributes to euthrophication and hypoxia (Wiegener & Seitzinger 2004).
- Terrestrial OM represents a huge source of reduced carbon for the marine environment (Schlesinger & Melack 1981).
- Knowledge about OM cycling is necessary to understand the biogeochemistry of various elements, function of ecosystems, and impact of human activities on global climate change (Guo & Sun, 2009).

Why stable isotopes of DOM?

- Excellent tool to distinguish between terrestrial and marine ($\delta^{13}C$) and between natural and anthropogenic ($\delta^{15}N$) sources.
- Organic matter from terrestrial sources (C3 plants) is relatively depleted in ^{13}C ($\delta^{13}C$: -35 to -25‰) compared to DOM released from marine phytoplankton ($\delta^{13}C$: ~-20‰).
- Can be used to identify processes.

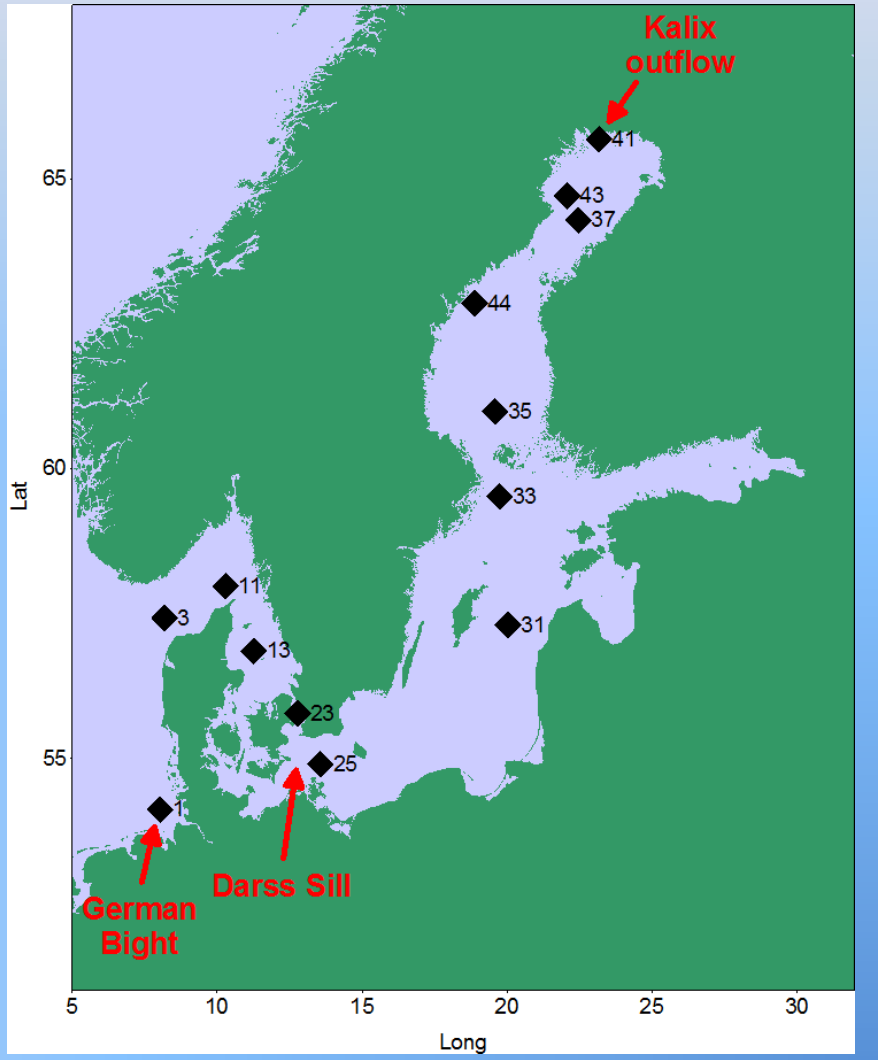
$\delta^{13}C$ and $\delta^{15}N$ values in HMW-DOM

Location	$\delta^{13}C$ [‰]	$\delta^{15}N$ [‰]	Reported in
Pacific Ocean (surface)	-21.7 ± 0.2	7.6 ± 0.3	Benner et al. (1997)
Atlantic Ocean (surface)	-22.2	6.6	Benner et al. (1997)
Gulf of Mexico	-21.7 ± 0.9	3.9 ± 0.7	Guo et al. (2003)
Chesapeake Bay	-24.1 ± 0.4	8.8 ± 0.2	Sigleo & Macko (2002)
San Francisco Bay	-26.7 ± 0.7	7.9 ± 0.8	Sigleo & Macko (2002)
Boston Harbour	-24.3, -25.7	2.9, 3.2	Zou et al. (2004)
Delaware/Chesapeake Bay	-24.8 to -23.1	4.4 - 8.9	Zou et al. (2004)
San Francisco Bay	-27.8 to -23.1	4.0 - 6.4	Zou et al. (2004)
Mississippi River plume	-24.5 ± 1.4	4.5 ± 0.5	Guo et al. (2009)
Potomac River	-27.3	4.6	Sigleo & Macko (2002)
Kalix River	-27.8 ± 0.7	1.4 ± 0.8	Deutsch et al. (in prep.)
Nemunas River	-25.3	5.0	Deutsch et al. (in prep.)

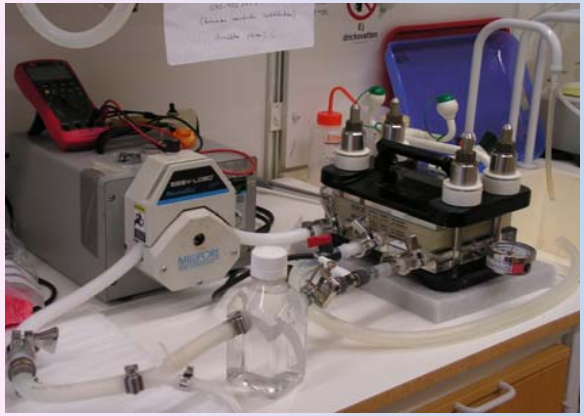
Sampling

MSM 12/4a (August/September 2009)

- Samples taken from CTD rosette in 5m depth.
- On-Board: pre-filtration and cross flow filtration.
- Lab: freeze-drying of DOM samples, stable isotope analysis, TOC/DOC, TN/DN measurements.

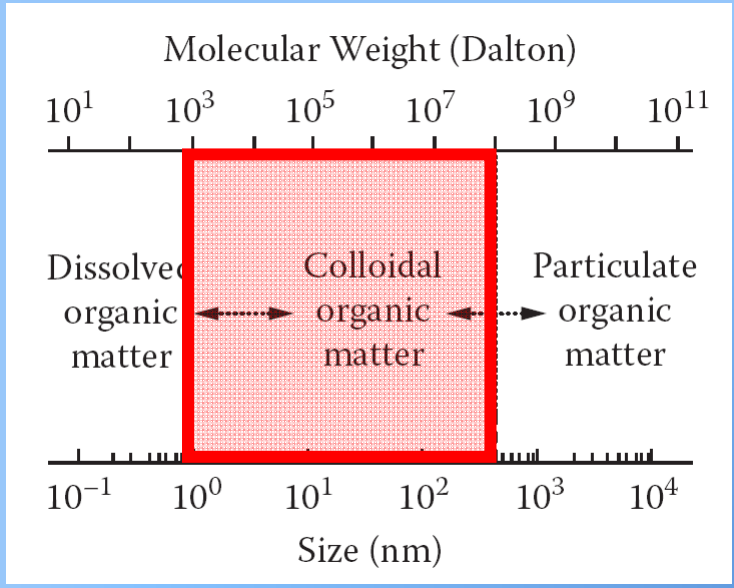


Cross-Flow Filtration to collect/enrich HMW-DOM

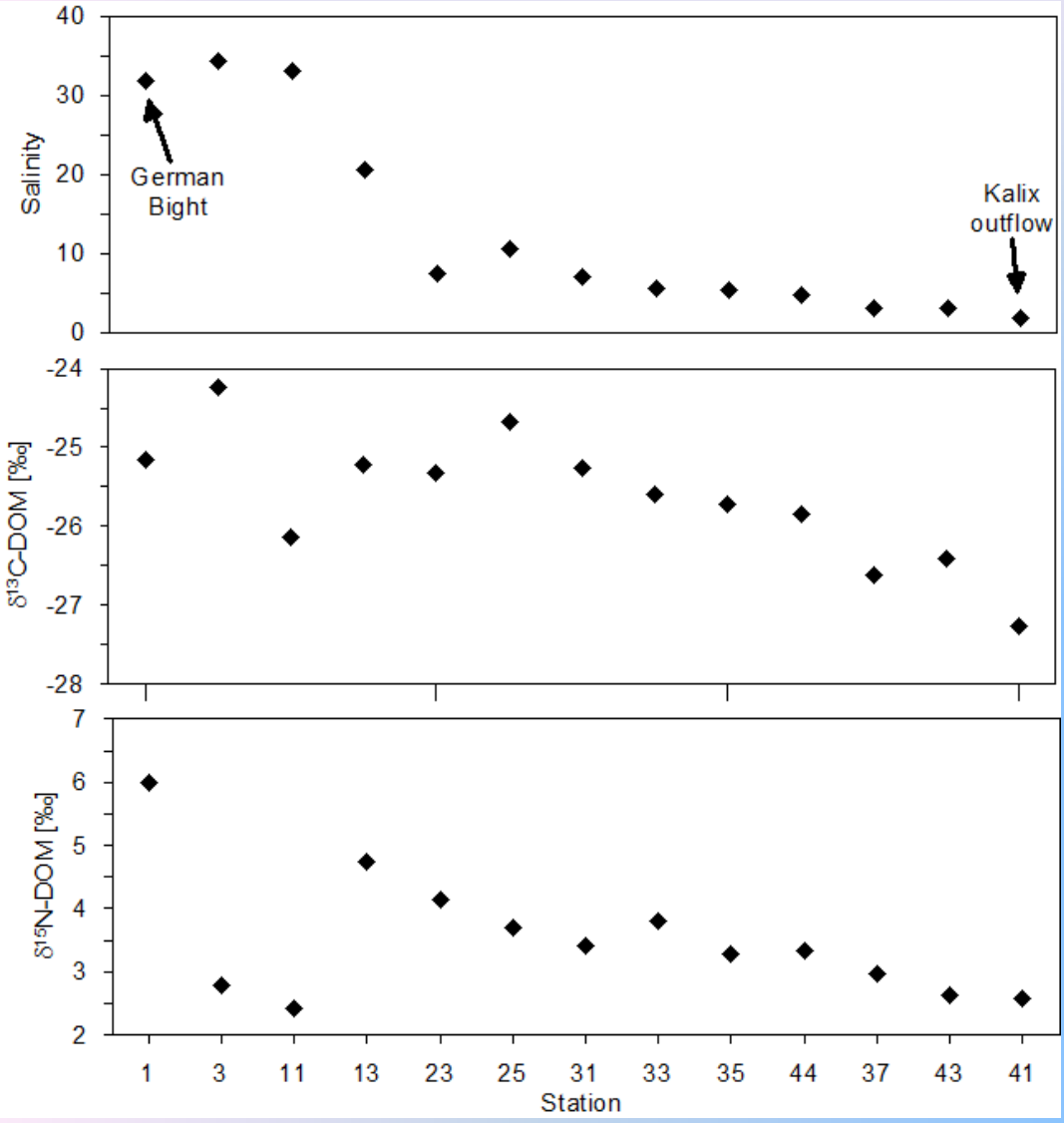


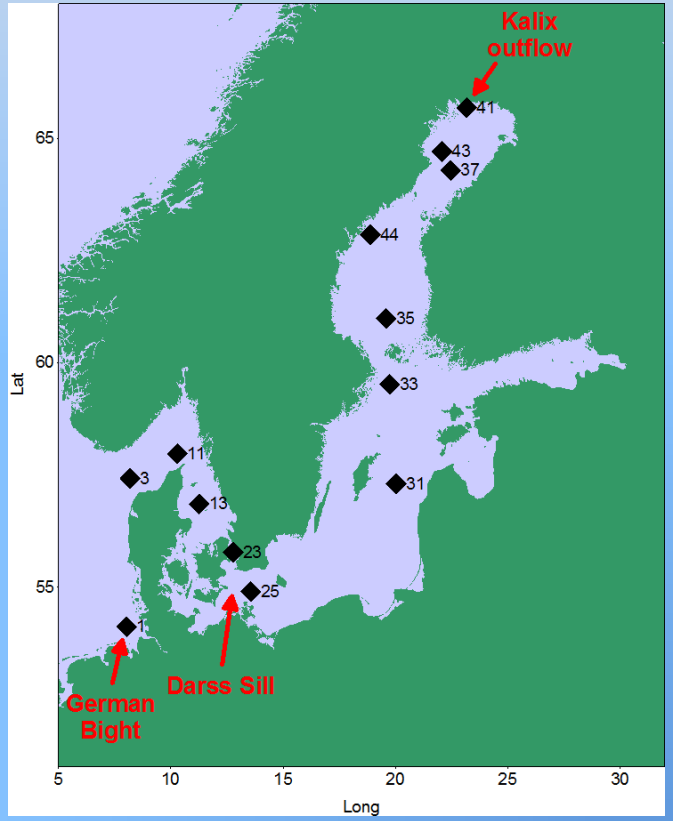
- Enrichment of the DOM fraction between 1 kD – 0.7 µm (colloidal DOM or HMW-DOM).

Freeze-dried HMW-DOM

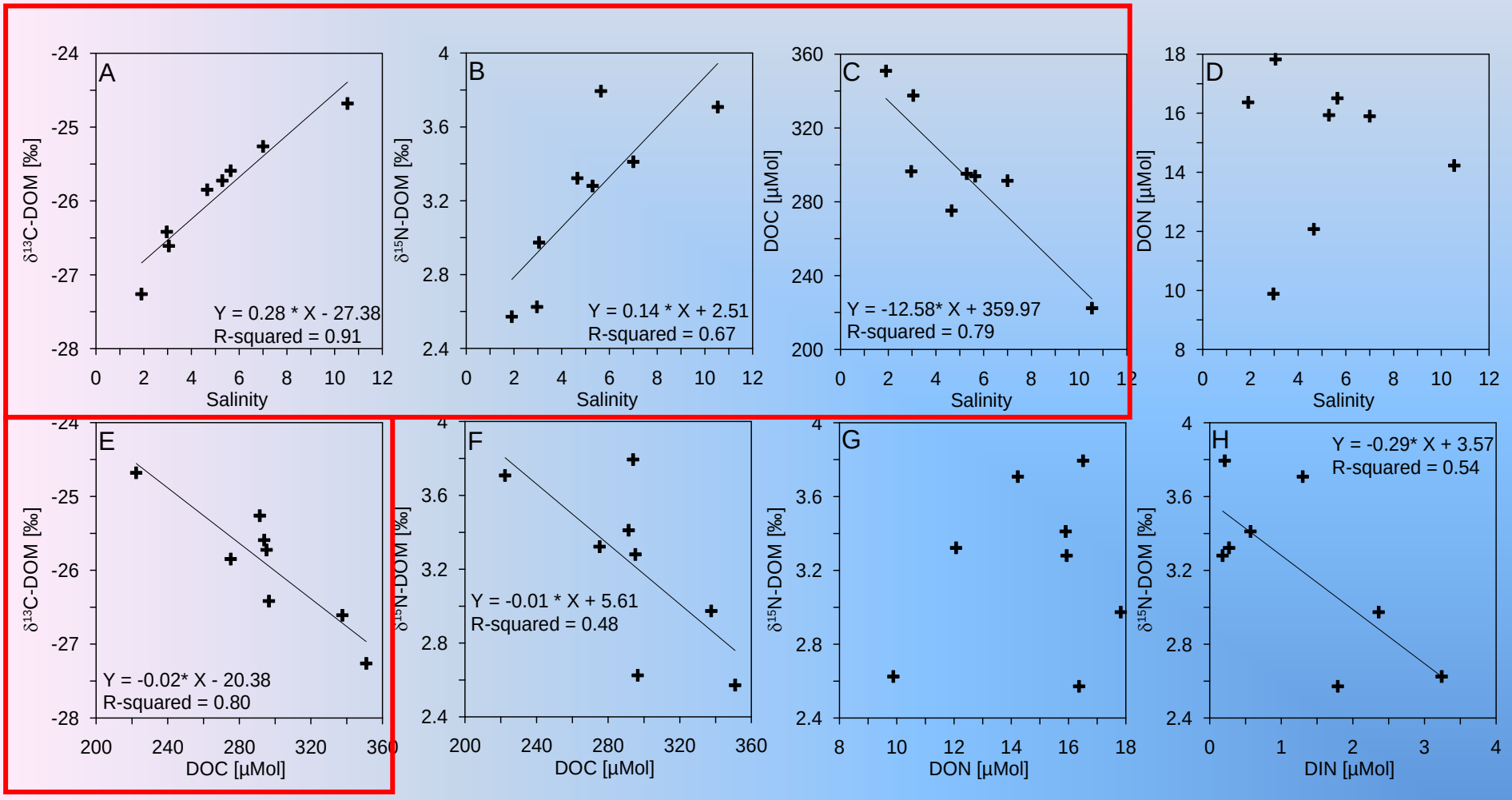


$\delta^{13}C$ and $\delta^{15}N$-DOM along the transect





East of the Darss sill



First conclusions

- The δ^{13}C-DOM values showed the expected gradient from more marine/autochthonous towards a terrestrial signal.
- The strong correlations between salinity and DOC and salinity and δ^{13}C-DOM indicate a conservative behavior in the open Baltic Sea.
- DON seems to be more subject to degradation.

EMMA-Approach to quantify terrestrial DOM in the Baltic Sea

$$f_{aut} + f_{ter} = 1$$

$$\delta^{13}C_{sample} = \delta^{13}C_{aut} * f_{aut} + \delta^{13}C_{ter} * f_{ter}$$

$$f_{ter} = (\delta^{13}C_{sample} - \delta^{13}C_{aut}) / (\delta^{13}C_{ter} - \delta^{13}C_{aut})$$

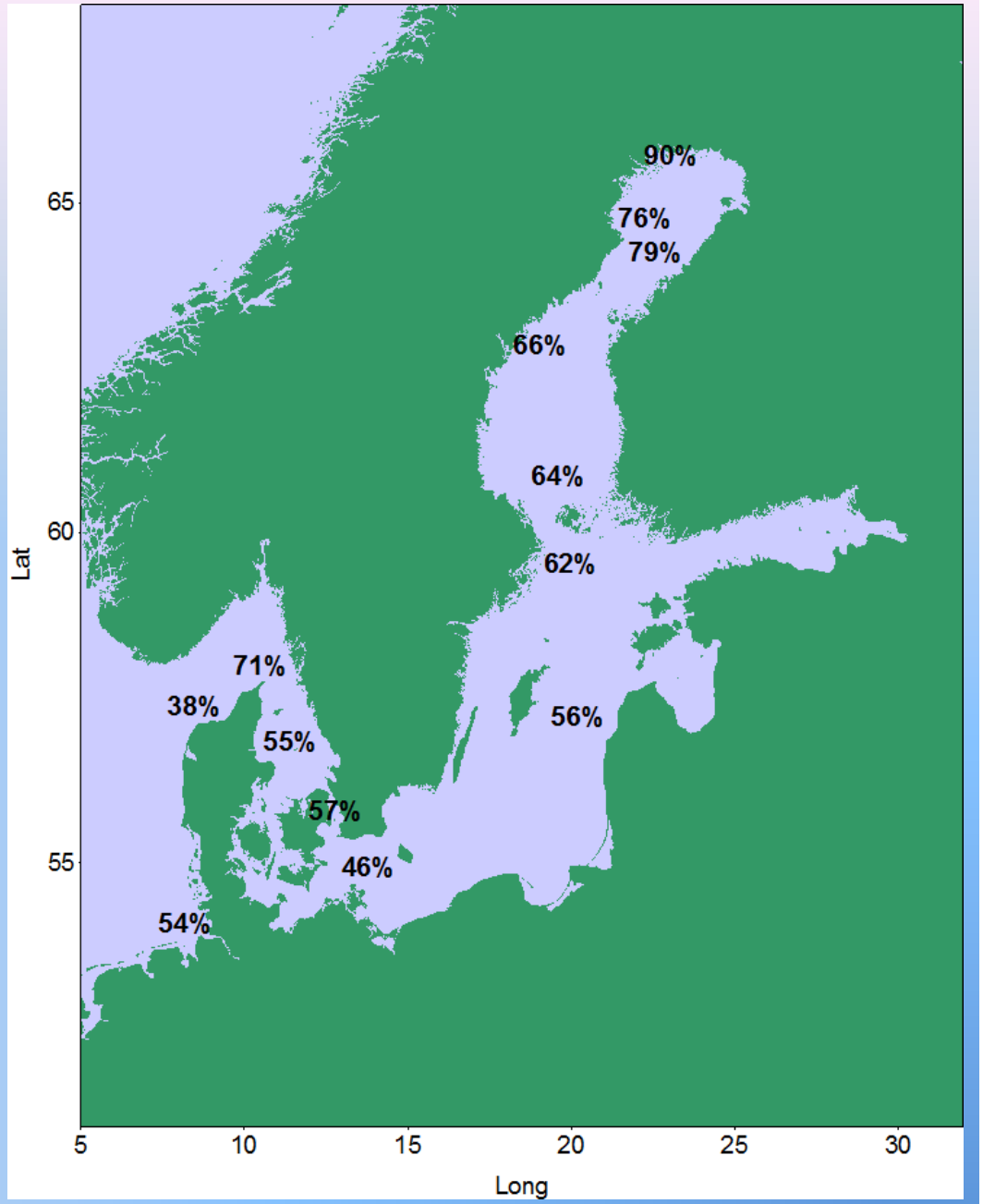
Endmember:

terrestrial $\delta^{13}C_{ter}$ = -27.8 ‰ (Kalix river water)

marine/autocht.: $\delta^{13}C_{aut}$ = -22.2 ‰ (Atlantic O. surface)

Share of terrestrial DOM

Bothnian Bay:	76-90%
Bothnian Sea:	~65%
Baltic Proper:	46-60%
Western Baltic:	~55%



Summary

- DOM distribution in the open Baltic Sea is mainly determined by mixing.
- Degradation of terrestrial DOM seems to take place very close to the coasts (estuaries, lagoons).
- The share of terrestrial DOM in the Baltic Sea ranges from 46-90% and increases with decreasing salinity.

To do 2011

- Seasonal samples from Kalix river.
- Samples from salinity gradient Odra, Curonian Lagoon outflow + additional samples BB.
- Publish data.

Publications

- Deutsch, Korth, Humborg, Mörth: “Tracing inputs of terrestrial dissolved organic matter within the Baltic Sea Ecosystem by means of stable isotope ratios” – in prep.
- Salinity gradient data (estuaries) + seasonal cycle Kalix (?).
- TOC/DOC budget for the Baltic Sea.
- Korth, Deutsch, Liskow, Voss: “Uptake of dissolved organic nitrogen by heterotrophic bacteria and phytoplankton along a salinity gradient from the North Sea to the Baltic Sea” - submitted.