End-member-mixing-analysis (EMMA) to estimate the contribution of terrestrial organic matter in water samples from the Baltic Sea

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EMMA is based on the assumption that the composition of a given sample can be explained as a conservative mixture of a limited set of end members (EM) (Haag et al. 2000).

To estimate the contribution of terrestrial organic matter in Baltic Sea samples we used the isotopic composition of carbon in dissolved organic matter (δ^{13}C-DOM) as tracer and used the two DOM sources marine/autochthon (EM1) and terrestrial (EM2) as end member. Presuming that only these two end member contribute to the DOM pool in the Baltic Sea, and that only a mixing of these two sources determines the DOM distribution in the Baltic Sea we can calculate the contribution of each end member in every sample from the following equations:

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

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

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

Where f_{ter} and f_{mar}, are the fractions of the terrestrial and marine DOM, and $\delta^{13}C_{sample}$, $\delta^{13}C_{mar}$, and $\delta^{13}C_{ter}$ are the δ13C values of the sample, and of the marine and the terrestrial DOM end member.

In our first EMMA approach we used as a terrestrial end-member an average δ^{13}C-DOM value from the Kalix River and have chosen the marine/autochthonous end member from literature (Benner et al. 1997). The results are presented in table 1 and figure 1.

Table 1: Results of the first EMMA approach

Station	Lat	Lon	$\delta^{13}C$ [‰]	f_{ter}	f_{ter} (%)
1	54,111	8,039	-25,16	0,54	54
3	57,414	8,183	-24,24	0,38	38
11	57,967	10,286	-26,13	0,71	71
13	56,852	11,268	-25,21	0,55	55
23	55,776	12,774	-25,32	0,57	57
25	54,896	13,559	-24,68	0,46	46
31	57,300	20,037	-25,26	0,56	56
33	59,518	19,744	-25,59	0,62	62
35	60,984	19,581	-25,72	0,64	64
37	64,285	22,465	-26,61	0,79	79
41	65,684	23,167	-27,26	0,90	90
43	64,707	22,066	-26,42	0,76	76
44	62,850	18,884	-25,85	0,66	66

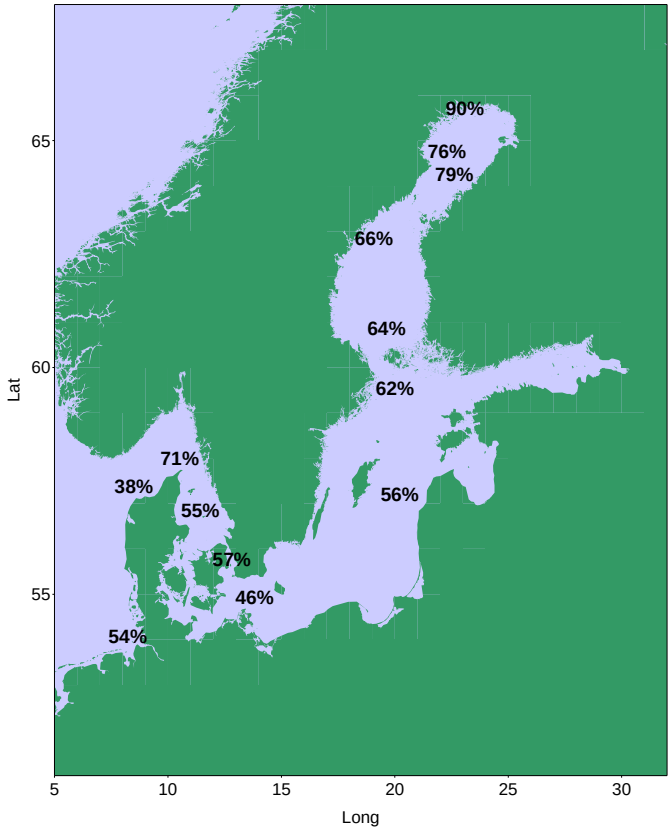

Fig. 1: Map of the Baltic Sea showing the relative contributions of terrestrial DOM in percent.

If additional end member contribute to the DOM pool, the EMMA can be expanded by adding additional tracers (eg: 3 end member → 2 tracers).

References:

Haag, I., Kern, U., Westrich, B., 2000. Assessing in-stream erosion and contaminant transport using the end-member mixing analysis (EMMA). The Role of Erosion and Sediment Transport in Nutrient and Contaminant Transfer. IAHS Publ. no 263.

Benner, R., Biddanda, B. Black, B. McCarthy M., 1997. Abundance, size distribution, and stable carbon and nitrogen isotopic compositions of marine organic matter isolated by tangential-flow ultrafiltration. Marine Chemistry 57: 243-263.