Supplementary information

The water identification was based on Rudels at al.(2005) with modifications marked in Table S1. In general we assumed that water characterized by density, potential temperature and salinity found south of 74N parallel could not be regard as PSW or PSWw due strong influence of high temperature on density.

Table S1. Water masses definition by Rudels et al. (2005) with modifications and remarks.

	Rudels at al. (2005)			Modifications			
Water Masses	Symbol	Θ [°C]	σ_θ [kg*m^{-3}]	S	Lat [N]	D [m]	Remarks
Atlantic Water	AW	>2	$27.7<\sigma_\theta\leq27.97$				
	AW	>0	$27.97<\sigma_\theta$, $\sigma_{0.5}\leq30.44$				
	AW	>0	≤27.7	>34.9			This part was separated from PSWw on the basis of high salinity >34.9. It covers the Atlantic domain where low density is caused by high temperatures
Polar Surface Water	PSW	≤0	≤27.7		>74		Assumption that PSW does not occur south of 74 N
Polar Surface Water warm	PSWw	>0	≤27.7	≤34.9	>74	≤50	Assumption that PSW does not occur south of 74 N, and surface water occur in first 50 m
Arctic Atlantic Water	AAW	0 < x≤2	$27.7<\sigma_\theta\leq27.97$				
Deep water	DW(AIW)	≤0	$27.97<\sigma_\theta$, $\sigma_{0.5}\leq30.44$				All waters classified to AIW in AREX cruises occur close to the bottom.

The example of excitation–emission matrix (EEM) from AREX expedition with marked ex/em region for three channels of Wet Star Wet Lab CDOM fluorometer is presented (Figure S1). Coble (1996) specific peak areas: the humic–like ‘A’ region at 260 nm excitation (ex)/380–460 nm emission (em); terrestrial fulvic ‘C’ region at 350 nm ex/420–480 nm em; marine humic–like ‘M’ region at 312 nm ex/380–420 nm em; and the tryptophan–like or protein–like ‘T’ region at 275 nm ex/340 nm em were marked on Figure S1. This allowed for association of channels with different excitation/emission characteristics with specific peak areas as given in Coble (1996): Channel 1 (CH1), ex./em. 310/450 nm, represents marine ultraviolet humic–like peak C and marine humic–like peak M; Channel 2 (CH2), ex./em. 280/450 nm, represents UVC

terrestrial humic–like peak A; and Channel 3 (CH3), ex./em. 280/350 nm, represents the protein–like tryptophane peak T (Figure S1).

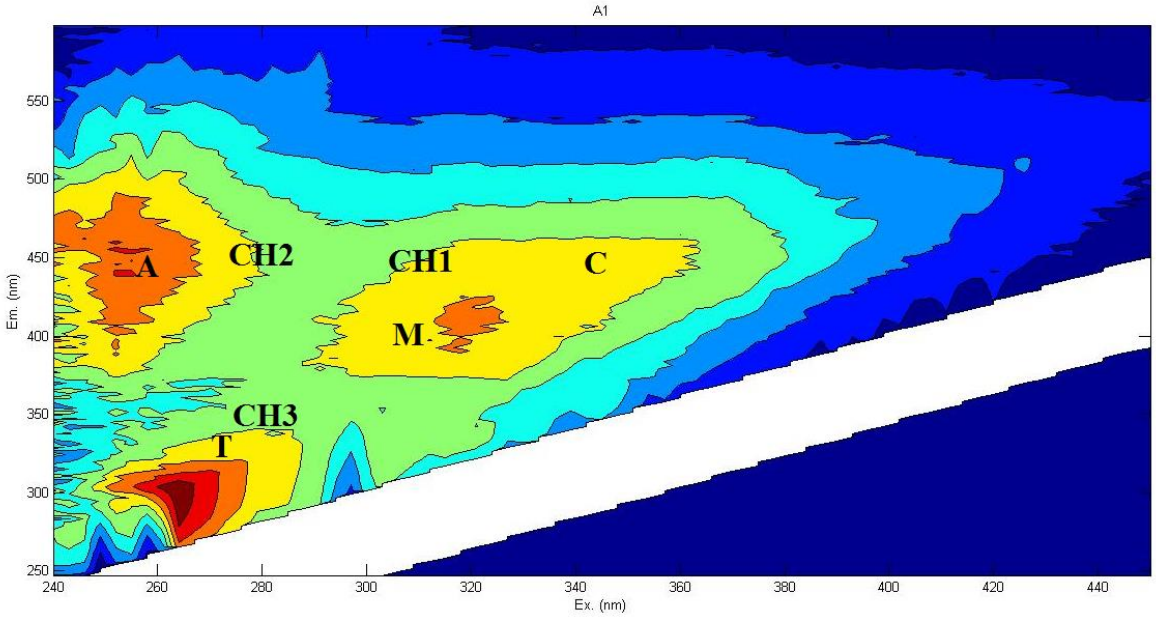
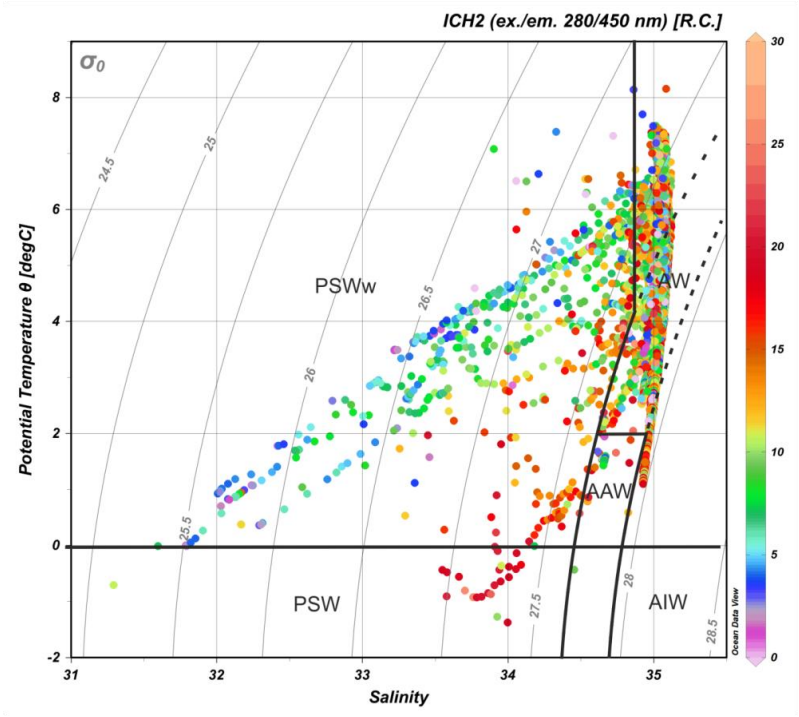


Figure S1: Typical example of excitation–emission matrix (EEM) from AREX expedition with marked ex/em region for three channels of Wet Star Wet Lab CDOM fluorometer (Channel 1 (CH1), ex./em. 310/450 nm, Channel 2 (CH2), ex./em. 280/450 nm,; Channel 3 (CH3), ex./em. 280/350 nm) together with Coble's specific EEM regions which characterize different sources of FDOM (the humic–like 'A' region at 260 nm excitation (ex)/380–460 nm emission (em); terrestrial fulvic 'C' region at 350 nm ex/420–480 nm em; marine humic–like 'M' region at 312 nm ex/380–420 nm em; and the tryptophan–like or protein–like 'T' region at 275 nm ex/340 nm em.).

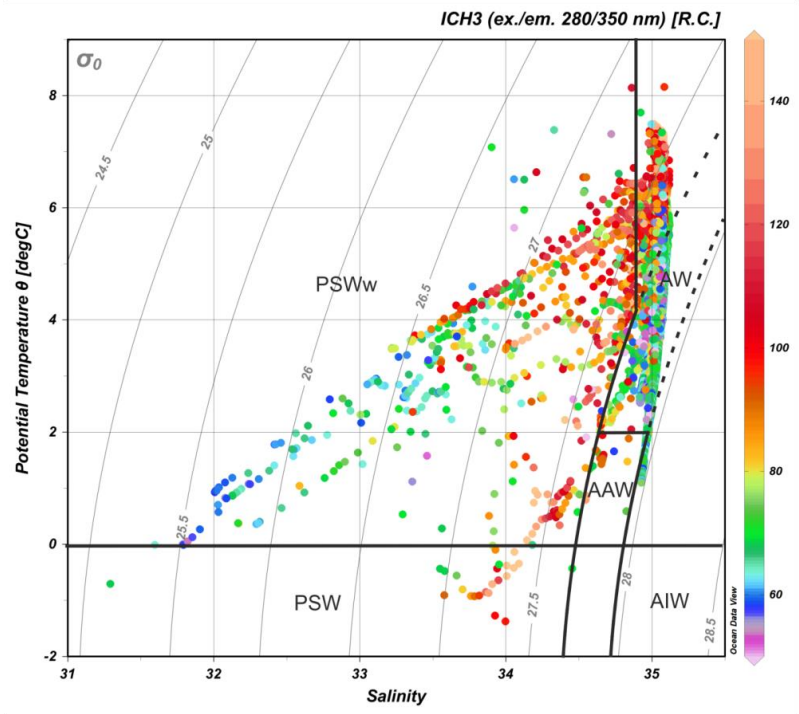
The distribution of fluorescence intensity of the terrestrial humic–like FDOM (I_{CH2}), protein–like FDOM (I_{CH3}) and $SUVA_{254}$ (ratio $a_{CDOM}254$ and DOC) in the TS diagram was shown in Figure S2. The highest terrestrial humic-like FDOM values were observed in PSW and part of PSWw in depth range 15-50 m. The lowest I_{CH2} values were found in surface layer of PSWw and there was a large variability in AW (Figure S2a). In case of protein-like FDOM the highest values were observed in PSW, PSWw mid depth (15-50m,what can be associated with chlorophyll a maximum) and in part of AW which was separated form PSWw (upper part: T>0, $\sigma_\theta \leq 27.7$, S>34.9). The lowest protein-like FDOM values were observed in AW (2 lower parts) and in PSWw where $\sigma_\theta \leq 26.5$ (Figure S2b). There was a large variability and no consistent

trends in distribution of $SUVA_{254}$ values in different water masses in the study area, as shown in the TS diagram (Figure S2c).

a)



b)



c)

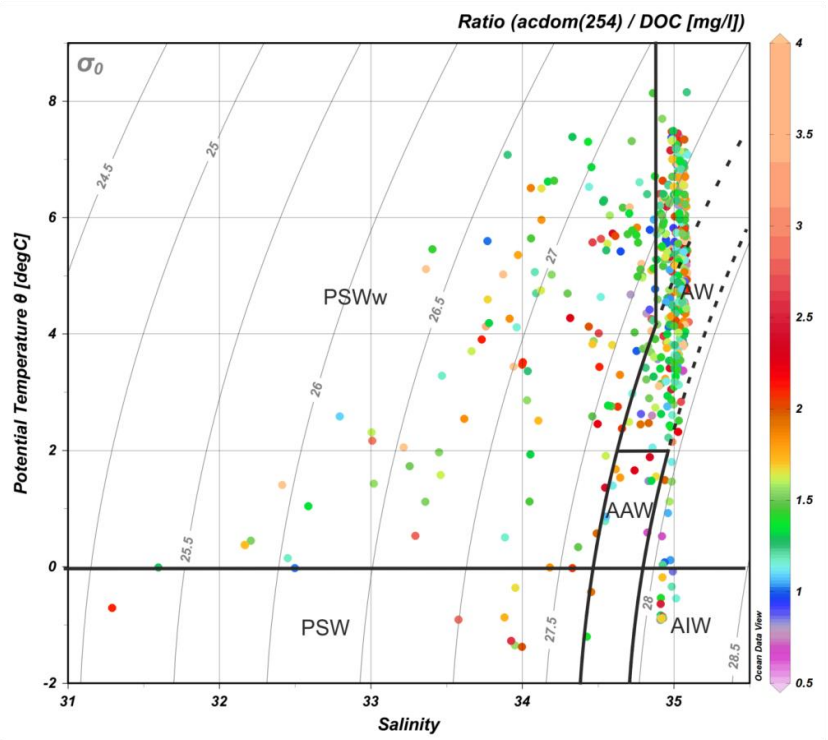


Figure S2: TS diagram of water mass distribution on the study 2013–2015. A) color represents terrestrial humic–like fraction fluorescence intensity I_{CH2}, (ex./em. 280/450 nm, [R.C.]). B) color represents protein–like fraction fluorescence intensity I_{CH3}, (ex./em. 280/350 nm, [R.C.]). C) color bar represents values of carbon specific CDOM absorption coefficient at 254 nm, $SUVA_{254}$ [$m^2\ gC^{-1}$]. The lower number of points in c) resulted from fewer number of discrete water samples for determination of CDOM. Water masses: AW (Atlantic Water), AAW (Arctic Atlantic Water), AIW (Arctic Intermediate Water), PSW (Polar Surface Water), PSWw (Polar Surface Water warm). Three areas noted as AW follow the three sets of conditions that define AW (see Table S1).

We presented the relationship between absorption coefficient at 676 and stimulated chlorophyll a fluorescence in 2014 and 2015 in the selected water masses to prove that measurements were not biased by instrument offset . The stability of chlorophyll *a* intensity output was assessed by regressing the measured fluorescence intensity values against calibrated values of total absorption coefficient non–water at 676 nm, $a_{tot-w}(676)$ in selected water masses. Value of the $a_{tot-w}(676)$ is a good proxy of the chlorophyll *a* concentration (Roesler and Barnard, 2013). There was very good linear relationship between I_{FChla} and $a_{tot-w}(676)$ in selected water masses in 2014 and 2015 with no visible offset in I_{FChla}, values in both years

ensuring negligible time drift in MicroFlu–Chl output (Figure S3). The difference in the in the I_{FChla}, and $a_{tot-w}(676)$ vertical distribution near the ocean surface in AW, shown on Figure 4, could in part be explained by a decrease in the fluorescence quantum yield by phytoplankton photoinhibition resulting from the stronger irradiance near the surface (Cullen, 1982).

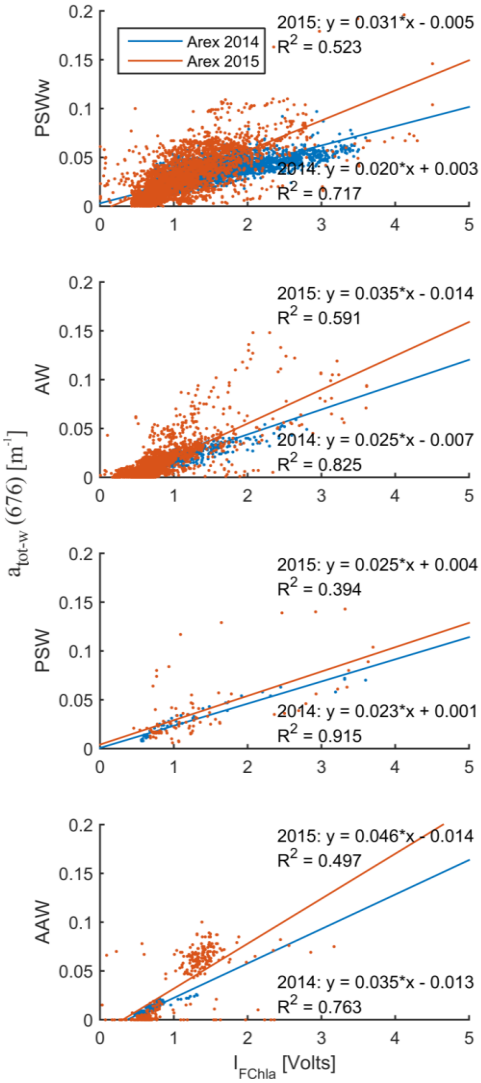


Figure S3: Relationship between total absorption coefficient non–water at 676 nm ($a_{tot-w}(676)$ and stimulated chlorophyll a fluorescence (I_{FChla}) in different water masses in 2014 and 2015.

According to Roesler and Barnard (2013) chlorophyll a concentration can be very well approximated by $a_{tot-w}(676)$. The very good correlation between I_{FChla} and $a_{tot-w}(676)$ in selected water masses shown on Figure S3, as well together with very good correlation between

I_{CH3} and I_{FChla} suggested a direct dependence between I_{CH3} and $a_{tot-w}(676)$. There was a significant correlation between I_{CH3} and $a_{tot-w}(676)$ as summarized on the Figure S4. This was another evidence confirming strong contribution of phytoplankton dynamics to spatial and temporal variability of FDOM protein–like fraction in Nordic Seas.

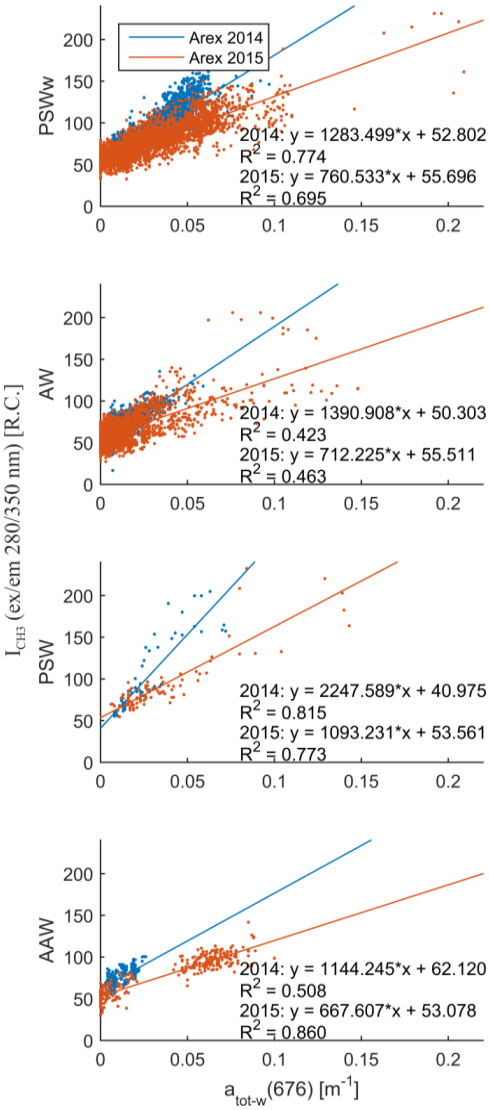


Figure S4: Relationship between fluorescence intensity of the protein–like component (I_{CH3}) and particulate absorption coefficient at 676 ($a_{tot-w}(676)$) in different water masses in 2014 and 2015.