ABSORBANCE AND FLUORESCENCE PROPERTIES OF THE LAPTEV SEA NATURAL SURFACE WATERS

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We report on field-based measurements of absorbance and fluorescence properties of the Laptev Sea surface waters. Water samples were collected from the surface layer at 14 hydrological stations along 130°E, Figure 1a, during the 63th cruise of RV «Akademik Mstislav Keldysh» in September 2015. These waters are of particular interest in optical studies since they allow the study of CDOM optical properties across a gradient from estuarine to near-oceanic environments withsalinities varying between 3 and 30 psu, Figure 1b.

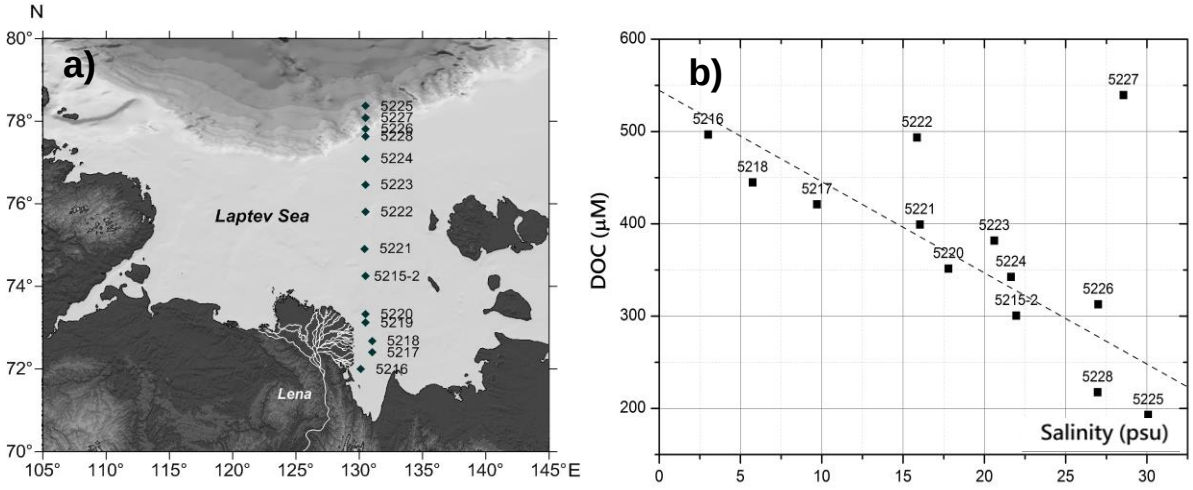

Figure 1: a) Location of hydrological stations in the 63th cruise of RV «Akademik Mstislav Keldysh»; b) DOC against salinity for the water samples from the surface layer of the Laptev Sea. The dashed line demonstrates a feasible conservative behaviour of DOM with respect to salinity.

Seawater samples were filtered using precombusted Whatman GF/F filters with a pore size of 0.7 μm. DOC concentration was measured onshore by high-temperature combustion with a Shimadzu TOC analyser. Absorption spectra were measured in a 1 cm quartz cuvette in the wavelength range 200-650 nm. Fluorescence measurements were performed on-board. Emission scans were acquired at excitation wavelengths (λ_{ex}) from 230 to 550 nm at 5 nm intervals and emission wavelengths from λ_{ex} + 10 nm to 650 nm at 1 nm intervals.

CDOM fluorescence spectra for most of the samples comprises a single band in the visible spectral region with a maximum at 425-455 nm, Figure 2a. It is most likely attributed to the humic compounds supplied by the Lena riverine waters (1). Position of the maximum of this band depends on the excitation wavelength: a change of λ_{ex} from 270 to 310 nm leads to a shift of the fluorescence maximum to shorter wavelengths; further increasing λ_{ex} results in a shift towards longer wavelengths. Blue shift parameters were defined as $\Delta_{270\text{-}310}$ = 29 nm and $\Delta_{350\text{-}310}$ = 30 nm. As the distance from the Lena Delta increases, fluorescence intensity of humic compounds decreases due to the mixing of river and sea waters, as well as photodegradation processes. For the samples collected near the continental slope fluorescence in the 290-320 nm region becomes visible, indicating the presence of labile autochthonous organic matter.

Absorbance of the studied seawater samples exponentially decreases between 220 and 600 nm and becomes no more measurable at 650 nm, Figure 2b. A slight shoulder is observed in the range of 240-265 nm, Figure 2a. In the wavelength range between 200-220 nm there is a dramatic difference in absorption properties of the sample from St. 5216 compared with the others, which is most likely the result of coagulation and flocculation of dissolved organic and inorganic matter during mixing of river water and seawater (2).

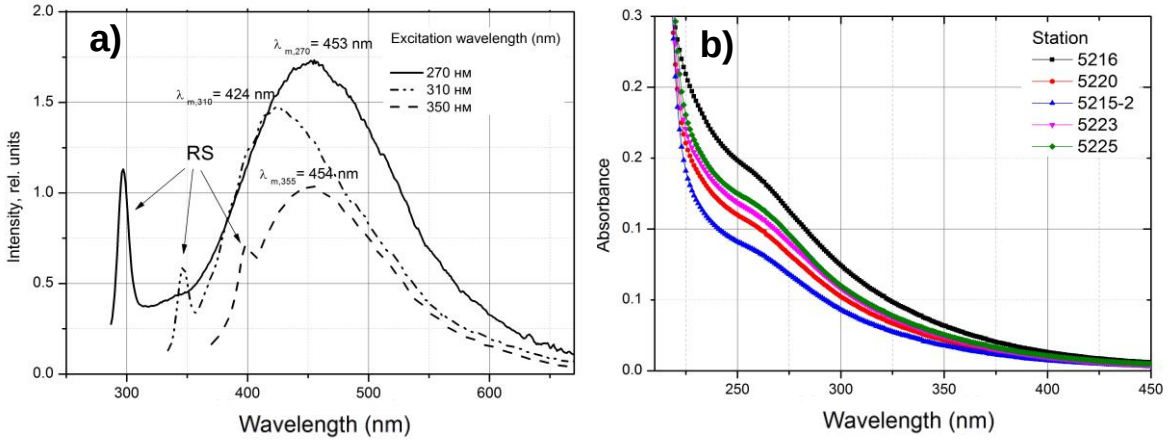

Figure 2: a) Fluorescence spectra of CDOM from station 5216 at excitation wavelengths 270, 310 and 350 nm. b) Absorbance of the seawater samples.

A specific UV absorbance (SUVA index) calculated by normalizing the decadic absorption at 254 nm to the DOC concentration is similar for the Laptev Sea shelf surface waters (2.41-2.52 m^2 g C^{-1}) and it increases significantly at the St. 5225 (5.25 m^2 g C^{-1}). According to Weishaar and co-workers, such a change of SUVA indicates an increase of percent aromaticity of DOM from 20 to 38% (3). Absorption spectra between 300 and 650 nm were characterized by the exponential spectral slope coefficient *S*. The *S* value for the Laptev Sea shelf surface waters does not vary a lot and amounts to an average of 17.3 μm^{-1}. The S_R ratio increases from 0.93 at the Lena Delta region to 1.07 near the continental slope, indicating, first, distribution of terrestrial CDOM throughout the Laptev Sea shelf, and, second, CDOM photodegradation processes occurring in the surface layer (1).

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