Spectral-Luminescent Characteristics of CDOM in Stratified Water Bodies of the Kandalaksha Coast of the White Sea

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Introduction. It is known that natural water always contains a certain amount of chromophoric dissolved organic matter (CDOM) and particulate organic matter including bacterial cells, that absorb or scatter sunlight. The optical properties of natural water play an important role in the functioning of aquatic ecosystems, which indicates the relevance of this kind of research. The content of chromophoric dissolved organic matter, particulate organic matter and microorganisms in water determines the spectral composition of light penetrating to a certain depth. In this paper, natural water from meromictic water bodies with high stable vertical stratification of layers was studied. These data are important to examine the development of phototrophic microbial communities inside the water column and also to understand the evolution of meromictic water bodies.

The aim of the current work is to study the features of absorption and fluorescence spectra of water from two meromictic lakes depending on the depth of the layer .

Method

Fluorescence spectra were measured using a luminescence spectrometer Solar CM2203 at wavelengths of the exciting radiation ranging from 250 to 500 nm. Absorption spectra were measured using a spectrophotometer Solar PB2201, the range of wavelengths was from 200 to 800 nm.

Using the obtained spectra, the quantum yield Φ and the dependences of the maximum of the fluorescence emission spectrum $\lambda_{em\ max}$ on the excitation wavelength were calculated.

Studied objects

Natural water was sampled in September 2022 from various depths of the meromictic lakes Trekhtzvetnoe and Elovoe of the Kandalaksha coast of the White Sea. Four water samples from different depths for each lake were selected and filtered with neilon filter with pore size 0,22 microns to study CDOM.

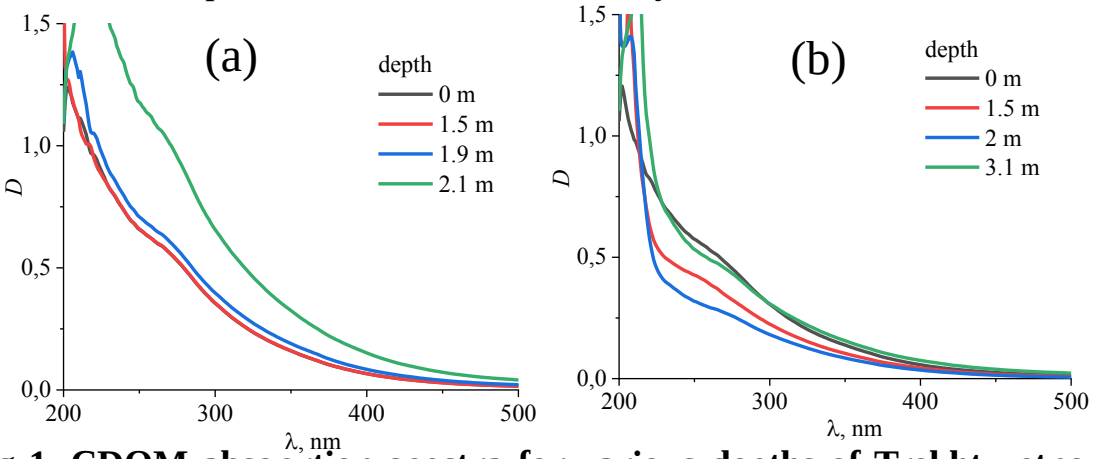

Fig 1. CDOM absoprtion spectra for various depths of Trekhtzvetnoye (a) and Elovoe (b) lakes (*D* is an optical density).

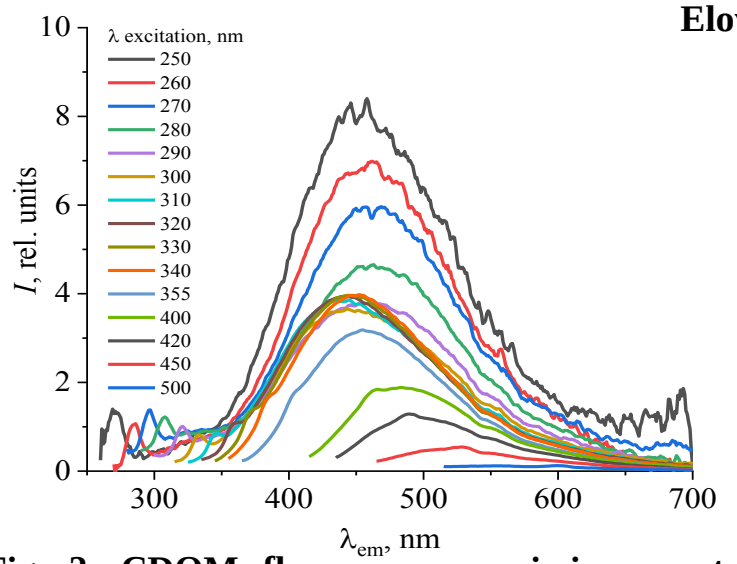

Fig. 2. CDOM fluorescence emission spectra with different excitation wavelengths λex for depth *l*=1.5 m for Elovoe lake (*I* is an intensity).

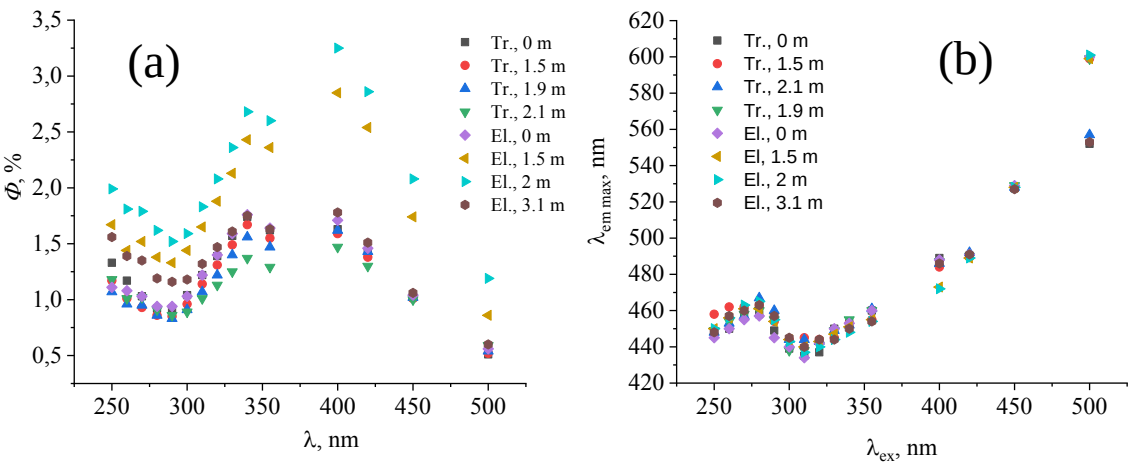

Fig. 3. (a) fluorescence quantum yield and (b) values of maximum of fluorescence emission spectra as dependences on the excitation wavelength for CDOM from various depths from Trekhtzvetnoe (Tr) and Elovoe (El) lakes.

It can be seen that the shape of the fluorescence spectra for different samples is similar. The dependence of the position of the maximum of the fluorescence emission spectrum on the excitation wavelength is practically the same for all samples. At the same time, the dependences of the fluorescence quantum yield on the excitation wavelength have a similar nature of dependence, but the magnitude of the fluorescence quantum yield differs significantly for different water layers, which is especially noticeable for samples from lake Elovoe. The difference in the absorption spectra for the two lakes is explained by the fact that the salt water layer begins at different depths.