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Seasonal qualitative and quantitative dynamics of dissolved organic carbon in a boreal mire complex in Northwest Russia.

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Dissolved organic carbon (DOC) is a poorly characterized component of the carbon cycle in the boreal regions of Russia, home to a considerable portion of global carbon-rich peatlands. However, due to the variable substrates, nutrient availability, and hydrological regime, different parts of a mire complex may exhibit distinctively different DOC concentrations. Therefore, the objective of the current study is to investigate the spatial variability of DOC, and to distinguish DOC temporal hot-spots during the course of the annual cycle.

Water samples were collected from the forest-fen transitional zone (lagg), from fen and bog zones, and from the peatland outflow into the river fluvial system in the Ust-Pojeg mire complex (61˚56'N, 50˚13'E) in the Komi Republic, Northwest Russia. The bulk DOC was separated from particulate organic matter with pre-combusted glass fiber filters. Afterwards, tangential flow filtration was used for fractionating the bulk DOC into colloidal and 'truly dissolved' fractions The organic carbon content of these fractions was analyzed via wet combustion, and the δ^{13}C value of this organic matter was determined through isotope-ratio mass spectrometry. This isotopic analysis allows determining the degree of degradation, as degradation increases the δ^{13}C signature of the remaining carbon due to microbial metabolic preference for lighter isotopes.

During the summer-autumn period, surface- and pore-waters from different parts of the mire complex exhibited clearly differing DOC concentrations. The highest DOC concentrations (41-55 mg L^{-1}) were detected at the transitional or lagg zone between forest and fen while the lowest concentrations were observed at the bog site (20-28 mg L^{-1}). During the spring snowmelt period, a significant amount (2.3 g C m^{-2}) of DOC was flushed away from the mire into the nearby regional Pojeg River.

The DOC composition, particularly with respect to the proportion of colloids, differed significantly between outflow, lagg, fen and bog surface waters. During the summer period, the highest relative contribution of the truly dissolved organic carbon to the bulk DOC was detected at the bog site (47% of the total) while after the snowmelt period its highest relative contribution was at the transitional (lagg) site (12% of the total). The δ^{13}C analyses showed that during the summer period under high temperature and low water table conditions the bog contained the most decomposed organic material, which may contribute to its large observed CO_2 emissions during the hot season.

We conclude that lagg, bog and fen zones represent separate hydrological and biogeochemical units within the single mire complex. Particularly, the transition (lagg) zones between mires and the surrounding mineral soils appear to be of major importance for organic matter export from boreal mire-forest landscapes into the fluvial system. The presented data suggest that further investigation of processes governing DOC dynamics is needed to understand the spatial-temporal variability of fluxes and to scale up aggregated fluxes for regional carbon budget estimations.