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Seasonality in Lena River biogeochemistry and dissolved organic matter

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The carbon export by rivers to the Arctic Ocean is expected to increase in response to the rapidly changing climate in the Arctic (Camill, 2005; Freeman et al., 2001; Frey and Smith, 2005). This is in part due to thawing permafrost and mobilization of particulate and dissolved organic matter (DOM). The Lena River delivers approximately one fifth of the total river discharge to the Arctic Ocean and is the main source of DOM in the Laptev Sea shelf (Thibodeau et al., 2014). To date river fluxes of DOM have been based on sparse coverage of sample across the hydrograph about 700 km upstream (Cooper et al 2005; Raymond et al 2007; Stedmon et al 2011; Amon et al 2012). The effects of low frequency sampling on load estimates are unknown and potentially large for systems such as these where there are considerable changes across the hydrograph. Here we present results from a unique high frequency sampling program and evaluate its viability to monitor export fluxes of DOM and its biogeochemistry in the Lena River. The sampling takes place close to the river mouth at the research station Samoylov in the central Lena River Delta. The Samoylov research station allows a unique chance for continuous sampling since it operates throughout the year. The sampling program includes measurements of several water parameters, such as temperature, electric conductivity, dissolved organic carbon (DOC), spectral CDOM absorption (aCDOM), fluorescent dissolved organic matter (FDOM) and water stable isotopes.
The data facilitated the identification of the main drivers behind the seasonality of DOM concentration and biogeochemistry of the Lena River. Three main water sources could be identified (1) (snow) melt water, (2) rain water and (3) subsurface water. Melt and rain water are found to be the prevailing water sources that combined transport 5.8 Tg C dissolved organic matter (~ 85 % of annual flux (6.8 Tg C)) into the Lena River. The high number of samples throughout the whole year allowed flux calculations that are independently from load models that likely lead to a large variation of earlier studies.
The absorption properties of DOM revealed changing composition and sources of DOM throughout the year. Decreasing SUVA values during the summer point towards an increasing fraction of old DOM which potentially originates from degrading permafrost. In contrast, during the spring freshet, high SUVA indicate mostly fresh organic matter with high molecular weight and

high aromaticity.
This dataset represents the first year of a planned long-term monitoring program at the Research Station Samoylov Island and provides a baseline data set against which future change of this large integrative system may be measured. A continuous sampling of Arctic River water will facilitate to identify intra and inter-annual trends with ongoing climate change.