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Chromophoric dissolved organic matter during the Mackenzie River spring freshet: Observations and freeze-thaw experiments

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Dissolved organic matter (DOM) in Arctic rivers is characterized by highly seasonal changes in concentrations, fluxes and composition. However, there is still relatively little knowledge of variations in riverine DOM during the spring freshet, when export of DOM is generally highest. Chromophoric dissolved organic matter (CDOM) absorption spectra have been shown to be useful indicators of concentrations and quality of DOM in high-latitude rivers. Here, we present ultraviolet-visible absorption spectra of CDOM, collected during the 2011 spring freshet on the Mackenzie River. The Mackenzie River is a major source of DOM to the coastal Beaufort Sea, delivering nearly 500 kilotons of carbon within the two month spring freshet. A high-resolution time series was collected from the East Channel in the Mackenzie River delta, along with lower-resolution time series of small upland rivers, large tributaries, and the Mackenzie main stem upriver of the delta region. CDOM concentrations, reported as a400, ranged from 1.6 to 26.9 m-1 (average 10.06 $\pm$ 4.9 m-1). Spectral slopes (S), which can be used to assess sources and molecular weight of CDOM, correlated well with concentrations. S was generally lower and less variable in small upland rivers than in the Mackenzie or its larger tributaries. These results suggest that the quality and composition of DOM vary substantially during the spring freshet period in the Mackenzie River. In addition, freeze-thaw experiments were conducted to determine whether frozen, archived water can provide reliable measurements of CDOM, regardless of initial DOM quantity or quality. Samples from the six largest Arctic rivers have been collected and archived since 2003, yet it is still unknown whether CDOM measurements from thawed samples are comparable to absorbance immediately after sample collection. Initial results from the Mackenzie river indicate that absorbance in the ultra-violet spectrum is not greatly impacted by freezing. In addition, experiments show that sonication of thawed samples can remedy flocculation and improve the reliability of visible spectrum absorbance. After corrections for freeze-thaw cycles, archived samples will be used to develop algorithms estimating DOM concentrations from satellite remote sensing, and produce spatially explicit time series of DOM variations in large arctic rivers.