Flux and Seasonality of Dissolved Organic Matter from the Northern Dvina (Severnaya Dvina) River, Russia

Johnston, S.E. (Florida State U., Earth Ocean and Atmospheric Science); Shorina, N. (Russian Academy of Science, Federal Center for Integrated Arctic Research); Bulygina, E. (Louisiana Universities Marine Consortium); Vorobjeva, T., Chupakova, A. (Russian Academy of Science, Federal Center for Integrated Arctic Research); Guillemette, F. (Florida State U., Earth Ocean and Atmospheric Science, University of Quebec at Trois-Rivieres); Shiklomanov, A. (U. of New Hampshire, Water Systems Analysis Group); Podgorski, D.C. (Florida State U, Earth Ocean and Atmospheric Science, U. of New Orleans, Chemistry) and Spencer, R.G.M. (Florida State U., Earth Ocean and Atmospheric Science)

Summary

Pan-Arctic riverine dissolved organic carbon (DOC) fluxes represent a major transfer of carbon from land-to-ocean, and past scaling estimates have been predominantly derived from the six major Arctic rivers. However, smaller watersheds are constrained to northern high-latitude regions and, particularly with respect to the Eurasian Arctic, have received little attention. In this study, we evaluated the concentration of DOC and composition of dissolved organic matter (DOM) via optical parameters, biomarkers (lignin phenols), and ultrahigh resolution mass spectrometry in the Northern Dvina River (a midsized high-latitude constrained river; Fig. 1). Elevated DOC, lignin concentrations, and aromatic DOM (Fig. 2) indicators were observed throughout the year in comparison to the major Arctic rivers with seasonality exhibiting a clear spring freshet and also some years a secondary pulse in the autumn concurrent with the onset of freezing. Chromophoric DOM absorbance at a350 was strongly correlated to DOC and lignin across the hydrograph; however, the relationships did not fit previous models derived from the six major Arctic rivers. Updated DOC and lignin fluxes were derived for the pan-Arctic watershed by scaling from the Northern Dvina resulting in increased DOC and lignin fluxes (50 Tg yr 1 and 216 Gg yr 1, respectively) compared to past estimates. This leads to a reduction in the residence time for terrestrial carbon in the Arctic Ocean (0.5 to 1.8 years). These findings suggest that constrained northern high-latitude rivers are underrepresented in models of fluxes based from the six largest Arctic rivers with important ramifications for the export and fate of terrestrial carbon in the Arctic Ocean.

Fig.1 Map showing the Northern Dvina watershed (yellow) and the six largest Arctic watersheds (blue) with dots for sample locations. The grey and red lines show the estimated extent of Pan-Arctic watershed 1 and 2, respectively.

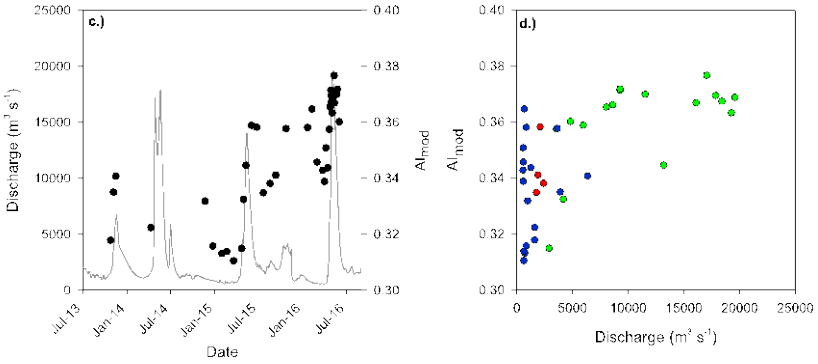

Fig.2 (c) Aromaticity index (AI_{mod}) and discharge versus date. (d) AI_{mod} versus discharge where color indicates season.

Acknowledgements

The National High Magnetic Field Laboratory is supported by the National Science Foundation through NSF/DMR-1157490/1644779 and the State of Florida. This research was supported by a grant from the Trust for Mutual Understanding awarded to R. G. M. S. This work was additionally partially supported by NSF grants ANT-1203885 and PLR-1500169 to R. G. M. S. and FASE Russia.

References

[1] Johnston, S.E., *et al*., Journal of Geophysical Research: Biogeosciences, **123**, 1041-1056 (2018).