

Impacts of watershed characteristics on the biogeochemistry of the Kolyma River basin, Northeast Siberia

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The Kolyma River basin in northeast Siberia is currently experiencing accelerated permafrost degradation and alteration of the hydrological cycle owing to regional climate warming. The basin is comprised of a diverse set of subwatersheds that are underlain by carbon-rich, permafrost dominated Pleistocene-aged loess deposits. Warming temperatures may cause this stored carbon to be unlocked from permafrost and released to the atmosphere as CO₂ and CH₄, but also to adjacent streams and rivers as dissolved organic carbon (DOC). In July 2009, a survey spanning 242 km of the Kolyma River was conducted to describe the biogeochemical constituents of an assorted set of streams, rivers and mainstem locations. A total of ten subwatersheds and nine Kolyma mainstem locations were sampled, at which dissolved oxygen (DO), conductivity, and pH were measured. In addition, water samples were collected for measurements of dissolved organic carbon (DOC), chromophoric dissolved organic matter (CDOM), and total dissolved nitrogen (TDN). Watershed areas were delineated in a GIS to extract watershed characteristics such as land cover and permafrost, which were then compared with our point observations of biogeochemical data from river sampling sites. Results indicate spatial variability in DOC concentrations, as concentrations decrease as waters travel from small streams to the Kolyma mainstem. DOC variation is observed most between watershed areas of less than 100 km² and watershed areas that are greater than 100 km², suggesting that within small watersheds local characteristics may have a significant impact on DOC concentrations. Developing general relationships for assessment of the impacts of watershed characteristics on the biogeochemistry of streams and rivers is critical for predicting how future warming will likely impact the flux of carbon and nutrients to the Arctic Ocean. This study is part of the Polaris Project, an NSF-funded undergraduate field program based out of the Northeast Science Station in Cherskiy, Northeast Siberia (www.thepolarisproject.org).