Assessing biogeochemical cycling and transient storage of surface water in Eastern Siberian streams using short-term solute additions

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Recent studies highlight the role of stream networks in the processing of nutrient and organic matter inputs from the surrounding watershed. Clear evidence exists that streams actively regulate fluxes of carbon, nitrogen, and phosphorus from upland terrestrial ecosystems to downstream aquatic environments. This is of particular interest in Arctic streams because of the potential impact of permafrost thaw due to global warming on inputs of nutrients and organic matter to small streams high in the landscape. Knowledge of functional characteristics of these stream ecosystems is paramount to our ability to predict changes in stream ecosystems as climate changes. Biogeochemical models developed by stream ecologists, specifically nutrient spiraling models, provide a set of metrics that we used to assess nutrient processing rates in several streams in the Eastern Siberian Arctic. We quantified these metrics using solute addition experiments in which nitrogen and phosphorus were added simultaneously with chloride as a conservative tracer. We focused on 5 streams, three flowing across upland yedoma soils and two floodplain streams. Yedoma streams showed similar uptake of N and P, suggesting co-limitation of biological processes, with large variation between these three streams in the magnitude of nutrient uptake. Floodplain streams both showed substantially higher P uptake than N uptake, indicating strong P limitation. Given these results, it is probable that these two types of streams will respond quite differently to changes in nutrient and organic matter inputs as permafrost thaws.