Transient storage, discharge, and nutrient uptake in streams of the Kolyma River basin

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Discharge is increasing in Arctic rivers, and is predicted to continue to increase under future climate change scenarios. At the same time, permafrost thaw is predicted to increase with Arctic warming, potentially increasing nutrient and organic matter inputs to headwater streams. Understanding how increased discharge will alter the ability of streams to process these material inputs is critical to assessing the potential impact of these changes on downstream ecosystems. Hydrologic factors, particularly transient storage of water as it moves downhill, are likely to change with discharge and to influence nutrient exports to larger streams. We used NH_4 and PO_4 enrichment experiments and conservative tracer additions to simultaneously assess nutrient uptake and the size of the transient storage zone in several small streams in the Kolyma River basin in Eastern Siberia. We found a clear negative relationship between transient storage and discharge. Moreover, phosphorus uptake was negatively related to transient storage, while nitrogen uptake showed no relationship with transient storage. Results suggest the transient storage zone is relatively inactive in terms of nutrient uptake. Implications of this result are an increase in P uptake and a decrease in the N:P of uptake as discharge increases. Given the possibility that both discharge and nutrient inputs will increase as permafrost thaws, longer-term nutrient enrichment experiments are needed to develop predictions of change in these ecosystems with changes in climate.