How ecosystems and catchment characteristics influence blue-green water fluxes and solute transport in a mountainous subarctic catchment, Yukon, Canada.

Sean K. Carey, Erin M. Nicholls, Arsh Grewal
School of Earth, Environment & Society, McMaster University, Hamilton, Ontario, Canada

Permafrost and frozen ground strongly influence the movement of water and solutes in cold environments. As the climate warms, enhanced thaw and permafrost degradation will enable new flow pathways and alter hydrological connectivity across the landscape. However, in alpine regions, there are elevation-based gradients in vegetation and precipitation magnitude/phase that are rapidly changing and confounding prediction of future hydrological response. There remain few integrated long-term measurements across complex cold watersheds to empirically evaluate multiple hypotheses of change. In this work, we present multi-year hydrometeorological measurements across the montane 178 km^2 Wolf Creek Research Basin (WCRB), Yukon, Canada and focus on two questions: 1) What is the role of ecosystem and seasonality on the major of sources and sinks of water and solutes, and 2) what is the specific role of plants among ecozones that influence blue/green water fluxes. Across WCRB, streams were sampled for stable water isotopes, major ions, and dissolved organic carbon in combination is continuous and instantaneous discharge. Eddy covariance, sapflow and stable isotopes analyses were used in shrub and forest ecosystems to measure ecosystem evapotranspiration, direct transpiration and sources of water use. Results indicate that headwater sites contributed greater volumes of water, particularly during freshet, yet lake, wetland and lowland sites were greater sources of solutes and DOC. The leverage of ecosystems on water and solute load varied strongly by season. Headwater ecosystems that were dominated by shrubs and tundra received greater precipitation, had a shorter growing season, yet where present, shrub species were effective and transpiring large amounts of water with species specific differences. At lower elevations, ecosystem evapotranspiration was greater, yet forests were more sensitive to changes in soil moisture and more reliant on snowmelt water to sustain transpiration. The complex asynchronous nature of the water cycle in mountain basins suggest multiple confounding possible responses to ecosystem change, as vegetation strongly controls water partitioning and snowmelt processes, whereas soils and permafrost influence flow pathways, timing and solute fluxes. The need for comprehensive long-term data is critical, as inter-annual variability reveals considerable complexity in hydrological processes across scales.