Dramatic seasonality of biogeochemical signatures in watersheds underlain by permafrost

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High latitude watersheds experience two extreme seasons: 6-9 months of cold, snow covered winter and a warm, bright, summer. The spring freshet between these seasons is a dramatic two to three week period when up to three quarters of the yearly precipitation runs off. The summer to winter transition is far less remarkable as temperatures and light slowly decrease. The intense seasonality and transitions in Arctic rivers are associated with unique biogeochemical signatures, soil, weathering, and water column processes.

Discerning sources or fluxes of compounds out of Arctic rivers is difficult in large rivers because they represent the combined effect of innumerable plot-scale melt water sources, each coming from different soil and vegetation types and each experiencing a slightly different melt timing and evolution. Work at Arctic sites typically means field work in remote locations with sparse ancillary data and this provides added challenges.

Spring melt is characterized by an ionic pulse of solutes, dissolved organic carbon and other nutrients (ammonium, phosphate and nitrate) leached by snow melt water from the surface organic mat of vegetation and near-surface soil. Summer and fall flows are comprised largely of shallow flow from a deepening seasonally thawed ("active") layer. During late summer with an expanded active layer, or at sites where permafrost is degrading, these processes may be associated with an increasing mineral weathering signal into watersheds. The watershed biogeochemical response to precipitation in continuous and discontinuous terrains may also yield insight into subsurface permafrost geomorphological characteristics. Winter processes are the least studied or understood but overflow ice ("aufeis") provides access to deep, old waters.

This presentation will focus on using water stable isotopes, major ion concentrations, trace metals, nutrients, and permafrost delineation to identify biogeochemical sources in watersheds draining continuous and discontinuous permafrost. Field sites represent permafrost terrains in Alaska from the North Slope to the Interior. Biogeochemical processes associated with scaling, meteorology, and climate warming will be discussed.