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Arctic land cover change alters silica retention in terrestrial biomass and export rates to aquatic systems

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Human activities exert an unprecedented reach on the biosphere, a reach that is strengthening in many respects due to climate change. There is a growing body of evidence highlighting that human activities have a direct impact on the global silica cycle. In addition to river damming and nutrient over-enrichment, land cover change is another important way by which humans are altering silica exports from terrestrial to aquatic systems. Understanding the controls on silica exports from terrestrial systems has direct implications for silica availability and carbon cycling in coastal receiving waters, due to the reliance of diatoms on silica.
Due to rapid climatic warming, the Arctic is undergoing land cover change in the form of shrub expansion, increasing extent and frequency of wildfires, extended growing season length, and northern migration of the treeline. Moreover, permafrost thaw alters watershed hydrology by deepening flowpath lengths and soil-water interaction times. All of these changes are likely to alter rates of silica exchange between terrestrial and aquatic ecosystems.
This talk will synthesize recent findings from the Alaskan Arctic demonstrating how rapid climate warming and associated shifts in watershed land cover and hydrology is altering silica cycling in terrestrial and freshwater aquatic systems. We will present evidence demonstrating that shrub expansion and wildfire both serve to increase the amount of silica sequestered in land plants, strengthening the magnitude of the terrestrial silica pump at local scales. Conversely, degradation of permafrost results and deepening of the active layer increases total silica exports from terrestrial systems via rivers at larger regional scales. It remains to be seen whether small-scale increases in silica retention via land plants can offset larger-scale silica releases from thawing permafrost over time. I will also address the implications of these results in the context of the global silica cycle.