

Poster #19

Nitrate in a Changing Terrestrial Arctic

Jeffrey Heikoop^{1*}, Carli Arendt², Brent Newman¹, Rachael McCaully², Nathan Wales¹, Sanna Sevanto¹, David Graham³, Cathy Wilson¹, and Stan Wullschleger³

¹Earth and Environmental Sciences Division, Alamos National Laboratory, Los Alamos, NM

²Department of Marine, Earth and Atmospheric Science, North Carolina State University, Raleigh, NC

³Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Contact: jheikoop@lanl.gov

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In addressing questions of terrestrial Arctic wetting versus drying, the NGEE Arctic project has observed relationships between nitrate concentration and soil moisture. For example, in the drier centers and rims of high-, flat- and low-centered polygons in the Barrow Environmental Observatory (BEO) nitrate concentrations are significantly elevated (up to 34 mg/l). In surrounding saturated sediments nitrate concentrations are typically below detection. Nitrate concentrations were particularly high in high-centered polygons related to recent human disturbance outside the BEO (up to 88 mg/l), suggesting rapid increases in nitrate production associated with geomorphic change. Similar patterns were observed in microtopographic features at the NGEE Teller site in the Seward Peninsula. There, degraded peat plateaus represent microtopographic highs with lower soil moisture and detectable nitrate concentrations, whereas surrounding saturated soils have nitrate levels below detection. Nitrate concentrations and moisture content in peat plateau sediments were similar to those found in low- and flat-centered polygons in the BEO, despite being associated with very different vegetation communities. Moisture is clearly a first order control on soil nitrate concentrations at the BEO and Teller watershed. Drier, more oxic, environments are favorable for nitrate production from mineralization and accumulation of atmospheric nitrate inputs, with concentrations modified by demand from primary producers. Our studies at the Kougarok site, however, have shown no correlation between nitrate and soil moisture content in alder stands where nitrogen fixation introduces new nitrogen into soils. Moreover, initial results from this site suggest that interflow can transport nitrate downslope away from areas of production. Thus, alder encroachment can increase nitrate availability in downslope areas. Within the BEO, we also find that the relationship between nitrate and soil moisture is complex. The rims of drained thaw lake basins and drier drainage slopes, despite having lower moisture content, do not always have elevated nitrate concentrations, possibly due to vegetation differences. Moisture content, quantity and quality of organic matter, microbial community composition, vegetation, and hydrology are all potential controls on nitrate contents in Arctic soils, with different controls dominant in different environments. Each of these factors is expected to change as permafrost thaws, landscapes evolve, vegetation communities shift (e.g. shrubification), moisture is redistributed across the landscape. A fuller understanding of the factors that control nitrate (and other nutrients) in different permafrost environments will be essential in predicting future nitrate levels and attendant feedbacks on Arctic carbon cycling.