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# Effect of unsteady flow on nitrate loss in an oligotrophic, glacial meltwater stream

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The McMurdo Dry Valleys of Antarctica are among the coldest, driest ecosystems on Earth. During the austral summer, glacial meltwater supports cyanobacterial mat communities in some streams, but they are not ubiquitous. We conducted a nitrate(NO3)enrichment tracer injection in Huey Creek to quantify NO3 loss in a Dry Valley stream where algal mats would not obscure hyporheic microbial processes. Unsteady streamflow led to diel variability in the tracer concentration and in surface/subsurface water and solute exchange. Subsequently, concentrations of NO3, nitrite (NO2),ammonium (NH4+), and dissolved organic carbon (DOC)varied significantly during the injection, with a net loss of NO3, NO2, and DOC, and production of nitrous oxide. These mass changes within a reach were often coincident with high stream flows. Reactivity also coincided with the highest DOC concentrations, suggesting that DOM is the primary limitation to heterotrophic microbial activity in the stream. Together, streamflow and DOC availability create the hot spots and hot moments that dominate NO3 reactivity and removal in this polar desert ecosystem. The combination of spatially and temporally variable hyporheic dynamics and solute availability underscore the limitations of common nutrient uptake metrics and transient storage models when unsteady flow conditions exist.