Geophysical Research Abstracts
Vol. 13, EGU2011-8898, 2011
EGU General Assembly 2011


# Spatial and Temporal Distribution of DON and DIN in a Linked Stream-Lake Ecosystem

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The movement of nutrients between streams and lakes can impact nutrient export and aquatic ecology in linked stream-lake ecosystems. Specifically, lakes can alter water chemistry and buffer downstream export of nutrients through physical, chemical, and biological processes. This study characterizes nitrogen storage and transport dynamics in a connected stream-lake ecosystem over the summer of 2008 in the Bull Trout Lake Watershed in the Sawtooth Mountains of central Idaho, USA. Water samples were collected for chemical analyses at the lake inflow, outflow, and at six sites across the lake, on hourly to bi-weekly intervals. Lake sampling sites were each sampled at six depths in order to capture all strata of the lake. Additionally, a dye-tracer (Rhodamine-WT) was co-injected with LiCl into the lake to determine water flow-paths and residence time distributions. Inflow and outflow fluxes, spatial and temporal distributions of DON and DIN, as well as water residence times at different lake depths were evaluated. Over the summer of 2008, net influx of NO3 to the lake and net export of DON and NH4 from the lake was observed. While NO3 dominated the DIN fraction at the inflow, NH4 was dominant both at the lake outflow and within the lake, suggesting potential contributions of NH4 to the lake from adjacent wetland and groundwater sources. Differences in transport dynamics between NO3 and NH4, and temporal concentration dynamics both in the stream and lake support this hypothesis. NO3 concentrations were driven by snowmelt flushing and peaked with the hydrograph, subsequently declining for the rest of the summer. NH4 concentrations however remained stable and peaked three weeks after NO3 at the lake outflow, at a time when the contribution of snow melt water had declined and groundwater contributions increased proportionally. This demonstrates contrasting NH4 and NO3 dynamics. In the lake, NH4 and DON concentrations declined from the peak runoff period in May to mid July, and increased again to near peak levels by the end of August. Conversely, NO3 concentrations in the lake were below detection for most of the summer following snowmelt flushing. Spatial patterns in the distribution of NH4 and NO3 were weak across the lake, but DON concentrations increased with depth towards the end of summer. Residence time analysis demonstrated the existence of quick flow paths through the lake near the surface, and increasingly immobile water from a 6m depth to the lake bottom. Our research elucidates DIN dynamics in a low nutrient, linked stream-lake ecosystem and offers new insights how lakes can alter biogeochemical signals and buffer watershed nutrient export downstream.