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Biochemical characterization of particulate and dissolved organic matter in pre-alpine Lake Lunz

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Abstract
In this field study, we investigated how particulate organic matter (POM) and dissolved organic matter (DOM) quantity and its biochemical quality changed between lake inflow and outflow as well as within the oligotrophic, pre-alpine Lake Lunz, Austria, from 2013 to 2015.
We tested the hypothesis that irrespective of seasons, stream water recharging the lake contains predominantly recalcitrant POM (>1.2 µm particle size) and DOM (<0.2 µm), whereas outflowing lake water is mostly composed of more labile, algae-derived organic matter. Samples were collected at a monthly basis from the lake layers, inflowing and outflowing streams, and analysed for fatty acids as biochemical indicators of POM and optical indices and matrices for DOM quality. Results showed that increasing precipitation and runoff predicted significantly increasing inflowing concentrations of POM (r = 0.72, R_2=0.52, *Sig. F*<0.001) and DOC (r = 0.40, R_2=0.16, *Sig. F* =0.04). The lake retained ~58% of total imported POM, but exported ~3X, ~8X, and ~6X more bacterial fatty acids (BAFA), and algae-derived omega-3 PUFA and omega-6 PUFA, respectively, than the inflow. Long-chain saturated fatty acids (used as proxy for terrestrial organic matter) constituted ~9% in inflow and ~6% of total SAFA in the outflow. The optical characterization of DOM, as indicated by qualitative fluorophores, depicted that the prevalence of allochthonous DOM in inflow and hypolimnion was significantly higher than in the epilimnion and outflow (p<0.05).
The values of the humification (HIX) and biological indexes (BIX) also suggest that the inflow stream was a predominant source of terrigenous organic matter, whereas the epilimnion and outflow indicated a prevalence of high bacterial and algal derived DOM. In general, Lake Lunz exports on average 8X more labile POM (algae-derived) and DOM containing 21% less allochthonous and 35% more autochthonous organic matter than the inflow. These results suggest that the oligotrophic, pre-alpine Lake Lunz is a biochemical upgrader within the fluvial network of this drainage basin and supplies highly labile and nutritional POM and DOM to consumers further downstream, irrespective of the season.