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Spatio-seasonal variability in dissolved organic matter optical properties and its bioavailability in a subalpine lake

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Allochthonous and autochothonous dissolved organic matter (DOM) in lakes mainly originate from terrestrial and aquatic primary production, respectively. Due to their differing biochemical composition the degradability of DOM by microorganisms is expected to vary. The carbon use efficiency of bacteria and DOM biodegradability determine whether the consumed DOM is incorporated into microbial biomass or respired to CO_2 and ultimately emitted into the atmosphere. Thus, understanding the interaction of biodegradable DOM and its consumers is crucial to increase our knowledge on the role of lakes in the global carbon cycling. However, interactions of specific aquatic DOM signatures and the microbial population still remain widely debated.

The aim of this study was to explore how DOM biodegradability changes along a stream-lake continuum at different seasons of the year. We monitored DOM quantity and its optical properties, inorganic nutrients, CO_2 and bacterial growth over 20 days in dark bioassays with water from the inflow, outflow and at three layers of an oligotrophic subalpine lake. Preliminary results reveal highest microbial abundance in the metalimnion in winter and summer (0.7 10^6 and 2.5 10^6 cells mL^{-1}, respectively) and the inflow in spring and autumn (1 10^6 and 1.4 10^6 cells mL^{-1}, respectively) after 20 days. Surprisingly, with the exception of winter samples final inflow bacterial abundance results high, despite its lowest initial natural cell concentration, providing evidence for effective utilisation of terrestrial DOM, even with its high humic signature as indicated by the humification index (HIX). Nonetheless, after a microbial biomass peak with the inflow yielding mostly highest after three days, at the final experimental stage microbial biomass does only marginally differ between all sites with the exception of autumn samples where outflow and metalimnion turn out most productive. Even though the DOM of all lake sites and the lake outflow were characterised by lower molecular weight (indicated by the slope ratio (S_R)) and a higher autochthonous signature (BIX) in all seasons, rapid growth of inflow bacteria highlight the potential of terrestrially-derived DOM to support bacterial growth, and challenge previous ideas that autchthonously-produced DOM would be more labile than DOM of terrestrial origin.