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Short-term and long-term carbon dynamics in a northern peatland-stream-lake continuum – a catchment approach

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Northern forests and peatlands are globally significant elements in carbon (C) cycling. Recent research has also highlighted the role of aquatic ecosystems in landscape C budgets. We measured contemporary carbon dioxide (CO_2) and methane (CH4) exchange, lateral C transfer (dissolved organic carbon (DOC), CO_2, CH4), and long-term C accumulation in a peatland-stream-lake-continuum in north-boreal Finland. On an annual scale the peatland, a rich fen, was a relatively strong C sink (27 g C m-2a-1). The stream that traversed through the fen had high CO_2 and CH4 effluxes (on average 480 and 12 g C m-2a-1, respectively) to the atmosphere, while the small oligotrophic lake was a small C gas source per unit area (15 g C m-2a-1). A catchment C budget was compiled by supplementing these measured values with literature values for the forests. The aquatic C fluxes equaled $\sim$13% of the net C input by the forest and peatlands in the catchment and the largest component was the downstream transfer of DOC. This study supports the proposition that ignoring the aquatic component would result in an overestimated regional C uptake. The contemporary net C input estimate for the fen, after accounting for the C transfer, was larger than the long term C accumulation rate based on peat cores (22 v. 6.3–16.0 g C m-2a-1). This study provides reference values for both the contemporary C exchange and long-term C accumulation history, and the terrestrial-aquatic linkage from the boreal-subarctic ecotone, which is vulnerable to ongoing climatic change.