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Comparison of carbon emission and accumulation rates in sub-arctic lakes

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Lakes play an important role for the carbon cycling in the sub-arctic landscape by both storing carbon in sediments and by releasing carbon to the atmosphere. Still, our knowledge regarding the importance of carbon accumulation rates vs. carbon emissions in lakes is poor, restricting large scale assessment of source sink potential of lakes in the landscape. In this study we compare annual carbon accumulation rates and CO_2 and CH4 emissions to the atmosphere for six Swedish subarctic lakes. We measured the partial pressure of CO_2 (every second hour) during the ice free season. CH4 emissions were measured using floating chambers. Furthermore, we sampled sediment cores from each lake (one to three cores per lake depending on lakes sizes) and calculated the recent accumulation rate of carbon into sediments by dating each core, using 210Pb. Total annual carbon emissions (CO_2 + CH4) ranged between 5 to 54 g C m-2 yr-1; hence, all lakes were atmospheric net sources of carbon. Carbon emissions were overall dominated by CO_2 which made up to over 90 % of the total annual carbon emission in all lakes except one, having low CO_2 emission, where CH4 counted for 40% of the annual carbon emission. Sediment carbon accumulation rates were of comparable magnitudes as the emissions, counting for rates of 30 to 60% of the total carbon emission to the atmosphere. This results stress the dual role of subarctic lakes as they are acting both as atmospheric sources of CO_2 and CH4 and as significant storages of carbon in sediments.