

Land use change supersede the effect of atmospheric acid deposition and climate on browning of boreal lakes

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Organic carbon (OC) in freshwaters is of critical importance for global carbon cycling, drinking water treatment and ecosystem functioning. During recent decades, widespread increases in OC have been reported across the northern hemisphere. While several competing mechanisms have been proposed for this phenomenon, there is no agreed upon explanation for the widespread browning of freshwaters. Here, we show the overarching importance of land use change as a control on surface water browning using sediment OC reconstructions between 1200 A.D and the present. Our novel study set up consists of ten lakes in the same catchment area with similar climate and deposition histories but markedly different land use histories prior to 20th century. Our data show two distinct patterns in OC concentrations connected to intensified industrial forestry in the early 20th century. This management shift increased OC concentrations between 3-6 mg L⁻¹ during the same time as the second subarea with continuous production forestry had a continuous OC decrease of 0-12 mg L⁻¹ related to historical lake acidification. Complementary sediment metal analysis provided further evidence of substantial land use effects. We conclude that land management is possibly the most important and underappreciated driver of historical and future changes in OC concentrations in surface waters. Land use change will be of great importance for future biogeochemical cycles in the natural environment and the potential for change to the global carbon cycle caused by land conversion must be included in any assessment of environmental impacts.