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Increasing organic C and N fluxes from a northern Boreal river basin - monitoring and modelling suggest climate related controls

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Increasing trends in total organic carbon (TOC) concentrations in lakes and streams across northern Europe and North America have been reported. Various hypotheses including enhanced decomposition of organic soils, changes in hydrology and flow paths, decreased acid deposition and land use changes have been put forward to explain the widespread occurrence of this phenomenon. Both observational and modelling studies are needed to identify the most important drivers and relevant processes controlling observed trends in TOC concentrations.

Typically, TOC concentrations in Finnish rivers and lakes are high. The Simojoki river basin (3160 km2) is located in the northern Boreal zone of Finland and experiences low, declining sulphate deposition and limited other human impacts. Forest harvest, land drainage and ditch maintenance are the main land management activities in the catchment. Long-term changes (30-40 years) and seasonal trends of total organic nitrogen (TON) and carbon (TOC) concentrations and fluxes in the Simojoki river system were studied. Concentrations of TOC and TON increased particularly during high flows. TOC concentrations are slowly but continuously increasing, fluctuating between droughts and wet periods. The highest concentrations were detected in 1998-2000 during a period of very high flows, after the drought period 1994-1997. Trends in concentrations of TOC and TON in Simojoki were not linked to declines in sulphate deposition but were more related to trends in climate and hydrology. The autumn season is particularly sensitive to climate change impacts. The INCA-C model was applied to simulate TOC dynamics in the catchment. Model results showed that climate change driven patterns in runoff and soil moisture and soil temperature were more important than temporal patterns of sulphate deposition and land management in controlling surface water TOC concentrations. The possible factors behind changes of TOC and TON concentrations and increasing fluxes to the coastal areas are discussed.