Nonlinear response of dissolved organic carbon concentrations in boreal lakes to increasing temperatures

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ABSTRACT: Recent increases in concentrations of dissolved organic carbon (DOC) in lakes and rivers over large regions have been related to both changes in the climate and in atmospheric deposition chemistry. Using a data set of 1041 boreal lakes along a 13° latitudinal gradient, sampled in 1995, 2000, and 2005, and an additional data set of 90 lakes along a 1000-m altitudinal gradient at 68° N, we show that DOC concentrations increase in a nonlinear way along a latitudinal and altitudinal temperature gradient. The nonlinear relation of DOC to increasing temperatures was consistent over space and time. Out of 14 meteorological, catchment, morphometric, and atmospheric deposition variables tested, the variable best explaining this kin of nonlinear pattern was the number of days when air temperatures exceeded 0° C, i.e., the duration of the main growing and runoff season ($D_{T>0}$). Using $D_{T>0}$ as an input variable, we were at to predict the nonlinear temperature response of DOC concentrations, both spatially (R^2 = 0.90, < 0.0001) and temporally (R^2 = 0.90, $p < 0.0001$). $D_{T>0}$ has an advantage over other variables becaus it includes the time factor, which is decisive for the duration that biogeochemical processes ca take place. We suggest that DOC concentrations in lakes are influenced by climate change and that present temperature increases over Sweden result in an accelerated DOC increase toward warmer geographical regions.