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Climatic and chemical drivers of trends in DOC in northern surface waters in Europa and North America

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Concentrations of DOC in boreal surface waters have increased to levels that create challenges for water treatment plants, and that potentially impact lake habitat through increased anoxia and thermal mixing, and productivity. Aquatic transport of DOC from land to oceans is likely to increase, even if runoff patterns would remain stable. Reduced acid deposition appears to be a dominant driver behind the increase in DOC concentrations, through increasing organic matter solubility. We hypothesize that the higher solubility of organic matter makes DOC more susceptible to climate change.

Here, we present trends in DOC from circa 500 lakes and streams in subarctic, boreal and temperate headwater catchments in Europe (UK, Fennoscandia, Czech Republic, Slovakia) and North America (Northeastern US, Ontario, Atlantic Canada) from 1990 until 2012; an extension of the trend analysis presented in Monteith et al. (2007). The water chemical data stem from national monitoring networks, assembled by the ICP Waters network. Sampling frequencies vary from 1 to 52 samples per year. Climate data were obtained from Climate Research Unit in the UK. Trends were calculated using the Mann-Kendall test and the Sen-slope estimator. We test 1) if DOC responds to changes in the rate of decline in acid deposition, and 2) if trends in temperature and precipitation affect trends and variability in DOC.

Positive trends dominate: the median ($\pm$2.5% quartile) of the absolute and relative DOC trends is +0.06 (+0.36 to -0.02) mg C L^{-1} yr^{-1} and +1.4 (+4.7 to -0.9) % yr^{-1}, respectively. Overall, the trends do not level off when comparing 1990-2004, and 1998-2012, except in the UK and Atlantic Canada. These two regions are strongly impacted by seasalt deposition but may also experience stronger warming than elsewhere. The response of DOC to changes in SO_4 (expressed as trend ratios) is stronger in 1998-2012 than in 1990-2004. We will explore whether this changing relates to increasing dominance of drivers, such as temperature or precipitation, and will present multivariate models of DOC trends in relation to climate and deposition.

References

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