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Understanding drivers of the export of dissolved organic carbon from headwater catchments in Germany using Generalised Additive Models

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In the literature, several causes of recently increasing concentrations of dissolved organic carbon (DOC) in headwaters across eastern North America and northern and central Europe have been debated. One likely driver of the widespread increase of DOC concentrations since the early to mid 1990s are decreasing depositions of acid rain resulting in an increased solubility of organic carbon compounds including humic acids. Here, we tested the hypothesis if the reduced availability of both nitrate and sulfate stimulated the reduction of ferric iron soil minerals and the mobilisation of DOC. Decreasing depositions often resulted in a reduced availability of both nitrate and sulphate, which are preferred electron acceptors in microbial decomposition processes. As iron minerals act as efficient sorbents of organic compounds in soils its reduction may have caused a release of humic substances and hence an increasing export of DOC from headwater catchments. To test this hypothesis, time series of DOC, dissolved iron, sulfate and nitrate from several German headwater catchments were examined using Generalised Additive Models. Using this modelling technique, discharge corrected time series of concentrations were represented as a sum of a seasonal and a non-linear trend component. Both, the computed trends and seasonalities supported the redox hypothesis.