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Understanding drivers of the export of dissolved organic carbon from a German headwater catchment 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 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 nitrate stimulated the microbial reduction of ferric iron soil minerals and the mobilisation of DOC. Forested catchments are relatively unaffected by agricultural and urban nitrate inputs. In these catchments, decreasing depositions often resulted in a reduced availability of nitrate, which are preferred electron acceptors in microbial decomposition processes. As ferric iron minerals act as efficient sorbents of organic compounds in soils its reduction may cause a release of humic substances and hence an export of DOC. To test this hypothesis, time series of DOC, dissolved iron and nitrate from a forested headwater catchment in Germany were examined using Generalised Additive Models. We found that rising DOC concentrations most likely resulted from a reductive dissolution of iron(III) minerals in soils and the associated mobilisation of adsorbed organic carbon. Phosphate, which can trigger undesired algal growth and is also known to be adsorbed by particulate iron(III), was released as well.