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Soil-solution partitioning of DOC in acid organic soils: Results from a UK field acidification and alkalization experiment

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Dissolved organic carbon (DOC) is an important component of the global carbon (C) cycle and has profound impacts on water chemistry and metabolism in lakes and rivers. Reported increases of DOC concentration in surface waters across Europe and Northern America have been attributed to several drivers; from changing climate and land-use to eutrophication and declining acid deposition. The last of these suggests that acidic deposition suppressed the solubility of DOC, and that this historic suppression is now being reversed by reducing emissions of acidifying pollutants. We studied a set of four parallel acidification and alkalization experiments in organic rich soils which, after three years of manipulation, have shown clear soil solution DOC responses to acidity change. We tested whether these DOC concentration changes were related to changes in the acid/base properties of DOC. Based on laboratory determination of DOC site density (S.D. = amount of carboxylic groups per milligram DOC) and charge density (C.D. = organic acid anion concentration per milligram DOC) we found that the change in DOC soil-solution partitioning was tightly related to the change in degree of dissociation (α = C.D./S.D. ratio) of organic acids (R2=0.74, p<0.01). Carbon turnover in soil organic matter (SOM), determined by soil respiration and β-D-glucosidase enzyme activity measurements, also appears to have some impact on DOC leaching, via constraints on the actual supply of available DOC from SOM; when the turnover rate of C in SOM is low, the effect of α on DOC leaching is reduced. Thus, differences in the magnitude of DOC changes seen across different environments might be explained by interactions between physicochemical restrictions of DOC soil-solution partitioning, and SOM carbon turnover effects on DOC supply.