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Connecting terrestrial-aquatic Dissolved-Organic-Carbon dynamics.

Summary

Waters in the northern hemisphere are getting browner because of increased runoff of Dissolved Organic Carbon (DOC). Exact reasons for this increase are still debated, but the source of the DOC is determined to be terrestrial. Soils play an important role in the export of DOC from land to inland waters, as they can both act as a source of DOC through leaching, or as a (temporary) sink through a process called DOC sorption – which binds DOC to soil particles. Here we have found that DOC leaching in the boreal forest soils consists only of fairly recent captured carbon leached mainly from the top soils. However, mineral subsoils still maintain the ability to leach DOC – as shown by our disruptive leaching experiments. While the B horizon consists of slightly older carbon compared to the topsoil, the horizon separating the top and B horizon has an age of roughly 1000 years old. Even more surprisingly the amount of E leaching is equal to the amount of leached DOC from the B horizon. In both cases, however, it is not the old carbon that is leached, but rather the relative new carbon that can be extracted. This means that in future climate scenarios there might be less capture of DOC by soils if leaching increases as a result of increased precipitation, but it is unlikely that old carbon will be released unless there is erosion of the soils itself.

Introduction

Dissolved Organic Carbon (DOC) in inland waters has been increasing across the northern hemisphere during the past decades (Hongve, Riise, & Kristiansen, 2004; Kritzberg & Ekström, 2012; Worrall & Burt, 2007). An increase in DOC in inland waters can deteriorate water quality by 'brownification', with possible negative effects on drinking water quality, increased CO_2 emissions and disruptions of the aquatic food web (Köhler, Kothawala, Futter, Liungman, & Tranvik, 2013; Roulet & Moore, 2006). Although the actual cause of the increase is debated, the source of the DOC is known to be mainly terrestrial. Furthermore with increasing environmental changes in the northern ecosystems a severe increase in DOC export from land to lakes and rivers is predicted (Larsen, Andersen, & Hessen, 2011).

In this project we set out to increase knowledge about potential DOC production of soils in the boreal forest and help gain insights useful for the prediction and modelling of DOC dynamics across the terrestrial – aquatic interface. The main approach; using unique cross-analyses based on the stable ^{13}C and ^{14}C DOC analyses, decay experiments and chemical characteristics.

Findings

In our experiments we have found that the A horizon, a fairly decomposed and compacted horizon, leaches the highest amounts of DOC per gram of dry weight, followed by – but with approximately two times higher leaching rates as - the relative newly formed organic horizon. Taking into account the predominate mineral nature of the subsoils (E and B) we still found they can leach DOC at approximately 5% of organic horizon capacity. In terms of weight and size the subsoil can, however, be much larger than the relatively small organic topsoil. All

leached DOC was of relative young ages, regardless of the age of the soils itself. This indicates that leaching of DOC across soil-layers comes from recently captured carbon and that old carbon is not likely to be exported from soils unless the soils themselves are eroded.

Scientific output

The data gathered in this project will be published in a scientific journal, scheduled at the end of 2018. Data collected will be freely available for the modelers working on the DOC module of the dynamic vegetation model LPJ-Guess or with the ForSafe model.