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Biogeosciences Discussions

Interactive comment on "Three representative UK moorland soils show differences in decadal release of dissolved organic carbon in response to environmental change" *by* M. I. Stutter et al.

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We welcome the recognition that this paper makes a contribution in highlighting the role of podzolic upland soils in DOC loss, the importance of long term monitoring of soils for process understanding and a need to promote and collate a similar set of wider global data on soil C change. Using this new fundamental data set of soil solution DOC we have attempted not to reproduce previous analyses looking at single sets of processes, or drivers, but instead to try to portray the true complexity of the physical, geochemical and biological processes affecting DOC solubility. Taken together these inter-related C release processes are impacted by many simultaneous environmental change drivers

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across multiple time-scales, acting either additively, synergistically, or antagonistically. We acknowledge both reviewers' feelings that this attempt to introduce these multiple aspects has produced a paper that is dense with results and concepts. However, we strongly believe that it is not until these factors are considered together, by monitoring programmes, empirical scientists to model developers, that the science for DOC will progress. One aspect of this is the understanding of 'tipping points' where a number of processes seem to act synergistically to cause a stable elevated baseline solubility state. In our revised paper we will aim to clarify some of the geochemical modelling used to support the explanations of the data as suggested by reviewer 2.

The conclusions that soil type should be better incorporated into catchment to global C release models are recognised as important by both reviewers. In the revision of the paper we will aim to place these conclusions in a better context of current modelling limitations and ways to develop future models. The following gives examples of our proposed arguments. The available data allowed us to compare C solubility and controlling processes in the upland mineral podzols compared to the more frequently studied peat. The observations of greater DOC change in the freely draining podzol compared to wetter humic rich soils has relevance to modelling at global scales, due to the prevalence of upland podzols in northern ecosystems where stream DOC rises have been most noticeable, and plot to catchment scales, for local predictions of environmental change impacts. It should also be considered that C density in podzol subsoils can exceed that of peat due to the much greater bulk densities of podzols. Our data suggest the varied nature of sorption and decomposition conditions in podzols and their strong controls on DOC production, solubility and transport. This provokes a challenge for linking geochemical solubility, biological decomposition and transport models together with spatial soil properties data. We have highlighted some current models and previous attempts to unite geochemical and biological processes. Yet bringing these detailed process models to C simulations and predictions at the landscape scale (across soil property changes in upland peat-organo-mineral and upland-agricultural transitions with coupled hydrology has not been achieved. These are the modelling applications we hope

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data such as ours will allow to develop. Reviewer 1 points out that prediction of soil organic matter stability has conventionally used basic soil properties of clay content, soil moisture and particle size. These considerations for mineral soils have come from the development of organic matter turnover models used predominantly in lowland soils (such as Century and RothC). Yet we have shown how turnover models must be developed for upland mineral soils introducing vital new properties such as reactive Fe compounds, Al complexation, SO4 sorption competition, redox and DOC fractions of a spectrum of solubilities. It will be necessary though to strike a balance between the representations of complex spatially- heterogeneous interactions for DOC release in models and model 'usability' at appropriate landscape scales.

Interactive comment on Biogeosciences Discuss., 8, 7823, 2011.