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Representation of N and DOC leaching in the JULES-DOCN model

Mahdi Nakhavali (1), Ronny Lauerwald (2), Sarah Chadburn (1), Anna Harper (1), Pierre Regnier (2), and Pierre Friedlingstein (1)

(1) University of Exeter, Physics and mathematics, EXETER, United Kingdom (m.nakhavali@exeter.ac.uk), (2) Biogeochemistry and Modelling of the Earth System, Department Geoscience, Environment and Society, Université Libre de Bruxelles, Bruxelles, Belgium

A fraction of the terrestrial uptake of CO_2 is displaced as organic carbon along the terrestrial-aquatic continuum which represents an important link in the global carbon (C) cycle (Battin et al. 2009; Regnier et al. 2013). This lateral export is important for the terrestrial C budget, but hard to assess based on empirical methods (Regnier et al. 2013). Leaching of dissolved organic carbon (DOC) from soils to rivers accounts for an important fraction lateral C fluxes, and is assumed to drive a large proportion of the net-heterotrophy of river systems and the related CO_2 emissions (Battin et al., 2008).

The degradability of DOC produced in and leached from the soil is largely depending on the C:N ratio of plant litter and soil organic matter. Higher C:N ratios lead to increased production of more refractory DOC (Sanderman et al. 2009; Van den berg et al. 2012), and by that to higher DOC concentrations in the soil solution, in the leaching flux and in the receiving surface waters.

Here, we introduce the new land surface model JULES-DOCN which simulates the coupled cycling of C and N in vegetation and soils, including the cycling of DOC and dissolved organic N in the soil column, and finally the leaching of DOC and dissolved N from soils to the inland water network. Upscaling from observed values used for calibration and validation, we use this model to assess the present-day DOC and N leaching fluxes in their spatial and seasonal variability at global scale. We further investigate the role of N-availability and vegetation types for the decomposability of DOC leached into the river network.

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