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Global soil Dissolved Organic Carbon model – JULES-DOCM

Mahdi Nakhavali (1), Ronny Lauerwald (1), Sarah Chadburn (1,2), Bertrand Guenet (3), Pierre Regnier (4), and Pierre Friedlingstein (1)

(1) College of Engineering, Mathematics and Physical Sciences, University of Exeter, Exeter, United Kingdom (m.nakhavali@exeter.ac.uk), (2) School of Earth and Environment, University of Leeds, Leeds, United Kingdom, (3) Laboratoire des Sciences du Climat et de l'Environnement, LSCE/IPSL,CEA-CNRS-UVSQ, Université Paris-Saclay, 91191 Gif-sur-Yvette, France, (4) Université Libre de Bruxelles, Brussels, Belgium

Current global carbon (C) models are not representing the fraction of C which is displaced along the terrestrial-aquatic continuum thus overestimating the land sink capacity. In order to obtain more reliable C budgets, we need to integrate the lateral transfers of C from terrestrial ecosystems through the inland water network down to the oceans, including biogeochemical transformation during transport and C exchange with the atmosphere. Representing the production and cycling of dissolved organic C (DOC) in the soil column and the leaching of DOC into the inland water network is a first major step in this development.
In this study, we use the newly developed model JULES-DOCM to provide the first global map of soil DOC concentrations. JULES-DOCM represents DOC production from soil organic C (SOC) decomposition, ad-/desorption and diffusion of DOC in soil, DOC decomposition and its leaching out of the soil to the water system. It represents all these processes based on a 3-meter soil profile.
JULES-DOCM has so far been calibrated and tested at plot scale using a few sites in the temperate zone. Here, based on an extensive literature review on soil DOC measurements, we optimized the model performance for the global scale, re-calibrating DOC decomposition and production rates for each of the 9 plant functioning types (PFTs) distinguished in the model. Latin hypercube method was used to explore the parameter space and optimise the parameters for each PFT, minimizing the root mean square error (RMSE) between model's simulations and observations. Hence the combination of parameter sets for each PFT with the lowest RMSE was used for the global scale simulation.
Results shows that the model is capable of reproducing the large-scale patterns of the soil DOC concentrations in both top and bottom soil layer. As an outcome, we provide the first global map of soil DOC concentration which could be used by the scientific community studying C cycling and soil biogeochemistry at regional to global scales.