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Riverine dissolved organic carbon model as a link of terrestrial carbon and hydrology within MPI-ESM

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The current state of the art Earth System Models (ESMs) do not simulate the lateral transport of terrestrial carbon to oceans via the global river network as the carbon cycle is primarily evaluated based only on vertical gas exchange processes between atmosphere and land. Particularly in high latitudes, the interaction between permafrost and lateral hydrology is a substantial factor impacting the organic carbon inflow to the Arctic Ocean and its associated atmospheric exchange.

This study quantifies the riverine transport of terrestrial soil organic carbon to the oceans using the hydrological discharge scheme (HD Model) of MPI-ESM (Max-Planck Institute for Meteorology Earth System Model). The terrestrial soil carbon classification is based on the YASSO scheme. The water-soluble fraction of the soil carbon pools is attributed to the dissolved organic carbon (DOC) flushing into the rivers via runoff (fast carbon pool, above ground) and base-flow (slow carbon pool, below ground). The HD model, which simulates the river discharge for all land areas at a resolution of 0.5 degree, is extended with the carbon cascade (transport) scheme. The flow properties of the transported soil organic carbon are the same as for the transported water depending on terrain slope and reservoir storage. The fraction of available water soluble soil carbon as a source for transport into the river stream is evaluated by model sensitivity tests in comparison to observations and previous studies over selected river basins. For river basins in high latitude areas influenced by permafrost, the availability of liquid water in comparison to ice is considered as a change in source of terrestrial soil organic carbon entering the river system. The study is aimed to derive a global distribution of model derived terrestrial DOC concentration together with the DOC seasonality over major river networks. The simulation of carbon transfers along the terrestrial-aquatic continuum over tropical and high-latitude river reservoirs will be evaluated based on observations (Arctic Great Rivers Observatory data) as well as on similar studies by other ESMs.