Geophysical Research Abstracts
Vol. 20, EGU2018-13511, 2018
EGU General Assembly 2018

Global distribution of riverine DOC concentration: Coupling terrestrial carbon and lateral hydrology in MPI-ESM

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The interplay of lateral transport of terrestrial carbon to oceans via the global river network is not quantified in the current state of the art Earth System Models (ESMs). The global carbon cycling is primarily evaluated based only on vertical gas exchange processes between atmosphere and land or ocean carbon reservoirs. In high latitudes, the permafrost plays an important role in contributing to riverine organic carbon. Moreover, the vertical gas exchange processes are active during the lateral riverine carbon transport but are not considered in the impact of thawing permafrost on global climate. The interaction between permafrost and lateral hydrology is a substantial factor impacting the organic carbon inflow to the Arctic and its associated atmospheric exchange.

This study proposes a framework of coupling the soil carbon transport to the oceans via rivers using the hydrological discharge scheme (HD-Model) of MPI-ESM (Max-Planck Institute for Meteorology Earth System Model). The soil carbon classification is based on the solubility properties (YASSO soil carbon pools) and their subsequent attribution to the dissolved organic carbon (DOC) via runoff (fast carbon pool) and baseflow (slow carbon pool). The HD-model, which simulates the river discharge for all land areas at a resolution of 0.5 degree, will be modified with separation of discharge over land surface (runoff) and below the land surface (drainage). The DOC concentration depends on soluble soil carbon and the respective hydrological flow. Water soluble soil carbon availability is defined using an empirical approach with in-situ DOC concentration values at reservoir scale. The analysis will include major global river networks for DOC transport with focus on permafrost and high latitude areas. The model results will be compared with observations (Arctic Great Rivers Observatory data) as well as similar studies over other ESMs.