Geophysical Research Abstracts
Vol. 21, EGU2019-13946-1, 2019
EGU General Assembly 2019

Quantifying daily dissolved organic carbon exports in watersheds at global scale

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Organic carbon exported from rivers to oceans is a main driver of biogeochemical exchanges in the hydrosystems food web. Organic carbon is exported from rivers to oceans in two forms, the dissolved organic carbon (DOC) and the particulate organic carbon (POC). Organic carbon fluxes going from lands to oceans by rivers represent 0.3 to 0.6 PgC.yr-1 with 0.2 PgC.yr-1 of DOC and 0.1 to 0.4 PgC.yr-1 of POC but these exports are highly variable depending on time and pedo-climatic conditions. Climate change could have an impact on these fluxes, which could have a feedback effect on climate evolution at a global scale. This study tries to understand the complex processes at daily time scale involved in DOC exports to the oceans among 156 watersheds presenting different soil and meteorological conditions and more than 90% of water fluxes to the oceans. The DOC export equation has been adapted from the Michaelis-Menten equation. The results reveal that the model can represent fluxes of DOC at a daily time step for different watersheds in the world under different pedo-climatic properties. We have identified that the rivers present different behaviors regarding DOC concentrations based on the Köppen climate groups. The total export returned is about 0.11 PgC.yr-1 which is in the range of previous global estimates. The exports are more important in the tropical and the cold zones than in the arid and temperate zones with average contributions of 56 % and 32.4 % of the global flux for tropical and cold areas, 10.9 % of the total flux for temperate zones and 0.7 % for arid basins. At a daily time step, the cold basins present an important increase in DOC exports in April and May due to the freshet. The tropical areas present slow increase and decrease in the exports with a peak during the period between May and September. The temperate basins return lower exports than the tropical watersheds but present a similar duration in the peak with higher exports between March and July. Finally, the arid basins present a short export in October. Besides, at a continental scale, the DOC exports are more important from European, South American and Asian rivers while, at an ocean scale, the Atlantic Ocean is by far the most fed in DOC. This approach could be introduced in hydrological models to study DOC flows in a context of climate change.