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Organic carbon transport through a discontinuous fluvial system in a Mediterranean catchment after a greening-up process

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Quantification of different organic carbon pools mobilized by lateral fluxes is important to close organic carbon (OC) budgets at the catchment scale. This quantification helps to identify in which forms OC is transferred, deposited, and mineralized during the erosion cycle. Many Mediterranean mountain catchments have experienced important land use changes in the last 50 years leading to a recovery of the vegetation in many cases. Furthermore, many of them are characterized by stream discontinuity with high runoff rates responding to intensive hydrological pulses. There is a current lack of knowledge on fluvial OC fluxes and their relation to soil organic carbon stocks in these systems. The objective of this research was to quantify the amount of organic carbon transported by these systems in a catchment representative of Mediterranean conditions and to explore how intermittent fluvial systems can affect organic carbon transported by lateral flows. During six years OC fluvial fluxes in a catchment of 77 km2 in SE Spain were monitored. The catchment experienced a greening-up process in the last 50 years through a conversion mainly from agricultural use (decrease 44%) to forest (increase 45%). Data on water discharge, sediment concentration, total organic carbon (OC) of suspended sediments and dissolved organic carbon (DOC) were collected throughout 32 rainfall events and 13 sampling periods with base flow conditions. The data were collected from two monitoring stations located on two nested subcatchments covering permanent and ephemeral flow conditions. We found no significant differences in OC concentrations in suspended sediments (10.1 $\pm$ 5 g kg-1) and DOC (0.014 $\pm$ 0.010 g kg-1) between the ephemeral and the permanent streams. However, sediment concentration, index of aggregation and silt content of suspended load were significantly higher in the ephemeral stream than in the permanent one. OC concentration of suspended sediments was much lower than OC concentration of the catchment soils (20.5 $\pm$ 7 g kg-1), and it showed a strong positive correlation with clay content. DOC concentrations were quite high, being in the upper limit of the mean values reported for European rivers and close to DOC values of runoff generated in natural forests from similar areas. A strong positive correlation between DOC and sediment concentration was also observed. DOC represents a 20% and 12% of the total OC fluvial flux in the permanent and ephemeral streams, respectively. OC in suspended solids represents an 80% and 88% of the total OC fluvial flux in the permanent and ephemeral streams, respectively. The ephemeral stream (with a contribution of 70% to the total catchment area) provides up to 20% to the total transported OC downstream. The OC transported to the catchment outlet (1.97 g C m-2 year-1) constitutes 33 % of the OC lateral flux mobilized in the upper subcatchment areas (6 g C m-2 year-1). These findings highlight the strong dynamic character of organic carbon during transport in these fluvial systems and the important role of the hydrological regime for carbon transport and stability.