Eco-hydrological soil carbon fluxes in established Nature-based solutions for soil protection

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Nature-based solutions (NBS) for soil protection generally involve planting trees to provide effective soil reinforcement, stability and resilience over time. Atmospheric carbon accumulates in both plant and soil materials as the tree cover develops and establishes on a given NBS. However, the carbon stored in a given NBS is subjected to continue cycling as a result of decomposition and soil respiration processes, both linked to the soil’s water content. Consequently, carbon cycling rates within NBS could be regulated by the partition of rainfall into throughfall, dripfall and stemflow at the tree’s canopy. Yet, quantification of soil carbon fluxes related to eco-hydrological processes occurring at the plant-soil-atmosphere interface is rare and needs further investigation. As a result, a figure on the carbon footprint of NBS remains inaccurate. The aim of this study was to quantify soil carbon fluxes under changing meteorological conditions in a tree-vegetated embankment to ascertain the effect of rainfall partition at the tree’s canopy on carbon cycling. To this end, we investigated rainfall partitioning and soil carbon fluxes under six adult tree individuals of Populus nigra L., Dyospiros kaki Thunb., and Melia azedarach L. growing on an embankment in Xuzhou, China. The results showed that soil carbon fluxes were substantially higher on rainy days than on dry days. Nonetheless, we did not find convincing evidence suggesting that rainfall partition at the trees’ canopy contributed to the regulation of the soil carbon cycle. Herein, we discuss experimental limitations that should be addressed in future work to verify the eco-hydrological effect of vegetation on soil carbon fluxes in established NBS, as well as approaches for quantifying the carbon footprint of NBS.