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Pulsed terrestrial organic carbon persists in an estuarine environment after major storm events

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The transport of dissolved organic carbon from land to ocean is a large and dynamic component of the global carbon cycle. Export of dissolved organic carbon from watersheds is largely controlled by hydrology, and is exacerbated by increasing major rainfall and storm events, causing pulses of terrestrial dissolved organic carbon (DOC) to be shunted through rivers downstream to estuaries. Despite this increasing trend, the fate of the pulsed terrestrial DOC in estuaries remains uncertain. Here we present DOC data from 1999 to 2017 in Neuse River Estuary (NC, USA) and analyze the effect of six tropical cyclones (TC) during that period on the quantity and fate of DOC in the estuary. We find that TCs promote a considerable increase in DOC concentration near the river mouth at the entrance to the estuary, on average an increase of 200 $\mu\text{mol l}^{-1}$ due to storms was observed. TC-induced increases in DOC are apparent throughout the estuary, and the duration of these elevated DOC concentrations ranges from one month at the river mouth to over six months in lower estuary. Our results suggest that despite the fast mineralization rates, the terrestrial DOC is processed only to a minor extent relative to the pulsed amount entering the estuary. We conclude that the vast quantity of organic carbon delivered to estuaries by TCs transform estuaries from active biogeochemical processing “reactors” of organic carbon to appear more like passive shunts due to the sheer amount of pulsed material rapidly flushed through the estuary.

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