COMPARISON OF PARTICULATE AND DISSOLVED ORGANIC CARBON EXPORTS FROM FORESTED PIEDMONT CATCHMENTS

by

Gurbir Singh Dhillon

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ABSTRACT

While much is known about dissolved organic carbon (DOC), considerable uncertainty exists regarding the relative contributions of particulate organic carbon (POC) to the total organic carbon (C) flux, especially from small, headwater catchments. This study investigated the temporal patterns and relative contributions of POC and DOC to storm runoff from two (12 and 79 ha) nested, forested catchments in the mid-Atlantic, Piedmont region of USA. A total of 14 storm events were sampled over a 16-month period extending from September 2010 to December 2011. The POC and DOC in runoff samples were separated using a 0.45 μm filter. While the concentrations of both DOC and POC increased with storm-event discharge, the increase in POC concentrations was greater and occurred earlier on the rising limb of the hydrograph. DOC concentrations peaked at or after the discharge peak. End-member mixing analyses suggested that POC transport occurred with surface runoff delivering carbon-rich forest floor material to the stream, whereas DOC export was facilitated by surface runoff and rising groundwater that leached accumulated DOC from surface soil horizons.

Peak POC concentrations decreased with closely spaced, successive storm events whereas no such decrease in concentrations was observed for DOC. On the other hand, very large events with peak discharges exceeding 3mm/hr (storms

associated with remnants of hurricanes) produced a dilution in DOC concentrations at peak flow whereas POC concentrations continued to increase. These results suggest that there are important differences in the storage pools and leaching rates and kinetics for POC and DOC. Concentrations of both POC and DOC decreased with increasing catchment scale (12 to 79 ha) but there was a sharper drop in POC concentrations. POC: DOC ratio dropped from 4.3 at the 12 ha catchment to 2.5 at the 79 ha catchment.

Export of POC and DOC from the study catchment was estimated to be 34 kg C ha^{-1} yr^{-1} and 17.5 kg C ha^{-1} yr^{-1} respectively. Thus, POC was the dominant form of organic carbon export. During stormflow conditions, POC accounted for 84% of the total organic carbon flux from the watershed during storm events. The three largest events in terms of sampled event precipitation (48% of total precipitation) contributed to 84 % and 63 % of the storm-event exports of POC and DOC, respectively. Flow-duration analysis revealed that 90 % of POC and 75 % of DOC was exported during storm flows that were exceeded less than 10 % of the time. These results underscore the importance of POC for the total carbon flux during storm events, as well as the dominant role of large, high-intensity storm events for C flux from catchments. Large, high-intensity storm events that are predicted to increase under future climate-change scenarios will likely enhance the storm-induced carbon flux from catchments with substantial contributions from POC. This study also suggests that POC in headwater catchments could be an important component of fluvial C cycling and its interactions with the atmospheric carbon stores.