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Downstream alterations in biodegradability and optical characteristics of dissolved and particulate organic carbon fractions exported during storm events in a mixed land-use watershed

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Although storm pulses of dissolved organic carbon (DOC) and particulate organic carbon (POC) can account for a significant C loss from the terrestrial sink of atmospheric CO_2, there have been rare attempts to compare the biodegradation and chemical transformation of terrestrially derived DOC and POC in receiving waters. Short-term laboratory incubations were performed with water and sediment samples collected during intense monsoon rainfalls at four stream locations in a mountainous, mixed land-use watershed, Korea to compare biodegradation and optical properties of DOC and POC exported from different sources. Biodegradable DOC (BDOC) and fluorescence EEMs coupled with PARAFAC modeling in either bulk or flow field-flow fractionated samples were measured to track changes in biodegradation and optical characteristics of DOC and suspended sediment-derived DOC (SS-DOC). During a 30 day incubation at 25 °C, both DOC and POC from a forested headwater stream initially exhibited rapid biodegradation of labile components, whereas sediment-derived materials increased continuously not just DOC concentrations, but also fulvic- and humic-like fluorescent components. In the second 13-day incubation with DOC and POC samples from a forest stream, an agricultural stream, and two downstream rivers, the BDOC of filtered waters differed little between sites, whereas the BDOC of SS-DOC was higher in downstream rivers. Higher ratios of protein- to fuvic- or humic-like fluorescence in the SS-DOC from two downstream rivers compared to upstream measurements pointed to a higher contribution of labile organic components to the biodegradation of SS-DOC from the downstream rivers. Downstream increases in labile moieties of SS-DOC were also observed in fluorescence measurements of field-flow fractionated samples. The results suggest that storm pulses of POC contain labile organic components that are increasingly released from downstream sources and can rapidly change in optical properties during riverine transport.