BIOGEOMON Abstract

Multiple Lines of Evidence Elucidate Sediment and Phosphorus Dynamics in Midwestern USA Watershed

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Many agricultural and mixed land use watersheds within the midwestern USA have water quality concerns regarding sediment and phosphorus. Export of both sediment and phosphorus rely on a cascade of catchment and in-stream processes including source, transport and storage, each with their own range of timescales, and, yet events remain critical for solute and sediment export from the watershed at nested scales. We examined stormflow C-Q, hysteresis, and flushing patterns of total suspended sediment (TSS) and soluble reactive phosphorus (SRP) in two stream reaches of a severely impaired agricultural watershed in northeastern Wisconsin, USA. The upper watershed reach— draining a relatively flat, row crop-dominated contributing area with minimal tile drainage— showed predominantly anti-clockwise TSS hysteresis during storms, suggesting that particulate materials were mobilized more from distal upland sources than near- and in-channel areas. In contrast, the incised lower watershed reach produced strong TSS flushing responses on the rising limb of storm hydrographs and clockwise hysteresis, signaling rapid mobilization of near- and in-channel materials with increasing event flows. C-Q relationships for SRP showed complex patterns in both the upper and lower reaches, demonstrating largely non-linear chemodynamic C-Q behavior during events. As with TSS, anti-clockwise SRP hysteresis in the upper reach suggested a delay in the hydrologic connectivity between SRP sources and the stream, with highly variable SRP concentrations during some events. A broad range of clockwise, anti-clockwise, and complex SRP hysteresis patterns occurred in the lower watershed, possibly influenced by in-channel legacy P stores and connection to more extensive tile drainage networks in the lower watershed area.

Notes/ etc

Plum Creek work. Basis is Lucy's CQ paper, plus additional from Ethan and Ryan's theses.

Concentration–discharge (C-Q) relationships are an effective tool for identifying watershed biogeochemical source and transport dynamics over short and long timescales. We examined stormflow C-Q, hysteresis, and flushing patterns of total suspended sediment (TSS) and soluble reactive phosphorus (SRP) in two stream reaches of a severely impaired agricultural watershed in northeastern Wisconsin, USA. The upper watershed reach— draining a relatively flat, row crop-dominated contributing area— showed predominantly anti-clockwise TSS hysteresis during storms, suggesting that particulate materials were mobilized more from distal upland sources than near- and in-channel areas. In contrast, the incised lower watershed reach produced strong TSS flushing responses on the rising limb of storm hydrographs and clockwise hysteresis, signaling rapid mobilization of near- and in-channel materials with increasing event flows. C-Q relationships for SRP showed complex patterns in both the upper and lower reaches, demonstrating largely non-linear chemodynamic C-Q behavior during events. As with TSS, anti-clockwise SRP hysteresis in the upper reach suggested a delay in the hydrologic connectivity between SRP sources and the stream, with highly variable SRP concentrations during some events. A broad range of clockwise, anti-clockwise, and complex SRP hysteresis patterns occurred in the lower watershed, possibly influenced by in-channel legacy P stores and connection to tile drainage networks in the lower watershed area. Total suspended sediment and SRP responses were also strongly related to precipitation event characteristics including antecedent precipitation, recovery period, and precipitation intensity, highlighting the complexity of stormflow sediment and phosphorus responses in this severely impaired agricultural stream.

Observational experiments and data analysis frameworks indicate reaches and watershed locations to further study with a wider variety of approaches.

Primarliy agricultural, riparian forests in place as move downstream.

events account for the vast majority of sediment and phosphorus transport. In the upper watershed, hysteresis and flushing indicies under storm flow conditions throughout the growing season indicate distal or landscape sources, while the same indicies at the outlet gage show the importance of near-stream and in-stream sources