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Phosphorus mitigation at headwater catchment-scale: is increased hydrological flashiness overriding the management efforts?

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Headwater agricultural catchments are battle fields for meeting opposing needs of food production that exacerbates negative effects on water and management efforts to reduce these impacts through mitigation measures. Here we show the effectiveness of mitigation measures for reducing phosphorus (P) and suspended sediment (SS) losses in a clay soils-dominated headwater catchment utilizing novel high-temporal resolution sampling. The catchment is a hot-spot of eutrophication in Sweden and different mitigation measures were implemented: improved drainage, structure liming, lime filters (LF), buffer zones, a two-stage ditch (SD) and a sedimentation pond (SP). Our experimental setup includes continuous determination of P using optical sensors and wet-chemistry analyzers, nitrogen, carbon and SS at the catchment outlet and along the stream network upstream and downstream of each in-stream measure. Our results show a significant difference in stream P and sediment concentrations between before and after introduction of the measures, both at the catchment outlet and at the location of the individual measures. However, the effectiveness of each measure depends on the prevalent meteorological and hydrological conditions. The concentration-discharge relationships show that the catchment is an abundant source of P and SS and their transport is driven by large storm events, the frequency of which has increased in the last decade. These results suggest that increased hydrological flashiness due to climate change can override the generally positive effect of the mitigation measures. We discuss these results by looking at the long-term hydrological flashiness and P and SS transport in other catchments in Sweden with mitigation measures.