FUSING LONG-TERM, HISTORICAL, AND HIGH-RESOLUTION DATA TO INFORM ESTIMATES OF WATERSHED-SCALE NITROGEN RETENTION

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Closing watershed nitrogen budgets is difficult because inputs typically far exceed outputs. A leading hypothesis to explain this discrepancy is that retention is poorly constrained because a disproportionate amount of denitrification occurs in small portions of the landscape (hot spots) during brief hydrologic conditions (hot moments). Many measurement and modeling frameworks under-sample denitrification and transport associated with these hot spots and hot moments. Significant progress in closing a watershed nitrogen budget requires combining a suite of sensors to capture spatial and temporal heterogeneity of nitrogen dynamics. Long-term weekly sampling of stream chemistry at Pond Branch, MD USA, a 37 ha forested watershed in the Piedmont physiographic province, has revealed recurrent summer peaks in nitrate concentrations and loads. A high-frequency in-stream in situ nitrate sensor has revealed that concentration-discharge dynamics of diel and storm events are different from those calculated using weekly data. Statistical calculations of nitrogen export and concentration-discharge analyses yield important insights into biological vs. hydrologic mechanisms of retention. Resolving denitrification in soils requires mapping spatial heterogeneity with high-resolution topographic data derived from LiDAR. A combination of soil oxygen probes and soil core measurements is required to estimate denitrification from watershed soils. Riparian microtopography in Pond Branch has been shown to be an important control in watershed scale denitrification. Enhanced consideration of the hydrogeomorphic template of watersheds to predict the location and importance of biogeochemical hotspots ultimately requires understanding their genesis. In Pond Branch, a fuller understanding of historical land use change and the corresponding geomorphic changes is important to help constrain our interpretation of landscape form and biogeochemical function. Fusing long-term, historical, and spatiotemporal sensor data is required for moving towards closing the watershed nitrogen budget.

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