CATCHMENT BIOGEOCHEMICAL RESPONSES TO FOREST HARVEST AMOUNT AND SPATIAL PATTERN

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Abstract

We used an ecohydrological model, Visualizing Ecosystems for Land Management Assessments (VELMA), to analyze the effects of forest harvest location and amount on ecosystem carbon (C) and nitrogen (N) dynamics in an intensively studied headwater catchment (WS10) in western Oregon, USA. Our goal is to elucidate how the interaction of hydrological and biogeochemical processes within harvested and unharvested areas regulates losses of dissolved C and N from the terrestrial system to the stream and atmosphere. The model was previously calibrated to simulate observed ecohydrological responses of WS10 to a whole-catchment clearcut in 1975. Here we apply 100 scenarios for which harvest amount ranged from 2% to 100% of catchment area. Model results show that (1) NH_4 and NO_3 losses increased exponentially when unharvested riparian buffer zones fell below 60% of total catchment area, and (2) for each 1% increase in harvest area DON and DOC losses increased linearly. We then apply 20 scenarios for which harvest amount was fixed at 20% but harvest location varied with respect to hillslope position. As harvest distance to the stream decreased, simulated NH_4 and NO_3 losses increased exponentially, and DON and DOC losses increased linearly. Our analysis examines how specific biogeochemical processes (decomposition, nitrification, denitrification and plant N uptake) and hydrological processes (evapotranspiration, and vertical and lateral flow) interact within soil profiles and hillslopes to regulate short and long-term losses of nutrients following harvest. This exercise demonstrates VELMA's potential for informing riparian forest management practices aimed at protecting stream water quality.