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Influence of hydrological flow paths on carbon and nitrogen transformations and loss pathways in a small Mediterranean catchment

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Hydrologic flushing during seasonal transitions in Mediterranean ecosystems can exert a strong control on nitrogen (N) and carbon (C) export, yet few studies have examined the influence of different hydrological flow paths on N transformations and loss pathways. Here we examine the influence of variations in precipitation and hydrological pathways on C and N cycling and export along a toposequence of a well-characterized Mediterranean catchment in northern California. We analyzed seasonal patterns of dissolved organic carbon (DOC) and nitrogen (DON), nitrate and ammonium concentrations in rainfall, throughfall, matrix and preferential flow, and stream samples over the course of two water years. We also analyzed seasonal soil N pools and transformations along this toposequence. During the transition to the winter rain season, but prior to any soil water displacement to the stream, DON and nitrate moved through near-surface soils as preferential flow. Once hillslope soils became saturated, saturated subsurface flow flushed nitrate from the hollow resulting in high stream nitrate/DON concentrations. During the transition to the wet season, rates of soil nitrate production were the highest in the hollow relative to the hillslope soils. In the spring, these rates systematically declined as soil moisture decreased. Potential denitrification assays followed similar patterns. Results from our study suggest seasonal fluctuations in soil moisture control soil N cycling and seasonal changes in the hydrological connection between hillslope soils and streams control the seasonal production and export of hydrologic N.