**Dynamic effects of hydraulic redistribution on nutrient availability and ecosystem carbon pools.**

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Hydraulic redistribution (HR) of soil water by plant root systems occurs in seasonally dry ecosystems worldwide. Using measurements and modeling, we are exploring small- and large-scale effects of HR on soil water content throughout the soil column, decomposition and microbial activity, and net ecosystem carbon and energy exchange, in seasonally dry ecosystems of the Western U.S.

At the single root scale, using MIN3P, we have modeled a 10-cm radial soil domain, with root at center, and simulated solute transport, soil cation exchange, and root nutrient uptake under two water flow patterns: daytime transpiration alone, and daytime transpiration with nighttime HR. We find that daytime transpiration leads to the accumulation of cations in the rhizosphere. Some of these cations accumulate to high concentration if not taken up by roots (e.g. calcium, magnesium, and sodium); the cessation of transpiration at night allows these cations to diffuse back out into soil where they outcompete and release ammonium ($NH4^+$) and potassium ($K^+$) from soil cation exchange sites, generating hotspots of $NH4^+$ and $K^+$ availability ~0.5 cm from the root. Hydraulic redistribution, releasing water from roots at night, intensifies the effect, but also flushes mobile nutrients away from roots. $NH4^+$ hotspot generation depends on both CEC and flow, and may influence root-microbial competition belowground and microbial food webs.

At the ecosystem scale, we folded Ryel et al.’s (2002) HR formulation into CLM4.5 and examined how well the combined model simulated measured evapotranspiration and the vertical profile of soil moisture, at eight seasonally-dry Ameriflux sites in Washington, Arizona, and California. We extended the analysis to incorporate Ryel’s HR formulation into CLM4.5-BGC, to investigate effects of HR on net ecosystem exchange of carbon (NEE), net primary productivity, and plant and soil carbon pools. Preliminary results suggest that at the Washington Wind River Crane (US-Wrc) site, HR-associated changes in NEE mainly occurred during dry periods; CLM4.5 alone strongly overestimated NEE during drought, whereas modeled CLM4.5+HR matched observed NEE more closely. At US-SRM, HR-associated changes in NEE occurred throughout the year. At both sites, modeled soil carbon storage was increased by inclusion of HR, as were multiple plant carbon pools (LAI, leaf and stem and root C).