"Enhanced Carbonate Weathering due to Woody Encroachment",
author = "Sadayappan, Kayalvizhi and Keen, Rachel and Moreno, Victoria and Sullivan, Pamela and Nippert, Jesse and Li, Li",
abstract = "Woody encroachment is a widespread phenomenon in grassland ecosystems, driven by overgrazing, fire suppression, nitrogen deposition and climate change, among other environmental changes. The influence of woody encroachment on processes such as chemical weathering however is poorly understood. In particular, for fast reactions such as carbonate weathering, root traits associated with woody encroachment (e.g., coarser, deeper, and longer residence times) can potentially change fluxes of inorganic carbon into streams and back to the atmosphere, providing CO2-climate feedbacks. Here we examine the influence of deepening roots arising from woody encroachment on catchment water balance and carbonate weathering rates at Konza, a tallgrass prairie within a carbonate terrain where woody encroachment is suspected to drive the groundwater alkalinity upwards. We use a watershed reactive transport model BioRT-Flux-PIHM to understand the ramifications of deepening roots. Stream discharge and evapotranspiration (ET) measurements were used to calibrate the hydrology model. The subsurface CO2 concentration, water quality data for groundwater, stream, soil water and precipitation were used to constrain the soil respiration and carbonate dissolution reaction rates. The hydrology model has a Nash-Sutcliffe Efficiency value of 0.88. Modelling results from numerical experiments indicate that woody encroachment results in overall lower stream flow due to higher ET, yet the groundwater recharge is higher due to deep macropore development from deepening roots. The deeper macropores enhance carbonate weathering rate as more acidic, CO2-rich water recharges the deeper calcite bedrock. Accounting for the change in inorganic carbon fluxes caused by such land use changes gives a better estimate of carbon fluxes in the biosphere. Such knowledge is essential for effective planning of climate change mitigation strategies.",
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