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Wasser-, Stoff- und Energietransport im Boden und zum Grundwasser

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Titel
Does plant diversity affect the water balance of established grassland systems like in manipulative biodiversity experiments?

Abstract
Land-use intensification and biodiversity loss are known drivers of the water cycle but their interactions are unclear. We investigated how evapotranspiration (ETa), downward water flux (DF), and capillary rise (CR) in topsoil and subsoil are related to land-use and plant diversity in established, commercially managed grassland and compared these results to findings from an experiment in which plant diversity was manipulated.
In three Central European regions ("Biodiversity Exploratories"), we studied 29 grassland plots (50 m x 50 m; 9-11 plots per region). Land-use intensity increases in the order, pasture < mown pasture < meadow. In 2010-2015, we measured soil moisture, meteorological conditions, plant species richness, number of species in the functional groups of grasses, herbs, and legumes, and root biomass. ETa, DF, and CR were calculated for two soil layers with a soil water balance model. Land-use and biodiversity effects on water fluxes were analyzed with repeated-measures analysis of variance.
Land-use intensity did not affect water fluxes. Species richness did not influence DF and CR. ETa from topsoil decreased with increasing species richness while ETa from subsoil increased. Opposing effects on ETa in the two soil layers were also observed for the number of herbs and legumes. In manipulative biodiversity experiments, such opposing effects were explained by higher biomass in species-rich mixtures, which increases shading of topsoil and reduces evaporation. In subsoil, deeper roots in species-rich mixtures increased transpiration. In the commercially managed grasslands, biomass and species richness correlated negatively because fertilizer application increased biomass and decreased species richness. Thus, similar effects of biodiversity on water fluxes in commercially managed and experimentally manipulated grassland had different reasons. We speculate that improved infiltration and enhanced bioturbation in species-rich grassland explained our observations.