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Elucidating soil moisture dynamics in agricultural landscapes under varying weather patterns

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Changing weather patterns and anthropogenic land use change significantly alter the terrestrial water cycle. A key variable that modulates the water cycle on the land surface is soil moisture and its variability in time and space. Hydrological models are used to simulate key components of the water cycle including infiltration, soil storage and uptake by plants. However, uncertainties remain in accurately representing soil moisture dynamics in models. Here, with the aid of several sensors installed at a 30-ha experimental research facility, we attempt to quantify differences in soil water storage across multiple land use types – cropped area, mosaic of turf grass and native plants, and an unkept weeded area as control land use. We will also discuss the accuracy of sensors to correctly measure soil water storage. Our study was conducted at an agricultural experimental station in Columbia, Missouri, USA. We use a variety of instruments to measure weather, evapotranspiration, and soil water. We used boundary layer scintillometers to measure near-surface turbulence, sensors to continuously track soil moisture and temperature, as well as weather stations for precipitation, air temperature, solar radiation and wind speed. Changes in volumetric water content and soil temperature are measured at 5-minute intervals at 10-, 20-, and 40-cm soil depths to compare soil water storage among the three land use types. We also took soil samples before and after several storm events to calibrate the sensor readings at three sites. We, then, analyzed several storm events over a period of five months and compared the actual soil moisture and soil temperature dynamics at finer time intervals. With additional measurements of weather and boundary layer turbulence, we hope to reveal the landscape and weather control on soil moisture distribution across multiple land uses, and their subsequent impact on plant water uptake. Our preliminary results indicate that continuously disturbed agricultural lands depletes soil moisture at faster rates, which may present challenges in maintaining land productivity in the long term.