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A Land Information System (LIS) based hydroclimatic assessment of the U.S. Midwest

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Climate change is predicted to alter the hydrologic regime across the globe, particularly with increased extreme rainfall events that will likely affect temporal soil water patterns and hence ecosystem and cropland responses. In order to generate realistic scenarios for climate change impacts on water resources, it is helpful to analyze past hydroclimatic changes based on existing data. Several studies have focused on changes in total rainfall amounts, but do not address changes in the frequency and intensity of storms. In this research we address the temporal properties and trends of observed and simulated hydroclimatic variables at ten sites with various land use/land cover within the agriculturally important U.S. Midwest. NASA's Land Information System (LIS) was used for numerical simulations of growing season precipitation, evapotranspiration and soil water content across the study region. The Mann-Kendall trend test was used on simulated precipitation and soil-water content and its crossing properties from 1980-2012. While the studied region has undergone a change in hydroclimatic forcing over the past three decades, this has not significantly impacted average or extreme water-storage states or the persistence of dry and wet conditions. We find that total growing season precipitation is slightly increasing, however, in agreement with climate projections, storm frequency and mean rainfall depth are significantly decreasing and increasing, respectively. We find no trends in shallow (0-10 cm) or root zone (0-100 cm) soil water content, drought/flood occurrence or duration which is likely due to increasing potential evapotranspiration as a result of a general warming of the study region. This research shows that predicted changes in hydroclimatic forcing for the study region are detectable in past precipitation records, and particularly that storms have become less frequent yet more intense in the last three decades. A more extreme rainfall regime, like the trajectory indicates for the U.S. Midwest, has implications for ecosystem function and agricultural production, and hence management of these systems.