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Temporal trends in evapotranspiration in selected watersheds in Illinois, United States

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One of the major components in the water balance of watersheds is evapotranspiration. It is therefore of great importance to quantify changes in long term evapotranspiration (ET) pattern and examine possible causes to manage and sustain water resources in an efficient way. The Corn Belt region in United States is an area, which has undergone extensive vegetative change through human intervention in the past. This area therefore provides a good opportunity to investigate changes in the water balance components over time. In this study, we estimate actual ET in three selected watersheds in central (tiled drainage) and south-eastern (non-tilled drainage) Illinois for a 50 years period, ranging from 1950 to 2000 using statistical approaches and a conceptual rainfall-runoff model (COSERO). In order to detect temporal trends, the study period is divided into two sub-periods, namely prior to 1975 (pre-change), and after 1975 (post-change). We examine the presence of trends in rainfall and runoff by the Mann-Kendall trend test with a significance level at 5%. Changes in historical land use and land cover (LULC) maps for pre- and post-change periods are investigated and detected using ArcGIS tools.
We then conduct the modelling to investigate the changes in water balance components, more specifically the temporal ET trends. The COSERO model provides good model efficiency for the simulated runoff during calibration and validation periods. Consistent with the statistical test, we show that the evapotranspiration has decreased in the second period (post-change period), where we observe a significant increased trend in runoff associated with a non-significant trend in precipitation. In a tile- drained watershed (LA MOINE RIVER), long-term ET declined from 648 to 610 mm/a. In this watershed, land use change was observed with the agriculture fraction increasing from 54 to 59 percent while grassland decreasing from 24 to 17 percent between the two periods. In second tile-drained watershed (SPOON RIVER) the trends were similar with a decrease in ET from 660 to 626 mm/a, increased agricultural and decreased grassland shares in second period. In contrast, for a non tile-drained watershed (LITTLE WABASH RIVER), where no LULC change was observed, also no noticeable change in ET was found in the hydrological model. In conclusion, our results may shed light on how ET, can provide information on driving force of recent experienced increased runoff (climate and/or LULC changes) in many watersheds.