Regional Variability of Subsurface Drainage in the U.S. Corn Belt

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Charlotte Lee

Charlotte grew up in the Great Lakes State and attended Michigan State University, where she received her bachelor's degree in environmental geoscience. As an undergraduate NSF S-STEM scholar she worked as a field and laboratory assistant in several water-related research groups on campus and participated in an Antarctic System Science study abroad program, which solidified her interests in hydrology and climate change. Since joining the Ecological Sciences and Engineering Interdisciplinary Graduate Program at Purdue University, she has been a member of the Purdue Hydrologic Impacts Group, co-chaired the 2015 ESE Symposium *Inequalities in Complex Systems*, and travelled with the Water Access to Empower Rural Tanzania global engineering design team. She will continue working with Dr. Laura Bowling towards her PhD. When not in the office she enjoys hiking, canoeing, printmaking, photography, music, and volunteering for the Wabash Sampling Blitz.

Intensive agricultural drainage in the U.S. Corn Belt is the primary non-point source of nutrient loading in the Upper Mississippi River Basin. Understanding the historic regional variability in hydroclimate drivers of subsurface drainage, as well as the influences of climate change, is important for implementing appropriate DWM practices to improve water quality. Observed drainflow data from Minnesota, Iowa, Illinois, Indiana, and Ohio were used to parameterize the VIC macro-scale hydrologic model, with a subsurface drainage algorithm, for use in the Corn Belt. Simulated soil frost depth, winter precipitation, and USDA Hardiness Zone were found to have the strongest correlations with subsurface drainage regime during the historic period of 1981 – 2010. Northern climate zones (3a – 4b) experience deeper frost depths and less precipitation, resulting in shorter drainage seasons that starting later in the spring and produce lower, more variable annual drainage compared to southern zones (5a – 6b). This generally aligns with field observations, however simulated drainage season was shorter and the ratio of annual drainflow to precipitation was on the lower end of reported range. An ensemble of three GCMs (PCM, GFDL, HadCM3) was used to calculated multi-model means across low (B1), moderate (A1B) and high (A2) carbon emissions scenarios to evaluate projected changes in hydroclimate and drainage metrics. By mid-century (2035 – 2064) for the A2 scenario, annual subsurface drainage is projected to have a median regional increase of 39% as frost depth decreases 16 – 27 cm in northern zones and 4 – 18 cm in southern zones while winter precipitation increases 12 – 18% in northern zones and 9 – 12% in southern zones. The largest increase in subsurface drainage depth (37 – 64 mm) occurs in the southern climate zones. However, zone 4b is projected to experience the greatest percent increase in drainage (31 – 53 %) and overland flow (13 – 24 %) across the region due to increases in annual precipitation and changes in cold season processes.