Urbanization impacts on the hydroclimatology of the Upper Great Lakes Region

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Global land cover/land use is changing notably due to expansion of urban areas, resulting in the conversion of natural landscapes to roads, industrial areas, and buildings. This landscape transformation leads to changes in land surface heterogeneities, which result in alterations of hydrologic processes, hydroclimatology, storm patterns and land atmosphere interactions. This study aims to analyze the impacts of urbanization on hydroclimatic processes by integrating projected land cover/land use (LCLUC) scenarios, the Regional Atmospheric Modeling System (RAMS) and the Variable Infiltration Capacity (VIC) land surface scheme across the Upper Great Lakes Region. It seeks to use this coupled modeling system to quantify the extent to which changes in streamflow hydrology around urban areas are a result of changes in storm patterns versus a direct result of impervious area increase. Projected land cover scenarios for future urban, forest and agriculture for the period of 2005-2030 are derived using the Land Transformation Model (LTM) for the three state region of Wisconsin, Michigan, and Illinois. To study the impact of urbanization on land–atmosphere interactions, we couple RAMS, an explicit 3-D urban surface energy balance model, the Town Energy Budget (TEB) model and land cover forecasts from the LTM. We analyze precipitation and air temperature spatial-temporal trends from these simulations. Using precipitation and air temperature data from these coupled simulations, the VIC model, with an updated urban component, is used to simulate the impact of increased urbanization on various hydrologic processes. Finally, the projected hydroclimatic patterns (i.e. streamflow, heat fluxes, and storm patterns) for three major cities; Chicago, Detroit and Milwaukee are examine.