Landscape Change and Atmospheric Feedback: Impact on Water Resources

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Land Use Land Cover (LULC) change (conversion of natural vegetation into agricultural land, and urbanization) is a major global change phenomenon. Between 1700 and 2000, global extent of natural vegetation has decreased by 45%, and agricultural land area has increased by 500%. LULC change impacts hydrology by changing regional climate (temperature and precipitation) and land surface hydrologic responses (evapotranspiration and runoff). Evapotranspiration (ET) is a major pathway through which land surface interact with the atmosphere, and it is a major component (60-65% of total precipitation) of global hydrologic cycle. Three objectives of this study are: (1) to investigate impacts of regional scale LULC change on hydroclimatology and compare impacts of LULC change with impacts of climate change due to green house gas emissions, (2) to evaluate uncertainties in reanalysis and climate model ET outputs using AmeriFlux observations and basin scale water and energy balance study, (3) to quantify contributions of major driving forces for LULC change in the United States.

Large scale wetland drainage activity was carried out in the latter half of 19th century and early half 20th century to bring swamp/marshy land of the Midwestern United States (pre-settlement landscape) into agricultural production (Corn Belt of USA). Impacts of wetland drainage (LULC change) on hydroclimatology of the Midwestern United States are compared with impacts of climate change using a coupled land-atmosphere global climate model (CCSM3). The wetland drainage data is synthesized from United States Census reports. Results from this study suggest that impacts of wetland drainage can be of comparable magnitude to impacts of climate change from greenhouse gas emissions.

The Community Land Model (CLM) and North American Regional Reanalysis (NARR) outputs are evaluated using AmeriFlux observations, PRISM precipitation and temperature data, USGS streamflow observations in the Mississippi River Basin. Average over 11 AmeriFlux sites, NARR shows higher biases (59%) in ET compared to CLM (11%). Issues related to point scale observations verses climate model grid cell outputs, and model parametrization differences between CLM and NARR are also investigated in the study.

The land-cover change history of the United States is investigated to determine major driving/governing forces. County level cropland and population data from 1850 to 2000 (@ per decade), and high resolution topography, climate, and biophysical suitability data are used. Results from this study suggest that the spatial distribution of cropland was governed by population distribution during 19th century and

biophysical suitability (for cropland) during 20th century. The major influence of biophysical suitability is expected to continue in the near future landscape of the United States.