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Project Abstract

Multisensor/Multiscale Assessment of Urban Impacts in the Great Lakes Region

Urbanization is altering the global landscape at an unprecedented rate. This form of land cover/land-use change (LCLUC) can significantly reduce infiltration and runoff response times, and alter heat and water vapor fluxes, which can further change surface-forced regional circulation patterns and modulate precipitation volume and intensity. Our central objective is to develop an integrated modeling tool, incorporating spatial data from multiple sensors, to study the interactions between LCLUC, weather, and surface hydrometeorology, with a specific focus on the impacts of urbanization within the Upper Great Lakes region. The project will evolve on three fronts, including multisensor analysis, model development and integrative analysis and modeling. Datasets from multiple spaceborne sensors will be utilized to explore the role of resolution and spatial heterogeneity on observed and predicted hydrometeorology. Spatial patterns of future LCLUC will be predicted using the Land Transformation Model (LTM), enhanced to incorporate dynamic landcover, economics and policy using Bayesian Belief Networks (LTM-BBN), into its land use change predictions. Different land use scenarios predicted by the LTM-BBN will be represented through the Unified Noah Land Surface Model (LSM) with an enhanced urban canopy model, embedded in the Weather Research and Forecasting (WRF) model. The coupled WRF-Noah LSM model will be used to investigate the connections between land-use, hydrometeorology and the atmosphere, through analysis of water and energy balances over several urbanized watersheds within the Upper Great Lakes region. This analysis will focus on how changing spatial extents of urban and forested areas affect episodic, hydrometeorological events both for current land use as well as projected land use changes. Developing tools that will lead to an increased understanding of the causal relationships and assessing the impacts of urbanization at regional scales is a critical challenge and central to the science questions underlying NASA's LCLUC Program. The proposed project is directly responsive to the LCLUC and CSREES missions linking LCLUC with climate variability and its effect on the natural environment, with an emphasis on regions undergoing significant urban expansion. In particular, the proposed research addresses a major U.S. Climate Change Science Program question: "How do climate variability and change affect land use and land cover, and what are the potential feedbacks of change in land use and land cover to climate?" The proposed research bridges all three topical areas of the current solicitation, but most directly addresses the goals of the monitoring topical area through development of a suite of tools to better characterize future and current land-use and land-cover attributes and their dynamic contribution to atmospheric and land surface processes.