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EDITORIAL

Land-Use/Land-Cover Change and Its Impacts on Weather and Climate

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Land-use and land-cover changes (LULCC) significantly affect weather and climate as is well documented in the scientific literature. These impacts include changes in air temperature, precipitation, atmospheric moisture content, energy fluxes, and mesoscale and potentially large-scale circulations. Recently, the United States National Research Council (2005) highlighted the importance of LULCC and recommended the broadening of the climate-change issue to include land-use/land-cover processes as an important climate forcing. The report noted that, "*Regional variations in radiative forcing may have important regional and global climatic implications that are not resolved by the concept of global mean radiative forcing. Tropospheric aerosols and landscape changes have particularly heterogeneous forcings. To date, there have been only limited studies of regional radiative forcing and response. Indeed, it is not clear how best to diagnose a regional forcing and response in the observational record; regional forcings can lead to global climate responses, while global forcings can be associated with regional climate responses. Regional diabatic heating can also cause atmospheric teleconnections that influence regional climate thousands of kilometres away from the point of forcing. Improving societally relevant projections of regional climate impacts will require a better understanding of the magnitudes of regional forcings and the associated climate responses.*" Therefore, it is critical that we further investigate and understand the impacts of LULCC on weather and climate predictability.

In this context, an National Science Foundation (NSF) funded workshop was organized in Boulder, Colorado, USA in 2007 to further highlight the importance of LULCC, to present results of new research in LULCC, and to discuss the challenges of the monitoring and modelling of LULCC at various temporal and spatial scales. The articles included in this

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special issue of *Boundary-Layer Meteorology* are based on several of the presentations at the Boulder workshop. Urbanization represents one of the most extensive changes to the natural landscape. Urbanization produces urban heat islands, modifies mesoscale and regional-scale precipitation and atmospheric circulation patterns and, obviously, surface energy balance. The Balogun et al. article investigates modifications to energy fluxes in a unique 'exurban' environment due to recent LULCC in the Kansas City area. In this article the 'exurban' area is defined by 'extensive, open vegetated types typical of low-density residential areas that have been newly converted from rural land use'. They found that energy balance for the exurban area of a large metropolitan region was more similar to rural areas than older suburbs with mature trees. It is an important finding and the study provides valuable data relevant to understanding the impacts of urban sprawl in humid mid-latitude environments.

Land-surface heterogeneity produces significant variability in energy fluxes over various spatial scales. LULCC further modifies these variabilities, and the quantification of these spatial variabilities of fluxes is essential for a better understanding of the impacts of LULCC. The article by Alfieri et al. addresses this issue. They tested four different methods and assessed their accuracy in quantifying spatial variability of surface fluxes by using data from the 2002 International H2O (IHOP) Project. Their results should be valuable in the future for quantifying the impacts of LULCC on the spatial variability of surface fluxes from different sensors.

Interactions between the synoptic scale and mesoscale have been a topic of interest for many decades. It is possible that the mesoscale influence on synoptic-scale systems is dominated by mesoscale land-surface features and their influence on surface processes. Again, LULCC can further enhance or mute the impacts of these processes. Frequently we use models to investigate these interactions across scales to investigate the impacts of LULCC on atmospheric phenomena. However, a challenge in these simulations includes, inter alia, representative land-surface data (which influences quantification of land-surface processes) and the performance of data assimilation techniques. The article by Vindokumar et al. addresses these research issues. They tested several data assimilation schemes to determine their relative performance in the simulation of a monsoon depression. They found that mesoscale surface processes affected rainfall, and that improved representation of land-surface processes leads to more realistic simulation by the model. In short, this article addresses a key point related to the precision of simulations when we investigate the impacts of LULCC on weather and climate. Furthermore, LULCC has been shown in previous studies to modify mesoscale circulations and potentially affect the dispersion of various airborne gaseous and particulate matters. Wu et al. is an important addition to the literature on this topic. Their study demonstrates how land-surface heterogeneity (including topography, vegetation, and soil moisture) could modify mesoscale atmospheric dispersion.

Overall, the articles included in this special section address some pressing research issues related to the study of LULCC and its impacts on weather and climate. Based on the results from these articles we call for a more deliberate inclusion of LULCC and its impacts in future weather, climate, and climate change related studies.