EDITORIAL

Impacts of Land Use and Land Cover Change on the Atmosphere

Significant changes have occurred in the global environmental system over the last century. Local, regional, and global air temperatures have increased significantly, in large part because of anthropogenic forcing. However, this forcing consists not only of greenhouse gas forcing. A significant portion of the warming is also due to land use and land cover changes. Rapid and extensive alterations to the land surface have occurred in parts of North America, Europe, and southern and Southeast Asia. Different land surface types—in particular, different types of vegetation—are shown to exhibit different temperature responses such that barren areas warm more than vegetated areas, as shown in the paper by Lim et al. Baldi et al. show that landscape variability decreases the temperature in the near-surface atmospheric layer. Furthermore, conversions of forests and grasslands to cultivated croplands, the creation and expansion of urban areas, and other disturbances to the natural ecosystems of global land areas all bring about important consequences for local to regional weather and climate processes. Albedo changes resulting from alterations to the land surface impact the radiative forcing and the energy balance. Some land surface changes can result in shifts from latent to sensible heating, resulting in amplified warming (and vice versa). Vegetation changes, caused by socioeconomic forcing, also directly affect soil moisture and the near-surface hydrologic cycle and introduce further modifications to the energy balance. For example, Vinodkumar et al. found that the direct inclusion of soil moisture and ground/skin temperature in model simulations reproduces the large-scale structure associated with an Indian monsoon depression. Overall, not only are there direct effects of changes in land cover and land use on the atmosphere, but positive and negative feedbacks potentially amplify or lessen the local impact or may produce entirely different ecosystem changes. For example, in high-latitude or high-altitude regions, simple surface disturbances in areas underlain by permafrost can trigger landscape degradation and lead to the development of thermokarst.

Urbanization also greatly affects local to regional weather and climate. The displacement of forests, other vegetative covers, and natural landscapes with asphalt and concrete significantly changes local and regional meteorological and climatic variables. Not only are urbanized areas potentially several degrees warmer than their rural surroundings, but the enhanced surface roughness and altered convergence patterns can affect precipitation in and downwind from cities. Despite the role of urbanization on the local- and regional-scale atmosphere, most models do not include detailed urban parameterizations. Oleson et al. produce such a parameterization as part of the land surface component of the Community Climate System Model and find that the model appears to be a useful tool for evaluating urban climates as part of global climate model simulations.

This special collection provides a diverse look at many different and unique aspects of the impacts of land use and land cover change on the atmosphere: from global (Lim et al.; Oleson et al.) to regional (Vinodkumar et al.) to local (Baldi et al.; Bedford) effects, and considerations of landscape type (Lim et al.), landscape variability (Baldi et al.), soil moisture (Vinodkumar et al.), urbanization (Oleson et al.), and the effects of changing lake levels on local climate (Bedford). We suggest that the assessment of these varying aspects of land surface–atmospheric processes associated with land use and land cover change will lead to better understanding and improved parameterizations in regional (Vinodkumar et al.) and global (Oleson et al.) climate models, thereby providing improved projections of future warming.

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List of papers in this special collection

Lim, Y.-K., M. Cai, E. Kalnay, and L. Zhou, 2008: Impact of vegetation types on surface temperature change. *J. Appl. Meteor. Climatol.,* **47,** 411–424.

Baldi, M., G. A. Dalu, and R. A. Pielke Sr., 2008: Vertical velocities and available potential energy generated by landscape variability—Theory. *J. Appl. Meteor. Climatol.,* **47,** 397–410.

Vinodkumar, A. Chandrasekar, K. Alapaty, and D. Niyogi, 2008: The impacts of indirect soil moisture assimilation and direct surface temperature and humidity assimilation on a mesoscale model simulation of an Indian monsoon depression. *J. Appl. Meteor. Climatol.,* **47,** 1393–1412.

Oleson, K. W., G. B. Bonan, J. Feddema, M. Vertenstein, and C. S. B. Grimmond, 2008a: An urban parameterization for a global climate model. Part I: Formulation and evaluation for two cities. *J. Appl. Meteor. Climatol.,* **47,** 1038–1060.

Oleson, K. W., G. B. Bonan, J. Feddema, and M. Vertenstein, 2008b: An urban parameterization for a global climate model. Part II: Sensitivity to input parameters and the simulated urban heat island in offline simulations. *J. Appl. Meteor. Climatol.,* **47,** 1061–1076.

Bedford, D., 2008: Area-dependent climatic influence of the Great Salt Lake, Utah. *J. Appl. Meteor. Climatol.,* submitted.