Geophysical Research Abstracts
Vol. 14, EGU2012-10943, 2012
EGU General Assembly 2012

The impacts of land cover change on surface energy fluxes and radiometric surface temperature in the temperate zone

P.C. Stoy (1), M. Jammet (2), S. Luyssaert (3), G.G. Katul (4), J.-Y. Juang (5), M.B.S. Siqueira (6), K.A. Novick (7), S. Dore (8), T.E. Kolb (8), M.C. Montes-Helu (8), and R.L. Scott (9)

(1) Montana State University, Land Resources and Environmental Sciences, Bozeman, MT, USA, (2) Department of Geography and Geology, University of Copenhagen, Denmark, (3) LSCE, Gif-sur-Yvette, France, (4) Nicholas School of the Environment and Earth Sciences, Duke University, Durham, NC, USA., (5) Department of Geography, National Taiwan University, Taipei, Taiwan, (6) Departamento de Engenharia Mecânica, Universidade de Brasília, Brasília, Brazil, (7) USDA Forest Service, USA, (8) School of Forestry, College of Engineering, Forestry, and Natural Sciences, Northern Arizona University, Flagstaff, AZ, USA , (9) Southwest Watershed Research Center, USDA-Agricultural Research Service, Tuscon, AZ, USA

Vegetation is an important control on the surface energy balance, but the impacts of land use and land cover change on changes to surface energy fluxes and radiometric surface temperature (Tsurf) in the temperate zone remain the subject of active research. We quantified the mechanisms driving changes in Tsurf following landcover changes using paired ecosystem case studies from the Ameriflux database. A differential analysis of models of varying complexity was used to quantify the change in Tsurf attributable to structural and functional ecosystem changes. Results support previous findings that deciduous and coniferous forests in the Duke Forest, NC, are about 1 °C cooler than an adjacent field on an annual basis because an aerodynamic and ecophysiological cooling of ca. 2 °C outweighs an albedo-related warming of ca. 1 °C upon transition to forest. A 50-70% reduction in the aerodynamic resistance to sensible and latent heat exchange in the forested ecosystems dominated the cooling effect. In northern Arizona, a grassland ecosystem that succeeded a stand-replacing ponderosa pine fire was ca. 1 °C warmer than unburned stands for similar mechanisms to the Duke Forest case study; a 1.5 °C aerodynamic warming offset a slight surface cooling due to greater albedo and soil heat flux. In southern Arizona, ecosystems dominated by mesquite shrub encroachment were nearly 2 °C warmer than a native grassland ecosystem because aerodynamic and albedo-related warming outweighed a small cooling effect due to changes in soil heat flux. Further to these findings, an investigation of over 8 million data points in the FLUXNET database revealed that surface temperature increased less per unit net radiation in forests than in short-statured ecosystems globally. Together, these results suggest that temperate forests tend to cool the land surface in addition to their high CO_2 sequestration potential.