Geophysical Research Abstracts
Vol. 13, EGU2011-3066, 2011
EGU General Assembly 2011

Energy balance closure at global-distributed eddy covariance research sites: the role of landscape-level heterogeneity

Paul Stoy (1) and Matthias Mauder (2)

(1) Department of Land Resources and Environmental Science, Montana State University, Bozeman, MT, USA (paul.stoy@montana.edu), (2) Institute for Meteorology and Climate Research, Atmospheric Environmental Research, Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany (matthias.mauder@kit.edu)

The lack of closure in the energy balance (CEB) at many eddy covariance research towers represents an impediment to surface-atmosphere water and energy flux synthesis despite excellent closure at some sites. A recent review by Foken [2008, Ecological Applications, 18(6): 1351-1367] identified exchange processes and turbulent motions at large spatial and temporal scales in heterogeneous landscapes as the primary cause of lack of energy balance closure at select, intensively-researched sites. We characterize CEB across 180 ecosystems in the FLUXNET database including relationships with landscape heterogeneity using remote sensing products from MODIS. CEB averaged 0.83 at the site-level with best average closure in grasslands, evergreen broadleaf forests, and savannas (ca. 0.95) and worst average closure in crops, mixed forests and wetlands (0.73-0.75). Both CEB and the energy balance residual (REB, W m-2) increased with friction velocity (u*) and decreased with solar zenith angle, and were greatest for near-neutral conditions, demonstrating that whereas relative closure is greatest during daytime, this is also the period when more energy goes missing. The variability in MODIS plant functional type, as quantified by its entropy, in the 20 x 20 km area surrounding flux towers was significantly related to CEB (r=-0.17; p=0.011) as was the landscape-level variability of enhanced vegetation index (EVI) as quantified by its variance (r=-0.21; p=0.004) and the mean EVI surrounding towers (r=-0.20; p=0.008). These results point to the role of landscape-level heterogeneity and its influence on mesoscale meteorological motions as a likely explanation for incomplete energy balance closure. Noting minor known unmeasured energy fluxes like vegetation heat storage and metabolic terms, the energy balance across a number of sites and even some plant functional types in the database can be effectively considered closed. Future research should focus on the physical explanations behind the relationship between energy balance closure and landscape heterogeneity.