Geophysical Research Abstracts
Vol. 16, EGU2014-14652, 2014
EGU General Assembly 2014

A simple interpretation of energy partitioning at the land surface of three eddy covariance sites in Germany and effects after precipitation

Maik Renner (1), Christian Bernhofer (2), Uta Moderow (2), Uwe Spank (2), and Axel Kleidon (1)

(1) Max-Planck-Institute for Biogeochemistry, Biospheric Theory and Modelling Group, Jena, Germany (mrenner@bgc-jena.mpg.de), (2) TU Dresden, Faculty of Environmental Sciences, Chair of Meteorology, Tharandt

Absorbed solar radiation heats the surface while the emission of thermal long wave radiation and the turbulent heat exchange with the atmosphere both cool the surface. Using a highly simplified energy balance model and neglecting horizontal heat exchange the radiative–turbulent partitioning can be predicted by assuming that the atmospheric heat exchange operates at a limit of maximum power (Kleidon and Renner, 2013). At this state, which corresponds to a state of strong surface–atmosphere interactions, both the turbulent and the radiative heat exchanges are solely driven by absorbed solar radiation R_{sn}. This model, established for climatological means, predicts that the radiative partitioning ratio R_n/R_{sn} and the turbulent ratio $(H + LE)/R_{sn}$ should be constant. Based on this climatological reference we explore the deviations from observations of the partitioning ratios at the diurnal to the seasonal time scale for three neighboring FLUXNET sites of TU Dresden with different land use.

We find that the fixed ratios represent the average energy partitioning quite well. When then evaluating the deviations, dominant diurnal and seasonal cycles in both ratios get apparent. However, the ratios tend to be rather constant in summertime, when turbulent exchange is strongest. A not so apparent, but consistent effect is found on days after precipitation events. To test for effects of precipitation on the partitioning, we subset the data into time steps with precipitation (> 0.1 mm/h) in the previous 24 hours into *wet* and all other as *dry*. It is found that under wet conditions the radiative ratio is higher, whereas the turbulent ratio is smaller compared to dry conditions. This finding is evident for diurnal to seasonal time scales and at all three sites. Further analysis of ground based radiation data reveals that precipitation events alter the long wave radiation emission of both the atmosphere and the surface. The combination of both effects results in distinctly lower radiative temperature differences between the surface and the atmosphere under wet conditions and corresponds to more stable atmospheric conditions. As the temperature difference also displays seasonal changes with lower values in wintertime this suggests that long wave radiation regimes of both the surface and the atmosphere exert a strong second order control on energy partitioning. We conclude that our simple thermodynamic approach provides an useful reference to interpret the dominant effects on land surface energy partitioning.

Kleidon, A. and Renner, M.: Thermodynamic limits of hydrologic cycling within the Earth system: concepts, estimates and implications, Hydrol. Earth Syst. Sci., 17, 2873–2892, 2013.