Geophysical Research Abstracts
Vol. 13, EGU2011-12337, 2011
EGU General Assembly 2011

The influence of evaporation on afternoon convective rainfall events

Benoît Guillod (1), Sonia I. Seneviratne (1), Boris Orlowsky (1), Markus Reichstein (2), Philippe Ciais (3), Adriaan J. Teuling (4,1), and Nina Buchmann (5)

(1) ETH Zurich, Institute for Atmospheric and Climate Science, Environmental Sciences, Zurich, Switzerland (benoit.guillod@env.ethz.ch), (2) MPI for Biogeochemistry, Jena, Germany, (3) LSCE, Gif-sur-Yvette, France, (4) Wageningen University, Netherlands, (5) ETH Zurich, Institute of Agricultural Sciences, Zurich, Switzerland

Soil moisture has been shown to play a crucial role for summer climate, through its impact on the water and energy balance at the land surface. Among others it controls the partitioning of energy in sensible and latent heat flux at the surface. Feedbacks between the land surface and the atmosphere are crucial for temperate climates. A feedback still subject to high uncertainties is the soil moisture - precipitation feedback: Given its control on evapotranspiration, soil moisture may influence the triggering of convection and thus the frequency of convective rainfall. Its investigation has been the focus of much research for several years (e.g. Seneviratne et al. 2010). However, due to its complexity, much remains to be explored. Some modeling studies show a potential positive or slightly negative feedback, depending on the early morning atmospheric condition, through the triggering of convection. For a thorough understanding of the underlying processes to be developed, each step of the coupling has to be understood comprehensively: a) the influence of soil moisture on evapotranspiration; b) the influence of evapotranspiration on subsequent precipitation; c) the influence of precipitation on soil moisture.

While several studies concentrated on the control of soil moisture on evapotranspiration (i.e. part (a)), both with model and measurements data, and since relationship (c) can be considered as trivial in most cases, the most uncertain link remains the relationship between evapotranspiration anomalies and subsequent precipitation anomalies (b). Indeed, if several studies have investigated this process based on model or reanalysis data, mostly identifying a possible positive feedback, much remains to be explored and observational studies remain inconclusive up to now, mainly due to the confounding effect of precipitation impact on soil moisture. In this context, FLUXNET stations (e.g. Baldocchi et al. 2001) provide continuous measurements of evapotranspiration at a half-hourly time scale, which can be used as a complementary and necessary step towards a better understanding of relationship (b) and thus of the whole soil moisture-precipitation feedback.

Using FLUXNET measurement network, we explore the relationship between evapotranspiration and precipitation and avoid confounding issues by desaggregating data based on the diurnal cycle, i.e. by evaluating morning evapotranspiration vs afternoon precipitation. We investigate the processes by which convection can get triggered by evapotranspiration anomalies, and thus evaluate whether evapotranspiration influences convective precipitation frequency and intensity and to which extent. We further analyze the dependence of the relationships sign and strength for different early morning atmospheric conditions and identify some regions of strong/weak and positive/negative feedback.

References:

Baldocchi, D.D., et al., 2001. FLUXNET: a new tool to study the temporal and spatial variability of ecosystem-scale carbon dioxide, water vapor and energy flux densities. B. Am. Meteorol. Soc. 82, 2415–2435.

Seneviratne, S.I., T. Corti, E.L. Davin, M. Hirschi, E.B. Jaeger, I. Lehner, B. Orlowsky, and A.J. Teuling, 2010: Investigating soil moisture-climate interactions in a changing climate: A review. Earth-Science Reviews, 99, 3-4, 125-161, doi:10.1016/j.earscirev.2010.02.004