Geophysical Research Abstracts
Vol. 19, EGU2017-3724, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Spatial and temporal variability of soil moisture–temperature coupling in current and future climate

Clemens Schwingshackl, Martin Hirschi, and Sonia Isabelle Seneviratne
ETH Zürich, Institute for Atmospheric and Climate Science, Zürich, Switzerland (clemens.schwingshackl@env.ethz.ch)

While climate models generally agree on a future global mean temperature increase, the exact rate of change is still uncertain. The uncertainty is even higher for regional temperature trends that can deviate substantially from the projected global temperature increase. Several studies tried to constrain these regional temperature projections. They found that over land areas soil moisture is an important factor that influences the regional response. Due to the limited knowledge of the influence of soil moisture on atmospheric conditions on global scale the constraint remains still weak, though.

Here, we use a framework that is based on the dependence of evaporative fraction (i.e. the fraction of net radiation that goes into latent heat flux) on soil moisture to distinguish between different soil moisture regimes (Seneviratne et al., 2010). It allows to estimate the influence of soil moisture on near-surface air temperature in the current climate and in future projections. While in the wet soil moisture regime, atmospheric conditions and related land surface fluxes can be considered as mostly driven by available energy, in the transitional regime - where evaporative fraction and soil moisture are essentially linearly coupled - soil moisture has an impact on turbulent heat fluxes, air humidity and temperature: Decreasing soil moisture and concomitant decreasing evaporative fraction cause increasing sensible heat flux, which might further lead to higher surface air temperatures. We investigate the strength of the single couplings (soil moisture → latent heat flux → sensible heat flux → air temperature) in order to quantify the influence of soil moisture on surface air temperature in the transitional regime. Moreover, we take into account that the coupling strength can change in the course of the year due to seasonal climate variations.

The relations between soil moisture, evaporative fraction and near-surface air temperature in re-analysis and observation-based data products (Schwingshackl et al., in review) are compared to CMIP5 model outputs for current climate conditions. This allows to estimate if the single models correctly reproduce the observed relations. Moreover, the analysis is conducted for future climate projections to identify regions where shifts in soil moisture regimes occur. Eventually, the impact of these shifts on near-surface air temperature is analyzed to evaluate the influence of soil moisture on future temperature changes.

References:

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), 125–161, doi:10.1016/j.earscirev.2010.02.004.

Schwingshackl, C., M. Hirschi, and S. I. Seneviratne: Quantifying spatio–temporal variations of soil moisture control on surface energy balance and near-surface air temperature. *Journal of Climate* (in review)