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Contributions of soil moisture interactions to the climate biases in the EC-Earth earth system model

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Similar to many other global climate models, the EC-Earth earth system model is characterized by biases in various aspects of the simulated climate. These biases in precipitation give an important contribution to corresponding biases in the simulated soil moisture. In this study, we assess the extent to which these soil moisture biases contribute to the biases in various aspects of climate in EC-Earth through interactions with the atmosphere. A better understanding of this particular aspect of climate biases is also relevant for the evaluation of simulated future climate changes. Our study is a contribution to the Land Surface, Snow and Soil moisture Model Intercomparison Project (LS3MIP).

The study is based on a) an offline simulation with H-TESSEL, the land surface model of EC-Earth, and b) several simulations with the atmospheric GCM version of EC-Earth with different treatments of the soil moisture conditions for the recent period 1979-2014. The purpose of the offline simulation with H-TESSEL is to obtain a realistic representation of the land surface conditions. We do that by forcing H-TESSEL with the meteorological conditions originating from the ERA-Interim re-analyses (with a correction for the precipitation bias). We perform two simulations with EC-Earth, one where soil moisture is developing freely and one, where soil moisture constrained by the realistic estimates originating from the offline simulation with H-TESSEL. For the latter, we have implemented a relaxation technique into EC-Earth, where at the end of each time step the simulated soil moisture is relaxed towards the realistic estimates.

The comparison of these simulations with observational data from various sources yields assessments of the climate biases in H-TESSEL and EC-Earth, respectively. The differences between the two simulations with EC-Earth, without and with the relaxation of soil moisture, reveal the role of realistic soil moisture for the simulation of climate in EC-Earth. The ratio between the climate bias of the simulation with freely developing soil moisture and the corresponding difference between the simulations with and without constraining soil moisture, then, allows us to quantify the contributions of soil moisture interactions to the biases in various aspects of climate simulated by EC-Earth. In the presentation, we will focus on near-surface temperatures and precipitation, also including the day-to-day variability and extreme daily values. Moreover, we will address particular aspects of the large-scale atmospheric circulation, i.e. the West African monsoon or the Indian summer monsoon, as these regional monsoon systems are governed by the land surface conditions.ase fill in your abstract text.