Geophysical Research Abstracts
Vol. 20, EGU2018-4846, 2018
EGU General Assembly 2018

An improved Hydraulic Conductivity Parametrization for Regional Climate Models

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Several studies over the last years indicate that systematic cold biases, caused by spuriously simulated soil-moisture-temperature couplings in Land Surface Models (LSMs), are a common problem occurring in a lot of Regional Climate Models (RCMs). To reduce such systematic cold biases, in this paper, a new depth-dependent description of the saturated soil hydraulic conductivity function is presented that can be implemented LSMs. The new function is characterized by exponentially decreasing conductivity values with depth, accounting for the reduced pore volume in deeper soil layers. With this method, simulations with the RCM COSMO-CLM, coupled to the LSM VEG3D, are performed (CCLM-VEG3D). The simulations are driven by ERA-Interim over period (2001-2010) at a horizontal resolution of 0.22°. The model domain is identical to the Coordinated Regional Climate Downscaling Experiment-European Domain (EURO-CORDEX). The CCLM-VEG3D simulation results are compared to a reference run with the standard depth-constant saturated hydraulic conductivity values. The study reveals that the new depth-dependent saturated hydraulic conductivity function improves the soil-moisture-temperature coupling by changing the vertical soil water profile. Due to a reduced soil water amount in the upper soil layers, less water is available for evapotranspiration and the latent heat fluxes are reduced. In turn, soil heating and the sensible heat fluxes are increased, leading to higher near surface temperatures compared to the reference run. A comparison of these simulations results with the E-OBS observational dataset shows that the new depth-dependent saturated hydraulic conductivity function effectively reduces the systematic cold bias in CCLM-VEG3D simulations over almost all of Europe.