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Quantification of the uncertainties in soil and vegetation parameterizations for regional climate predictions

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The aim of the german research program MiKlip II is the development of an operational climate prediction system that can provide reliable forecasts on a decadal time scale. Thereby, one goal of MiKlip II is to investigate the feasibility of regional climate predictions. Results of recent studies indicate that the regional climate is significantly affected by the interactions between the soil, the vegetation and the atmosphere. Thus, within the framework of MiKlip II a workpackage was established to assess the impact of these interactions on the regional decadal climate predictability.

In a Regional Climate Model (RCM) the soil-vegetation-atmosphere interactions are represented in a Land Surface Model (LSM). Thereby, the LSM describes the current state of the land surface by calculating the soil temperature, the soil water content and the turbulent heat fluxes, serving the RCM as lower boundary condition. To be able to solve the corresponding equations, soil and vegetation processes are parameterized within the LSM. Such parameterizations are mainly derived from observations. But in most cases observations are temporally and spatially limited and consequently not able to represent the diversity of nature completely. Thus, soil and vegetation parameterizations always exhibit a certain degree of uncertainty.

In the presented study, the uncertainties within a LSM are assessed by stochastic variations of the relevant parameterizations in VEG3D, a LSM developed at the Karlsruhe Institute of Technology (KIT). In a first step, stand-alone simulations of VEG3D are realized with varying soil and vegetation parameters, to identify sensitive model parameters. In a second step, VEG3D is coupled to the RCM COSMO-CLM. With this new model system regional decadal hindcast simulations, driven by global simulations of the Max-Planck-Institute for Meteorology Earth System Model (MPI-ESM), are performed for the CORDEX-EU domain in a resolution of 0.22°. The identified sensitive model parameters in VEG3D are stochastically disturbed, whereby an ensemble is created representing the model uncertainty caused by insufficient soil and vegetation parameterizations. The quality of this ensemble and its ability to improve regional decadal predictions are analysed by comparing the ensemble simulations with observations.