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Sensitivity of the regional climate model RegCM4.7 to land-surface and planetary boundary layer parameterisations over the Carpathian region

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Precipitation is one of the most important climate variables, and it is still a great challenge for climate models to realistically simulate the regional patterns, temporal variations, and intensity of precipitation. The difficulty arises from the complexity of precipitation processes within the atmosphere stemming from cloud microphysics, cumulus convection, large-scale circulations, planetary boundary layer processes, and many others.
The aim of the study is to reproduce the historical precipitation pattern through improving the parameterization of surface processes. The appropriate representations of land surface component in climate models are essential for the simulation of surface and subsurface runoff, soil moisture, and evapotranspiration. Furthermore, the planetary boundary layer (PBL) strongly influences temperature, moisture, and wind through the turbulent transfer of air mass.
The current study focuses the newest model version of RegCM (RegCM4.7), with which we carry out simulations using different parameterization schemes over the Carpathian region. We investigate the effects of land-surface schemes (i.e. BATS - Biosphere-Atmosphere Transfer Scheme and CLM4.5 - Community Land Model version 4.5) in the regional climate model. In general, CLM offers improvements in terms of land–atmosphere exchanges of moisture and energy and associated surface climate feedbacks compared with BATS. Our aims include the evaluation of completed simulations whether this is the case on regional scale for the Carpathian region. Additionally, we used the two planetary boundary layer (PBL) schemes, namely, the Holtslag scheme and UW PBL scheme.
Four 1-year-long (1981) experiments (excluding the spin-up time) are compared with the CARPATCLIM observed, homogenised, gridded dataset by using the same domain, initial and lateral atmospheric boundary data conditions (ERA-Interim), as well as a 10 km spatial resolution. We carry out a detailed analysis of RegCM outputs focusing not only on standard climatological variables (precipitation and temperature), but also on additional meteorological variables, such as cloudiness, convective precipitation, sunshine duration and energy fluxes. It is found that the simulated near-surface temperature and precipitation are better represented in the CLM scheme than in the BATS when compared with observations both over the lowland and mountainous area.