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Assessing the contribution of different factors in RegCM4.3 regional climate model projections using the Factor Separation method over the Med-CORDEX domain

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A set of regional climate model (RCM) simulations applying dynamical downscaling of global climate model (GCM) simulations over the Mediterranean domain specified by the international initiative Coordinated Regional Downscaling Experiment (CORDEX) were completed with the Regional Climate Model RegCM, version RegCM4.3. Two GCMs were selected from the Coupled Model Intercomparison Project Phase 5 (CMIP5) ensemble to provide the driving fields for the RegCM: HadGEM2-ES (HadGEM) and MPI-ESM-MR (MPI). The simulations consist of an ensemble including multiple physics configurations and different "Reference Concentration Pathways" (RCP4.5 and RCP8.5). In total 15 simulations were carried out with 7 model physics configurations with varying convection and land surface schemes. The horizontal grid spacing of the RCM simulations is 50 km and the simulated period in all cases is 1970-2100 (1970-2099 in case of HadGEM driven simulations). This ensemble includes a combination of experiments in which different model components are changed individually and in combination, and thus lends itself optimally to the application of the Factor Separation (FS) method. This study applies the FS method to investigate the contributions of different factors, along with their synergy, on a set of regional climate model (RCM) projections for the Mediterranean region. The FS method is applied to 6 projections for the period 1970-2100 performed with the regional model RegCM4.3 over the Med-CORDEX domain. Two different sets of factors are intercompared, namely the driving global climate model (HadGEM and MPI) boundary conditions against two model physics settings (convection scheme and irrigation). We find that both the GCM driving conditions and the model physics provide important contributions, depending on the variable analyzed (surface air temperature and precipitation), season (winter vs. summer) and time horizon into the future, while the synergy term mostly tends to counterbalance the contributions of the individual factors. We demonstrate the usefulness of the FS method to assess different sources of uncertainty in RCM-based regional climate projections.