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Selection of the best-performing CMIP5 general circulation models for the climate change analysis of the Carpathian Basin using large-scale circulation patterns

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There is a growing interest to provide possible regional climate change scenarios for individual regions worldwide by using regional climate models (RCMs). These projections are essential to analyse the possible impacts of climate change, as well as develop appropriate adaptation strategies on regional/local scale. RCMs are driven by general circulation models (GCMs), therefore, one of the most important steps of regional climate modelling is to select suitable GCM simulation, from which boundary conditions are used. GCMs are able to capture large-scale atmospheric circulation patterns (i.e. phenomena related to the spreading of Rossby waves, e.g. atmospheric oscillations).
The main ultimate aim of our study is to analyse the regional climate change of the Carpathian Basin. The projected decrease of freezing conditions in winter will be likely to result in both positive and negative consequences (i.e. less energy will be necessary for heating on the one hand, and pests will be more likely to survive winter and later cause damages in agriculture, on the other hand). The winter climate of the Carpathian Basin is moderated mainly by large-scale circulation, therefore, it seems to be reasonable to evaluate GCMs with respect to atmospheric oscillations. For that purpose historical GCM simulations of the Coupled Model Intercomparison Project Phase 5 (CMIP5) with a spatial resolution finer than 2.5° are compared to reanalysis datasets. To get more reliable results, not only the ERA-20C reanalysis data of the European Centre for Medium-Range Weather Forecasts (ECMWF) is analysed but also the NCEP-NCAR 1 reanalysis data of the National Centers for Environmental Prediction (NCEP) and the National Center for Atmospheric Research (NCAR). GCM simulations and reanalysis datasets cover six 30-year-long time periods with 5-year-long overlaps between 1951 and 2005, thus allowing us to analyse the temporal evolution of the large-scale circulation patterns. Instead of analysing model averages, simulations of each GCM are the subjects of multivariate statistical analysis to determine model metrics, which helps to choose the best-performing GCMs for the Carpathian Basin with respect to atmospheric oscillations.