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Uncertainties in downscaling of global climate change scenarios. Comparison between dynamical and statistical techniques.

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Abstract

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• Changes in monthly temperature and precipitation at stations in two small areas placed in western (Banat Plain) and southwestern (Oltenia Plain) part of Romania for the periods 2021-2050 and 2071-2100 (compared to 1961-1990), under the IPCC A1B scenario, are estimated through two downscaling techniques (statistical-SDM and dynamical-RCM). These results were obtained within the SEE project CC-WaterS (www.ccwaters.eu). The statistical downscaling technique uses a model based on canonical correlation analysis (CCA). New improvement is achieved in this paper comparing to other previous studies, mainly referring to the combination of the local standardized temperature and precipitation anomalies (11 stations) in a single spatial vector considered as predictand, giving more physical consistence to the results. Various predictors were tested to find the optimum statistical downscaling model (SDM): the temperature at 850 hPa (T850), sea level pressure (SLP) and specific humidity at 700 hPa (SH700), either used individually or together. The observed predictand data are based on homogenized dataset. It was found that the T850 is good predictor for all seasons but the combination between the three predictors gives higher skill (in terms of explained variance) for winter and similar skill for other seasons. From physical reasons both versions were retained in order to analyse the uncertainty (similar skill should give similar future climate change signal if the statistical relationship will be also valid in the future and all predictors capture the entire climate change signal). The model was fitted with the data set for the period 1961-1990 and validated over the independent data set 1991-2007.The optimum statistical downscaling model, established over the independent data set for each season, has been then applied to predictors from the A1B scenario simulations of the ENSEMBLES RCMs (http://ensemblesrt3.dmi.dk), RegCM3 and CNRM, driven by the global models ECHAM5 (run 3) and ARPEGE, respectively. To estimate the uncertainty related to the downscaling technique (dynamical or statistical), the results achieved through the statistical downscaling model (SDM) applied to the global model ECHAM5 have been compared to those derived directly from 5 RCMs (including RegCM3) with the same driver as well as with those derived from the SDM applied to the two mentioned RCMs. The final ensemble achieved from 8 ENSEMBLES RCM outputs and SDM outputs has been considered to estimate the uncertainty associated to the climate change signal at the 11 stations. The optimum (most plausible) climate change signal (represented by the ensemble average) and the model spread (represented by the standard deviation of the 10 values) have been computed. The uncertainties related to the RCMs/GCM skill in reproducing the predictor variability are analysed in details for the pair RegCM3-ECHAM5.