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Estimation of changes in monthly temperature and precipitation over the Banat and Oltenia Plains in Romania. Comparison between statistical and dynamical downscaling techniques

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Abstract

A statistical downscaling model based on canonical correlation analysis (CCA) is used to estimate monthly temperature and precipitation changes 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. These results were achieved within the EU project CC-WaterS (www.ccwaters.eu). For this purpose, the statistical downscaling model (SDM) is applied to various predictors, the temperature at 850 hPa (T850), sea level pressure (SLP) and specific humidity at 700 hPa (SH700) (either used individually or together). The NCEP and ERA40 predictors were used, comparing the results. New improvement were achieved in this paper compared 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. The observed data were before homogenized and precipitation data were additionally adjusted considering physical-geographic factors (mainly wind speed and the share of solid precipitation). 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 signal if the statistical relationship will be also valid in the future). 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 with the ENSEMBLES RCMs (http://ensemblesrt3.dmi.dk), RegCM3 and CNRM, driven by the global models ECHAM5 and ARPEGE, respectively. The results achieved through the statistical downscaling model have been compared to those derived directly from the two RCMs, to estimate the uncertainty. It has been found that, for temperature, the climate signal is similar but with underestimation/overestimation for some months. The signal is homogeneous over the two analysed areas. Even if on monthly scale there are some differences between the magnitude of RCM and SDM signals, on annual average the two signals are quite close, especial for the Banat Plain, giving more confidence in these results. Same characteristic can be also seen for precipitation: the annual average of the monthly precipitation change based on the SDM results is consistent with those based on the RCM outputs. On monthly scale , there are also quite more similarities between RCM and SDM signals but only in a few cases these similarities are extended over the two RCMs-SDMs pairs (March, June, July for Oltenia Plain over the period 2071-2100) meaning that only in these cases the confidence is higher.

In order to better estimate the uncertainties associated to the SDM results, the comparison with the ENSEMBLES RCM outputs at 11 stations derived directly from other additional 7 RCMs is also presented. The estimations based on the SDMs are within the ranges of the 9 RCM ensemble. An ensemble average of the climate signal over these 9 RCMs was computed for each local station and this is considered the best estimation of change in temperature and precipitation over the two test areas for the periods 2021-2050 and 2071-2100, under the A1B scenario.