



## The effect of large-scale nudging on climate indices in the Regional Climate Model CCLM

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Spectral nudging imposes time-variable large-scale atmospheric states on a regional atmospheric or climate model, in order to condition the regional-scale climate statistics by the large-scale flow conditions of the driving conditions. Although this technique is often described to improve the large-scale features, an improvement of sub-synoptic or small-scale features is less straightforward. Moreover, these results could be biased due to the fact that spectral nudging studies often compare the mean properties of meteorological variables (e.g. temperature, precipitation, GPH500...) between runs with and without spectral nudging. In the present research, we opt to test the performance of spectral nudging in an extended hindcast simulation using the COSMO4.8-CLM10 model on 0.44° with initial and lateral boundary conditions from the ERA40 reanalysis dataset for the period 1988-2000, of which the last 10 years are used for the analysis. A set of 11 spectral nudging experiments are defined in which the nudging coefficients (nudging strength, lowest nudging level, nudged variables, and number of nudged waves) are varied. Moreover, three ensemble runs are done using different initial time steps to account for the models' internal variability.

First, the model performance of the reference simulation without nudging is addressed for temperature and precipitation against the ECA&D EOBS dataset, in terms of means and interannual variability. The largest number of consecutive frost/summer and dry/wet days are taken as climate extreme indices. The results are confronted against the models' internal variability obtained from the ensemble runs. Secondly, all nudging runs are evaluated for three specific measurement sites, for a range of variables important for air quality (e.g. cloud cover, relative humidity, wind speed and direction, Tmax, Tmin, ...). Here, the Taylor diagram is used to summarize the relative merits of the collection of spectral nudging experiment runs against point observations, again with a focus on the higher percentile statistics. This research could provide further insight in the advantages or disadvantages of spectral nudging, and could be used as a platform for the regional climate modelling community for further use of this indirect data assimilation technique.