

On the ability of statistical downscaling methods in simulated climates.

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The application of statistical downscaling methods for the estimation of regional climate change assumes that the future relationship between large-scale predictors and local predictands will be the same as in the observational record. This hypothesis cannot be tested with real data, but it can be tested in transient simulations of future climates with climate models.

In the present study, we test the skill of two statistical downscaling models (SDMs) in the surrogate climates simulated by two different models (ECHO-G and HadCM3). Here, a strict realism of the climate simulations, in the present or in the future, is not required. They are considered as plausible realizations of climates that are close to the real present climate and it is assumed that they provide also a plausible realization of the future climate.

The SDMs are based on canonical correlation analysis (CCA) and the search for analogs. We use these linear and non-linear techniques to estimate the precipitation over two European regions, the Iberian and Scandinavian Peninsulas. As large-scale predictors, sea level pressure, 500mb geopotential height and relative humidity at 850mb over the North Atlantic area have been considered.

The precipitation estimated by the statistical methods within the simulated world is evaluated versus the direct output from the climate models. The results show that the different SDMs yield quite similar results and the differences were mostly due to the use of different predictors than to the method. The estimation based on sea level pressure alone agree with the target precipitation in the Iberian Peninsula, but estimates for Scandinavia in the 21th century are too dry. Geopotential height as predictor performs clearly worse in both regions, estimating more precipitation in the past and too dry climates in the future. This is likely due to changes in the geopotential height linked to the evolution of temperatures which are colder in the past centuries and higher in the 21th century. The SDM based on CCA seems to be more sensitive to this effect than the one based on analogs. In the Iberian Peninsula, SLP is a sufficient predictor,

whereas errors in the estimations for Scandinavia are related to changes in relative humidity, which also contribute to future precipitation changes in the simulations.