Testing Statistician Downscaling Methods *in virtual climates*

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The spatial resolution of global climate models – about 300 hundred km- is in many instances too coarse to allow or a trustful simulation of climate change at the small spatial scales required for climate impact studies, which can be a as short as a few tenths of kilometres. This scale mismatch has to be bridged by ad-hoc methods, either by high resolution regional climate models that incorporate the required regional details- topography, coastlines, sometimes vegetation cover, soil type, etc.- , or by statistical models that link the large-scale climate features, that are hopefully well simulated by global climates, to the local climate variables of interest. A simple academic example would be a regression model between the North Atlantic Oscillation index and local precipitation at some station in Western Europe. Changes in the NAO simulated by a global climate model can then be readily translated in terms of changes in local precipitation, provided that:

-The link between predictor and predictand remains essentially unchanged in the future climate

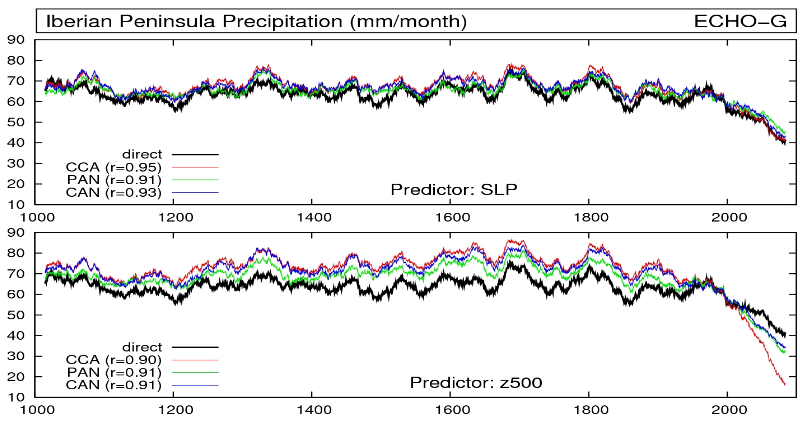
-The chosen predictors can describe most of the decadal variability of the local variable

-The statistical model, calibrated with interannual data, remains valid for multidecadal timescales.

Normally, the statistical models models are tested in a validation period. But there is no easy way to ascertain the fulfilment these assumptions, since the observational record is usually too short and too close to the mean of the calibration period to allow for a stringent test. In this sense, statistical downscaling methods face similar problems as other statistical models in many other areas.

Experience so far indicates that there is no universal downscaling method that is valid for all regions and all target variables. Instead, research has extended so far in developing new and more sophisticated methods. In this presentation, a schematic description of the main groups of statistical downscaling methods will be outlined, but the main focus will lie in a new venue of research, namely *in testing some of this methods in the virtual reality of climate model simulations, where the changes in the target variable are known and different predictors can be used.*

One of the most difficult target variable is arguably precipitation at daily timescales. For this variable, linear models are of little use and previous studies have explored clustering methods, neural networks and more simple analog methods, with geopotential height, sea-level-pressure and humidity as predictors. It will be shown that simple methods can yield surprisingly good results, but also that obvious predictors for short-term precipitation predictions can lead to biased estimation in a long-term climate context.



Output of three different methods to downscale monthly winter precipitation in the model 'Iberian Peninsula' from sea-level-pressure and 500mb geopotential height, compared to the 'true' simulated precipitation, in a climate simulation spanning the period 1000-2100. The statistical methods were calibrated in 1960-1990.