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PDF added value of a high resolution climate simulation for precipitation

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General Circulation Models (GCMs) are models suitable to study the global atmospheric system, its evolution and response to changes in external forcing, namely to increasing emissions of CO_2. However, the resolution of GCMs, of the order of 1o, is not sufficient to reproduce finer scale features of the atmospheric flow related to complex topography, coastal processes and boundary layer processes, and higher resolution models are needed to describe observed weather and climate. The latter are known as Regional Climate Models (RCMs) and are widely used to downscale GCMs results for many regions of the globe and are able to capture physically consistent regional and local circulations.

Most of the RCMs evaluations rely on the comparison of its results with observations, either from weather stations networks or regular gridded datasets, revealing the ability of RCMs to describe local climatic properties, and assuming most of the times its higher performance in comparison with the forcing GCMs. The additional climatic details given by RCMs when compared with the results of the driving models is usually named as added value, and it's evaluation is still scarce and controversial in the literuature. Recently, some studies have proposed different methodologies to different applications and processes to characterize the added value of specific RCMs. A number of examples reveal that some RCMs do add value to GCMs in some properties or regions, and also the opposite, elighnening that RCMs may add value to GCM resuls, but improvements depend basically on the type of application, model setup, atmospheric property and location.

The precipitation can be characterized by histograms of daily precipitation, or also known as probability density functions (PDFs). There are different strategies to evaluate the quality of both GCMs and RCMs in describing the precipitation PDFs when compared to observations. Here, we present a new method to measure the PDF added value obtained from dynamical downscaling, based on simple PDF skill scores. The measure can assess the full quality of the PDFs and at the same time integrates a flexible manner to weight differently the PDF tails.

In this study we apply the referred method to characaterize the PDF added value of a high resolution simulation with the WRF model. Results from a WRF climate simulation centred at the Iberian Penisnula with two nested grids, a larger one at 27km and a smaller one at 9km. This simulation is forced by ERA-Interim. The observational data used covers from rain gauges precipitation records to observational regular grids of daily precipitation. Two regular gridded precipitation datasets are used. A Portuguese grid precipitation dataset developed at 0.2º$\times$ 0.2º, from observed rain gauges daily precipitation. A second one corresponding to the ENSEMBLES observational gridded dataset for Europe, which includes daily precipitation values at 0.25º.

The analisys shows an important PDF added value from the higher resolution simulation, regarding the full PDF and the extremes. This method shows higher potential to be applied to other simulation exercises and to evaluate other variables.