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Is there added value in the EURO_CORDEX hindcast simulations? A new simple method to assess the added value using high-resolution climate distributions

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The resolution of Regional Climate Models (RCMs) has been steadily increasing in order to explicitly represent small-scale atmospheric processes excluded from low resolution simulations. Higher resolution usually allows a better representation of near surface temperature gradients and precipitation in the vicinity of complex topography such as coasts and mountain ranges. However increased resolution does not imply, per se, improved results, since these are region and variable dependant. The skill of a given RCM to improve, or not, the representation of atmospheric processes in relation to its forcing model (reanalysis or global climate models) is commonly known as added value. Here we propose a new method to assess added value of the high resolution simulation in relation to its forcing model or coarser resolution counterpart through the analysis of probability density functions (PDF) matching scores. A PDF matching score is determined between the model results and the forcing model or between model resolutions and the normalised difference of these scores assess the distribution added value (DAV). DAV is an objective added value measure that can be applied to any variable, temporal scale or regions, from grid-point to large areas. Since it does not imply temporal synchronicity between distributions it can be applied to historical (global climate model driven simulations - non-synchronous) as well as hindcast simulations. DAV and its application to the EURO-CORDEX hindcast daily precipitation and maximum and minimum temperature data is here presented. Generally, the EURO-CORDEX precipitation results at both resolutions (0.44o,0.11o) display a clear added value in relation to ERA-Interim, with maximum values around 30% in summer and 20% in the intermediate seasons. When both RCM resolutions are directly compared, only 3 out of 5 models (0.11o) show added value for precipitation, with a maximum of ∼10%. The regions with the larger DAVs are areas where convection is relevant, e.g. Alps and Iberia. For the extreme PDF tails, the higher resolution improvement is generally greater than the low resolution for seasons and regions. Finding added value in relation to ERA-Interim near surface temperatures is more difficult. 4 out of five models show a limited maximum temperature anomaly added value (∼2-3%) at both resolutions. The higher resolution does not show added value in relation to its lower resolution counterpart, except in winter. Minimum temperature anomalies are better simulated by all models, now the maximum improvement in relation to the reanalysis is 5%. There is added value in the intermediate seasons and winter, this is more significant when analysing the lower tail of the pdf (maximum of 7% in winter and 16% in summer). The higher resolution has added value in relation to the lower resolution, but between seasons, this is not consistent across models. The regions with larger DAVS era Iberia, British Isles, Scandinavia and Mediterranean for minimum temperature and Alps, British Isles and Mediterranean for maximum temperatures. Depending on the region and model, some 0.11o have added value in relation to the 0.44o resolution.

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