The added value of regional climate simulations at kilometre-scale resolution to describe daily wind speed: the CORDEX FPS-Convection multi-model ensemble runs over the Alps

María O. Molina | Claudia Gutiérrez | Enrique Sánchez | FPS-CONVECTION team
MOfelia.Molina@uclm.es

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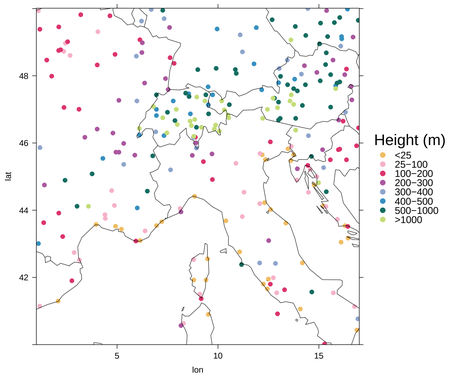
1. ABSTRACT

The World Climate Research Program's Coordinated Regional Downscaling Experiments Flagship Pilot Studies (**FPS**) on convective phenomena encompasses a set of simulations driven by the ERA-Interim reanalysis for the period from 2000-2009 (hindcast). Most models feature a horizontal resolution of 2.2 to 3 km **(ALP)**, nested in an intermediate resolution of 12-25 km **(EUR)**. An extended Alpine domain is considered for the simulations, due to the complexity of the mountain system together with heavy precipitation events, a large observational network and the high population density of the area. This initiative aims to build first-of-its-kind ensemble climate experiments of convective-permitting models (**CPRCMs**) to investigate convective processes over Europe and the Mediterranean.

In this study, the **Distribution Added Value** metric is used to determine the improvement of the representation of all available FPS hindcast simulations for the daily mean wind speed. The analysis is performed on normalized empirical probability distributions (**PDF**) and considers station observation data (from HadISD) as a reference. The use of a normalized metric allows for spatial comparison among the different seasons. This approach permits a direct assessment of the added value between the higher resolution CPRCM simulations against their global driving simulations and respective coarser resolution Regional Model counterparts. Although the complexity of such simulations, those not always reveal an added value. In general, results show that models add value to their forcing reanalysis, but the nature and magnitude of the improvement on the representation of wind speed vary depending on the model, the spatial distribution and the season.

2. DATA AND METHOD



DATA: HadISD observations, CPRCMs FPS-CONV models and ERA-Interim reanalysis.

METHOD: Distribution Added Value, **DAV** (Soares and Cardoso, 2018):

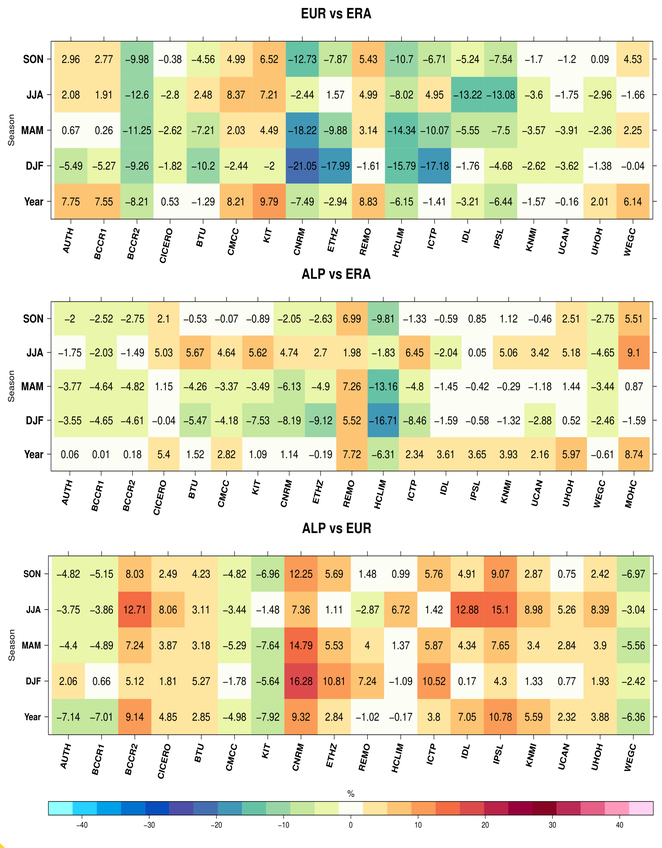
1. A score (S) between 0 and 1 is obtained as a measure of the common area between the high (hr) and low (lr) resolution model or the ERA-Interim data PDFs.
2. The daily wind speed DAV is obtained with the relative difference between the scores of the hr and lr resolution model.

$$S = \sum_{1}^{n} min(Z_m, Z_o) \qquad DAV = 100 * \frac{S_{hr} - S_{lr}}{S_{lr}}$$

ANALYSIS: Yearly and seasonal PDF, full PDF and PDF section above the 95th percentile of the observations (extremes), composite of different station observations altitudes (orography dependence).

3. RESULTS AND CONCLUSIONS

3.1. Yearly and seasonal analysis: full PDF

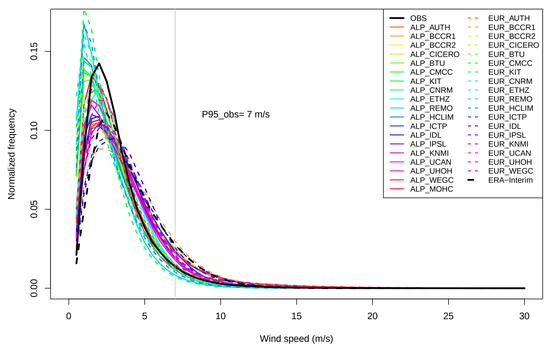


HIGHLIGHTS

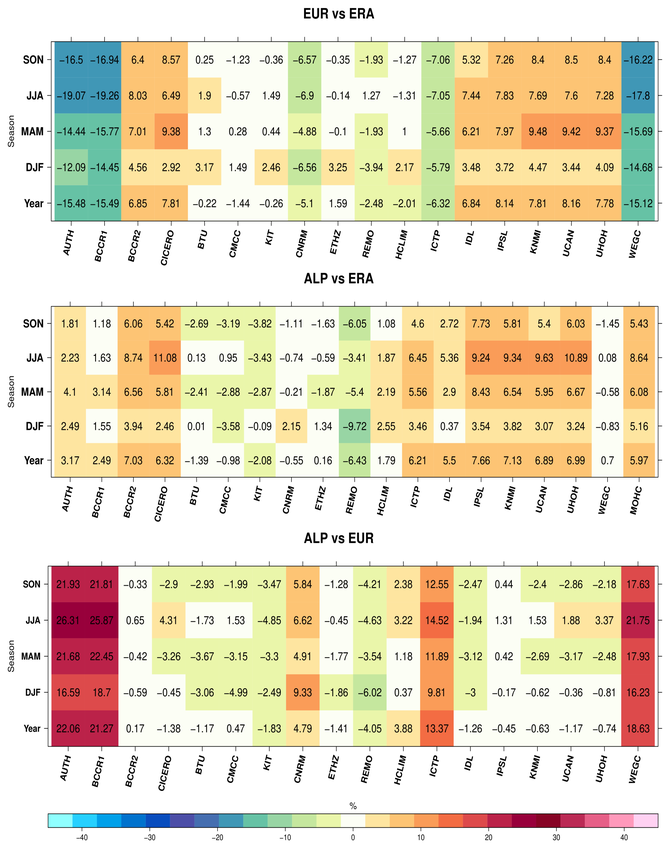
- In the comparison of the CPRCMs with the RCMs, an added value is seen in the wind speed representation, with yearly DAV values between 2-10% in 11 out 18 of the models. This improvement is usually larger in winter than summer.

- Overall, larger DAV than those for the whole PDF are obtained in the EUR vs ERA and in the ALP vs ERA comparisons of the DAV values for the wind speed partial PDF regarding the wind speed bins above the p95 of the observations. The obtained DAV reflect that the AUTH, BCCR1, CNRM, HCLIM, ICTP and WEGC models represent better the high extreme winds at higher resolution. DAV are larger in summer than winter.

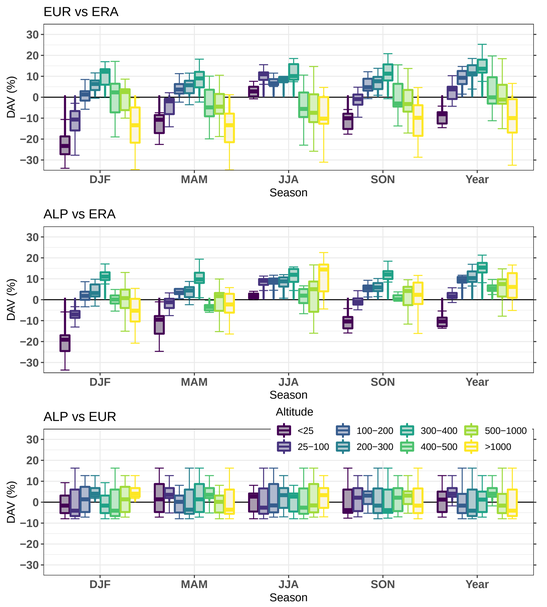
Yearly PDF for the simulations, ERA-Interim and observed data



3.2. Yearly and seasonal analysis: upper-tail PDF



3.3. Orography dependency



HIGHLIGHTS

CPRCMs and RCMs tend to represent the wind speed better than ERA-Interim as height increases up to 400 m, and then the DAV decreases with altitude. In the CPRCMs vs RCMs comparison, DAV are positive for the range of altitudes lower than 100 m and between 300-500 m in the yearly PDF.

4. REFERENCES

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