

Review of “Enhanced representation of the power spectra of wind speed in Convection-Permitting Models”

General comments

The authors present an analysis of the wind speed power spectra from four regional convection-permitting models (three from the CORDEX Flagship Pilot Project and the New European Wind Atlas, NEWA). The wind speed power spectra are compared with theoretical expectations, and an observed spectrum from mast data, and contrasted with a reanalysis dataset that parameterizes convection (ERA5). The key finding of the work is that the convection-permitting models from the CORDEX project produce a wind speed power spectrum for high frequency variations (sub-daily) that matches with observations, offering an improved representation compared with the NEWA and ERA5. This has implications for wind resource and extreme wind assessments using model datasets. The improvement in representation over the NEWA is suggested to be a result of not using large-scale nudging in the model configuration. Although, this is not shown in the paper, and I have a comment related to this theory, below.

Overall, this a nice analysis that is well-written, and I think it is suitable for publication in Wind Energy Science after minor revisions (see comments below).

Specific comments

1. The authors have demonstrated the improved power spectrum of wind in the CORDEX CPMs. It is suggested that this is a result of the models being free-running and not nudged towards the large-scale. But I wonder if this improvement is balanced by other aspects becoming less accurate than the nudged simulations. What about the wind speed distribution, for example? This will also affect estimations of U_{50} . There are some biases in the CORDEX model wind speed suggested in Figure 1, as acknowledged by the authors. I know the authors may not be able to provide any further analysis of this in this brief communication, but maybe this could be mentioned or relevant references cited?
2. Line 5: I don't think ERA5 is a “mesoscale” model
3. Some more background could be useful in the Introduction. For example, I am not sure what the second-order spectral moment is, and how it relates to estimating extreme winds. Same for Nyquist frequency on line 20.

4. The authors say that hourly wind data is used, but do not mention how the temporal window of these data are defined. For example, do the wind speeds represent 10-minute averages, hourly averages, or instantaneous wind speeds at the hourly model time step? I imagine that this could impact the high frequency variations assessed in this study, especially if they differ between datasets.
5. Figure A1: I assume the CPMs cover a much larger area than this? It would be useful to see the points in relation to the CPM domain (in case any points are close to the boundary, for example).
6. Figure 1: Could f_c be indicated to show where the slopes have been corrected? And why aren't the observations shown on panel d?
7. Line 116: I was slightly confused by “de-trended” as I usually would interpret this to mean that a long-term trend was subtracted from the time series. But it sounds like the wind speed anomalies from the mean were calculated?
8. Line 145: Is “almost identical” a correct assessment? The two lines appear to diverge significantly at the upper tail.
9. Do the spectrum correction methods preserve the diurnal and semi-diurnal wind cycle? Some of these peaks appear to disappear in Figure 1 (but not all). This is not crucial to the paper, but I am curious.
10. Line 159: What is meant by large-scale offsets? I assume this relates to bias in the wind speed distribution in the models, including the mean wind speed?

Technical corrections

1. Acronyms should be defined throughout where they first appear, such as on lines 4 and 5. There are some acronyms that are not defined (HIRHAM, REMO, CFSR, MERRA)
2. Line 20: Is ‘climatological average’ the correct term here?
3. Line 91: Should be “3 km grid spacing”