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Evaluation of CERRA for wind energy applications

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The Copernicus European Regional ReAnalysis (CERRA) is a new limited-area reanalysis covering Europe at 5.5 km resolution, produced in the framework of the Copernicus Climate Change Service (C3S) and available in its Climate Data Store (<https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-cerra-height-levels>).

Near-surface wind speeds are essential variables to simulate wind power production for wind energy applications or prospective studies of the European power system. The purpose of this study is to assess the quality of CERRA's wind speeds (especially at the height level of 100 m) in respect to these studies and in comparison to other reanalyses such as ERA5.

A first part of the study was to determine which forecast steps to use. CERRA provides an analysis every three hours and hourly forecasts up to 6 hours, therefore forecast streams are overlapping. For example, values at 04 UTC are provided by the step +4h of the 00 UTC analysis and also by the step +1h of the 03 UTC analysis. CERRA documentation leaves the choice to the user. For wind speeds, we recommend not to use the forecast steps close to the analysis as they exhibit too low values. This phenomenon was already observed in AROME NWP model (Jourdi, 2020). This wind deficit is more pronounced in summer, in Northern Europe and offshore. Therefore we chose to use steps +4 to +6h of each analysis.

In a second part, average 100 m wind speeds from CERRA were compared to other reanalyses:

- ERA5, ECMWF's global 32-km reanalysis, which provides the boundary conditions to the CERRA system.
- COSMO-REA6, DWD's European reanalysis which has a similar horizontal resolution but is based on older ERA-Interim global reanalysis.

Compared to ERA5, CERRA exhibits large differences (up to 6 m/s in average), much higher wind speeds over mountains (especially over the Scandinavian Mountains, the Alps and Dinaric Alps) and higher wind speeds in general over most of Europe either offshore or onshore (except Sweden and Finland). This was expected as ERA5 winds are known to be too low, especially in mountainous areas.

Compared to COSMO-REA6, CERRA exhibits smaller differences (up to 3 m/s). CERRA's wind speeds

are higher over Eastern Europe and much higher over some mountains (parts of the Scandinavian Mountains, the Alps). They are lower over the British Isles, most of Scandinavia and most parts of the Mediterranean Sea.

Finally, hourly wind power production series were simulated based on CERRA for all wind farms in France. Compared to observed power, CERRA shows less bias than ERA5 and similar hourly correlations. Still some bias remain, mainly positive in Western France and negative in Eastern and Southern France.