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Spatial complementary of offshore wind farm Iberian Peninsula sites based on COSMO-REA6 high-resolution reanalysis

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1. BACKGROUND

Spain and Portugal have a high potential in the wind offshore development [1,2] and their governments are planning to strongly increase the installed offshore wind power capacity in the near future.

However, wind power generation is, by nature, complex, irregular and hard to be forecasted. Thus, increasing interconnections between regions can dampen the impact of wind variability on local wind power generation [3].

This work proposes an analysis of the spatial complementarity of the main potential sites for floating offshore wind farms across the Iberian Peninsula at the typical hub heights of current and future offshore wind installations (105 and 150 m, respectively) on annual and seasonal time scales.

2. DATA & METHODS

Hourly wind fields at 105 and 150 m from COSMO-REA6 high resolution reanalysis (0.055º) [4] in the 1995-2018 period were used to compute the wind capacity factor.

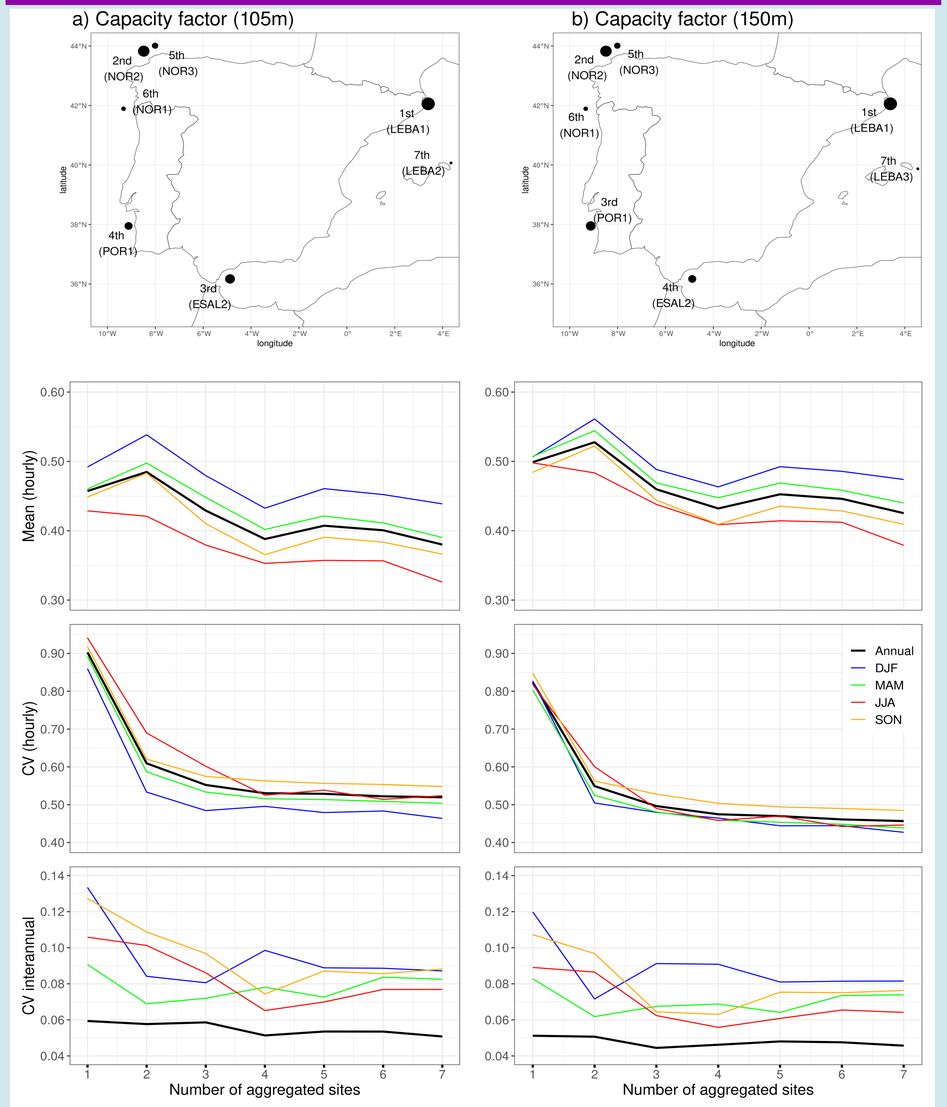
15 gross locations were chosen based on the publicly available planning information given by Spanish and Portuguese governments.

Step 1: Wind capacity factor was computed at 105 and 150 m using the Vestas V164-10.0 MW and Haliade-X 13 MW powers curves provided by [5], respectively.

Step 2: The top 7 of the 15 sites were chosen by applying the method proposed by [6] that finds the combination of sites that minimizes the coefficient of variation (CV) of the aggregate wind power.

Step 3: The geographical aggregation of the sites was analysed using the following statistics on an annual and seasonal timescale: hourly mean, hourly CV and interannual CV.

3. RESULTS



Capacity factor characteristics of the combination of the 7 best potential offshore wind sites for 105 m (a) and 150 m (b). The first row shows the locations marking the order of the sites added in the combination. The second, third and fourth rows show the hourly mean, hourly CV and interannual CV of the capacity factor, respectively. Note that the values of the X-axis marks correspond to the order of the aggregated locations marked in the first row.

4. CONCLUSIONS

It is more advantageous for the Iberian electricity system to build wind farms farther apart, giving priority to wind farm projects located in the northeast and northwest coastal corners of IP.

It is shown that at both 105 and 150 m, as more distant sites are added, the coefficient of variation decreases (~40%) more than the capacity factor mean (~15%). This behaviour varies slightly by season, with the hourly variation decreasing the most in winter (~45%) and the capacity factor mean decreasing the most in summer (~ 24%). On the other hand, the interannual CV varies little on an annual scale, but shows a highly variable behaviour as sites are aggregated.

At higher altitudes, a larger and more stable offshore wind resource can be obtained. It is especially interesting in summer, when the capacity factor increases ~ 11% and the hourly variation decreases ~ 14% at 150 m with respect to 105m.

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