Complementarity of Iberian offshore wind farm potential sites using COSMO-REA6 high-resolution reanalysis

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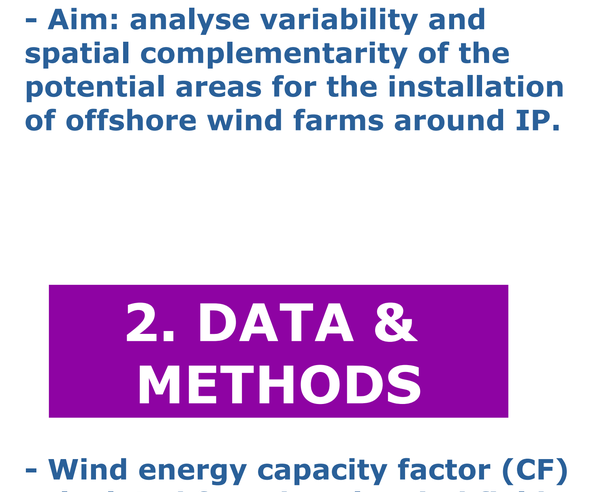
1. BACKGROUND AND AIM

- High offshore wind potential in Spain and Portugal
- Floating wind turbines necessary
- Recent definition of areas where offshore wind farms can be installed
- Semi-closed power system in the Iberian Peninsula (IP)
- Already high share of renewables (nearly 50% in Spain, 60% in Portugal)
- High summer power demand
- Is there an added value of offshore wind energy for the Iberian power system, beyond the high resource amount?
- Aim: analyse variability and spatial complementarity of the potential areas for the installation of offshore wind farms around IP.

2. DATA & METHODS

- Wind energy capacity factor (CF) calculated from hourly wind fields at 105 and 150 m height from COSMO-REA6 high-res. reanalysis (0.055°) for 1995-2018 period
- 15 possible location areas based on the publicly available planning information given by Spanish and Portuguese government:



- Aggregated wind energy CF for combination of possible areas that minimizes the variability (Reichenberg et al., 2014. Dampening variations in wind power generation-the effect of optimizing geographic location of generating sites. Wind Energy, 17(11), 1631–1643)

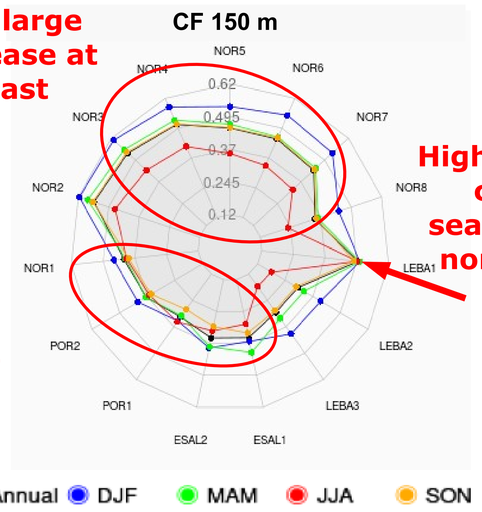
3. RESULTS

Seasonal capacity factors for individual areas

High CFs, but large summer decrease at northern coast

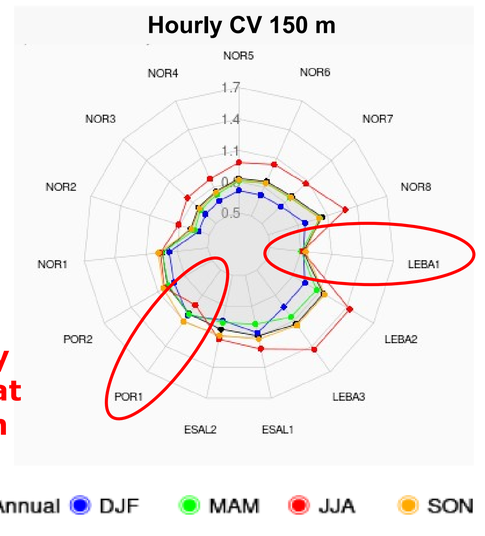
Lower CFs, but small summer decrease at western and southern coasts

High and nearly constant seasonal CF at northeastern coast



Hourly CV for individual areas

Lower summer hourly variability near Lisbon and at the northeastern coast

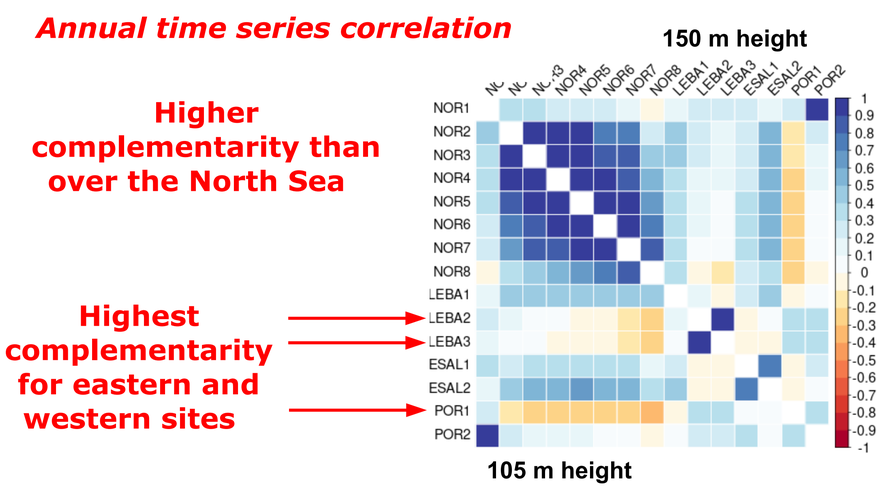


Pairwise complementarity of the different potential areas

Annual time series correlation

Higher complementarity than over the North Sea

Highest complementarity for eastern and western sites

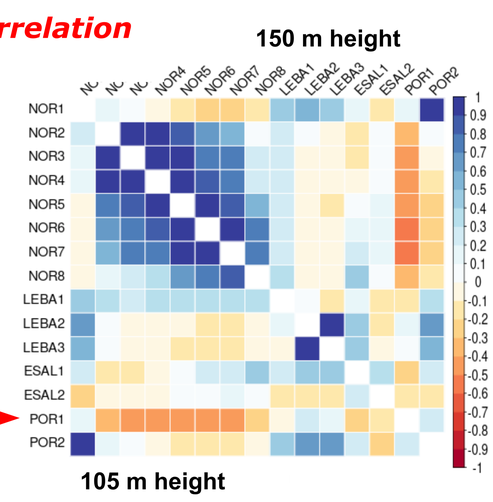


Pairwise complementarity of the different potential areas

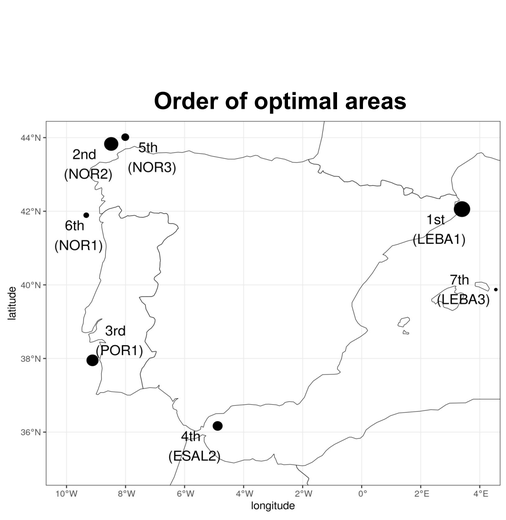
Summer time series correlation

High summer complementarity

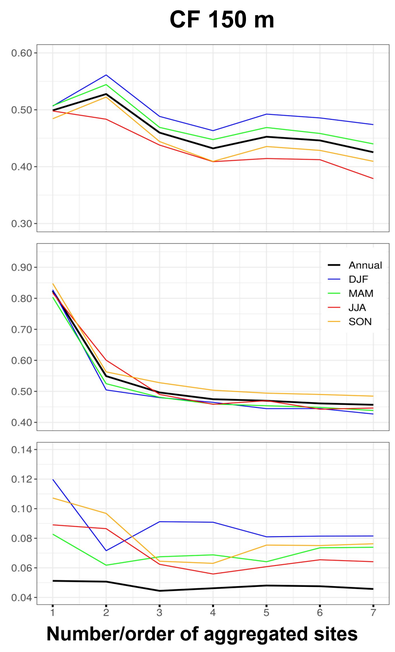
Outstanding complementarity near Lisbon



Optimal aggregation of potential areas



1st site: northeastern (LEBA1)
2nd site: northwestern (NOR2)
3rd site: western (POR1)



Aggregation of several sites: strong variability reduction and much lower seasonality than onshore wind energy

Capacity factor characteristics of the combination of the 7 best potential offshore wind areas for 150 m. The values of the X-axis marks correspond to the order of the aggregated locations marked in the map on the left.

4. CONCLUSIONS

- Low winter-summer variations of capacity factor for several areas: good adaptation to demand
- Complementarity depends not only on distance, but also on coastal orientation
- Optimal spatial combination of sites can reduce variability strongly: stable aggregated contribution to power system with much lower seasonality than onshore wind energy
- Auctions should include non-price criteria in order to harness the added-value for the power system

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