Supplementary Materials:

Wind Energy Assessment during High-Impact Winter Storms in Southwestern Europe

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Wind Energy Potential (WEP) using various values of z_0 (equation 1) and α (equation 2)

We proceed to the WEP calculations using the various values of z0 (Table S1) in equation 1 (LogL) and α (Table S2) in equation 2 (PL), according to the tabulated values [32] and the results are shown in Figures S1 and S2, respectively, of the supplementary material.

Table S1. Roughness coefficient (z_0). Adapted from [32].

Description	Roughness Length z_0 (m)
Water surface	0.0002
Open areas with a few windbreaks	0.03
Farm land with some windbreaks more than 1 km apart	0.1
Urban districts and farm land with many windbreaks	0.4
Dense urban or forest	1.6

Table S2. Friction coefficient (α). Adapted from [32].

Terrain Characteristics	Friction Coefficient (α)
Smooth hard ground, calm water	0.10
Tall grass on level ground	0.15
High crops, hedges, and shrubs	0.20
Wooded countryside, many trees	0.25
Small town with trees and shrubs	0.30
Large city with tall buildings	0.40

Figure S1 shows in the first column (Fig.S1 A, F, K) the WEP values calculated with z0 for offshore regions and the remaining columns correspond to values of z0 for onshore conditions. This analysis was repeated for the three months of December (2017, 2018 and 2019) under study.

In general, it is notable that when we increase the value of z0, the roughness of the land is devalued allowing the increase of WEP in the onshore regions. This pattern is similar for the 3 months under study. The second column (Figures S1. B, G, L) with the value of z0 = 0.03 m is the reference for comparison between the different figures (columns), considering that it was the value of z0 used in the entire study.

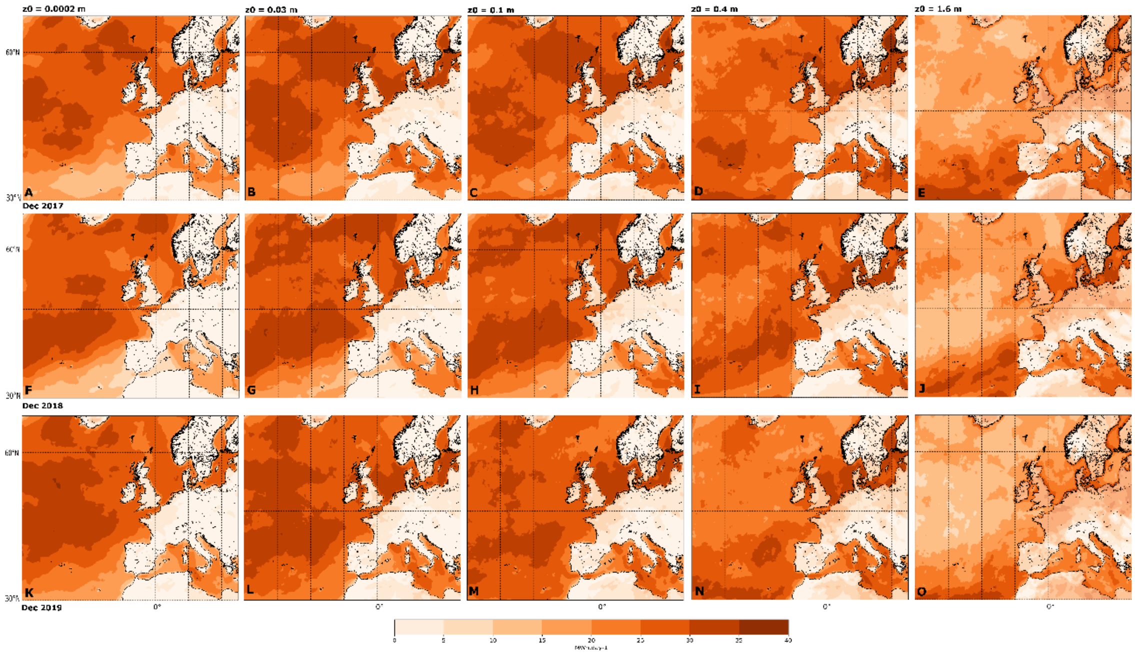

Figure S1. Wind Energy Potential (WEP) (MWh.day-1): December 2017 (A), (B), (C), (D) and (E); December 2018 (F), (G), (H), (I) and (J); December 2019 (K), (L), (M), (N) and (O); Calculations made using equation 1 (LogL); (A), (F) and (K) calculations made using 0.0002m as z_0 coefficient; (B), (G) and (L) calculations made using 0.003 m as z_0 coefficient; (C), (H) and (M) calculations made using 0.1 m as z_0 coefficient; (D), (I) and (N) calculations made using 0.4 m as z_0 coefficient; (E), (J) and (O) calculations made using 1.6 m as z_0 coefficient, for the respective months of each year.

In Figure S2 the first column (Fig. S2 A, G, M) corresponds WEP values calculated using the α for offshore conditions (α = 0.10) and the remaining columns (figures) correspond to α values for onshore conditions. As the α value increases, the WEP values increase in the onshore regions, and there is a decrease in the offshore regions. This means that when we increase the value of the friction coefficient of the terrain, the influence of this parameter in the extrapolation of the wind speed is neglected, thus allowing to obtain higher values of WEP in the onshore regions. The third column (Fig. S2 C, I, O) with the value of α = 0.20 is the reference for comparison between the different figures (columns), since it was the value used in the entire study.

In Figures S1 and S2, the low WEP values in the mountainous regions of the Pyrenees and Alps should be highlighted, with this pattern being maintained in all figures.

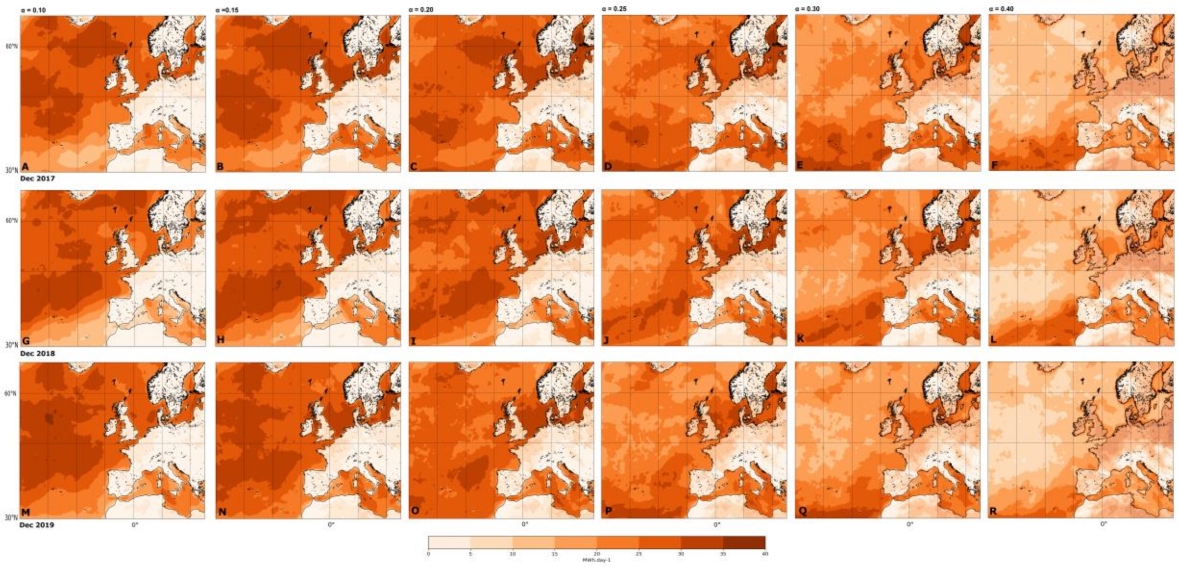

Figure S2. Wind Energy Potential (WEP) (MWh.day^{-1}): December 2017 (A), (B), (C), (D), (E) and (F); December 2018 (G), (H), (I), (J), (K) and (L); December 2019 (M), (N), (O), (P), (Q) and (R); Calculations made using equation 2 (PL); (A), (G) and (M) calculations made using 0.10 as α coefficient; (B), (H) and (N) calculations made using 0.15 as α coefficient; (C), (I) and (O) calculations made using 0.20 as α coefficient; (D), (J) and (P) calculations made using 0.25 m as α coefficient; (E), (K) and (Q) calculations made using 0.30 m as α coefficient; (F), (L) and (R) calculations made using 0.40 m as α coefficient, for the respective months of each year.