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Relationship between wind power production over northeastern Iberia and North Atlantic atmospheric circulation

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This work explores the regional variability of the wind power production based on its relation with the large scale atmospheric circulation over the North Atlantic area. The evaluation of changes in wind energy at the different timescales is imperative for the assessment of alternative to more traditional and controversial energy resources. The availability of wind power records at several wind farms in northeastern Iberian Peninsula favours the treatment of the power production as an independent variable, alternatively to the classical procedures that obtain wind energy density as a wind derived product. The analysis of this variable as a response to the large scale circulation constitutes a new take on the topic with wind power production playing the role of a non-atmospheric variable. This is aligned with impact oriented type of studies and the basis for such an approach lies in evidences of linearity at monthly timescales between the wind power and its main driver, the wind. Previous stages of the analysis explored the associations between the large scale circulation and the regional wind field over the same area by means of a statistical downscaling method (Canonical Correlation Analysis) that is based on linearity assumptions. Therefore, the question arises whether a direct linear relationship can be established between large scale circulation and the regional non-meteorological predictand (wind power) at monthly timescales. To answer this question a comparable analysis to the case of the wind field is applied to the wind power. The assessment herein includes an evaluation of the methodological uncertainties.

Results evidence that the regional variability of the wind power generated at various wind farms within the region under study can be partly attributed to variations of the relevant large scale modes in the region. The spread of the ensemble of estimations obtained in the methodological uncertainty inspection remains in the range of the variability of the observations, and thus, the statistical method proved robust to changes in the model configuration. Comparisons among a set of methodological variants that made use of the downscaled wind field and transfer linear functions to obtain final wind energy estimates, revealed that the direct downscaling performs generally better than the rest. These approaches proved useful to provide wind power production estimates in areas or periods with no availability of power data. This serves as illustration of some applications providing information of the available wind power over a wider region and for longer than the observed periods with low computational efforts.