Improving WAsP predictions in (too) complex terrain

Reanalyses of a case study using field measurements taken over 3½ years over rugged terrain in northern Portugal have been carried out using contemporary calculation procedures and topographical input data. The significance of the site ruggedness index (RIX) and the associated performance indicator (ΔRIX) are confirmed and the consequences of applying WAsP outside its operating envelope are quantified. A loglinear relation between WAsP prediction errors and the performance indicator ΔRIX is found to describe the field measurements and modelling results well. The largest coefficient of determination is obtained with a calculation radius of about 3.5 km and a critical slope of about 0.40-0.45 used in the RIX calculations. A simple procedure is further proposed to improve wind speed and power production predictions in terrain outside the operational envelope of the WAsP flow model. Results from the case study in northern Portugal, employing five meteorological stations with ruggedness indices between 10 and 33%, indicate an average improvement of WAsP power production predictions of 69%. Cross-predictions between sites with ΔRIX values larger than 5% are improved by more than 90% on average. The procedure has further been applied to a 23-MW wind farm sited in similar terrain and in similar climatological conditions. Here, the prediction of the net annual energy production was improved by about 70%. The correction procedure is empirical and requires the determination of a site-specific fitting constant.

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