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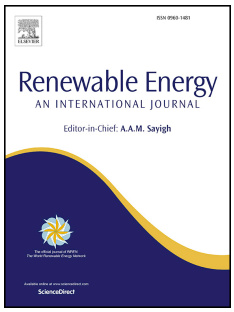

Surface turbulence intensity as a predictor of extrapolated wind resource to the turbine hub height: method's test at an offshore site

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Surface turbulence intensity as a predictor of extrapolated wind resource to the turbine hub height: method's test at an offshore site

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Abstract

Originally developed and validated at the Cabauw (Netherlands) topographically flat onshore location, the α–I wind resource extrapolating method was tested at the FINO3 offshore site in the North Sea (Germany). The aim was to prove its validity also when applied over a substantially different environment in terms of surface characteristics and stability conditions. Data from local mast at 30, 80, and 100 m were used, with extrapolations to 80-m and 100-m turbine hub heights accomplished based on 30-m turbulence intensity observations. Trained over a 2-year period (2011–2012), the method was validated on year 2013.

Similarly to the onshore application, the method was reliable in extrapolating wind speed to both 80 m and 100 m, with bias within 5%, NRMSE=0.20 and r=0.94.Conversely, scores were largely better than at the onshore site in predicting the annual energy yield, biased by 0.41–1.02% at 80 m, and 1.12–1.36% at 100 m. The method proved to be highly sensitive to the stability classification, as not considering this option increased its biases to 4.51–5.93% at 80 m, and 7.46–8.23% at 100 m. Method's reliability might suitably help reduce the number of masts installed throughout a large offshore area.

Keywords:
Wind resource extrapolating methods; Turbulence intensity; Wind shear coefficient; Atmospheric stability; Offshore site; Wind energy yield

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