Application of the spectral correction method to reanalysis data in South Africa

In connection with applying reanalysis data for extreme wind estimation, this study investigates the use of a simple approach that corrects the smoothing effect in numerical modeling through adding in missing spectral information for relatively high, mesoscale frequencies. This approach, called the spectral correction method, has been applied in the wind energy community for estimating the design winds. Two particular aspects are examined, firstly the diurnal spectral peak and then the meso-microscale interface. Both aspects provide challenges for the application of the method, and the purpose of this study is to evaluate the applicability of the method to the relevant region. The impacts from the two aspects are investigated for interior and coastal locations. Measurements from five stations from South Africa are used to evaluate the results from the spectral model $S(f)=af^{-5/3}$ together with the hourly time series of the Climate Forecast System Reanalysis (CFSR) 10 m wind at 38 km resolution over South Africa. The results show that using the spectral correction method to the CFSR wind data produce extreme wind atlases in acceptable agreement with the atlas made from limited measurements across the country to a temporal resolution of 1 h. However, the modeled data tend to underestimate the diurnal peaks in the coastal areas, with a resultant underestimation of the 1:50-year wind speed. Measurements, even of limited length, could improve the estimate. Lastly, the validity of using the spectral model into higher frequencies is limited by the spectral gap between the meso- and microscale.

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