De-trending of wind speed variance based on first-order and second-order statistical moments only

De-trending of wind speed variance based on first-order and second-order statistical moments only

The lack of efficient methods for de-trending of wind speed resource data may lead to erroneous wind turbine fatigue and ultimate load predictions. The present paper presents two models, which quantify the effect of an assumed linear trend on wind speed standard deviations as based on available statistical data only. The first model is a pure time series analysis approach, which quantifies the effect of non-stationary characteristics of ensemble mean wind speeds on the estimated wind speed standard deviations as based on mean wind speed statistics only. This model is applicable to statistics of arbitrary types of time series.

The second model uses the full set of information and includes thus additionally observed wind speed standard deviations to estimate the effect of ensemble mean non-stationarities on wind speed standard deviations. This model takes advantage of a simple physical relationship between first-order and second-order statistical moments of wind speeds in the atmospheric boundary layer and is therefore dedicated to wind speed time series but is not applicable to time series in general.

The capabilities of the proposed models are discussed by comparing model predictions with conventionally de-trended characteristics of measured wind speeds using data where high sampled time series are available, and a traditional de-trending procedure therefore can be applied. This analysis shows that the second model performs significantly better than the first model, and thus in turn that the model constraint, introduced by the physical link between the first and second statistical moments, proves very efficient in the present context. Copyright © 2013 John Wiley & Sons, Ltd.

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