

Novel statistical validation of long-term consistency of reanalysis models in South Africa

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Motivation

Uncertainty in long-term wind assessments is a significant contributor to the overall uncertainty in wind farm energy yield predictions. Better understanding of the uncertainty attributable to the consistency of reference data, the purpose of this study, results in more robust wind resource assessments and financial models for a project.

Problem Statement

Reanalysis models have been shown to exhibit inconsistencies in the long-term wind speed and as such they currently cannot be used without a nearby validation of their consistency from an alternative source such as a ground measurement station. This work attempts to address this by performing a validation for South Africa and provides confidence levels in the use of reanalysis data where no ground stations are found to be representative of the wind farm conditions.

The work uses available reference wind data in South Africa, both from traditional measurements such as anemometers and from global reanalysis models (MERRA-2 and ERA-Interim).

Methodology

Following a comprehensive review of the available reference data, pairs were created between known consistent and inconsistent ground stations and the nearest reanalysis node. A statistical approach, changepoint analysis, was applied to each of the datasets in order to identify any inconsistencies. The ability of the changepoint analysis to detect inconsistencies within the ground station data was tested and suitable thresholds for identification of inconsistency within measured data are suggested within the work. By comparing the ability of the changepoint analysis to detect inconsistencies within the reference data and testing sensitivities to different parameters it is possible to determine appropriate thresholds for the use of reanalysis data as a standalone source of long-term reference wind data and the related confidence levels.

Results

The work is still ongoing and this will be the first opportunity to present the findings, however the results will provide:

- 1) A validation of the changepoint technique for identifying inconsistencies within long-term reference wind data with associated confidence levels;
- 2) Recommendations as to optimal parameters for implementation of the changepoint analysis for detecting inconsistencies;
- 3) Details of the resulting uncertainty associated with each of the reference data sources considered;
- 4) Guidelines for the selection of appropriate long-term reference wind data sources in South Africa.

Conclusions

The findings of the study will inform the private sector but also authorities, planners and academia as to the best approach to long-term wind resource estimation, and particularly in areas where no long-term reference measurements are available will provide confidence levels in the use of reanalysis data for long-term correction.