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Dynamical and statistical downscaling approaches for extreme wind atlas of South Africa

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Two independent approaches are used to obtain the extreme wind atlas for South Africa. The first one is a statistical downscaling approach. The reanalysis provides wind fields that are smoothened due to the effective resolution of the global models, which leads to underestimation of the extreme winds. The statistical approach adds in the missing wind variability to the time series of the global reanalysis data through spectral power under the assumption of a Gaussian process. The power spectrum can be provided by existing measurements which can be as short as a few months. In the absence of measurements, a power spectral model based on experimental and theoretical studies is used. The extreme wind value is thus corrected to a desired temporal resolution in the mesoscale range. The power spectral model is most suitable for simple to moderate terrains and relatively high uncertainty is expected in complex terrains. This leads to our second approach, the selective dynamical downscaling method, which employs mesoscale weather model WRF to model storm episodes at high resolution for relatively more challenging terrains. For a selected area, the annual strongest storms are first identified from the global data during 1999 – 2012 at all grid points in the domain of interest. WRF is used to model all the selected storms. A post-processing procedure is applied to the extreme winds from the mesoscale modeling before they can be put further into a microscale model. The estimations from both approaches are validated with measurements from South Africa.