Geophysical Research Abstracts
Vol. 17, EGU2015-14271, 2015
EGU General Assembly 2015

Development of a numerical wind atlas for South Africa

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A Numerical Wind Atlas for South Africa (WASA) is being developed through collaborative efforts between the Climate Systems Analysis Group (UCT), the Council for Scientific and Industrial Research, the South African Weather Service and the Danish Technical University. The method is based on a state-of-the-art approach that includes an observations campaign, both statistical and dynamical mesoscale modelling as well as microscale and extreme wind modelling.

One unique feature of the project lies in the application of a dynamical mesoscale model (WRF) for the generation of a dynamical wind atlas in addition to the more conventional statistical-dynamical KAMM-WAsP atlas. We verify the two atlases against an observational wind atlas generated from 10 measurement masts with two years of data observation data and find the KAMM-WAsP method underestimates the generalized mean wind speeds at the sites (mean bias of -8.2% and mean absolute bias of 9.3%).

The WRF model was run at 3km over the region of interest in an 8-year integration. In the WRF-based method there is, on average, a difference of 4.7% (either positive or negative) between the WRF-based NWA results and the corresponding observed values. The combined average across all the sites is an over-estimate of 2.5%. The method captures dynamical processes like the land-sea thermal gradient on the west coast of the country and also resolves topographic and topographically enhances flows such as valley breezes that the KAMM-WAsP method cannot.

Although within the WRF results there are uncertainties to be considered e.g. the forcing reanalysis, WRF configuration, representativeness of the 8-year period and the generalization method, the results suggest that the dynamical wind atlas presents a more realistic picture of potential wind energy resource.