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A statistical model to downscale GCM output to wind speeds at turbine rotor height

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During the last thirty years surface wind speed observations of the northern hemisphere show a declining trend of 10%. It is however unclear whether such a trend would continue in future, but if a reduction of this magnitude would continue over 50 years it would affect wind-power generation (McVicar et al, 2010).

Global circulation models are useful tools to assess this trend, but their horizontal and vertical resolution is coarse and output parameters are of varying quality. Therefore we use a statistical model to downscale GCM output to the height of the wind turbine rotor.

The statistical downscaling technique is based on a lineair relationship between rotor-height windspeed observations on the one hand and GCM modeled atmospheric variables on the other hand. Unlike most statistical downscaling techniques, the predictors and predictands in the regression model are not the absolute values of the atmospheric variables, but the parameters of their distribution. This allows us to downscale the entire wind speed distribution.

The downscaling technique, which was build up for a site in the Netherlands (Cabauw), is calibrated with ERA-interim reanalysis data, tested on a control period and applied to ECHAM5 present data and future scenario's. The ECHAM5 data has first been evaluated using ERA-interim reanalysis data and only the parameters that are adequately represented by the GCM were taken into account.

This technique of downscaling wind speed distributions parameters proves to be a appropriate method to study the average wind climate and the extremes in wind speed. Therefore it offers valuable information to wind energy industries.

McVicar, T., Roderick, M., 2010, Winds of change, Nature Geoscience, Vol 3, 747-748