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Ten years of the Wind Atlas of South Africa: Final results from WASA 3

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We present the evolution of the methods used to create and validate the various numerical wind atlases during the past ten years of the Wind Atlas for South Africa (WASA) project. In WASA 3, we improved on the previous numerical wind atlases by:

- Creating an ensemble of 2-year simulations to find the optimal set of parameterisations and surface conditions for the wind climate of South Africa.
- Using a new method of generalisation and downscaling of the WRF-derived wind climate using the PyWAsP engine.
- Producing the most extensive to date wind climatology for South Africa, 30 years (1990–2019) simulation covering all South Africa at 3.33 km × 3.33 km spatial resolution and 30 minutes time output.

We will discuss these three areas and their improvements to the wind atlas' quality. The WASA 3 wind atlas' final error statistics show that the new WRF + PyWAsP method has a MAPE of 11.8% and 3.5% for the long-term mean power density and mean wind speed, respectively. These statistics are improved from those in WASA 1 and WASA 2.

When disregarding the two masts (WM09 and WM11) located in highly complex terrain, where the methodology was never designed, the use of the WRF and WRF + PyWAsP downscaling narrows the error distributions for both long-term wind speed and power density compared to the global reanalysis, ERA5.

The validated numerical wind atlas has further been used to model the wind resources of the entire land area of South Africa using the microscale WAsP model. Raster data exist with a horizontal resolution of 250 meters and three levels of 50, 100 and 150 meters a.g.l. of mean wind speed, power density, air density, Weibull A and k parameters, and ruggedness index. These data sets and the WRF dataset will be made available in the public domain at the end of the project. Data sets for other heights above the ground and offshore can easily be added later.