Interim High-Resolution Wind Resource Map for South Africa

Metadata and further information

October 2017

METADATA	
Data set name	Interim High-Resolution Wind Resource Map for South Africa
Data set date	October 2017
Data provider	DTU Wind Energy and CSIR
Contact persons	Niels G. Mortensen (DTU) or Eugéne Mabille (CSIR)
Contact details	nimo@dtu.dk (DTU) or EMabille@csir.co.za (CSIR)
Data type	Raster data sets with a grid cell size of 250 m
Data format	ArcGIS ASC
File name(s)	ZA_<province>_<resolution>_<parameter>_<version ID>.asc
Data origin	Microscale modelling in each grid point; no interpolation

DATA PARAMETERS	
Mean wind speed	Annual mean wind speed U [ms^{-1}] @ 50, 100 and 200 m a.g.l.
Mean power density	Annual mean power density P [Wm^{-2}] @ 50, 100 and 200 m a.g.l.
Terrain elevation	Elevation of modelling site in [m] above mean sea level
Ruggedness index RIX	Site RIX value calculated by WAsP (standard parameter setup)

COORDINATE SYSTEM	
Projection	Universal Transverse Mercator (UTM)
Zone number	34S (two provinces) and 35S (seven provinces)
Datum	World Geodetic System 1984 (WGS 84)

TECHNOLOGY	
Calculation software	WAsP Resource Mapping System with WAsP engine version 11
Wind-climatological input	5-km NWA (WRF-based, code name WASA2-MYN-NOAH-10D)*
Elevation data input	100-m elevation grid derived from SRTM+ (NASA version 3)
Roughness data input	300-m land cover grid derived from GlobCover 2009 (version 2.3)
Air density input	Standard atmosphere approximation w/ elevation variations only

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NOTES

Purpose

This data set was created for the Department of Environmental Affairs (DEA) of South Africa as a *Fast-track High-resolution Wind Resource Map and Database covering all of South Africa*. The wind resource maps were designed specifically for inclusion in GIS-based strategic environmental assessments (SEA) for the entire land mass of South Africa. The maps cover 9 provinces and an area of about 1,221,000 km^2. Wind resource maps are preliminary and subject to change without notice if and when more accurate and reliable data, models and procedures become available.

Methodology

Reference is made to the information and documentation available from www.wasa.csir.co.za. A more detailed description of the data sets available are given at the end of this document. Validation is reported elsewhere.

Limitations

The data set is limited by the operational envelopes of the wind atlas methodology and the WAsP models. The accuracy depends on a) the accuracy of the VNWA, which has been validated against the data from 10 WASA measurement masts, b) the WAsP microscale modelling and c) the input topographical data.

In complex terrain (RIX > 5%), the wind resources may be significantly over-estimated by the WAsP microscale modelling. Above and close to built-up areas like cities, towns and villages, the results are less reliable. Close to and above forested areas, the results are also less reliable and should be interpreted and used accordingly.

The data set was designed specifically for planning purposes and should be used with utmost care for design, development and detailed assessments of actual wind farms; where local, on-site measurements are strongly recommended.

Available documentation

The wind atlas methodology is described in the European Wind Atlas (1989); the application of WAsP in the software documentation, see www.wasp.dk. The Validated Numerical Wind Atlas (VNWA) for South Africa is a product of the Wind Atlas for South Africa project (WASA) and is described on the WASA download pages.

Acknowledgements

WASA team for provision of wind-climatological and topographical data. WAsP development teams at DTU Wind Energy and World in a Box Oy for Frogfoot development and application. SRTM Plus data were downloaded from NASA's Land Processes Distributed Active Archive Center (LP DAAC) located at the USGS Earth Resources Observation and Science (EROS) Center. GlobCover data are © ESA 2010 and UCLouvain, see the ESA DUE GlobCover website. Province boundaries by Municipal Demarcation Board (MDB).

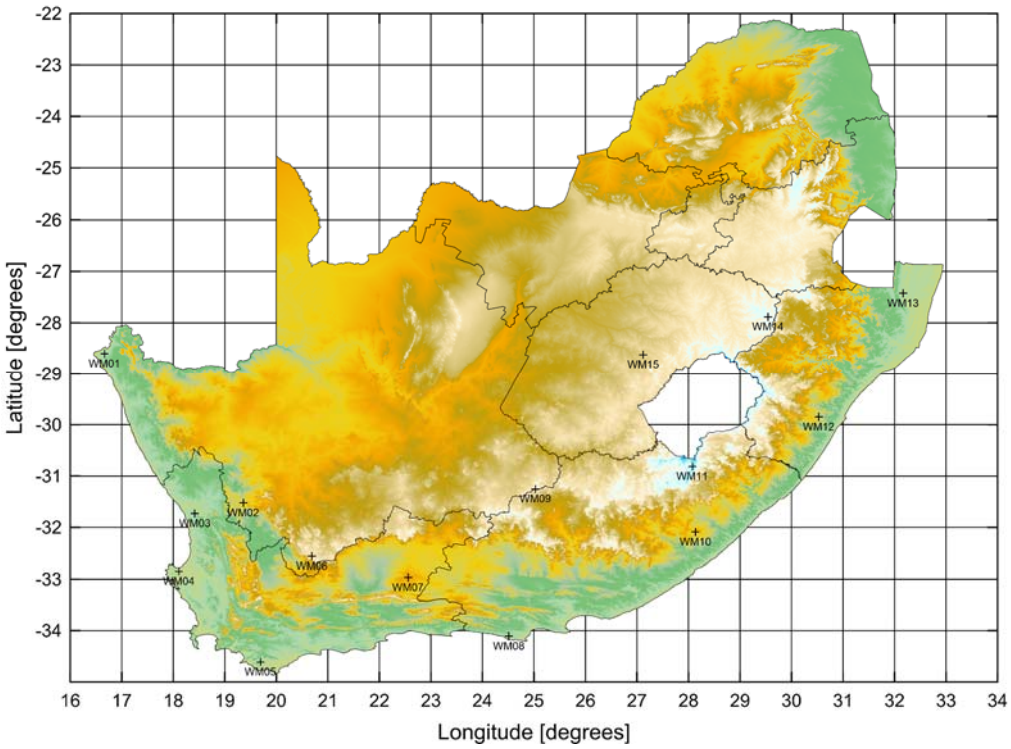
DISCLAIMER

In no event will the Technical University of Denmark (DTU) or any person acting on behalf of DTU be liable for any damage, including any lost profits, lost savings, or other incidental or consequential damages arising out of the use or inability to use the information and data provided in this data set, even if DTU has been advised of the possibility of such damage, or for any claim by any other party.

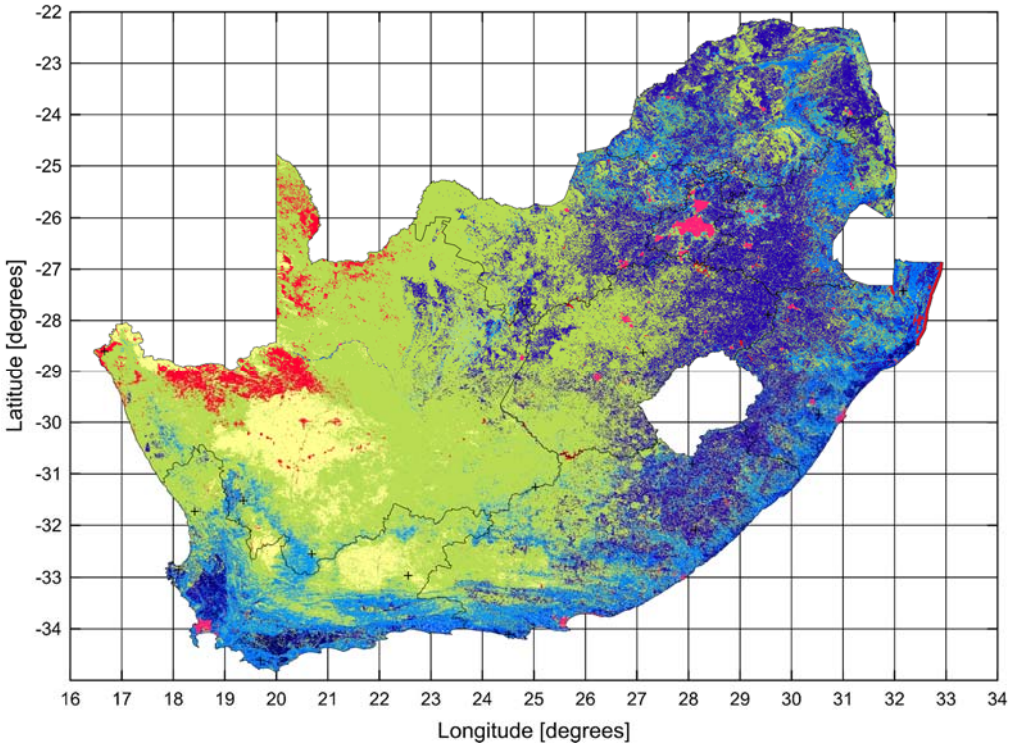
The principles, rules, exclusions and limitations provided in the Disclaimer on the WASA download site apply to the data set described here as well, even though this data set may not be distributed via the web site. By using this data set, you agree that the exclusions and limitations of liability set out in this disclaimer are reasonable. If you do not think they are reasonable, you must not use this data set.

**Wind climatologies for Limpopo north of 24 degrees south are given at a resolution of 15 km.*

South Africa terrain elevation (SRTM+, NASA version 3)



South Africa land cover (GlobCover version 2.3, 2009)



Detailed wind resource maps

The data sets are organised according to each of the nine provinces of South Africa.

ISO	Province	Capital	Area	Fraction	UTM
EC	Eastern Cape	Bhisho (Bisho)	168,966 km^2	14%	35
FS	Free State	Bloemfontein	129,825 km^2	11%	35
GT	Gauteng	Johannesburg	18,178 km^2	1%	35
LP	Limpopo	Polokwane (Pietersburg)	125,754 km^2	10%	35
MP	Mpumalanga	Nelspruit	76,495 km^2	6%	35
NC	Northern Cape	Kimberley	372,889 km^2	31%	34
NL	KwaZulu-Natal	Pietermaritzburg	94,361 km^2	8%	35
NW	North West	Mahikeng (Mafikeng)	104,882 km^2	9%	35
WC	Western Cape	Cape Town	129,462 km^2	11%	34
ZA	Republic of South Africa	Pretoria, Cape Town, Bloemfontein	1,220,813 km^2	100%	

For each province, the following information is provided in metric ArcGIS ASC format grid files:

- Mean wind speed [ms^{-1}]
- Mean power density [Wm^{-2}]
- Terrain surface elevation [m a.s.l.]
- Terrain ruggedness index, RIX

Wind information given for 50, 100 and 200 m above ground level and all data sets are given at 250 m horizontal resolution. The ASC files are distributed in ZIP archives.

Database of wind climates

For each province, the following information is provided in ASCII TXT format files:

- Weibull *A*- and *k*-parameters for 12 sectors at each node and height
- Wind direction distribution (rose) for 12 sectors at each node and height

Climate information at each of the 250-m modelling grid points will make it possible to calculate, say, specific mean power density from 0-25 ms^{-1}, energy yield for any given wind turbine, capacity factor for any given wind turbine, etc. Wind climate and energy information is given for 50, 100 and 200 m above ground level. Data are stored in ASCII text files with the following format:

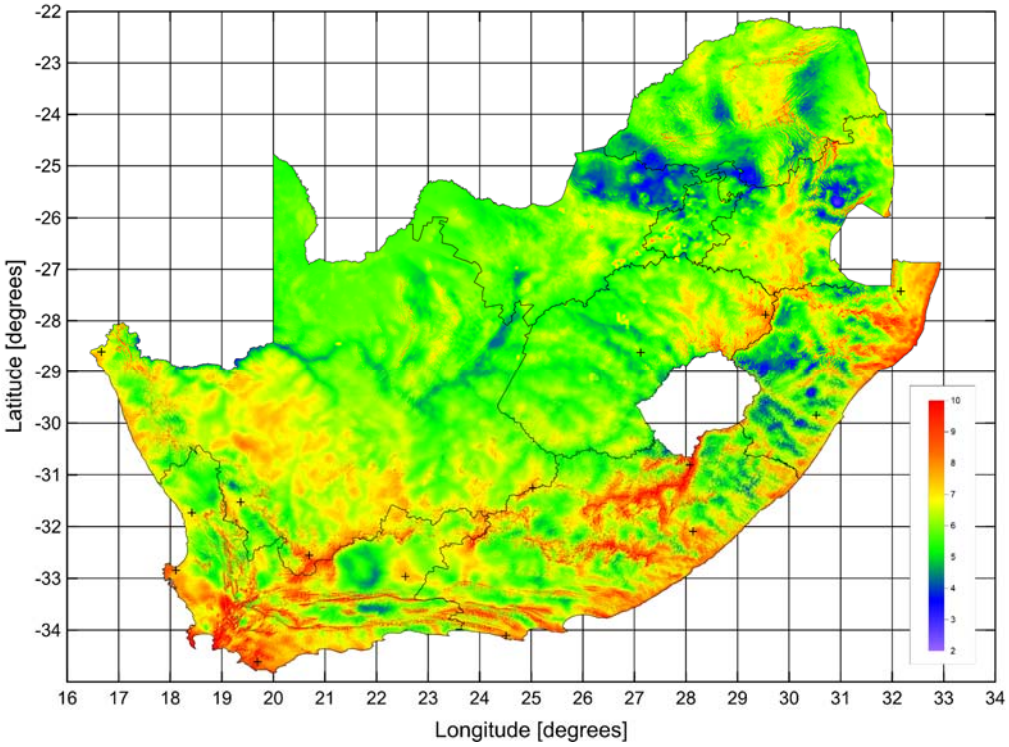
- *JobID; x; y; z; SectorIndex; A; k; f;*

where *x* is UTM Easting [m], *y* is UTM Northing [m], *z* is height above ground level [m], *SectorIndex* is a sector index from 1 to 12 clockwise starting from north, *A* is Weibull scale parameter [ms^{-1}], *k* is the Weibull scale parameter, and *f* is sector frequency. The TXT files are distributed in ZIP archives.

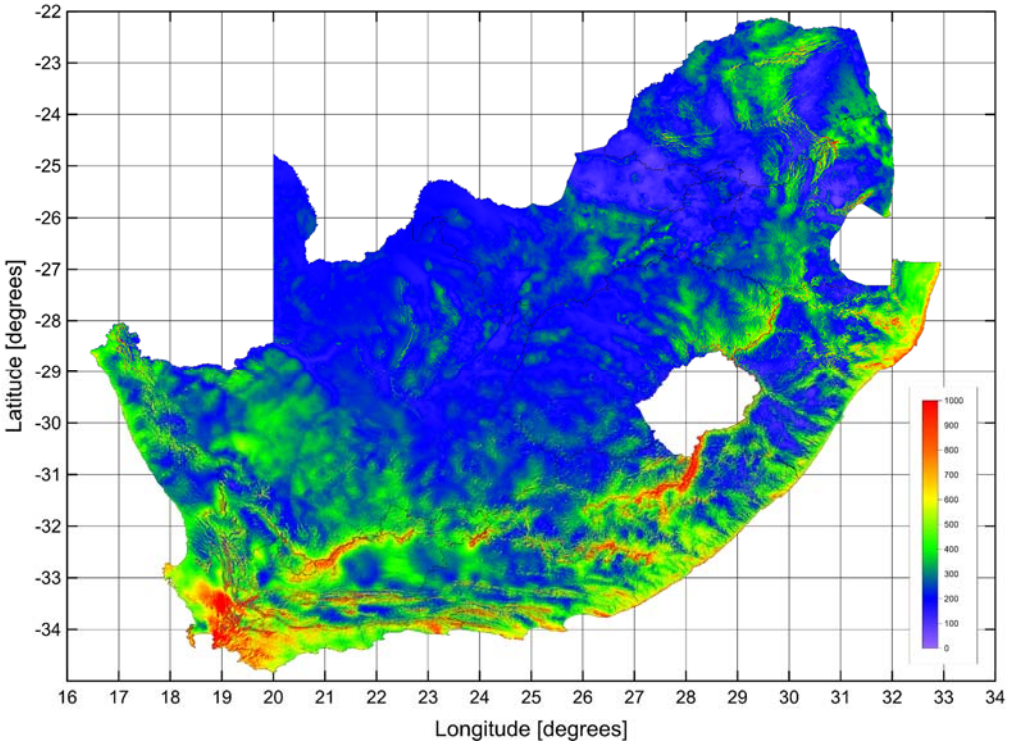
For South Africa, the following information is provided in geographical ArcGIS ASC format grid files:

- Terrain land cover classification code (GlobCover 2009)
- Transformation table from land cover to terrain surface roughness in [m]

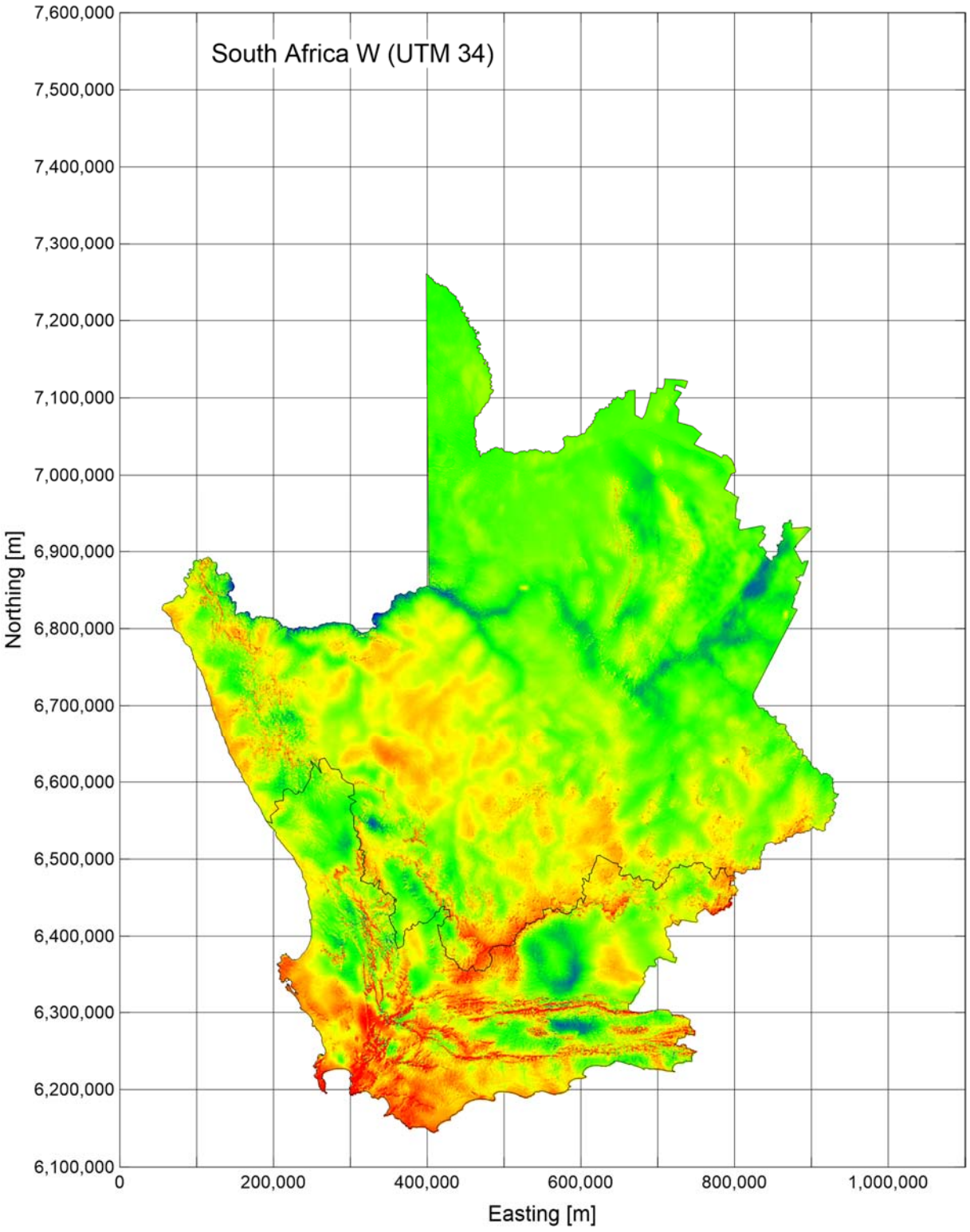
South Africa mean wind speed [ms^{-1}] @ 100 m a.g.l.



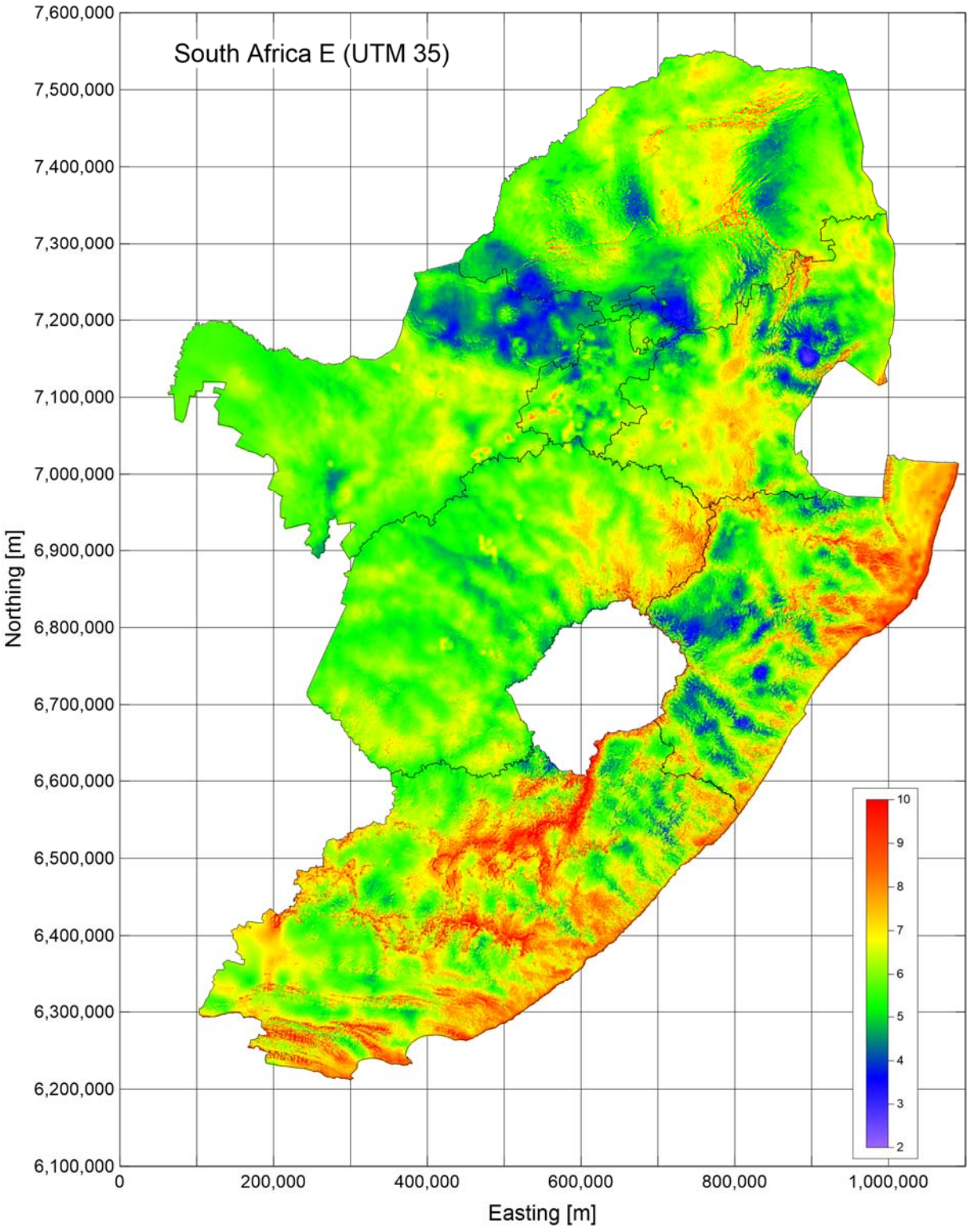
South Africa mean power density [Wm^{-2}] @ 100 m a.g.l.



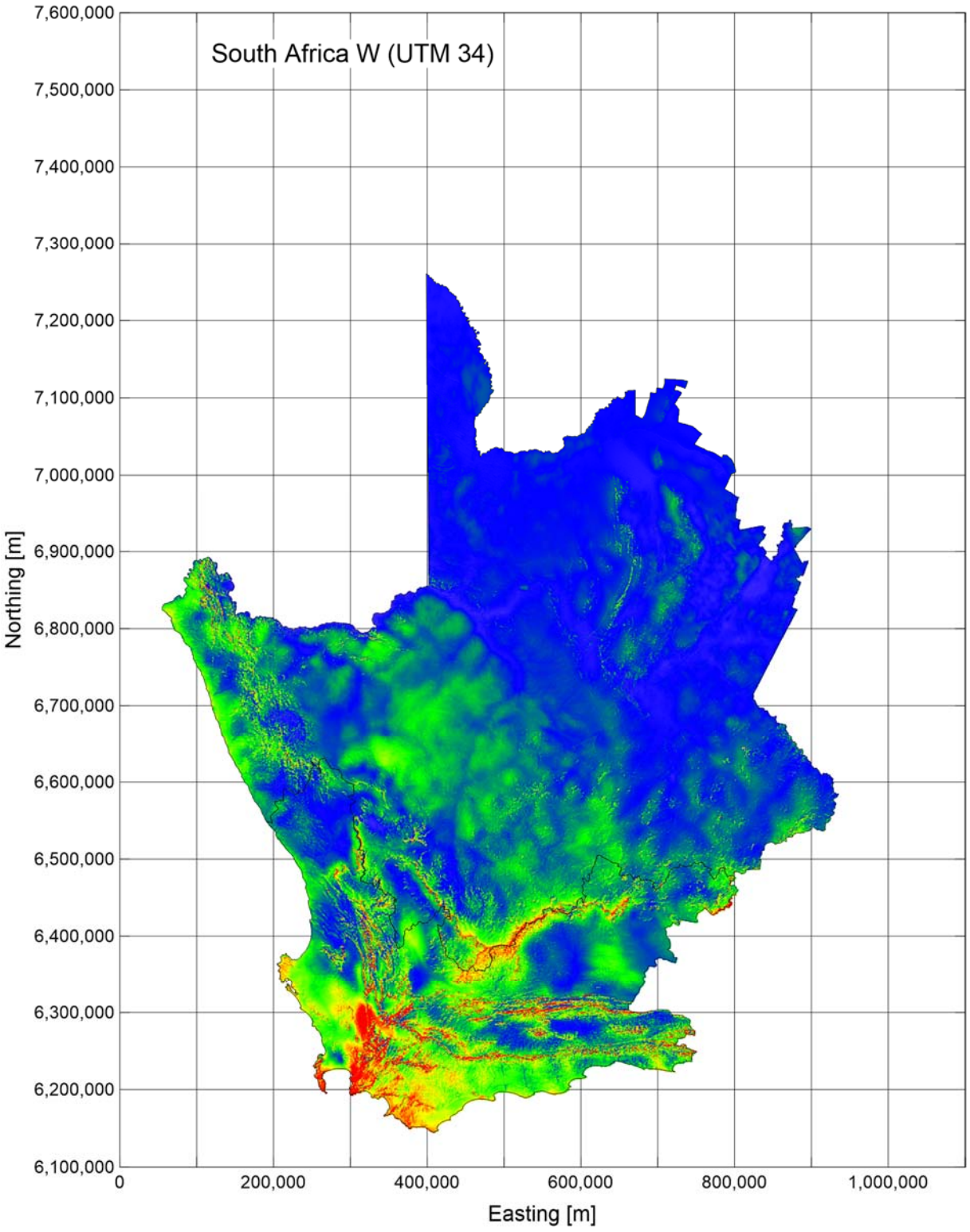
South Africa W mean wind speed at 100 m a.g.l.



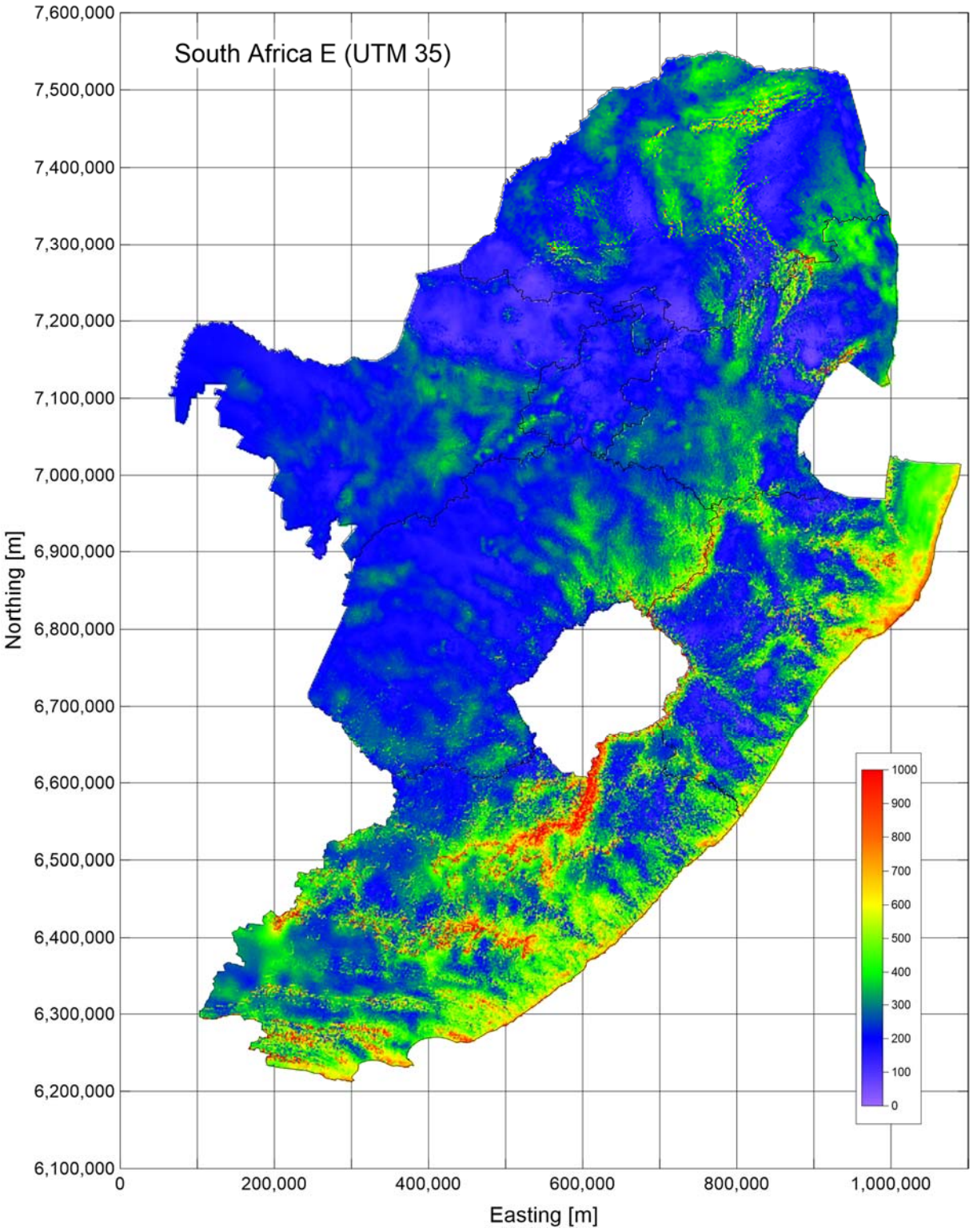
South Africa E mean wind speed at 100 m a.g.l.



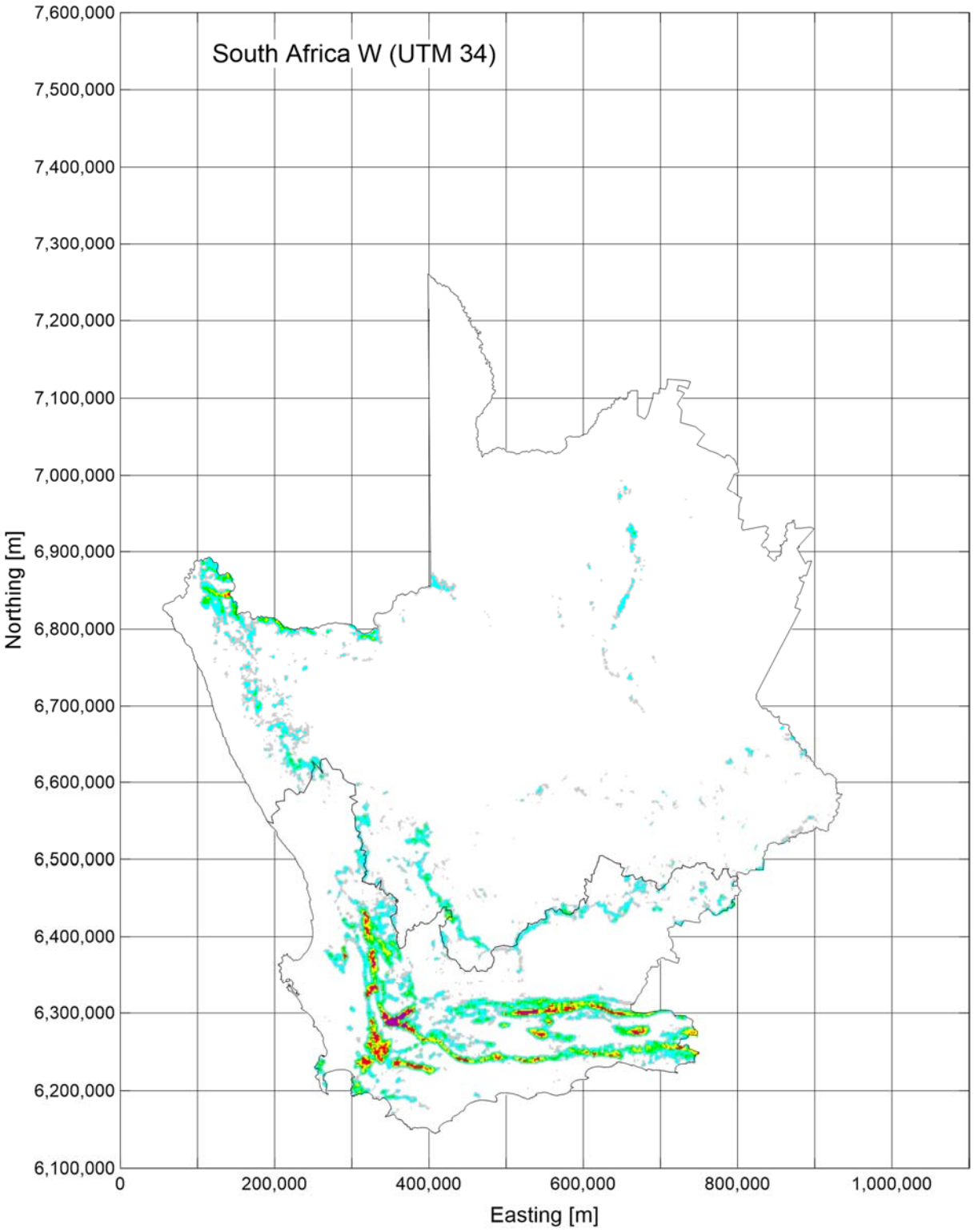
South Africa W mean power density at 100 m a.g.l.



South Africa E mean power density at 100 m a.g.l.



South Africa W ruggedness index



South Africa E ruggedness index