High Resolution Wind Resource Map for South Africa
December 2018

METADATA	
Data set name	High Resolution Wind Resource Map for South Africa 2018
Data set coverage	Land area of South Africa
Data set date	Compiled and published in December 2018
Data set creator	DTU Wind Energy and World in a Box Oy
Data set publisher	DTU Wind Energy and Council for Scientific and Industrial Research
Contact persons	Technical: Niels G. Mortensen (DTU), Andre Otto (SANEDI) Web site: Ursula von Saint Ange (CSIR)
Contact details	Technical: nimo@dtu.dk (DTU), andreo@sanedi.org.za Web site: UvstAnge@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 WAsP modelling in each grid point; no interpolation
Data storage	Wind Atlas for South Africa download site or DTU Data

DATA PARAMETERS	
Mean wind speed	Annual mean wind speed U [ms^{-1}] @ 50, 100 and 150 m a.g.l.
Mean power density	Annual mean power density P [Wm^{-2}] @ 50, 100 and 150 m a.g.l.
Mean air density	Annual mean air density ρ [kgm^{-3}] @ 50, 100 and 150 m a.g.l.
Terrain elevation	Elevation of modelling site in [m] above mean sea level
Ruggedness index RIX	Site RIX value [n/a] calculated by WAsP (standard parameters)

COORDINATE SYSTEM	
Projection	Universal Transverse Mercator (UTM)
Zone number	34S (NC, WC) and 35S (EC, FS, GT, LP, MP, NL, NW)
Datum	World Geodetic System 1984 (WGS 84)

TECHNOLOGY	
Modelling software	WAsP Resource Mapping System with WAsP engine (version 12)
Wind-climatological input	3.3-km NWA, WRF-based, code name L18_C18_F1.0_D1.0(8y)
Elevation input	100-m elevation grid derived from SRTM+ (NASA version 3)
Land cover input	300-m land cover grid derived from ESACCI 2015 (version 2.0.7)
Air density input	0.5-degree CFSR global reanalysis data 2011-2018 (version 2)

DESCRIPTION

Purpose

These data sets were created as part of the Wind Atlas for South Africa project (WASA). The wind resource maps were originally designed for inclusion in GIS-based strategic environmental assessments (SEA) for the entire land mass of South Africa. The maps cover the 9 provinces of South Africa, corresponding to an area of about 1,221,000 km^2. The wind resource maps are preliminary in nature, even though they are based on high-quality data and contemporary models; maps are 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 15 WASA measurement masts, b) the WAsP 12 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

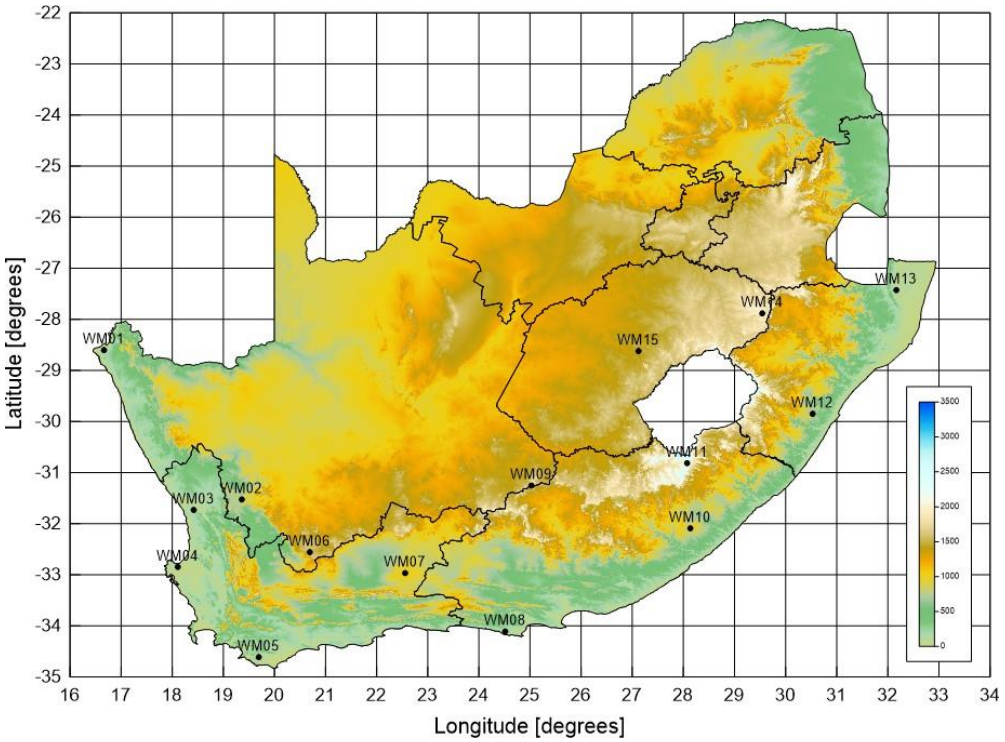
The wind atlas methodology is described in the European Wind Atlas (1989); the application of WAsP in the software documentation, see www.wasp.dk. The Validated Numerical Wind Atlas (VNWA) for South Africa is a product of the Wind Atlas for South Africa project (WASA) and is described on the WASA download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

Acknowledgements

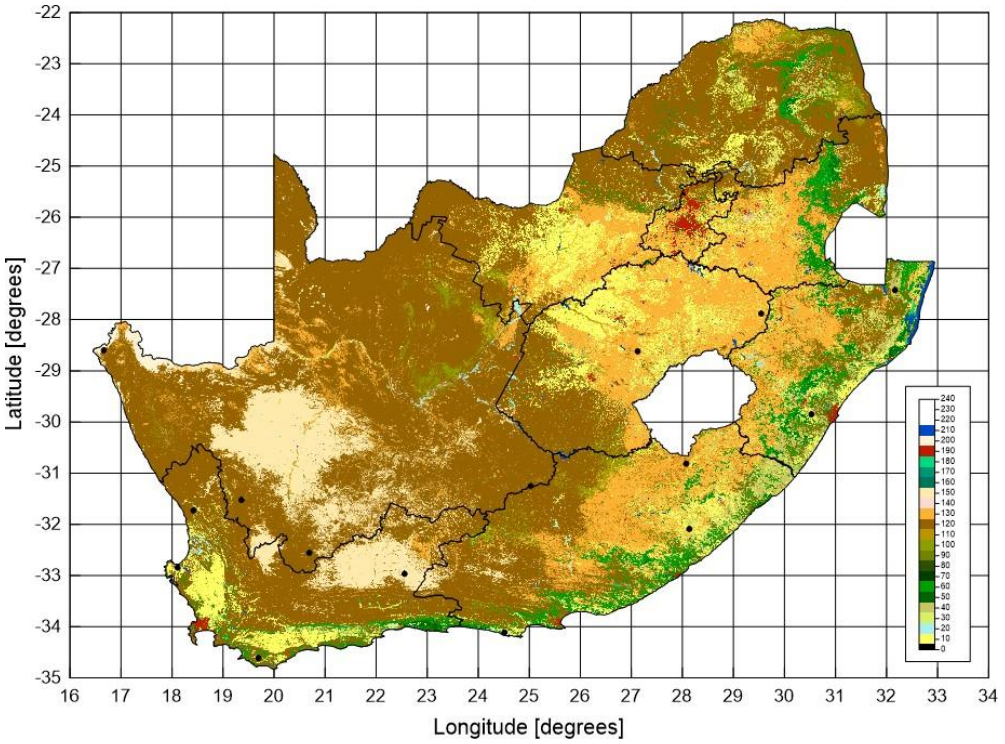
WASA team for provision of wind-climatological and topographical data. WAsP development teams at DTU Wind Energy and at World in a Box Oy for WAsP Resource Mapping System (Frogfoot) development and application. SRTM Plus data were downloaded from NASA's Land Processes Distributed Active Archive Center (LP DAAC) located at the USGS Earth Resources Observation and Science (EROS) Center. ESACCI land cover data are copyright © ESA Climate Change Initiative – Land Cover project 2017. South African province boundaries by Municipal Demarcation Board (MDB).

DISCLAIMER

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



South Africa land cover (ESACCI version 2.0.7, 2015)



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*:

- Annual mean wind speed [ms^{-1}]
- Annual mean power density [Wm^{-2}]
- Annual mean air density [kgm^{-3}]
- Terrain surface elevation [m a.s.l.]
- Terrain ruggedness index, RIX

Wind information given for 50, 100 and 150 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 makes 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 150 m above ground level. Data are stored in ASCII text files* with the following format:

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

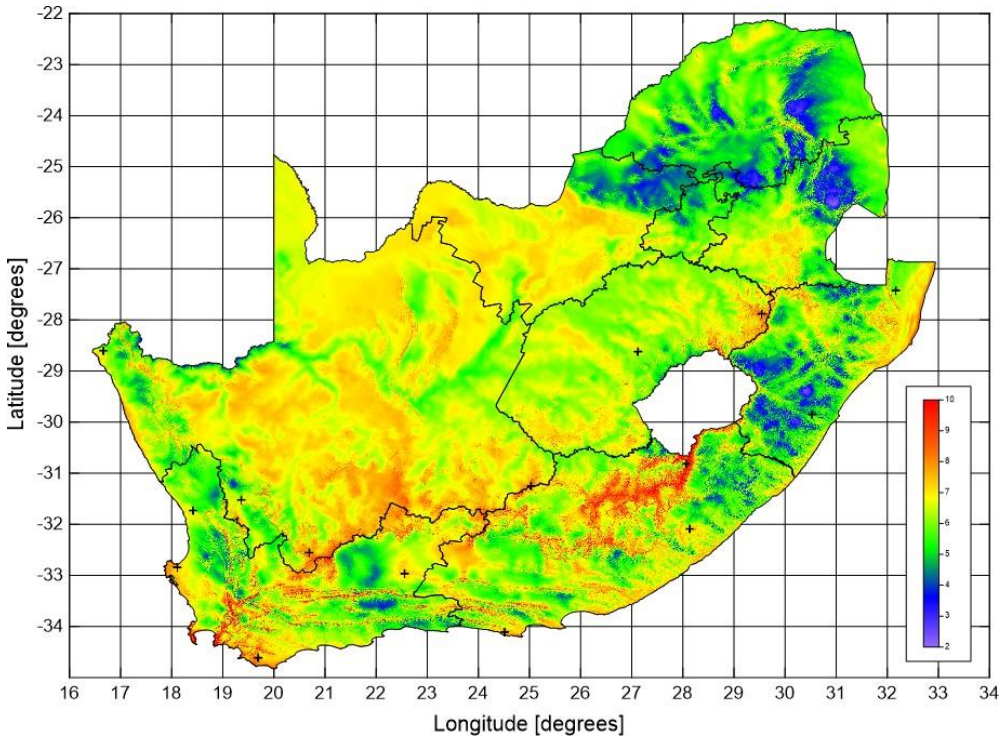
where *x* is UTM Easting [m], *y* is UTM Northing [m], *z* is height above ground level [m], *SectorIndex* is a sector index from 1 to 12 clockwise starting from north, *A* is the Weibull scale parameter [ms^{-1}], *k* is the Weibull scale parameter, and *f* is sector frequency. The TXT files are distributed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

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

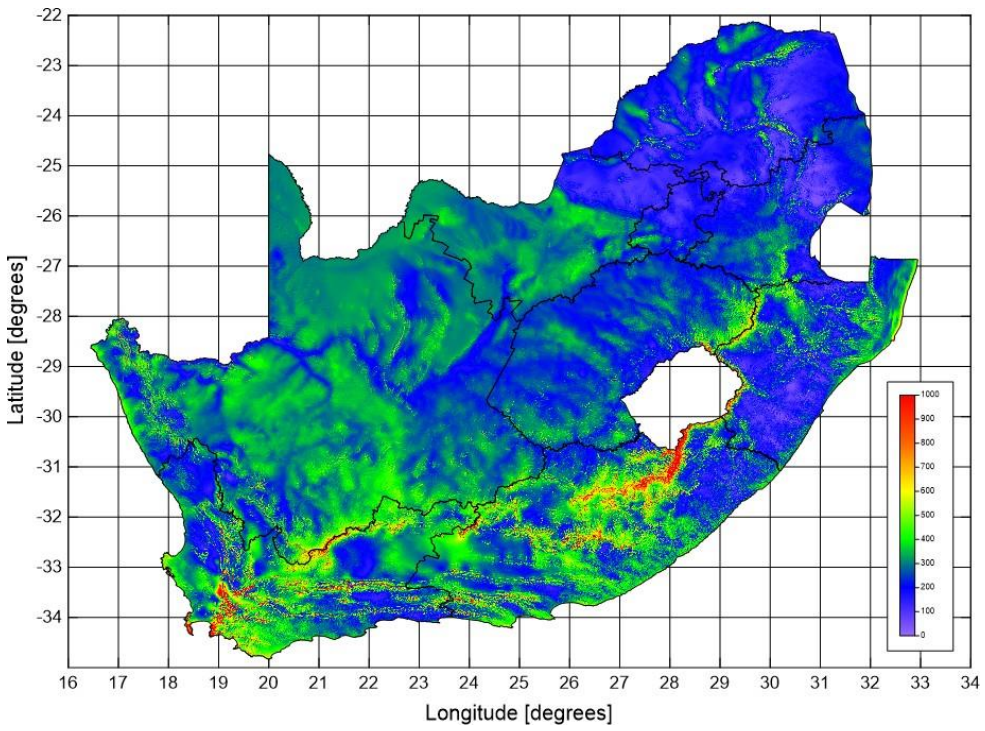
- Terrain land cover classification code (ESACCI, 2015)
- Transformation table from land cover to terrain surface roughness in [m]

**See http://wasadata.csir.co.za/wasa1/WASAData*
Register for free, log in and access the link "WASA High Resolution Wind Resource Map (December 2018) UPDATED (2019/03/29)"

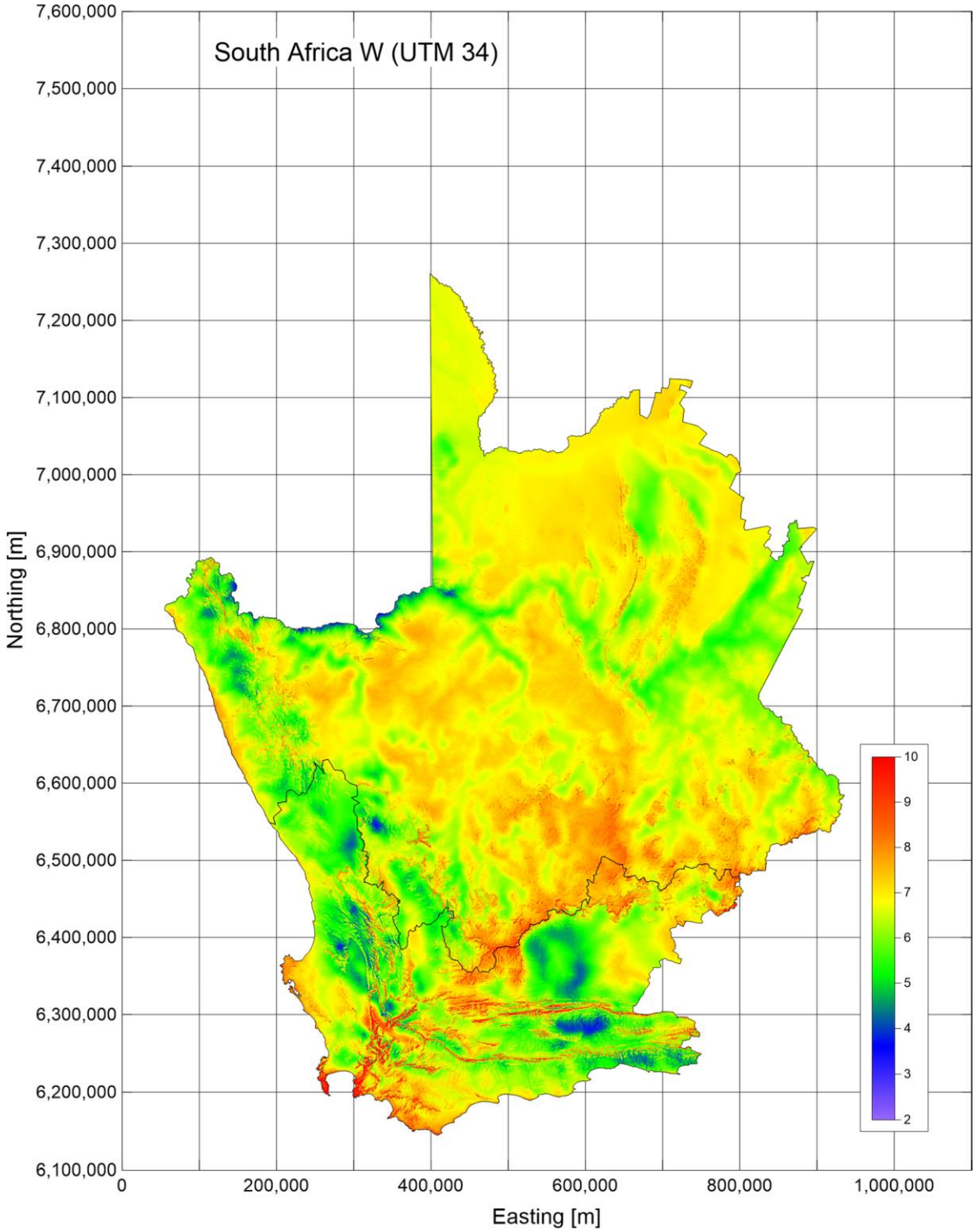
South Africa mean wind speed [ms^{-1}] @ 100 m a.g.l.



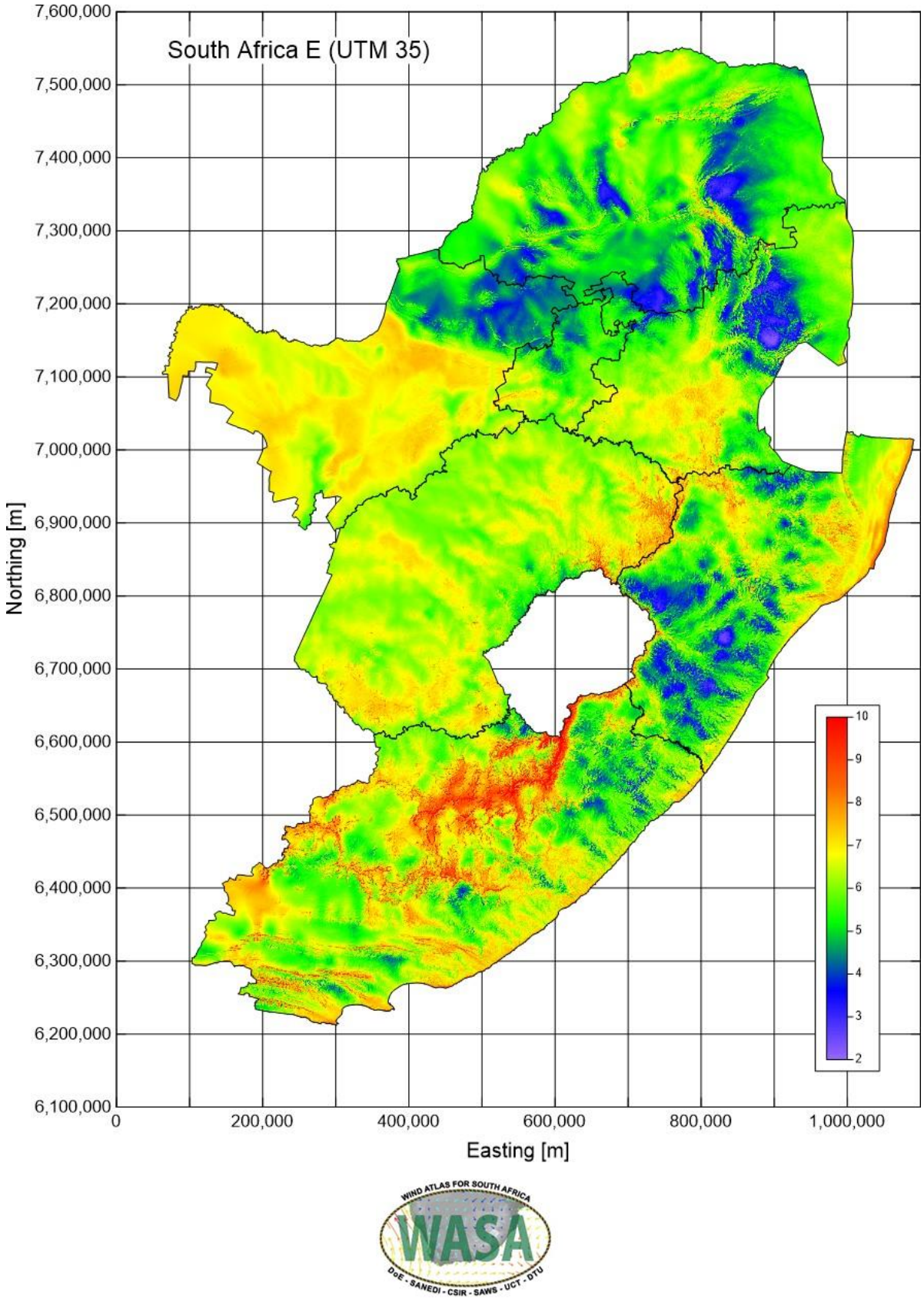
South Africa mean power density [Wm^{-2}] @ 100 m a.g.l.



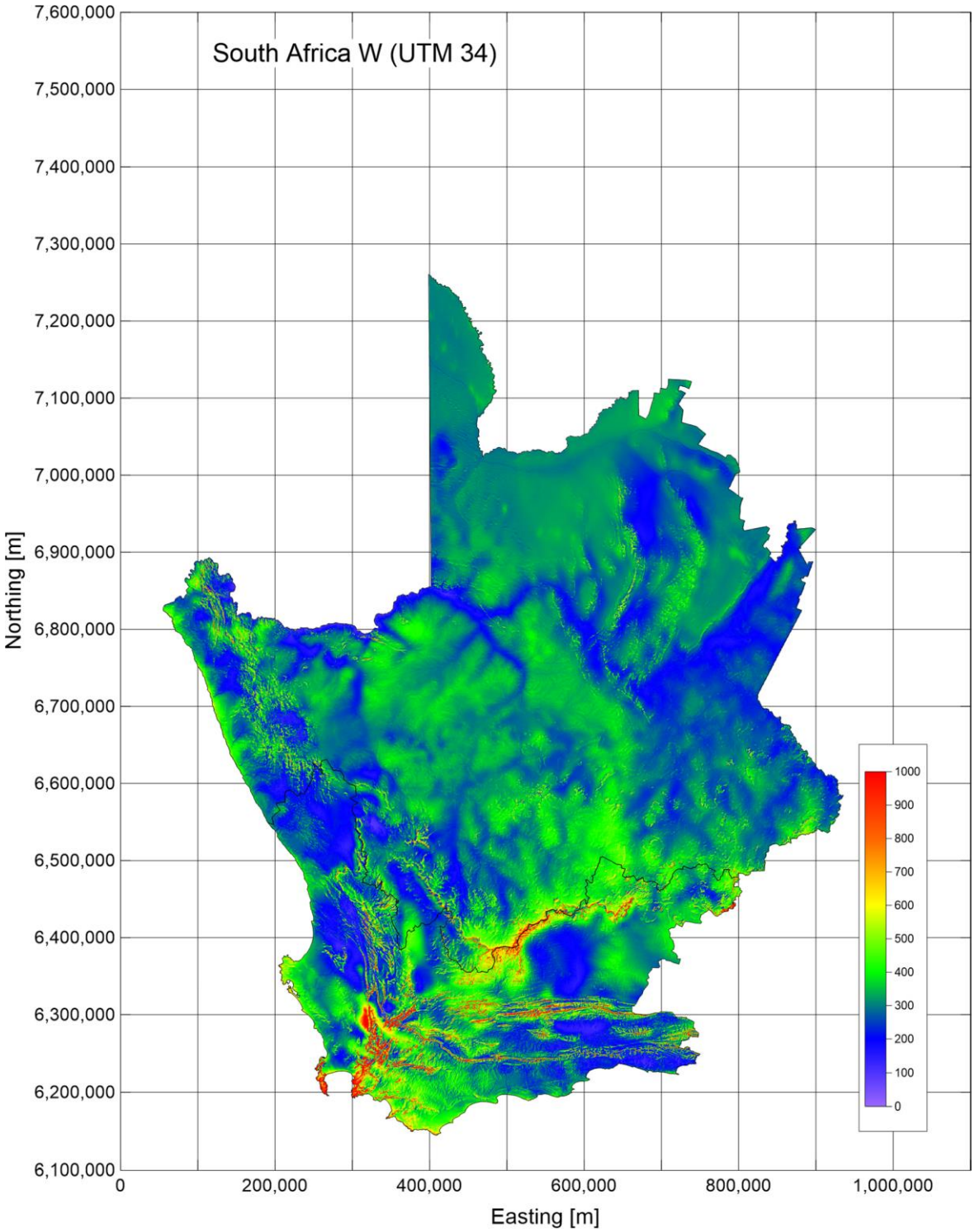
South Africa W mean wind speed at 100 m a.g.l.



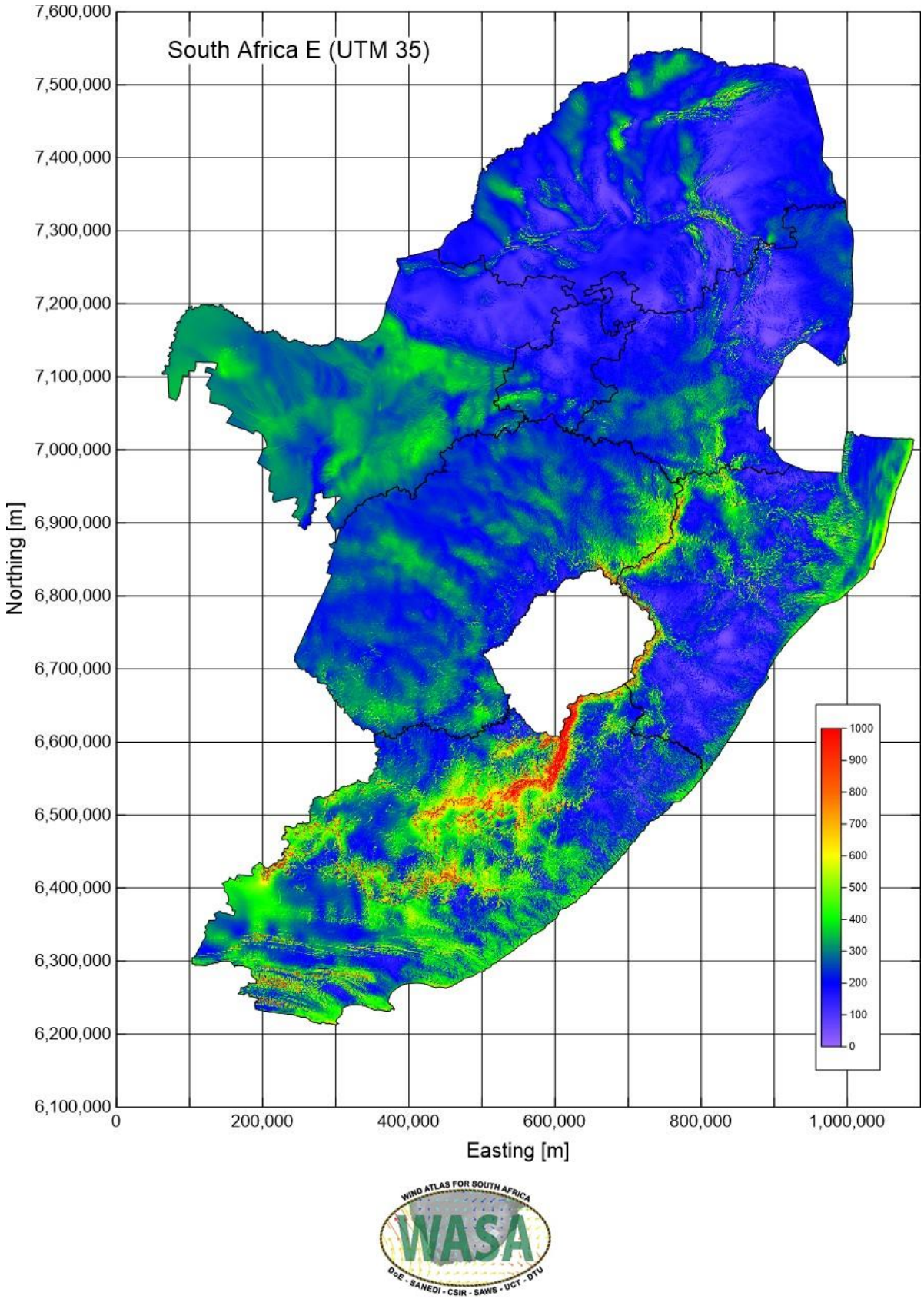
South Africa E mean wind speed at 100 m a.g.l.



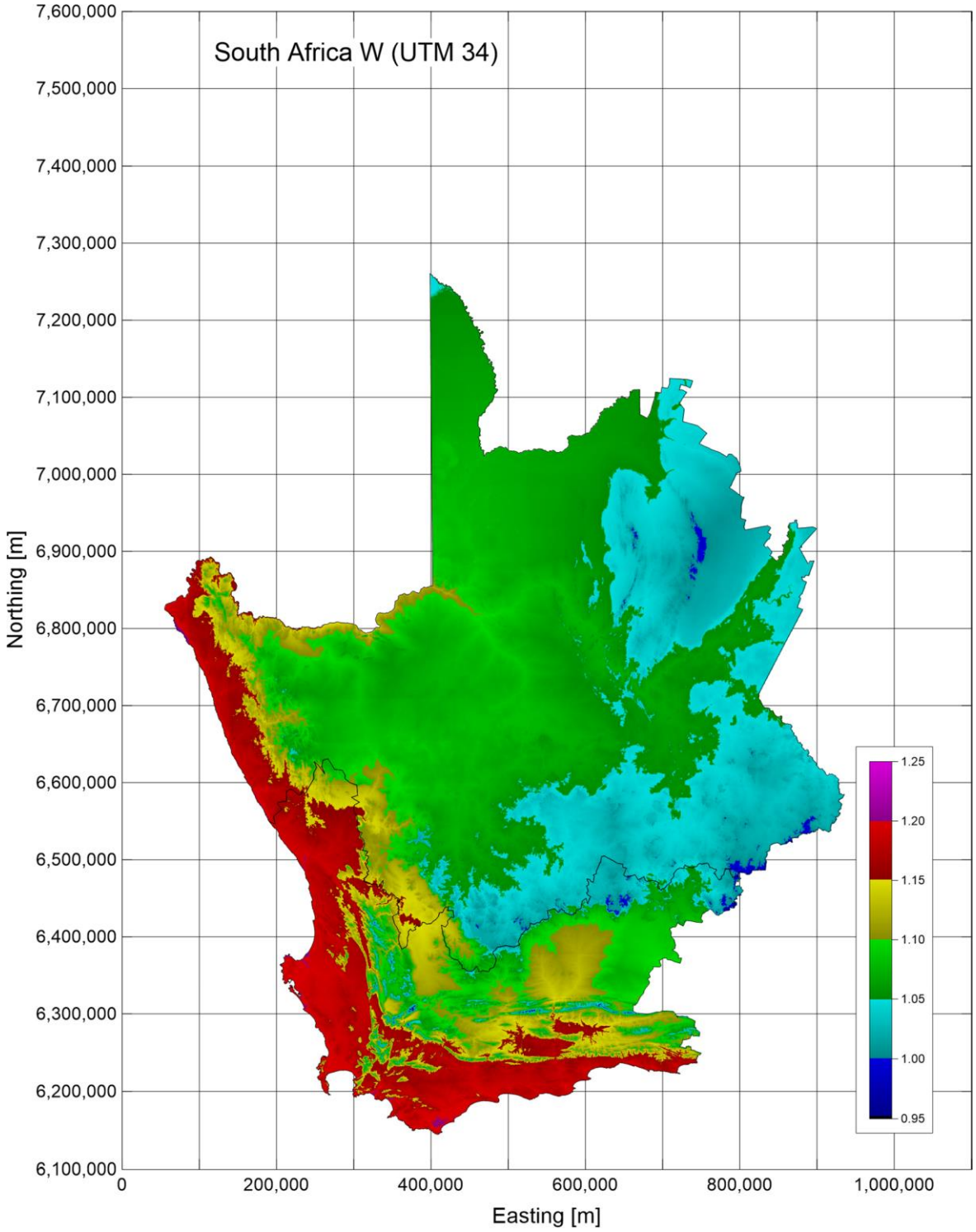
South Africa W mean power density at 100 m a.g.l.



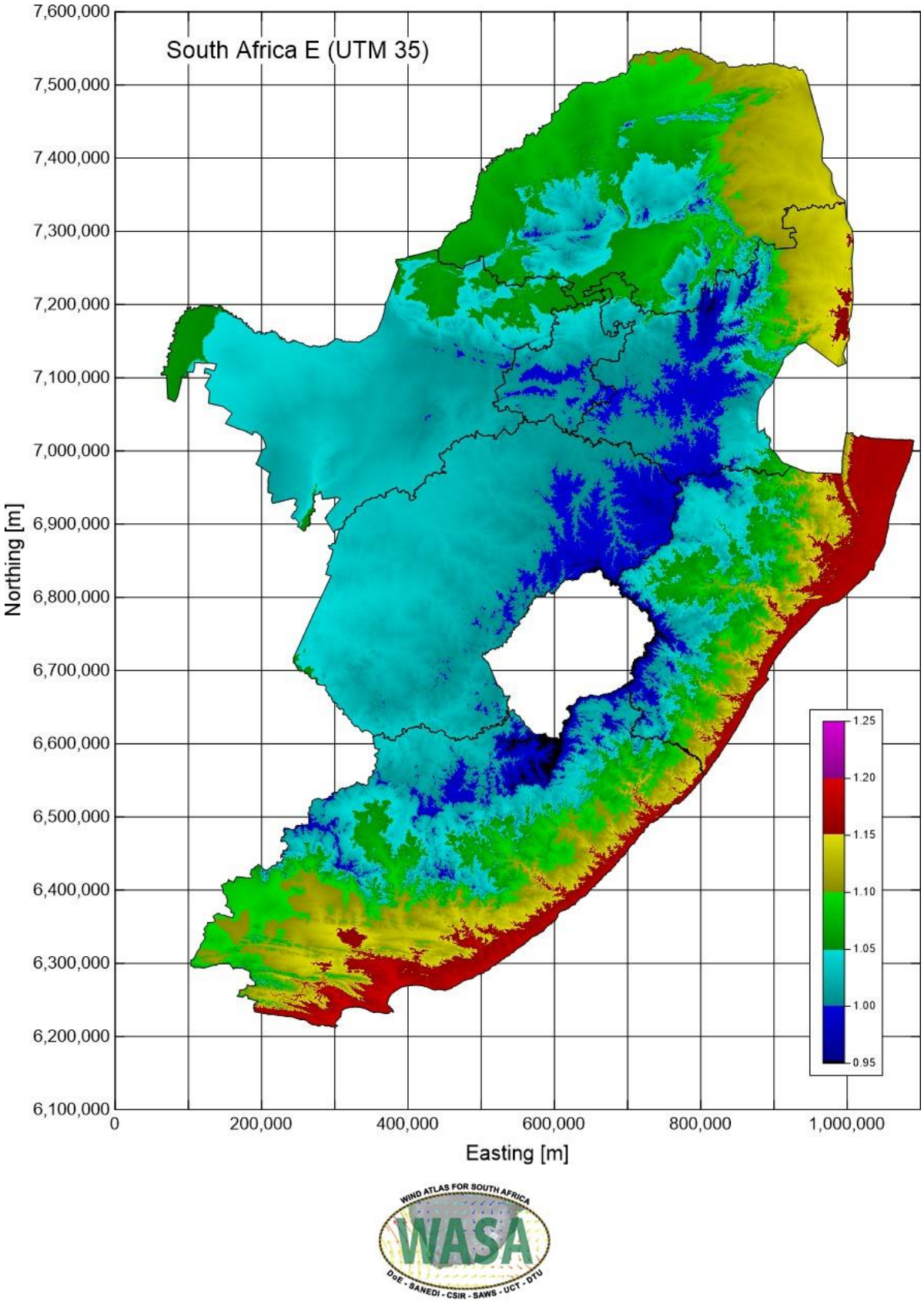
South Africa E mean power density at 100 m a.g.l.



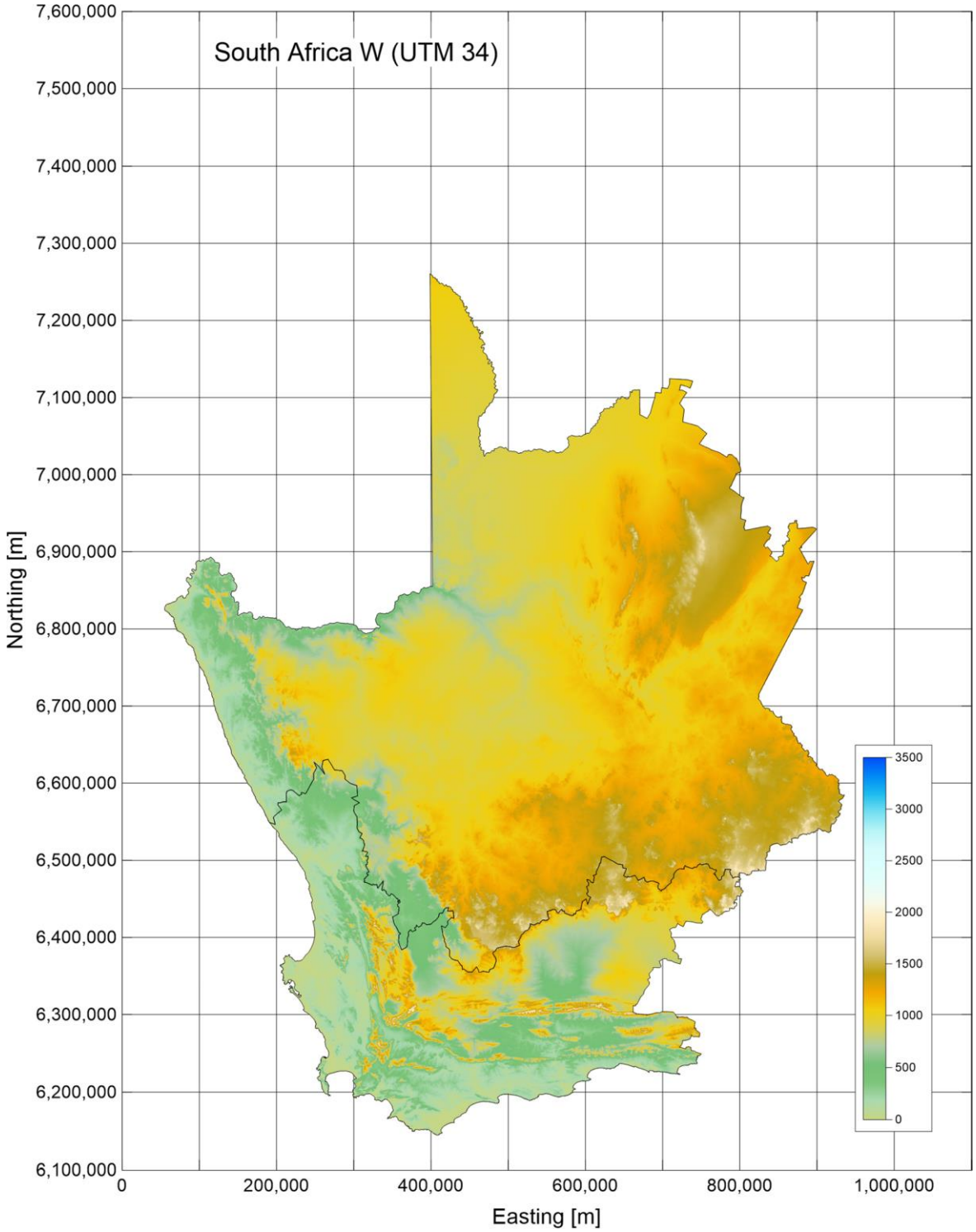
South Africa W air density



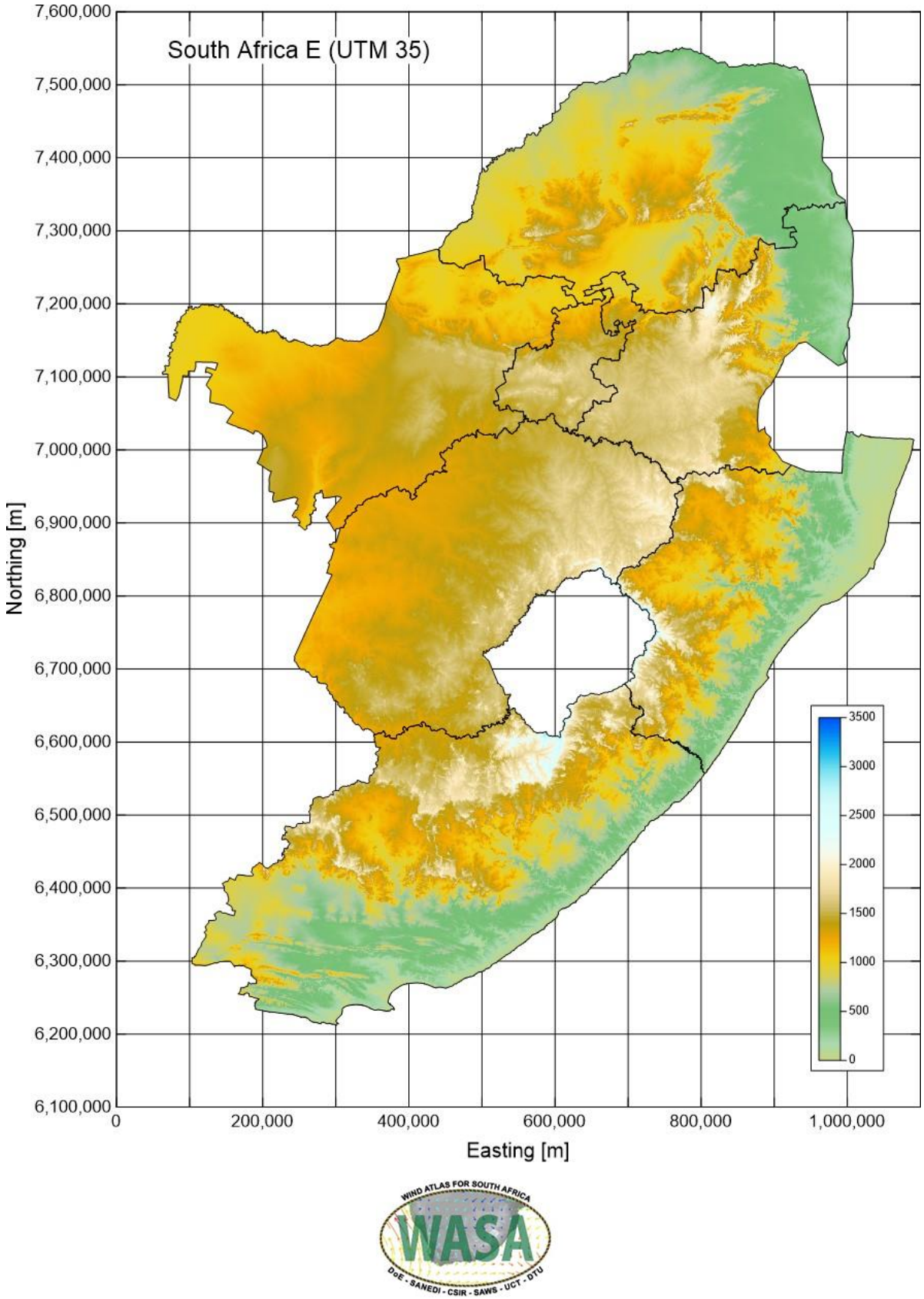
South Africa E air density



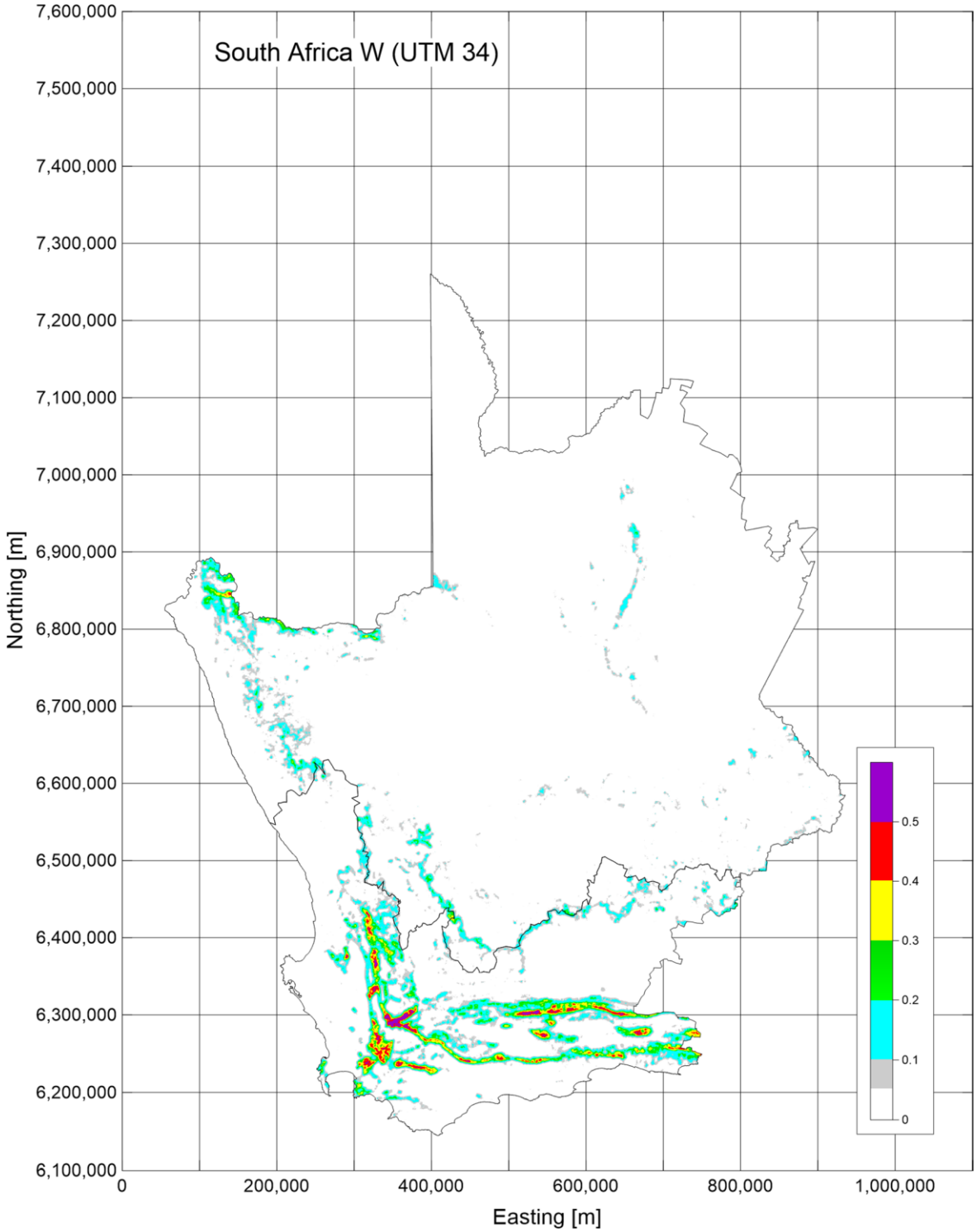
South Africa W elevation



South Africa E elevation



South Africa W ruggedness index



South Africa E ruggedness index