WP5 South African Extreme Wind Atlas (WASA)

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- Why do we need extreme wind statistics?
- Origins of strong winds in South Africa
- Estimation of extreme wind statistics – factors to consider (measured data and modelling)
- WASA 10 min map
- WASA 2-3 s gust map

Why do we need extreme wind statistics?

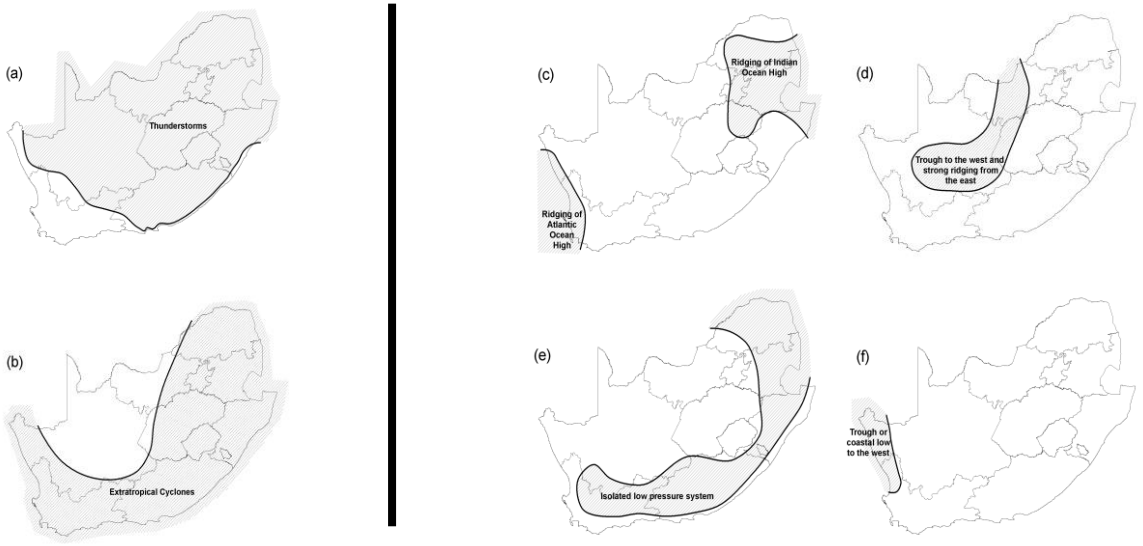
- Wind constitutes most critical environmental loading affecting structural design of built environment in South Africa;
- Information on extreme winds essential in the design of wind farms – situated in areas with relatively strong winds;
- Essential in planning of large-scale exploitation of wind power in South Africa;
- Application of REWC to obtain extreme wind statistics for wind farm position (2nd presentation).

Origins of strong winds

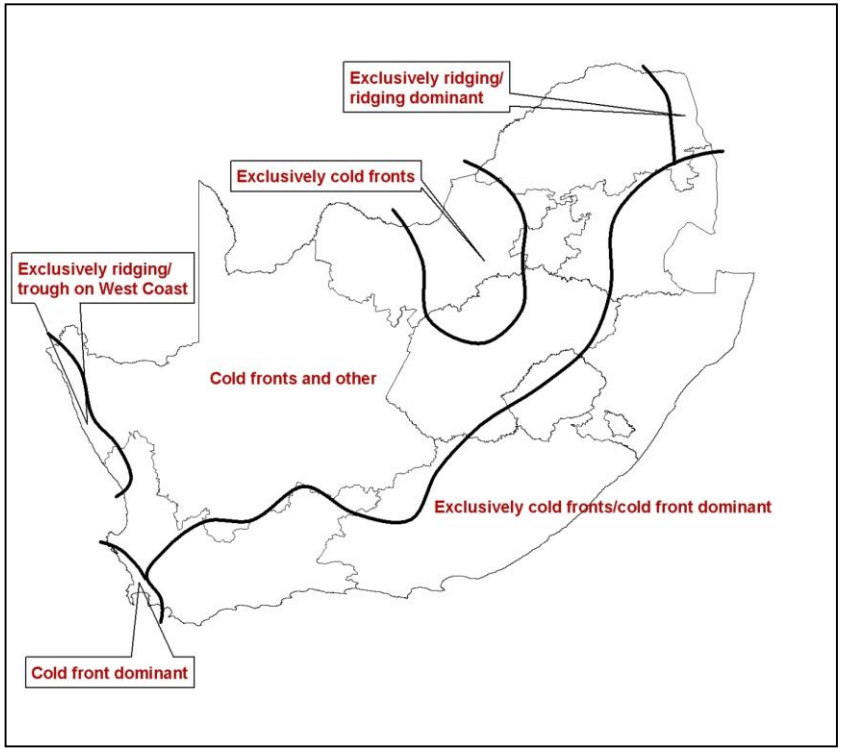
- Interior: Dominated by thunderstorms;
- Coast, adjacent interior – extratropical cyclone (cold front) dominated;
- Larger part of South Africa – mixed strong wind climate…

Zoning of Extreme Wind Causes / Mechanisms

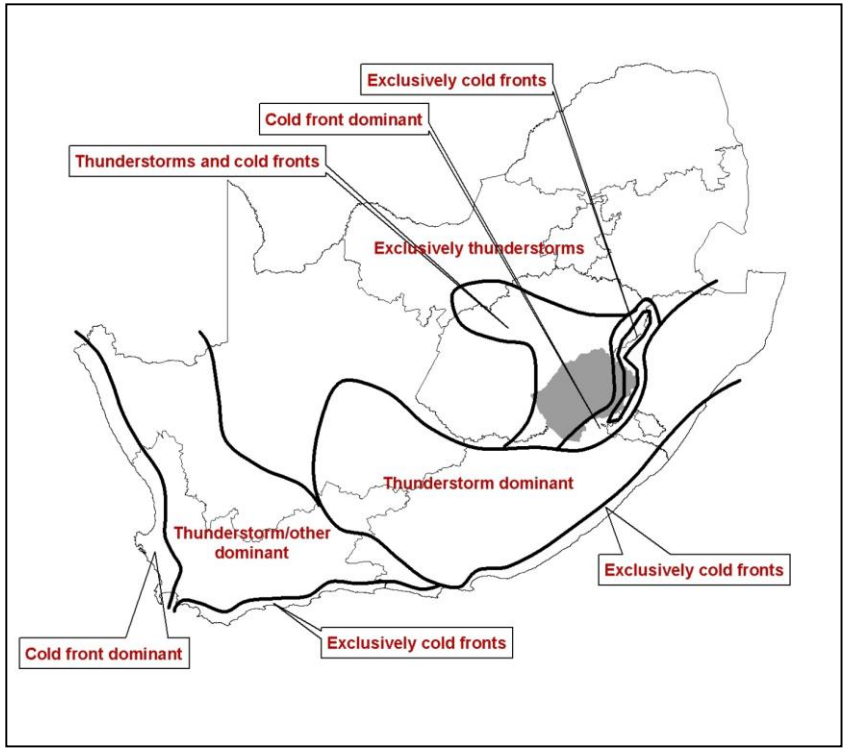
Primary Causes *Secondary Causes*



Analysis of measured data (annual maxima) shows dominance of different strong wind mechanisms:



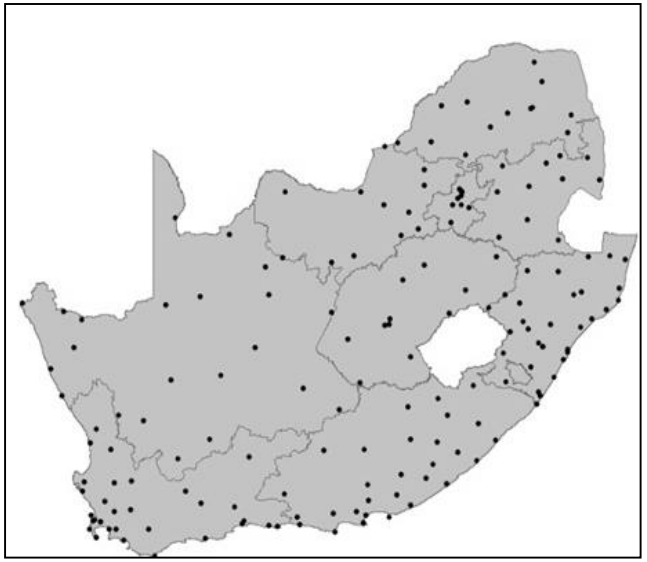
Hourly Mean



2-3 s Gust

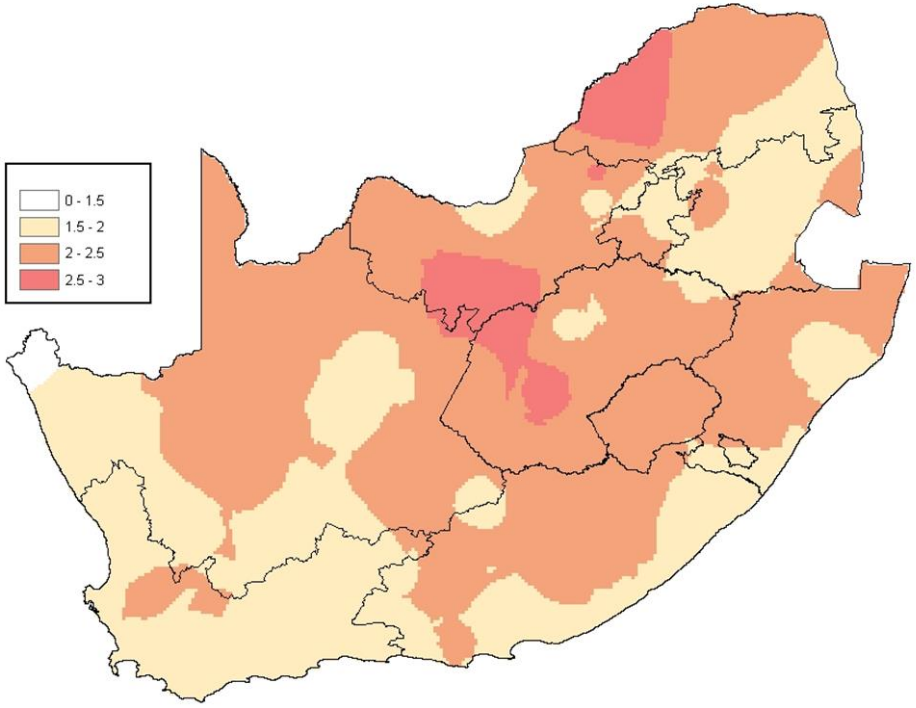
Effect of Mixed Strong Wind Climate

- Effect on optimal estimation of design wind speeds (particularly gusts);
- Ratios between 1:50 yr wind values at different time periods varies across South Africa - complicates conversion between time periods;
- Separation of mechanisms only possible in *analysis of measured data* - imperative in development of extreme wind statistics:



Time resolutions of extreme wind statistics

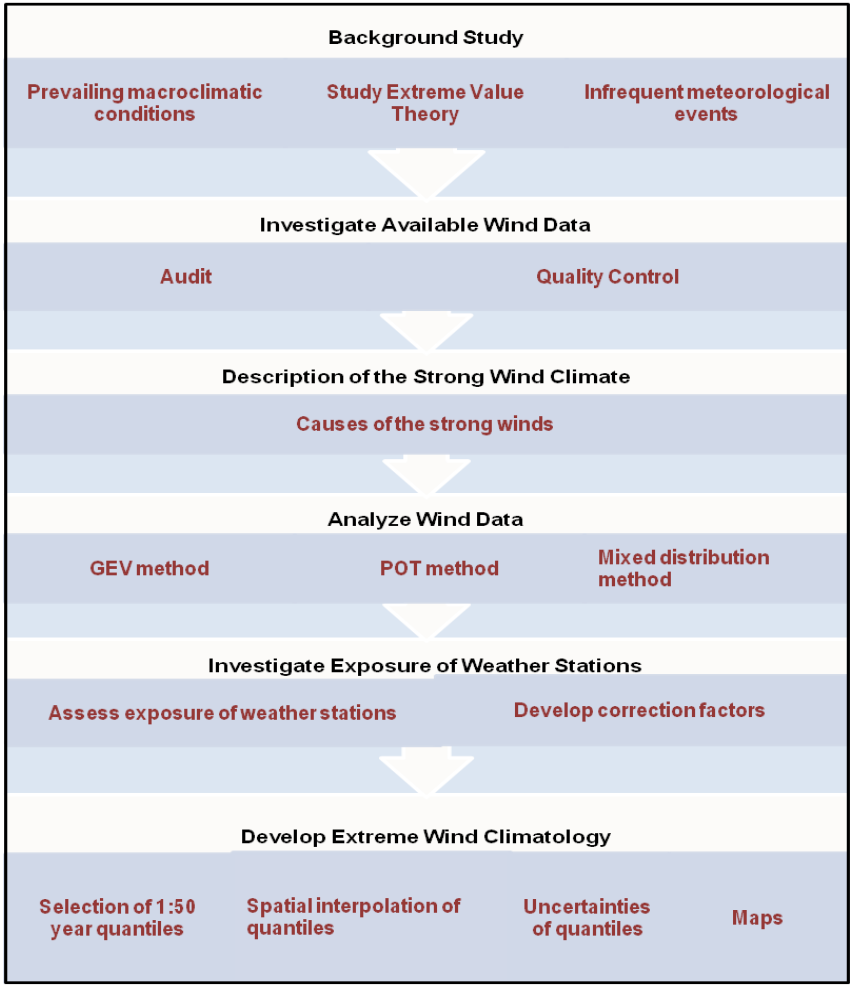
- Standard factors enable conversion between time periods;
- Fixed factors impossible in mixed climate environment;



- Necessary to analyse data separately for different time resolutions;
- WASA – analyses/modelling at 10 min and 2-3 sec (gusts).

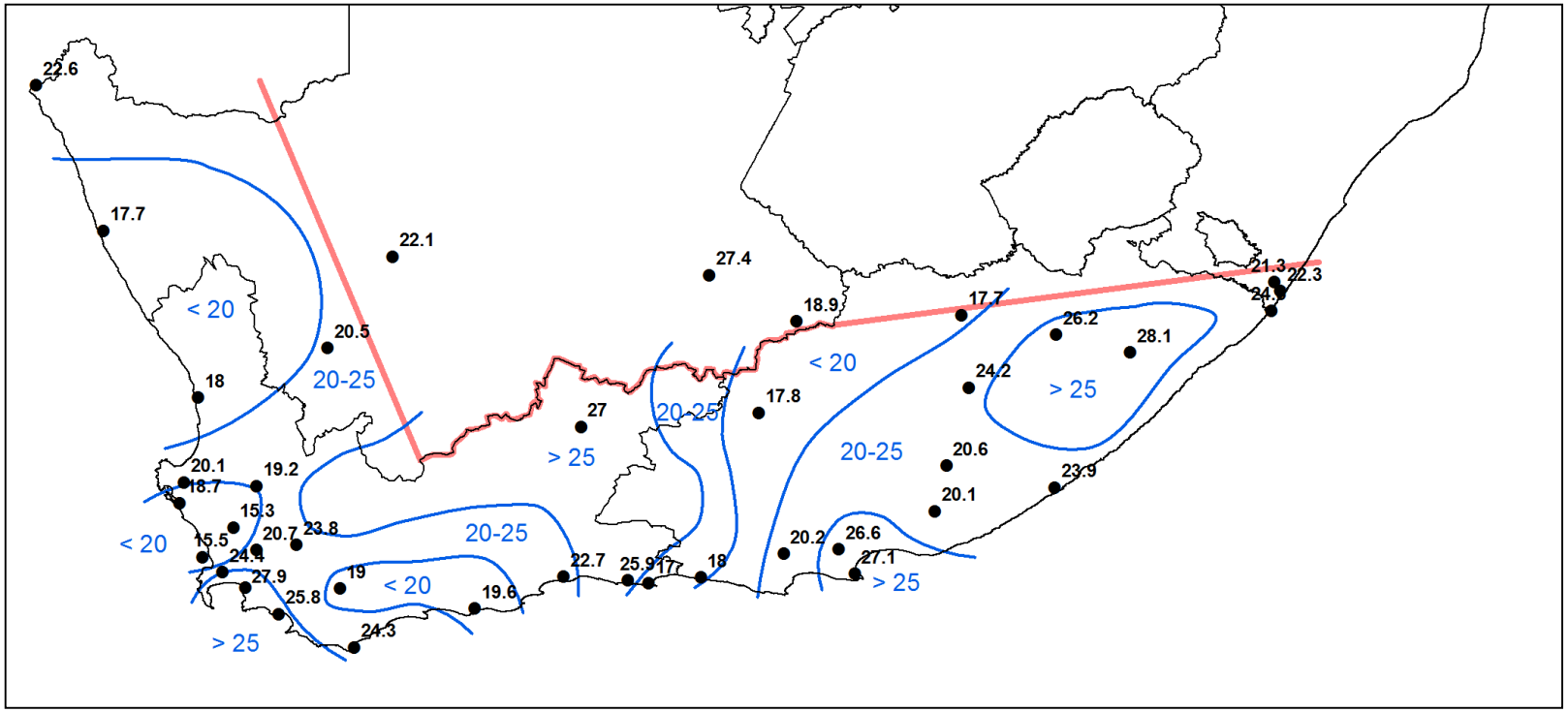
Analysis of measured data

Types of instrument, measuring environment and record lengths to be considered:



10 min map from measured data

- Compatible with mixed strong wind climates using appropriate statistical techniques;
- Low resolution – planned wind farms in remote areas not sufficiently covered by long-term measurements.

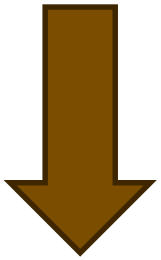


1:50 yr 10-min wind speed for WASA project area

Modeling

- High spatial resolution possible;
- New methods continuously researched:

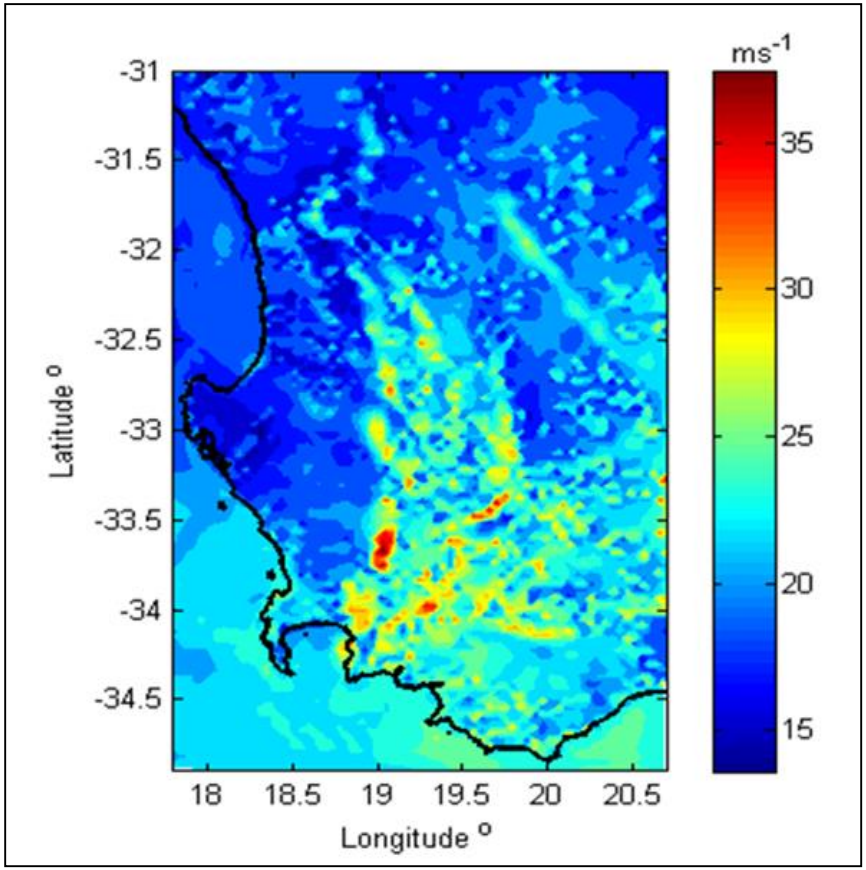
Low time-resolution data (e.g. 6-hourly wind speed)



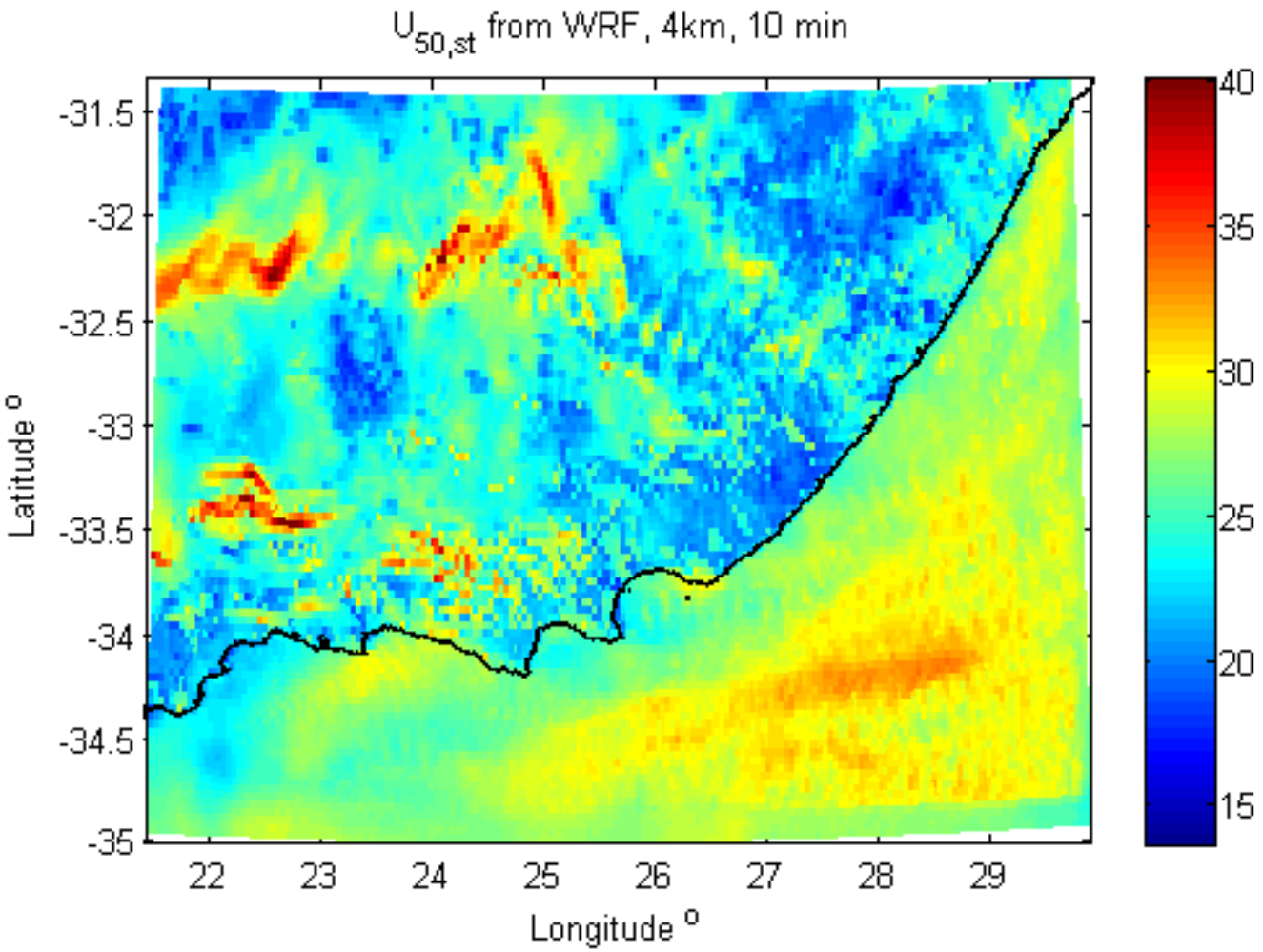
High time-resolution statistics (e.g. 1:50 yr 10 min wind speed)

- Temporal variability can be missed out by smoothing effect of numerical modelling;

Modelling done for most topographically and climatologically complex regions in WASA domain:

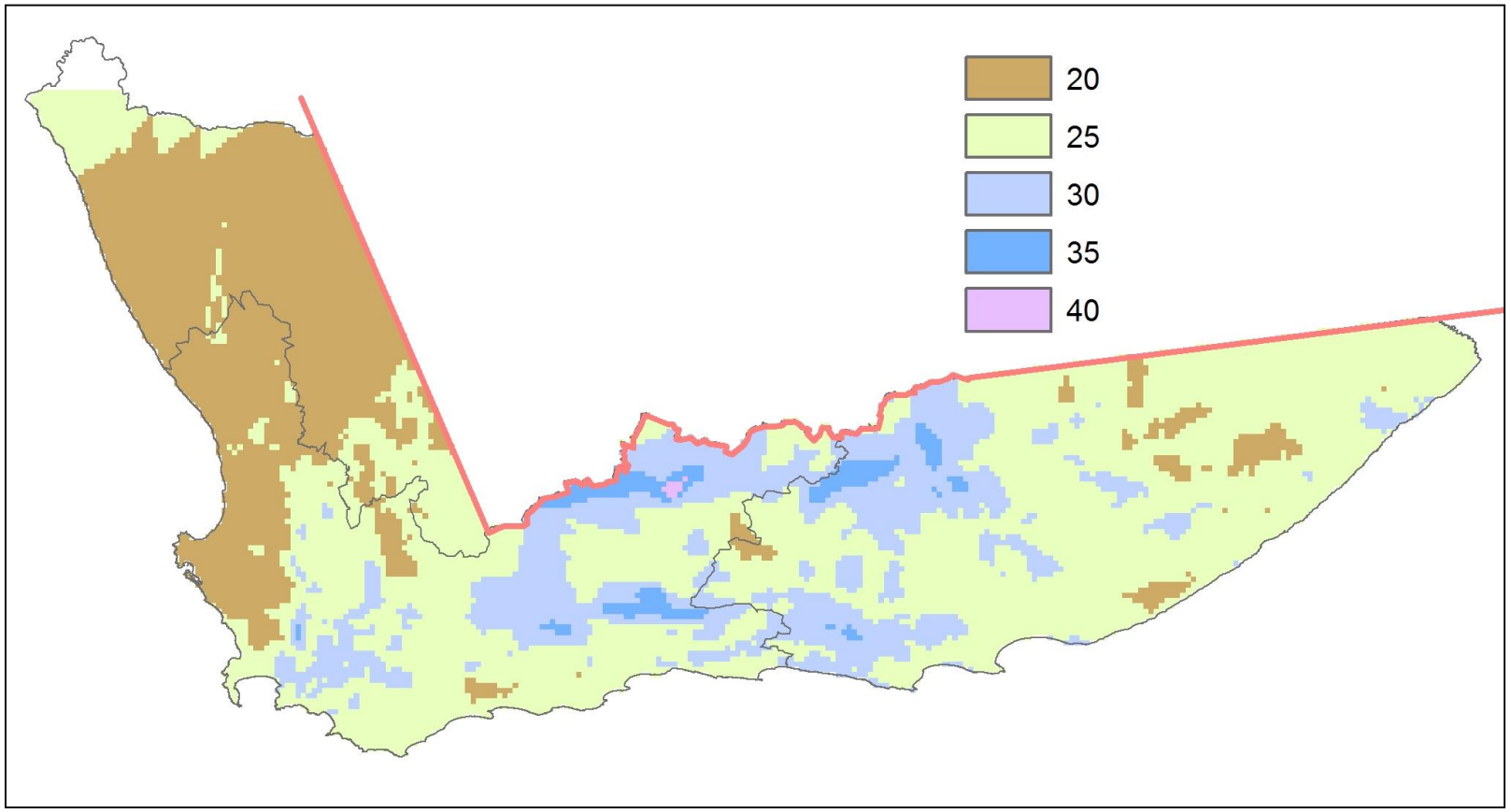


1:50 yr 10-min wind speed for SW Cape for level terrain



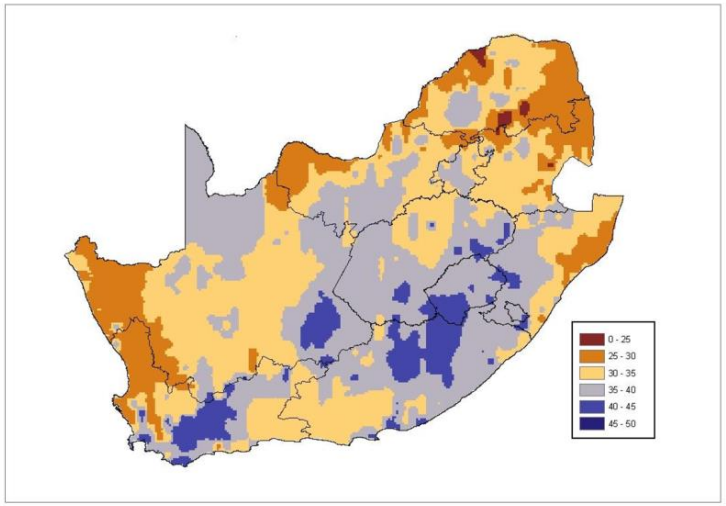
1:50 yr 10-min wind speed for Eastern Cape for level terrain

WASA Phase 1: 1:50 yr 10 min wind speed (m/s)

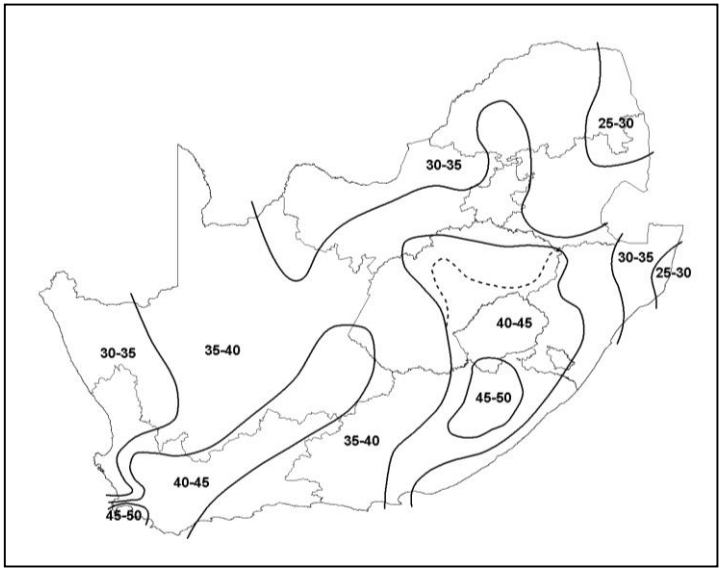


Gust estimation: Measured data

1:50 year gust estimations from measured data.

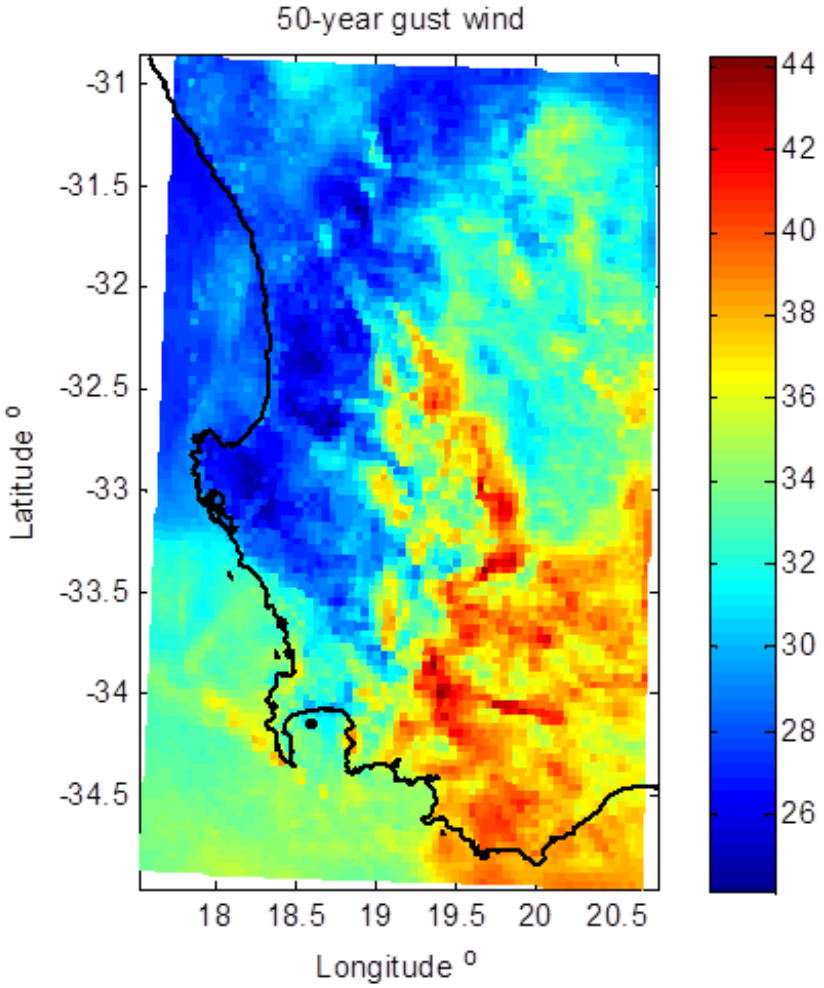


1:50 year gust map with adjustments for uncertainty.

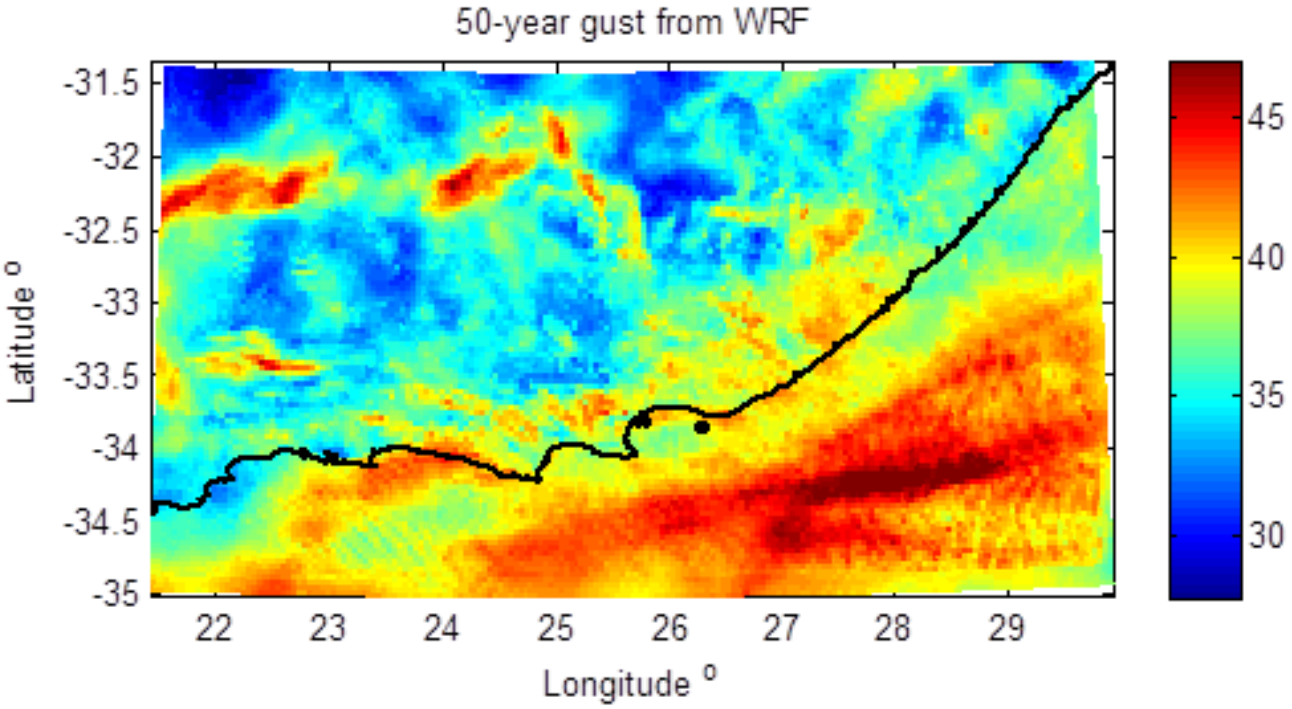


Gust estimation: Modeling

For shorter time-scales specific methods applicable - e.g. non-local gust theory:

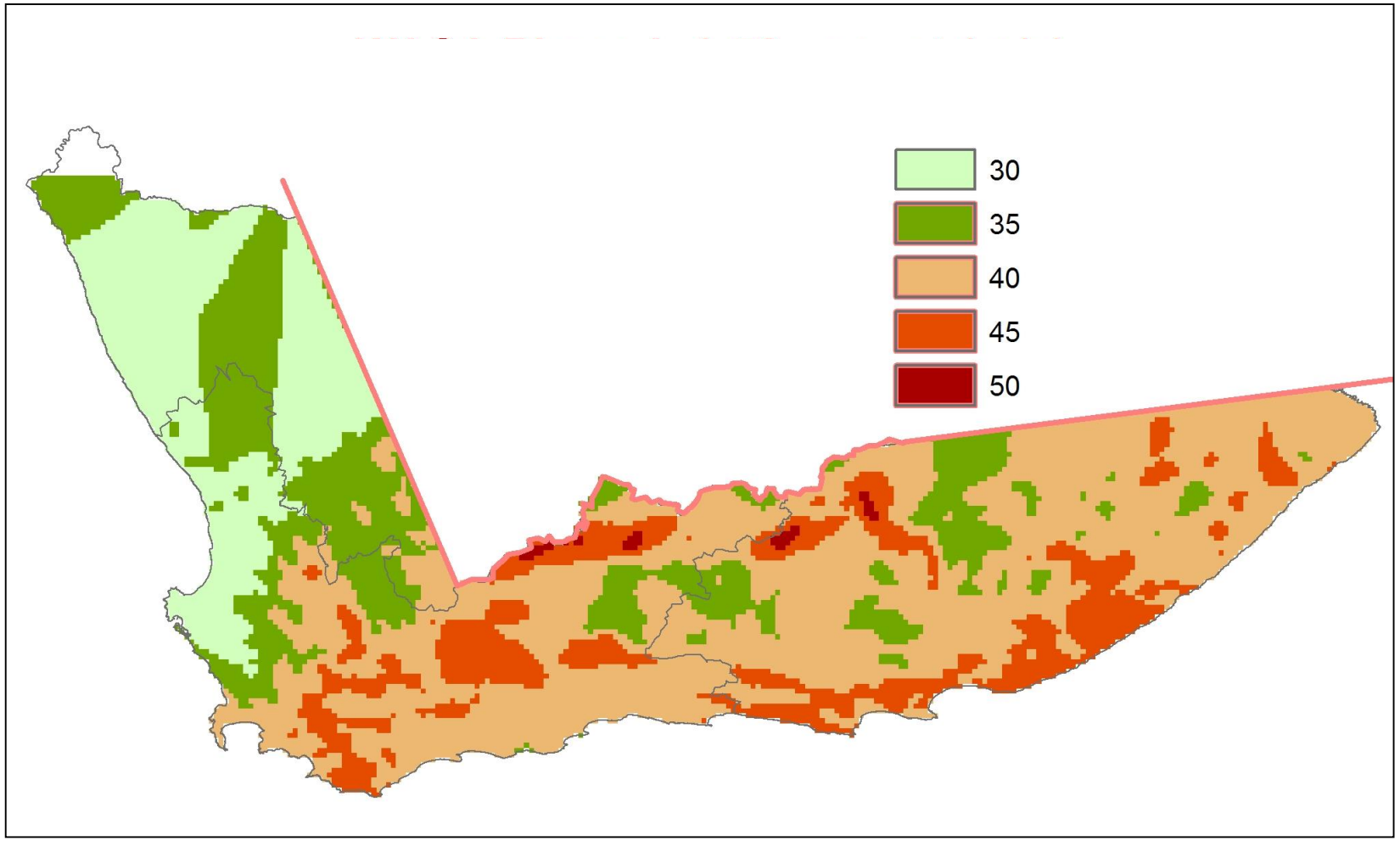


1:50 yr gust for SW Cape for level terrain



1:50 yr gust for Eastern Cape for level terrain

WASA Phase 1: 1:50 yr gust (m/s)



Thank you