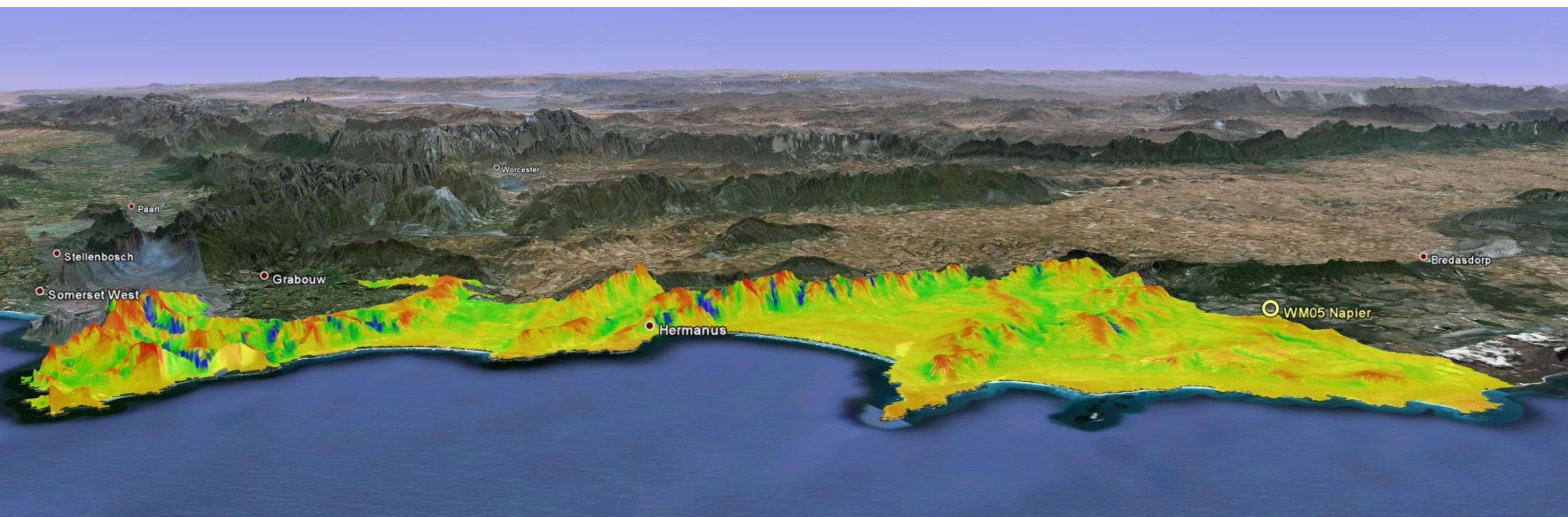
WASA WP3,4 Case Studies

WASA Project Team

08 April 2014, Cape Town, South Africa



Case Studies - introduction

These case studies are designed to:

- Demonstrate specific uses of the WASA data
- Show certain features of wind resource assessment
- Indicate understanding needed when interpreting results
- Serve as inspiration for exploring more about wind atlases

The site(s) have been chosen for the above purpose. Please bear the following in mind:

- Not a suggestion of a good wind farm location
- Aspects other than wind resource have not been reviewed
- Case studies are not intended to be a course in the use of wind resource assessment software

What can a wind atlas actually be used for?

Brief examples shown here

1) Input to planning processes
2) Wind farm project studies

Case study 1: Planning

Planning for wind energy by SA/province/district/municipality

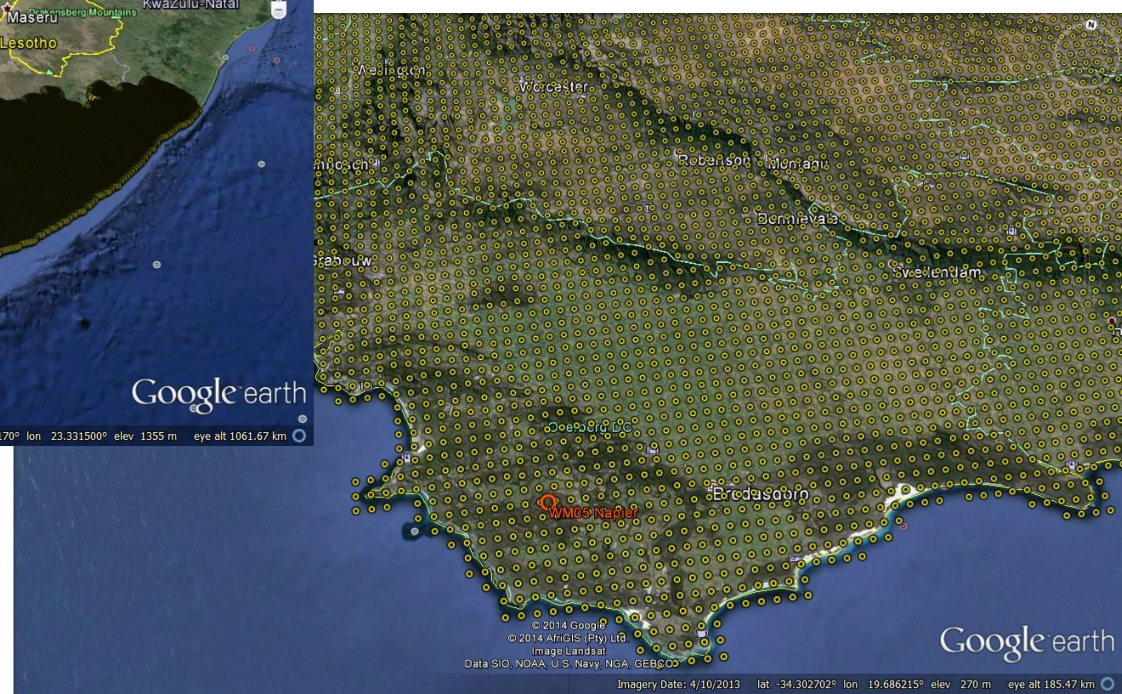
This case study demonstrates a typical use of the WASA data for planning and as input to assess the following questions:

Where are the good wind resources in the planning area so that we can:

- Understand the potential for wind power - identify where the best areas are physically located
- Know more as background for choice of planning approach and selection of zones for development
- Investigate any possible relations to other land uses

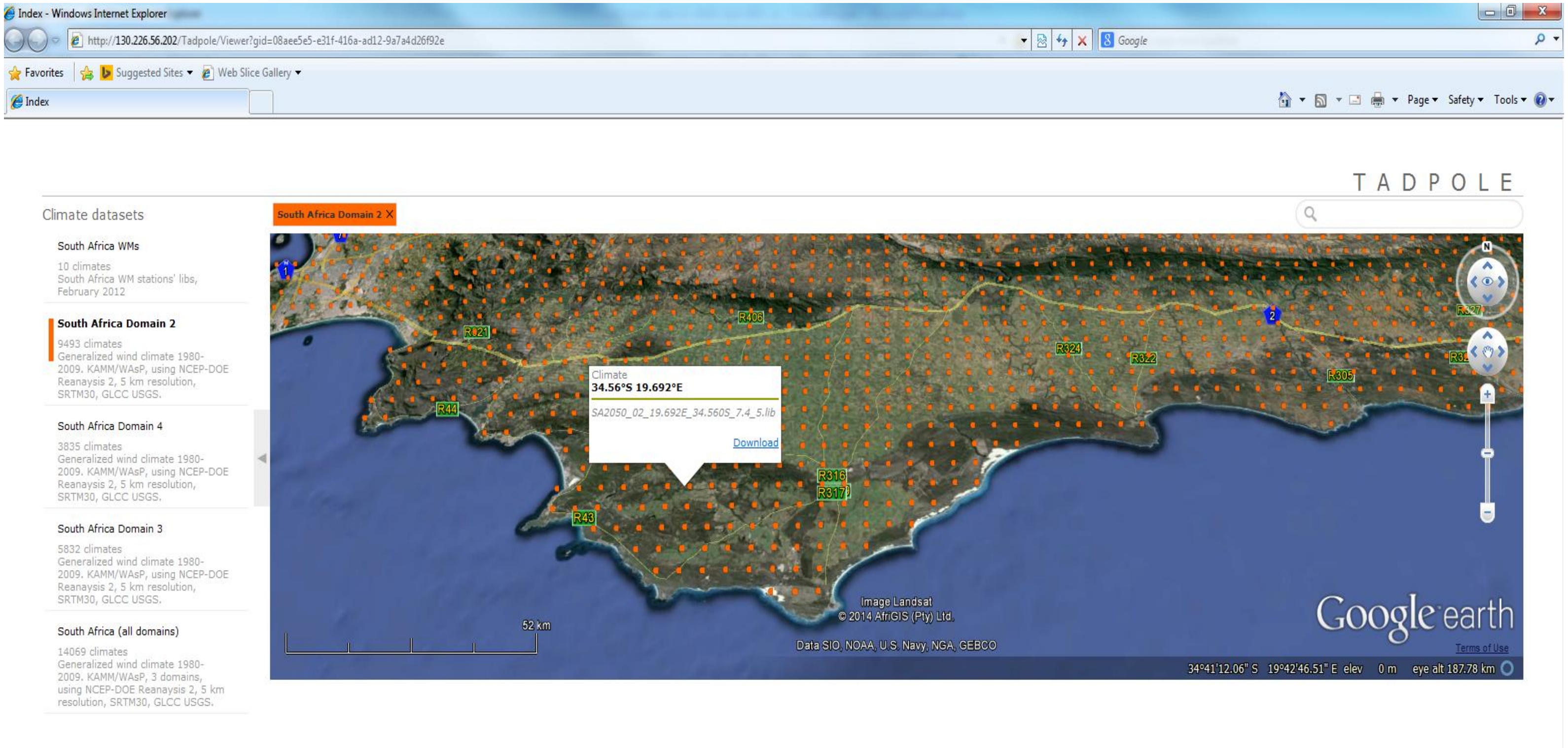
Case study 1: Planning SA/Province/District/Municipality

General wind resource in the area: NWA map
 100m height, uniform surface and uniform roughness



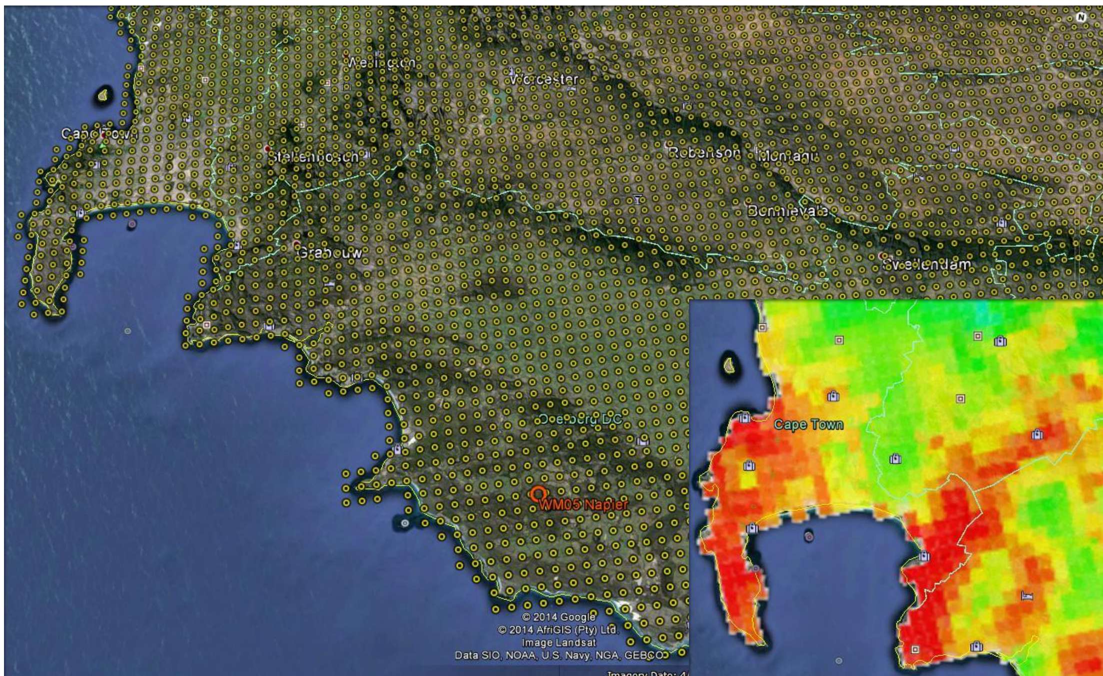
Case study 1: Planning SA/Province/District/Municipality

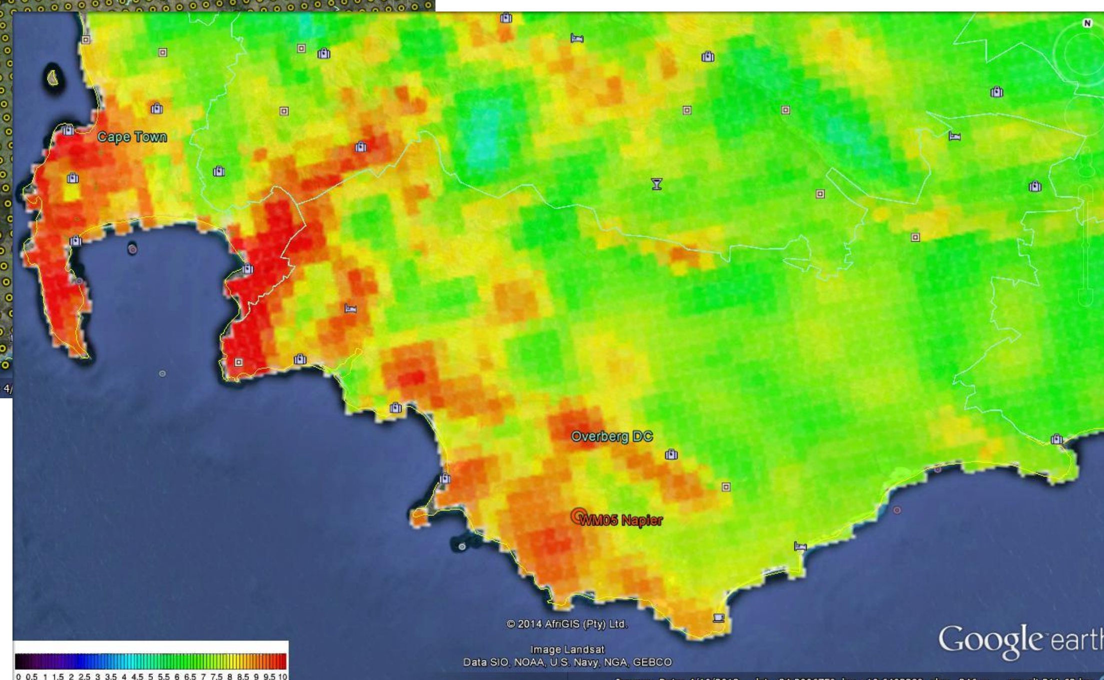
Identifying LIB files



Case study 1: Planning SA/Province/District/Municipality

General wind resource in the area: NWA map





Case study 1: Planning SA/Province/District/Municipality

More detailed wind resource in a particular area: microscale modelling using NWA

Steps:

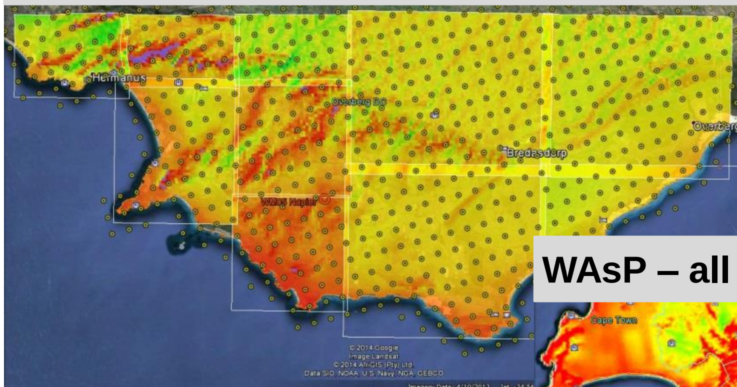
- Identify NWA nearest grid point and download LIB-files
- Make terrain maps for the area
  - Elevation (orography)
  - Land cover (roughness)
- Import maps and wind data into modelling software (e.g. WAsP)
- Run model to obtain resource maps as required

WIND ATLAS FOR SOUTH AFRICA
WASA
DoE - SANEDI - CSIR - SAWS - UCT - DTU

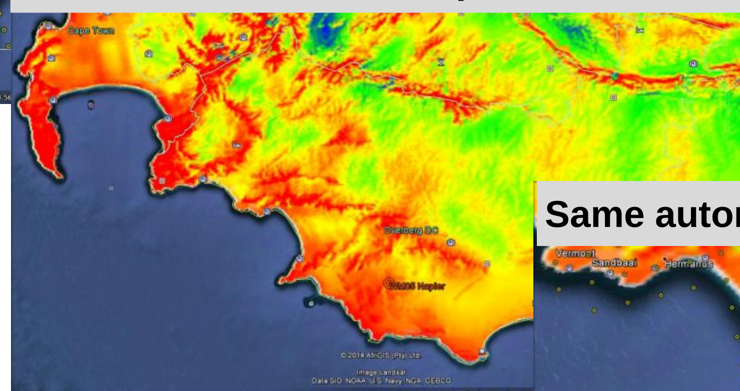
Case study 1: Planning SA/Province/District/Municipality

More detailed wind resource in a particular area: microscale modelling using NWA

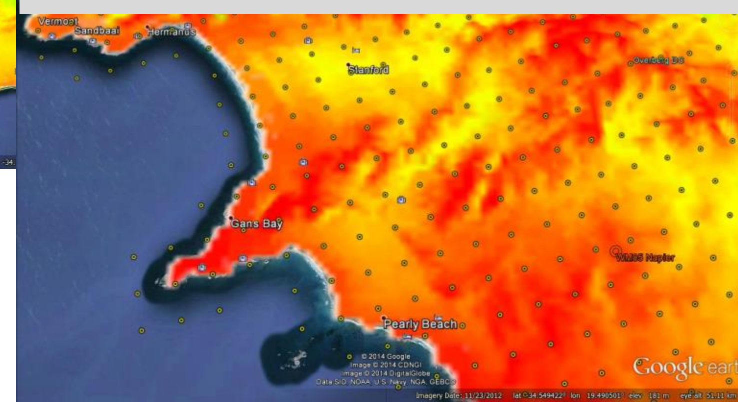
WAsP – 1 LIB-file per tile – large tiles



WAsP – all LIB-files interpolated – 250 m



Same automated WAsP zoomed



Case study 2: Wind farm energy yield

Wind farm development by a potential wind farm project

This case study reviews estimates of the potential Annual Energy Production (AEP) of a specific wind farm and is designed to show how WASA data can help with input to answer among others the following question:

How do we start assessing the wind resource so we can make a good wind farm project?

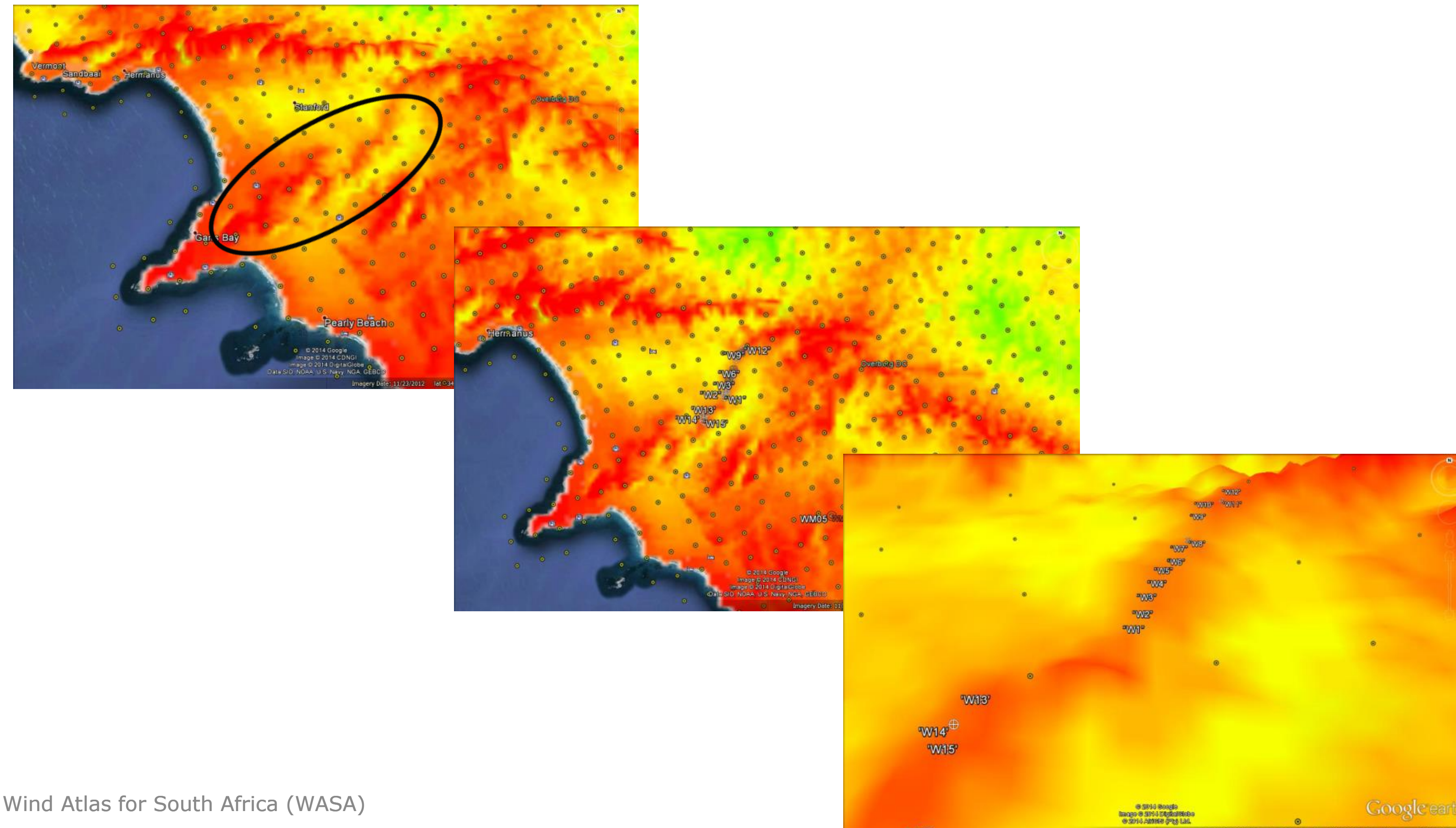
Case study 2: AEP Review

or in a little more words

- How do we find the good resource areas?
- Can candidate sites be identified?
- How many turbines and what capacity?
- What is a reasonable estimate of AEP?
- Further steps
  - How do we plan a wind measurement campaign to reduce uncertainty and make the project bankable?
  - How do we go about assessing the site conditions (turbulence intensity, flow angles, wind shear, 50-year wind, etc) – design wind conditions, class of turbine? *(covered by WP5 – Extreme Wind Atlas)*
- Other steps
  - How do we get information about our possible wind farm so we can begin to analyse the possibilities for grid connection, transport, planning permission, environmental impact , etc?

Case study 2: AEP Review

Potential good site identified from looking at wind resource map



Case study 2: AEP Review

Wind farm AEP according to WM05 measurements and NWAs based on WRF:

input to WAsP	Net AEP* "Stanford case"
LIB-file from WM05 measurements	149 GWh/y
Several LIB-files nearest to each WTG – WRF based NWA	117 GWh/y
Over-estimation when using WM05	**27 %**
* At simple assumptions incl. 100% availability, no losses, standard air density and standard WAsP parameters	

NWA verifications at WM05:

	OWA [m/s]	WRF [m/s]	Difference WRF
WM05	8.98	9.04	0.67%

Case studies – some concluding remarks

Application for planning

- NWA should be used directly as input to microscale modelling in order to get sufficient detail and avoid the underestimation of wind energy potential due to mesoscale model averaging
- Manual approach or automated interpolation method for microscale modelling may be applied. In case of manual approach small tiles are recommended.

Application for wind farm studies

- NWA LIB-files provide information about geographical variation of wind resources that may have significant impact on resource assessment at areas with wind climate gradients – as shown in the case study
- It is recommended to consult the verification made for the NWA when assessing uncertainties in energy yield studies
- Does not negate the necessity for on-site measurements that will reduce uncertainties and thereby capital costs