

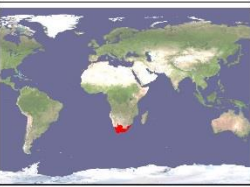
Sustainable wine production in South Africa within the context of climate variability

Strever AE, Southey, TO

ClimWine 2016, Bordeaux

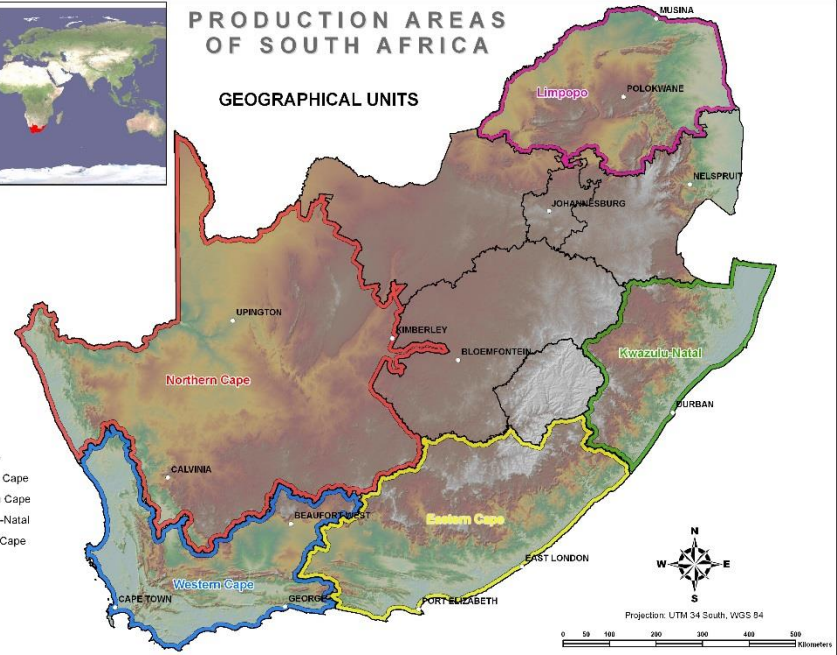
Department of Viticulture and Oenology, Stellenbosch University



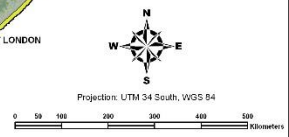


PRODUCTION AREAS OF SOUTH AFRICA

GEOGRAPHICAL UNITS

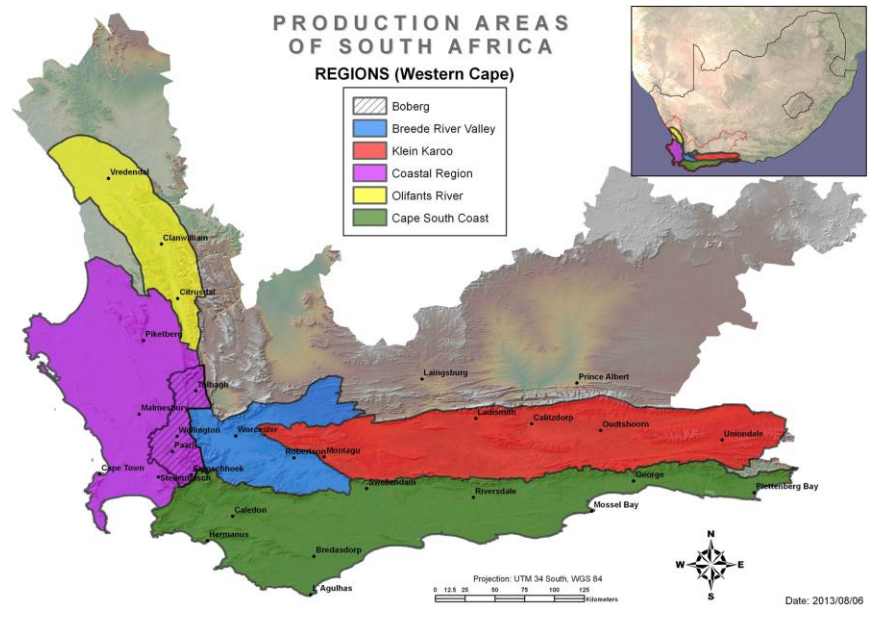


- Limpopo
- Western Cape
- Northern Cape
- Kwazulu-Natal
- Eastern Cape



PRODUCTION AREAS OF SOUTH AFRICA

REGIONS (Western Cape)

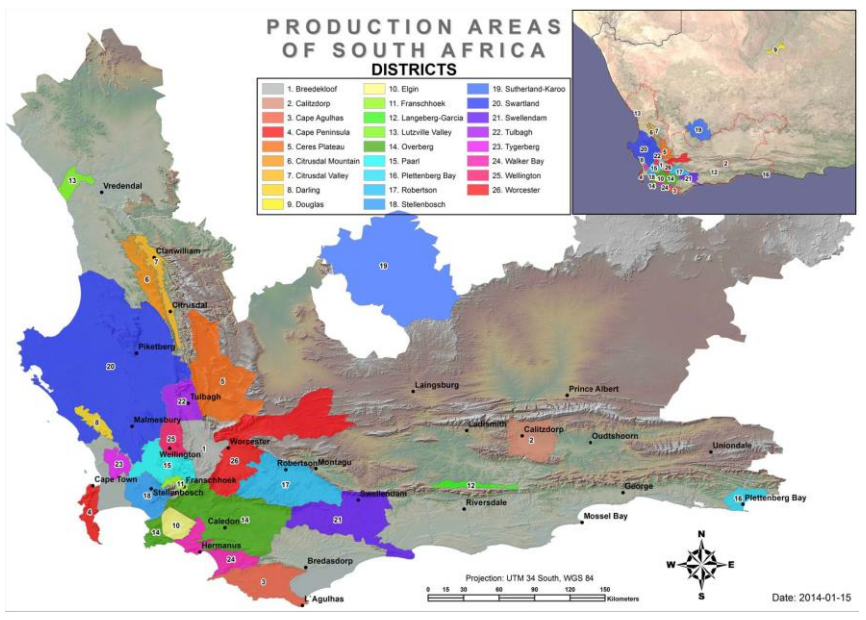


- Boberg
- Breede River Valley
- Klein Karoo
- Coastal Region
- Olifants River
- Cape South Coast



PRODUCTION AREAS OF SOUTH AFRICA

DISTRICTS

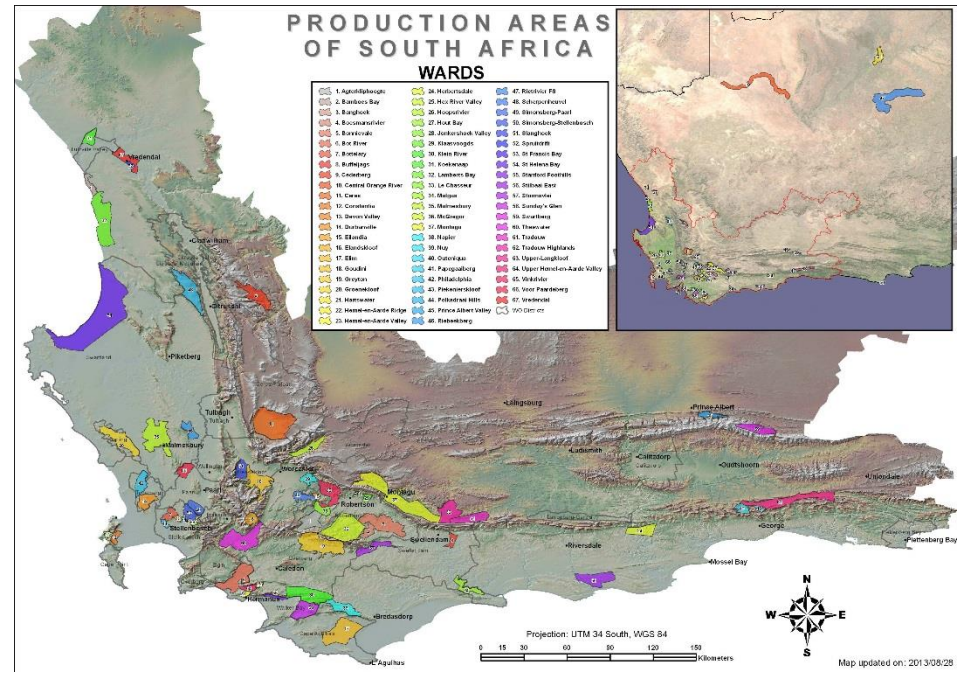


- | | | |
|----------------------|----------------------|----------------------|
| 1. BreedeKloof | 10. Elgin | 19. Sutherland-Karoo |
| 2. Caltzorp | 11. Franschoek | 20. Swartland |
| 3. Cape Agulhas | 12. Langeberg-Gardie | 21. Swellendam |
| 4. Cape Peninsula | 13. Lutzville Valley | 22. Tubbagh |
| 5. Ceres Plateau | 14. Overberg | 23. Tygerberg |
| 6. Cinsudal Mountain | 15. Paarl | 24. Walker Bay |
| 7. Cinsudal Valley | 16. Plettenberg Bay | 25. Wallington |
| 8. Darling | 17. Robertson | 26. Worcester |
| 9. Douglas | 18. Stellenbosch | |



PRODUCTION AREAS OF SOUTH AFRICA

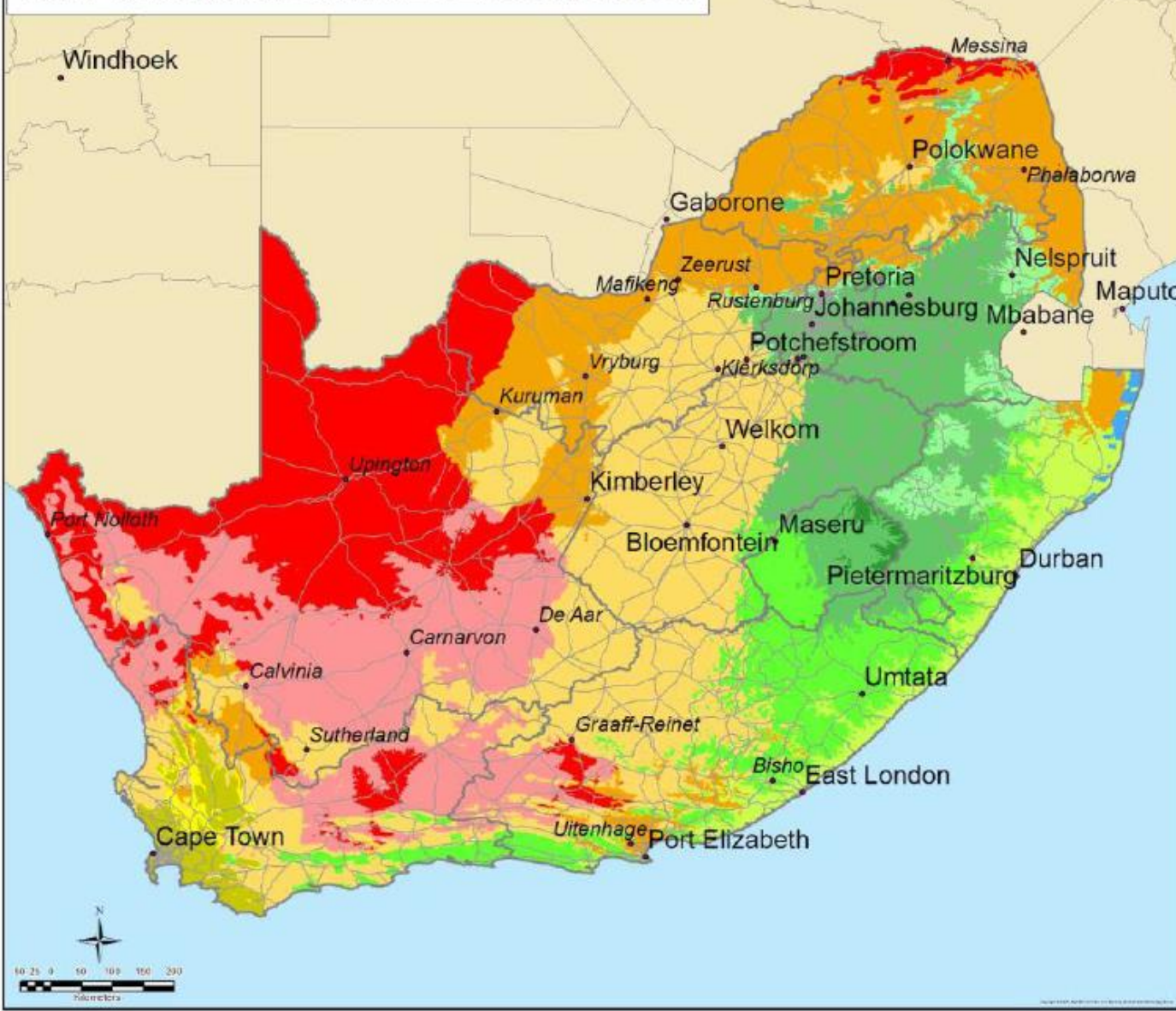
WARDS




- | | | |
|------------------|---------------------------|-------------------------|
| 1. Agulhasbaai | 34. Matieland | 47. Rooibos F8 |
| 2. Bantjes Bay | 35. Olifants River Valley | 48. Schabergfontein |
| 3. Bantjeskloof | 36. Rensfontein | 49. Swartkops |
| 4. Bouchardville | 37. Plettenberg Bay | 50. Swartkops-Botterbos |
| 5. Breda Valley | 38. Joubertskloof Valley | 51. Stellenbosch |
| 6. Breë Rivier | 39. Kasteelwagters | 52. Spitskops |
| 7. Brimley | 40. Kasteelwagters | 53. St. Ignace Bay |
| 8. Brits River | 41. Kasteelwagters | 54. St. Ignace Bay |
| 9. Breda Valley | 42. Kasteelwagters | 55. St. Ignace Bay |
| 10. Ceresberg | 43. Kasteelwagters | 56. St. Ignace Bay |
| 11. Ceres | 44. Kasteelwagters | 57. St. Ignace Bay |
| 12. Ceres | 45. Kasteelwagters | 58. St. Ignace Bay |
| 13. Ceres | 46. Kasteelwagters | 59. St. Ignace Bay |
| 14. Ceres | 47. Kasteelwagters | 60. St. Ignace Bay |

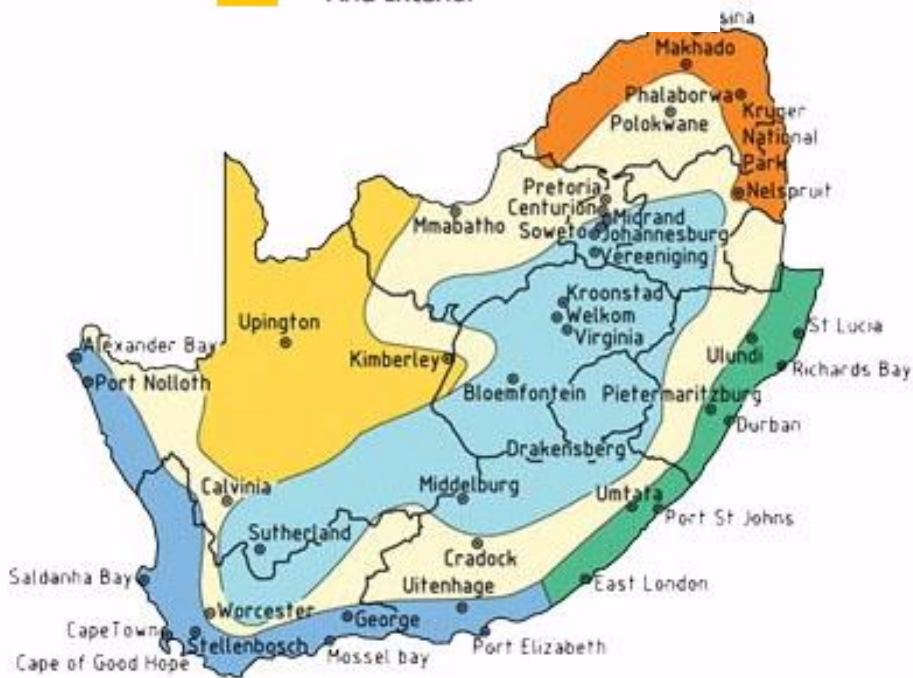


KÖPPEN-GEIGER CLIMATE CLASSIFICATION

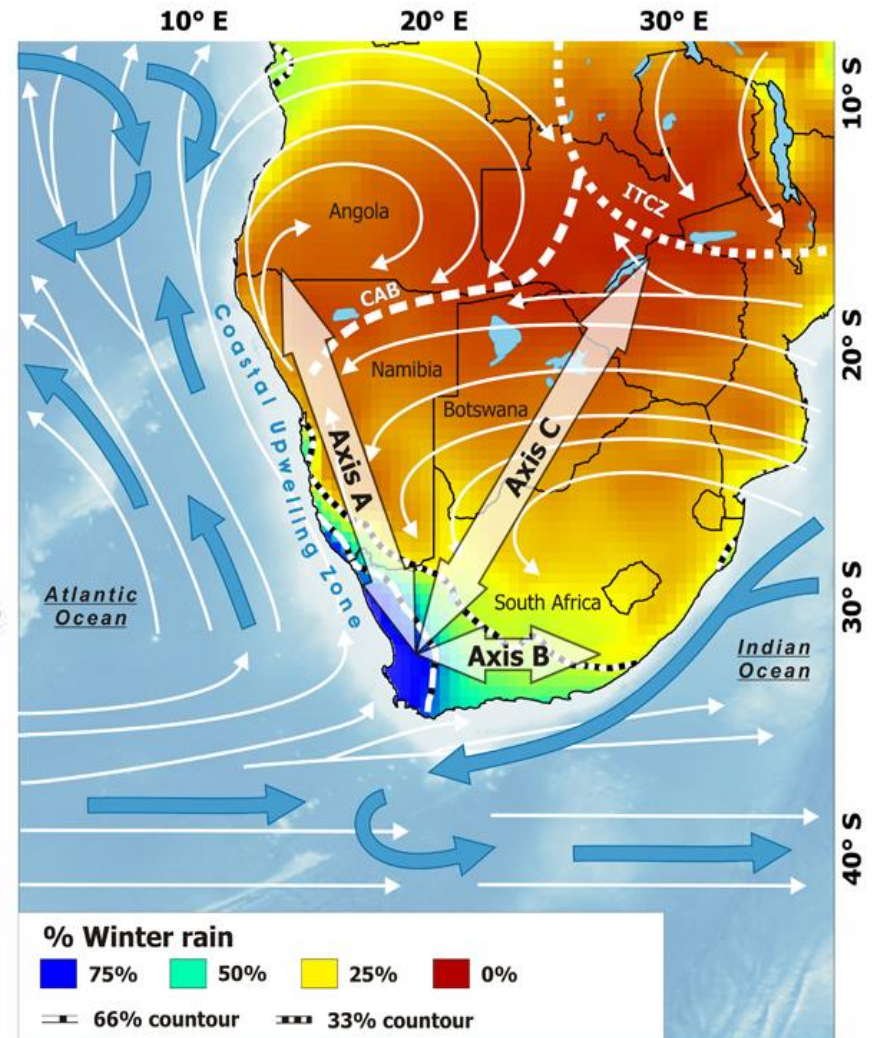


■	Af	Equatorial, Fully humid
■	Am	Equatorial, Monsoonal
■	Aw	Equatorial, Winter dry
■	BWh	Arid, Desert, Hot arid
■	BWk	Arid, Desert, Cold arid
■	BSh	Arid, Steppe, Hot arid
■	BSk	Arid, Steppe, Cold arid
■	Csa	Warm temperate, Summer dry, Hot summer
■	Csb	Warm temperate, Summer dry, Warm summer
■	Csc	Warm temperate, Summer dry, Cool summer
■	Cwa	Warm temperate, Winter dry, Hot summer
■	Cwb	Warm temperate, Winter dry, Warm summer
■	Cwc	Warm temperate, Winter dry, Cool summer
■	Cfa	Warm temperate, Fully humid, Hot summer
■	Cfb	Warm temperate, Fully humid, Warm summer
■	Cfc	Warm temperate, Fully humid, Cool summer
■	Dsa	Snow, Summer dry, Hot summer
■	Dsb	Snow, Summer dry, Warm summer
■	Dsc	Snow, Summer dry, Cool summer
■	Dsd	Snow, Summer dry, Extremely continental
■	Dwa	Snow, Winter dry, Hot summer
■	Dwb	Snow, Winter dry, Warm summer
■	Dwc	Snow, Winter dry, Cool summer
■	Dwd	Snow, Winter dry, Extremely continental
■	Dfa	Snow, Fully humid, Hot summer
■	Dfb	Snow, Fully humid, Warm summer
■	Dfc	Snow, Fully humid, Cool summer
■	Dfd	Snow, Fully humid, Extremely continental
■	ET	Polar, Tundra
■	EF	Polar, Frost

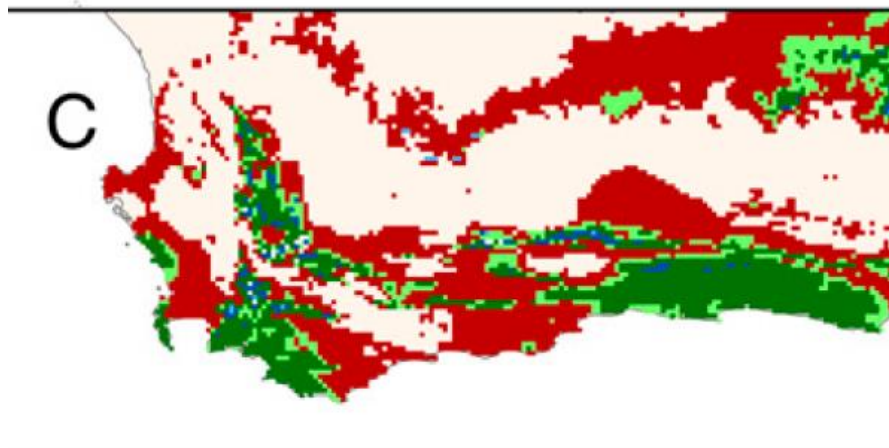
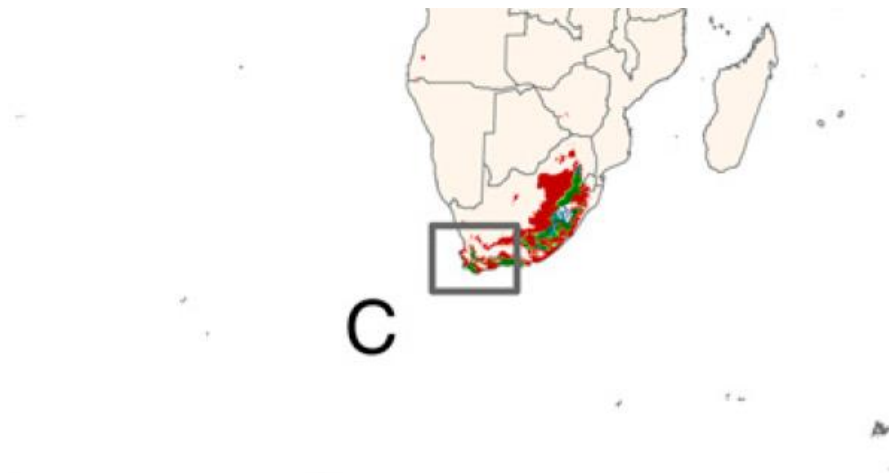
Zone	Climatic Conditions
	Cold Interior
	Temperate Interior
	Hot Interior
	Temperate Coastal
	Sub-tropical Coastal
	Arid Interior



SANS 204-2, 2008



Chase and Meadows, 2007



-  **Current Suitability**
-  **Suitability Retained > 50% GCMs**
-  **Suitability Retained > 90% GCMs**
-  **Novel Suitability > 50% GCMs**
-  **Novel Suitability > 90% GCMs**

What is special about this area?

● Topography

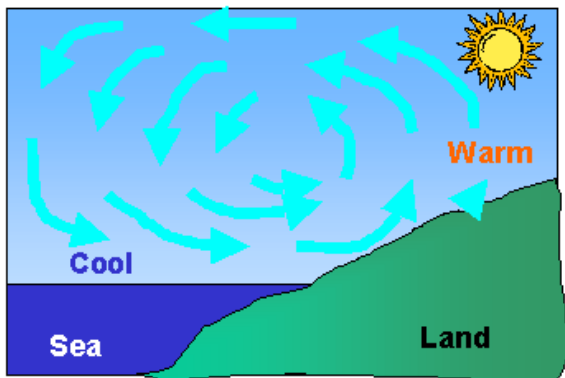
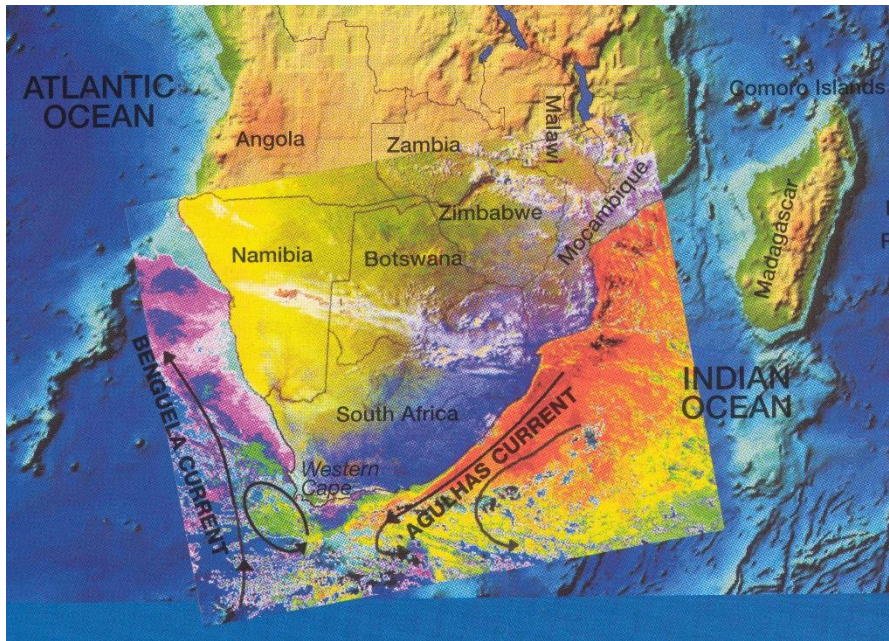
- Coastal plain, river valley, mountains, hills



● Geology

- Malmesbury shales, greywacke, granite, sandstone
- Orogeny during pre-Cambrian and Permian to Triassic periods
- Affects soil distribution and topography

What is special about this area?



● The sea-breeze

- Develops in afternoon due to differences in sea surface and land temperatures
- Penetration depends on topography of coastal area
- Implications for temperature, wind exposure, relative humidity

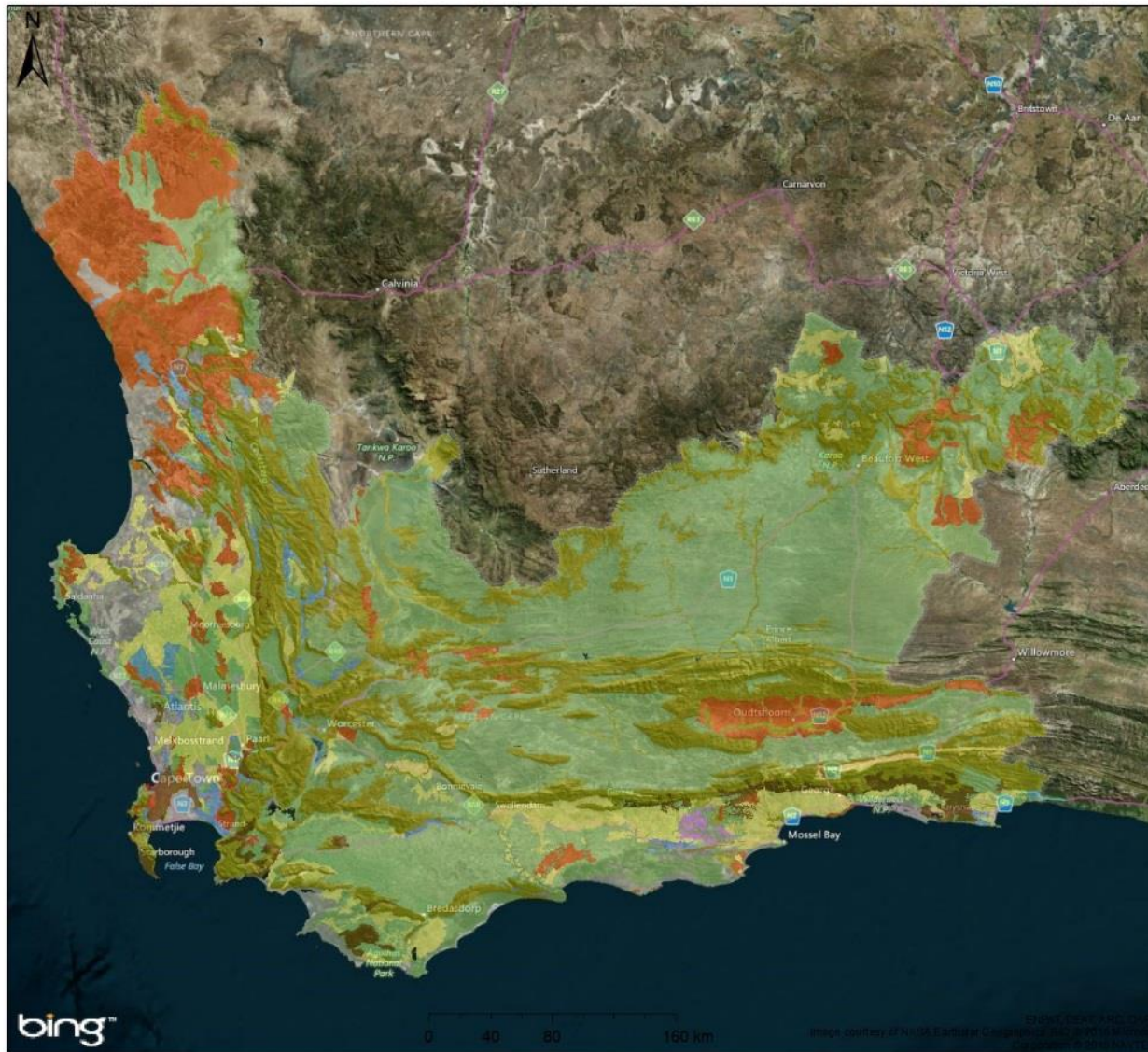
Modelled with RAMS: Bonnardot *et al.*, 2002, 2005; Bonnardot and Cautenet, 2009

CapeFarmMapper

Legend

Broad Soils Classification (ENPAT)

- Glenrosa and/or Mispah forms (other soils may occur)
- Grey regic sands
- Miscellaneous land classes, rocky
- Plinthic catena
- Prismacutanic and/or pedocutanic diagnostic horizons dominant
- Red-yellow apedal, freely drained soils
- Soils with a diagnostic ferrihumic horizon
- Vertic, melanic, red structured diagnostic horizons, undifferentiated



bing™

Scale: 1:3 409 091

Date created: March 27, 2016



Western Cape
Government

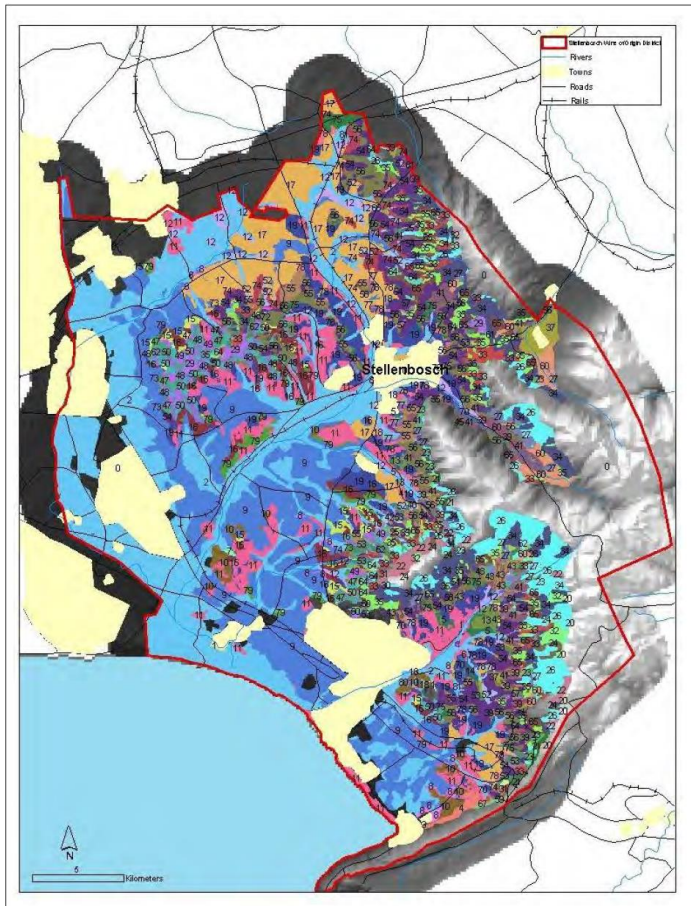
Agriculture



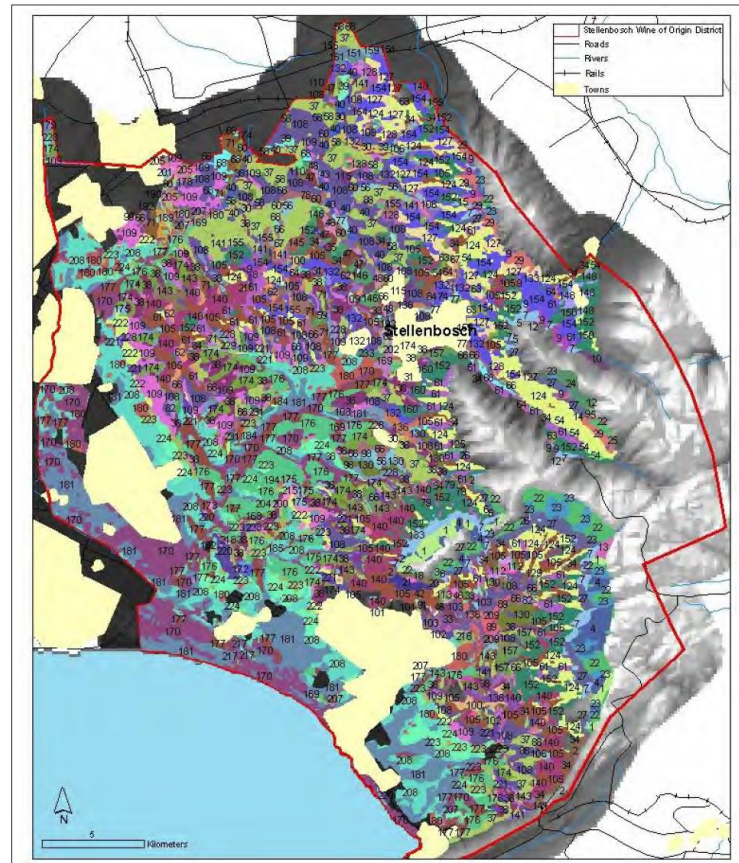
Previous studies

- The use of viticultural terroir units for demarcation of geographical indications for wine production in Stellenbosch and surrounds (Carey, 2005)

ADDENDUM 4.5 Map of terroirs identified for Cabernet Sauvignon in the Stellenbosch Wine of Origin District. Descriptions of associated viticultural and oenological performance are provided in Addendum 4.6.



ADDENDUM 4.7 Map of terroirs identified for Sauvignon blanc in the Stellenbosch Wine of Origin District. Descriptions of associated viticultural and oenological performance are provided in Addendum 4.8.

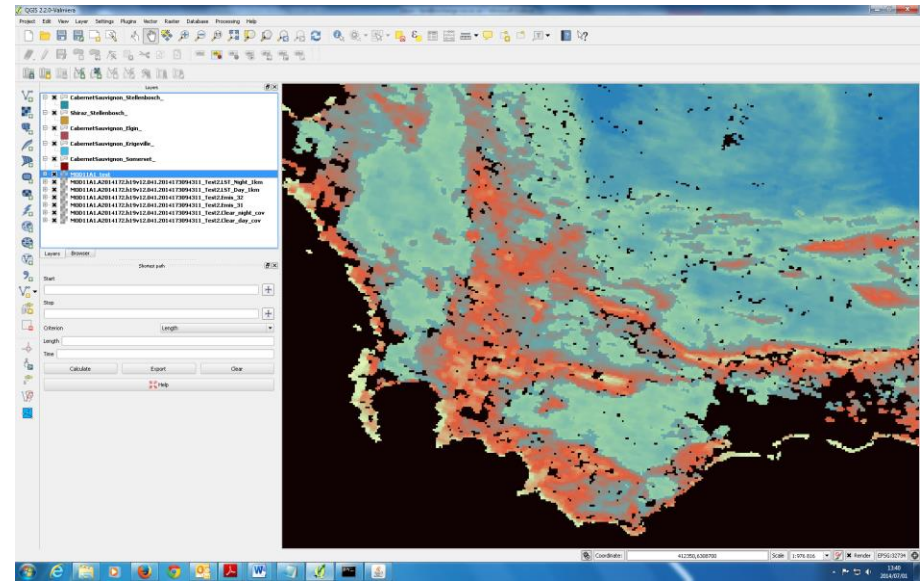


Current projects



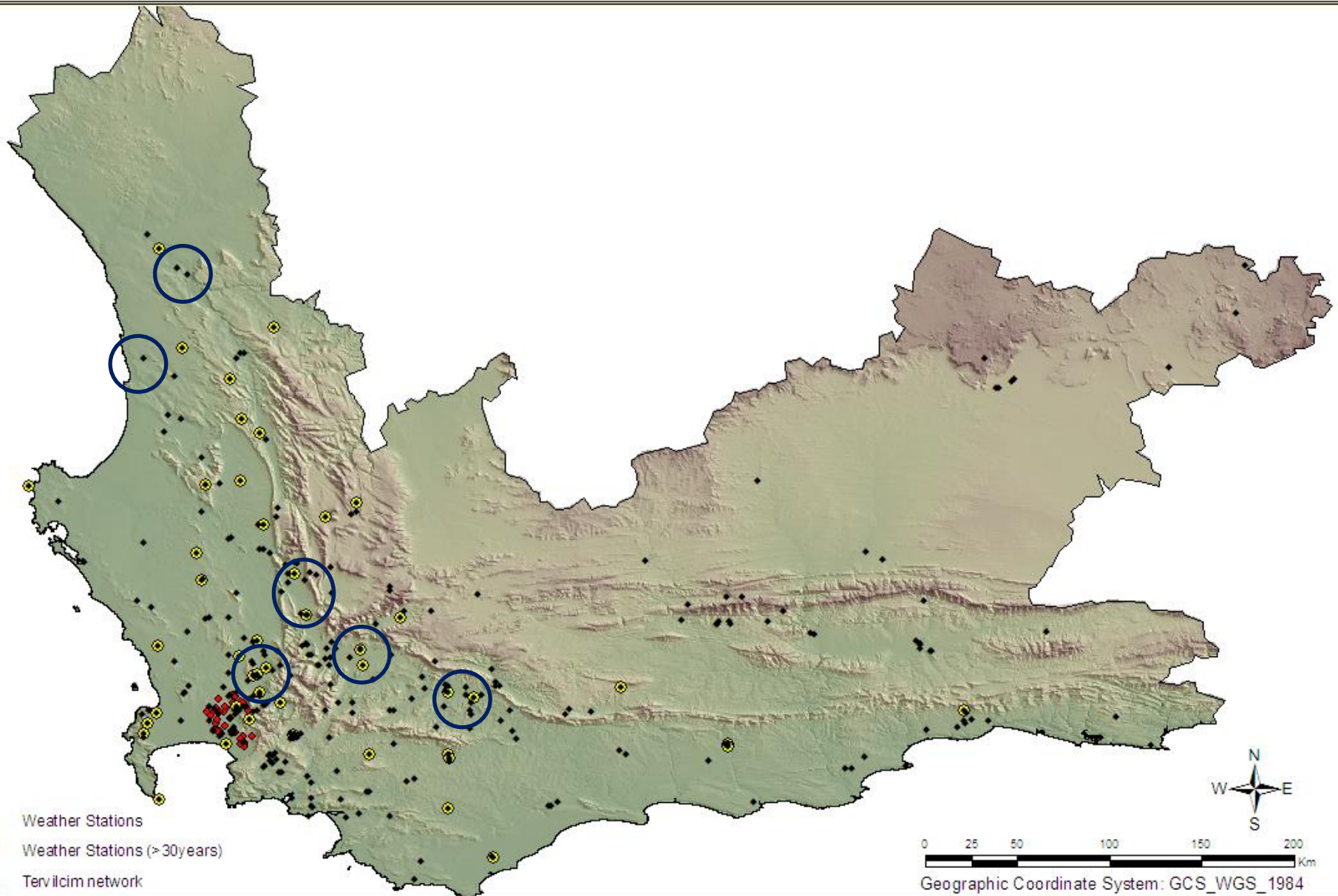
- Impact of **climate change factors (CO₂, temp)** on physiological and vegetative growth parameters of young grafted grapevines (WW HT 14/01).
- Evaluation of existing wine grape **rootstocks** for their ability to withstand the environmental challenges in SA (WW 12/29).
- Water footprint analysis to improve **water use efficiency in table grape production**. A case study in the Hex River Valley, Western Cape, South Africa (using Fruitlook satellite data).
- Integration of climate and GIS modelling as key factors in determining cultivar suitability and adaption to a specific environment.
 - Cabernet Sauvignon and Shiraz sites over climatic band

Macro scale

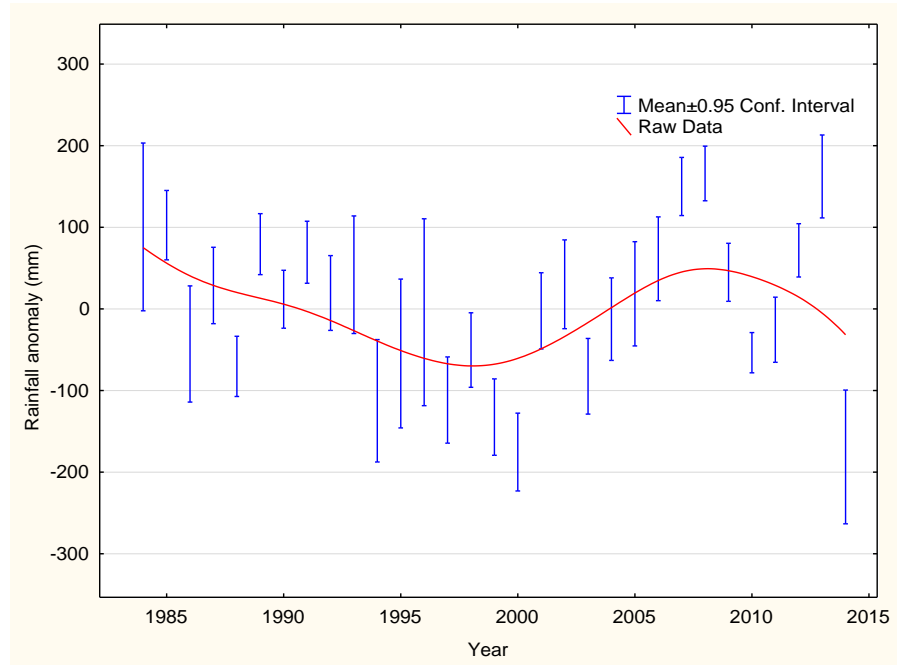
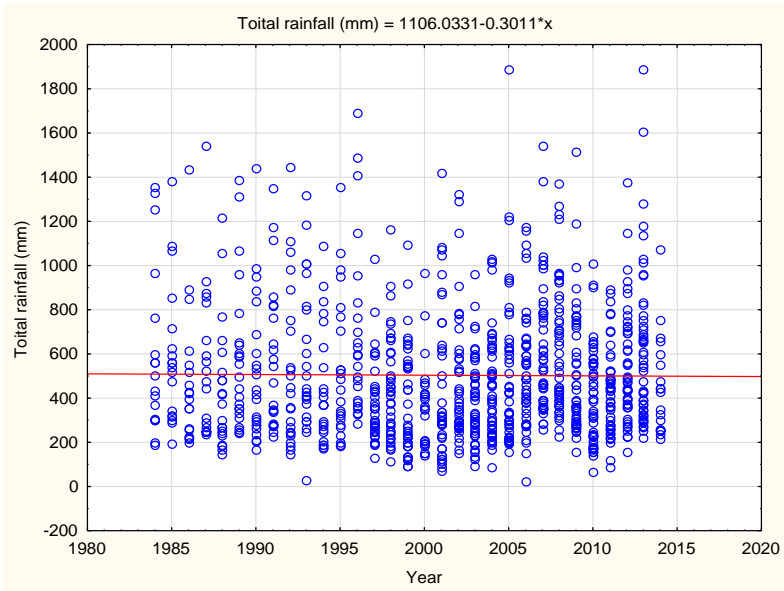


- Topography, soil, GIS layers.
- Regional climate data (35 years or more for some stations)
- MODIS_LST/ Other remote sensing products (i.e. Fruitlook)
- Refining Worldclim layers with local data (already done for data until 2010)

Selected Weather stations



Rainfall



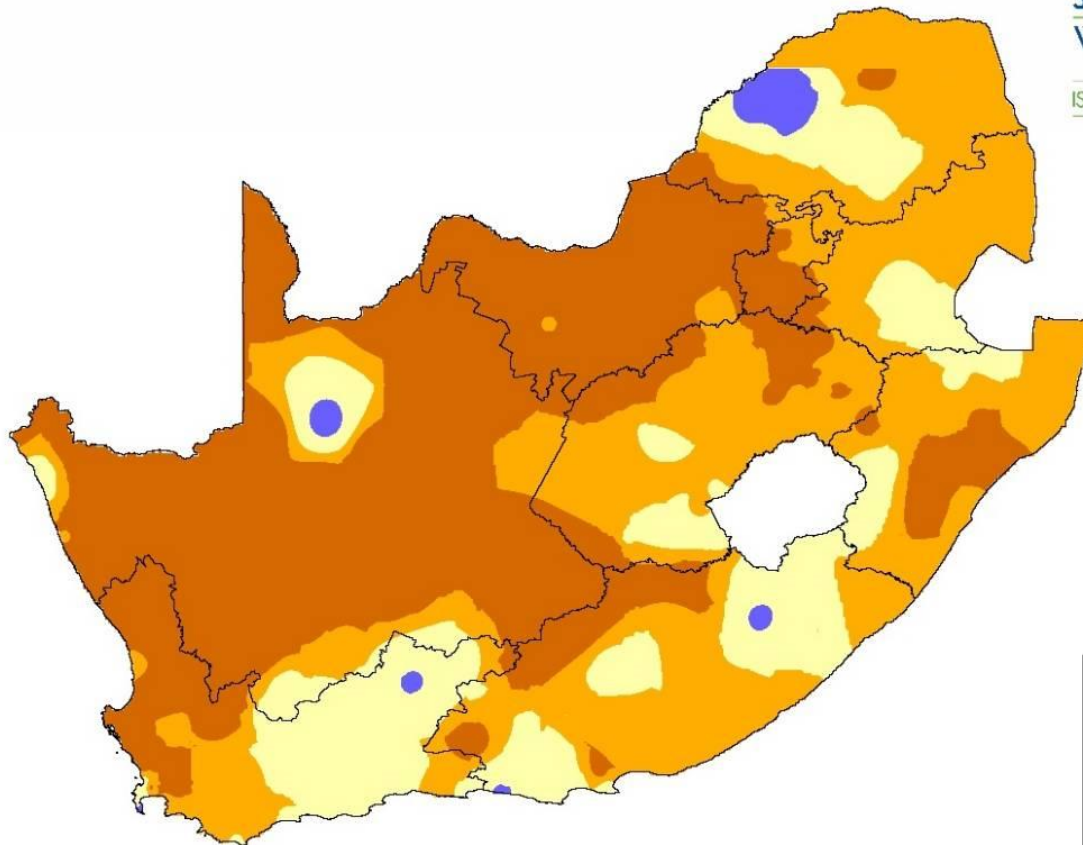
Rainfall/water resources

Percentage of Normal Rainfall for October 2015
(Based on preliminary data. Normal period 1981-2010)

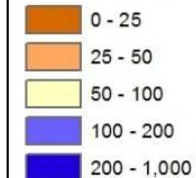


South African
Weather Service

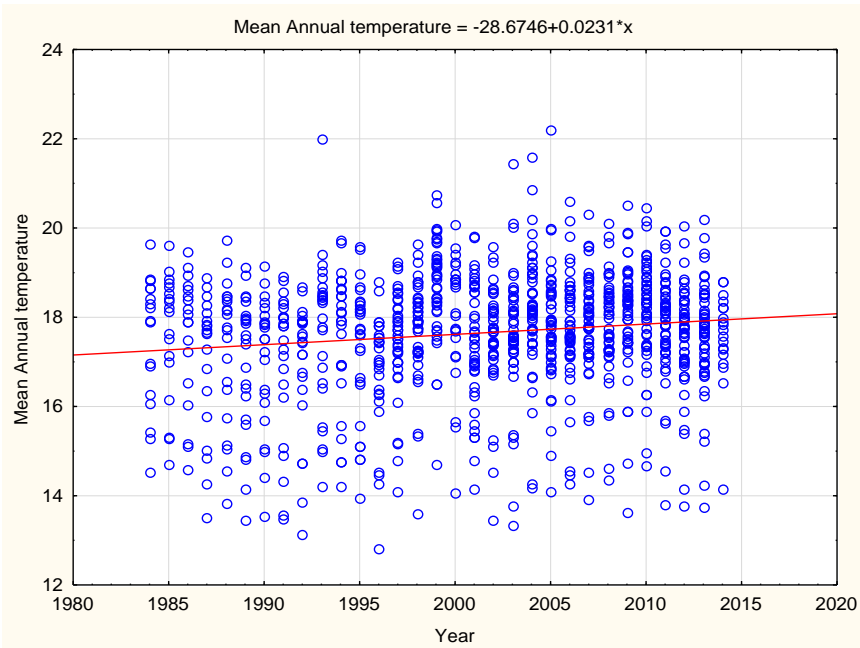
ISO 9001 Certified Organisation



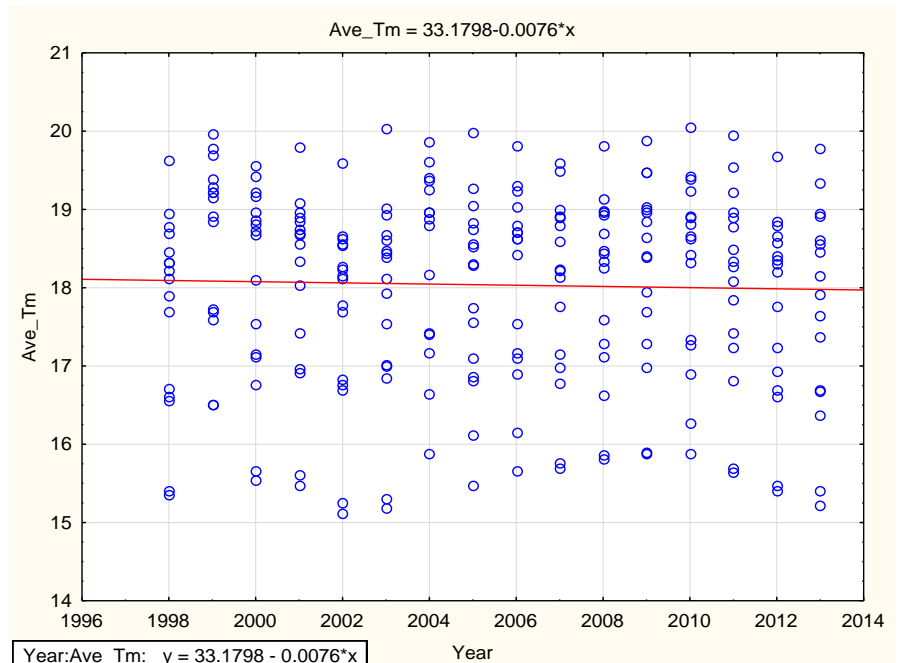
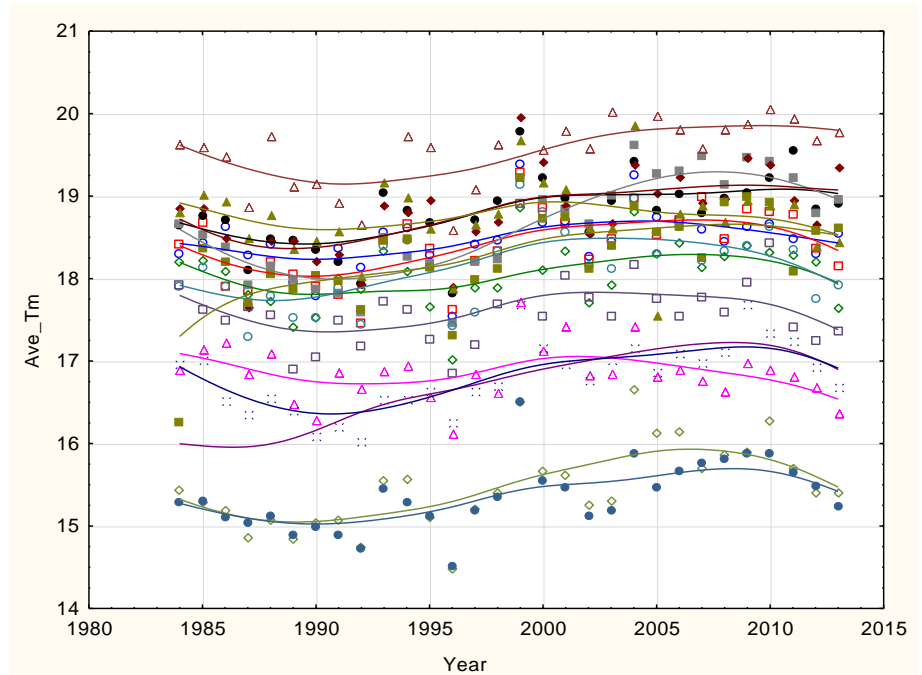
% of Normal



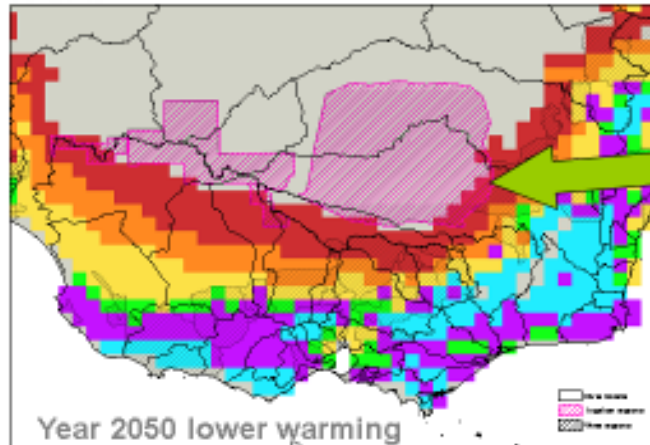
Temperature



- Upt mean annual temp 19°C
- Will take 43 years for the 42 Western cape stations to reach current Upt values.
- Will vineyards disappear then?



Adaptive challenges



What will happen behind this 'trailing margin'?

- Current infrastructure and production is concentrated in the traditional irrigation regions (~60%).
- Need to find varieties suitable for this warmer 'trailing margin'.

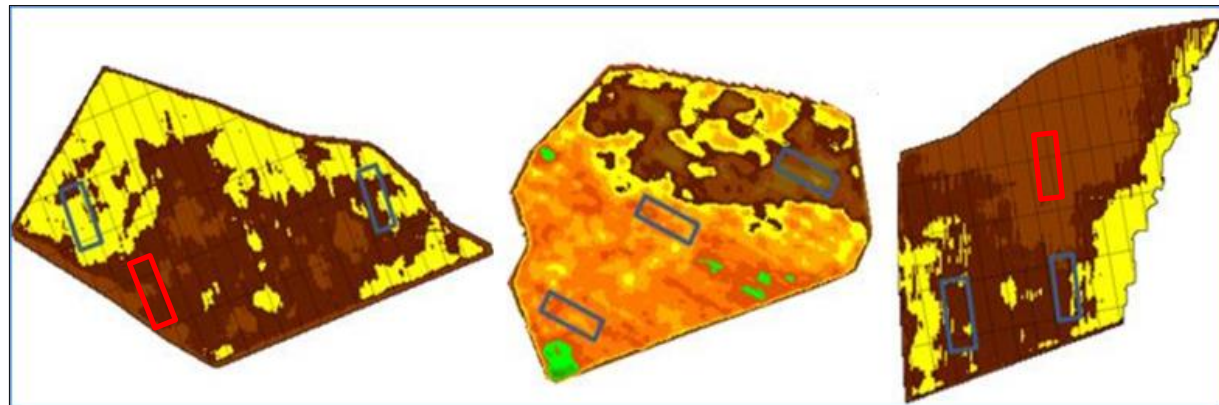
Barlow, 2010

Monthly analysis (30 yr stations)

Month	Ave T slope change	30 yr linear change	Measurement type	Rainfall per month slope	Rainfall change over period (linear)	Mean over period	% change over period	Rainfall variability between stations	Notes
January	0.058	1.7	Mean	0.25	7.5	17.4	43%	incr	
February	0.046	1.4	Mean	-0.13	-3.9	14.8	-26%	decr	
March	0.072	2.2	Max	-0.83	-24.9	21.0	-118%	decr	max temp increase, almost no min temp increase
April	0.040	1.2	Mean	-0.77	-23.1	40.9	-56%	decr	decrease in monthly rainfall limited mostly to high rainfall stations
May	0.031	0.9	Min	-0.46	-13.8	60.8	-23%		no max increase.
June	0.038	1.1	Min	0.25	7.5	77.6	10%		
July	0.063	1.9	Max	-0.68	-20.4	72.2	-28%		
August	-	-		1.17	35.1	69.1	51%		
September	-	-		-0.63	-18.9	40.5	-47%		
October	0.040	1.2	Mean	-0.13	-3.9	32.4	-12%		split to warmer max in 1997
November	-	-		1.2	36	31.1	116%	incr	nb
December	0.055	1.7	Mean	-0.49	-14.7	21.8	-68%	decr	

Meso scale

- Weather stations /TERVICLIM
- Remote sensing layers
- Fruitlook (ET, biomass, NDVI)
- Block records (cultivar, rootstock, yield etc.)
- Soil maps
- Phenology monitoring
- Growth monitoring
- Ripening monitoring

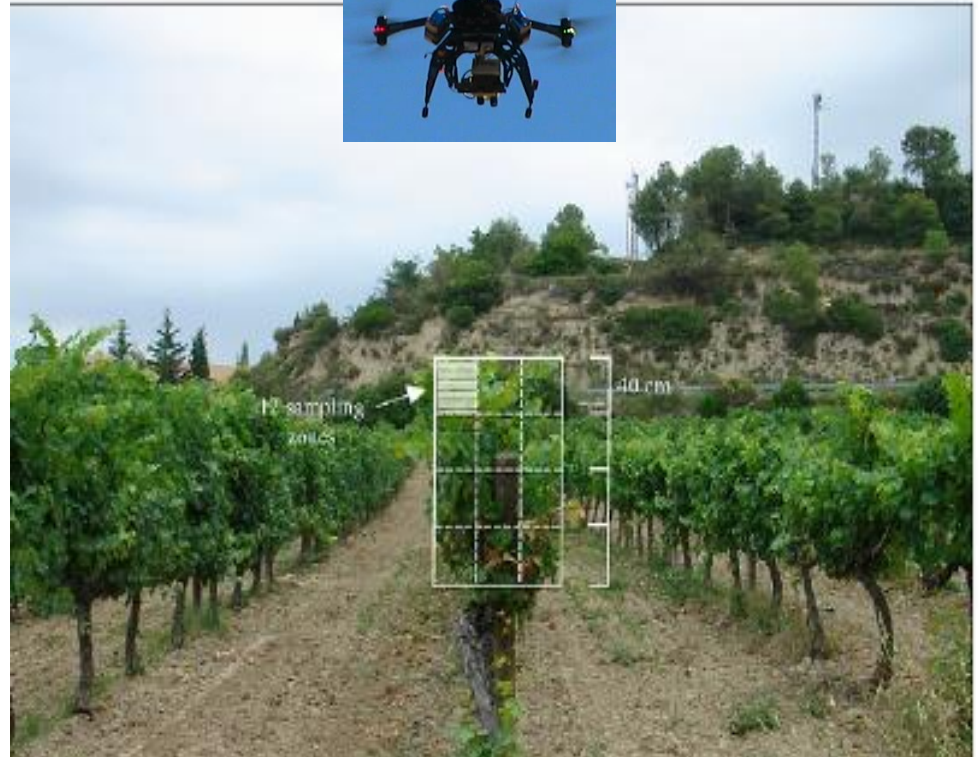


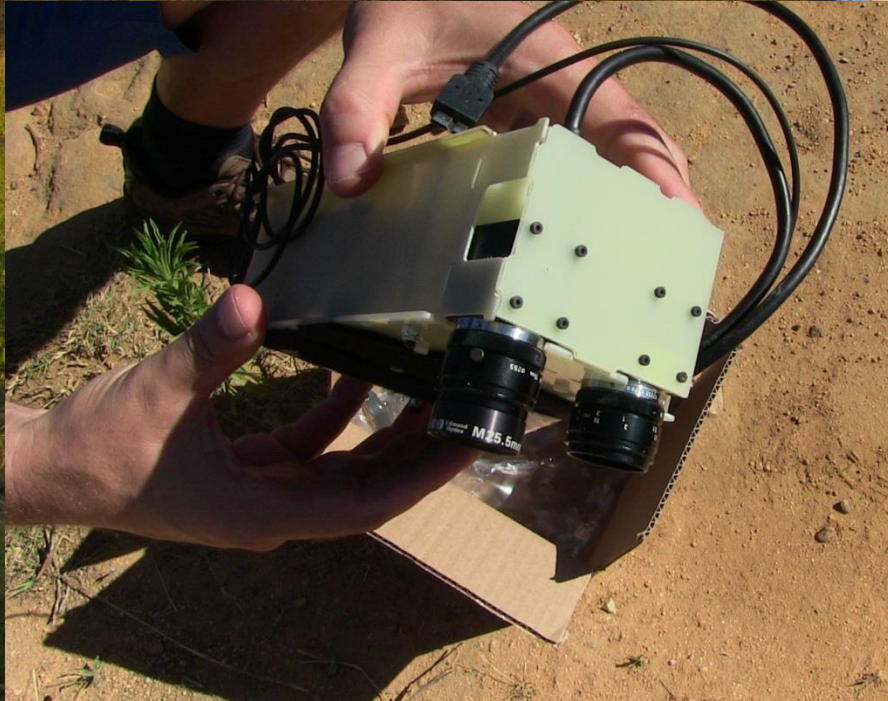
Micro scale

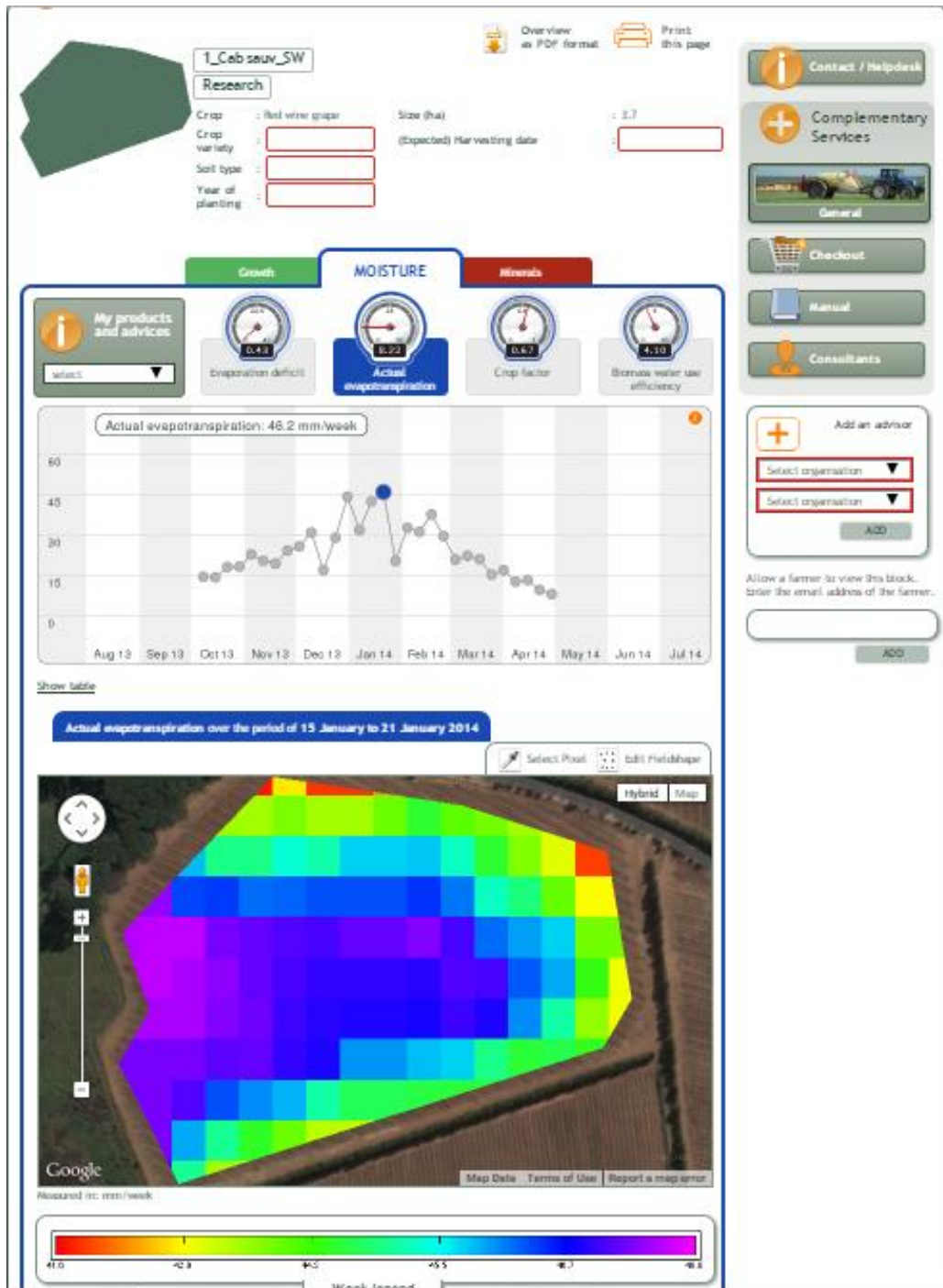
- Wireless sensor network (soil temp, canopy temp, RH)
- Contextualising each grapevine within its climatic regime over time with robotics (phenology, canopy development, ripening)
- LIDAR, thermal, EM, optics.
- 1st prototype tested
- 2nd end 2016 – autonomous.
- “Low-cost robotics”



“The Dassie”







Change in time



Change in space



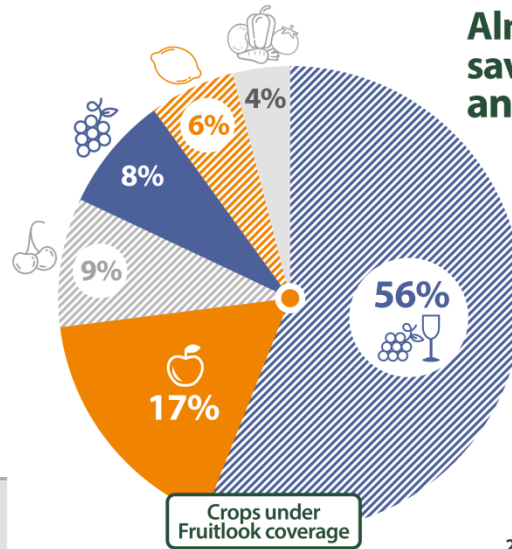
Growth (biomass), ET per week, NDVI index.

Weekly data provided during the full growing season

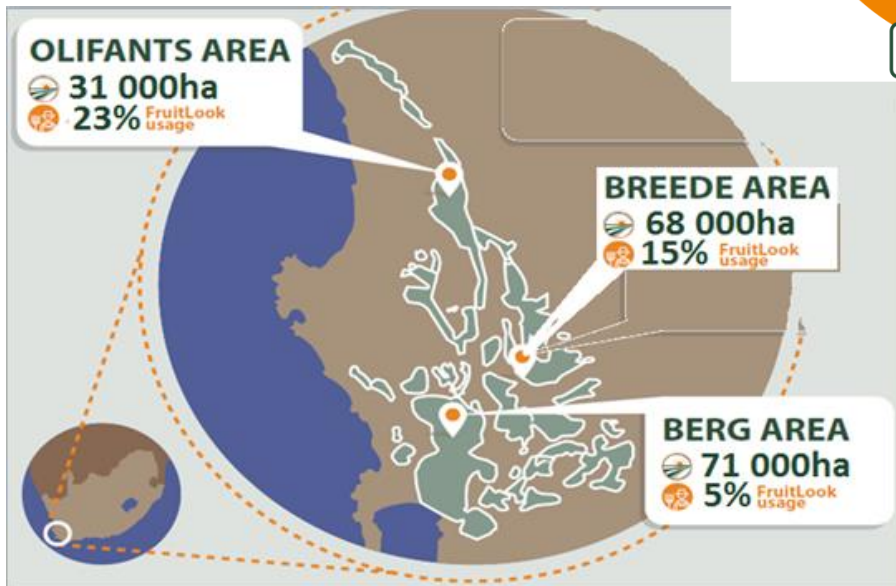
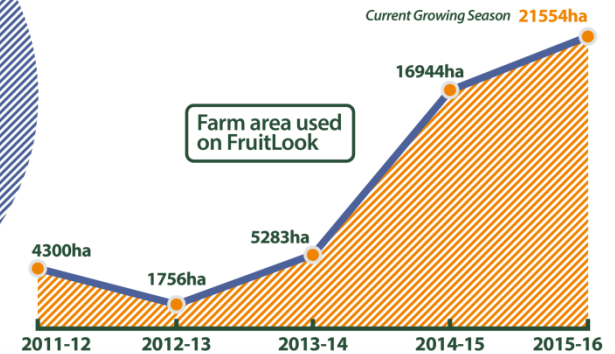
Free to use (government funded until 2016)

Data components are created without any input from the farmer!

FruitLook Status Quo & Future

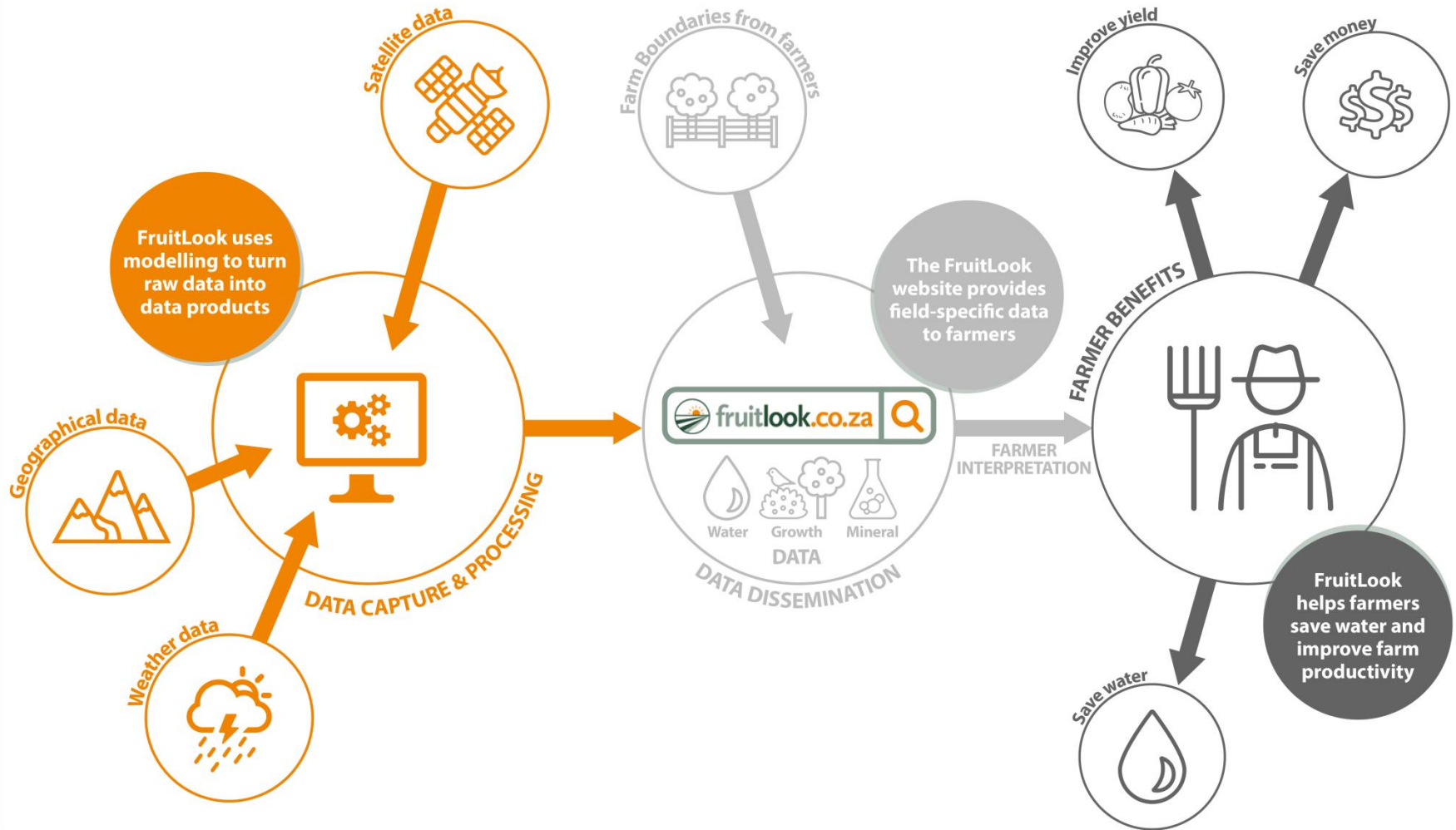


Almost half of FruitLook users save **MORE** than 10% water and 1 in 10 saves 30%



FruitLook covers more than **170 000ha** of which **21 000ha** is in **ACTIVE USE**

fruitlook.co.za is a tool that helps farmers improve crop productivity and water use by turning raw data into useful information



Acknowledgements

- Winetech/THRIP funding
- ARC-ISCW, Hortec, SAWS for weather data, TERVICLIM collaboration
- Colleagues at SU