CLIMATE CHANGE

Do We Need to be Concerned in Viticulture

Some Things We Have To Consider

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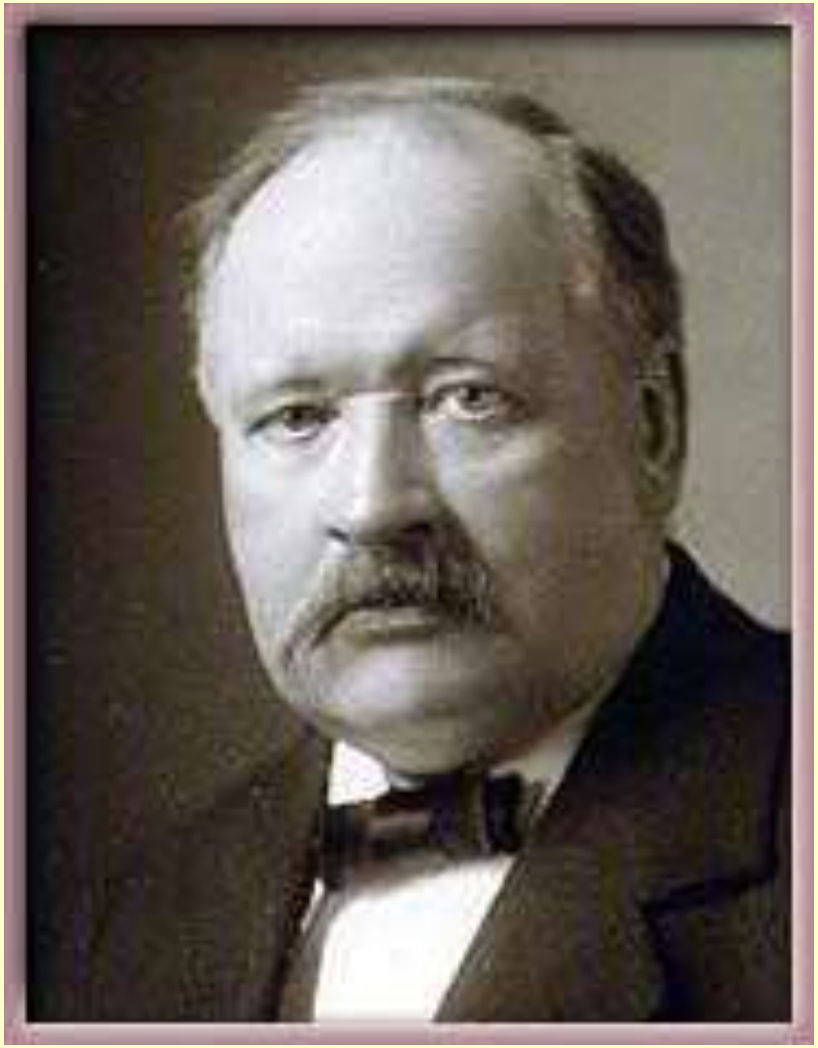
Adapt or fry: climate change is upon us

South Africa's agricultural sector will not escape the consequences and economic impacts of climate change.

1. We Have To Consider History

Let's start with some History !



Svante ARRHENIUS

1859 born 15 February

1884 PhD in Physics 4th Class

1896 First scientist to calculate how changes in CO_2 through burning fossil fuels could alter surface temperatures through the Greenhouse Effect

1903 Nobel Prize for Chemistry

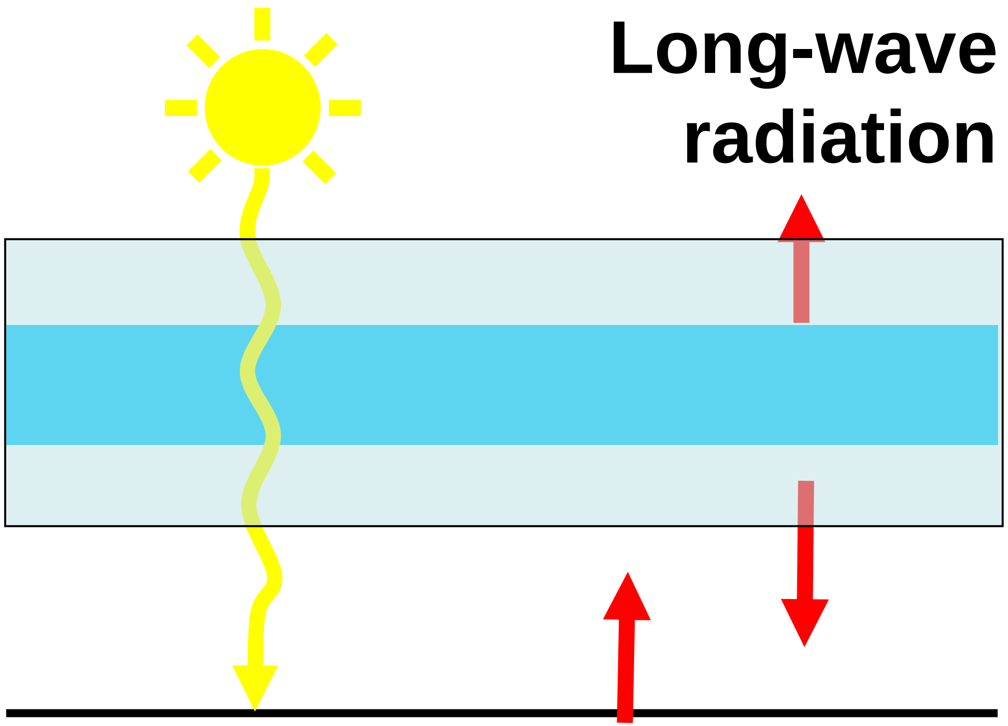
2. So, What is This Climate Change All About?

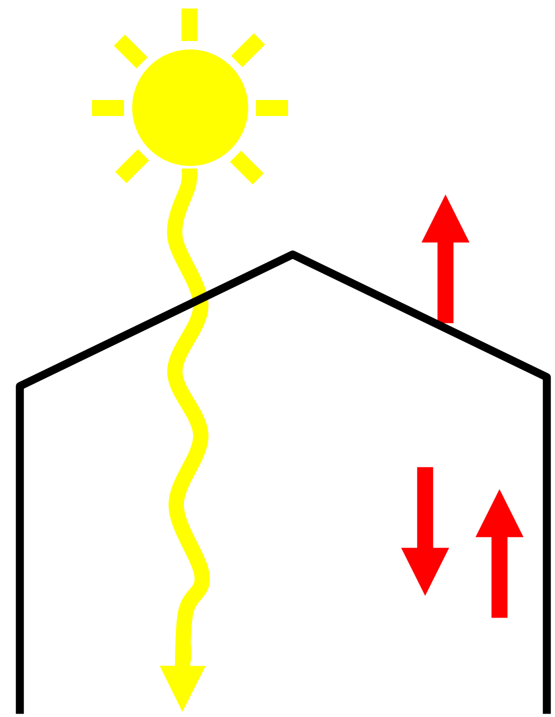
We are Polluting the Atmosphere with Greenhouse Gases (CO_2, N_2O, CH_4)

The Enhanced Greenhouse Effect

Solar radiation

Long-wave radiation



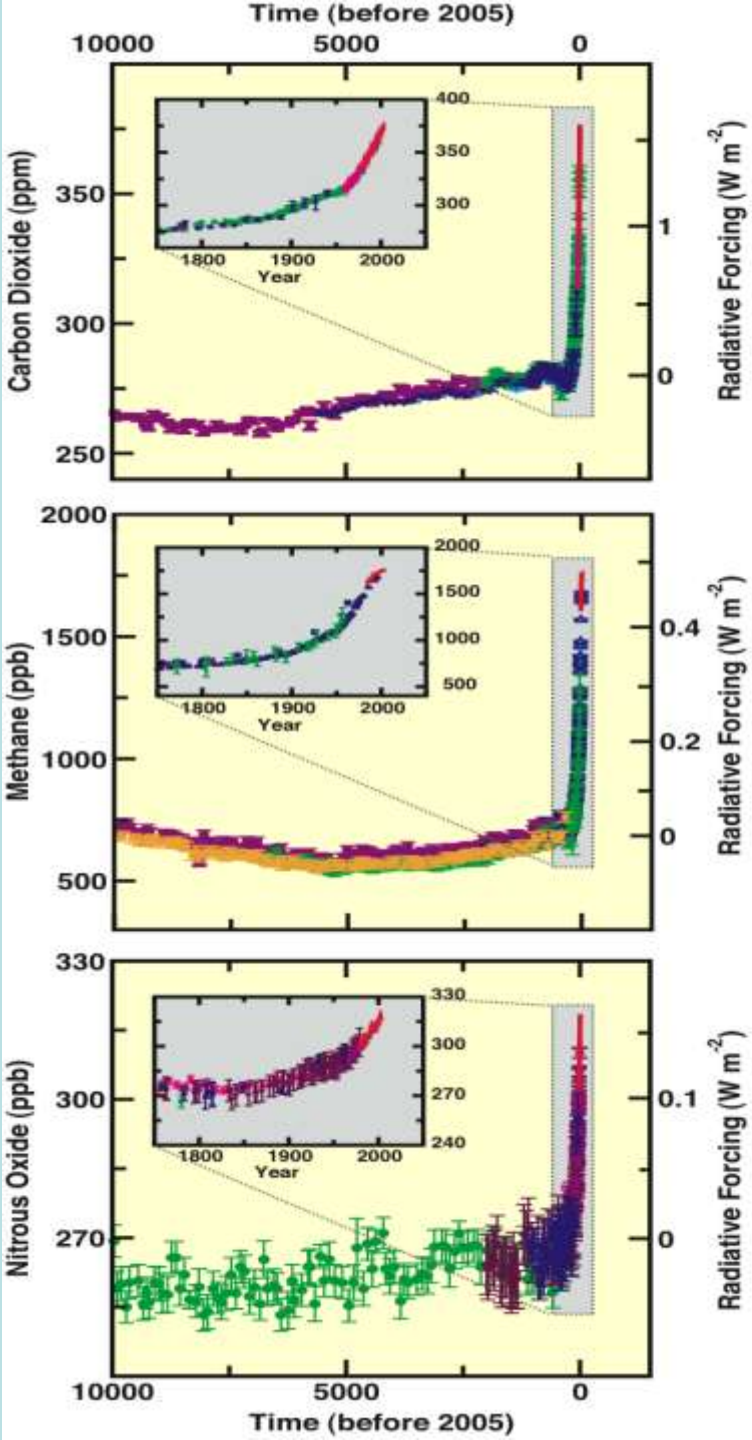


3. So, What Are We Already Observing ?

CO_2

CH_4

N_2O



The Result…1

Considerable changes have occurred since the industrial revolution

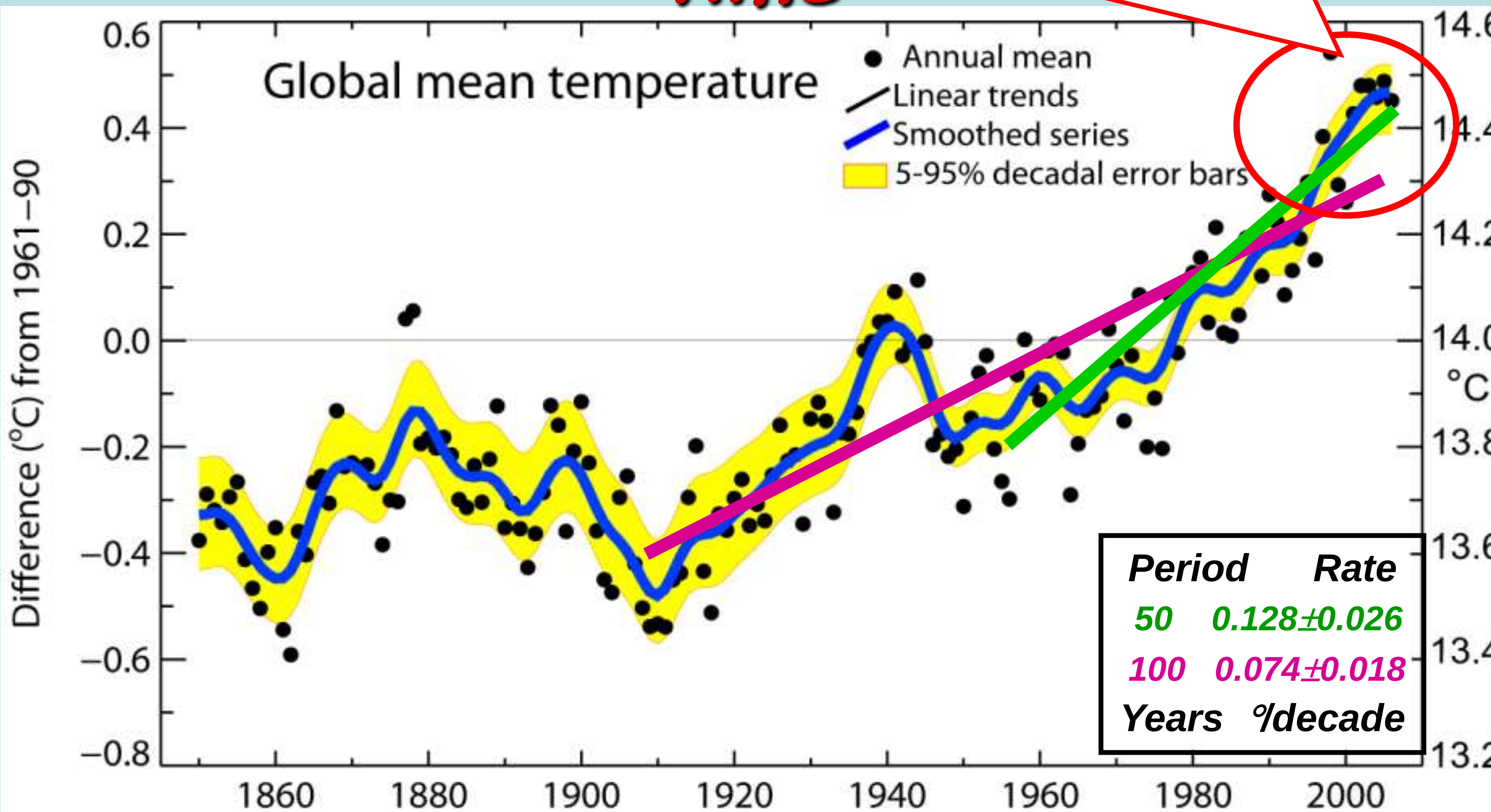
CO_2 radiative forcing has increased by ~ 20% in past 10 years

IPCC Figure SPM-1

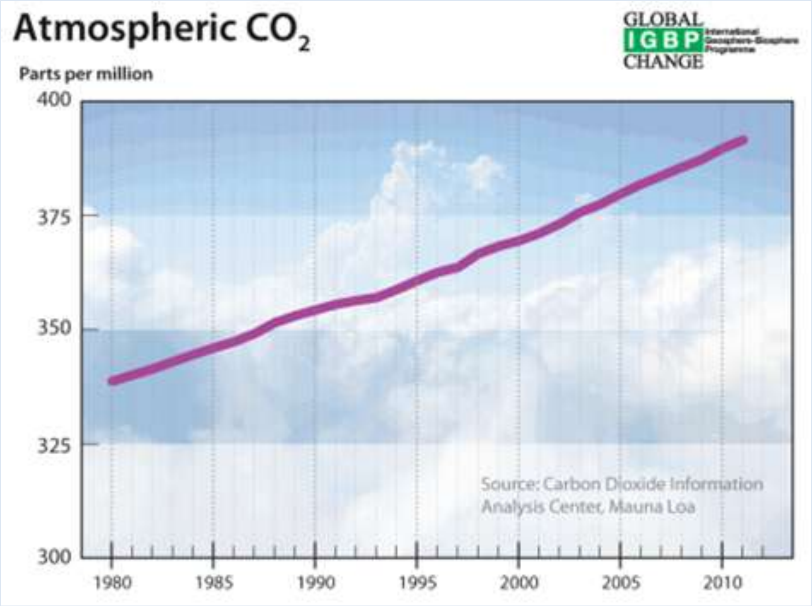
Result 2. Global mean temperatures

Warmest 17 years to 2011

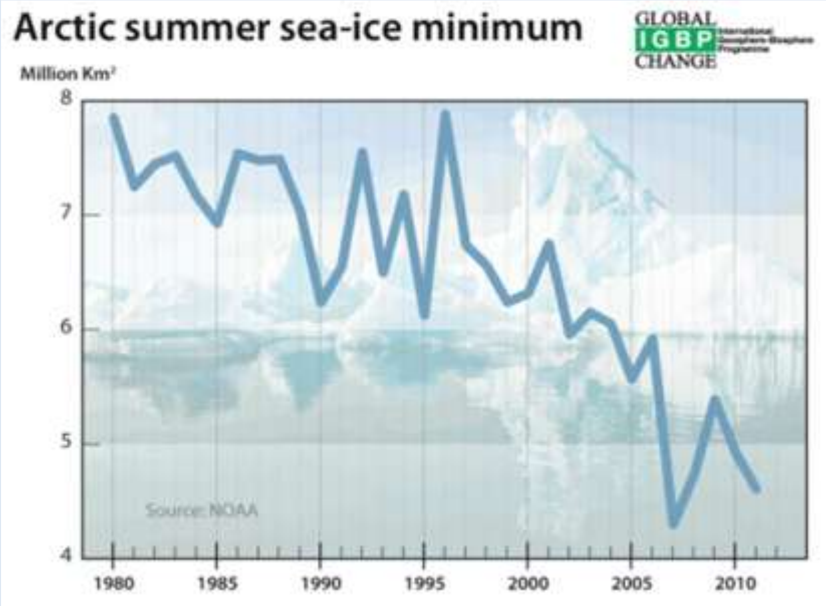
2010, 2007, 1998, 2005, 2003, 2002, 2004, 2006, 2008, 2011, 2001, 1997, 1995, 2009, 1999, 1990, 2000

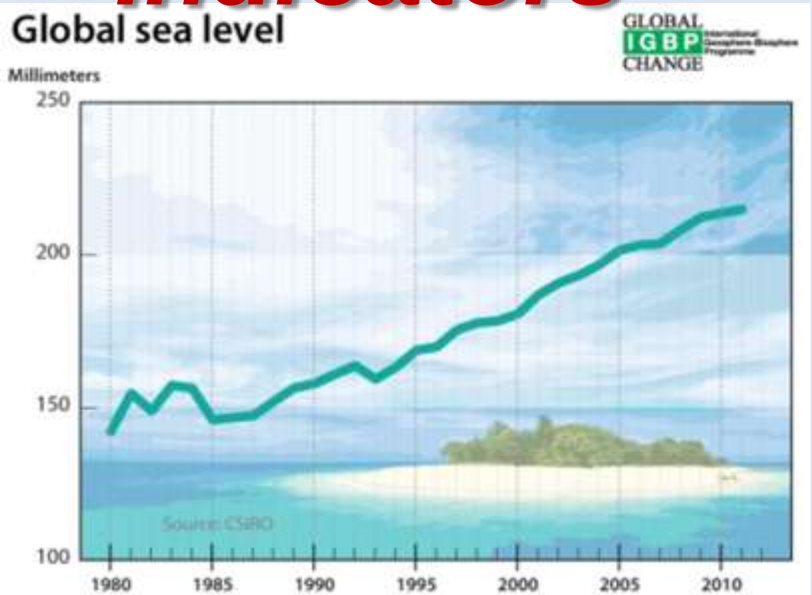


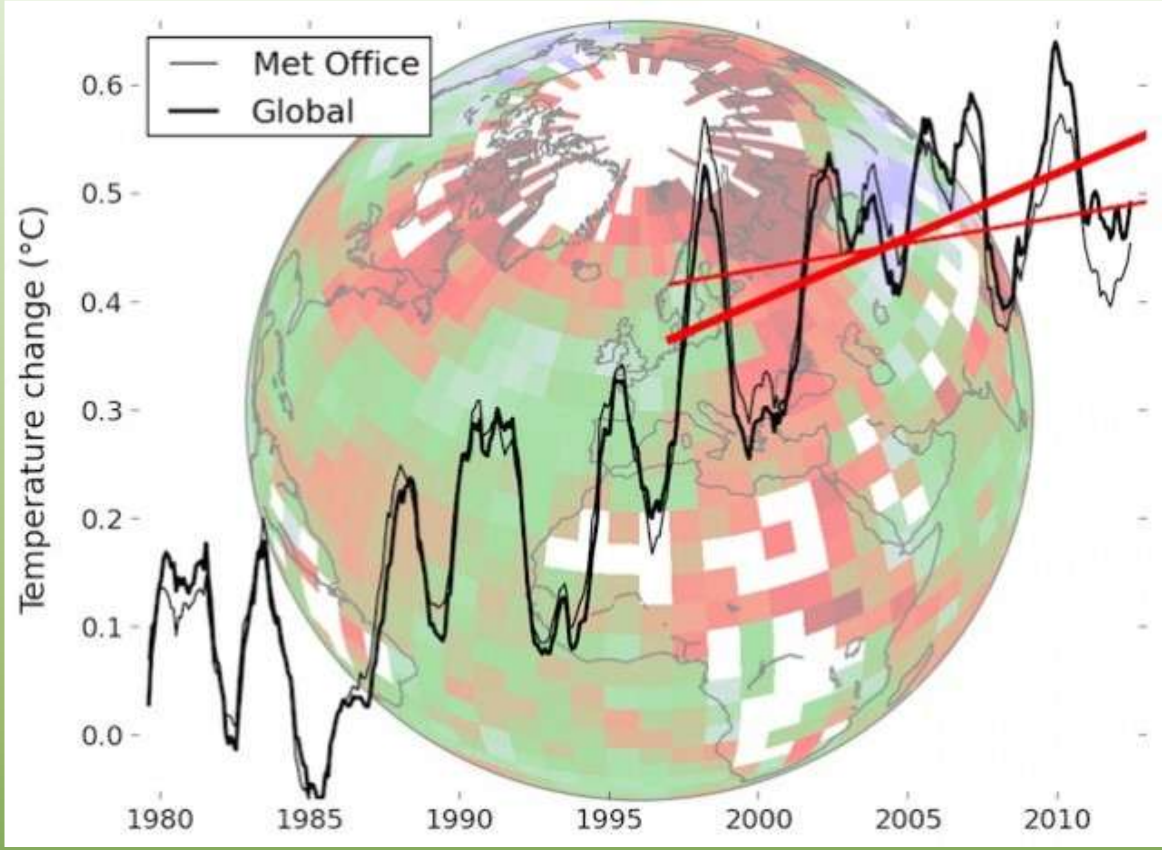
IPCC TS: Meehl



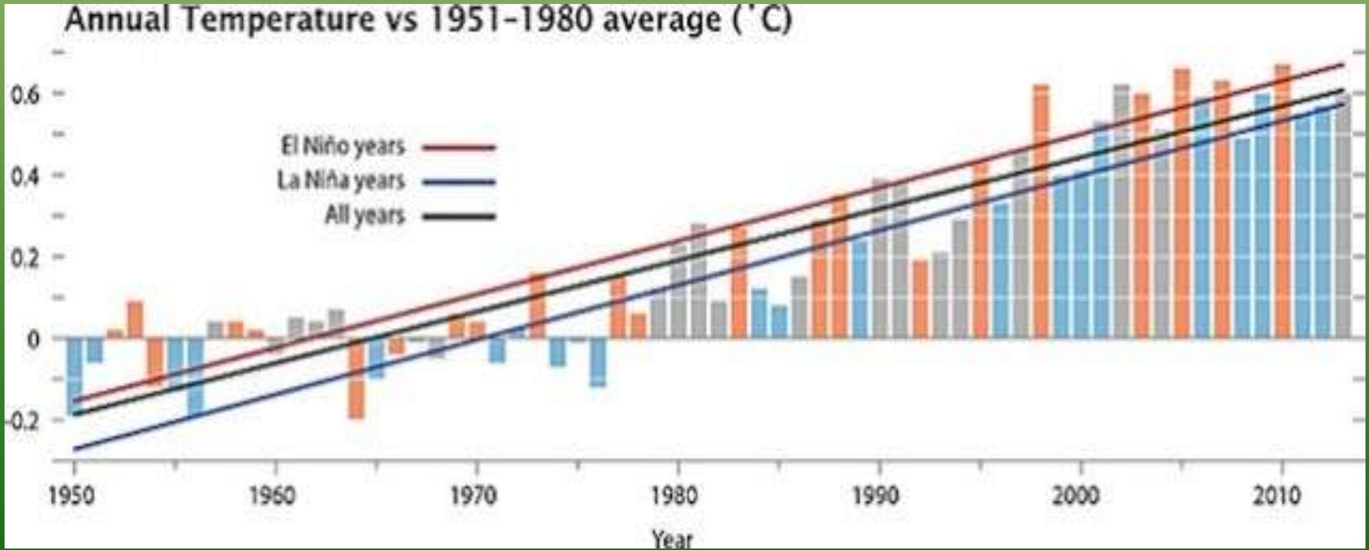
Science is now Monitoring CC with a Composite Index, like a Stock Exchange Index, Made up of Multiple Indicators





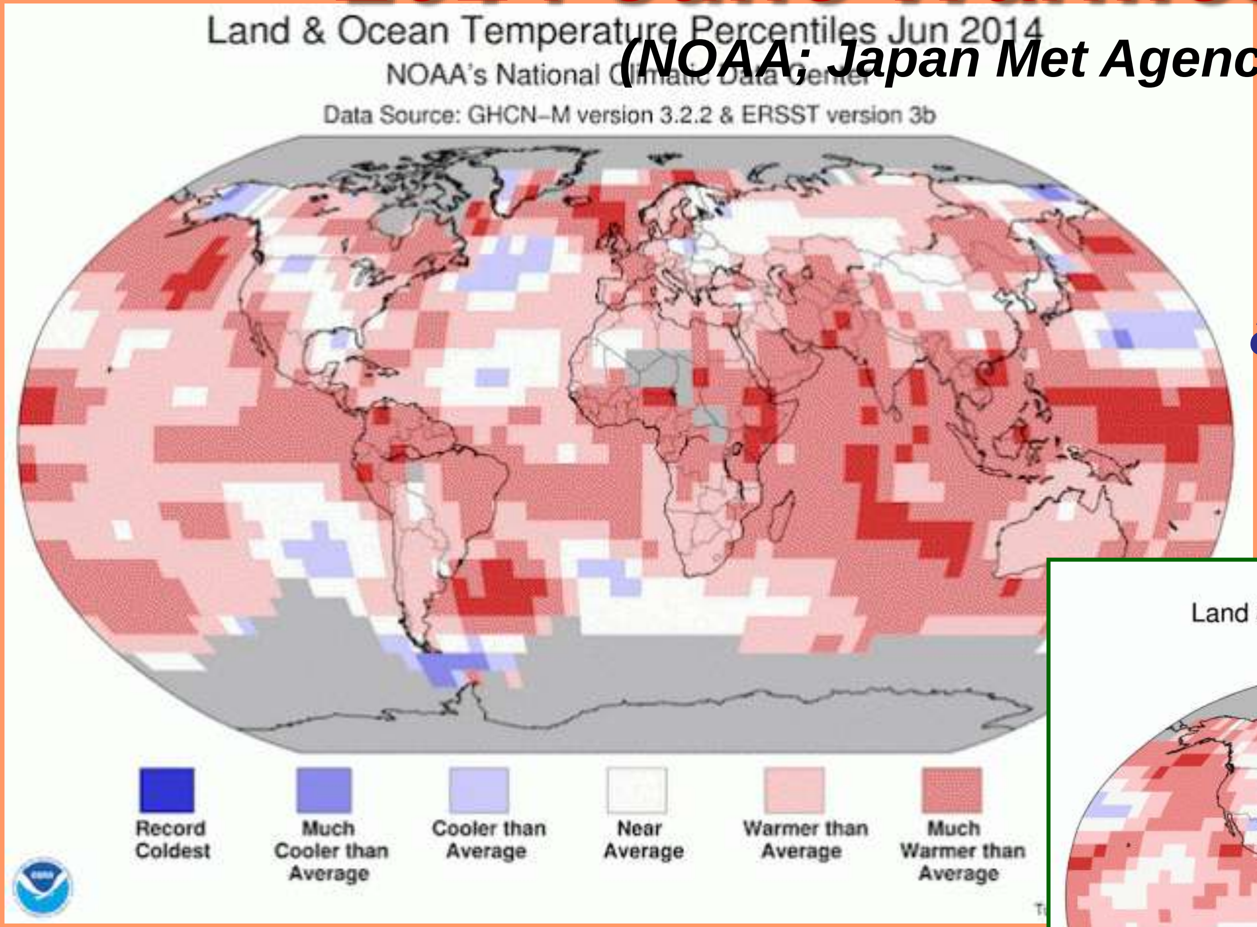


Results From More Recent (2014) Studies

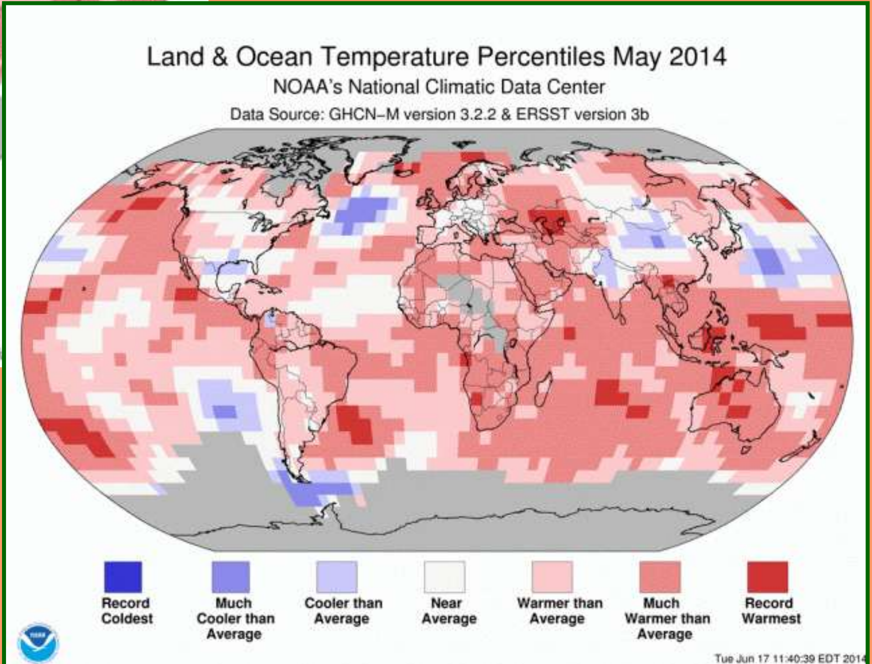


Results from 23 June 2014: 2014 June Warmest Ever

(NOAA; Japan Met Agency)

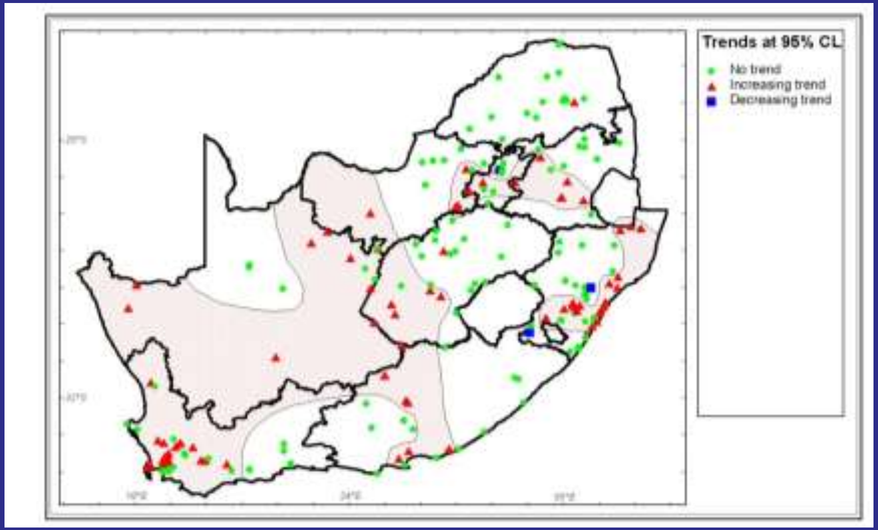


The last below average June was June, 1976

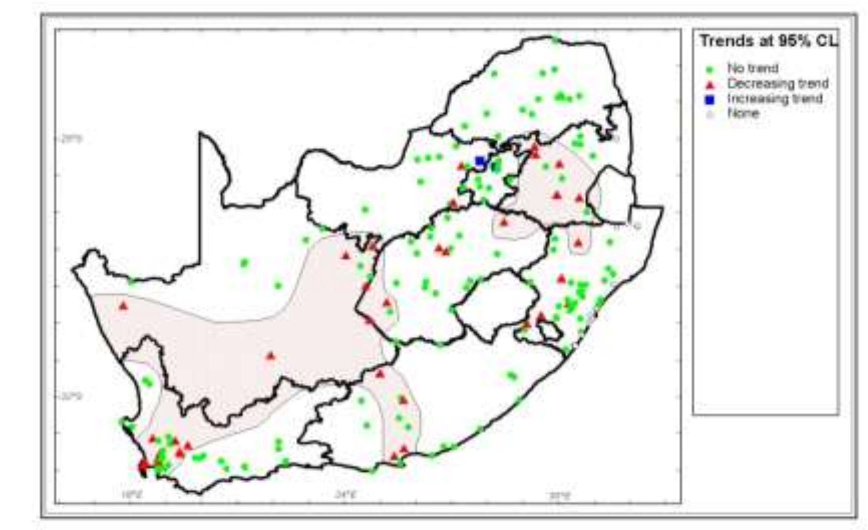


Every May in the past 25 years has been warmer than the long term global average

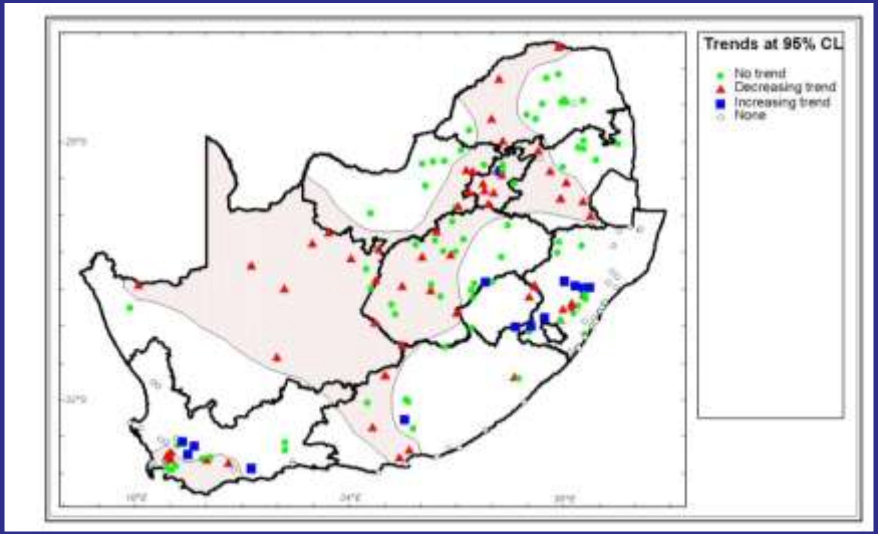
Observed Trends Over SA 1950 - 2000



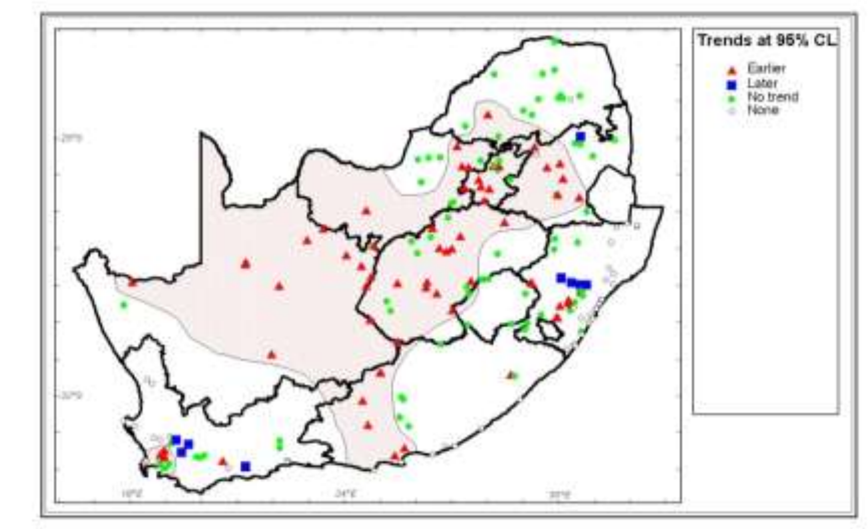
Winter Heat Units Increasing



May-Sept Chill Units Decreasing



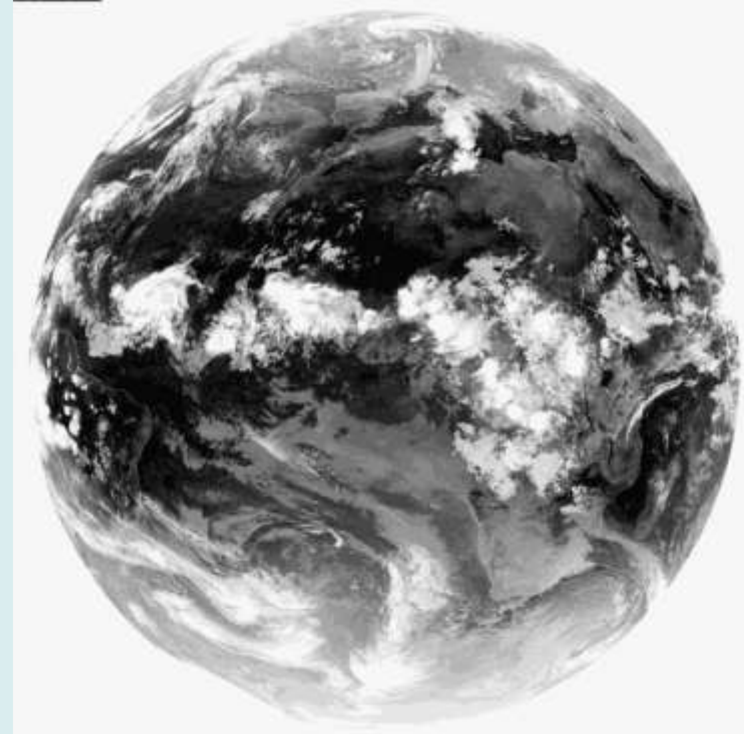
No. of Frost Occurrences Decreasing

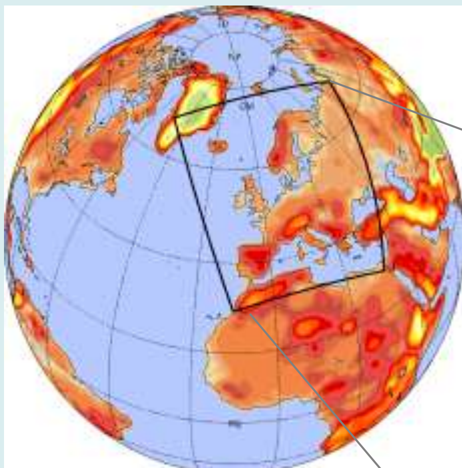


Date of Last Frost is Earlier

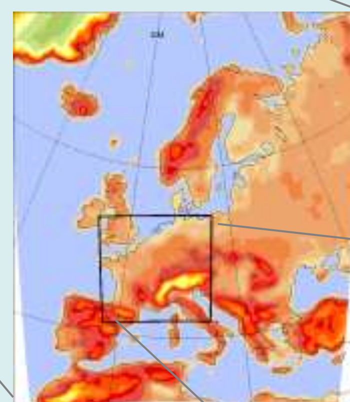
4. We Have To Consider The Local Context

Downscaling Global Climate Models

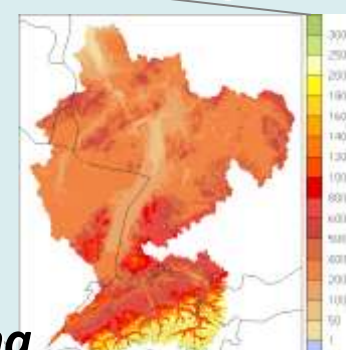




Global Climate Models (GCMs) (e.g. HadCM3, ECHAM5, ~200 km)



Regional Climate Models (RCMs) or statistical downscaling (~25 km)



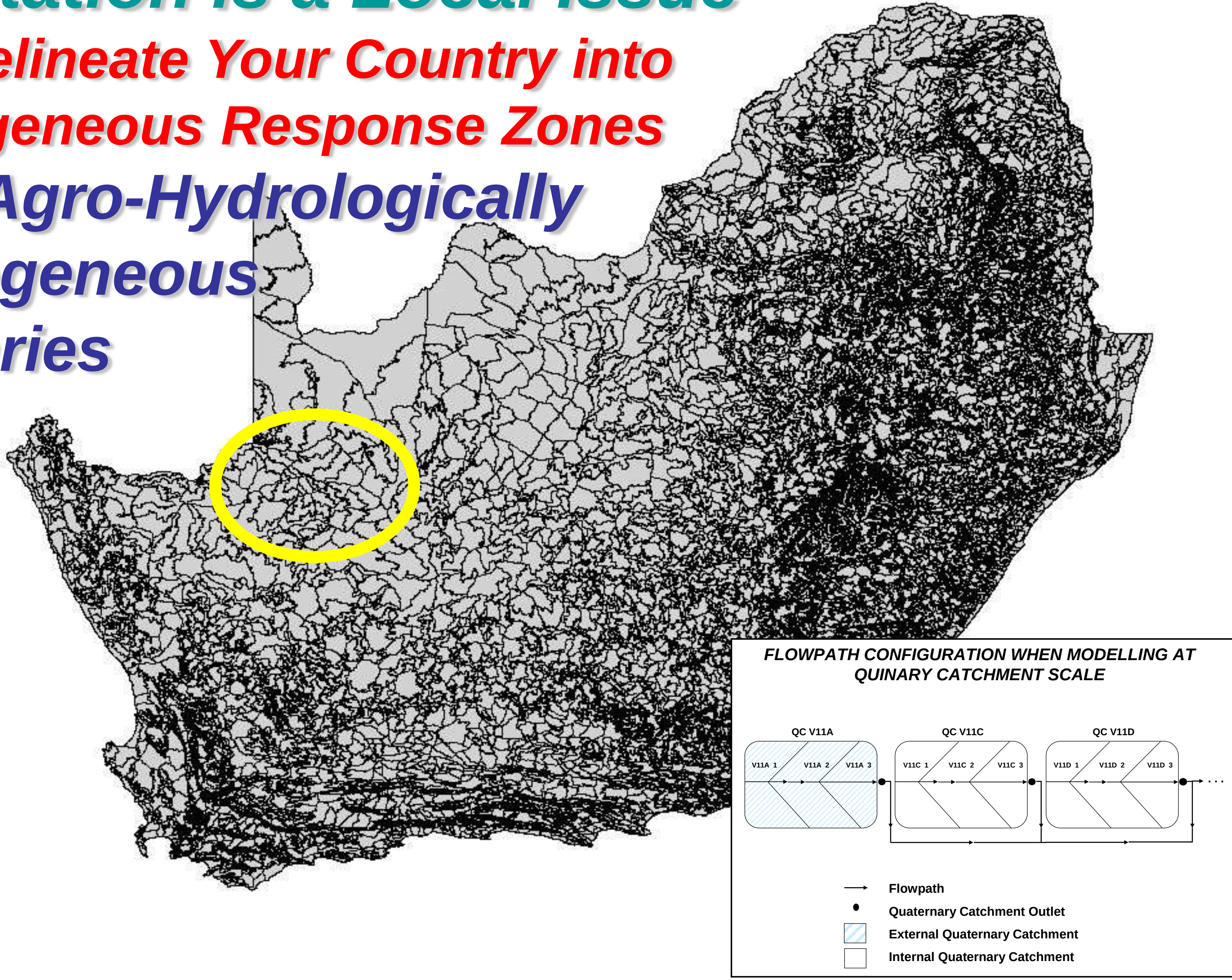
Impact Models (~5 km)

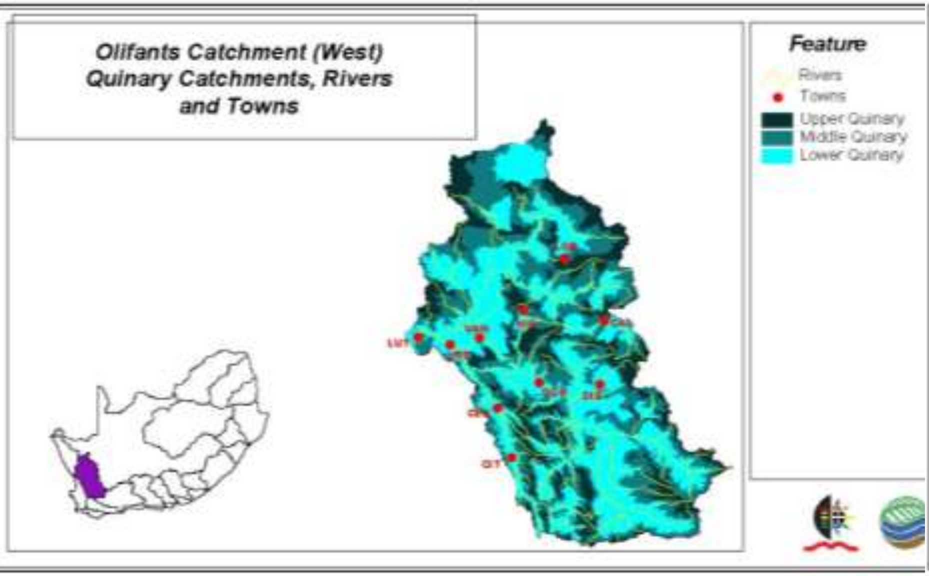
Hewitson, 2010

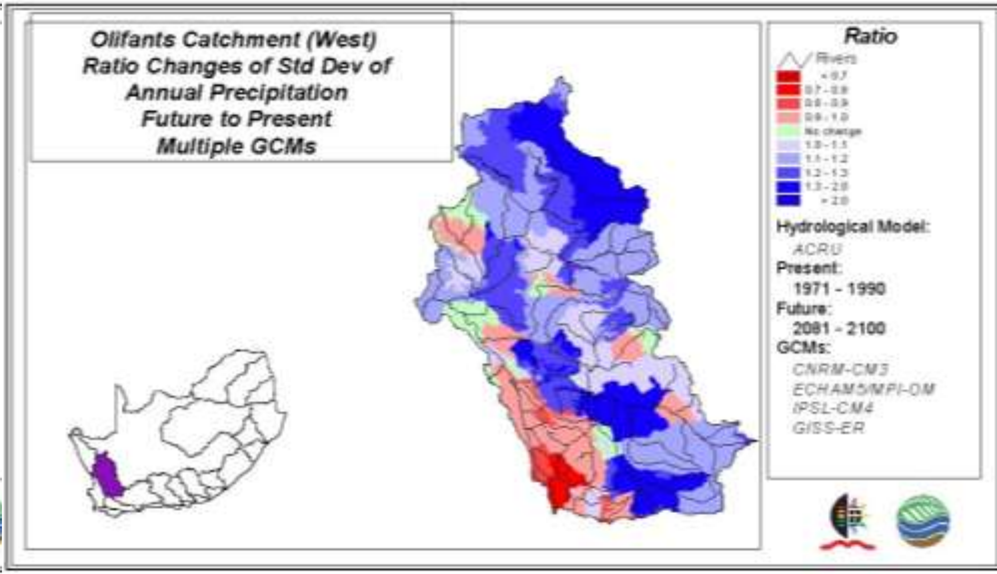
Adaptation is a Local Issue

Sub-Delineate Your Country into Homogeneous Response Zones

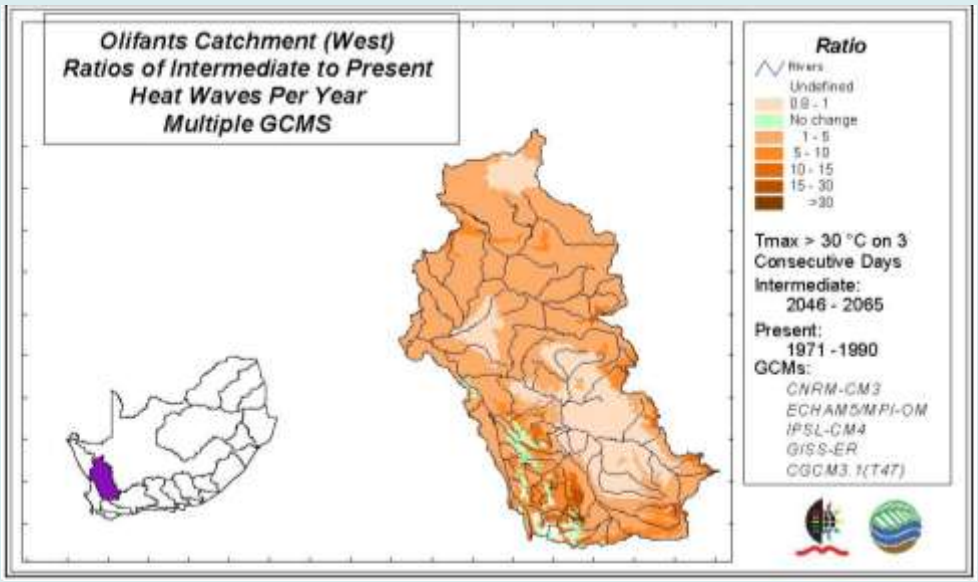
5838 Agro-Hydrologically Homogeneous Quinaries



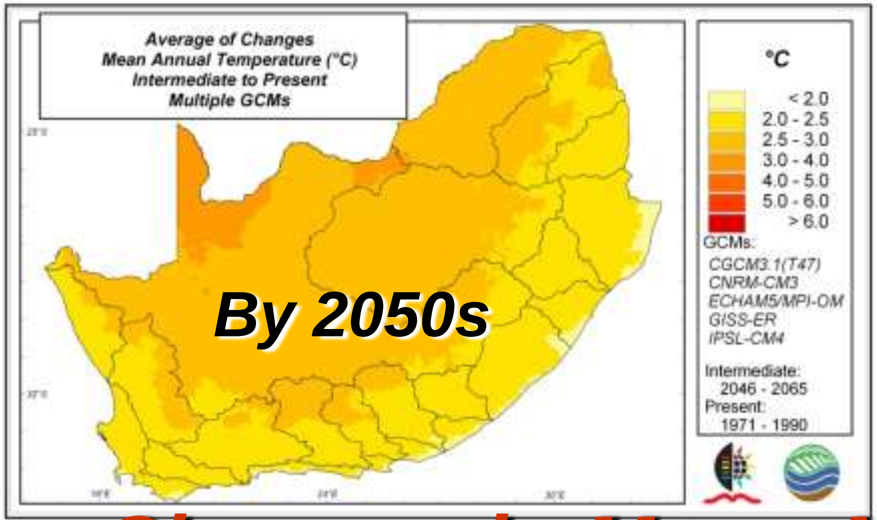


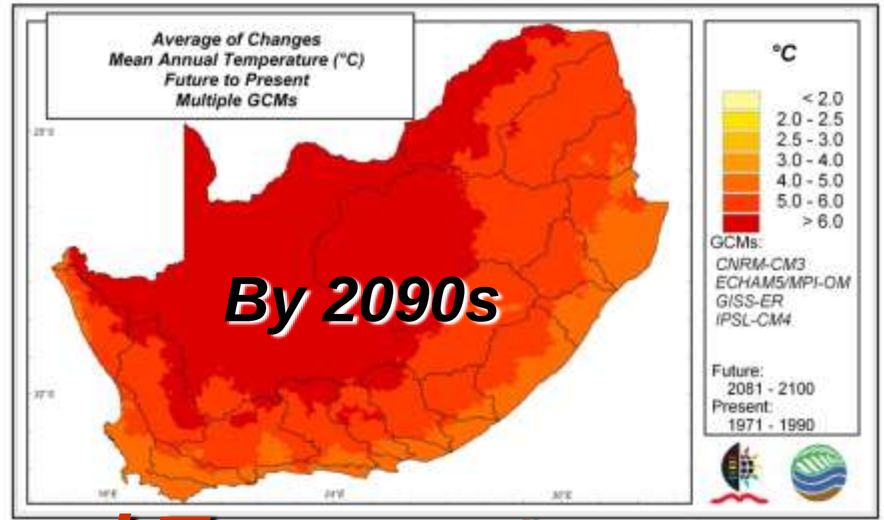


So, We Can Really Zoom In



5. So, Let's Consider Some "Pushes" of Climate Change Impacts, i.e. Things that Happen Gradually as Averages Change

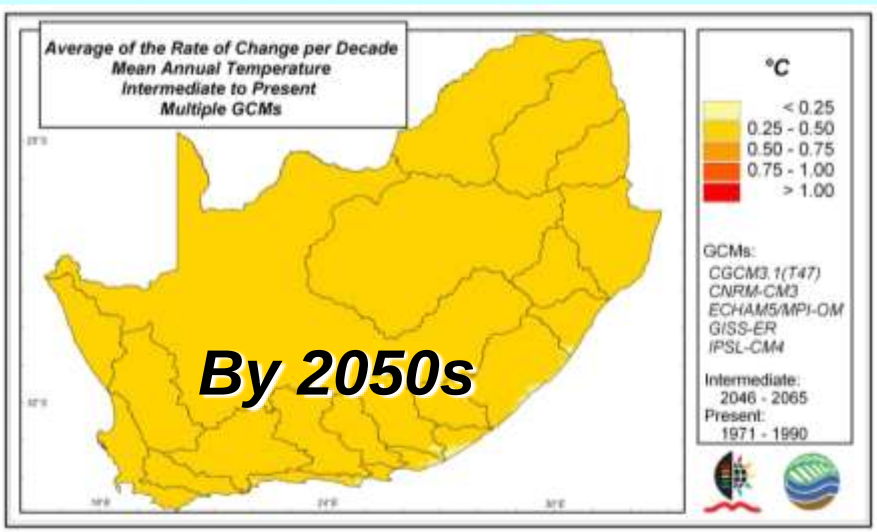


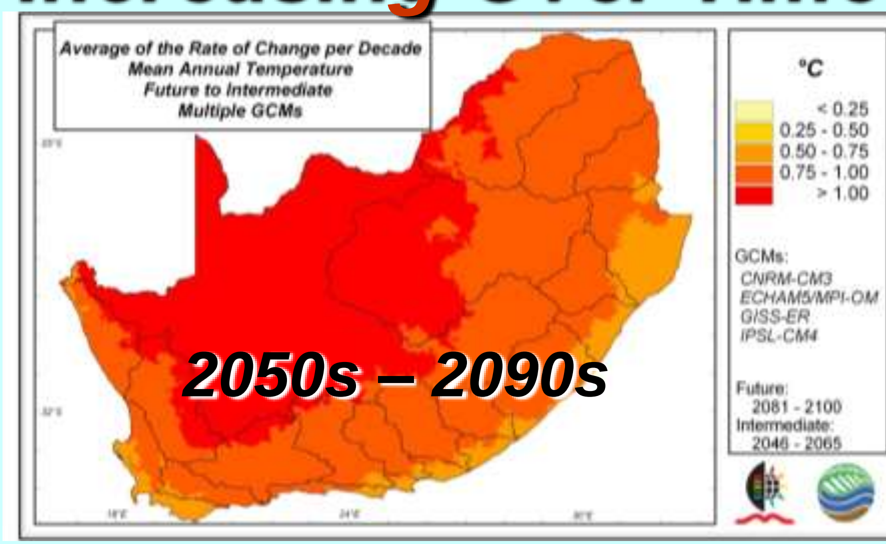


Changes in Mean Annual Temperature are Projected to be Significant

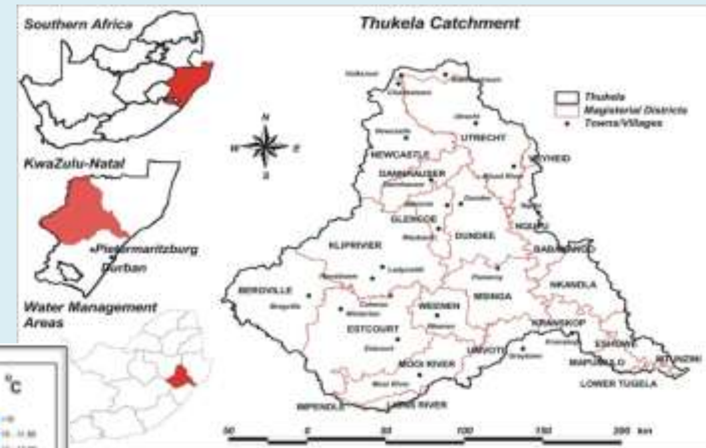
What are the consequences for SA's Hort Industry?

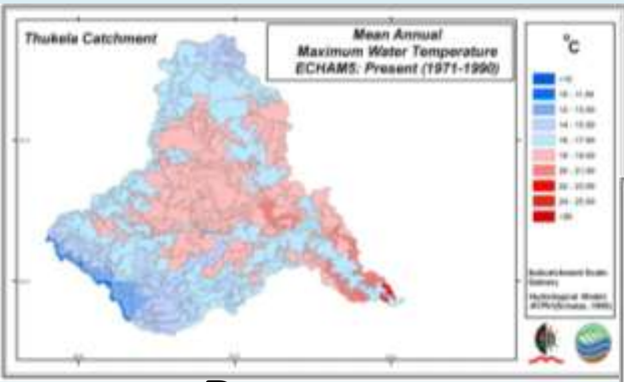
With the Rate of Change Increasing Over Time



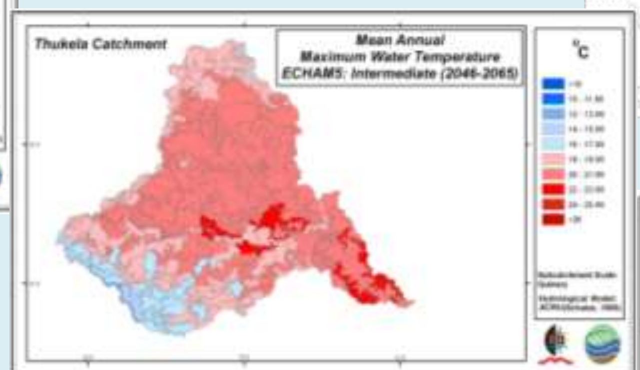


Water Temperatures are Projected to Increase Significantly with CC, with Health, Irrigation, Power Cooling & Aquatic Environmental Consequences

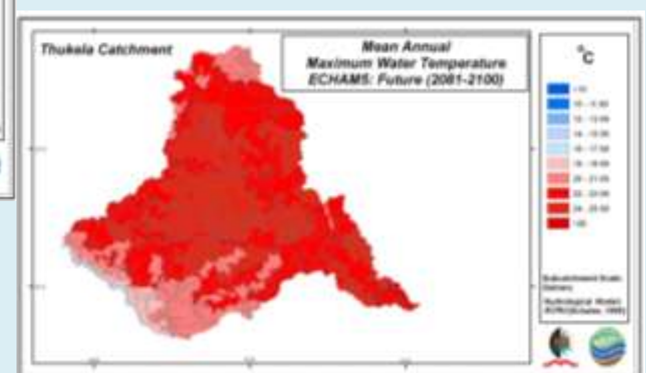




Present
1971 - 1990



Intermediate Future
2046 - 2065

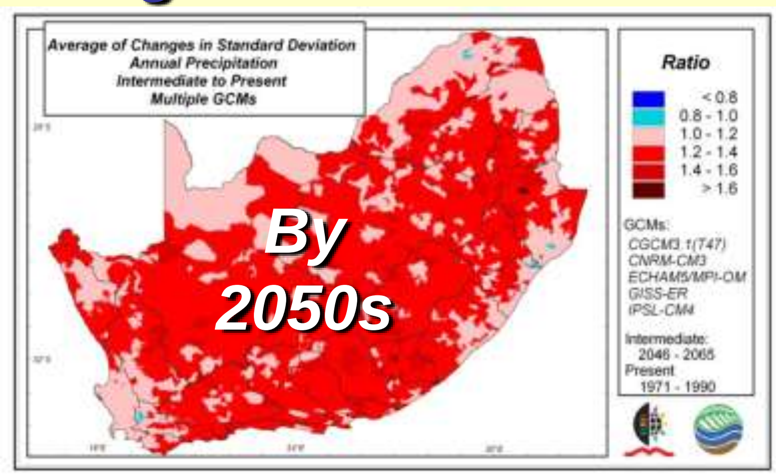


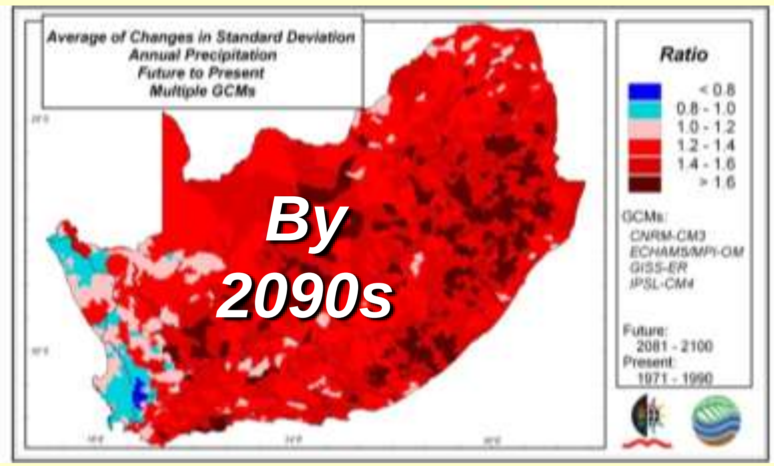
More Distant Future
2081 - 2100

Barichievy & Schulze, 2010

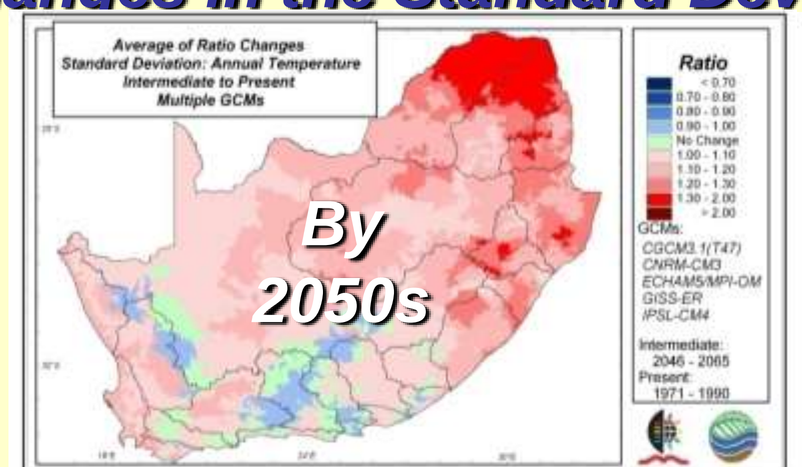
Future Year-to-Year Variability will Change…the Case of Projected Rainfall and Temperature over SA

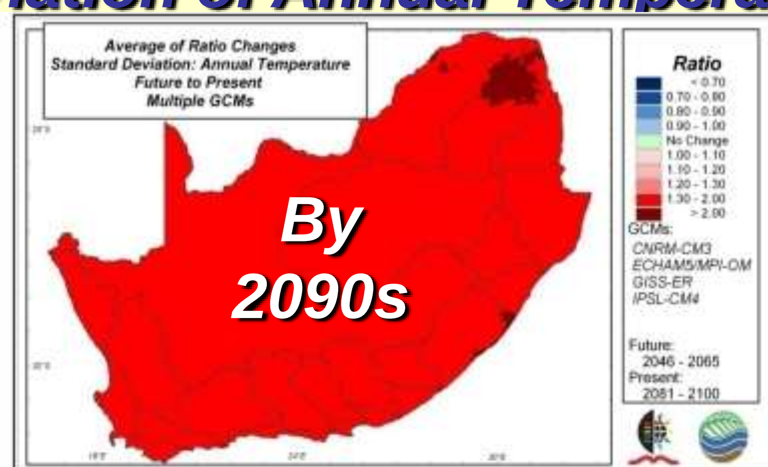
Changes in the Standard Deviation of Annual Rainfall





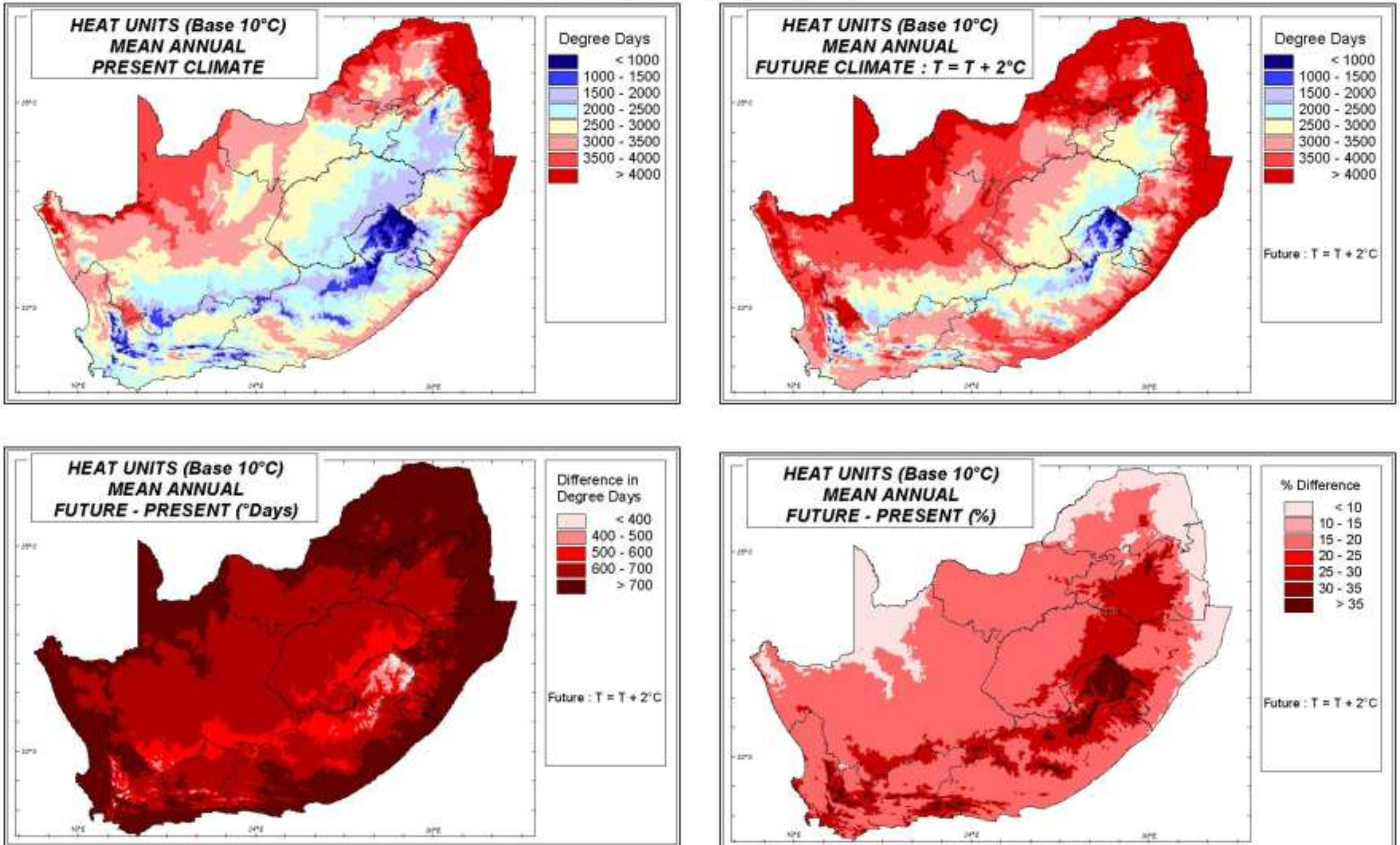
Changes in the Standard Deviation of Annual Temperature





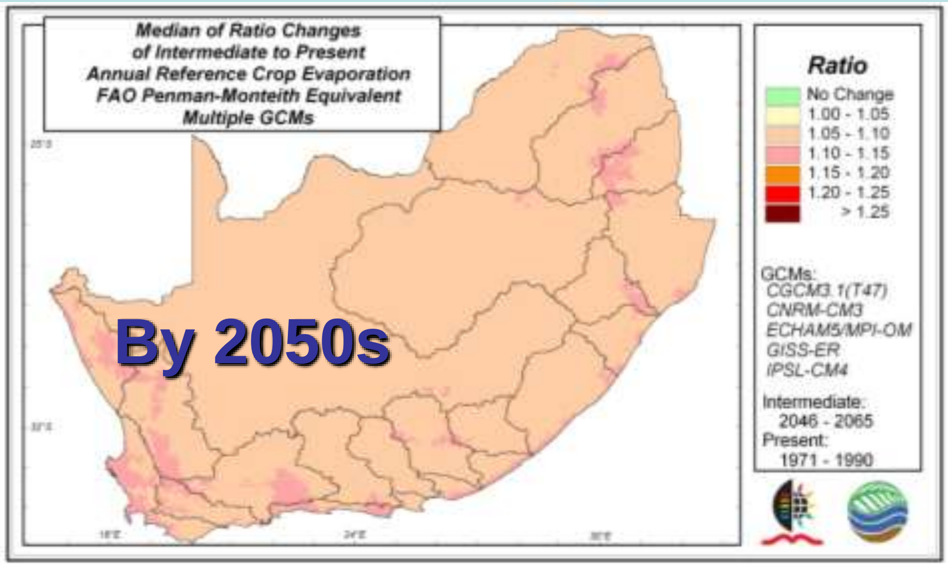
and what are the consequences for food security?

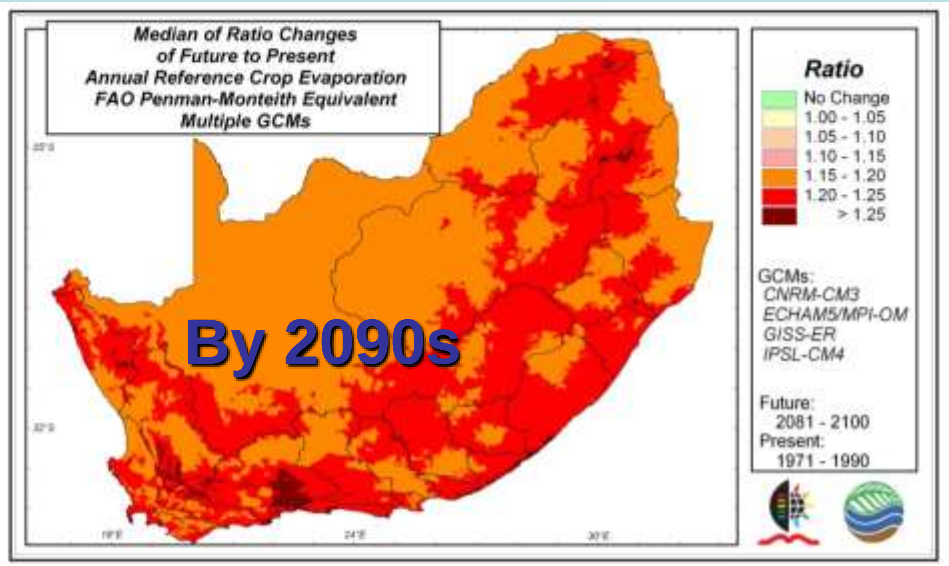
Heat Units (° Days) are Projected to Increase



What are the consequences…?

Evaporation from Dams and the Soil will Increase

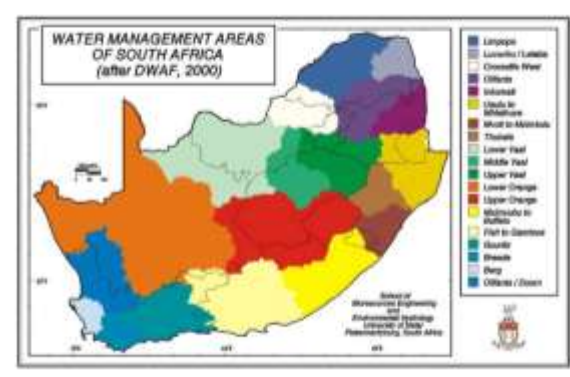




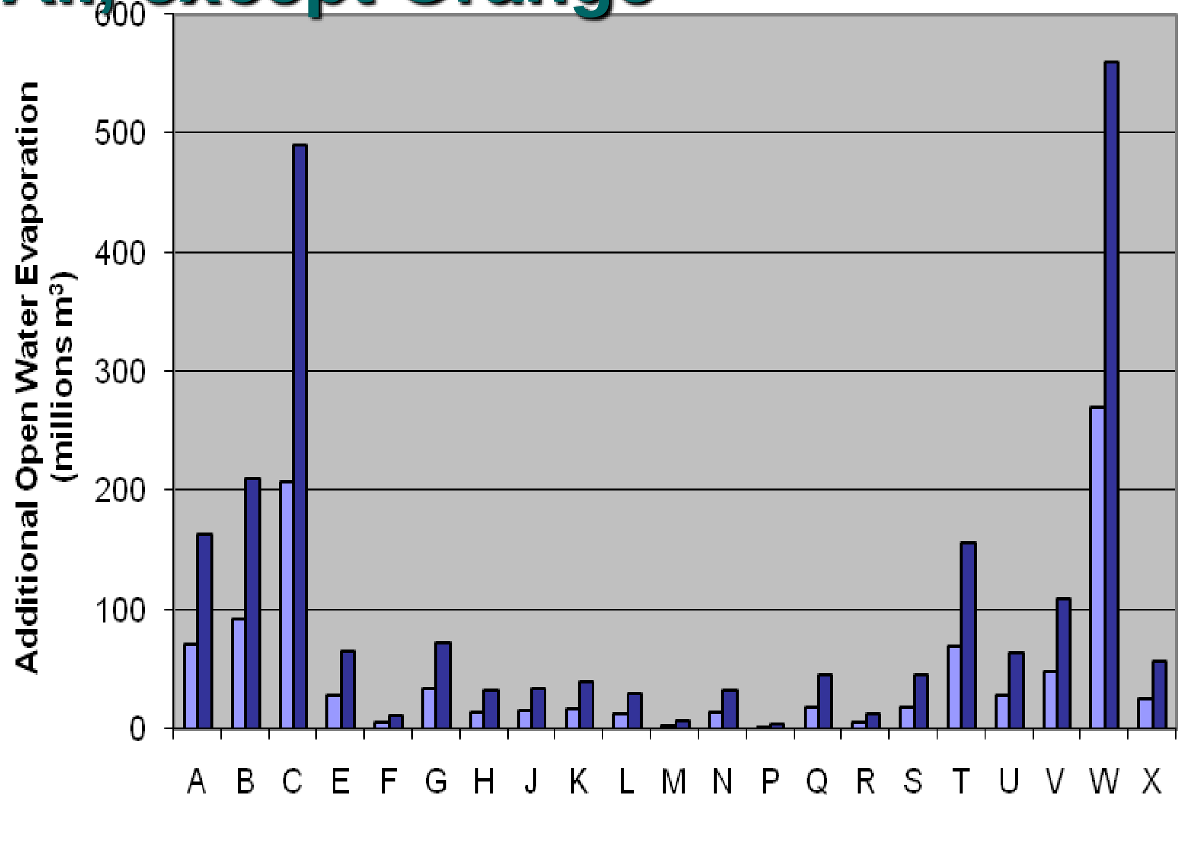
5 – 10 % **15 – 25 %**

But, what will the consequences be?

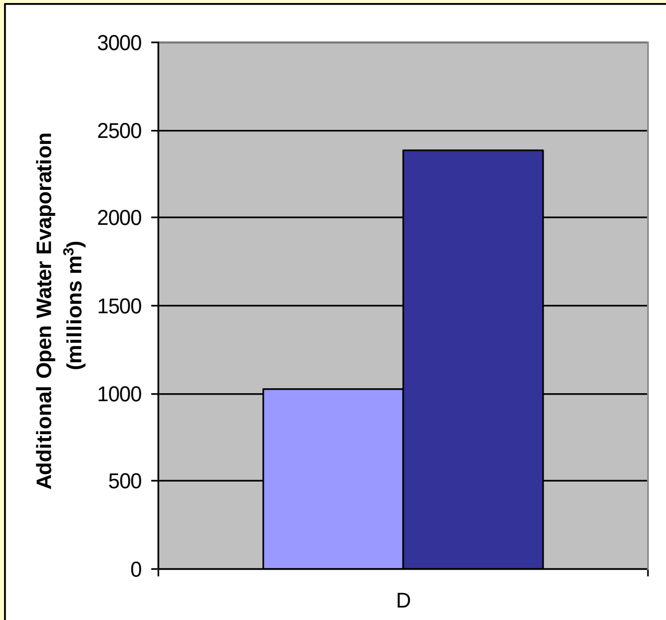
Additional Evaporation per Primary Catchment from Open Water Bodies (dams, rivers, wetlands) by 2050s (light) and 2090s (dark)



All, except Orange



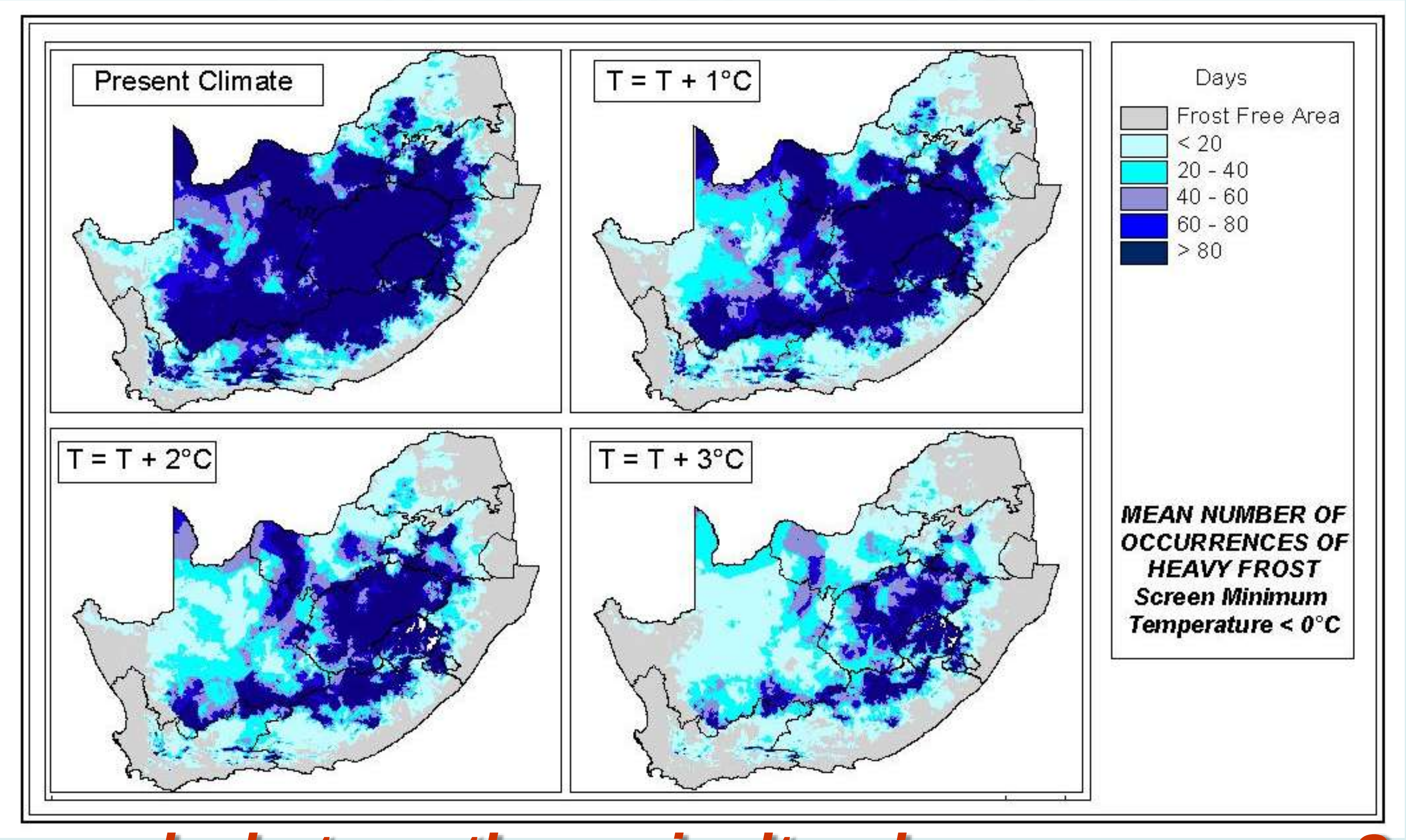
Orange



6. Similarly, Let's Consider Some "Pulses" of Climate Change Impacts, i.e. Changes in Events Rather than Averages

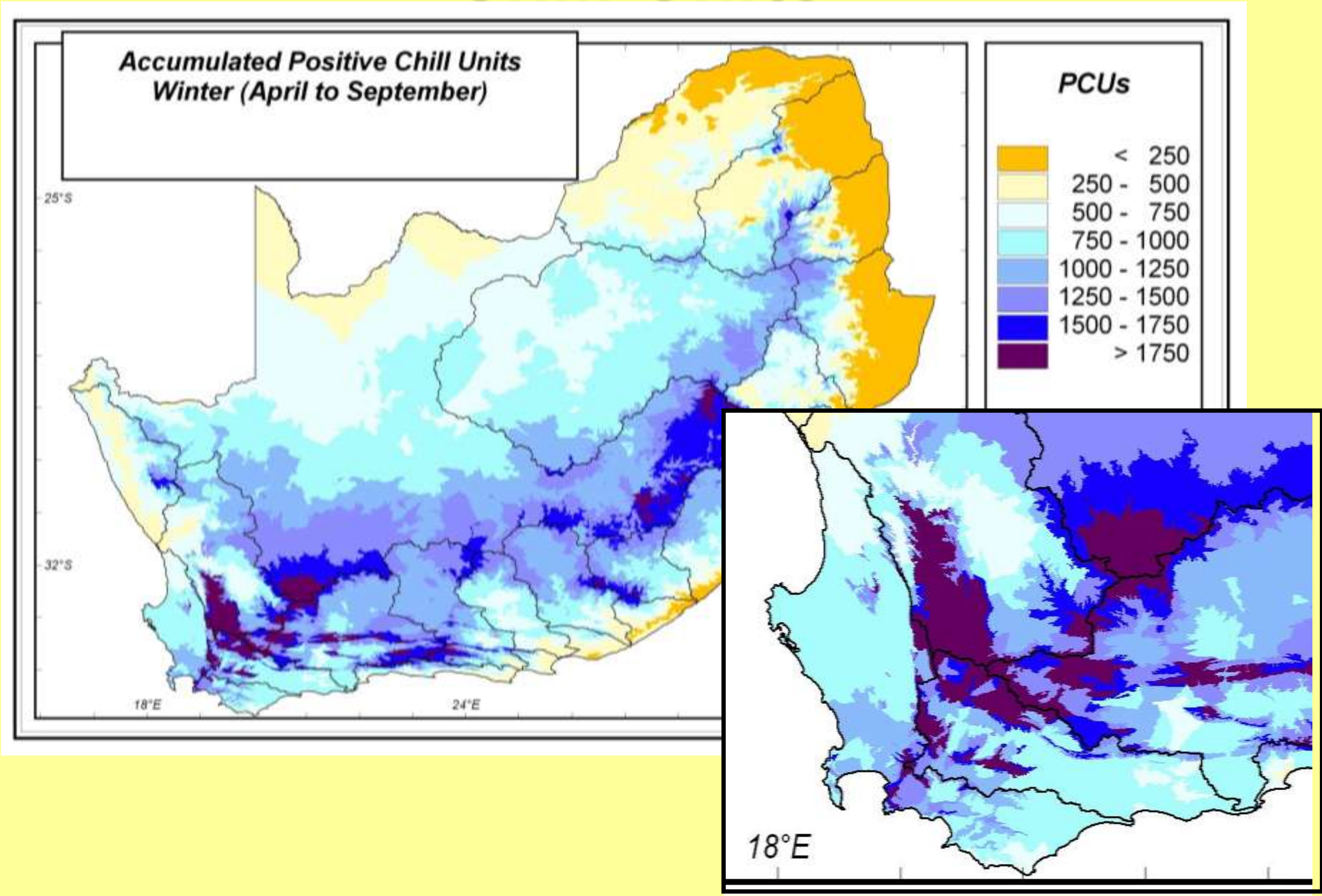
Frost Occurrences are Projected to Decrease

Number of Occurrences / Year



..and what are the agricultural consequences?

Chill Units


Accumulated Positive Chill Units
Winter (April to September)
25°S
32°S
18°E
24°E
PCUs
< 250
250 - 500
500 - 750
750 - 1000
1000 - 1250
1250 - 1500
1500 - 1750
> 1750
18°E

Changes in Positive Chill Units Will Decrease with Increases in Temperature

Province / Country	Accumulated *PCUs*			
	Present Climate	T=T+1°C (= % reduction)	T+2°C (= % reduction)	T+3°C (=% reduction)
Limpopo	222	144 (-35%)	87 (-61%)	49 (-80%)
Mpumalanga	671	532 (-21%)	405 (-40%)	292 (-56%)
North West	547	435 (-20%)	331 (-39%)	239 (-56%)
Northern Cape	821	670 (-18%)	538 (-34%)	403 (-51%)
Gauteng	746	589 (-21%)	441 (-41%)	311 (-58%)
Free State	934	805 (-14%)	673 (-28%)	540 (-42%)
KwaZulu-Natal	462	350 (-24%)	256 (-46%)	180 (-61%)
Eastern Cape	914	738 (-19%)	577 (-37%)	432 (-53%)
Western Cape	1068	825 (-23%)	607 (-43%)	425 (-60%)
Swaziland	233	147 (-37%)	87 (-63%)	47 (-80%)
Lesotho	1572	1472 (-6%)	1348 (-14%)	1202 (-24%)

WC LI NC

1° increase = - 23 % -35% -18%

2 ° increase = - 43 % -61% -34%

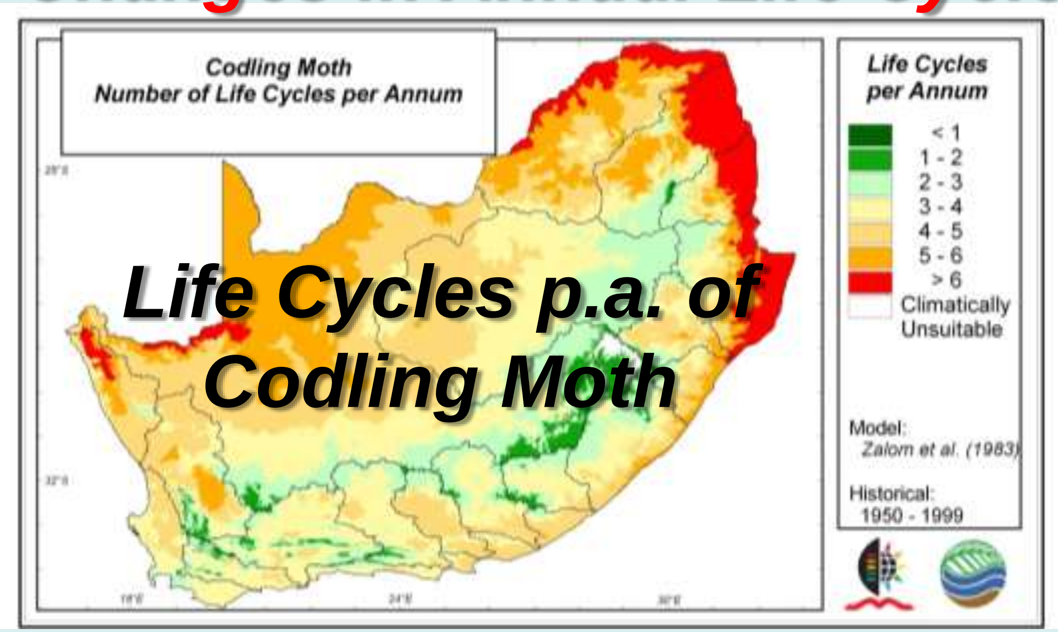
3 ° increase = - 60 % -80% -51%

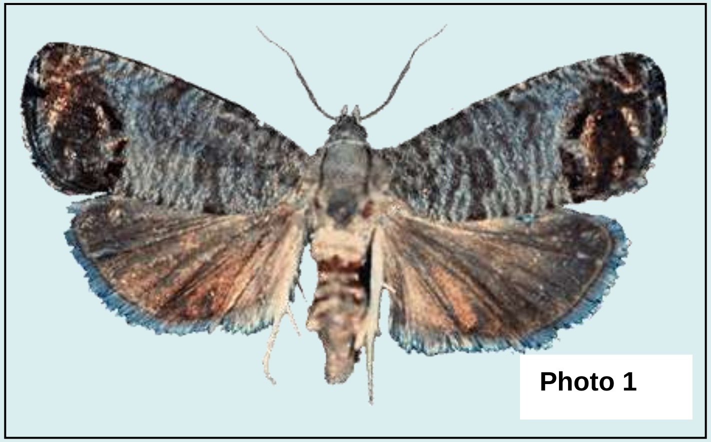
What are the consequences on ... Fruit quality? Foreign exchange earnings? Labour?

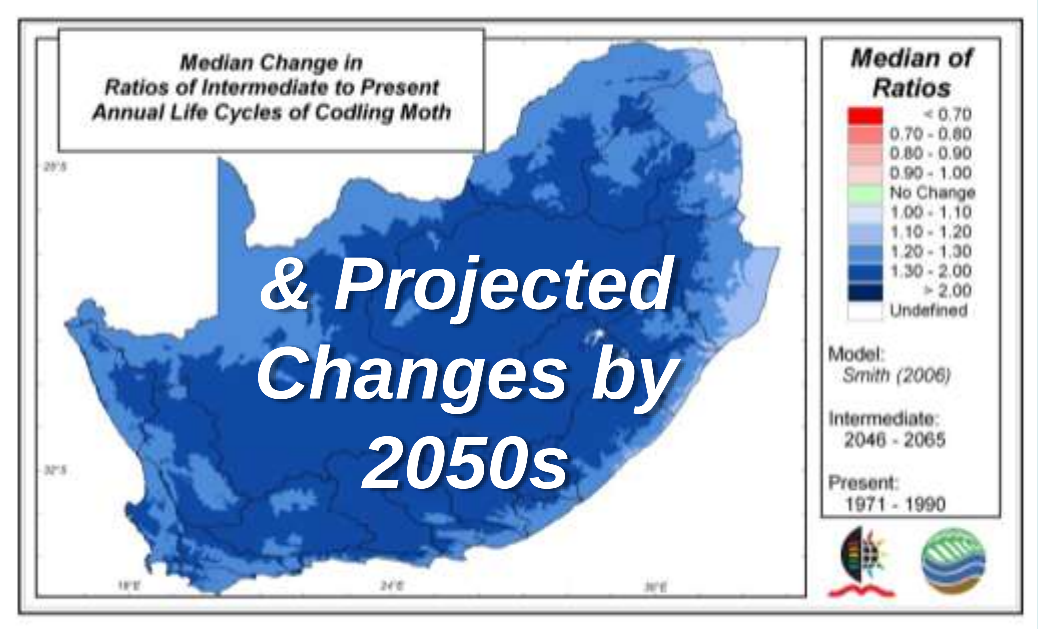
7. We Have To Consider Secondary Impacts, e.g. Pests & Diseases

Plant Health (Pests & Diseases)

Changes in Annual Life Cycles of the Codling Moth



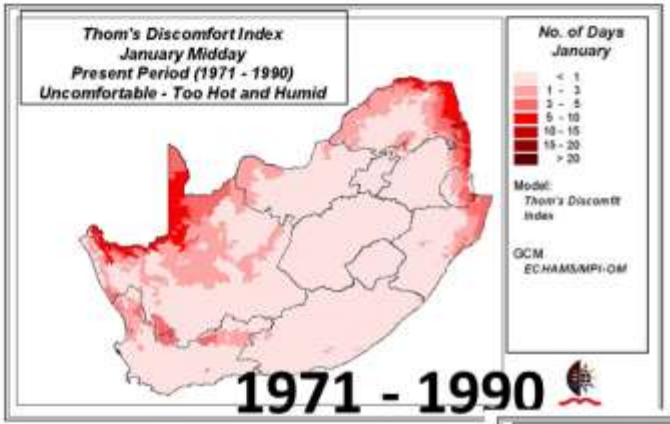


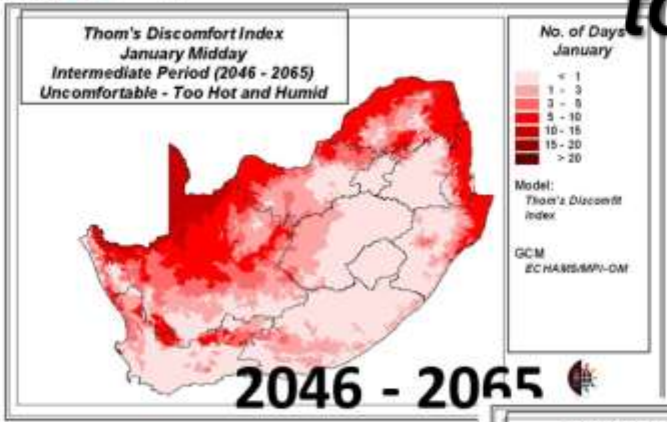


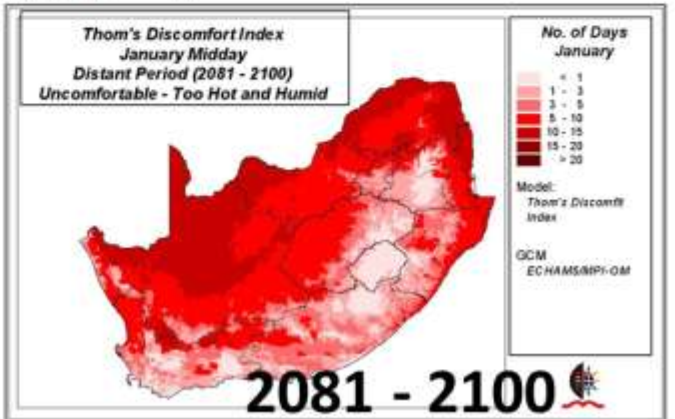
Schulze, 2011

8. We Have To Consider Other Secondary Impacts, e.g. Farm Labour

Projected Increases into the Future in Days in January which are too Hot / Humid for Human Comfort

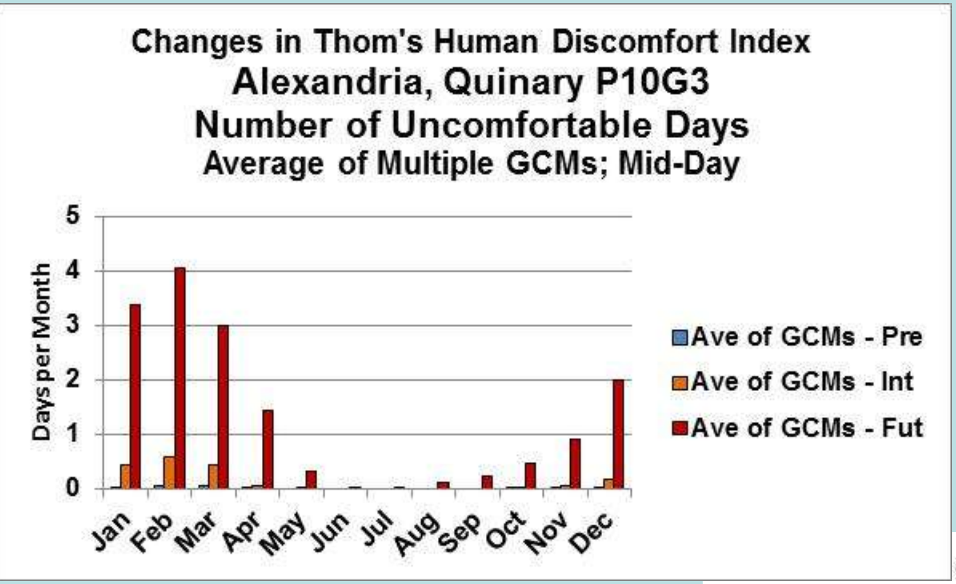


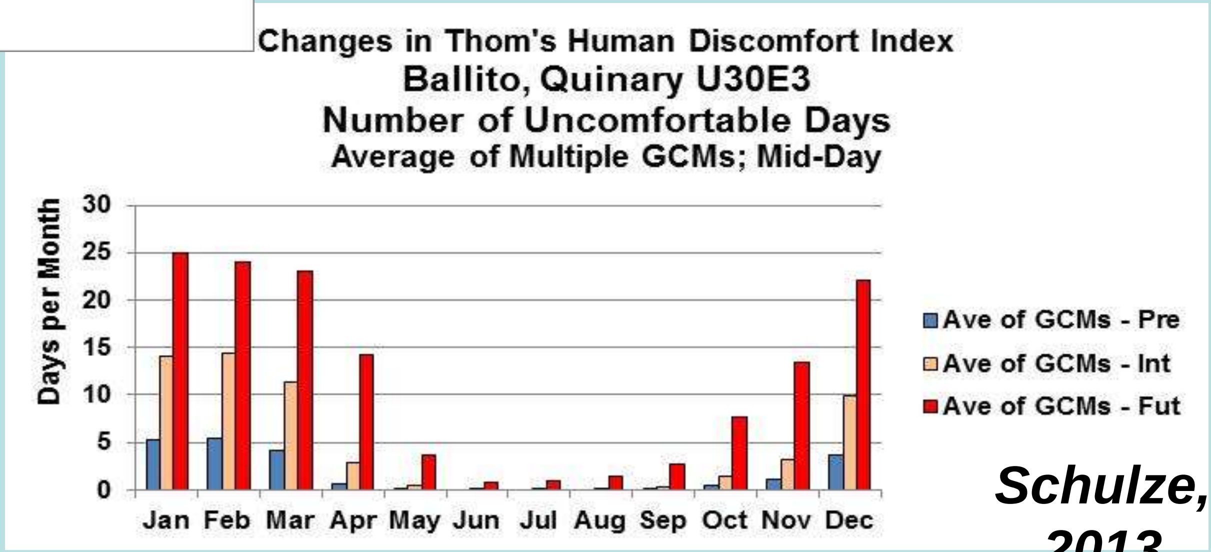




GCM: ECHAM5/MPI-OM

And, looking more closely…





Schulze, 2013

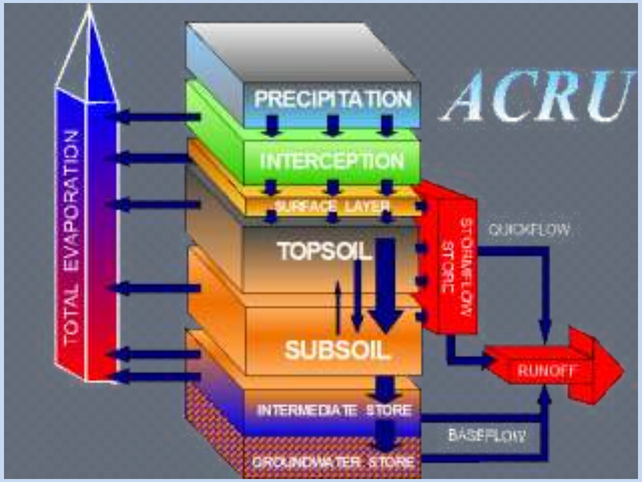
Repercussions: Agricultural labourers

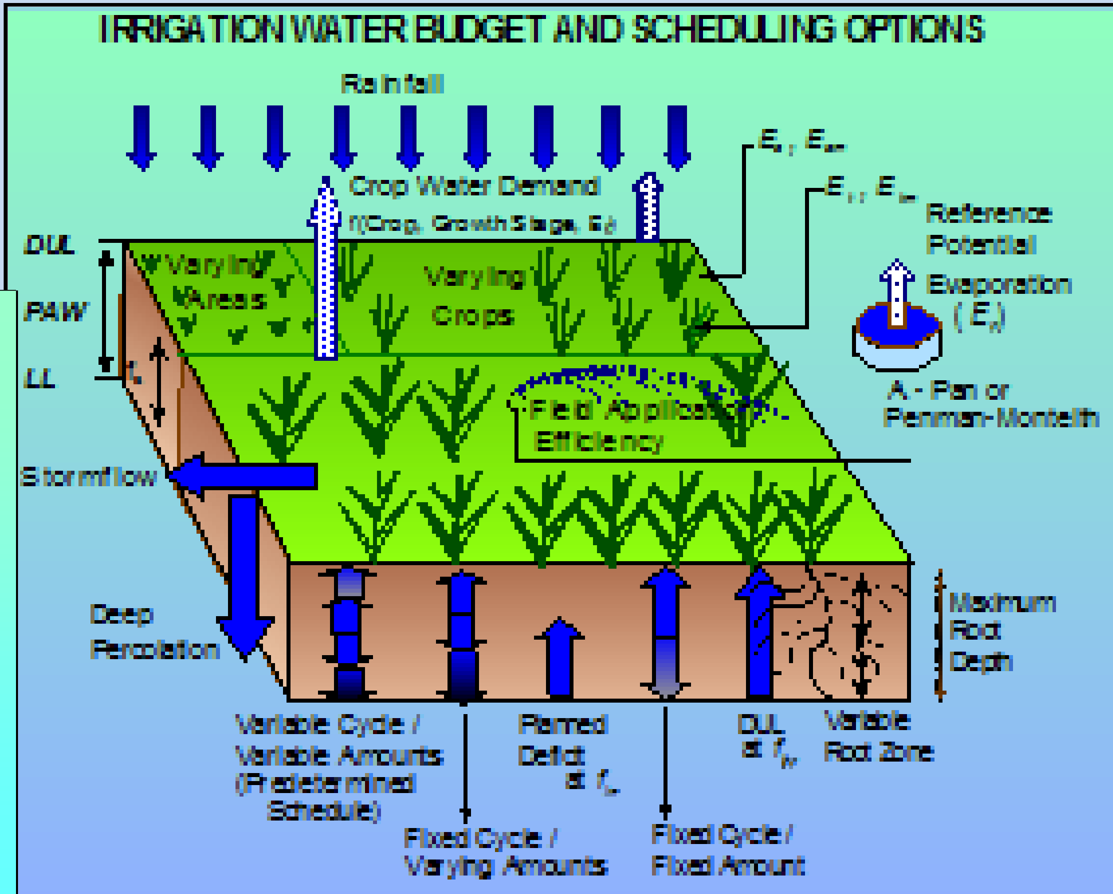
9. We Have To Consider The Irrigation Set-up

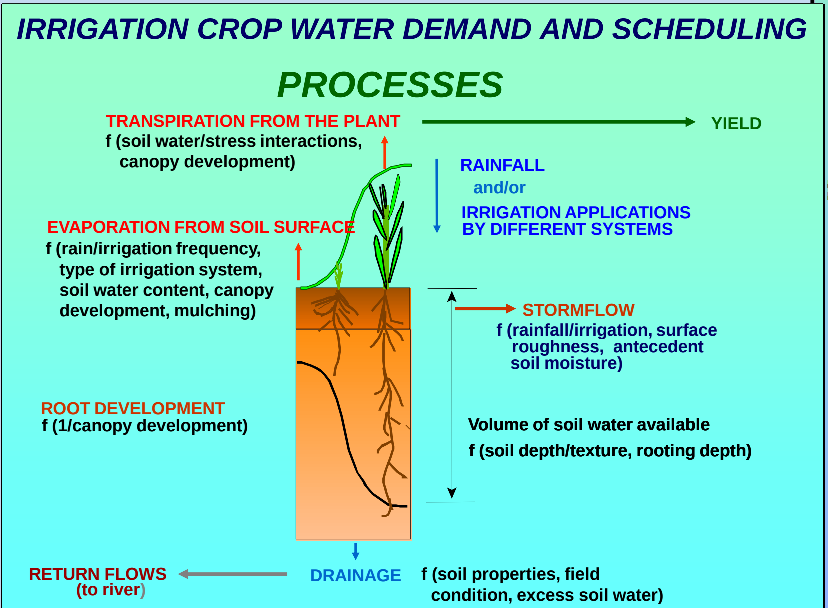
CC and Irrigation Water Usage

Photo: C. Dickens

What About Irrigation Water Demand by Crops ?





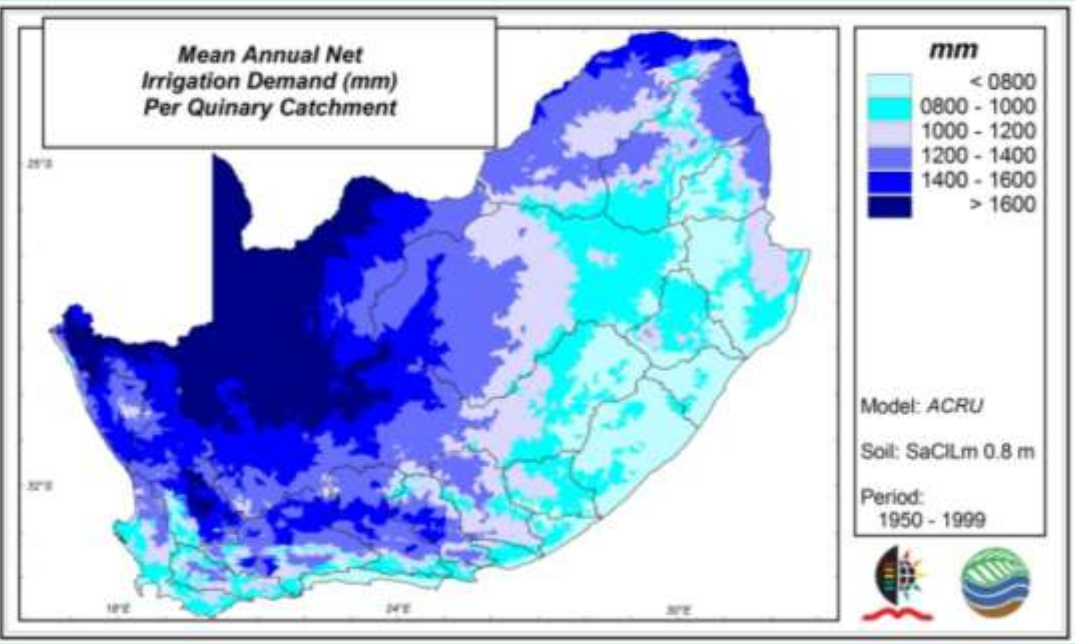


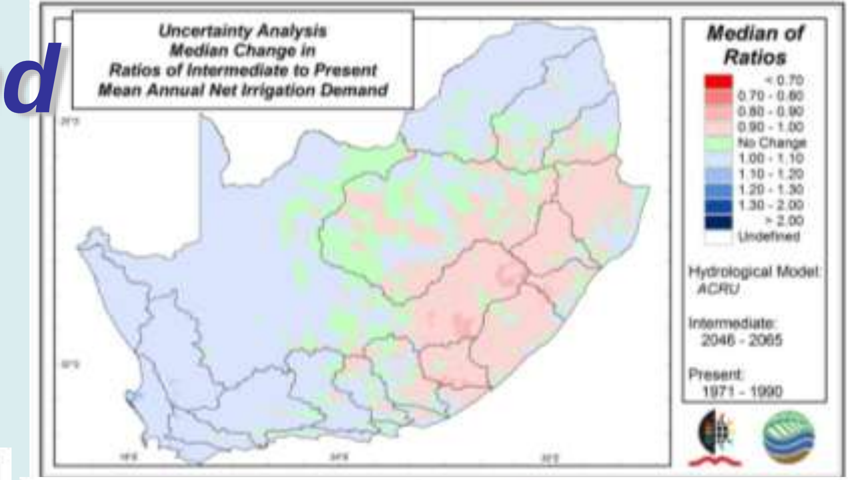
Irrigation Water Demand

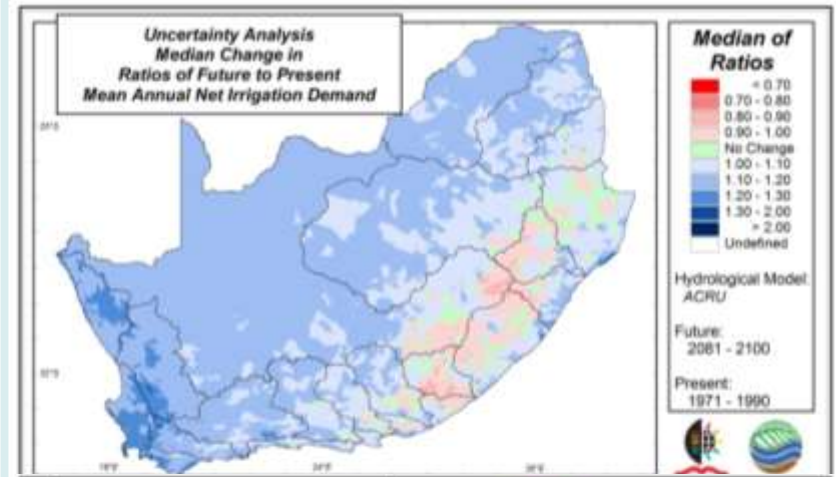
1. Present Demand

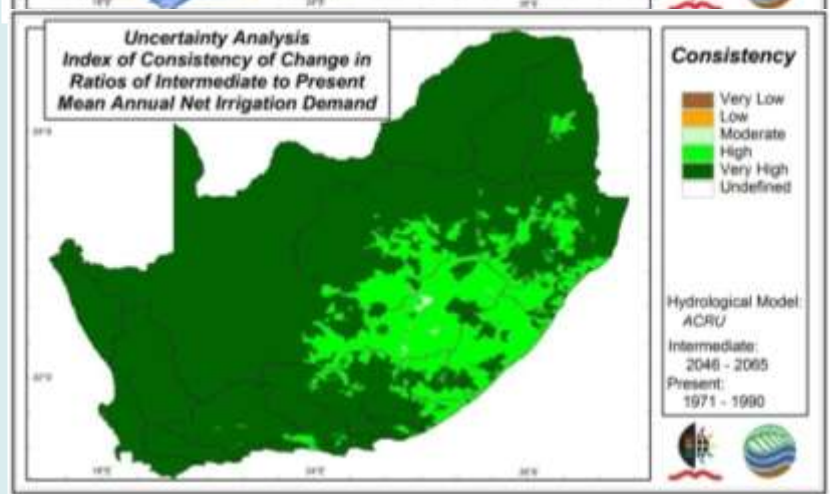
2. Future Projected Change

3. How Confident Are We?



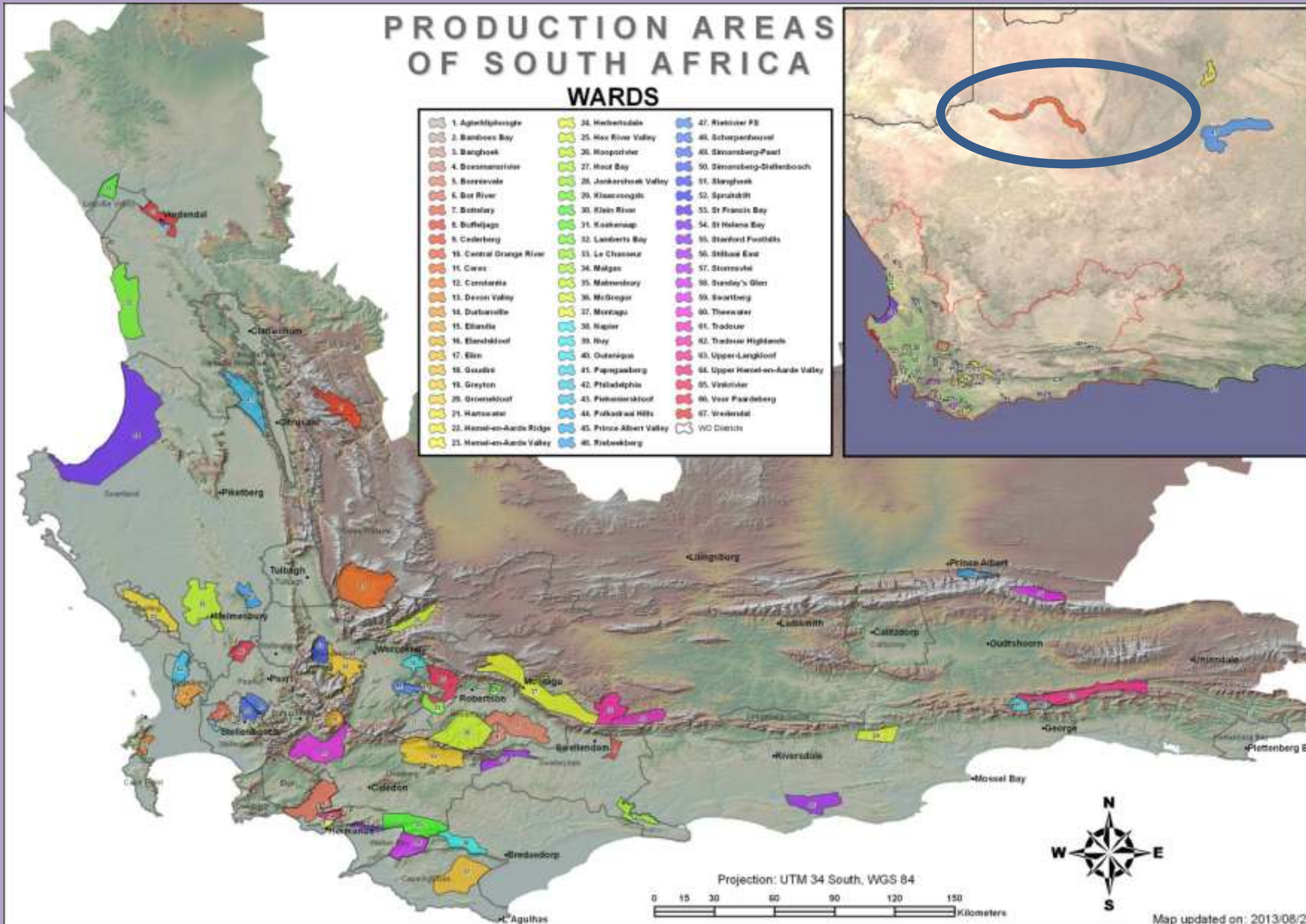






Winners and Losers

At Last … let’s Get to Grips With Grapes


PRODUCTION AREAS OF SOUTH AFRICA
WARDS
1. Agterkliphoogte
2. Bamboes Bay
3. Banghoek
4. Boesmansrivier
5. Bonnievale
6. Bot River
7. Bottelary
8. Buffeljags
9. Cederberg
10. Central Orange River
11. Ceres
12. Constantia
13. Devon Valley
14. Durbanville
15. Eilandia
16. Elandskloof
17. Elim
18. Goudini
19. Greyton
20. Groenekloof
21. Hartswater
22. Hemel-en-Aarde Ridge
23. Hemel-en-Aarde Valley
24. Herbertsdale
25. Hex River Valley
26. Hoopsrivier
27. Hout Bay
28. Jonkershoek Valley
29. Klaasvoogds
30. Klein River
31. Koekenaap
32. Lamberts Bay
33. Le Chasseur
34. Malgas
35. Malmesbury
36. McGregor
37. Montagu
38. Napier
39. Nuy
40. Outeniqua
41. Papegaaiberg
42. Philadelphia
43. Piekenierskloof
44. Polkadraai Hills
45. Prince Albert Valley
46. Riebeekberg
47. Rietrivier FS
48. Scherpenheuvel
49. Simonsberg-Paarl
50. Simonsberg-Stellenbosch
51. Slanghoek
52. Spruitdrift
53. St Francis Bay
54. St Helena Bay
55. Stanford Foothills
56. Stilbaai East
57. Stormsvlei
58. Sunday's Glen
59. Swartberg
60. Theewater
61. Tradouw
62. Tradouw Highlands
63. Upper-Langkloof
64. Upper Hemel-en-Aarde Valley
65. Vinkrivier
66. Voor Paardeberg
67. Vredendal
WO Districts
Vredendal
Clanwilliam
Citrusdal
Piketberg
Tulbagh
Malmesbury
Paarl
Worcester
Robertson
Montagu
Stellenbosch
Caledon
Swellendam
Hermanus
Bredasdorp
L'Agulhas
Laingsburg
Prince Albert
Ladismith
Calitzdorp
Oudtshoorn
Uniondale
George
Riversdale
Mossel Bay
Plettenberg Bay
Projection: UTM 34 South, WGS 84
0 15 30 60 90 120 150 Kilometers
N
W
E
S
Map updated on: 2013/08/28

Objective

Nature

Soil & Climate

Management

Long Term Practices
(Establishment, row orientation, vine spacing, trellising/training/pruning practices

Short Term Practices
(Irrigation techniques, fertilization, canopy management)

Harvest Criteria

Photosynthetic Activity

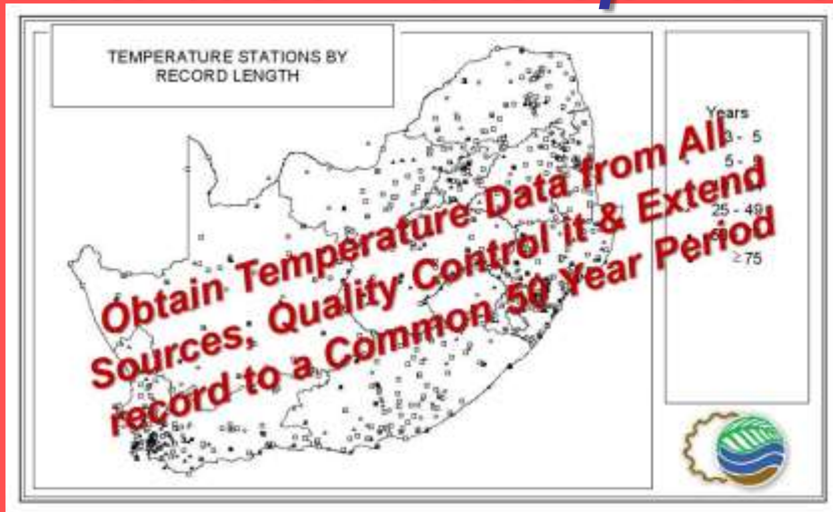
Colour and Flavour

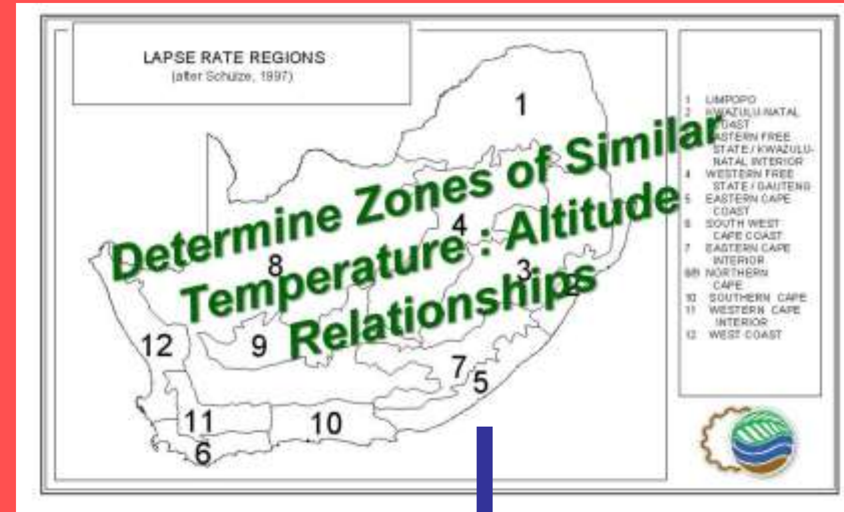
Sugar & Potassium Accumulation

Organic Acid Formation

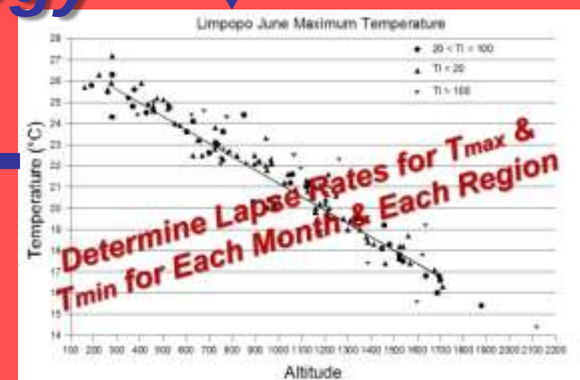
Pre- vs Post Véraison
Optimal vs Too Cold/Too Hot

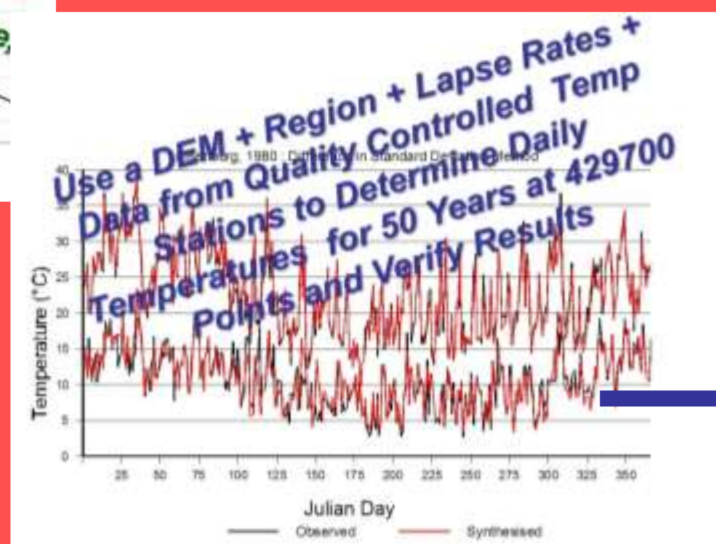
The SA Daily Temperature Database Development





1. Methodology





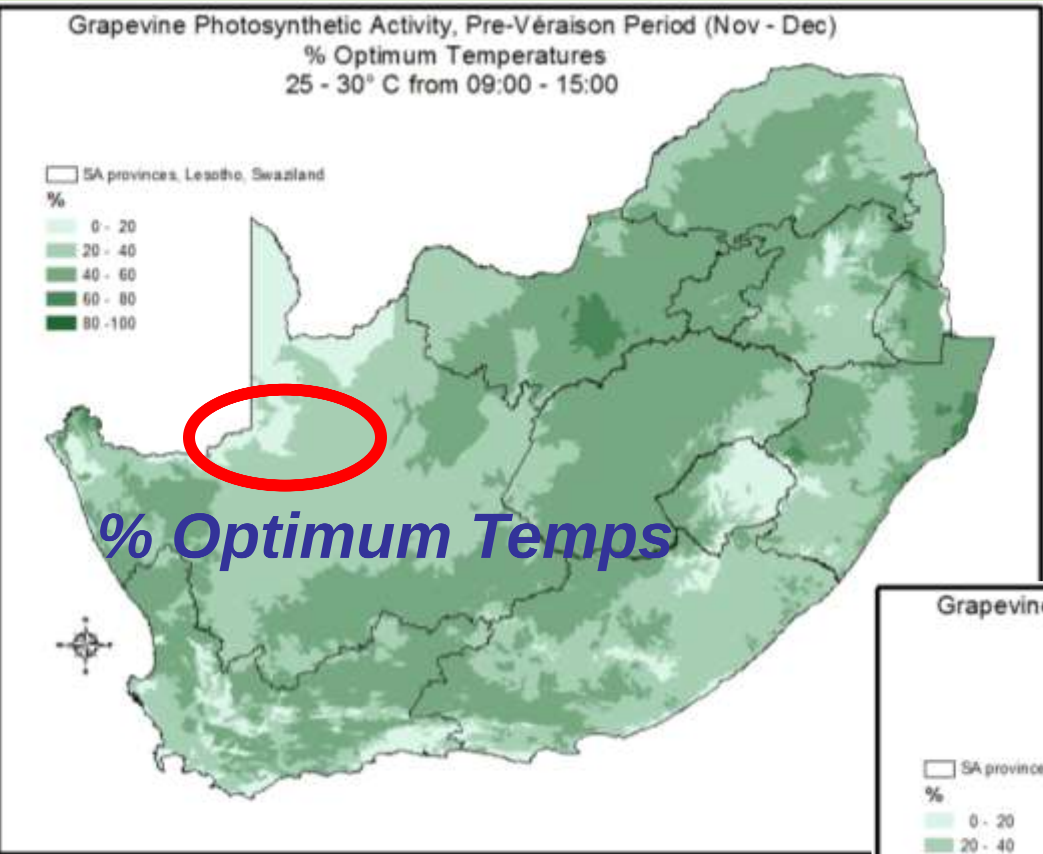
Schulze & Maharaj, 2004

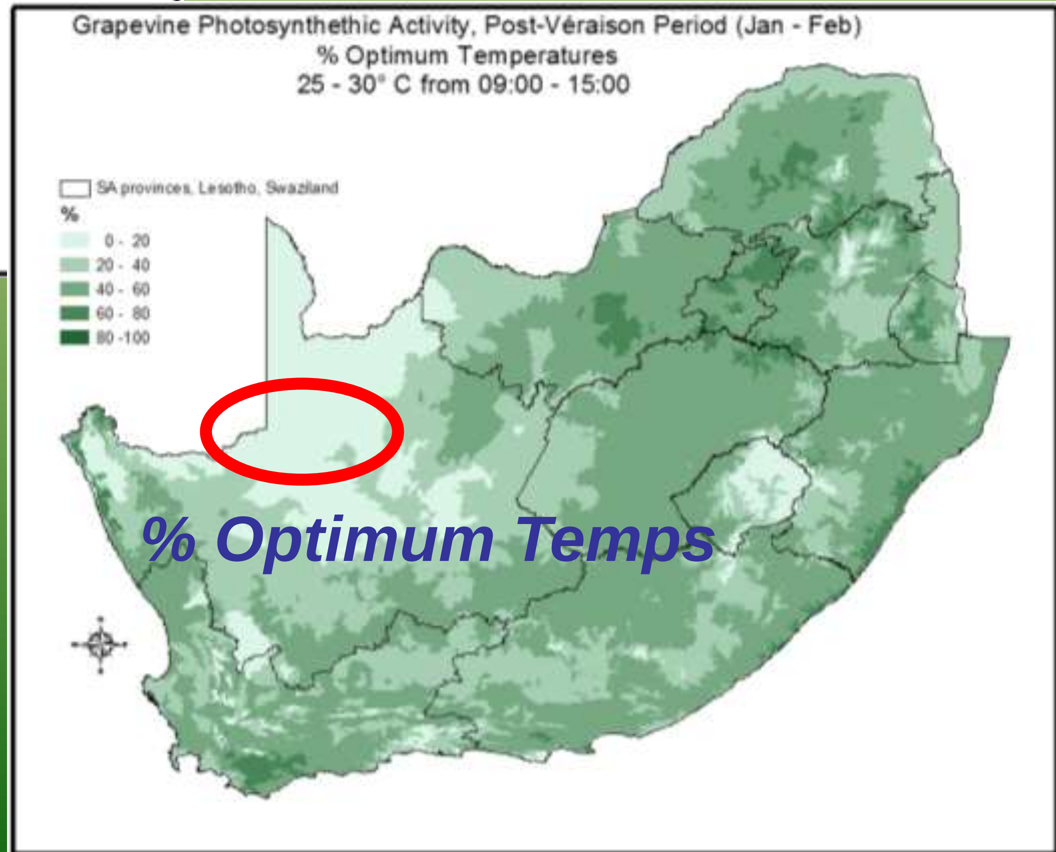
Research Tells Us: Grapevine Photosynthetic Activity as well as Colour as Flavour Depend on Hourly Temperature Ranges being Achieved or Exceeded for Certain Parts of the Day

We determined an hourly temperature dataset for every day for 50 years for each of 5838 Quinaries in South Africa

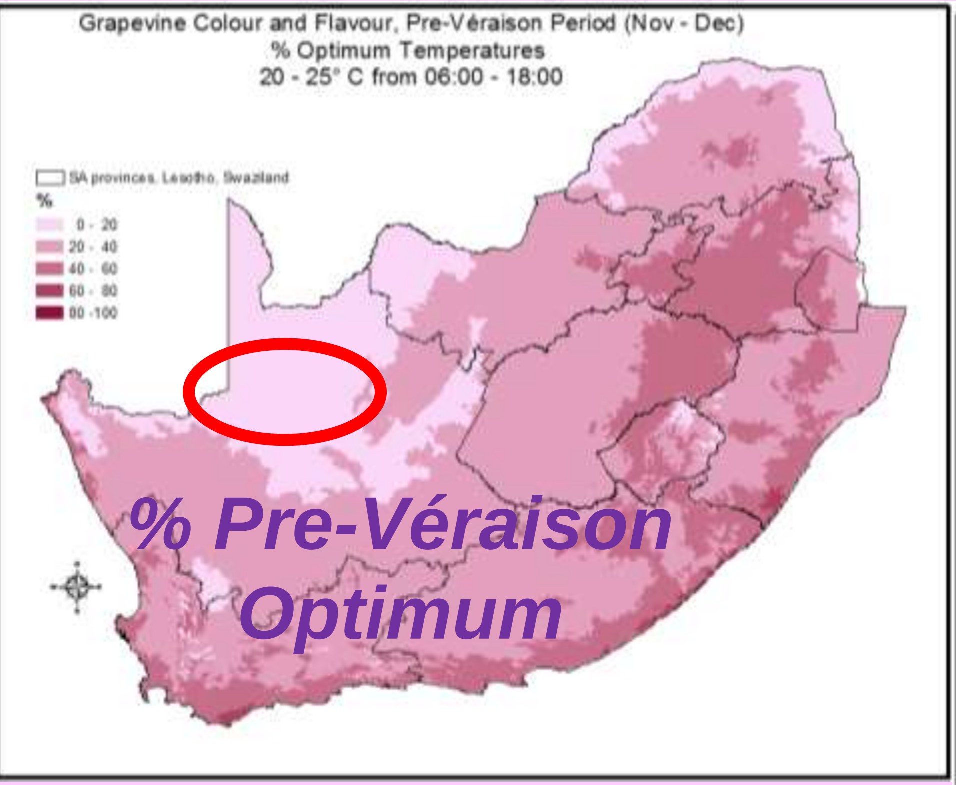
Day	Min	Max	Calculated hourly temperatures																							
	(^{o}C)	(^{o}C)	**1.0**	**2.0**	**3.0**	**4.0**	**5.0**	**6.0**	**7.0**	**8.0**	**9.0**	**10.0**	**11.0**	**12.0**	**13.0**	**14.0**	**15.0**	**16.0**	**17.0**	**18.0**	**19.0**	**20.0**	**21.0**	**22.0**	**23.0**	**24.0**
1	15.4	33.0	No calculations possible for this day							No calculations possible for this day								No calculations possible for this day								
2	17.4	29.8	18.2	17.9	17.8	17.7	17.6	19.5	21.7	23.7	25.5	27.1	28.3	29.2	29.7	29.8	29.4	28.7	27.6	26.2	24.6	22.6	21.2	20.3	19.7	19.2
3	18.3	31.3	18.9	18.7	18.6	18.5	18.4	20.5	22.8	24.9	26.8	28.5	29.8	30.7	31.2	31.3	30.9	30.2	29.0	27.5	25.6	22.8	21.0	19.7	18.8	18.2
4	16.9	23.4	17.8	17.5	17.3	17.2	17.1	18.0	19.1	20.2	21.2	22.0	22.6	23.1	23.3	23.4	23.2	22.8	22.3	21.5	20.5	18.9	17.8	17.1	16.6	16.2
5	15.5	24.6	16.0	15.8	15.7	15.7	15.6	17.0	18.6	20.1	21.5	22.6	23.5	24.2	24.5	24.6	24.3	23.8	23.0	21.9	20.8	19.4	18.5	17.9	17.4	17.1
6	16.5	27.7	16.9	16.8	16.7	16.6	16.6	18.4	20.3	22.2	23.8	25.3	26.4	27.2	27.6	27.7	27.4	26.7	25.7	24.4	23.0	21.2	19.9	19.1	18.5	18.1
7	17.3	29.6	17.9	17.7	17.6	17.5	17.4	19.4	21.5	23.5	25.4	26.9	28.1	29.0	29.5	29.6	29.3	28.5	27.4	26.0	24.4	22.3	20.9	20.0	19.3	18.9
8	17.9	27.5	18.5	18.3	18.2	18.1	18.0	19.5	21.2	22.8	24.2	25.4	26.4	27.0	27.4	27.5	27.2	26.7	25.8	24.7	23.2	21.0	19.5	18.5	17.8	17.3
9	16.3	23.6	17.0	16.8	16.6	16.5	16.4	17.5	18.8	20.0	21.1	22.0	22.7	23.3	23.5	23.6	23.4	23.0	22.3	21.5	20.4	18.8	17.7	16.9	16.4	16.1
10	15.3	22.3	15.8	15.6	15.5	15.5	15.4	16.5	17.7	18.8	19.9	20.8	21.5	22.0	22.2	22.3	22.1	21.7	21.1	20.2	19.3	18.0	17.2	16.6	16.2	15.9

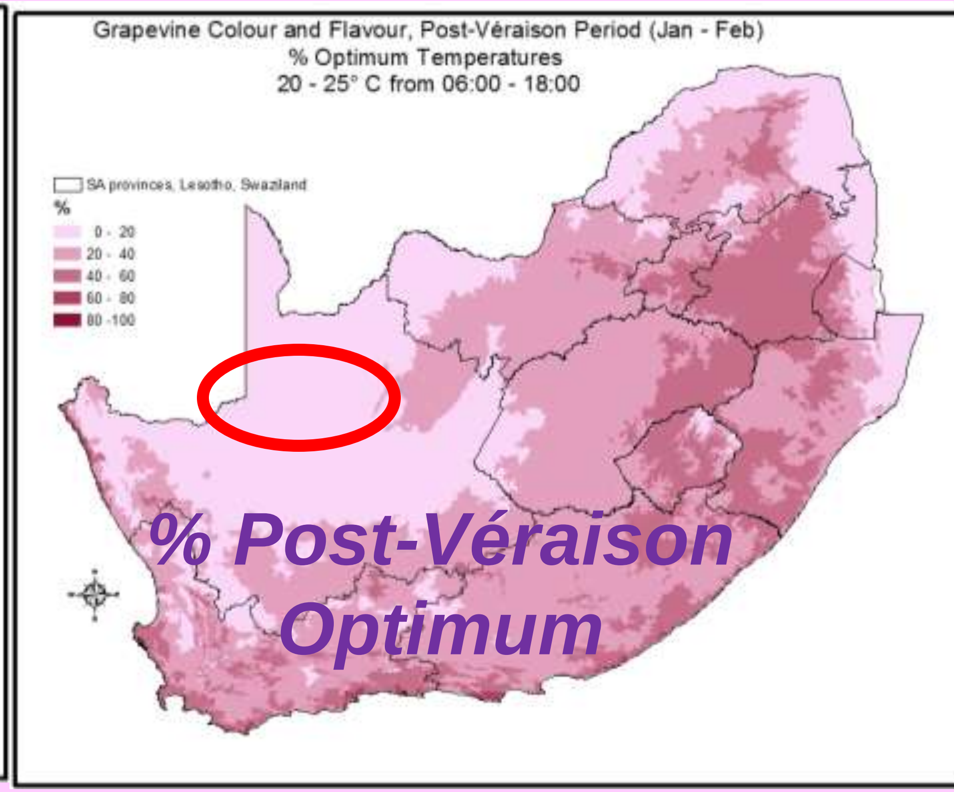
Grapevine Photosynthetic Activity
Present Climatic Conditions



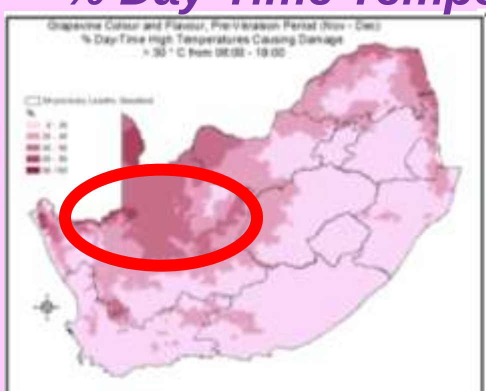


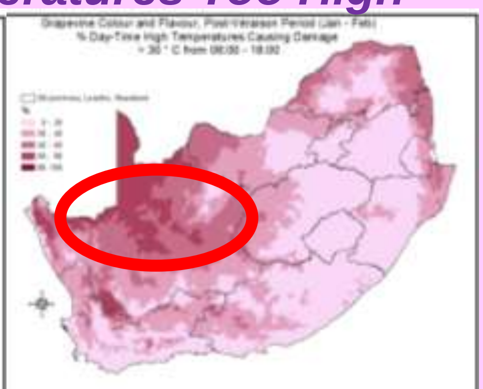
Grapevine Colour & Flavour Requirements



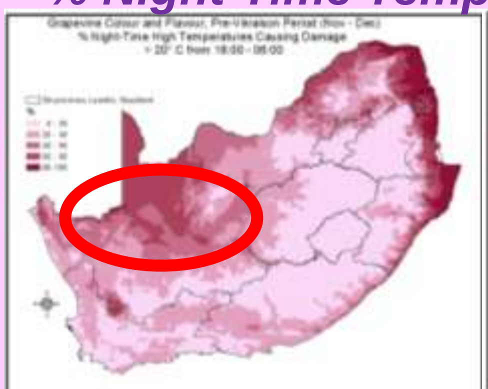


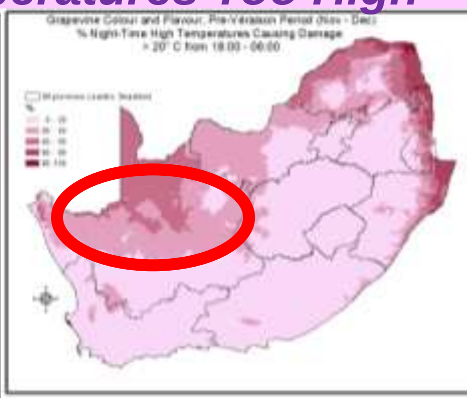
% Day-Time Temperatures Too High



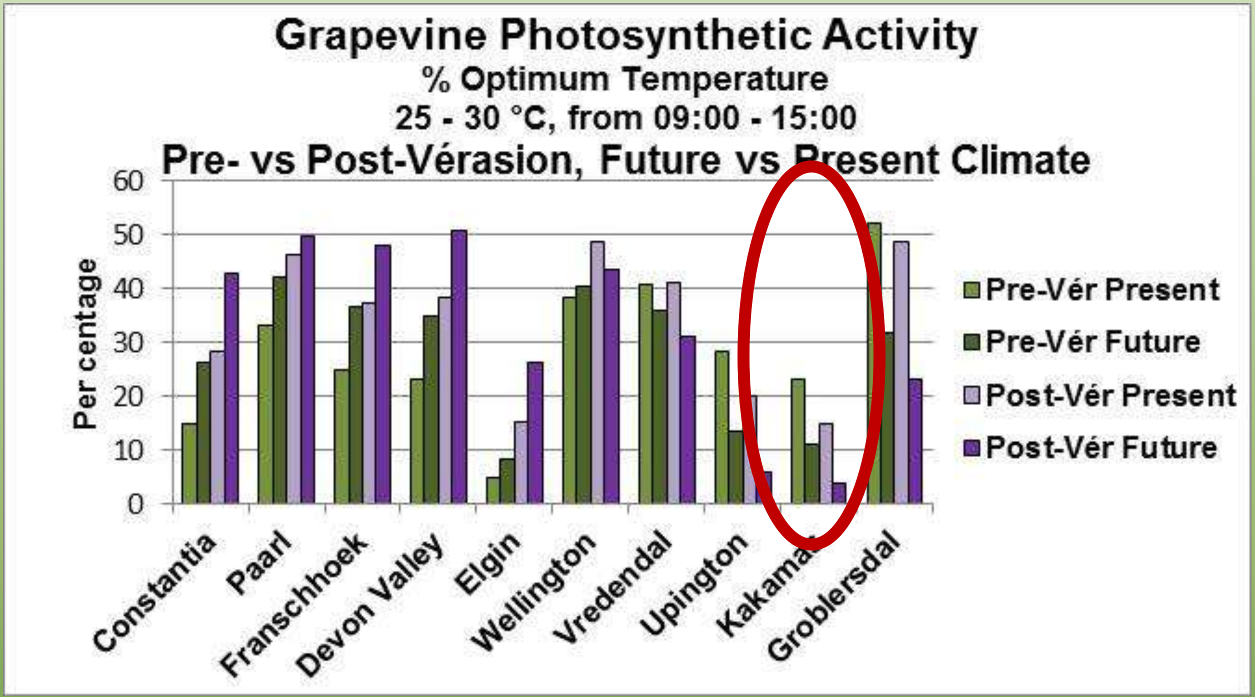


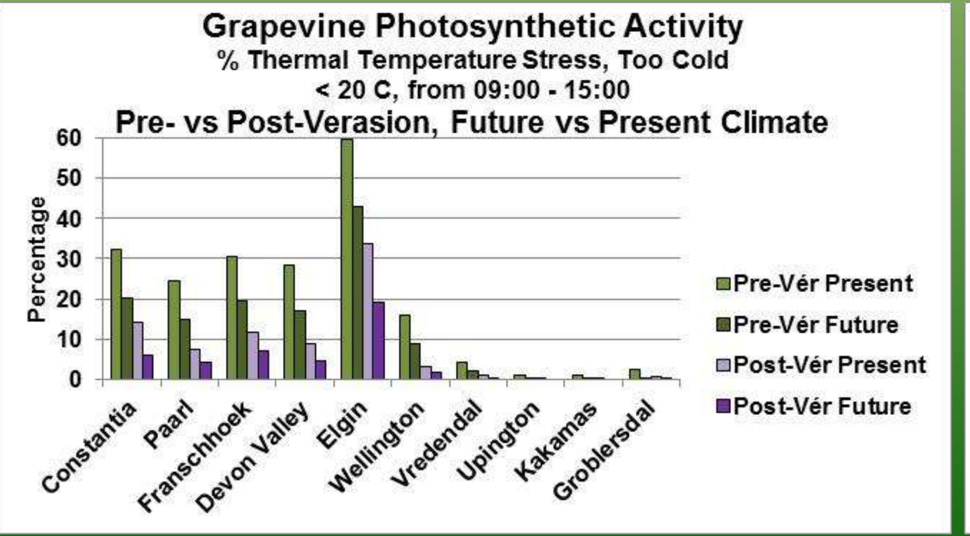
% Night-Time Temperatures Too High

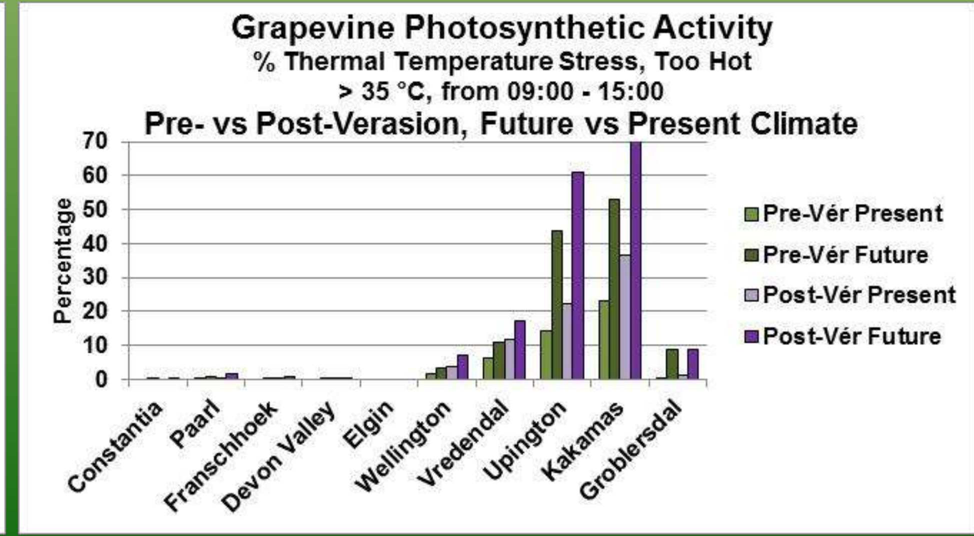




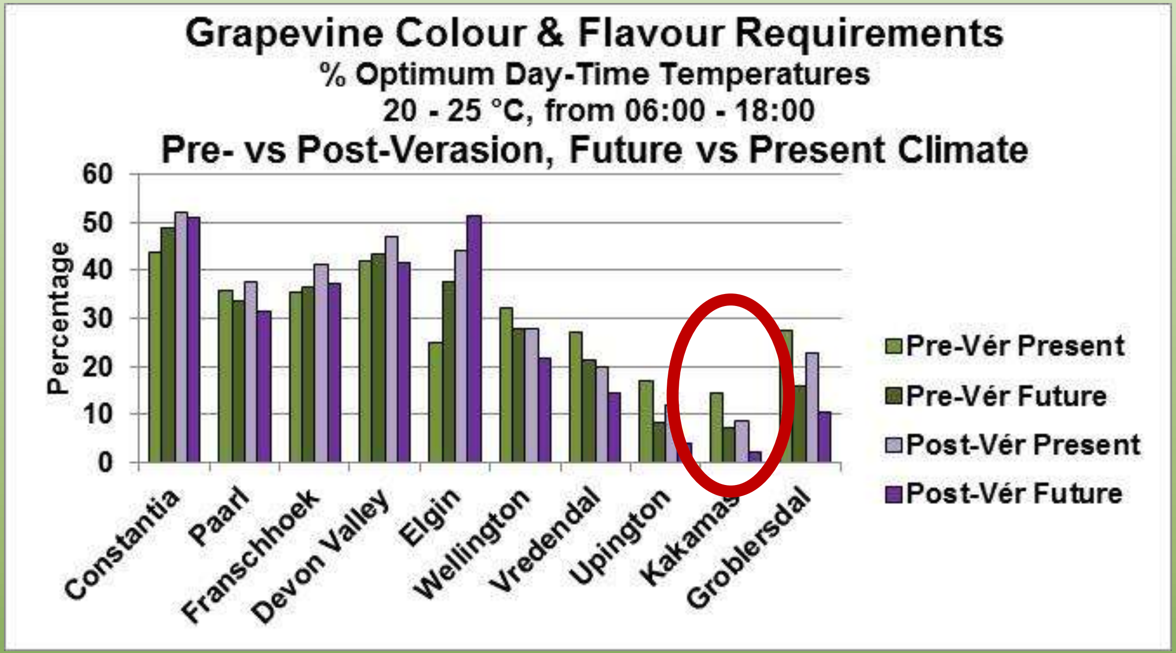
Comparative Analysis, Photosynthetic Analysis Future vs Present Climatic Conditions

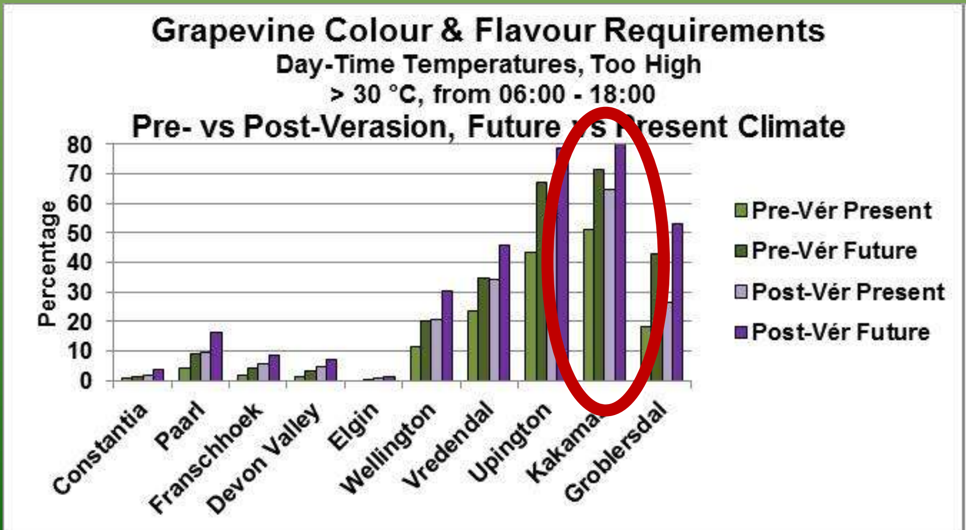


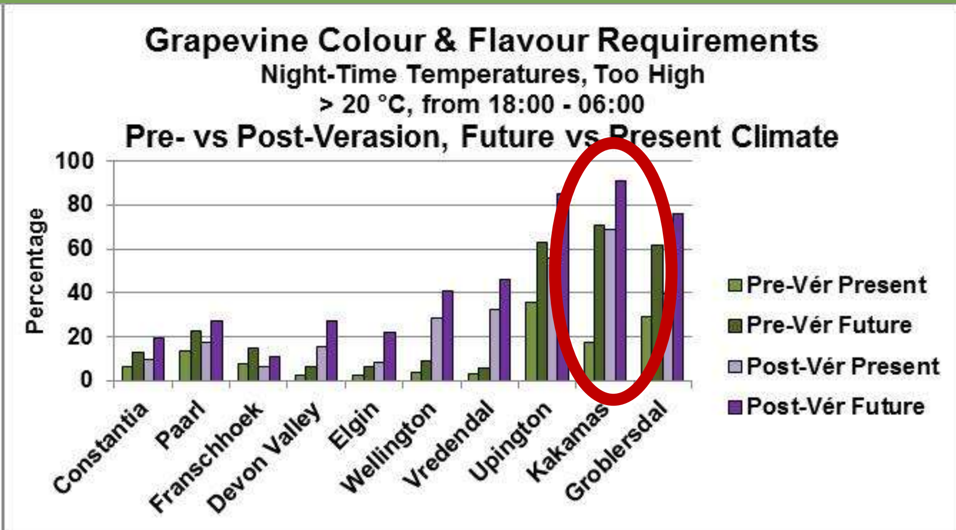




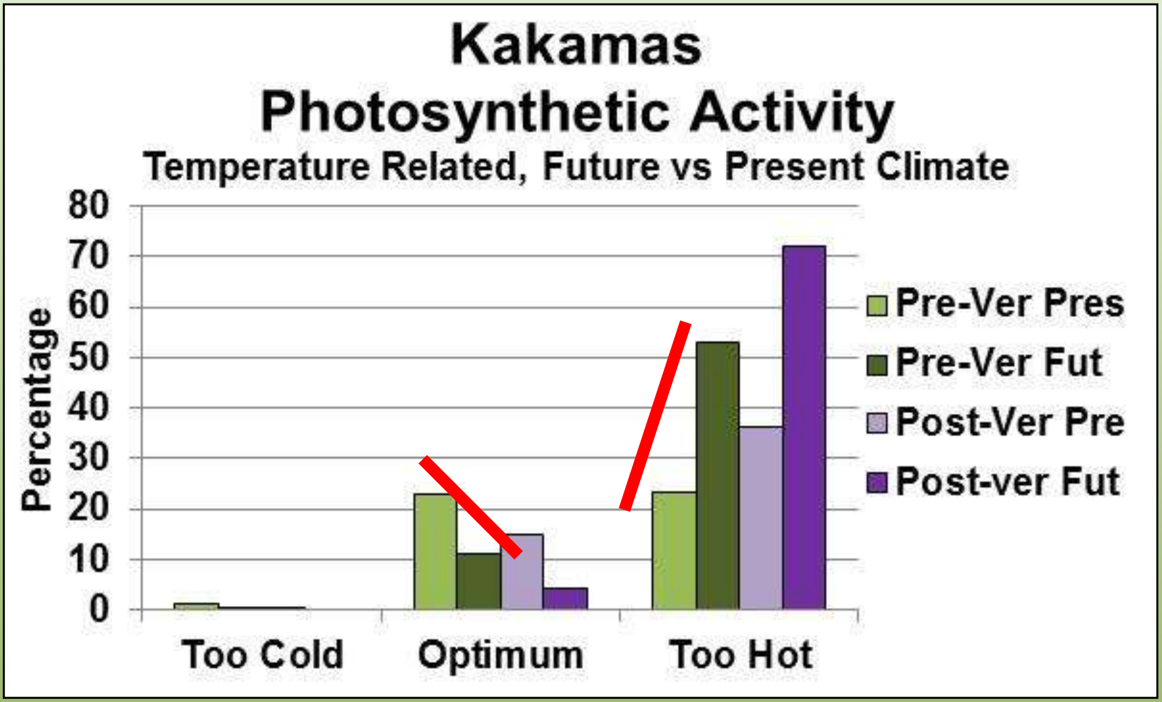
Comparative Analysis, Colour & Flavour Requirements
Future vs Present Climatic Conditions

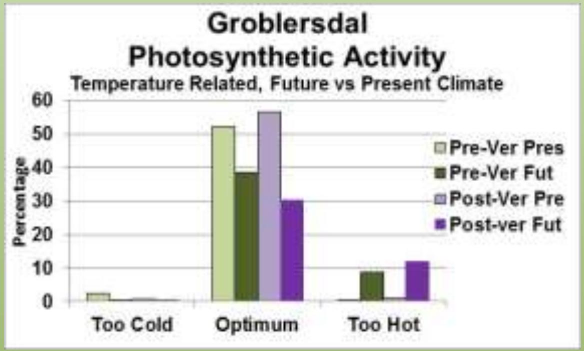


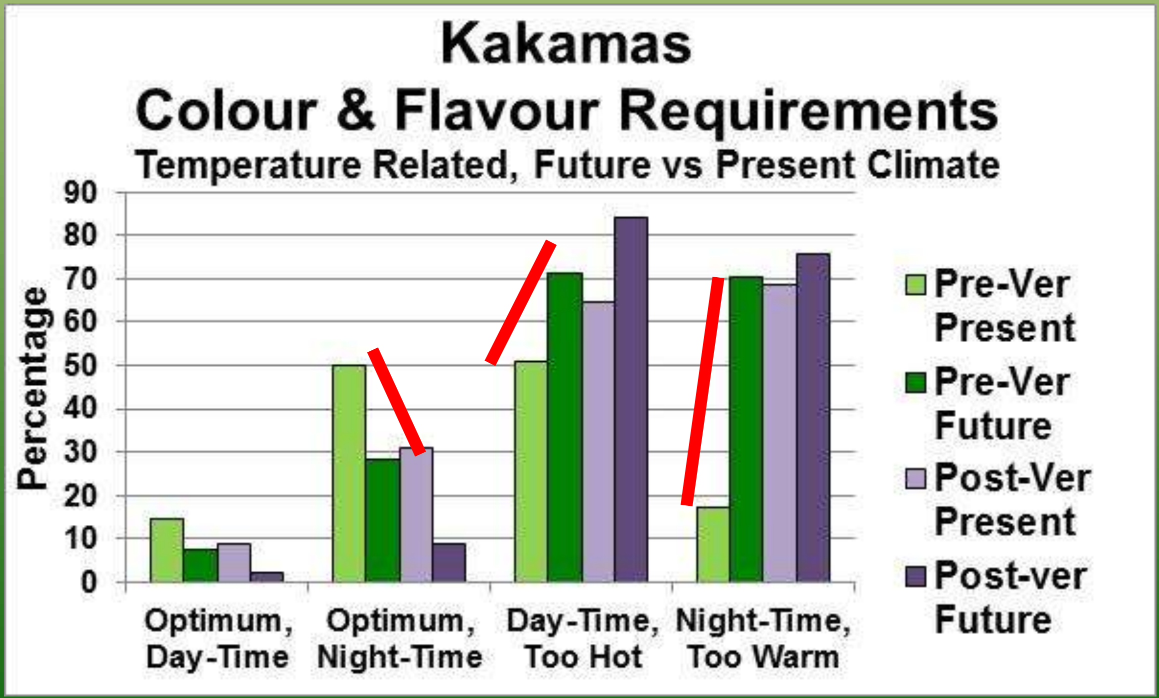


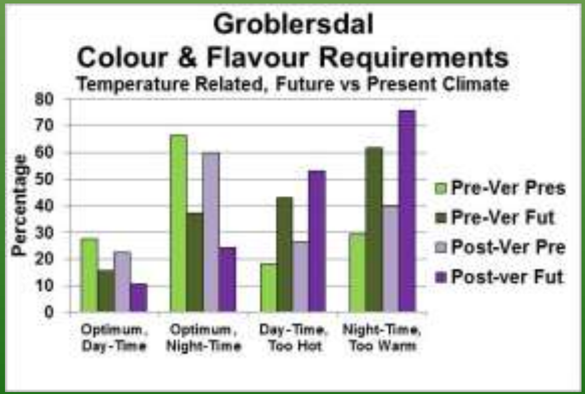


Let's Focus on Kakamas



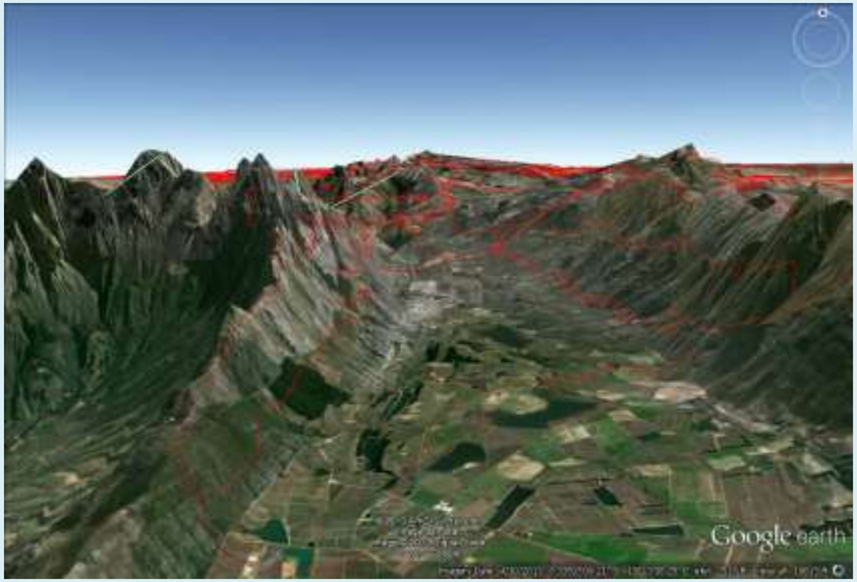






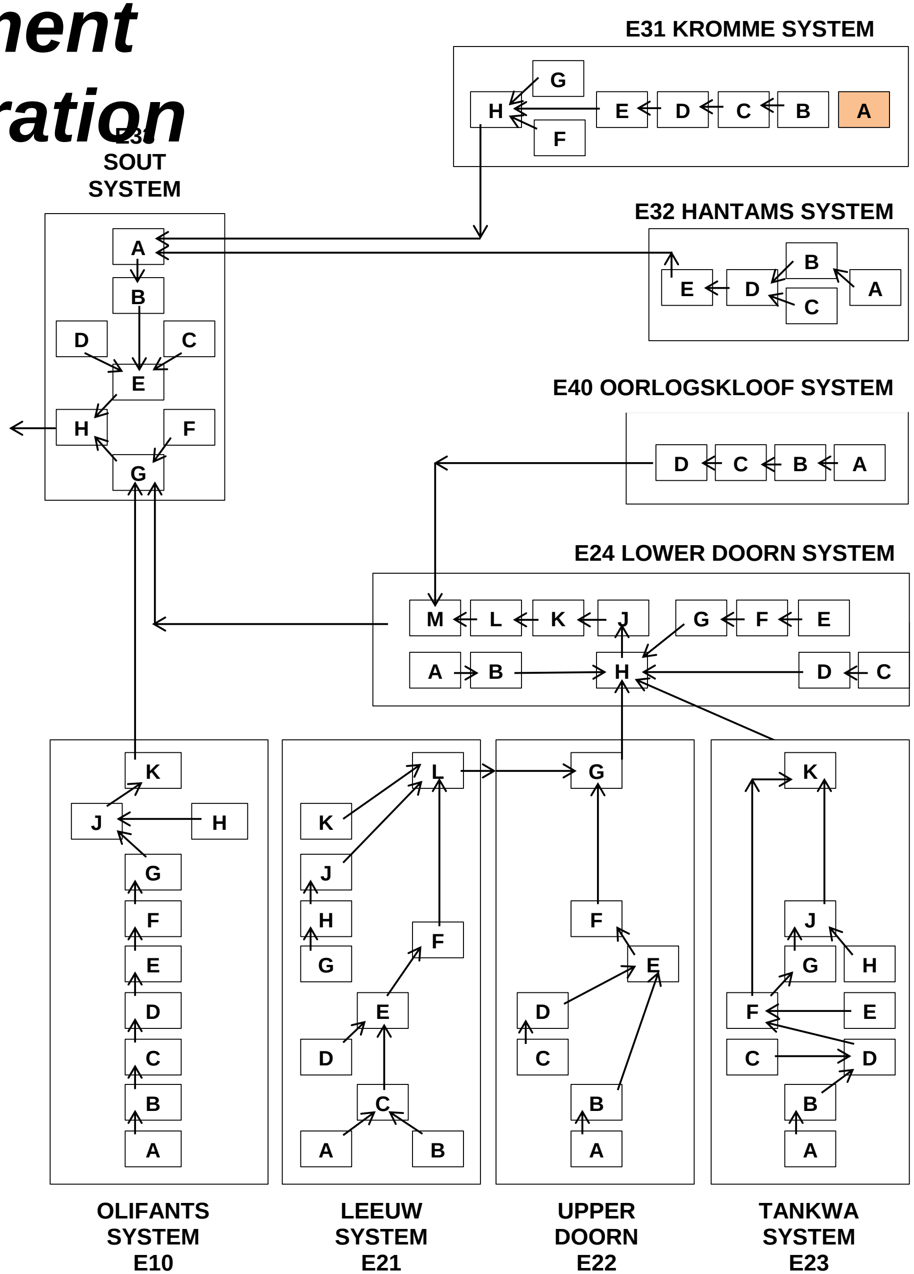
Quo vadis re. CC?

1. We Need to Consider Entire Regional Farming Systems



Case Study: Olifants-Doorn Catchment, W. Cape

Catchment Configuration



Irrigation and Land Cover Information

System	Quaternary / Quinary	BEEH Quinary	HRU/ Application Losses	Hectares Irrigated	Crop Combo
E21 LEEUW SYSTEM	E21A2	2297	10 / 10	4	1
	E21A3	2298	15 / 15	10 011[9900]	1
	E21B2	2300	25 / 10	79	1
	E21B3	2301	30 / 10	490[601]	1
	E21C2	2303	40 / 10	3	3
	E21C3	2304	45 / 10	225	1
	E21D2	2306	55 / 5	26	1
	E21D3	2307	60 / 5	3 291	4
	E21E3	2310	75 / 10	49	2
	E21F2	2312	85 / 2.5	24	1
	E21G2	2315	100 / 5	65	4
	E21G3	2316	105 / 5	4 341	4
	E21H2	2318	115 / 5	38	5
	E21H3	2319	120 / 5	602	5
	E21J3	2322	135 / 5	64	1
	E21K3	2325	150 / 15	111	1
	E21L3	2328	165 / 10	2	1
E22 UPPER DOORN SYSTEM	E22A2	2330	175 / 10	5	1
	E22A3	2331	180 / 10	30	1
	E22B1	2332	185 / 10	174	1
	E22C1	2335	200 / 5	72	2
	E22C2	2336	205 / 5	390	1
	E22C3	2337	210 / 5	83	1
	E22D1	2338	215 / 2.5	112	1
	E22E3	2343	240 / 15	17	1
	E22F3	2346	255 / 2.5	8	1
	E22G3	2349	270 / 2.5	142	1
E23 TANQUA SYSTEM	E23B1	2353	290 / 10	2	1
	E23D3	2361	330 / 10	247	1
	E23E1	2362	335 / 10	131	1
	E23E2	2363	340 / 10	54	1
	E23E3	2364	345 / 10	34	1
	E23F2	2366	355 / 2.5	24	1
	E23F3	2367	360 / 2.5	764	1
	E23J3	2376	405 / 5	351	1
	E23K3	2379	420 / 2.5	812	1
E40 OORLOGS-KLOOF SYSTEM	E40A1	2380	425 / 2.5	1	1
	E40A2	2381	430 / 2.5	2	
	E40A3	2382	435 / 2.5	189	
	E40B2	2384	445 / 2.5	74	
	E40B3	2385	450 / 2.5	2	
	E40C2	2387	460 / 2.5	173	
	E40C3	2388	465 / 2.5	59	
	E40D1	2389	470 / 2.5	330	
E24 LOWER DOORN SYSTEM	E24B2	2396	505 / 10	1	
	E24C3	2400	525 / 15	509	
	E24D3	2403	540 / 15	50	
	E24E2	2405	550 / 15	1	
	E24E3	2406	555 / 15	103	
	E24F3	2409	570 / 15	43	
	E24G3	2412	585 / 2.5	446	
	E24H3	2415	600 / 15	334	
	E24J1	2416	605 / 2.5	11	
	E24J3	2418	615 / 2.5	437	
	E24L3	2424	645 / 15	1 777	
	E24M1	2425	650 / 2.5	2	
	E24M2	2426	655 / 2.5	12	
	E24M3	2427	660 / 2.5	279	
OLIFANTS	E10A3	2430	675 / 15	1 380	7

Monthly Crop Coefficients for Different Irrigated Crop Combinations

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Crop Combo 1	0.65	0.61	0.53	0.48	0.55	0.79	0.99	0.86	0.47	0.47	0.47	0.56
Crop Combo 2	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Crop Combo 3	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Crop Combo 4	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Crop Combo 5	0.46	0.46	0.46	0.54	0.63	0.71	0.79	0.71	0.58	0.54	0.54	0.54
Crop Combo 6	0.25	0.25	0.33	0.42	0.67	0.67	0.83	0.88	0.67	0.58	0.50	0.42
Crop Combo 7	0.38	0.38	0.46	0.54	0.63	0.71	0.74	0.83	0.75	0.67	0.58	0.58
Crop Combo 8	0.63	0.63	0.67	0.71	0.79	0.83	0.88	0.96	0.63	0.63	0.63	0.63
Crop Combo 9	0.31	0.30	0.30	0.37	0.51	0.60	0.66	0.68	0.56	0.50	0.41	0.38

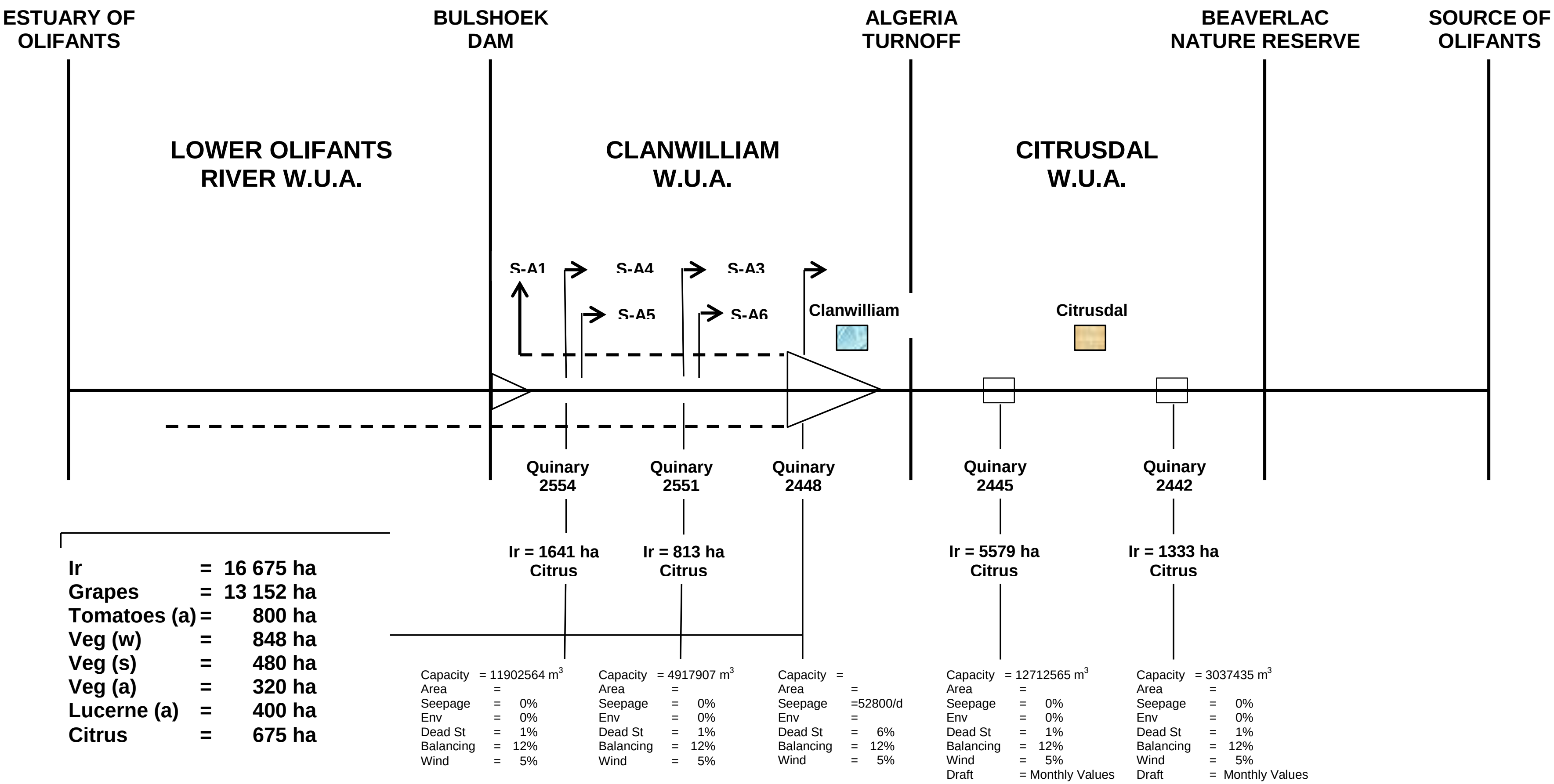
Natural Vegetation Acocks Veld Type 69 Macchia

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	De
Crop coefficient	0.45	0.45	0.50	0.60	0.60	0.60	0.60	0.60	0.60	0.55	0.50	0.4
Interception (mm)	1.00	1.00	1.10	1.20	1.20	1.20	1.20	1.20	1.10	1.10	1.00	1.0
Roots in Topsoil	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.8
Coef of Initial Abstraction	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.3

Natural Vegetation Acocks Veld Type 31 Succulent Karroo

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Crop Coefficient	0.30	0.30	0.30	0.30	0.30	0.40	0.40	0.35	0.30	0.30	0.30	0
Interception (mm)	0.20	0.20	0.20	0.25	0.35	0.40	0.35	0.30	0.20	0.20	0.20	0
Roots in Topsoil	0.90	0.90	0.90	0.90	0.95	1.00	1.00	0.95	0.90	0.90	0.90	0
Coef of Initial Abstraction	0.20	0.20	0.30	0.30	0.30	0.30	0.30	0.30	0.20	0.30	0.30	0

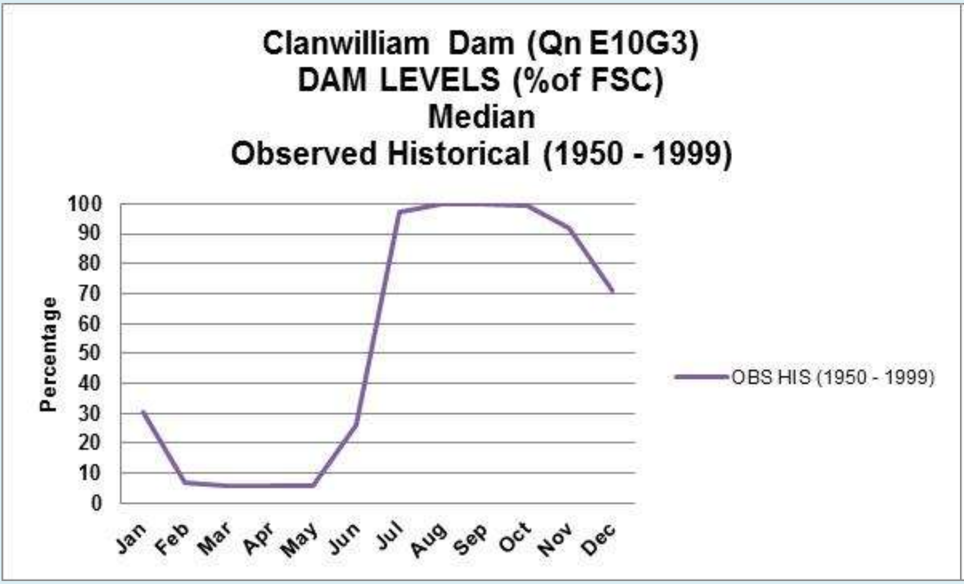
Irrigation Decisions

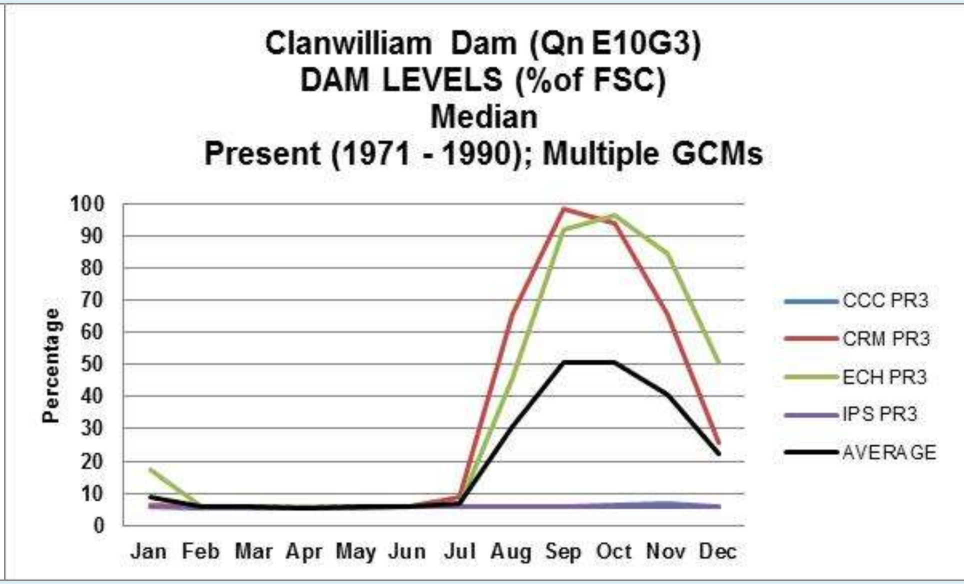


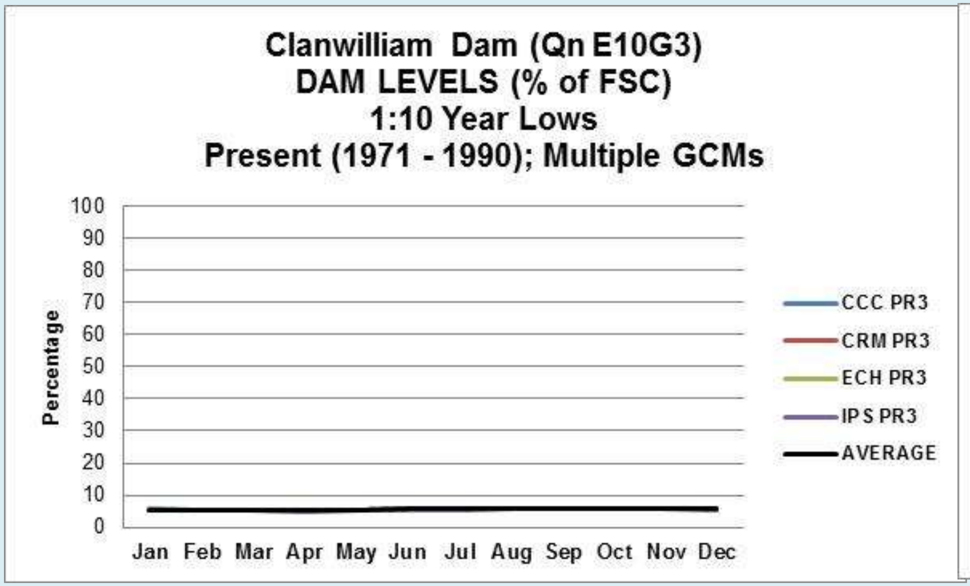
Storage Reservoir Information

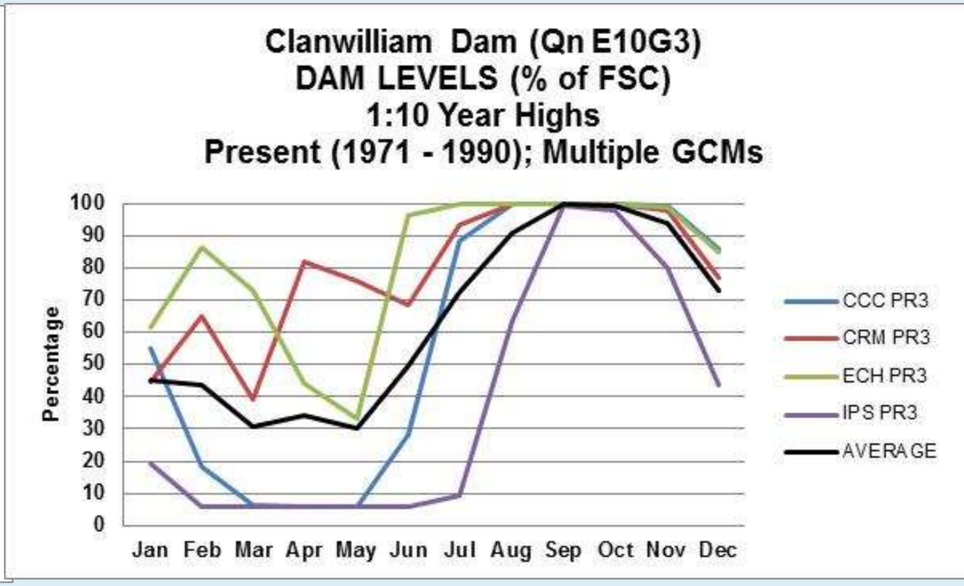
Quinary	HRU	Capacity (m^3) at FSC	Surface Area (ha)	Releases and Losses (m^3/day)
2442	735	3 037 435	44.8	Dummy Dam
2443	739	50 000	1.9	Dummy Dam -
2445	750	12 712 565	135.0	Dummy Dam -
2448	765	124 000 000	1436.0	335 963 Clanwilliam Dam
2451	780	9 600 633	108.7	Dummy Dam
2454	795	20 032 030	191.6	Dummy Dam
2517	872	50 000	1.9	Dummy Dam

Month	Reservoir Evaporation as a Fraction of A-Pan Evaporation (Every Dam)	Abstractions from Dummy Dam in Quinary 2442 HRU 735 to Supply Irrig & Citrusdal ($10^6 m^3$/month)	Return Flows from Citrusdal into Dummy Dam in Quinary 2443 HRU 739 ($10^6 m^3$/month)	Abstractions from Clanwilliam Dam in Quinary 2448 HRU 765 to Supply Downstream Irrig & Towns ($10^6 m^3$/month)	Return Flows from Towns into Quinary 2517 HRU 872 ($10^6 m^3$/ month)	Abstractions from Dummy Dam in Quinary 2445 HRU 750 to Supply Irrigation ($10^6 m^3$/month)
Jan	0.67	1.957711	0.0031	20.99585	0.346	8.167656
Feb	0.68	1.957112	0.0028	16.64503	0.346	7.587018
Mar	0.70	1.795086	0.0031	15.19475	0.346	4.083828
Apr	0.68	0.981756	0.0030	9.39365	0.346	3.403190
May	0.67	0.819330	0.0031	6.49310	0.346	8.167656
Jun	0.65	0.493878	0.0030	3.59255	0.346	2.041914
Jul	0.60	0.819330	0.0031	3.59255	0.346	2.041914
Aug	0.58	1.469634	0.0031	5.04283	0.346	3.403190
Sep	0.60	1.632460	0.0030	6.49310	0.346	6.125742
Oct	0.62	1.957512	0.0031	9.39365	0.346	6.806380
Nov	0.63	1.957712	0.0030	12.29420	0.346	8.167656
Dec	0.64	1.957712	0.0031	15.19475	0.346	8.167656


Clanwilliam Dam (Qn E10G3)
DAM LEVELS (%of FSC)
Median
Observed Historical (1950 - 1999)
Percentage
100
90
80
70
60
50
40
30
20
10
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
OBS HIS (1950 - 1999)


Clanwilliam Dam (Qn E10G3)
DAM LEVELS (%of FSC)
Median
Present (1971 - 1990); Multiple GCMs
Percentage
100
90
80
70
60
50
40
30
20
10
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
CCC PR3
CRM PR3
ECH PR3
IPS PR3
AVERAGE

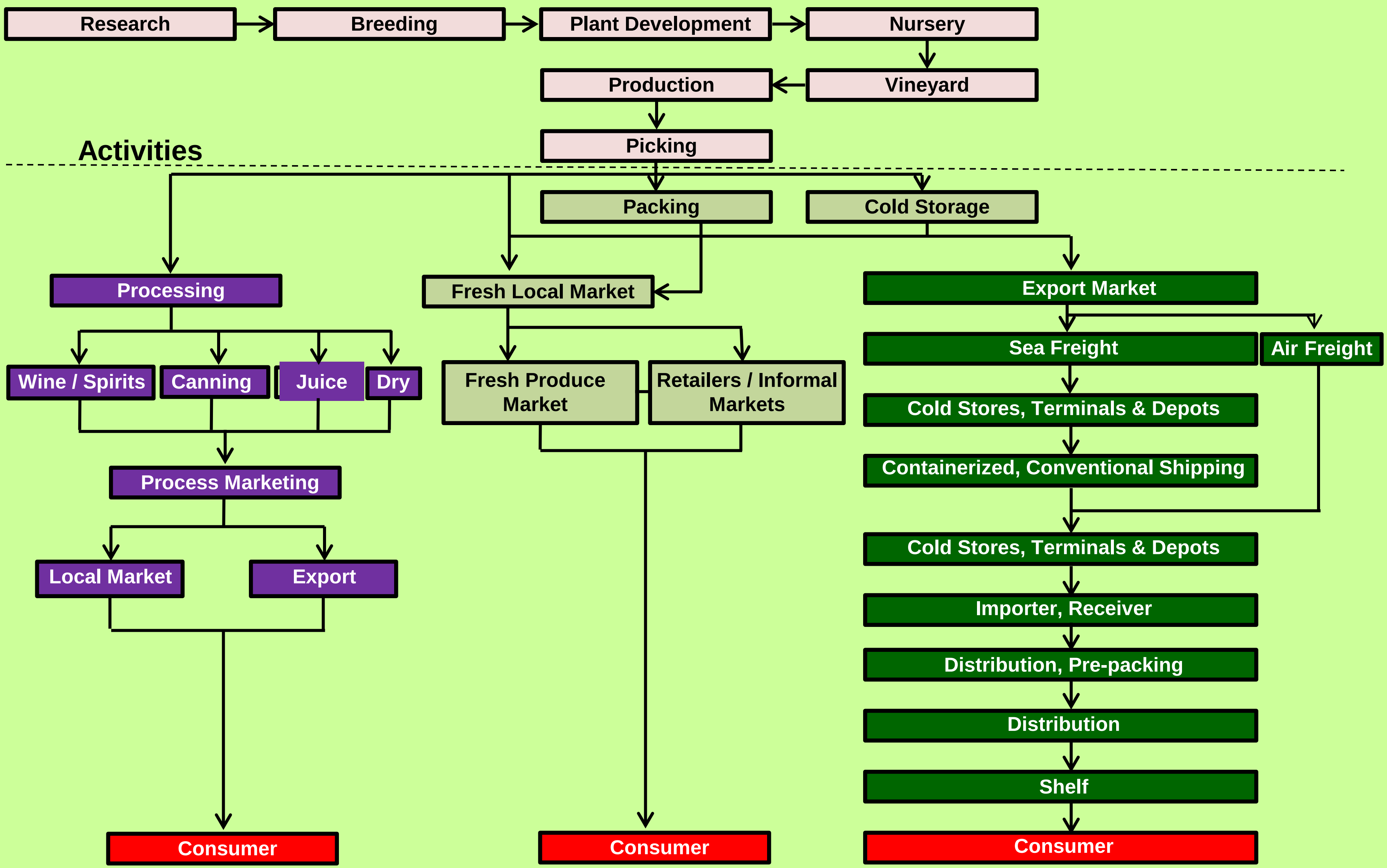

Clanwilliam Dam (Qn E10G3)
DAM LEVELS (% of FSC)
1:10 Year Lows
Present (1971 - 1990); Multiple GCMs
Percentage
100
90
80
70
60
50
40
30
20
10
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
CCC PR3
CRM PR3
ECH PR3
IPS PR3
AVERAGE


Clanwilliam Dam (Qn E10G3)
DAM LEVELS (% of FSC)
1:10 Year Highs
Present (1971 - 1990); Multiple GCMs
Percentage
100
90
80
70
60
50
40
30
20
10
0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
CCC PR3
CRM PR3
ECH PR3
IPS PR3
AVERAGE

Quo vadis re. CC?
2. We Have To Consider The Entire Value Chain

Table Grape Supply Chain

(Modified After: OABS, 2006)



Actors in the grape value chain & their exposure to CC impacts (WRC K5/1882, 2013)

Producers

- High input cost:land value ratio because increases in variable production costs/risks
- Increased costs of mitigating impacts of high temperatures, e.g. shade cloth, drip irrg

Processors

- Increased risks during packaging and transport due to increased temperatures
- Higher costs of air conditioning and cold chain maintenance
- Market supply remains a weather/climate related variable. If the timing of grape ripening period is altered, then profitability of grapes reaching the market affected
- External input providers (non-grape raw material, transport, packaging etc)
- Risks to power supply (& knock on risk to transport), due to increased temperature and more intense rainfall in electricity production areas
- Access and availability of water, leading to price increases
- Increased temperatures & moisture increase demand for pesticides & thus costs

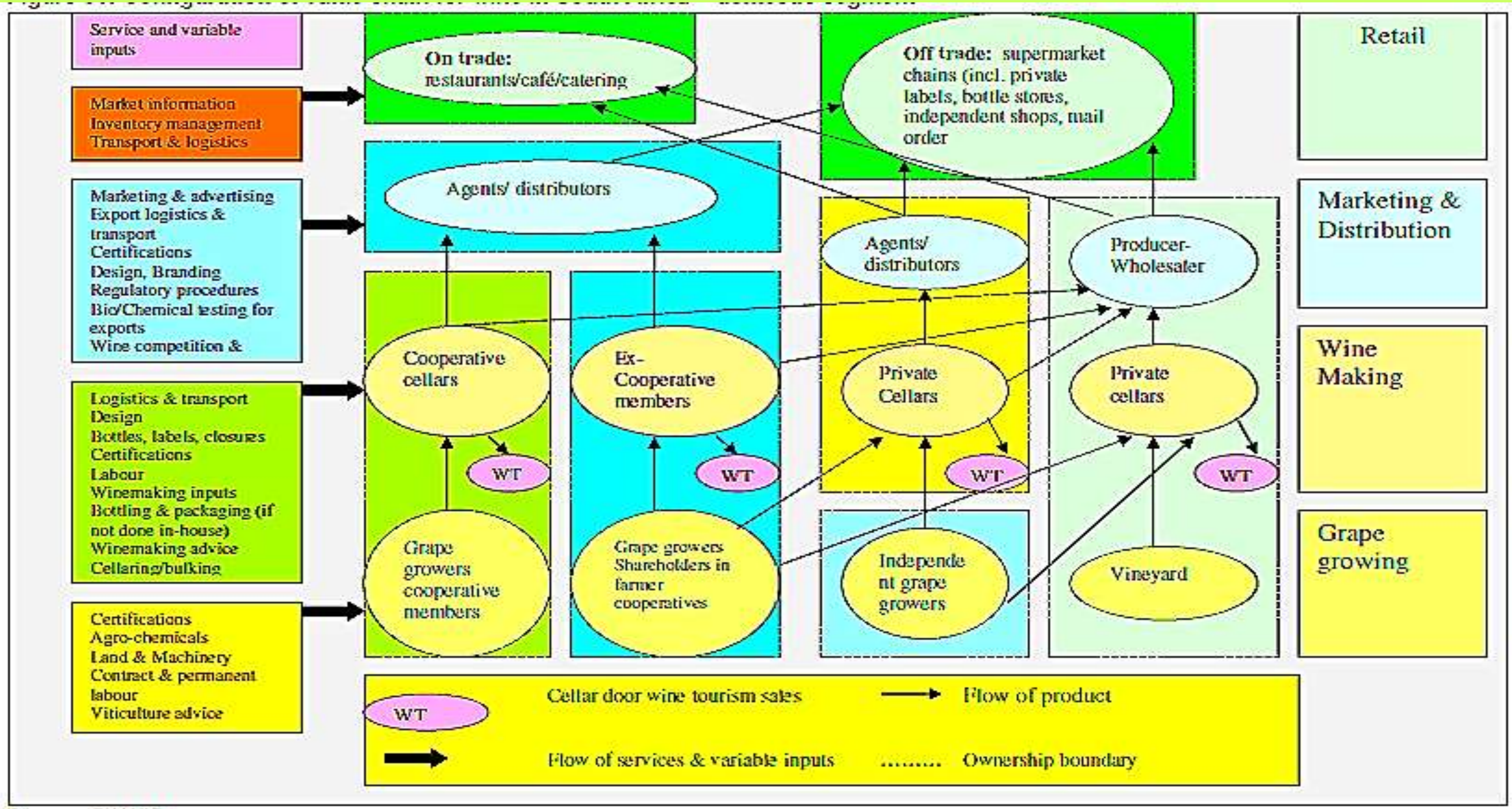
Wholesalers/Retailers

- Distribution risks due to transport cost & threats
- Increased risk of spoilage due to ↗ temperatures & variable, more intense, rainfall
- Increased raw material costs→ higher selling prices→ competition to export markets

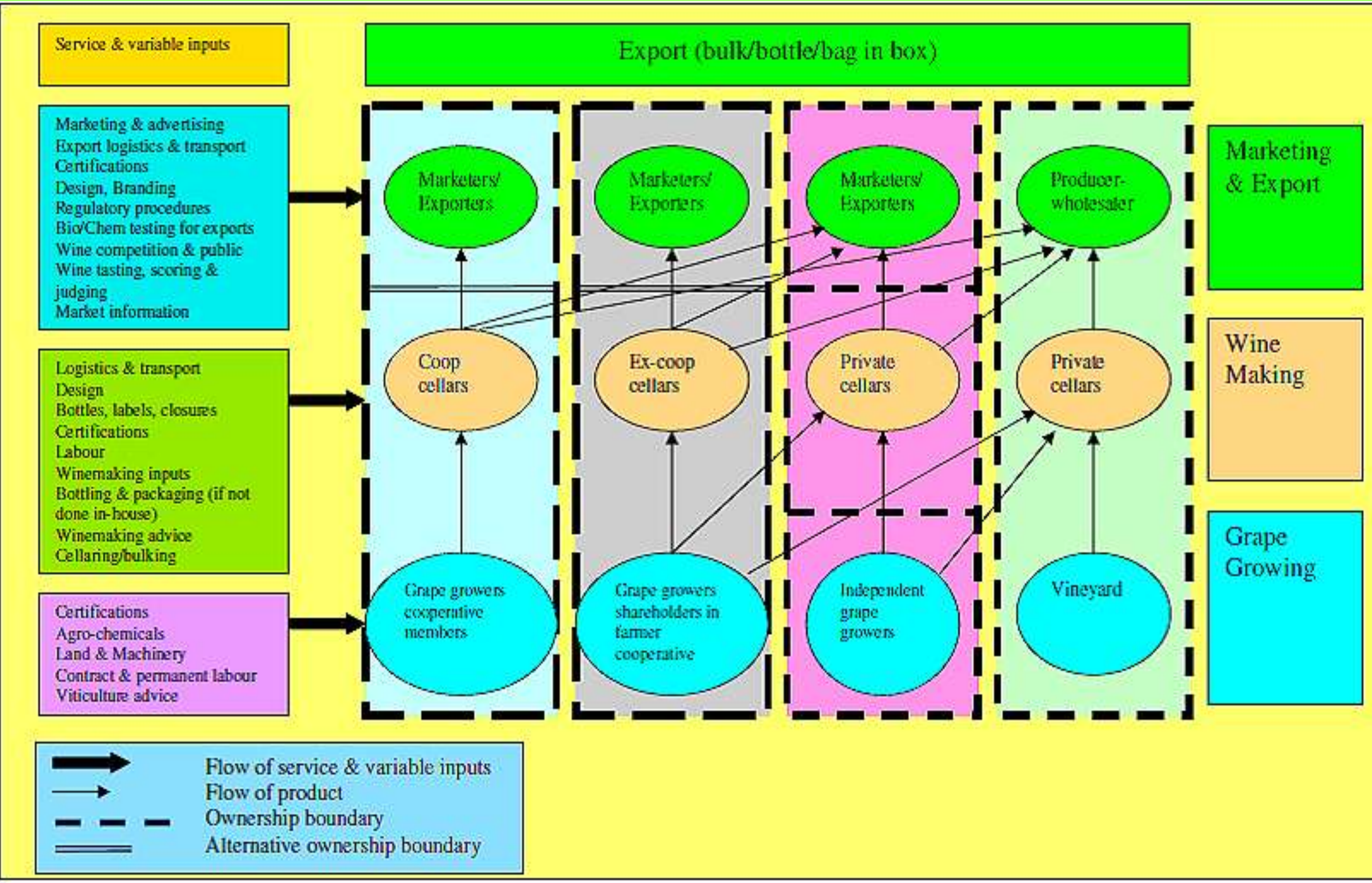
Socio-economic issues

- Decreasing production reduces seasonal & permanent labour → unemployment
- Any risks carried through to retailers will be reflected in the price & supply of fruit

The SA Wine Value Chain – Domestic Segment (SAWIS, 2010)



The SA Wine Value Chain – Export Segment (SAWIS, 2010)



Quo vadis re. CC?
3. We Have To Consider Management


ZS-HCU

Quo vadis re. CC?
4. We Have To Consider Crop and Location Specific Adaptation

Adaptation strategies
Olifants West

Wine grape cultivars

Red wine grape cultivars that will be **more tolerant** towards climate change include **Cabernet Sauvignon, Pinotage and Ruby**. Red wine grape cultivars that will be **most vulnerable** towards climate change are **Shiraz and Merlot**.

Oosthuizen and Louw, 2014

Adaptation strategies
Olifants West

<u>White wine</u> grape cultivars that will be **more tolerant** towards climate change include **Chenin Blanc and Colombard.** White wine grape cultivars that will be **most vulnerable** towards climate change include **Sauvignon Blanc and Chardonnay.**

Oosthuizen and Louw, 2014

Adaptation strategies
Olifants West

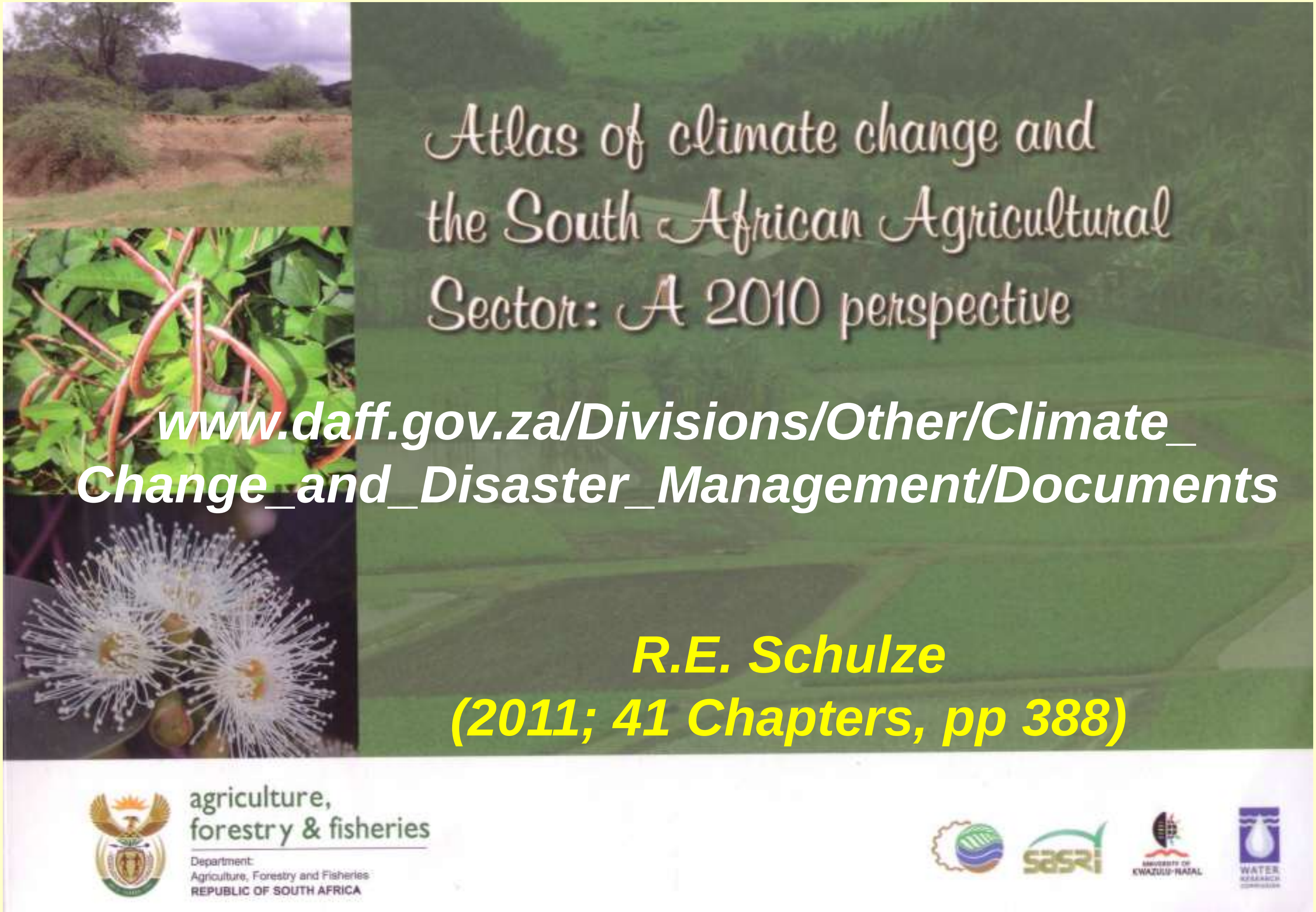
Increase in Table Grape production under nets

- More efficient water use
- More consistent yield and quality
- Increase in quality (less wind damage, less quality loss due to birds)
- Lower input cost (lower labour cost due to increased quality)

Quo vadis…In the Final Analysis?

1. More research … lowered uncertainties ?
2. What is the cost of adapting ?
3. What are the consequences of NOT adapting ?
4. Ecosystem vs. engineering based adaptation
5. Are we asking the right questions ?
6. Optimise growing regions in SA for cultivars for future climates

The Time Has Come To Move From Rhetoric To Action.. From Having 5 Year Perspectives to 50 Year Visions



www.daff.gov.za/Divisions/Other/Climate_ Change_and_Disaster_Management/Documents

R.E. Schulze
(2011; 41 Chapters, pp 388)