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 CO₂ 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 (CO₂, N₂O, CH₄)
The Enhanced Greenhouse Effect

Solar radiation

Long-wave radiation
3. So, What Are We Already Observing?
Considerable changes have occurred since the industrial revolution.

**CO₂ radiative forcing has increased by ~ 20% in past 10 years**
Result 2. Global mean temperatures are rising faster with time.

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate</th>
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<tr>
<td>50</td>
<td>$0.128 \pm 0.026$</td>
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<tr>
<td>100</td>
<td>$0.074 \pm 0.018$</td>
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Warmest 17 years to 2011:

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
Winter Heat Units Increasing
May-Sept Chill Units Decreasing
No. of Frost Occurrences Decreasing
Date of Last Frost is Earlier

Observed Trends Over SA 1950 - 2000
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

FLOWPATH CONFIGURATION WHEN MODELLING AT QUINARY CATCHMENT SCALE
QC V11A
V11A 1  V11A 2  V11A 3
QC V11C
V11C 1  ...  2  V11D 3
. . .
Flowpath
Quaternary Catchment Outlet
External Quaternary Catchment
Internal Quaternary Catchment
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

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

By 2050s

By 2090s

Changes in the Standard Deviation of Annual Temperature

By 2050s

By 2090s

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

By 2050s
5 – 10 %

By 2090s
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
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

Present Climate

$T = T + 1^\circ C$

Days
- Frost Free Area
- $< 20$
- $20 - 40$
- $40 - 60$
- $60 - 80$
- $> 80$

$T = T + 2^\circ C$

$T = T + 3^\circ C$

...and what are the agricultural consequences?
Chill Units

Accumulated Positive Chill Units
Winter (April to September)

PCUs
- < 250
- 250 - 500
- 500 - 750
- 750 - 1000
- 1000 - 1250
- 1250 - 1500
- 1500 - 1750
- > 1750
### Changes in Positive Chill Units Will Decrease with Increases in Temperature

<table>
<thead>
<tr>
<th>Province / Country</th>
<th>Present Climate</th>
<th>T=T+1°C (= % reduction)</th>
<th>T+2°C (= % reduction)</th>
<th>T+3°C (= % reduction)</th>
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<tbody>
<tr>
<td>Limpopo</td>
<td>222</td>
<td>144 (-35%)</td>
<td>87 (-61%)</td>
<td>49 (-80%)</td>
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<tr>
<td>Mpumalanga</td>
<td>671</td>
<td>532 (-21%)</td>
<td>405 (-40%)</td>
<td>292 (-56%)</td>
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<tr>
<td>North West</td>
<td>547</td>
<td>435 (-20%)</td>
<td>331 (-39%)</td>
<td>239 (-56%)</td>
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<tr>
<td>Northern Cape</td>
<td>821</td>
<td>670 (-18%)</td>
<td>538 (-34%)</td>
<td>403 (-51%)</td>
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<tr>
<td>Gauteng</td>
<td>746</td>
<td>589 (-21%)</td>
<td>441 (-41%)</td>
<td>311 (-59%)</td>
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<tr>
<td>Free State</td>
<td>934</td>
<td>805 (-14%)</td>
<td>673 (-28%)</td>
<td>540 (-42%)</td>
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<tr>
<td>KwaZulu-Natal</td>
<td>102</td>
<td>936 (-24%)</td>
<td>756 (-48%)</td>
<td>180 (-61%)</td>
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<tr>
<td>Eastern Cape</td>
<td>914</td>
<td>738 (-19%)</td>
<td>577 (-37%)</td>
<td>432 (-53%)</td>
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<tr>
<td>Western Cape</td>
<td>1068</td>
<td>825 (-23%)</td>
<td>607 (-43%)</td>
<td>425 (-60%)</td>
</tr>
<tr>
<td>Swaziland</td>
<td>222</td>
<td>147 (-37%)</td>
<td>87 (-63%)</td>
<td>47 (-80%)</td>
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<tr>
<td>Lesotho</td>
<td>1572</td>
<td>1472 (-6%)</td>
<td>1348 (-14%)</td>
<td>1202 (-24%)</td>
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</tbody>
</table>

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

Life Cycles p.a. of Codling Moth

& Projected Changes by 2050s

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...

Repercussions: Agricultural labourers

Schulze, 2013
9. We Have To Consider The Irrigation Set-up
CC and Irrigation Water Usage

Commercial

Community

Photo: C. Dickens
What About Irrigation Water Demand by Crops?

Volume of soil water available 
\( f (\text{soil depth/texture, rooting depth}) \)

Root Development 
\( f (1/\text{canopy development}) \)

Irrigation Crop Water Demand and Scheduling Processes

Transpiration from the Plant 
\( f (\text{soil water/stress interactions, canopy development}) \)

Evaporation from Soil Surface 
\( f (\text{rain/irrigation frequency, type of irrigation system, soil water content, canopy development, mulching}) \)

Root Development 
\( f (1/\text{canopy development}) \)

Rainfall 
and/or
Irrigation Applications by Different Systems

Stormflow 
\( f (\text{rainfall/irrigation, surface roughness, antecedent soil moisture}) \)

Volume of soil water available 
\( f (\text{soil depth/texture, rooting depth}) \)

Return Flows (to river) 
\( f (\text{soil properties, field condition, excess soil water}) \)

Drainage
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
Soil & Climate

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

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

Harvest Criteria

Sugar & Potassium Accumulation

Organic Acid Formation

Objective

Grape & Wine Quality

Photosynthetic Activity

Colour and Flavour

Pre- vs Post Véraison

Optimal vs Too Cold/Too Hot

Nature

Management
The SA Daily Temperature Database Development

1. Methodology

Obtain temperature data from all sources, quality control it, and extend record to a common 50-year period.

Establish lapse rates by variable, by month, by region.

Use a DEM + region + lapse rates + data from quality controlled temperature stations to determine daily temperatures for 50 years at 429700 points and verify results.

Determine lapse rates for $T_{\text{max}}$ and $T_{\text{min}}$ for each month and each region.

Determine zones of similar temperature-altitude relationships.

Schulze & Maharaj, 2004
### Calculated Hourly Temperatures

| Day | Min (°C) | Max (°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 | 15.6 | 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 | 21.9 | 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 | 16.3 |
| 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 |

### 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**

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Grapevine Colour & Flavour Requirements

% Day-Time Temperatures Too High

% Night-Time Temperatures Too High
Comparative Analysis, Photosynthetic Analysis
Future vs Present Climatic Conditions

Grapevine Photosynthetic Activity
% Optimum Temperature
25 - 30 °C, from 09:00 - 15:00

Pre- vs Post-Véraison, Future vs Present Climate

Grapevine Photosynthetic Activity
% Thermal Temperature Stress, Too Cold
< 20 °C, from 09:00 - 15:00

Pre- vs Post-Véraison, Future vs Present Climate

Grapevine Photosynthetic Activity
% Thermal Temperature Stress, Too Hot
> 35 °C, from 09:00 - 15:00

Pre- vs Post-Véraison, Future vs Present Climate
Comparative Analysis, Colour & Flavour Requirements
Future vs Present Climatic Conditions

Grapevine Colour & Flavour Requirements
% Optimum Day-Time Temperatures
20 - 25 °C, from 06:00 - 18:00
Pre- vs Post-Verasion, Future vs Present Climate

Grapevine Colour & Flavour Requirements
Day-Time Temperatures, Too High
> 30 °C, from 06:00 - 18:00
Pre- vs Post-Verasion, Future vs Present Climate

Grapevine Colour & Flavour Requirements
Night-Time Temperatures, Too High
> 20 °C, from 18:00 - 06:00
Pre- vs Post-Verasion, Future vs Present Climate
Let’s Focus on Kakamas

Kakamas Photosynthetic Activity
Temperature Related, Future vs Present Climate

Kakamas
Colour & Flavour Requirements
Temperature Related, Future vs Present Climate
Quo vadis re. CC?

1. We Need to Consider Entire Regional Farming Systems
Case Study: Olifants-Doorn Catchment, W. Cape
Catchment Configuration

OLIFANTS SYSTEM E10

LEEUW SYSTEM E21

UPPER DOORN E22

TANKWA SYSTEM E23

E31 KROMME SYSTEM

E32 HANTAMS SYSTEM

E40 OORLOGSKLOOF SYSTEM

E24 LOWER DOORN SYSTEM
## Irrigation and Land Cover Information

### Monthly Crop Coefficients for Different Irrigated Crop Combinations

<table>
<thead>
<tr>
<th>Month</th>
<th>07</th>
<th>08</th>
<th>09</th>
<th>10</th>
<th>11</th>
<th>12</th>
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<th>06</th>
<th>07</th>
<th>08</th>
<th>09</th>
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</thead>
<tbody>
<tr>
<td>Crop Combo 1</td>
<td>0.65</td>
<td>0.61</td>
<td>0.53</td>
<td>0.48</td>
<td>0.55</td>
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### Natural Vegetation Acoks Veld Type 59 Macchia

<table>
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<tr>
<th>Month</th>
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<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
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<tbody>
<tr>
<td>Crop Coefficient</td>
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<td>0.45</td>
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<td>0.60</td>
<td>0.60</td>
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<tr>
<td>Interception (mm)</td>
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<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
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<td>1.20</td>
<td>1.20</td>
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<td>Roots in Topsoil</td>
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### Natural Vegetation Acoks Veld Type 31 Succulent Karroo

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<th>May</th>
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<tr>
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<td>Interception (mm)</td>
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<td>Roots in Topsoil</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
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<td>0.90</td>
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<td>0.90</td>
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<tr>
<td>Coef of Initial Abstraction</td>
<td>0.20</td>
<td>0.20</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
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</tbody>
</table>
Irrigation Decisions

- **ESTUARY OF OLIFANTS**
- **BULSHOEK DAM**
- **CLANWILLIAM W.U.A.**
- **ALGERIA TURNOFF**
- **BEAVERLAC NATURE RESERVE**
- **SOURCE OF OLIFANTS**

**LOWER OLIFANTS RIVER W.U.A.**
- **Ir** = 16675 ha
- **Citrus** = 675 ha
- **Quinary** 2554

**CLANWILLIAM W.U.A.**
- **Ir** = 1641 ha
- **Grapes** = 13152 ha
- **Tomatoes (a)** = 800 ha
- **Veg (w)** = 848 ha
- **Veg (s)** = 480 ha
- **Veg (a)** = 320 ha
- **Lucerne (a)** = 400 ha
- **Citrus** = 675 ha

**ALGERIA TURNOFF**
- **Ir** = 813 ha
- **Citrus** = 1333 ha
- **Quinary** 2551

**SOURCE OF OLIFANTS**
- **Ir** = 5579 ha
- **Citrus** = 1333 ha
- **Quinary** 2445

**BEAVERLAC NATURE RESERVE**
- **Ir** = 1333 ha
- **Citrus** = 1333 ha
- **Quinary** 2442

**Capacity**
- **11902564 m³**
- **4917907 m³**
- **12712565 m³**
- **3037435 m³**

**Area**
- **S-A1**
- **S-A4**
- **S-A5**
- **S-A6**
- **S-A3**
- **S-A2**

**Seepage**
- **0%**
- **0%**
- **0%**
- **0%**
- **0%**
- **0%**

**Env**
- **0%**
- **0%**
- **0%**
- **0%**
- **0%**
- **0%**

**Dead St**
- **1%**
- **1%**
- **1%**
- **1%**
- **1%**
- **1%**

**Balancing**
- **12%**
- **12%**
- **12%**
- **12%**
- **12%**
- **12%**

**Wind**
- **5%**
- **5%**
- **5%**
- **5%**
- **5%**
- **5%**

**Draft**
- **Monthly Values**
- **Monthly Values**

**Ir** = 5579 ha
**Citrus** = 1333 ha
**Quinary** 2445

**Ir** = 1333 ha
**Citrus** = 1333 ha
**Quinary** 2442
<table>
<thead>
<tr>
<th>Quinary</th>
<th>HRU</th>
<th>Capacity (m$^3$) at FSC</th>
<th>Surface Area (ha)</th>
<th>Releases and Losses (m$^3$/day)</th>
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<tbody>
<tr>
<td>2442</td>
<td>735</td>
<td>3 037 435</td>
<td>44.8</td>
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<tr>
<td>2443</td>
<td>739</td>
<td>50 000</td>
<td>1.9</td>
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<tr>
<td>2445</td>
<td>750</td>
<td>12 712 565</td>
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<td>2448</td>
<td>765</td>
<td>124 000 000</td>
<td>1436.0</td>
<td>335 963 Clanwilliam Dam</td>
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<td>9 600 633</td>
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<tr>
<td>2454</td>
<td>795</td>
<td>20 032 030</td>
<td>191.6</td>
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<tr>
<td>2517</td>
<td>872</td>
<td>50 000</td>
<td>1.9</td>
<td>Dummy Dam</td>
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<table>
<thead>
<tr>
<th>Month</th>
<th>Reservoir Evaporation as a Fraction of A-Pan Evaporation (Every Dam)</th>
<th>Abstractions from Dummy Dam in Quinary 2442 HRU 735 to Supply Irrig &amp; Citrusdal (10$^6$m$^3$/month)</th>
<th>Return Flows from Citrusdal into Dummy Dam in Quinary 2443 HRU 739 (10$^6$m$^3$/month)</th>
<th>Abstractions from Clanwilliam Dam in Quinary 2448 HRU 765 to Supply Downstream Irrig &amp; Towns (10$^6$m$^3$/month)</th>
<th>Return Flows from Towns into Quinary 2517 HRU 872 (10$^6$m$^3$/month)</th>
<th>Abstractions from Dummy Dam in Quinary 2445 HRU 750 to Supply Irrigation (10$^6$m$^3$/month)</th>
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<tbody>
<tr>
<td>Jan</td>
<td>0.67</td>
<td>1.957711</td>
<td>0.0031</td>
<td>20.99585</td>
<td>0.346</td>
<td>8.167656</td>
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<tr>
<td>Feb</td>
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<td>0.0028</td>
<td>16.64503</td>
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<tr>
<td>Mar</td>
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<td>0.0031</td>
<td>15.19475</td>
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<td>0.981756</td>
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<td>0.0031</td>
<td>6.49310</td>
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<td>0.819330</td>
<td>0.0031</td>
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<td>3.403190</td>
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<tr>
<td>Sep</td>
<td>0.60</td>
<td>1.632460</td>
<td>0.0030</td>
<td>6.49310</td>
<td>0.346</td>
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<td>Oct</td>
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<td>12.29420</td>
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<tr>
<td>Dec</td>
<td>0.64</td>
<td>1.957712</td>
<td>0.0031</td>
<td>15.19475</td>
<td>0.346</td>
<td>8.167656</td>
</tr>
</tbody>
</table>
Quo vadis re. CC?

2. We Have To Consider The Entire Value Chain
Table Grape Supply Chain
(Modified After: OABS, 2006)

Activities

Research → Breeding → Plant Development → Nursery → Production → Vineyard → Picking → Packing → Cold Storage

Processing
- Wine / Spirits
- Canning
- Juice
- Dry

Fresh Local Market
- Process Marketing
  - Local Market
  - Export
- Consumer

Fresh Produce Market
- Retailers / Informal Markets
  - Export Market
    - Sea Freight
      - Containerized, Conventional Shipping
        - Cold Stores, Terminals & Depots
          - Importer, Receiver
            - Distribution, Pre-packing
              - Distribution
                - Shelf
                  - Consumer

- Local Market
- Export

- Consumer

- Consumer
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 irrig

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

White wine 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)

Oosthuizen and Louw, 2014
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
Atlas of climate change and the South African Agricultural Sector: A 2010 perspective

www.daff.gov.za/Divisions/Other/Climate_Change_and_Disaster_Management/Documents

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