

Climate extremes and climate change impact on future scenarios

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with thanks to ARC-SCW colleagues

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*Presented at Symposium on UFS-WRC Agricultural Water Management Scenarios
29 Nov 2018, Pretoria*

Current climate across SADC

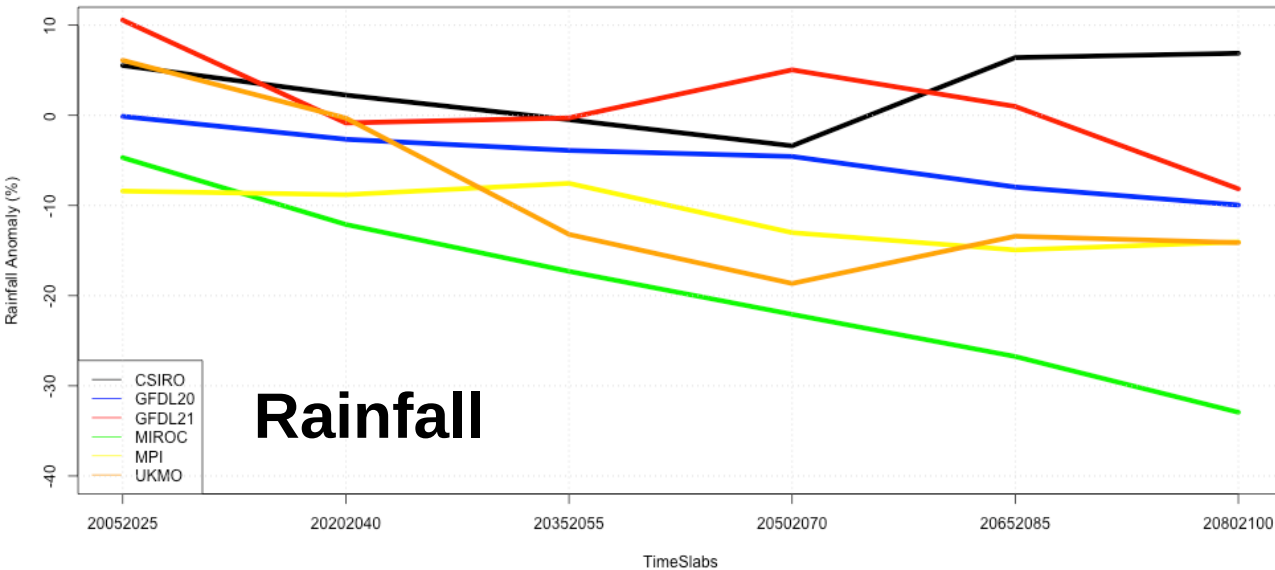


- Highly variable rainfall & frequent droughts.
- Future projections show continued variable rainfall and declining annual totals
- Different models give wide variation in future rainfall projections



Climate Change projections over South Africa

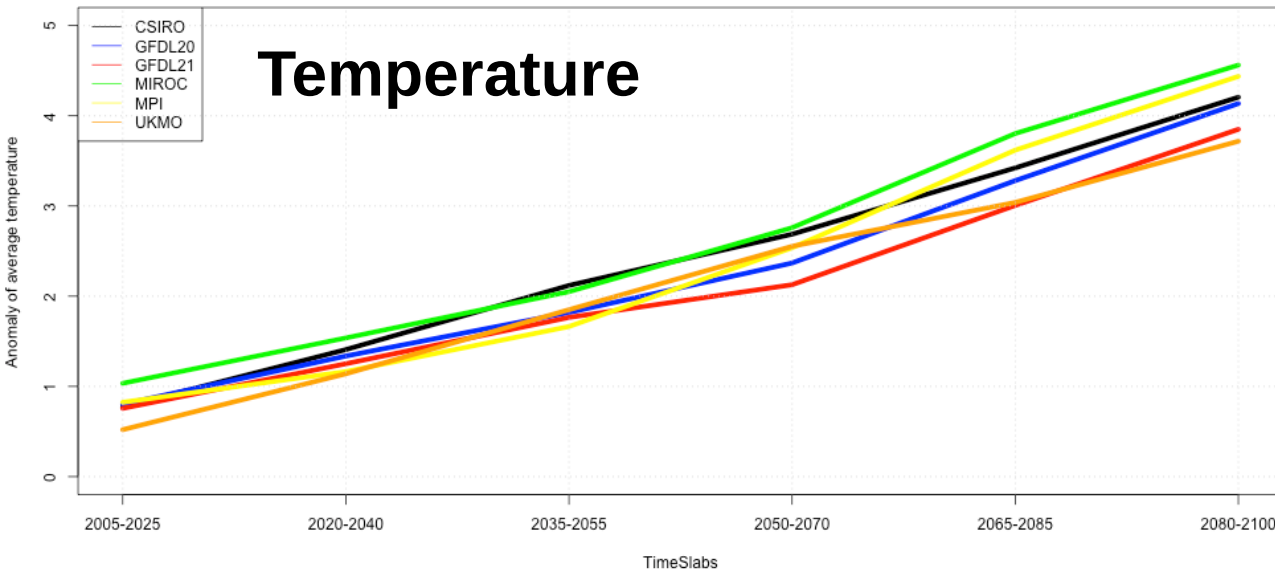
(a) from 6 climate models



Generally, predictions for rainfall are more difficult than prediction for temperatures.

For Rainfall -

as time increases (x-axis),
=> rainfall deviation from normal diverge notably.



For Temperature -

Most models give similar
increases in temperature
with time
by 2050-70: +2 to 2.5°C



Strong increases in warm extremes

Western, northeastern and extreme eastern parts

- stronger increases in warm extremes and
- decreases in cold extremes

Central parts

- relatively weaker warming trend

(Kruger & Sekele, 2013)

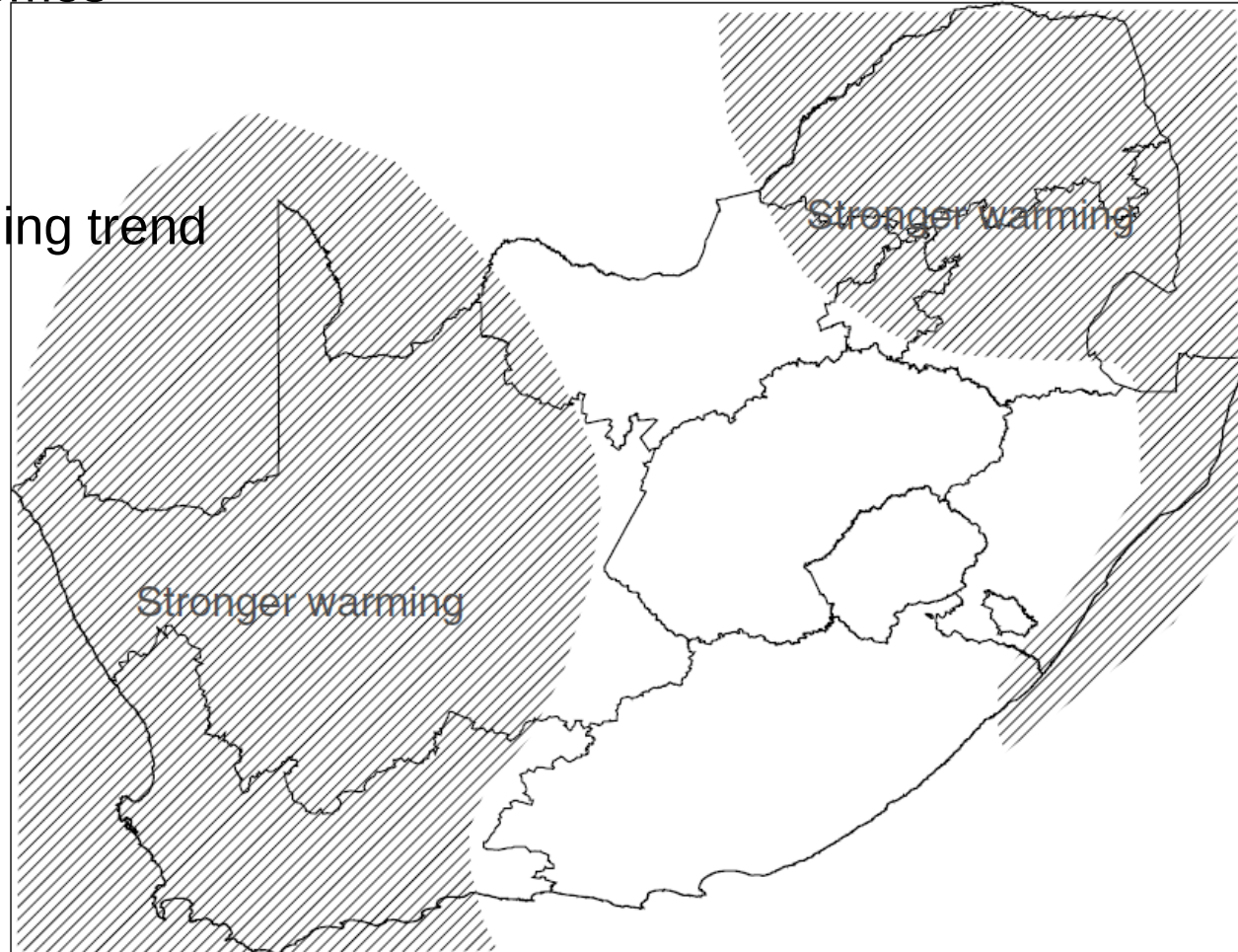


Figure 14. Summary of regions of relatively stronger warming in South Africa over the period 1962–2009

Heat waves & heat wave days in summer seasons (October to March)

Season	Number of heat waves	Number of “heat wave days”
2006/2007	6	21
2007/2008	0	0
2008/2009	1	4
2009/2010	1	3
2010/2011	1	4
2011/2012	3	11
2012/2013	2	6
2013/2014	2	6
2014/2015	1	4
2015/2016	12	71



Cropping with lower available rainfall

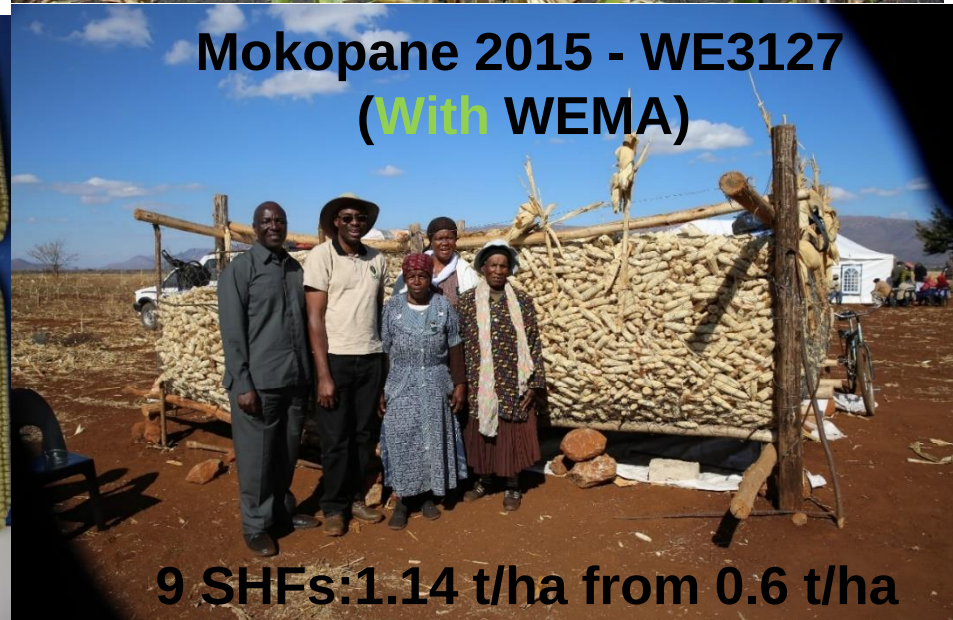
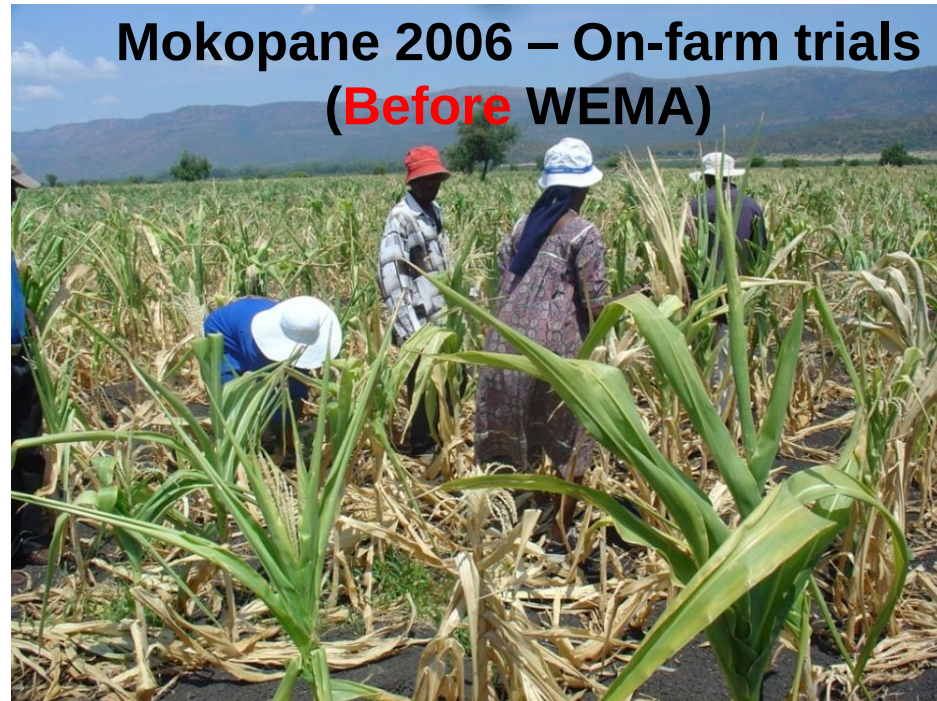
Maximize food-nutritional security under limited water resources

- Drought tolerant varieties
 - Maize – WEMA hybrids
 - Wheat – disease tolerant
 - Grapes – different rootstocks
 - Indigenous crops – honey-bush tea
- More water efficient
 - Root crops – sweet potatoes
- Rainwater harvesting
- Deficit irrigation



WEMA Drought **TEGO**[®] HYBRIDS

- Protection from drought
- Drought **TEGO**[®] varieties
- 14 hybrids registered
- Certified seed available:
WE3128, **WE3127**, **WE5321**,
WE5323



WEMA Drought **TELA**TM HYBRIDS

- Five Bt hybrids released and registered by ARC in 2017:
 - WE6206B; WE6207B
 - WE6208B; WE6209B
 - WE6210B
- ✓ Bt (MON89034) protection from stalk borer and fall armyworm



Heavy fall armyworm infestation in smallholder farmer's crop in Xikukwani, Limpopo province, (3 March 2017)

No fall armyworm
Damage in Bt crop



Wetlands help cope with extreme weather events

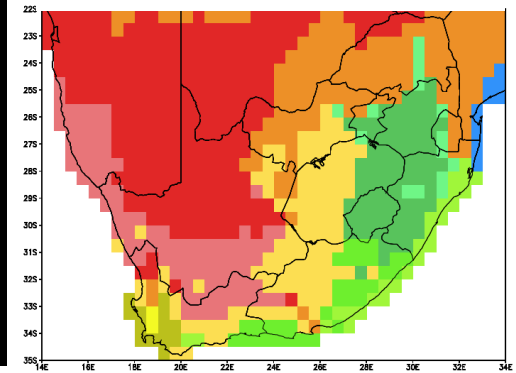
Good management of natural wetlands:

- Mangroves – roots bind shoreline & store carbon
- Rivers and flood plains - inland lakes & swamps act as a giant reservoir.
- Inland deltas - seasonal flows as strong natural safeguard against drought.
- Coral reefs – wave barrier & eco-tourism livelihoods
- Peatlands – 3% earth land surface & store Carbon

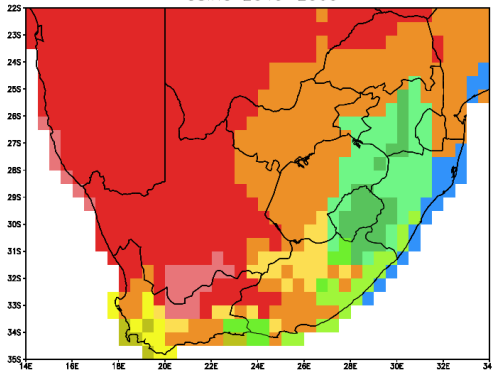


Projected Köppen-Geiger climate zones for a 2° C increase in average global temperature 2040-60

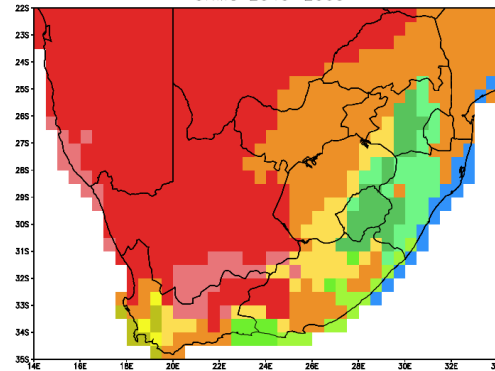
Present day climate



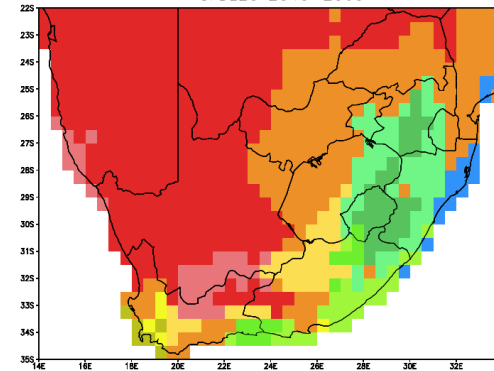
CSIRO 2040-2060



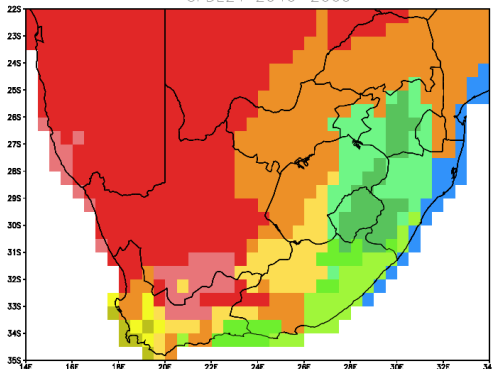
UKMO 2040-2060



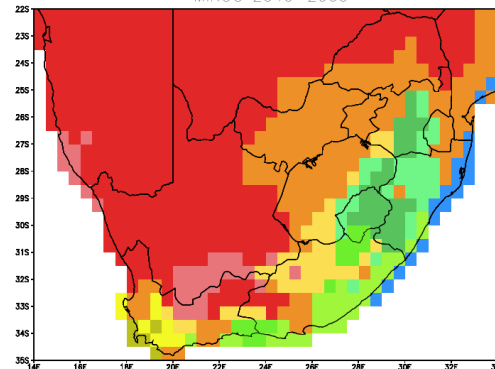
GFDL20 2040-2060



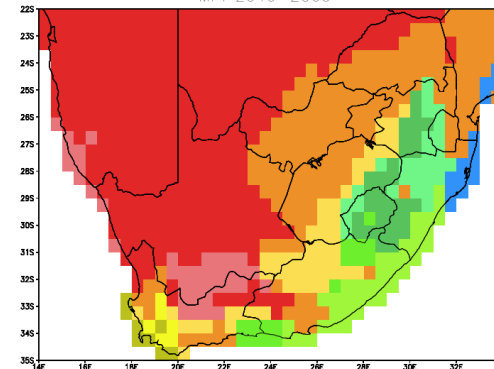
GFDL21 2040-2060



MIROC 2040-2060



MPI 2040-2060



Sustainable Cropping under Higher Temperatures

- Adapted varieties / crops
 - Low-chill stone fruit rootstocks
 - Pears & peaches for warmer winters
 - Cereals – maize to sorghum to millet
 - Legumes – beans / soybeans to cowpea to chickpea



Excellence in Research and Development

Sustainable Cropping under Higher Temperatures

Adapted varieties / crops

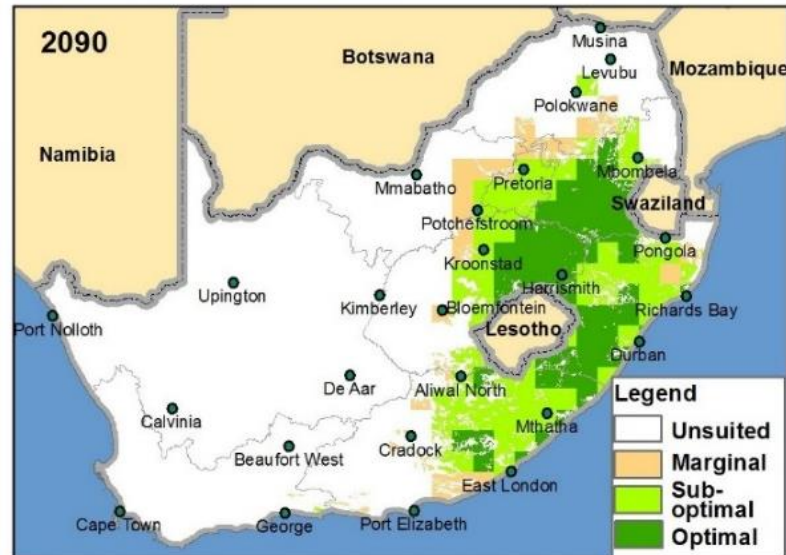
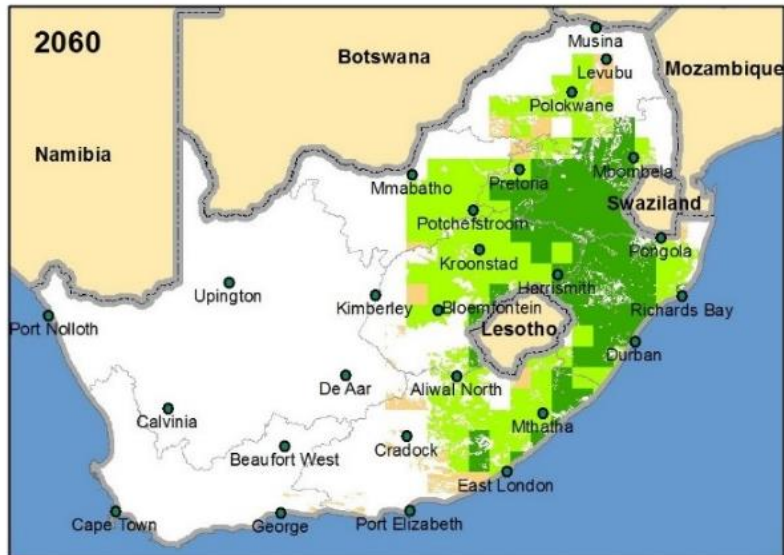
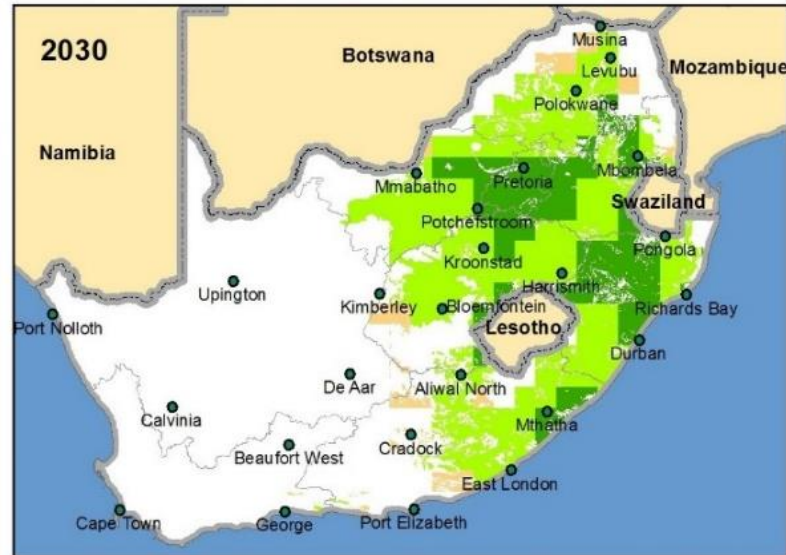
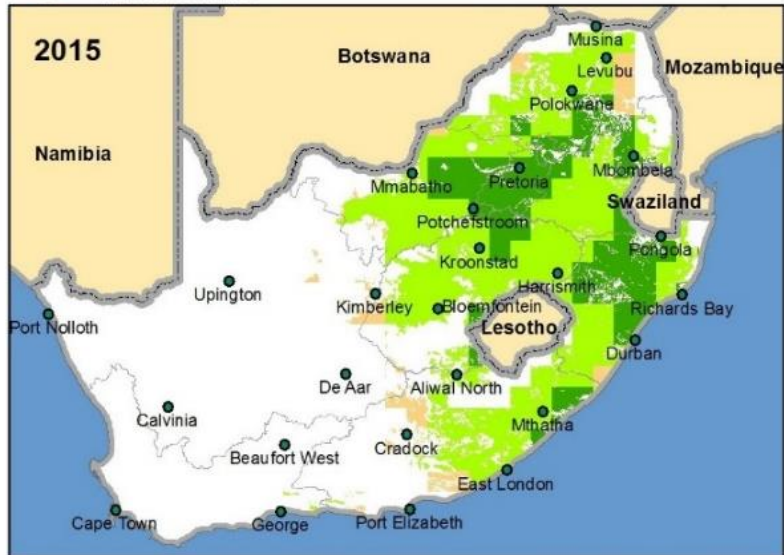
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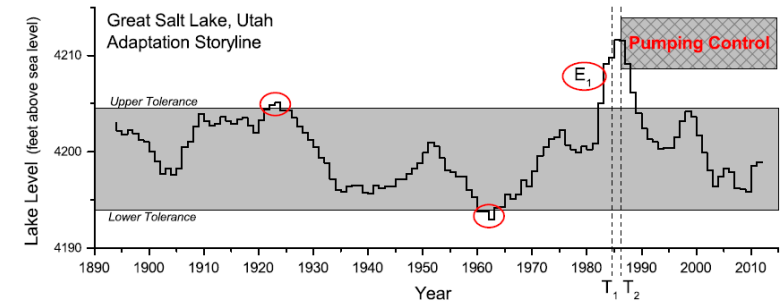
Shift in Maize Suitability Areas

Suitability for rainfed maize (long/medium growing period)

Criteria: rainfall, minimum temperature, maximum temperature and soil
 Median of six climate projections for 2015, 2030, 2060 and 2090



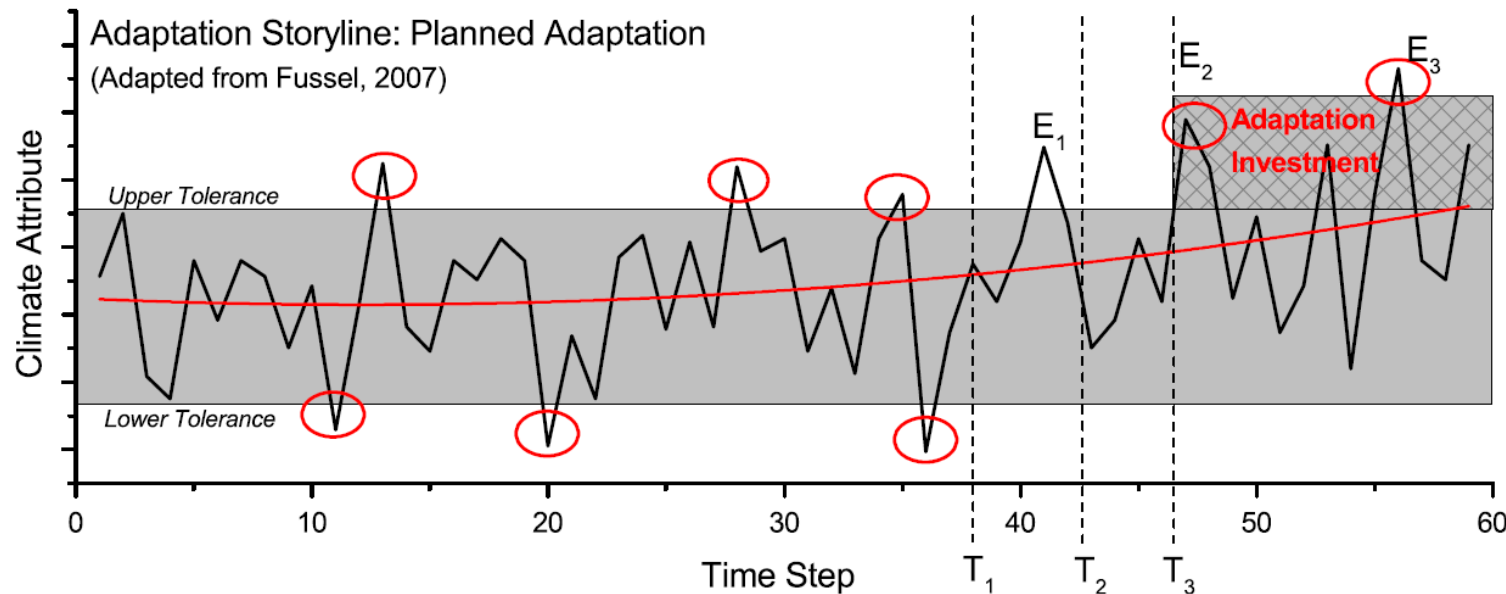
Adaptation Storyline



E_1 = Rapid rise to record lake level

T_1 = Managers begin to consider alternatives for controlling lake levels

T_2 = Pump system constructed and started; ran for 1.5 years before lake dropped naturally

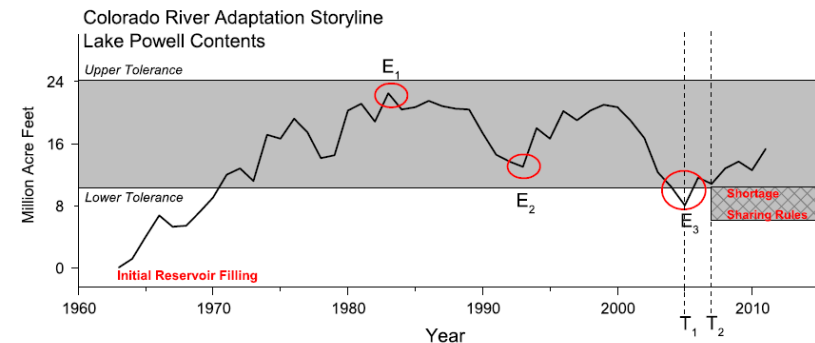


T_1 : Past extremes accepted as normal

E_1 : This extreme interpreted as reflecting underlying change

T_2 : Start planning to enlarge tolerance range for future extremes

T_3 : Increment tolerance range to accommodate expected increased in extremes



Climate affects on Livestock Production

- Direct effect of weather & extreme events on animal health, growth & reproduction (heat stress)
- Impact of changes in livestock feed / grain availability & price (grains to animals instead of people?)
- Impact on pastures & forage crops (change vegetation, C3 to C4 grasses, decline in grazing capacity)
- Changes in distribution of livestock diseases, disease vectors and parasites.

Breeding Strategies:

- The utilization of South Africa's adapted landrace breeds
- Cow-calf efficiency for sustainable beef production systems
- The effective use of crossbreeding
- Selection for alternative measures of efficiency.



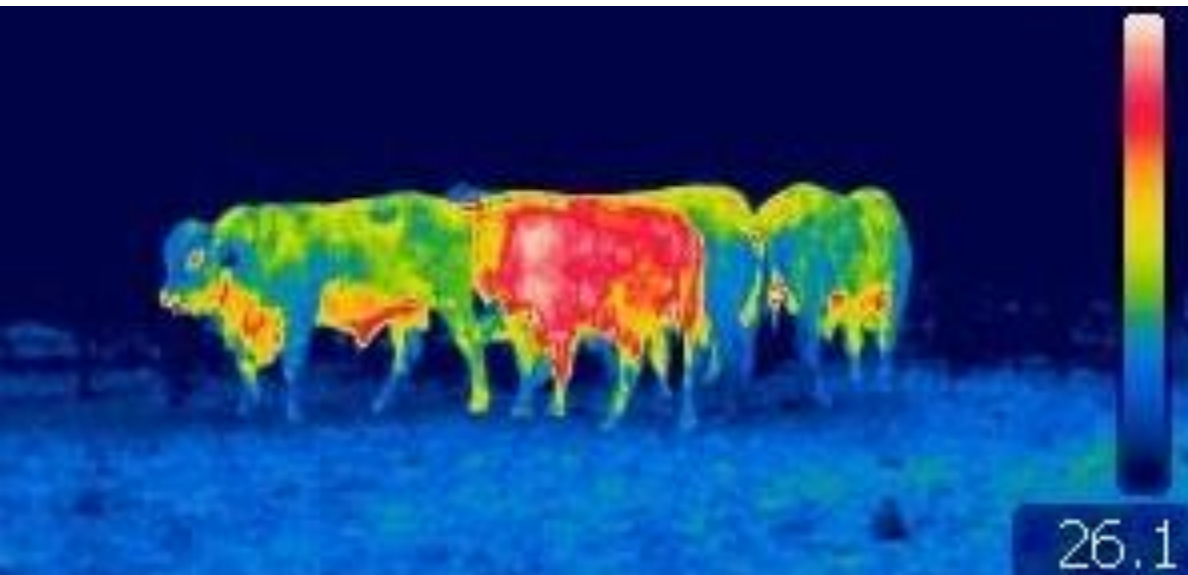
ADAPTED LANDRACE BREEDS

*A large number of indigenous livestock breeds in Africa
can survive harsh local conditions*



Livestock Adaptation to Heat Stress

- Heat stress common cause of reproductive inefficiency. Semen quality decreases when bulls exposed to high temperatures.
- After heat stress, semen quality does not return to normal for approximately 8 weeks,
=> carry-over effect of heat stress on reproduction.



Important to use bulls from adapted breeds during heat stress periods.



Adaptation to lack water for livestock

Use local adapted breeds:

- Only 2% weight loss in Afrikaner after 24 h without water
BUT 15% in exotic breed.
- Deprivation of water for 24h period did not reduce feed intake of Afrikaner,
BUT exotic breed feed intake was reduced by 24%.



Important to provide adequate water overnight.



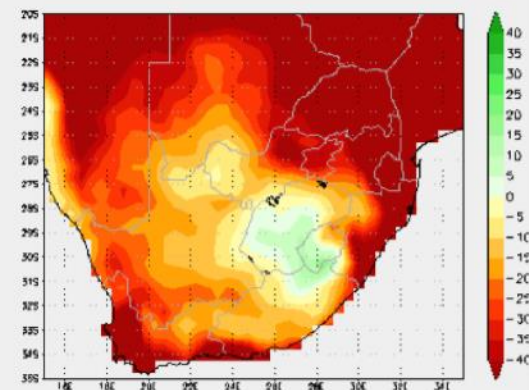
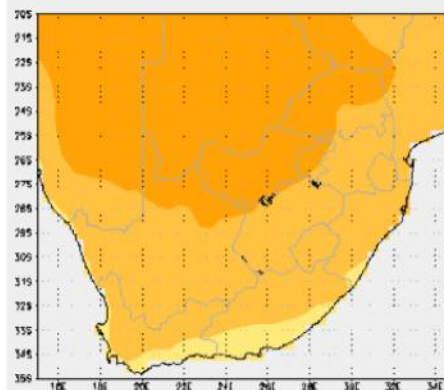
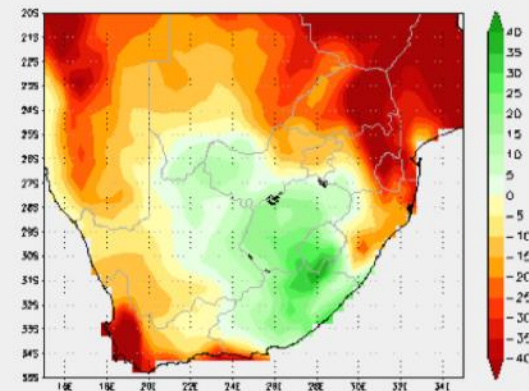
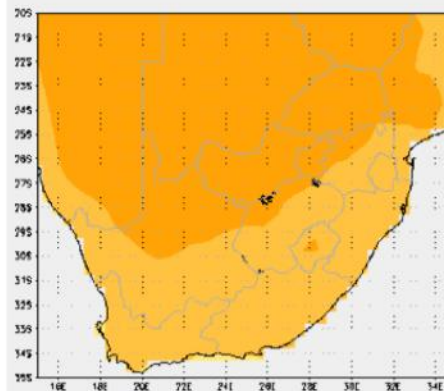
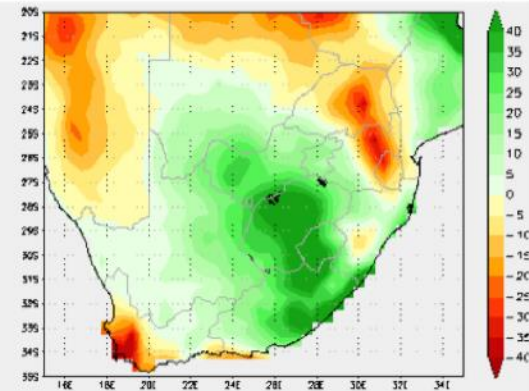
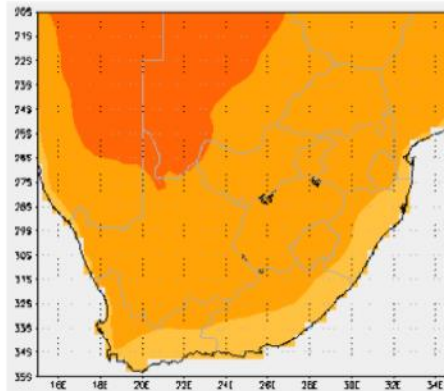
Prediction for Southern Africa

2021-2050 relative to
1961-1990

(Engelbrecht, CSIR)

Temperature

Rainfall



Consequences for South Africa

TEMPERATURE

- Increases in average temperature of 1.5 to 2°C
- Range from 0.5 at seaboard to 3 °C in eastern Namibia & western Botswana
- More heat spells

RAINFALL

- Variable rainfall
- SADC region - general drier except for central regions
- Eastern Cape → wetter.
- Significant reduction of more than 40 mm/annum in eastern parts of Limpopo & Mpumalanga, south-western Cape & Cape south coast.



Conclusion

- Expect Higher temperatures and Less rainfall
- Plan adaptation strategies considering
 - Heat waves
 - Frequent dry spells and droughts
- Using alternative crops and livestock breeds
 - With heat tolerance adapted landraces
 - With drought tolerance hybrids
- Careful use of every drop of water