

Shift in production areas due to climate change

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Overview of the presentation

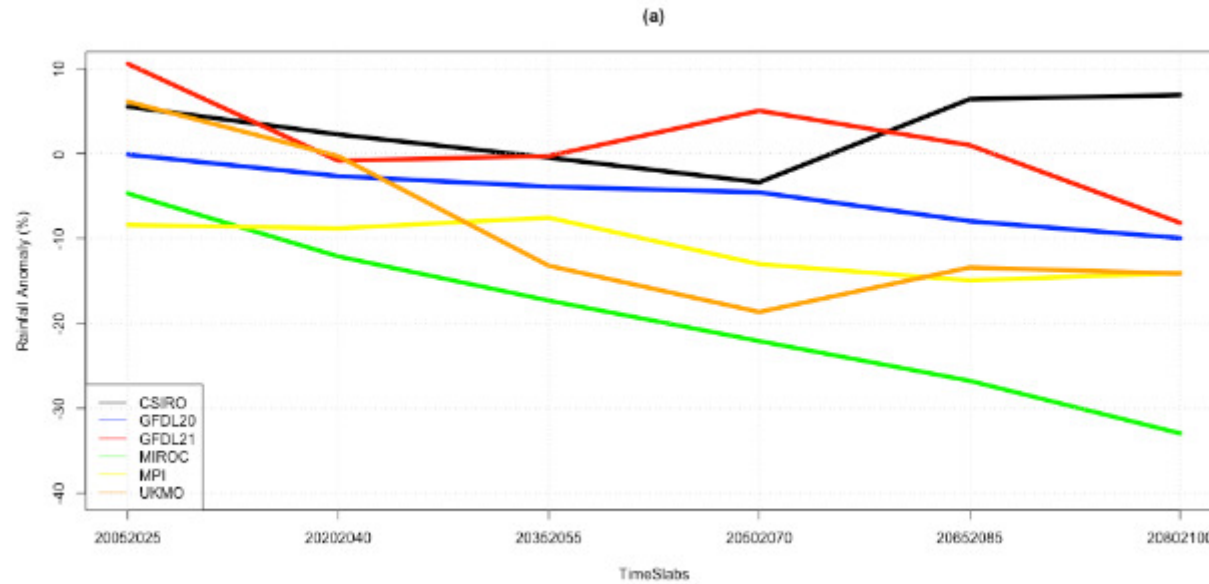
- Implications of Climate Change for Crop Production (National)
 - Short overview of climate projections
 - Köppen-Geiger climate zones
 - Macadamia
 - Maize
 - Sunflower
 - Winter wheat
 - Summer wheat



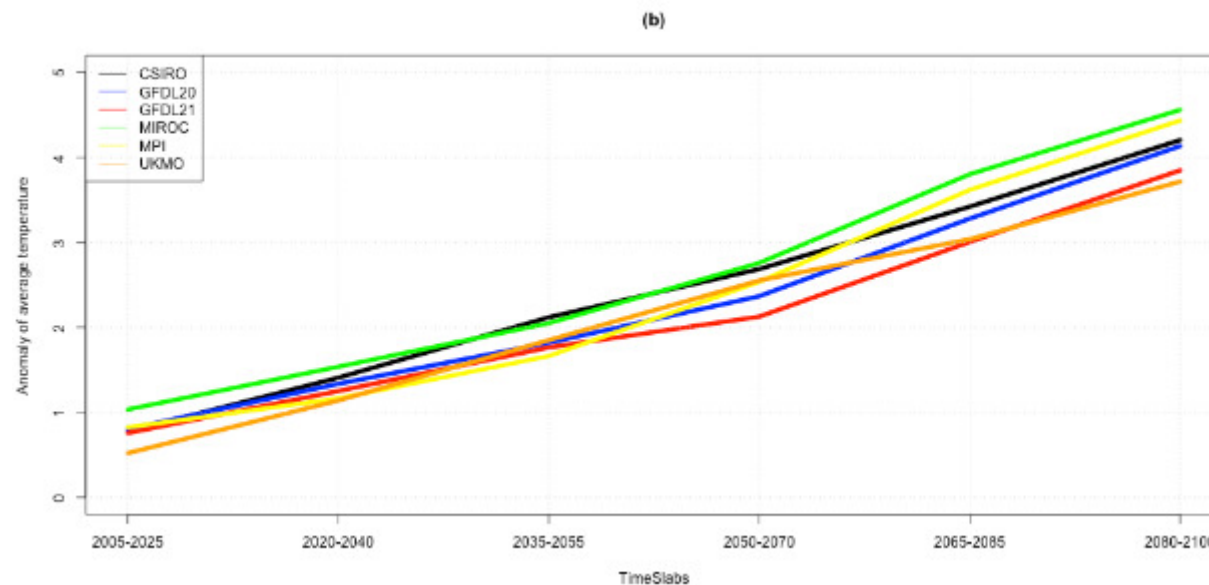
Acknowledgements

- Department of Agriculture, Forestry and Fisheries (DAFF) Directorate: Climate Change and Disaster Management (CCDM) for funding
- Council for Scientific and Industrial Research (CSIR) Climate Studies, Modelling and Environmental Health group for making climate projection data available.
- Crop specialist from ARC

Range of possible outcomes projected by 6 dynamically downscaled GCMs



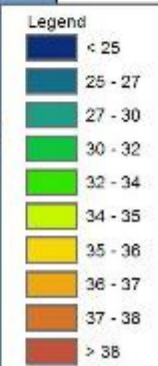
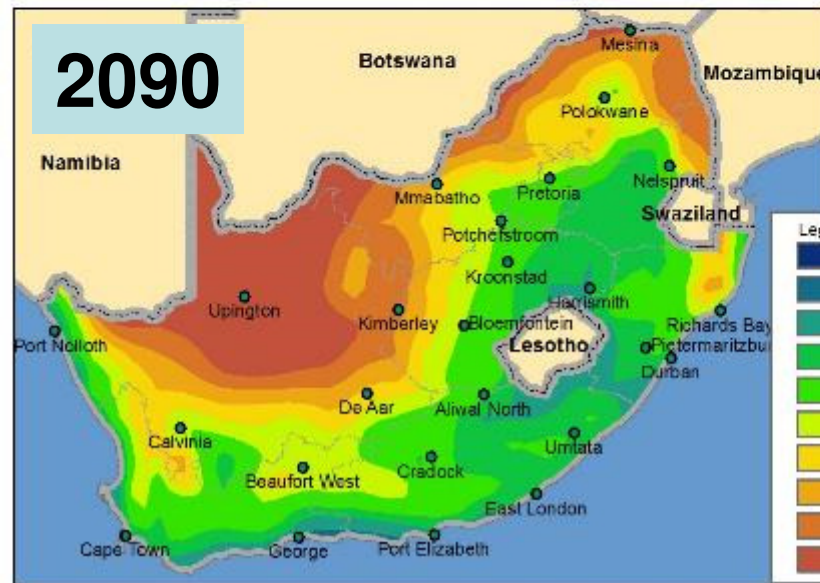
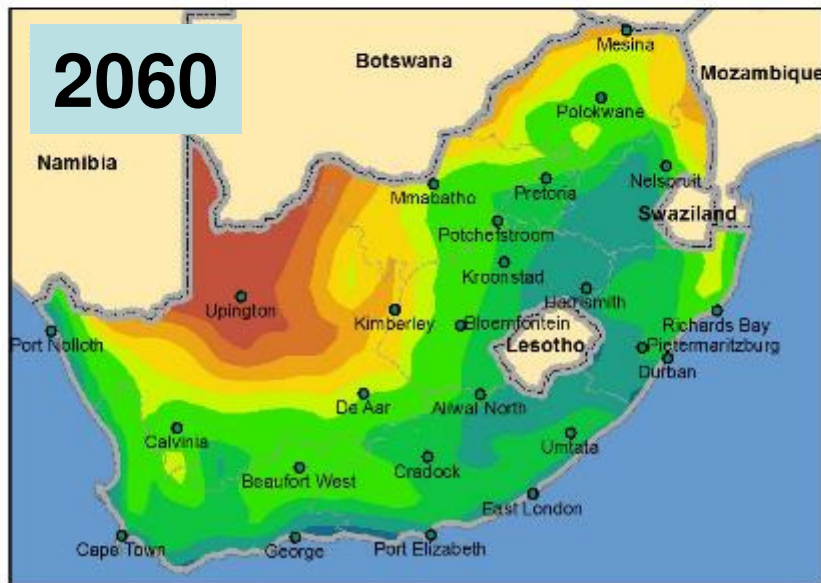
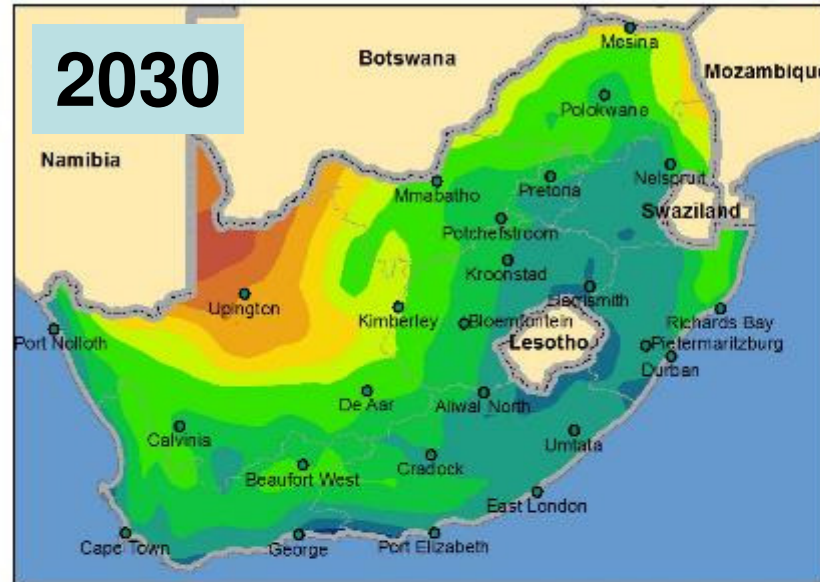
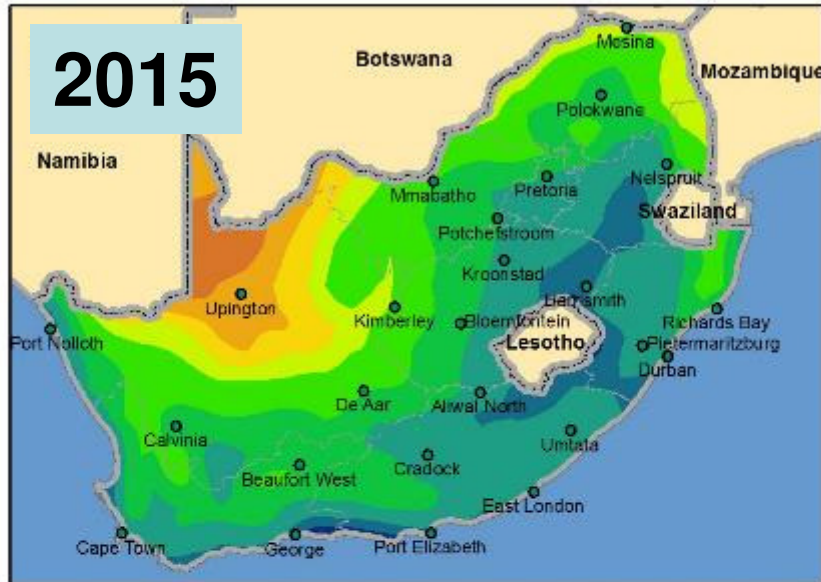
Rainfall:
uncertainty
increase the
further the
projection is
into the future



Temperature:
Very robust
signal with
limited
uncertainty

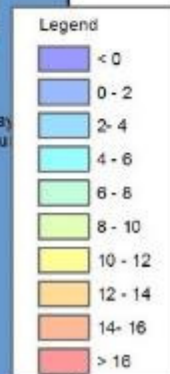
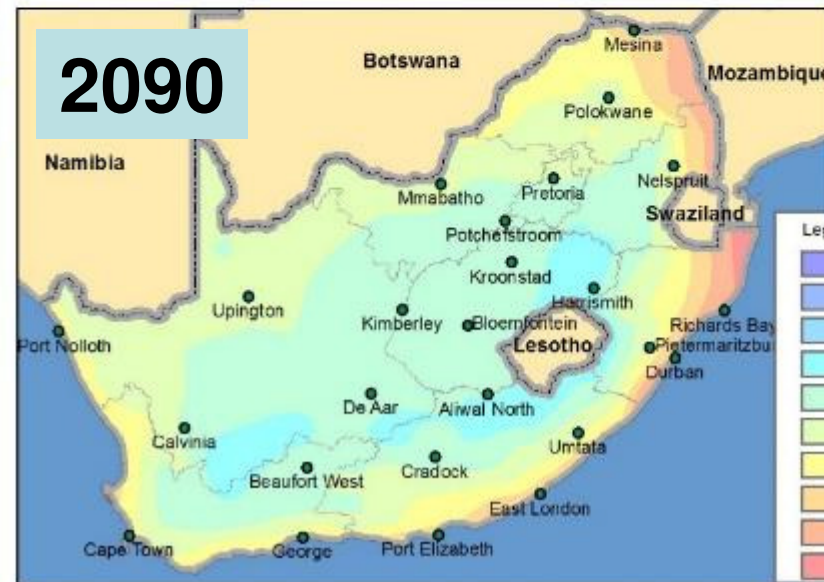
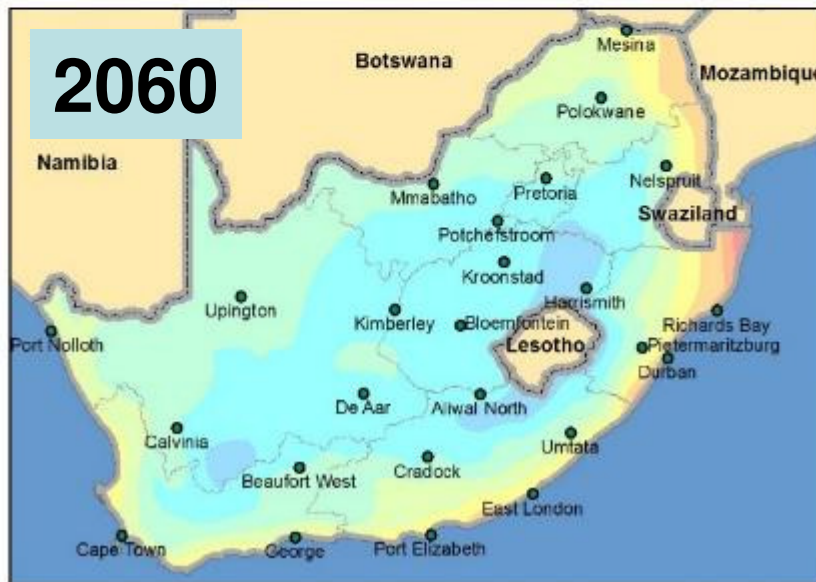
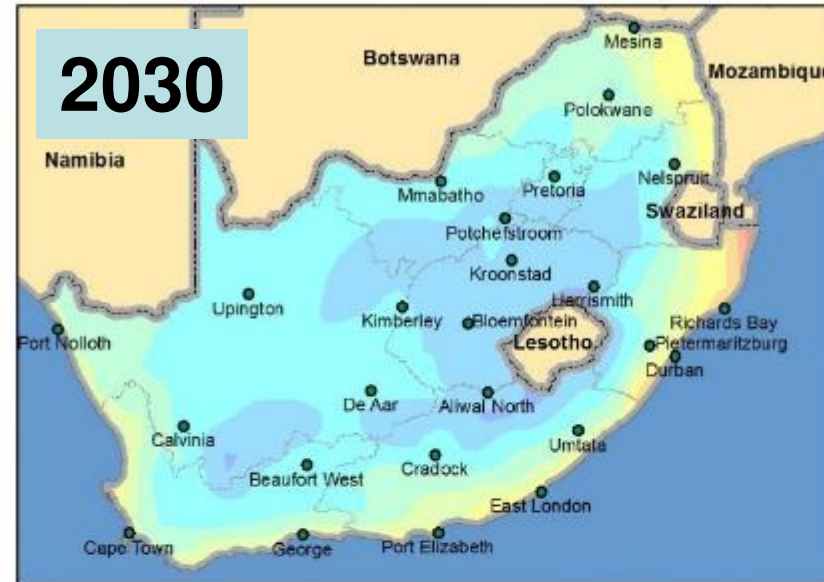
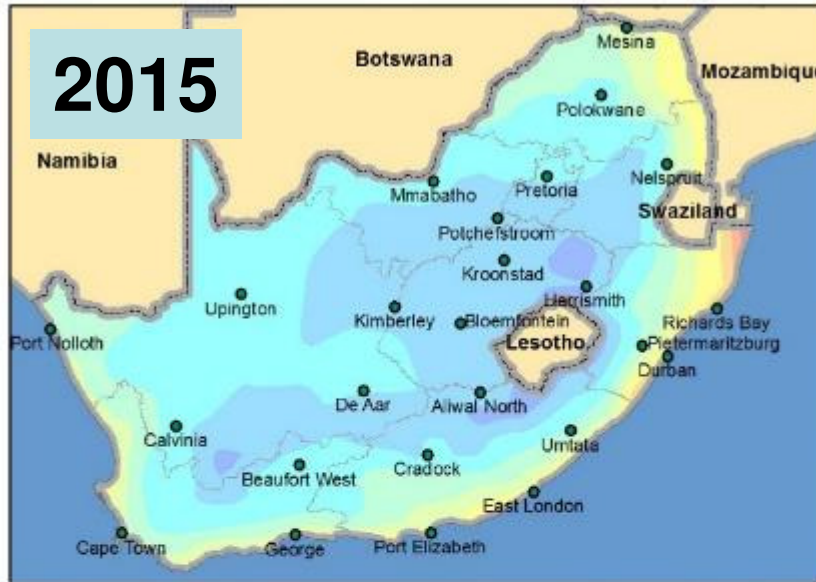
Average maximum temperature (°C)

Median of six climate projections for 2015, 2030, 2060 and 2090



Average minimum temperature (°C)

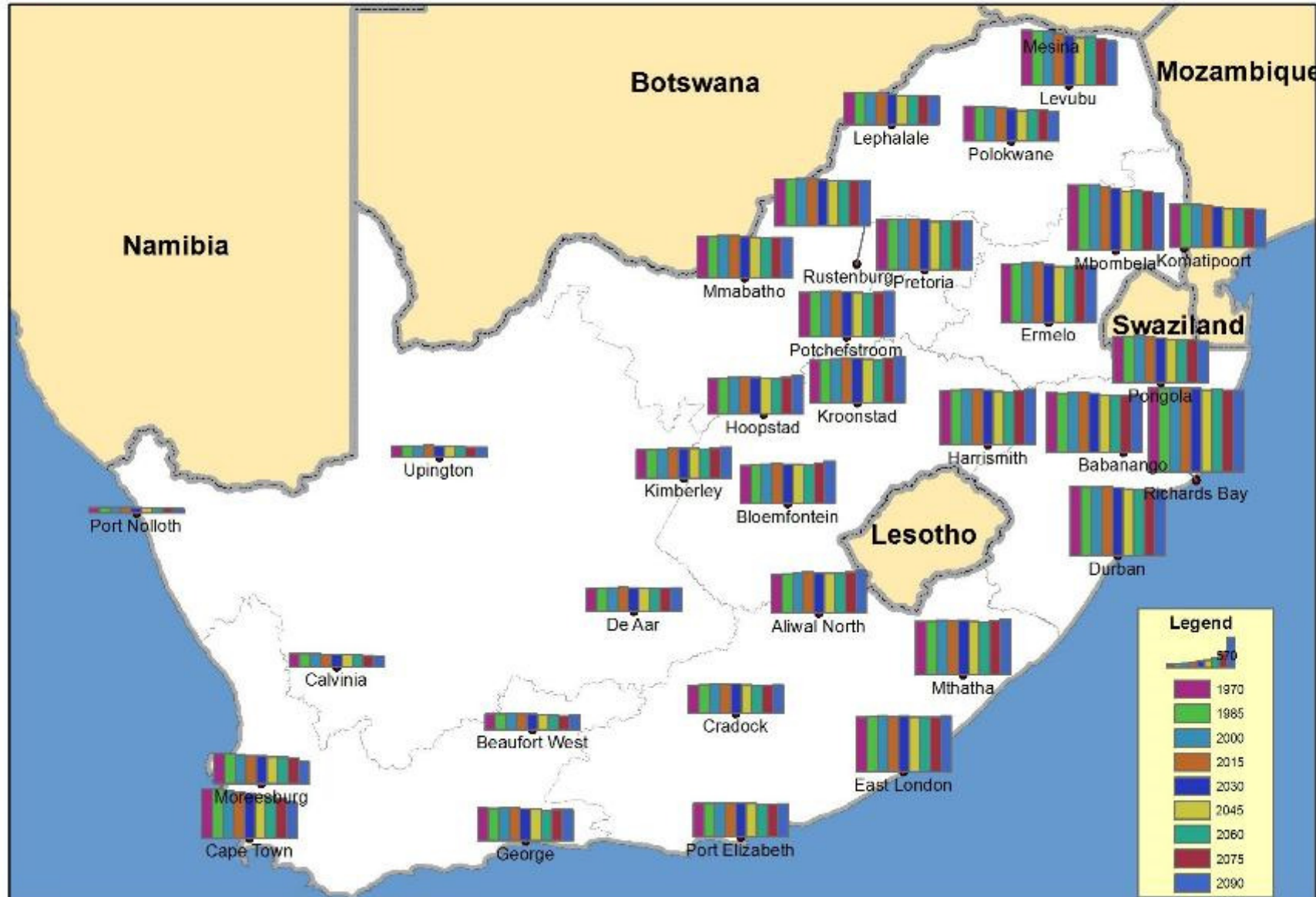
Median of six climate projections for 2015, 2030, 2060 and 2090

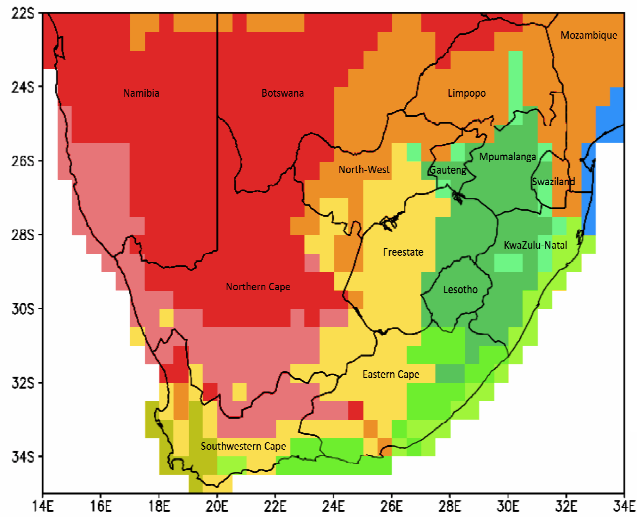




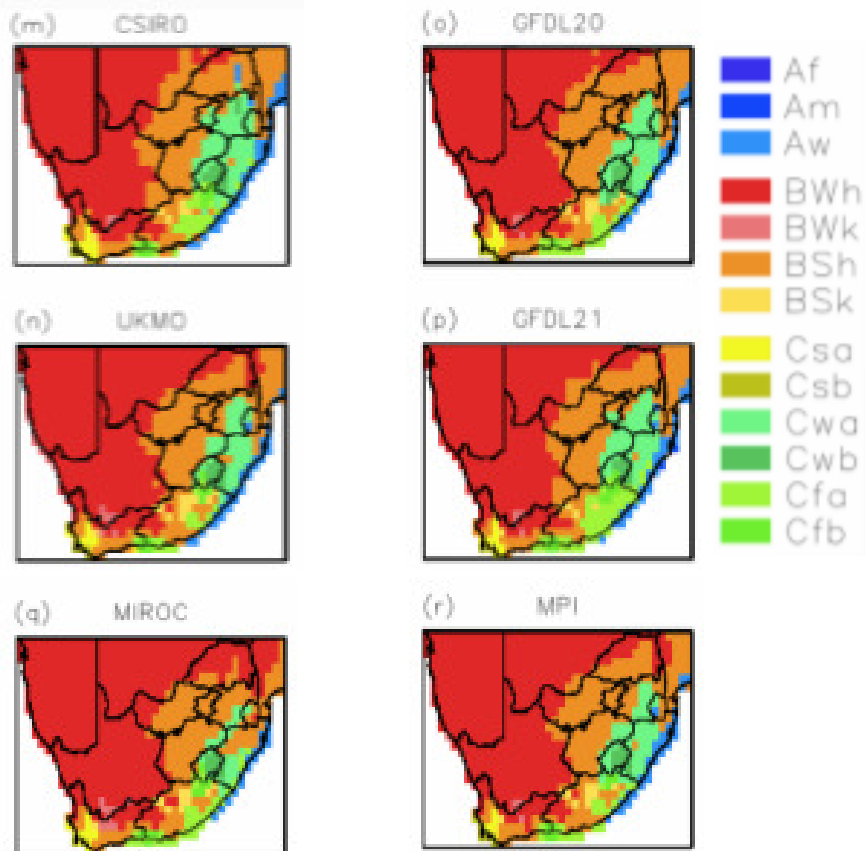
Average annual rainfall (mm)

Median of six climate projections





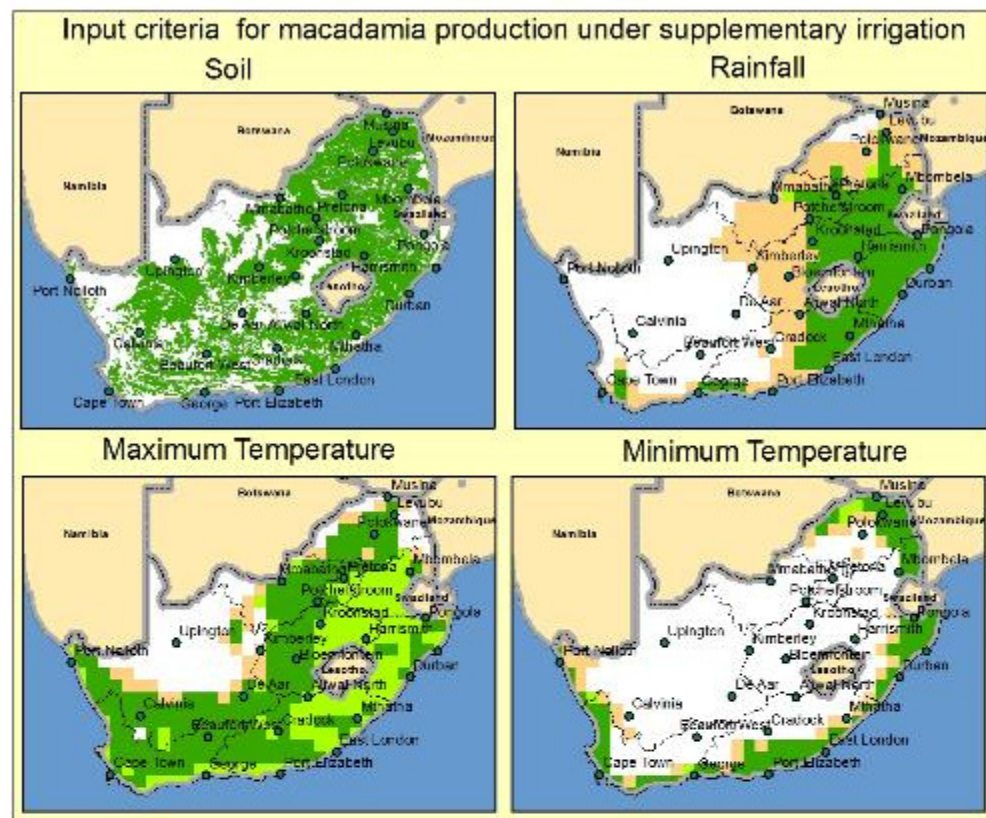
Shifting climate zones: Projected Koppen-Geiger climate zones for a 3°C increase in the average global temperature
A basic trend towards warmer and drier conditions



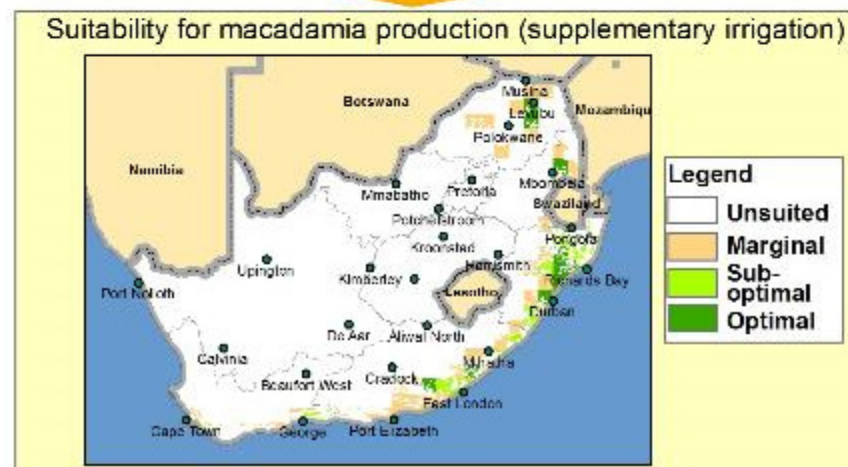
1st	2nd	3rd	Description	Criteria*
A			Tropical	$T_{cold} \geq 18$
	f		- Rainforest	$P_{dry} \geq 60$
	m		- Monsoon	Not (Af) & $P_{dry} \geq 100 - MAP/25$
	w		- Savannah	Not (Af) & $P_{dry} < 100 - MAP/25$
B			Arid	$MAP < 10 \times P_{threshold}$
	W		- Desert	$MAP < 5 \times P_{threshold}$
	S		- Steppe	$MAP \geq 5 \times P_{threshold}$
		h	- Hot	$MAT > 18$
		k	- Cold	$MAT < 18$
C			Temperate	$T_{hot} > 10$ & $0 < T_{cold} < 18$
	s		- Dry Summer	$P_{sdry} < 40$ & $P_{sdry} < P_{wwet}/3$
	w		- Dry Winter	$P_{wdry} < P_{swet}/10$
	f		- Without dry season	Not (Cs) or (Cw)
		a	- Hot Summer	$T_{hot} \geq 22$
		b	- Warm Summer	Not (a) & $T_{mon10} \geq 4$
		c	- Cold Summer	Not (a or b) & $1 \leq T_{mon10} < 4$

Environmental suitability criteria for macadamia Production under supplementary irrigation

Land attribute	Suitability class	
	Optimal	Unsuited
Annual rainfall (mm)	≥ 600	< 400
T_{min} (°C) July	> 7	< 6
T_{max} (°C) Nov-Feb	≤ 29	> 34
Soil depth (mm)		< 500
Topsoil clay (%)		< 6 and $> 40\%$



Lowest suitability class of criteria

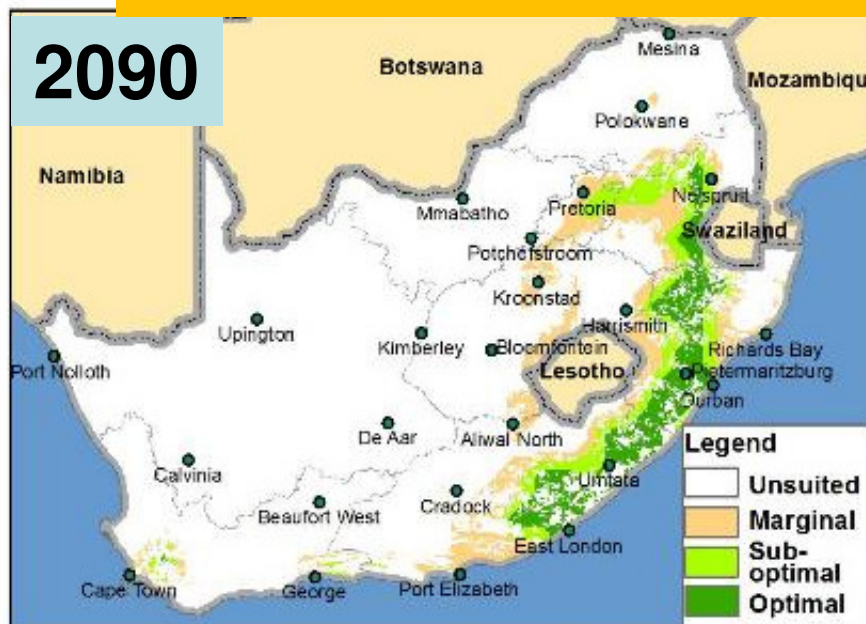
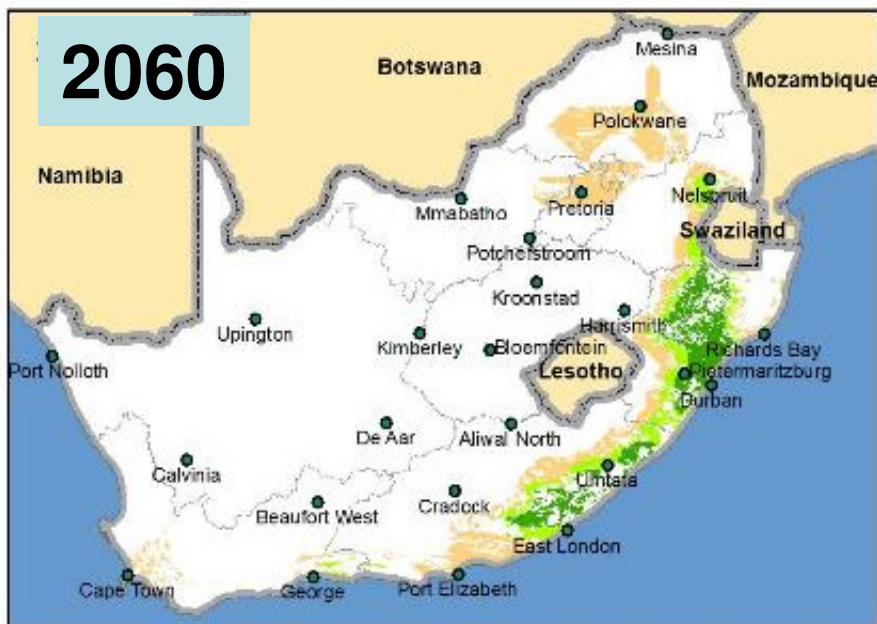
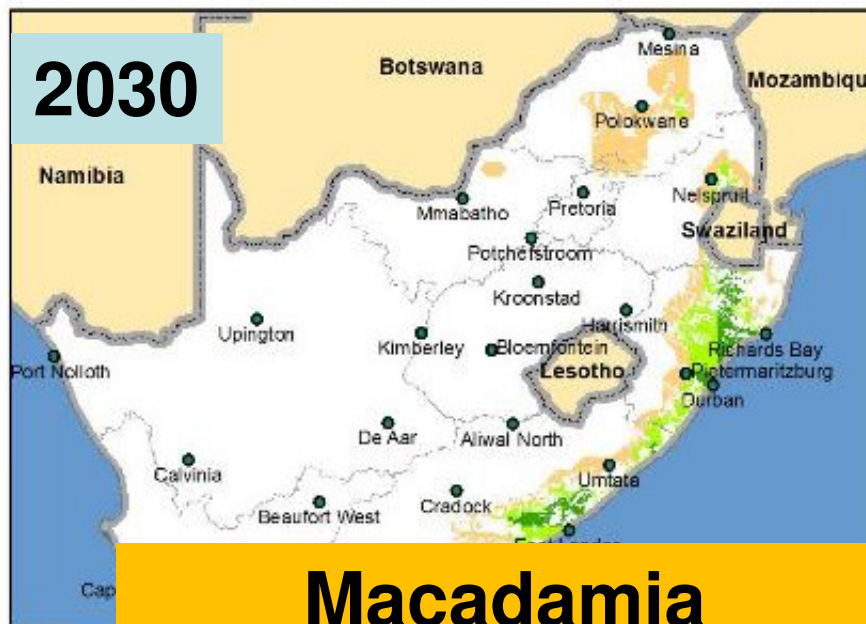
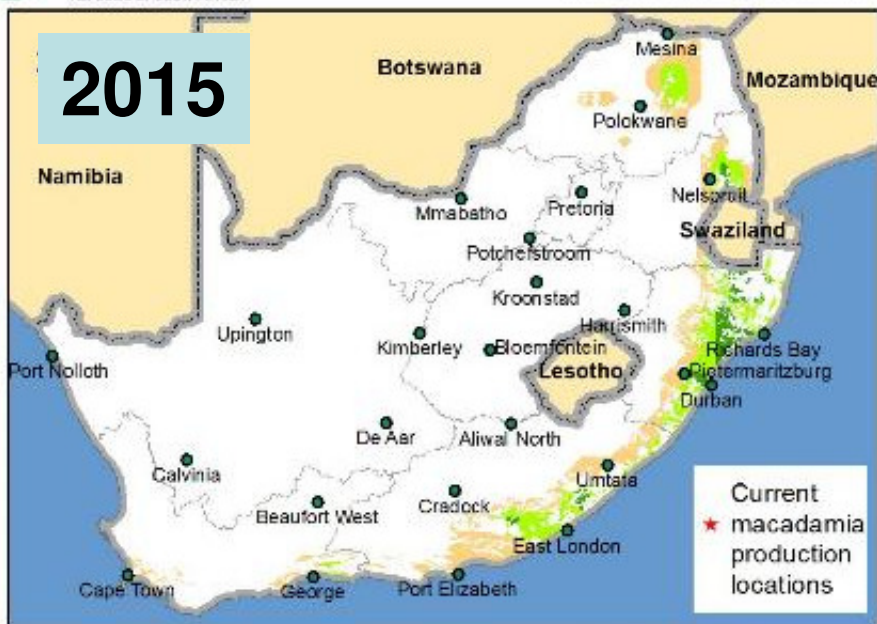




Suitability for macadamia production (supplementary irrigation)

Criteria: rainfall, minimum temperature, maximum temperature

Median of six climate projections for 2015, 2030, 2060 and 2090



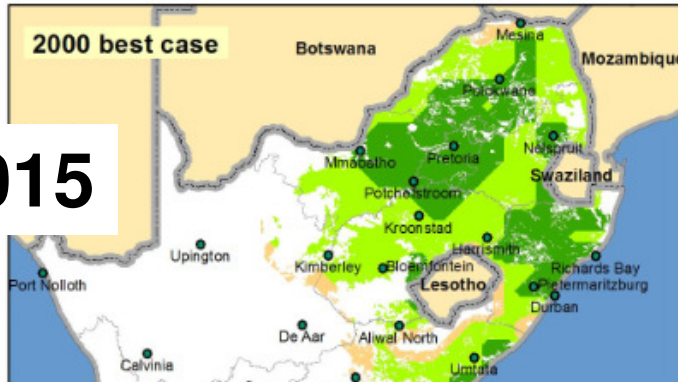
Environmental suitability criteria for rainfed maize production

Land suitability of rainfed maize production				
Suitability class	Optimal	Sub-optimal	Marginal	Unsuited
Land attribute				
Climate requirements				
Water requirement (during growing season, mm)	>450	300-450	250-300	<250
T_{max} (during growing season, °C)	25-32	24-25 and 32-33	22-24 and 33-34	<22 and >34
T_{min} (during growing season, °C)	12-25	11 - 12	10 - 11	<10 and >25
Soil requirements				
Soil depth (mm)				<500
Topsoil clay (%)				<5%

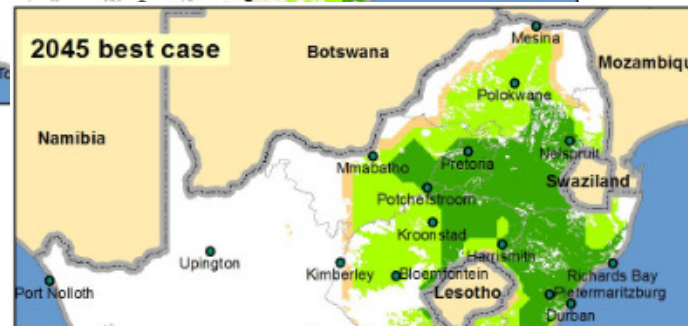
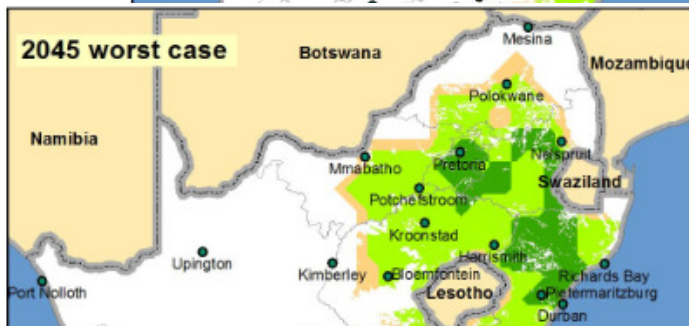
Suitability for rainfed maize (long/medium growing period)

using six climate projections

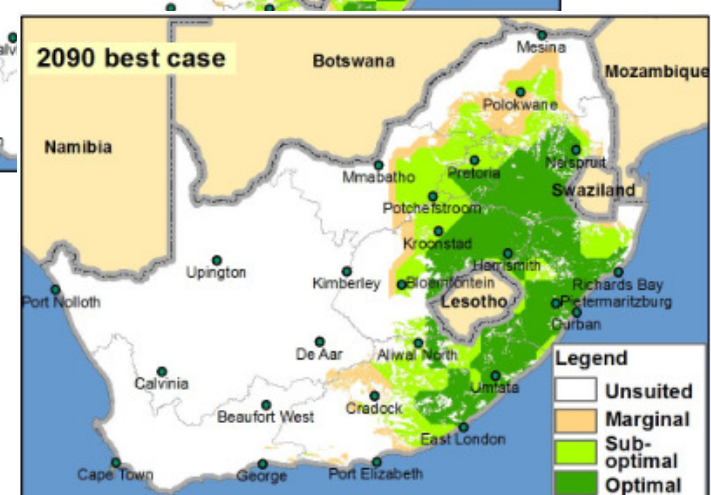
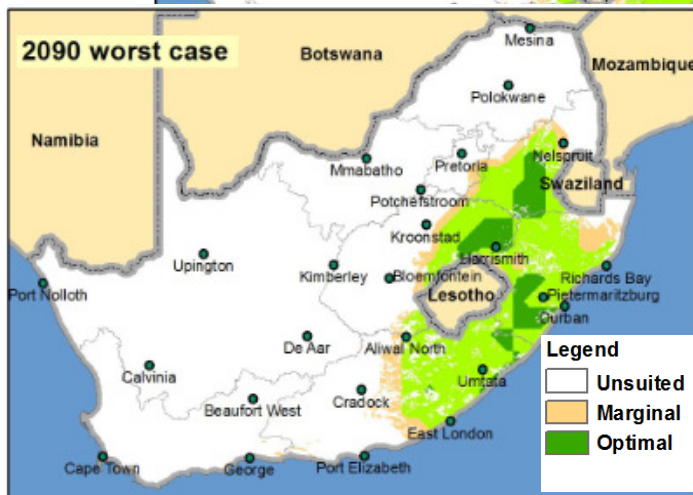
Criteria: rainfall, minimum temperature, maximum temperature and soil



2015



2045



2090

Legend

- Unsuited
- Marginal
- Sub-optimal
- Optimal

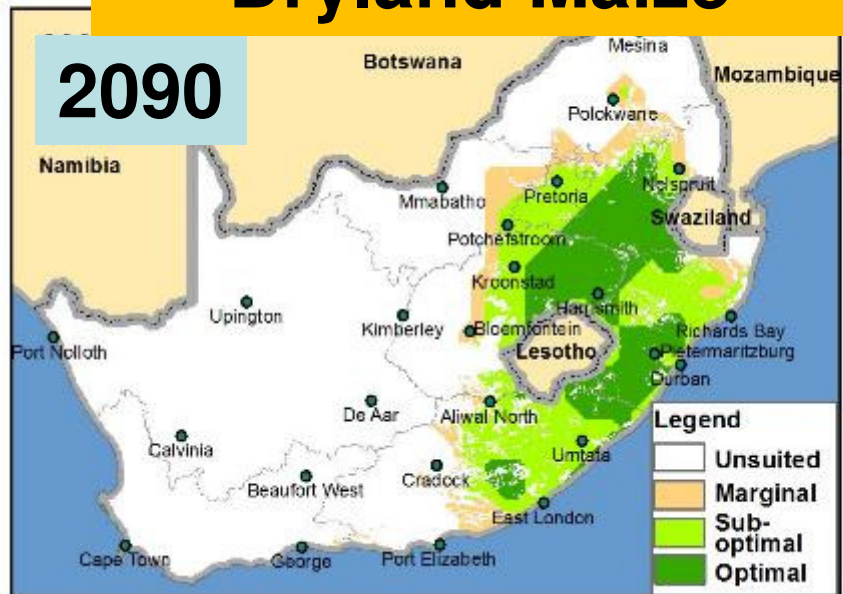
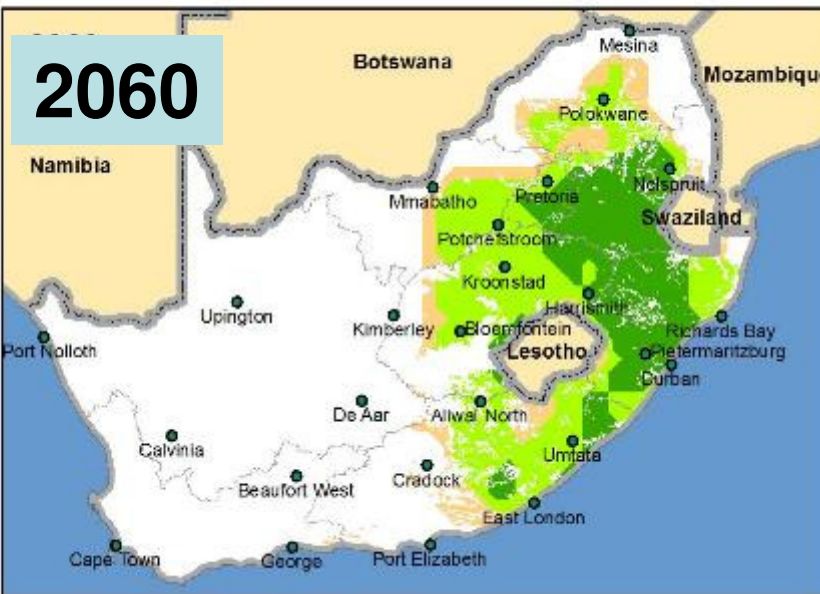
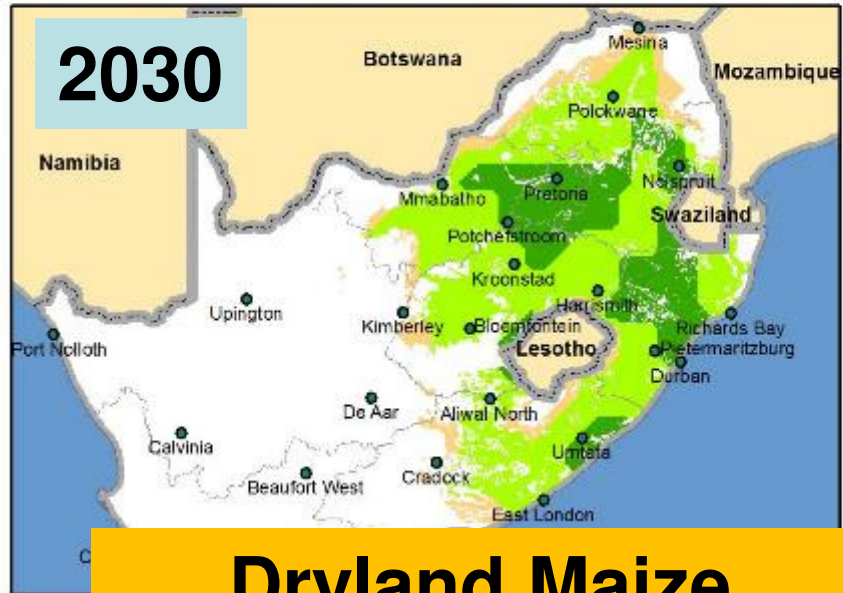
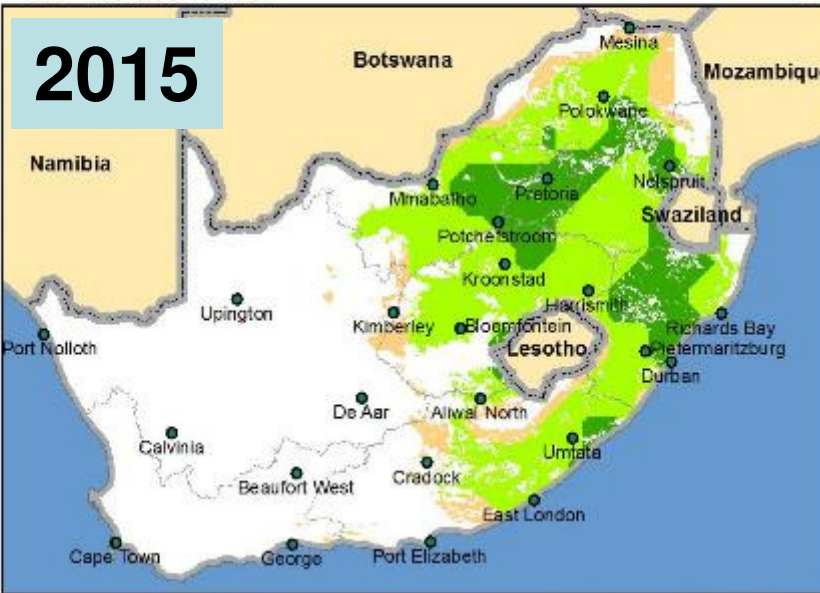
Legend

- Unsuited
- Marginal
- Sub-optimal
- Optimal



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



Dryland Maize

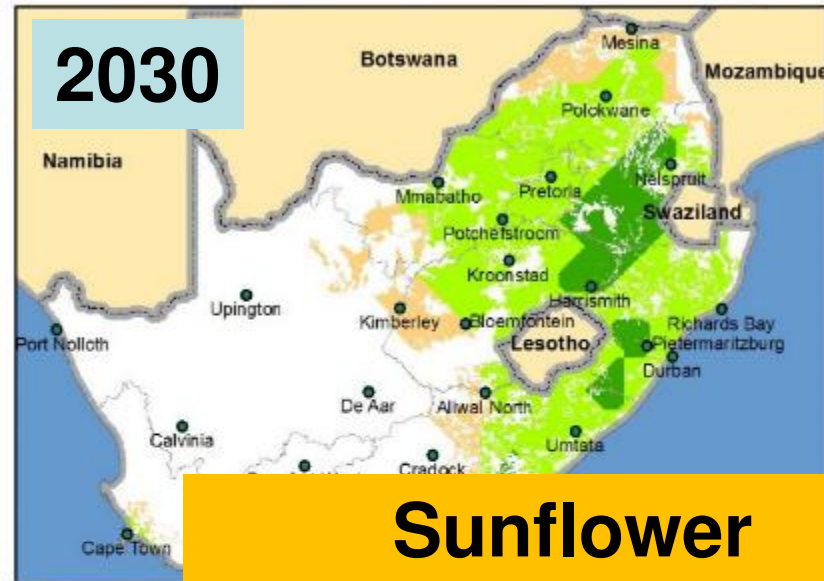
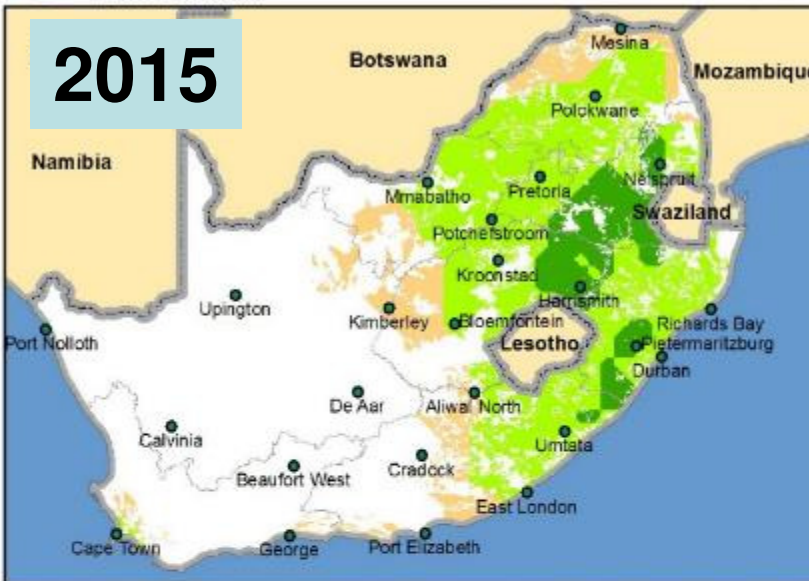
Legend

White	Unsuited
Orange	Marginal
Light Green	Sub-optimal
Dark Green	Optimal

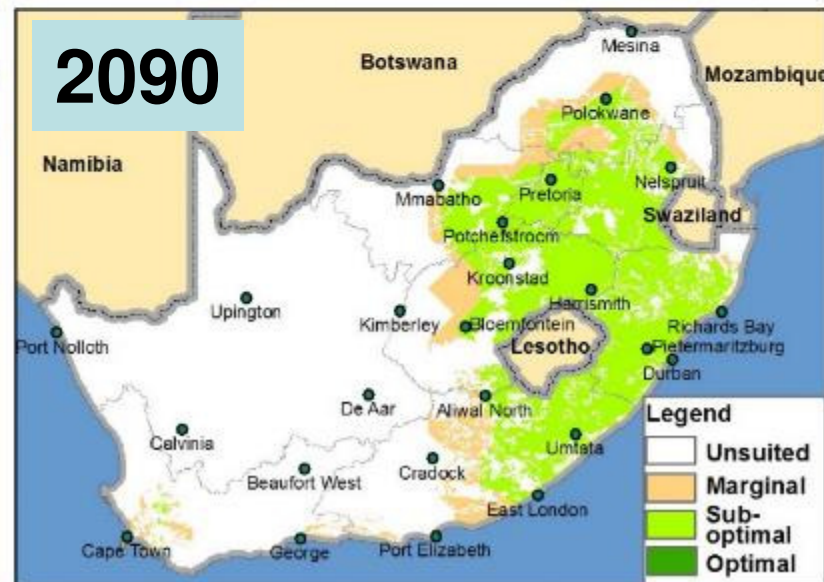
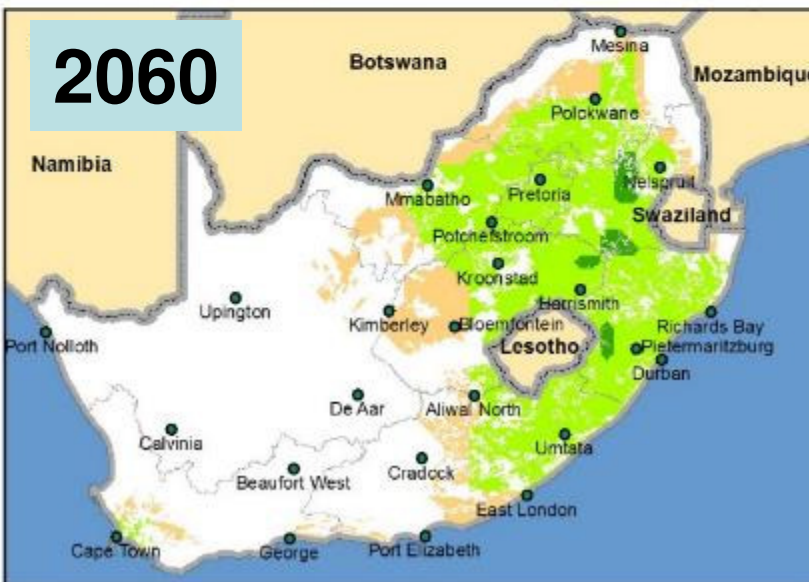


Suitability for rainfed sunflower

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

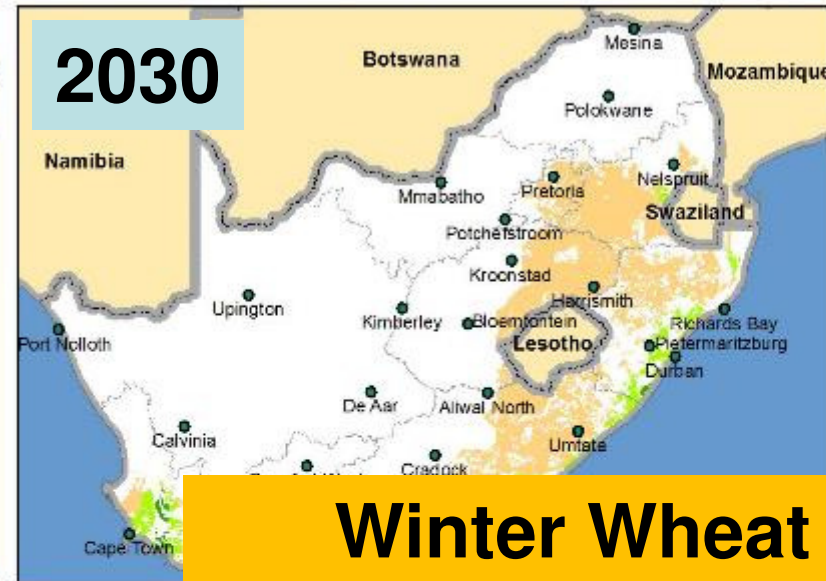
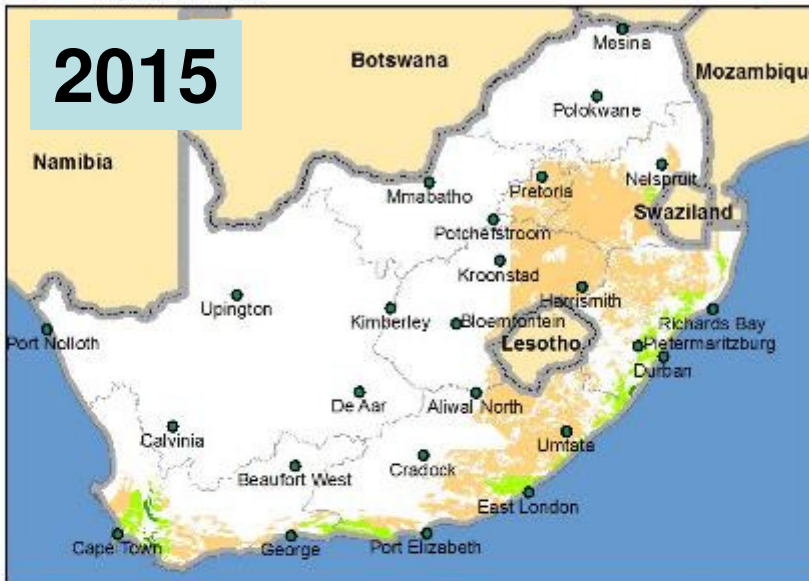


Sunflower

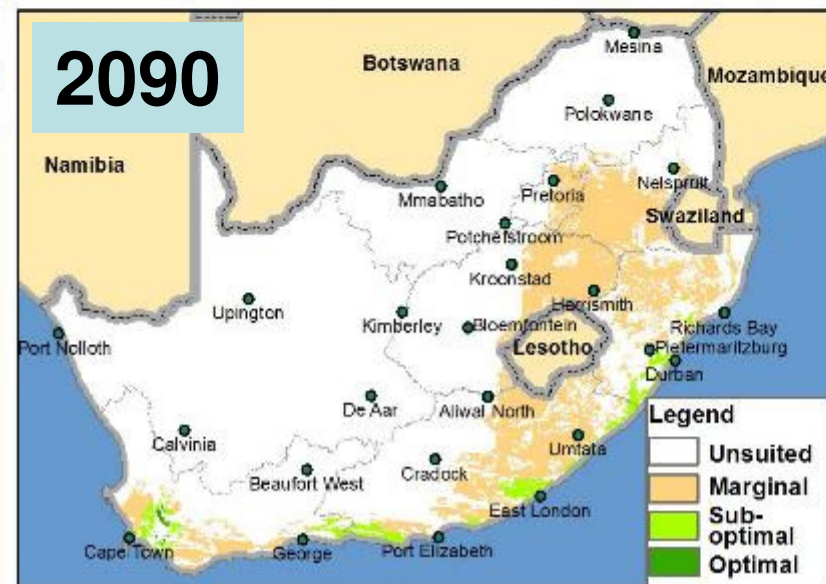
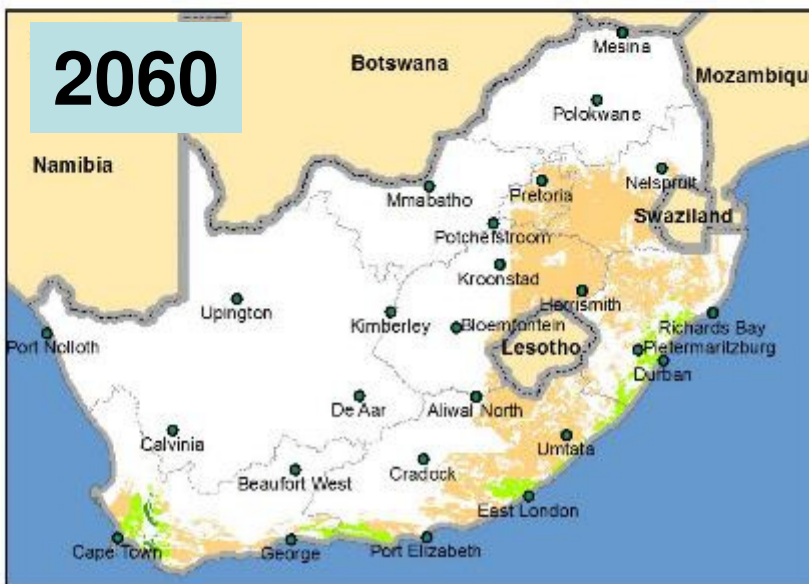


Suitability for rainfed wheat (Winter rainfall, May to Nov)

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



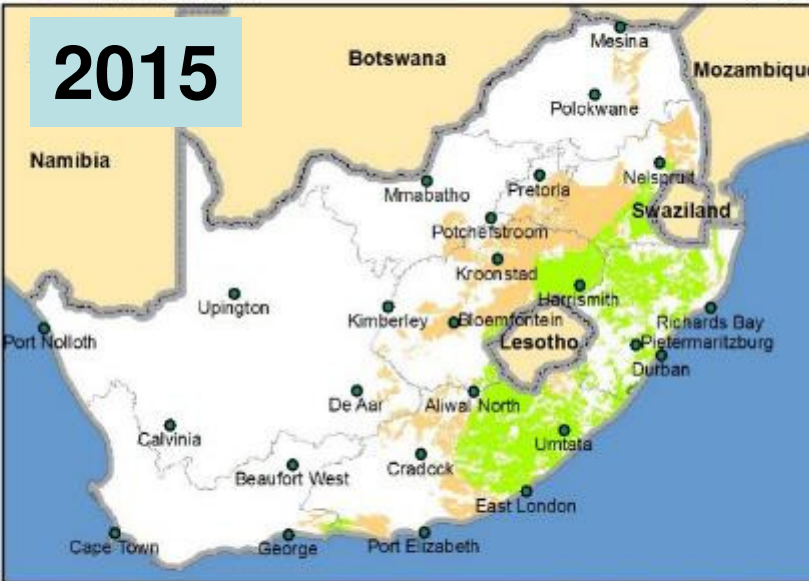
Winter Wheat



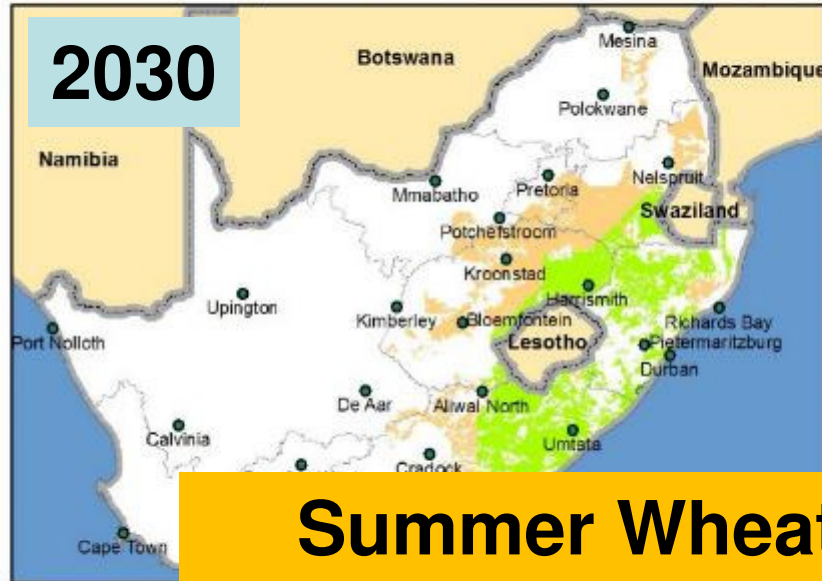


Suitability for summer rainfed wheat

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

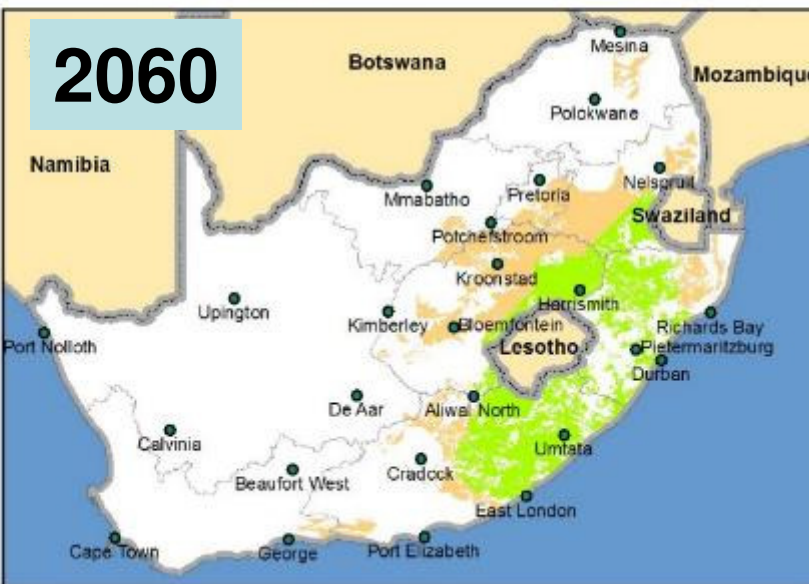


2015

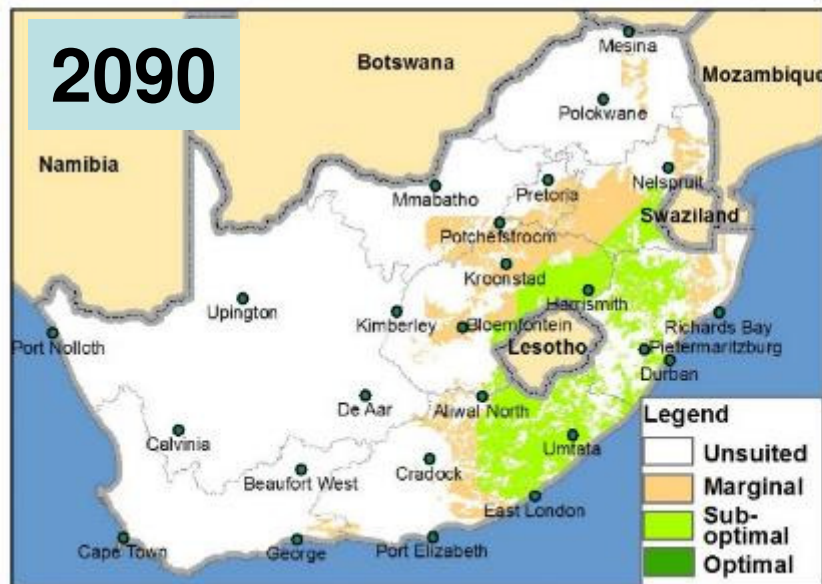


2030

Summer Wheat



2060



2090

Legend

White	Unsuited
Orange	Marginal
Light Green	Sub-optimal
Dark Green	Optimal

The crop suitability maps are based on environmental criteria only and do not consider the following:

- *New cultivars:* Development of new cultivars could make it possible to plant in higher temperatures, which would change the production areas correspondingly.
- *Plant diseases:* Climate change will affect the fecundity, dispersal and distribution of plant diseases and pests. Higher temperatures will increase overwintering of pathogens and pests, modify host susceptibility to infection, accelerate pathogen and vector life cycles and increase the sporulation and infectiousness of fungi.
- *Effect of increased CO₂:* Increased CO₂ levels are likely to have a positive effect on potential water use efficiency and crop productivity. Crops such as potato, cotton, wheat, and soybeans benefit substantially from additional atmospheric CO₂, while crops such as maize, sorghum and sugarcane are more limited.



Thank you

