



# Economic impacts of climate change and climate mitigation in SA

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<https://sa-tied.wider.unu.edu/climate>

1. *Climate uncertainty and agricultural vulnerability in South Africa (WP 162)*
  - Hartley, F., Gabriel, S., Cullis, J. and Arndt
2. *Climate mitigation in South Africa (forthcoming)*
  - Energy System Research Group, UCT

**SA-TIED**

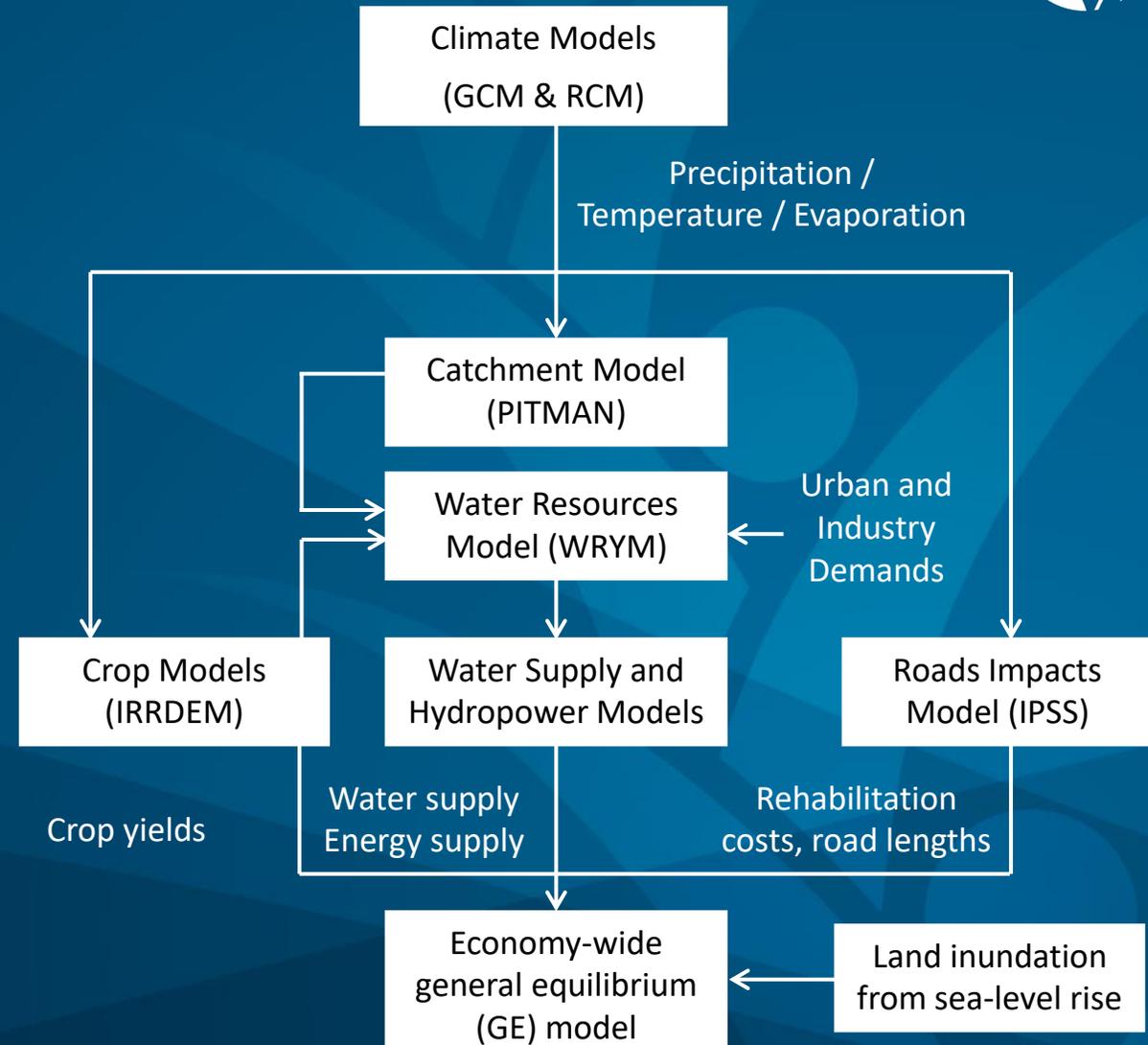
**Southern Africa – Towards Inclusive Economic Development**





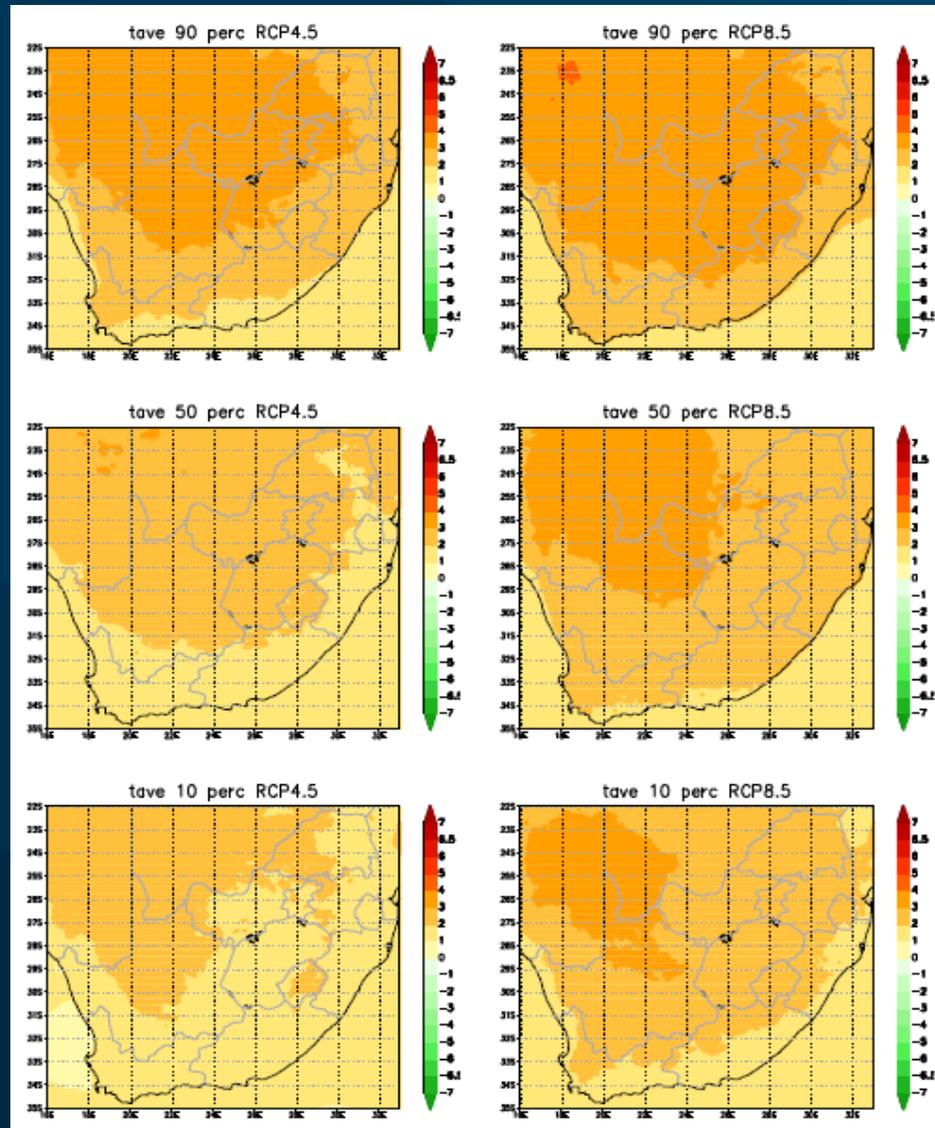
# Introduction

- Africa has been highlighted as the most vulnerable continent to climate change
  - Warm temperatures, insufficient water supply, hydro power dependence, under-developed infrastructure, large vulnerable population, low capacity for adaptation
- Need to implement adaptation measures early and as part of development plan but need to understand the potential impacts and where most vulnerable
- Systematic Assessment of Climate Resilient Development (SACReD) – integrated multi-model framework:
  - General framework - does not prescribe particular models
  - Permits analysis at global, regional, national, and sub-national levels
  - Handles uncertainty

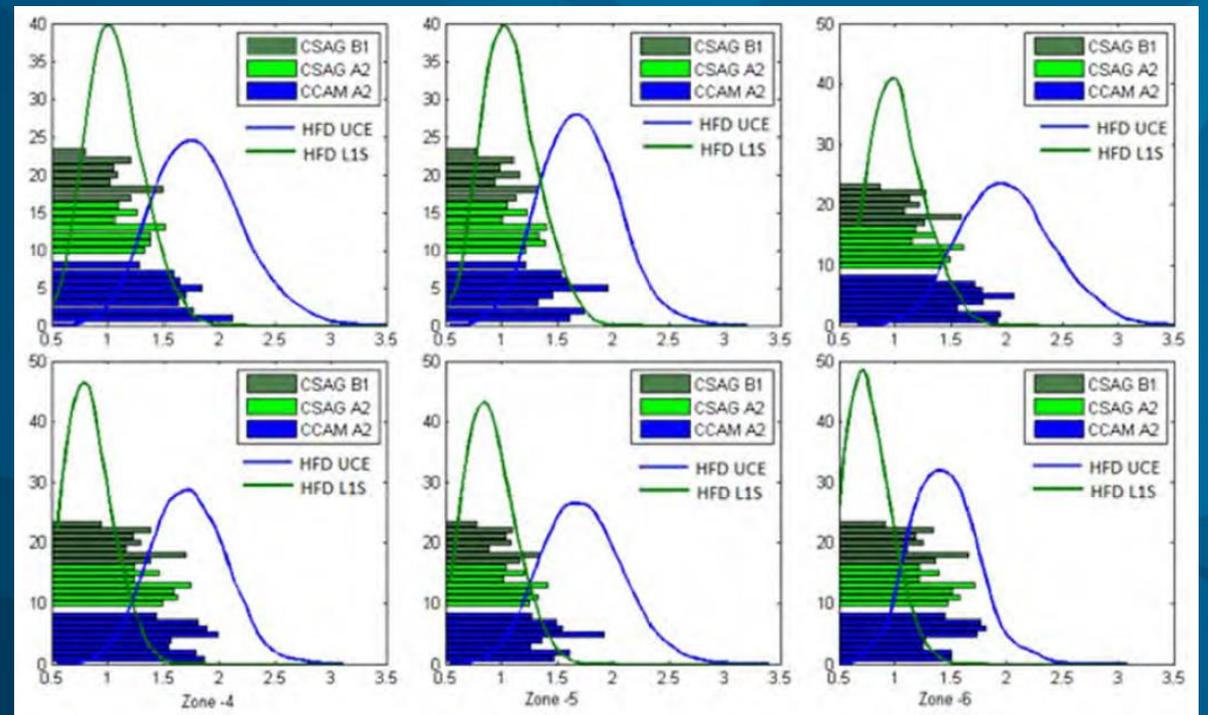




# SA to experience rise in average temperatures of between 1 and 3°C



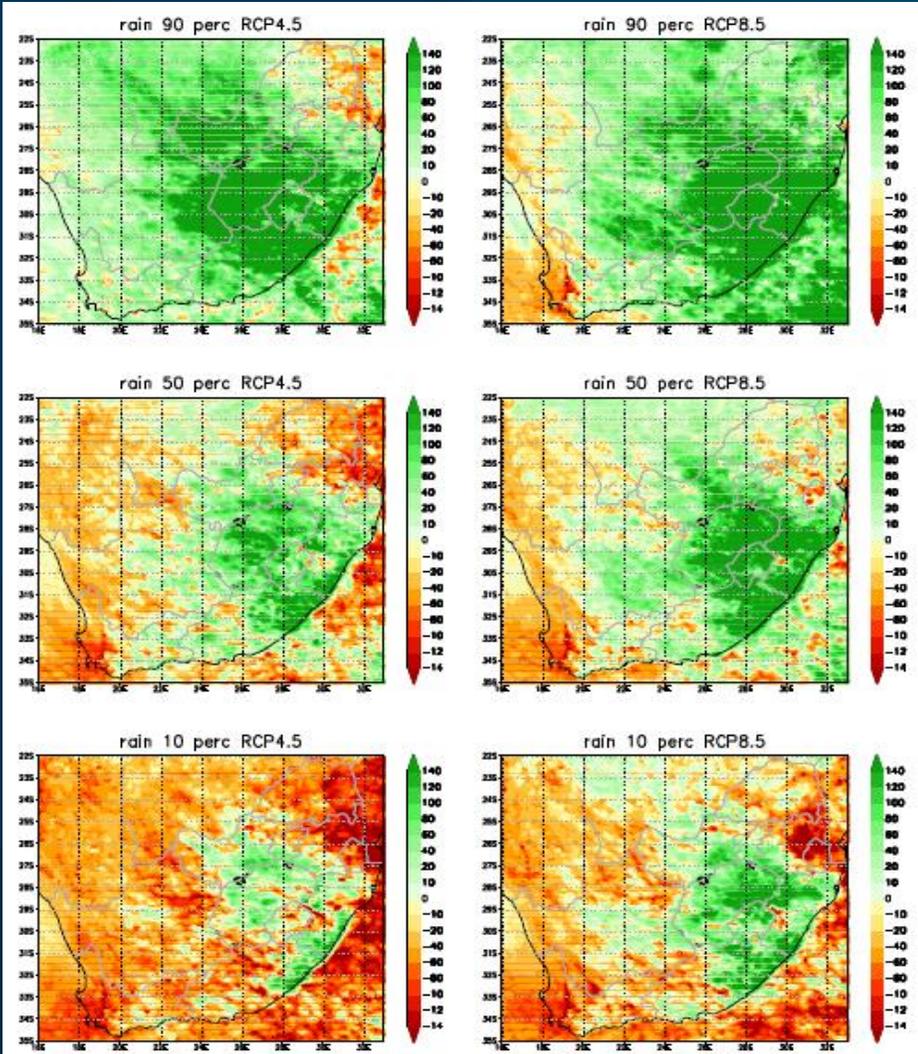
Change in annual average temperature (°C), 2021-2050  
Source: Engelbrecht, 2019



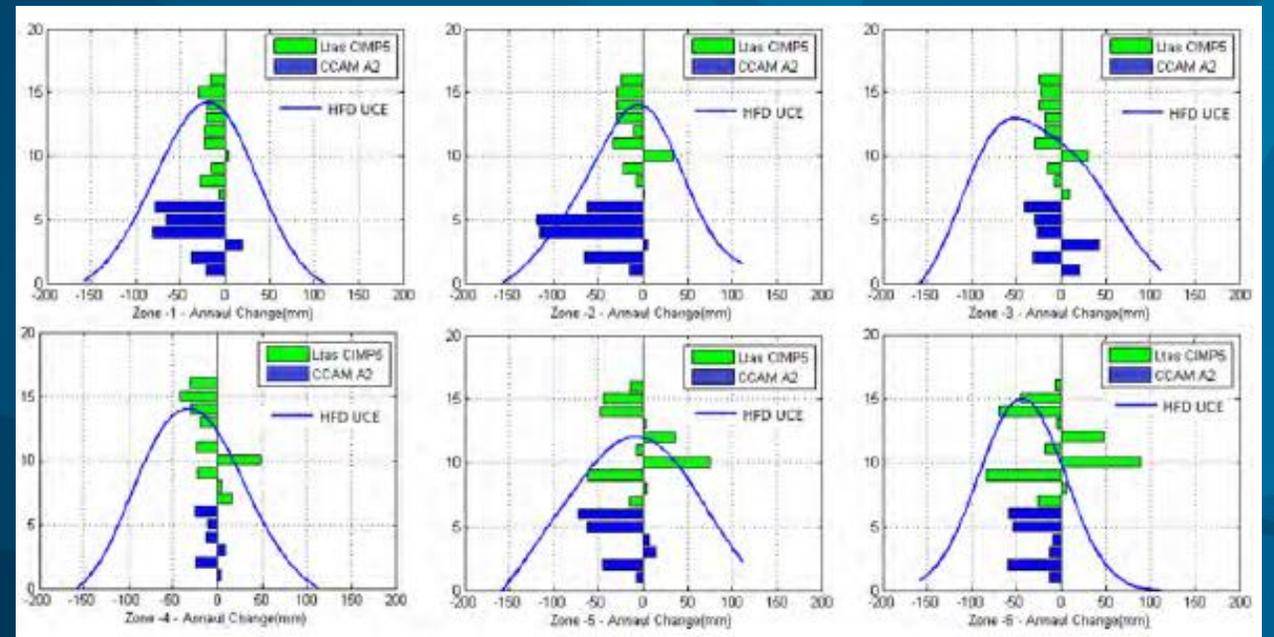
Change in average annual temperature (°C), 2040-50  
Source: Cullis et al., 2015. LTAS.



# Precipitation outcomes are more uncertain, median shows increased drying



Change in annual average rainfall (mm), 2021-2050  
Source: Engelbrecht, 2019



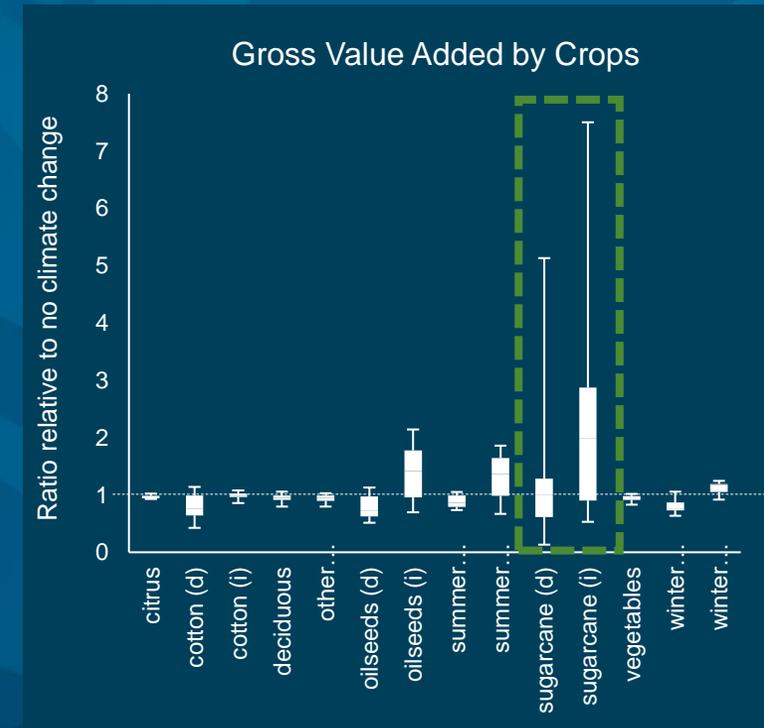
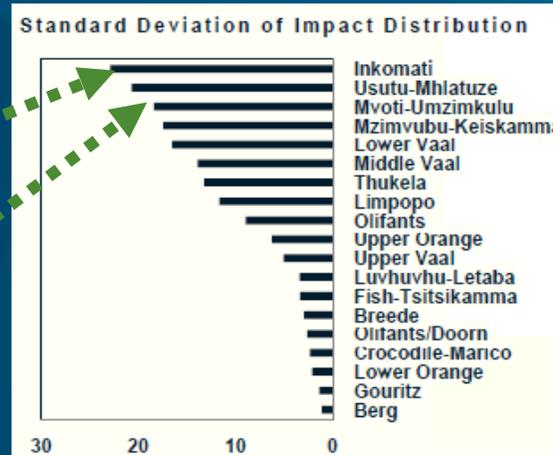
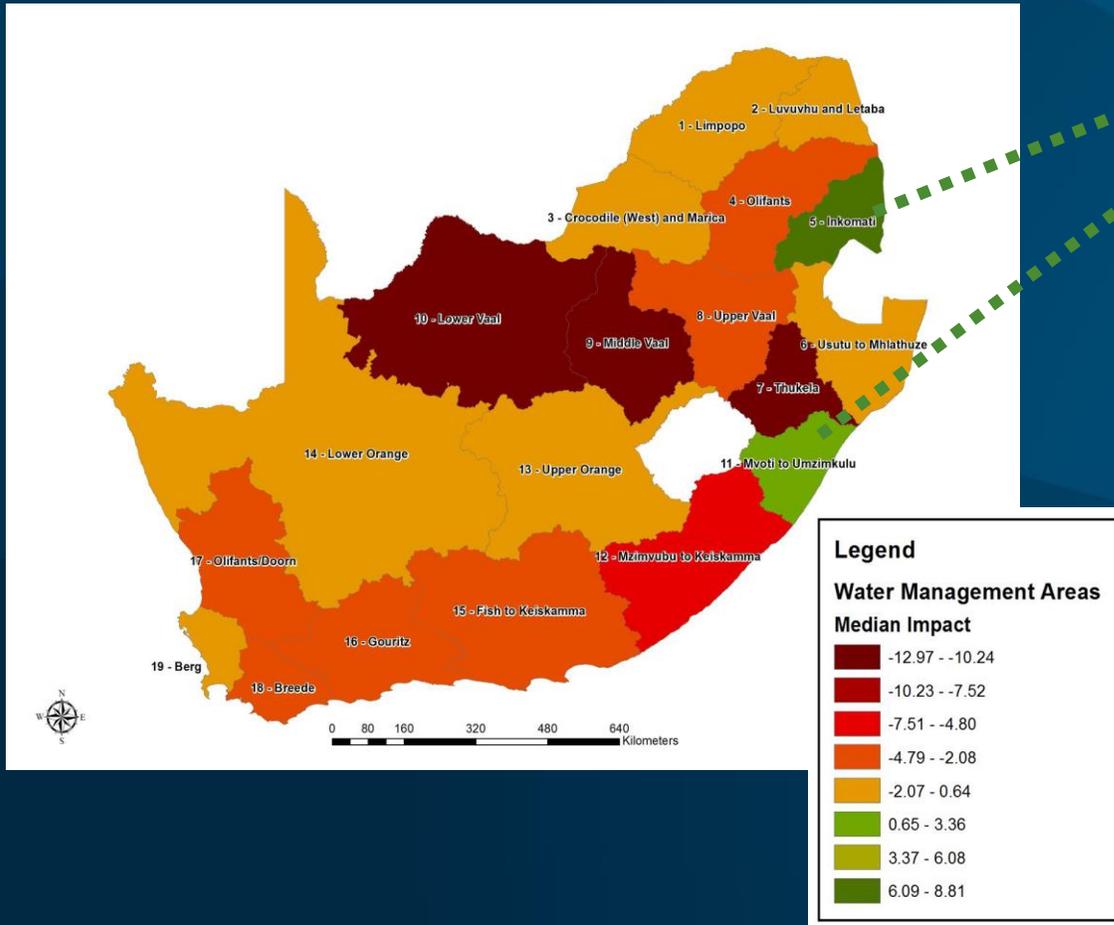
Median change in average annual precipitation (mm/year), 2040-50  
Source: Cullis et al., 2015. LTAS.





# Impacts on agriculture GVA

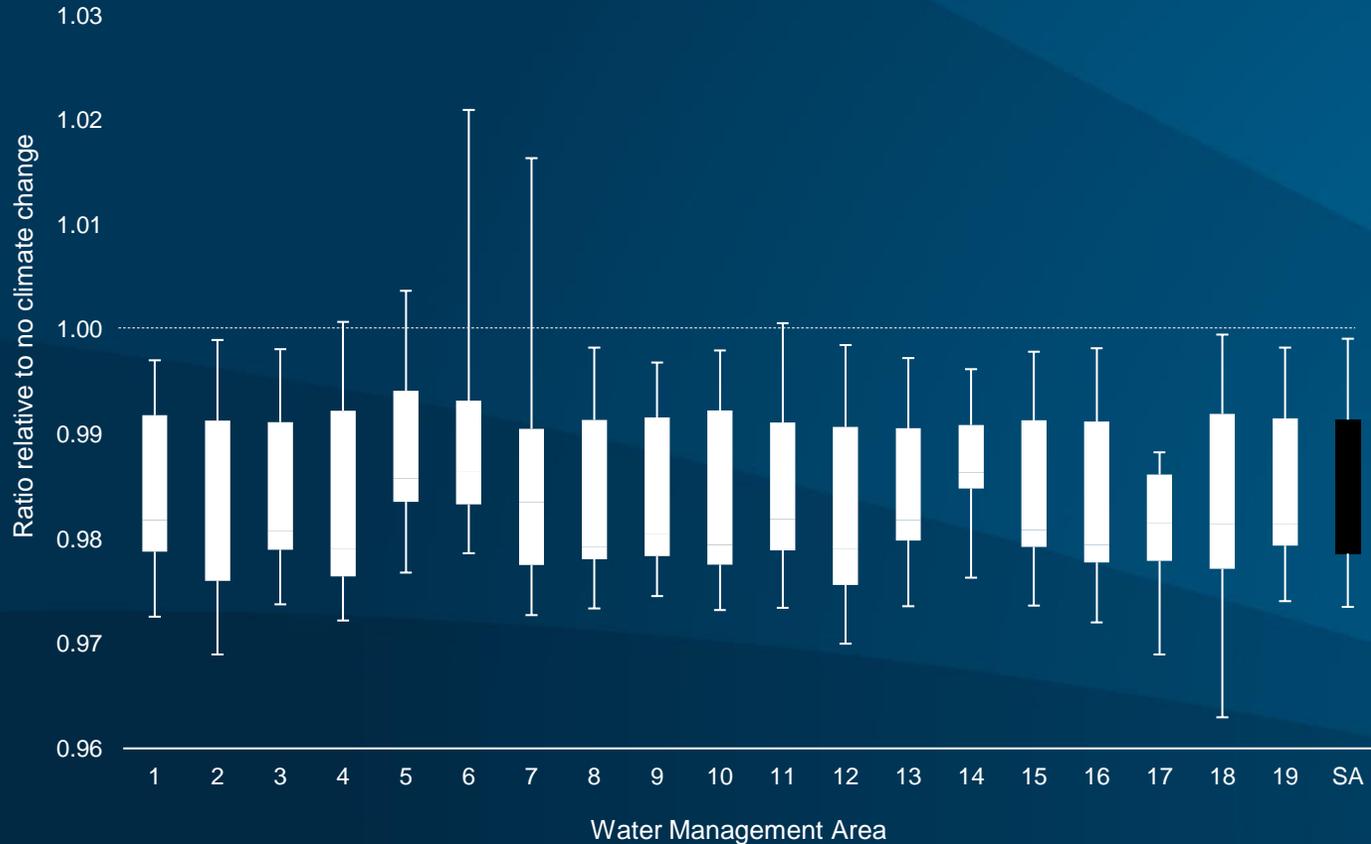
## Agriculture GVA: South Africa (2046-2050)



Cullis et al. 2015. LTAS;  
Hartley et al. (2021) Economic effects of climate uncertainty and vulnerability on South Africa agriculture.



# Impacts on household food consumption

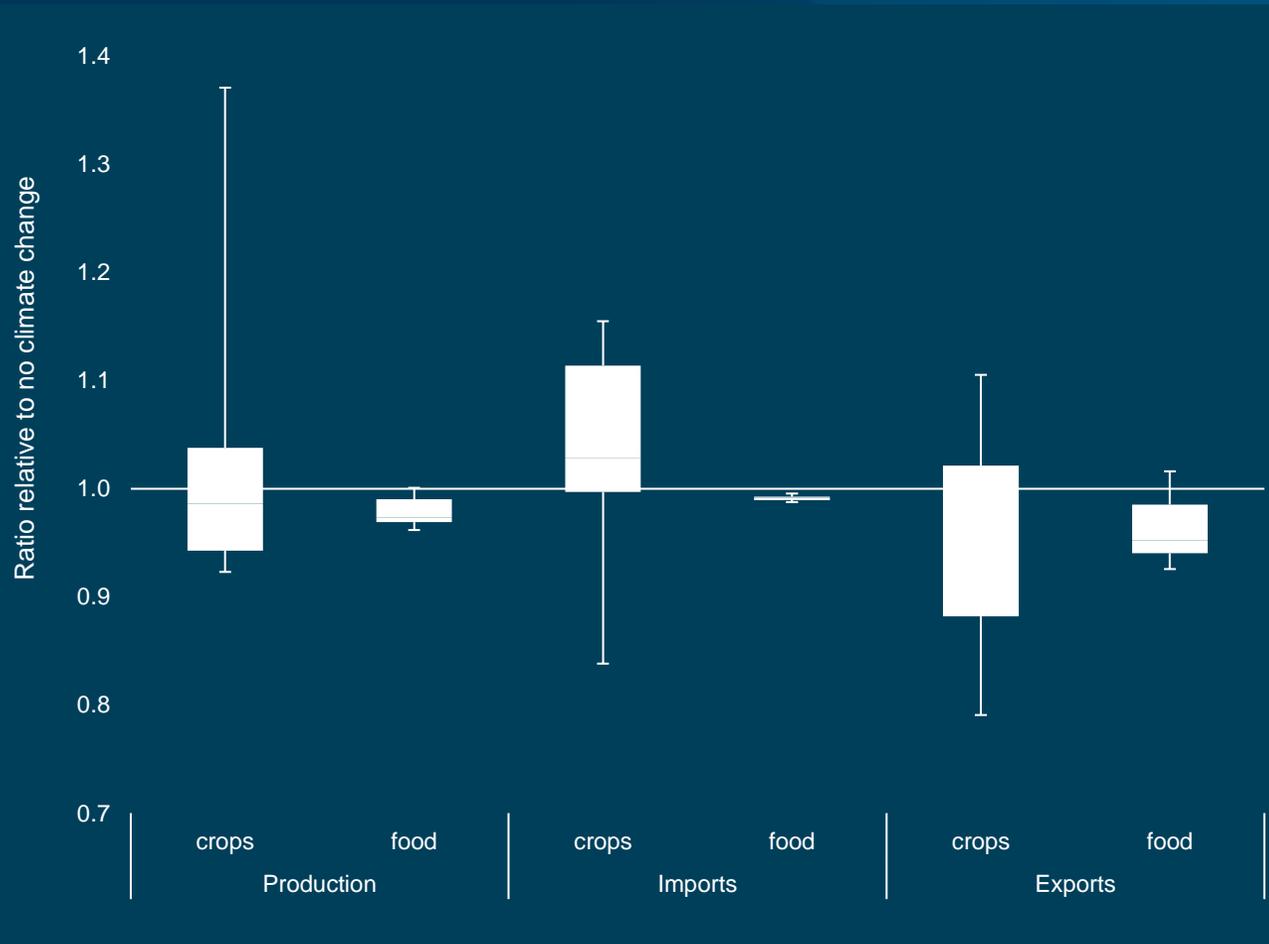


- Food secure nation but high levels of food insecurity particularly in rural areas
- Most climate models indicate a decrease in household food consumption and hence potential increase in insecurity
- All households affected, but first quartile are more vulnerable to larger shocks
- Climate change threatens both the availability of food (impact on production) and the ability to access food (rise food prices and decreases in incomes)
- Adaptation should include alternative income-generating activities that are less climate-dependent but provide money to buy food

*Hartley et al. (2021) Economic effects of climate uncertainty and vulnerability on South Africa agriculture.*



# Implications for trade balance: food



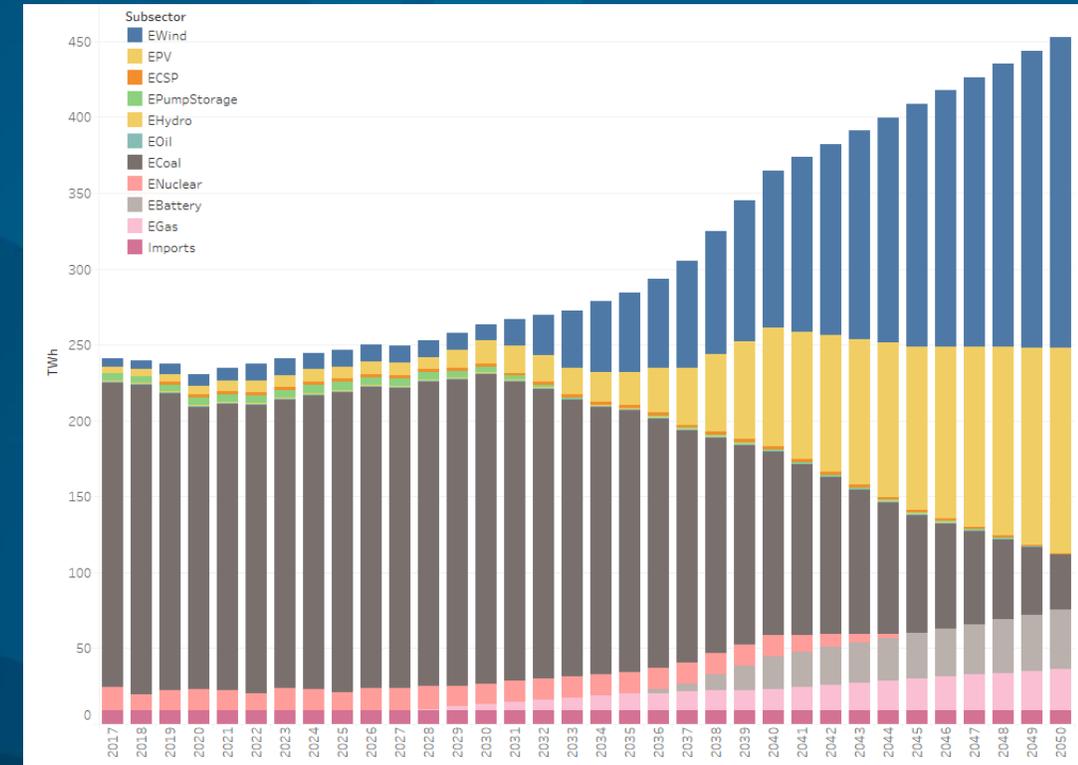
Hartley et al. (2021) *Economic effects of climate uncertainty and vulnerability on South Africa agriculture.*

- Lower agricultural production results in a decline in exports of agriculture commodities and food → deciduous and citrus fruits and oilseeds
- And an increase in imported crops, particularly winter and summer cereals, and oil seeds
- The combination of higher imports and lower exports leads to a deterioration in South Africa's food trade balance, making the country a net food importer (it is currently a net food exporter).
- Increased trade therefore becomes a key adaptation tool to ensure food security



# Climate mitigation adds additional channels that impact on economy

- Need for mitigation, lower clean technology costs driving investment towards cleaner technologies
- Energy optimization: renewables least-cost for power generation; not mutually exclusive to economic growth
  - lower investment and price increases
- Implications for fossil fuel sectors
  - coal mining (power); petroleum (transport)
  - global shifts will also drive
- Sectors along the value chain are also affected
  - for coal: small and concentrated
  - petroleum/transport: larger and broader
- Potential for new sectors/industries (hydrogen, EVs, mining)

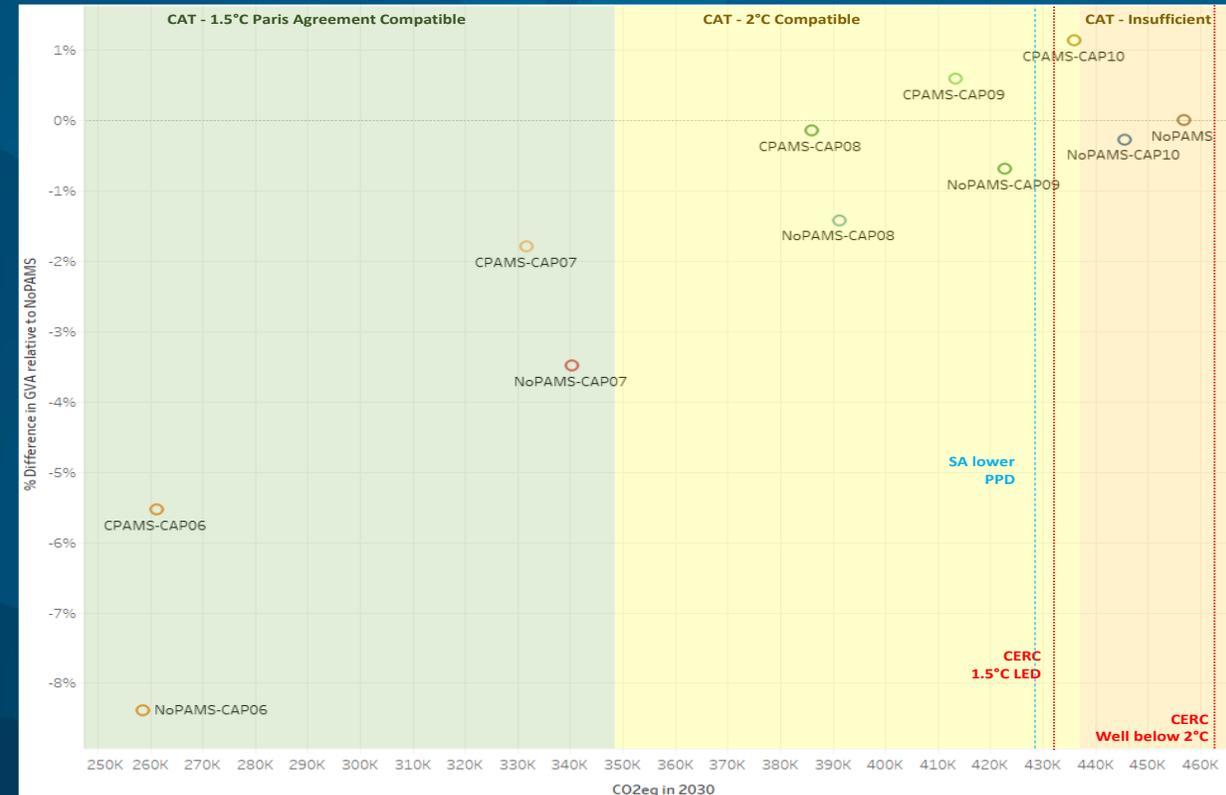


*Electricity sector production by technology, TWh (least-cost)  
Merven et al. (Forthcoming) Moving beyond a least-cost energy system:  
Assessing the trade-offs between increased mitigation ambition and  
economic development in South Africa*



# Mitigation commitments will influence size and pace of economic impact

- Increased ambition requires earlier decarbonization in the power sector; and decarbonization outside of power and transport
  - this has broader impacts on the rest of the economy as shift in industrial processes are necessary
- Current SA commitments are insufficient for 1.5 degrees
- Pace of shift has cost implications...
- ... although net impact can be minimized through increased energy efficiency
- Shifts in economic structure and development of new industries may offset costs



GVA impact and emissions level (excl. LULUCF), 2030  
Merven et al. (Forthcoming) Moving beyond a least-cost energy system: Assessing the trade-offs between increased mitigation ambition and economic development in South Africa

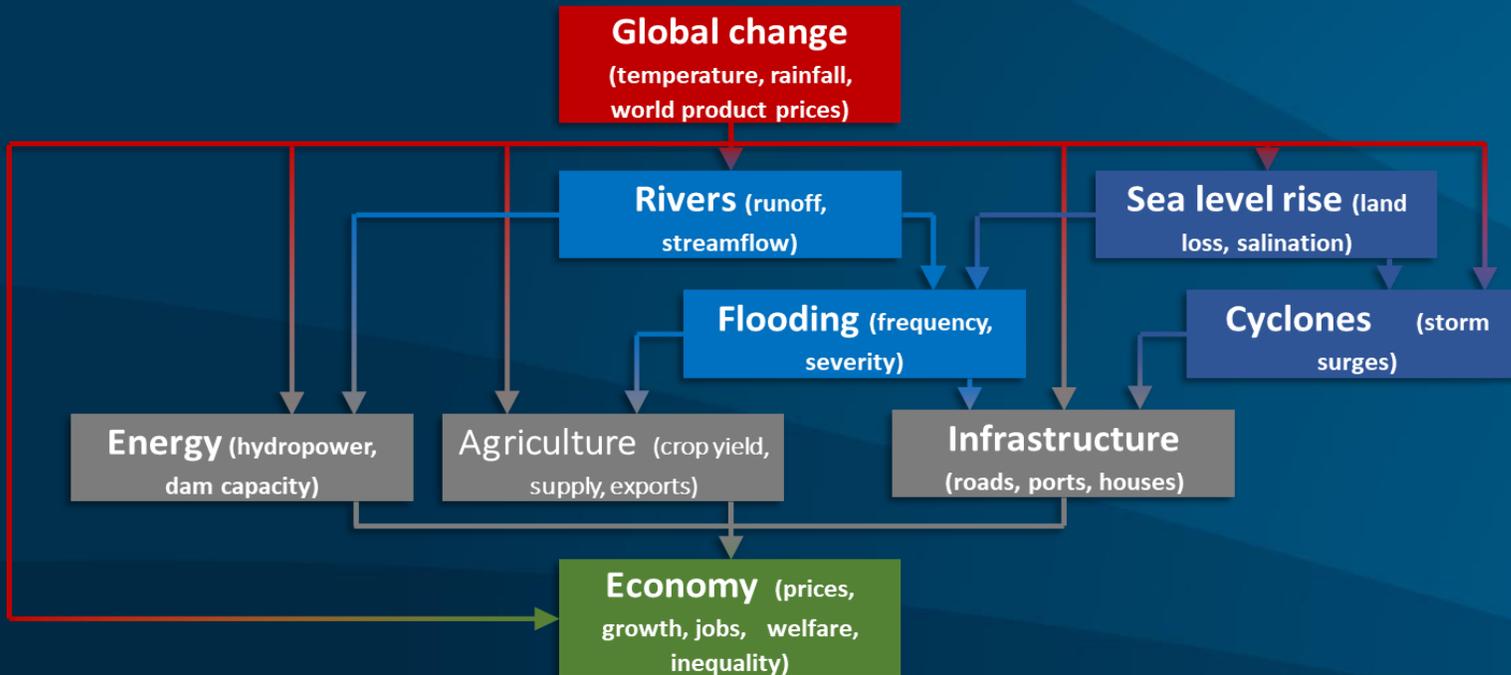


# Summary

- Changes in climate will have a negative impact on economic development
  - Impacts vary across region, vulnerable more affected
  - Large range of uncertainty with potentially large negative impacts
- Policies to adapt are necessary to minimize impacts, require effective investment
  - Include new infrastructure, information tools, better water management systems, conservation agriculture techniques, increased trade
  - But also alternative income-generating activities that are less climate-dependent
- Climate change and adaptation policy can change the structure of the economy and the importance of trade
- Need for mitigation and the transition to greener sustainable growth also influences economic structure
  - Realistic and sufficiently ambitious targets to responsibly mitigate against climate change could accelerate structural shifts



# Current/future climate research: Updating SACReD



- Updated climate emissions scenarios
  - Paris Forever
  - 2 degrees
  - 1.5 degrees
- Improved energy-water modelling
  - Regional water basins
- Improved crop modelling
  - Detailed agriculture crop modelling using IMPACT-SIMM
- Reassessing economic impacts



# Current/future climate research: Expand to regional focus

- Water/Power and Food
  - Water-energy-food nexus
- Assess same climatic scenarios across southern Africa
  - Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe
- Examine similarities and differences in climatic futures
- Identify whether climate change is a regional threat to food security
- Identify opportunities for regional adaptation



# Current/future research climate research: Adding weather

- Results presented considers changes in average long-term temperature and precipitation
- Need to include changes in short-term weather events (e.g. droughts/floods)
- Example: preliminary results for Zambia
  - Much difference in the spread in the tails of the distributions between climate only (blue) and climate plus weather (red).
  - By including weather, we are therefore more able to carefully examine the tails of distributions, where the “low frequency, high impact” events occur

