National Climate Change Information System Training Workshop: Northern Cape

SAWS - Research and Development

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Seasonal Forecast

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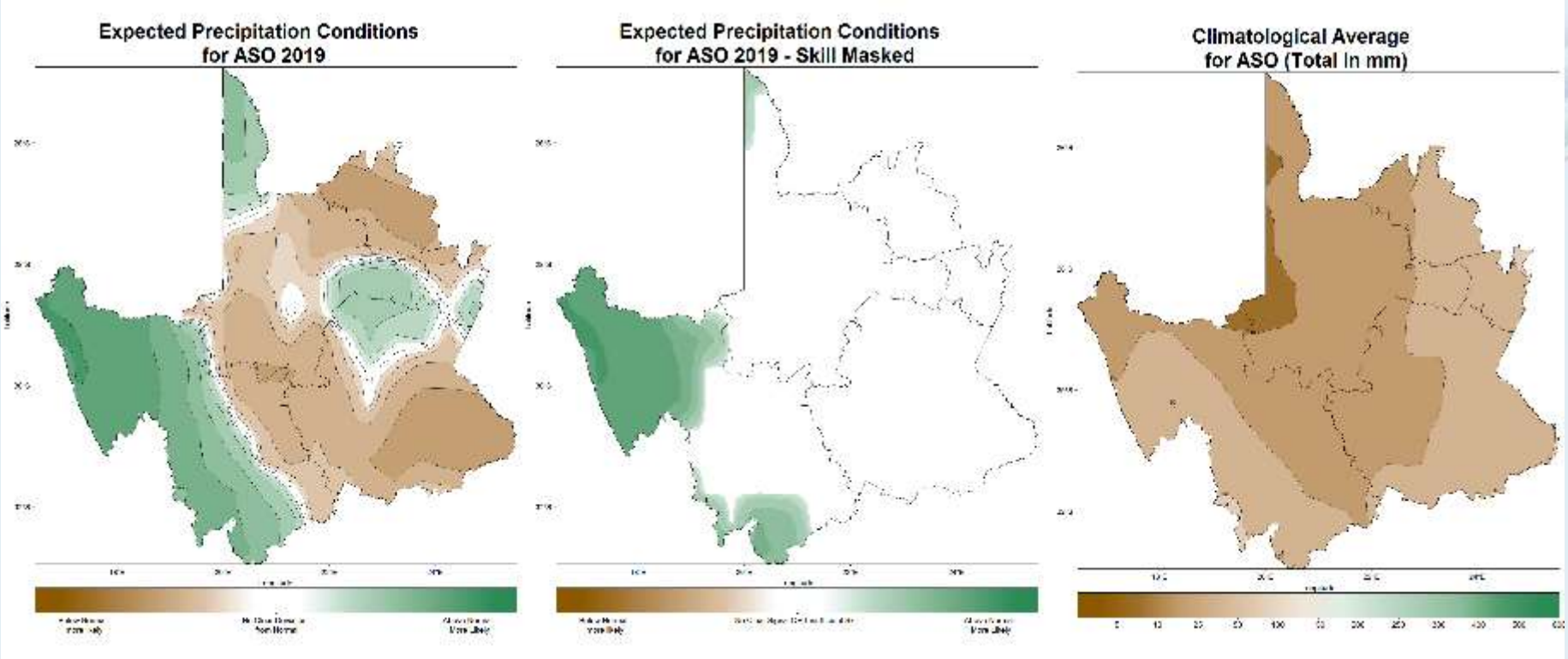
Rainfall



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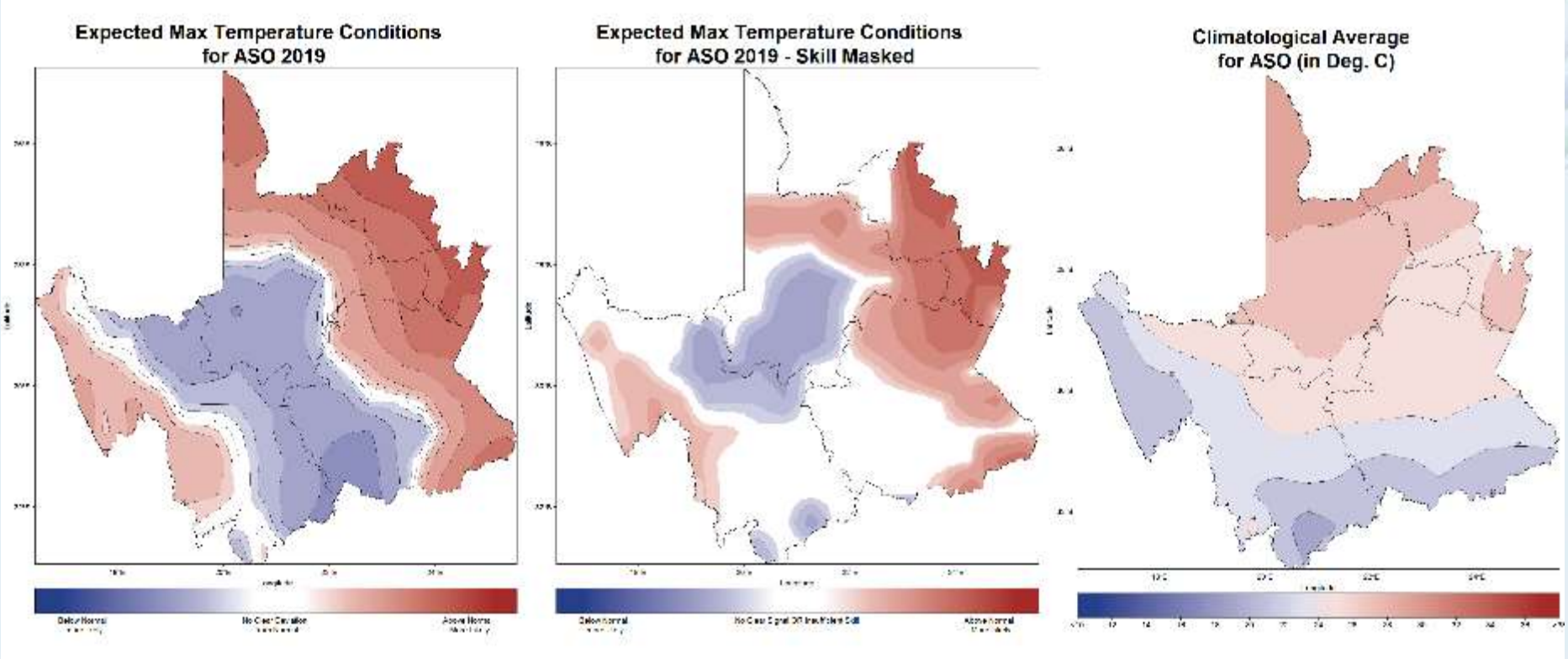
Temperature



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Climate Change Projections

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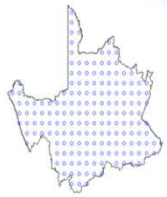
Experimental Design

COoRdinated Downscaling EXperiment (CORDEX) Grid resolution of 0.44º x 0.44º (≈50km x 50km).

Model name	Country	Resolution	Literature
CanESM2m	Canada	2.8° x 2.8°	Arora et al., (2011)
CNRM-CM5	France	1.4° x 1.4°	Voldoire et al., (2013)
CSIRO-Mk3	Australia	1.9° x 1.9°	Rotstayn et al., (2013)
IPSL-CM5A-MR	France	1.9° x 3.8°	Hourdin et al., (2013)
MICRO5	Japan	1.4° x 1.4°	Watanabe et al., (2011)
HadGEM2-ES	UK	1.8° x 1.2°	Collins et al., (2011)
MPI-ESM-LR	Germany	1.9° x 1.9°	Ilyina et al., (2013)
NorESMI-M	Norway	1.9° x 2.5°	Tjiputra et al., (2013)
GFDL-ESM2M	USA	2.0° x 2.5°	Dunne et al., (2012)

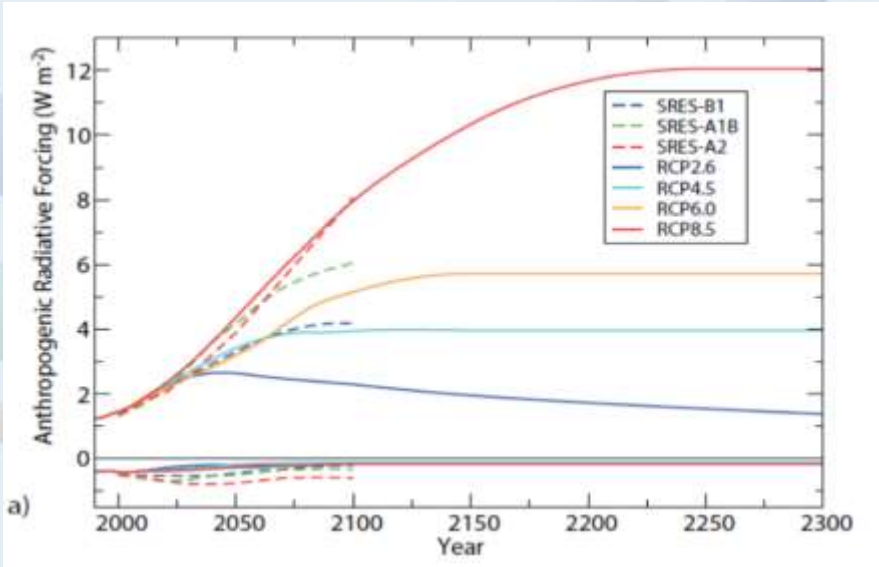
Dynamical downscaling: Nine ocean-atmosphere CGCMs provided lateral boundary input to the Rossby Centre regional model (RCA4)



Variables:
Temperature
Rainfall
CCD
SDII
(ensemble means)

30-year periods:
1976-2005: history
2036-2065
2066-2095

Pathways:
RCP 4.5
RCP 8.5



Surface Temperature Projections: Annual

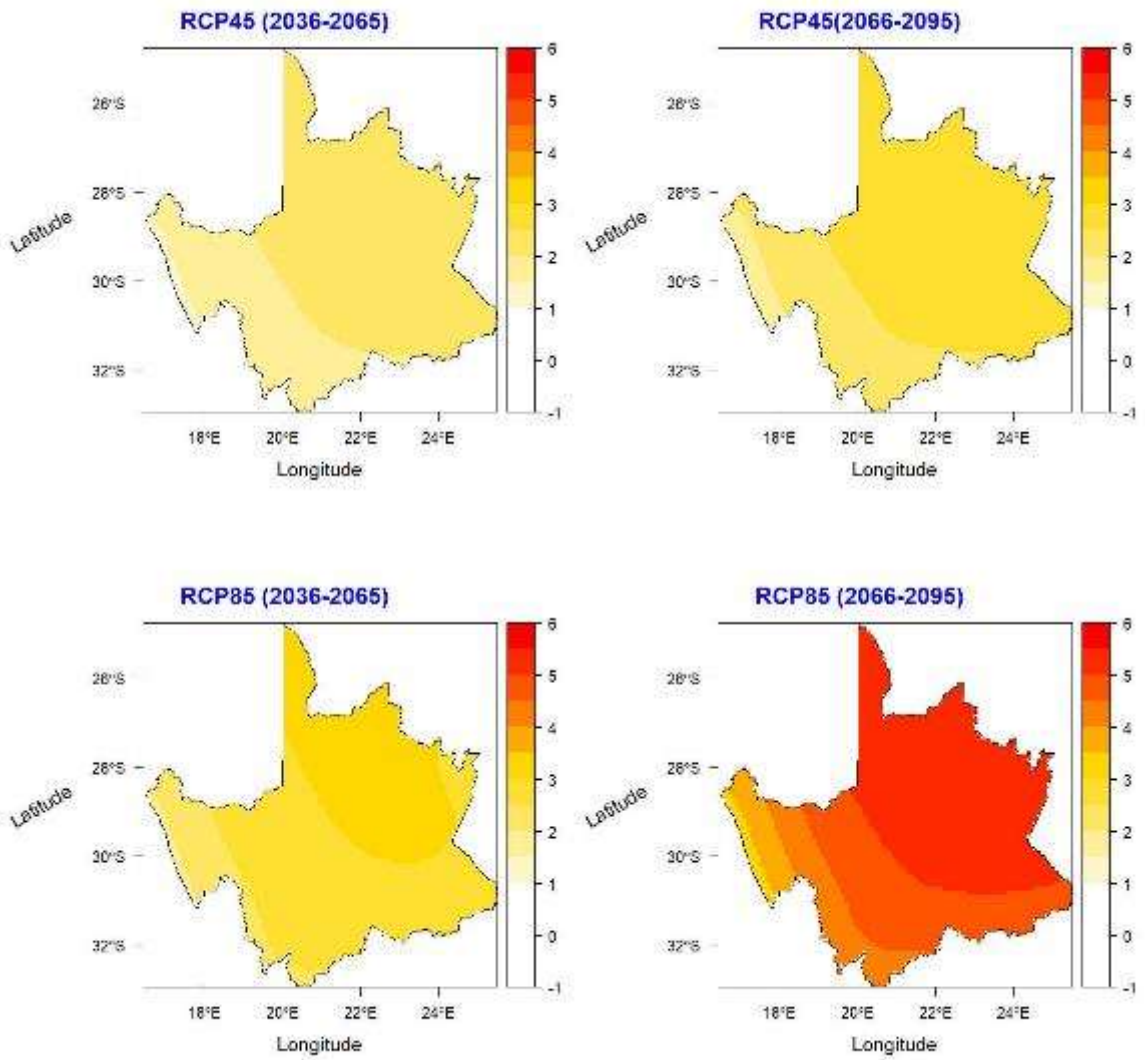


Figure 1: Annual mean near-surface (2m) temperature (˚C) change projected for 2036-2065 (left) and 2066-2095 (right), relative to present (1976-2005), under conditions of the RCP4.5 (top row) and RCP85 (bottom row).

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Rainfall Projections: Annual

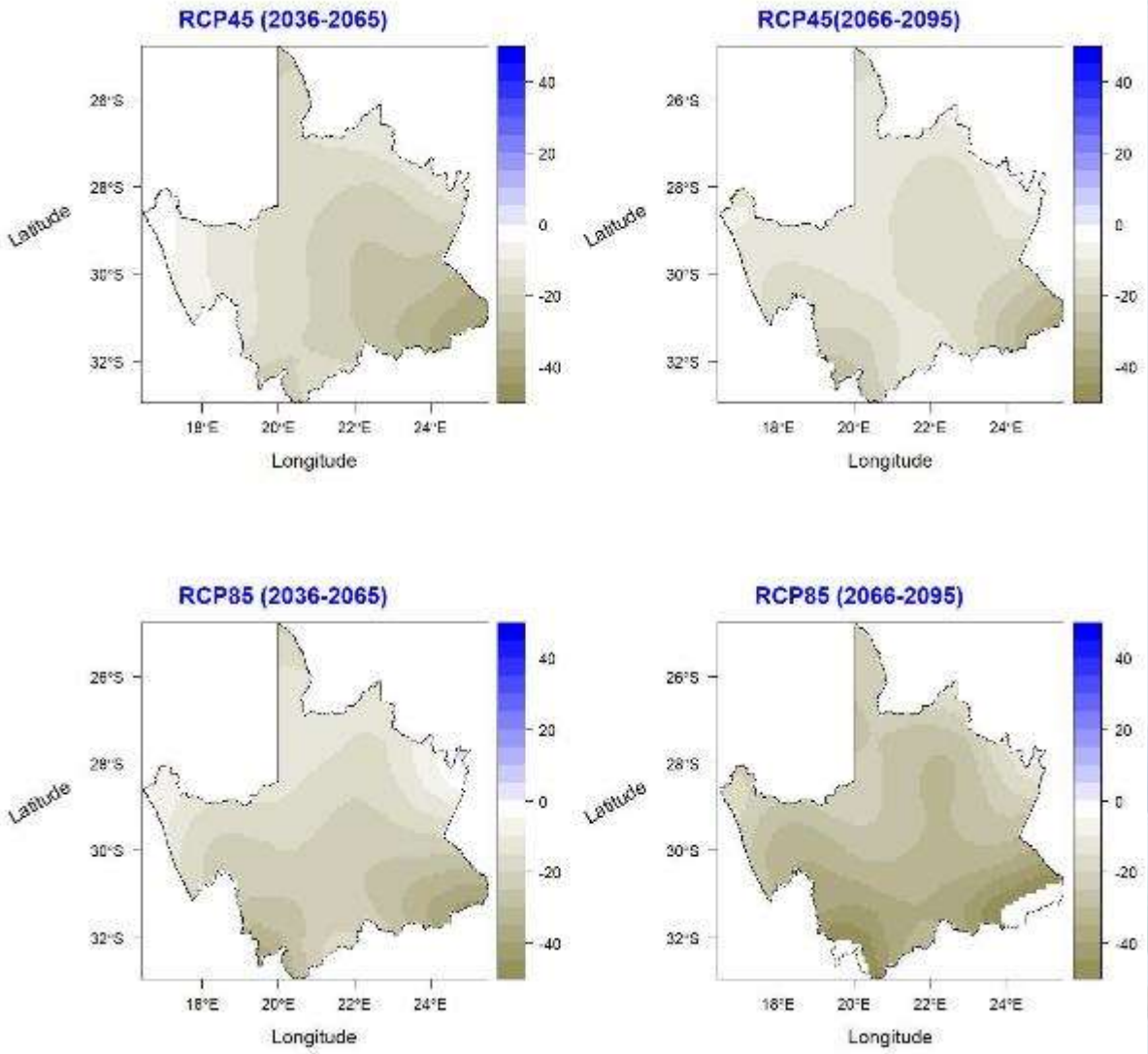

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Figure 6: Annual total rainfall (mm per year) change projected for 2036-2065 (left) and 2066-2095 (right), relative to present (1976-2005), under conditions of the RCP4.5 (top row) and RCP85 (bottom row).

Consecutive Dry Days Projections: Annual

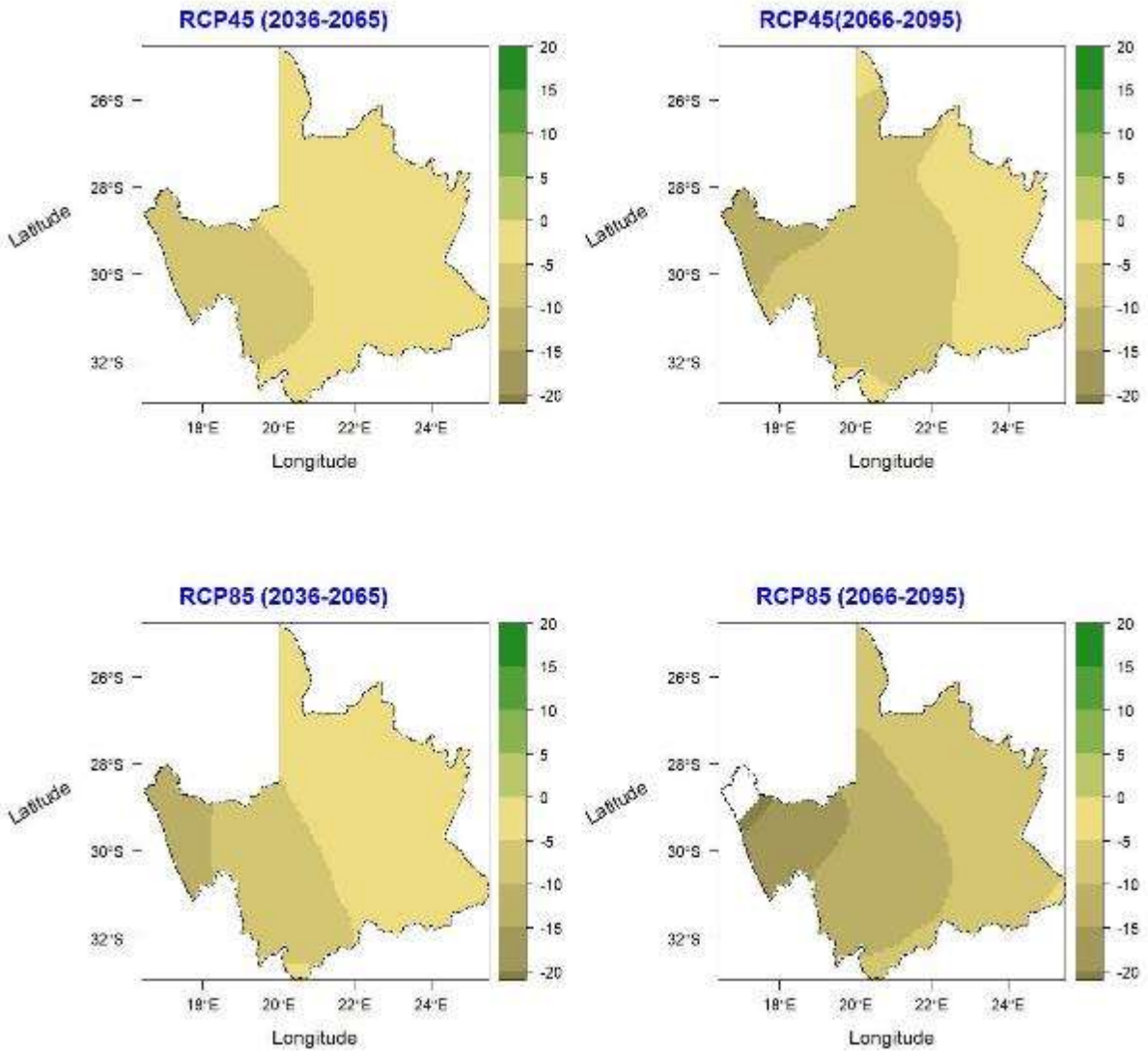

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Figure 11: Projected change in consecutive dry days for 2036-2065 (left) and 2066-2095 (right), relative to present (1976-2005), under conditions of the RCP4.5 (top row) and RCP85 (bottom row)

Rainfall Intensity Projections: Annual

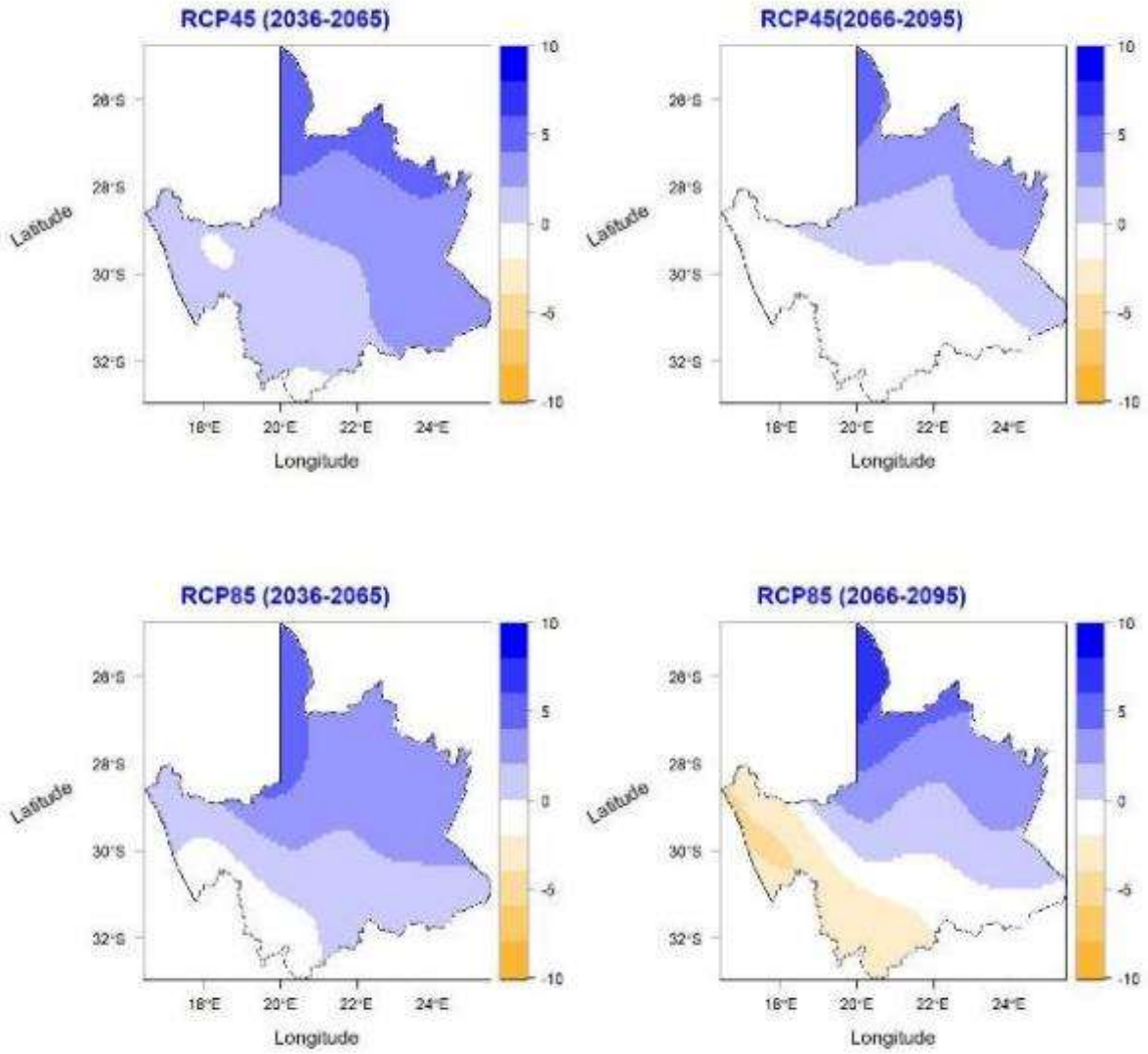

Figure 13: Projected change in daily rainfall intensity for 2036-2065 (left) and 2066-2095 (right), relative to present (1976-2005), under conditions of the RCP4.5 (top row) and RCP85 (bottom row).

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Products in Applications Research

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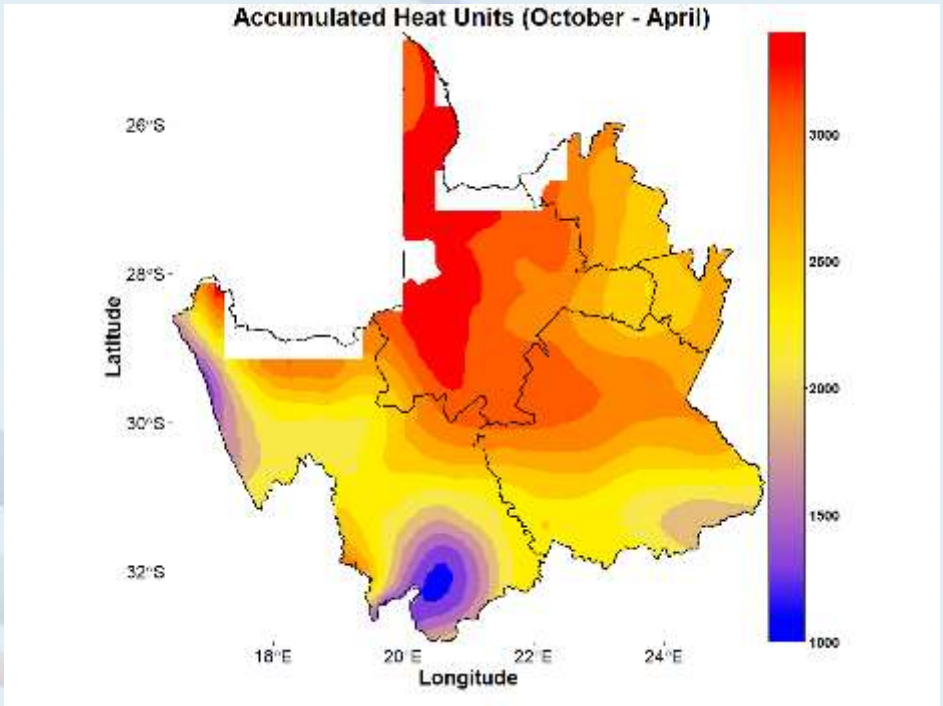
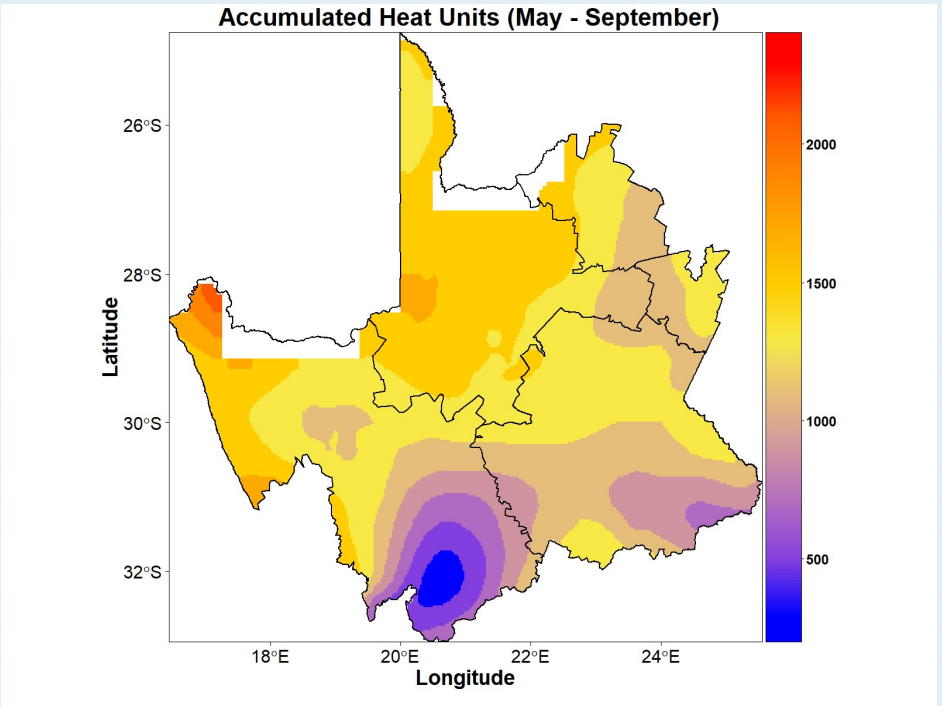
Agrometeorological Products

- Heat unit systems quantify the thermal environment of organisms
- Also known as: Growing Degree Days (GDD), Degree Days (DD), Crop Heat Units (CHU) or Thermal time (TT)
- Heat unts are used:
  - To assess the suitability of a region for crop production and to select suitable hybrids and varieties
  - Estimate the growth-stages of crops, weeds, and life stages of insects
  - Predict best timing of fertilizer or pesticide application
  - Estimate the heat stress on crops



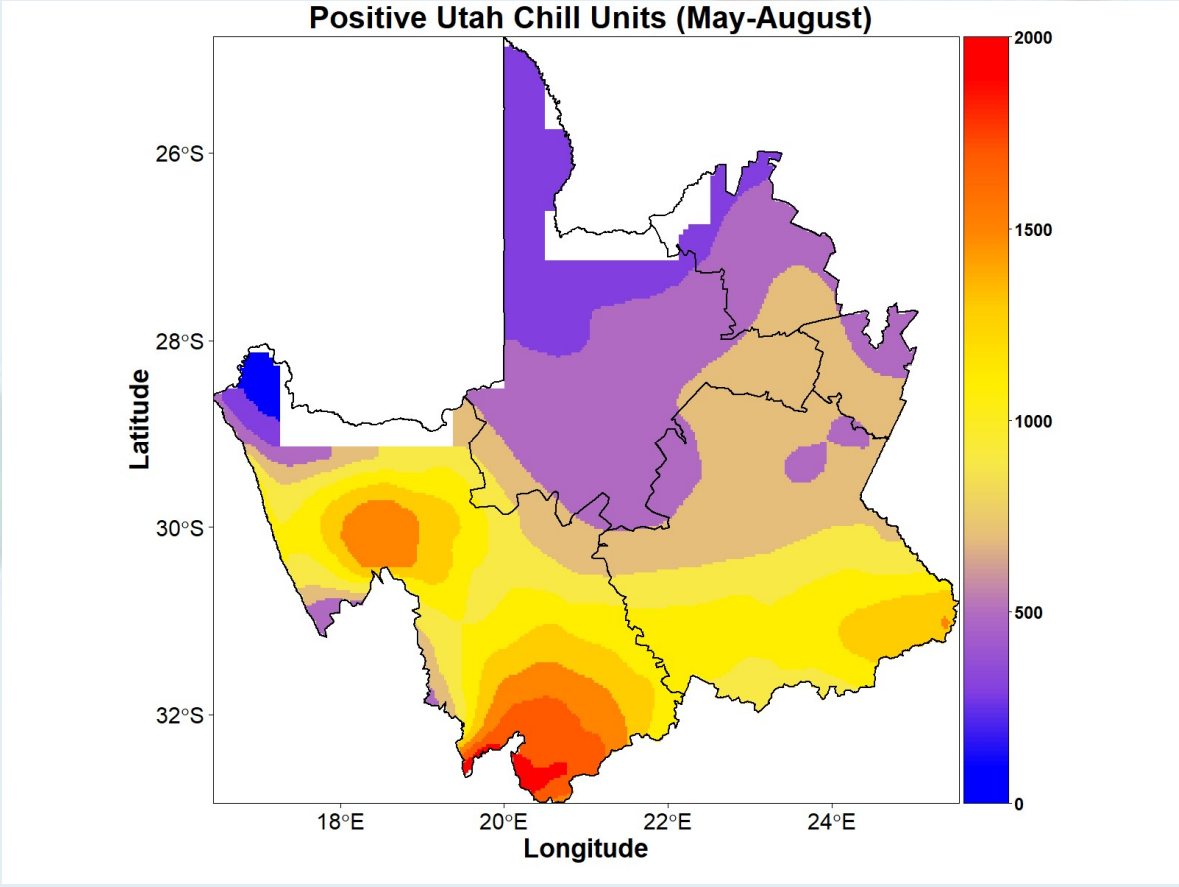


Agrometeorological Products

- Fruit trees break dormancy after a prescribed 'sum' of winter conditions has passed.
- This sum of cold weather is known as **Winter Chill**

- Winter chill is essential for most perennial plants and differs by fruit type and variety and location

- Applications of chill units
  - Predict the end of the dormancy period
  - Determine time for cultivation practices
  - Identify potential growing locations



Energy Products

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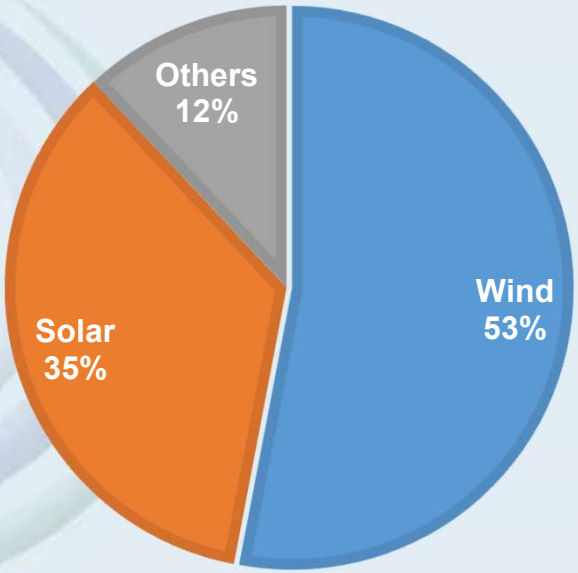
Renewables in South Africa

South Africa is among the top 3 countries in the world:

- 2 500 hours of sunshine per year
- direct solar radiation 4.5-6.5 kWh/m^2 per day

[Singh et al., 2017]



RENEWABLES MIX (%)

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Renewables in South Africa

The South African government aims to:

- Reduce 34% of GHG emissions by 2020 and 42% by 2025

  [Herbst and Rautenbach, 2005]

- Increase electricity generation from renewables from 9% to 40% by 2030, namely CSP, solar PV and biomass

  [Craig et al., 2017]

- Support Independent Power Producers (IPPs) by putting forth plans and policies to increase their share of supply (currently ~90% Eskom, 10% IPPs)

  [*Singh et al., 2017]*

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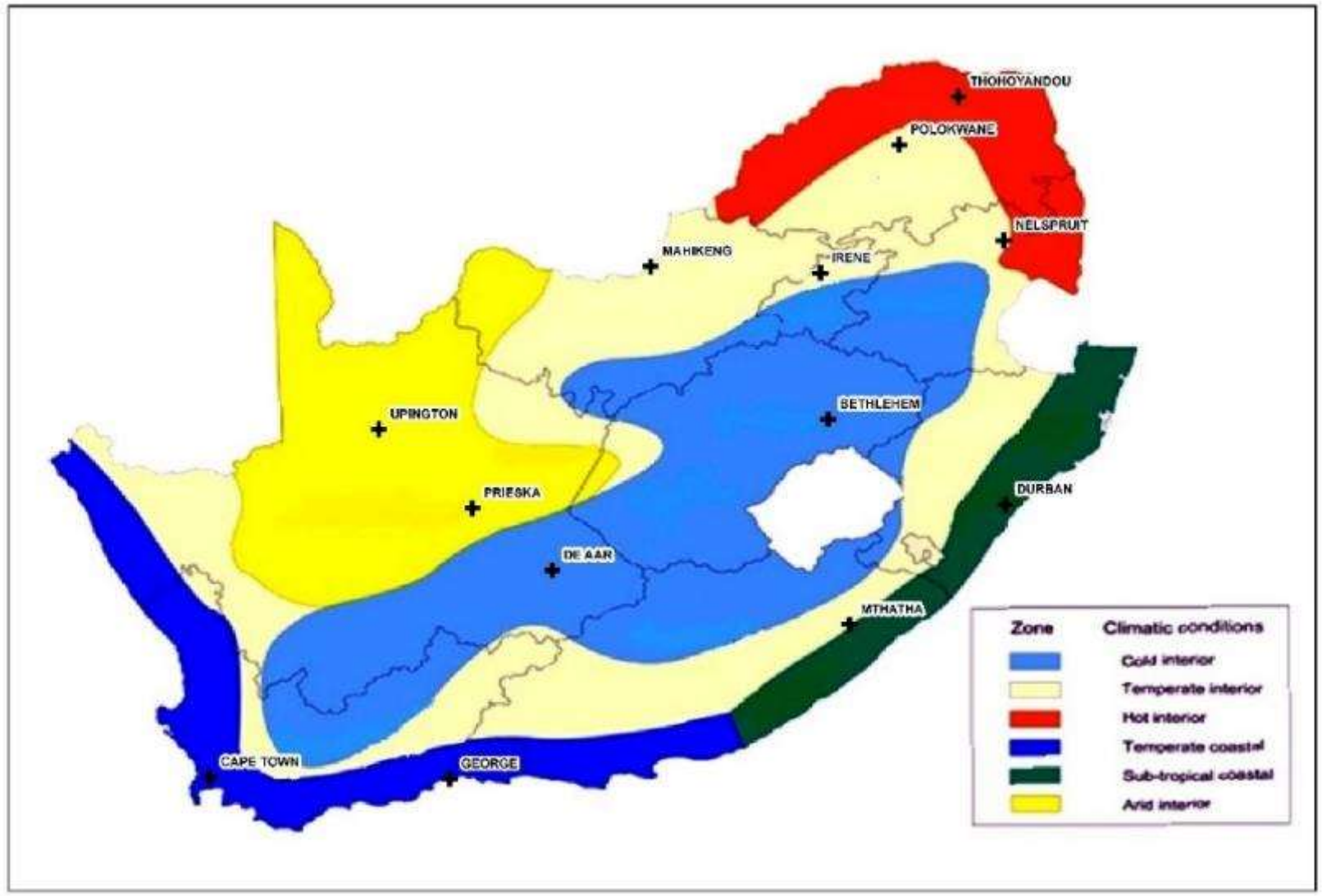
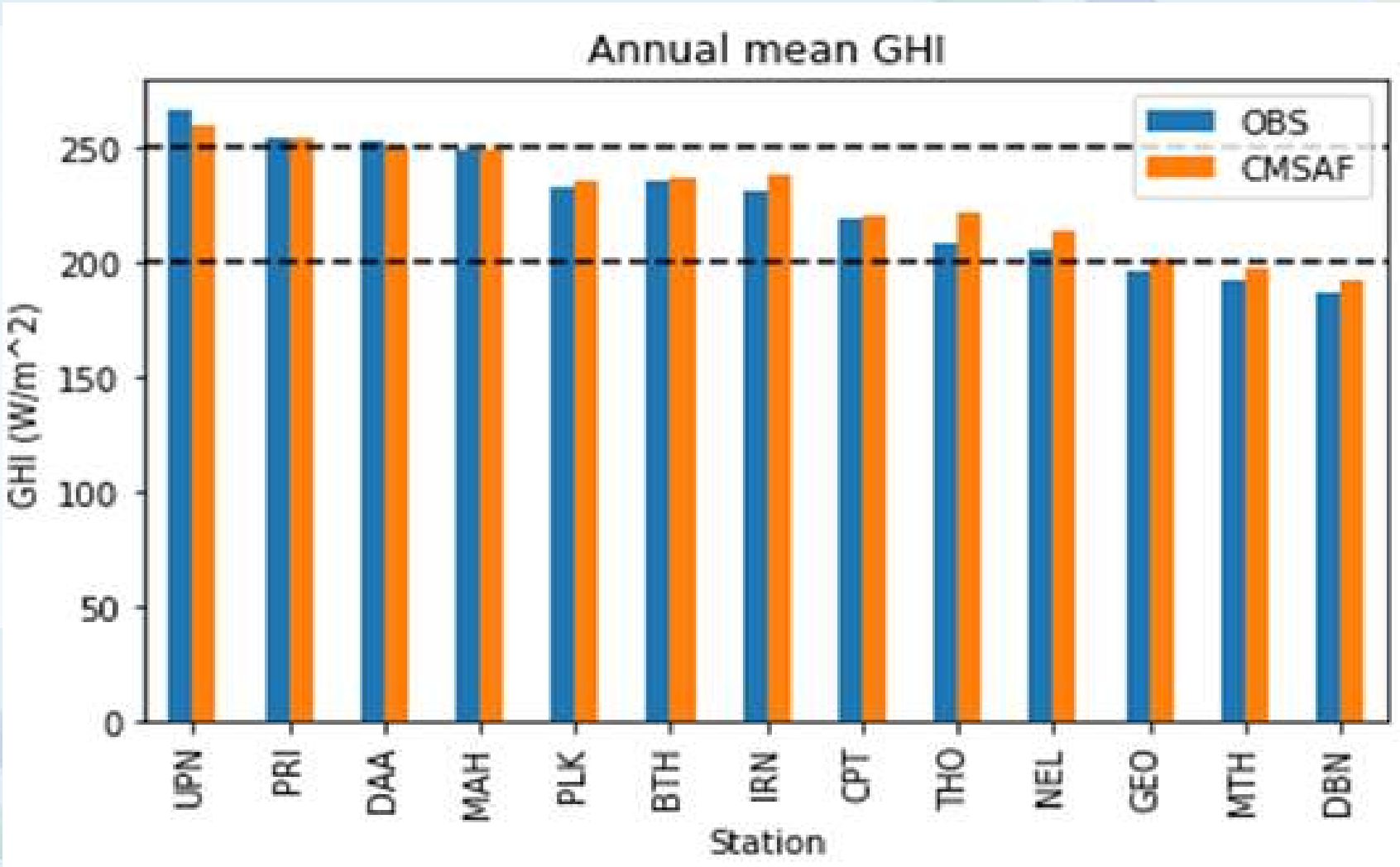
SAWS Solar Radiation Network




Annual mean GHI
OBS
CMSAF
GHI (W/m^2)
0
50
100
150
200
250
UPN
PRI
DAA
MAH
PLK
BTH
IRN
CPT
THO
NEL
GEO
MTH
DBN
Station

Health Products

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Heat Stress & Temperature Extremes

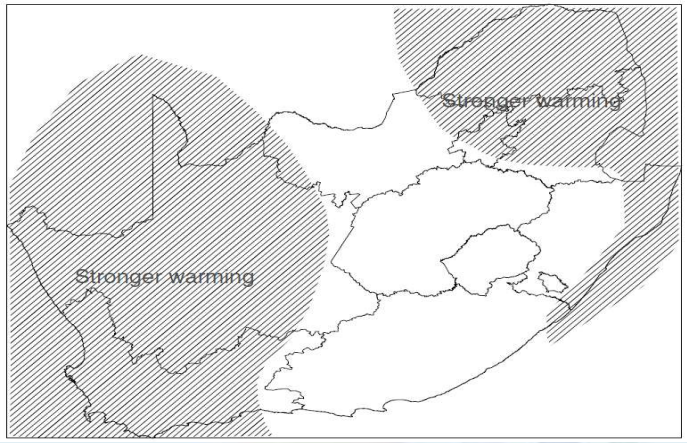
- Heat is 1 of the 9 identified potential health risks due to climate change in South Africa (DEA,2014).
- Heat is known as a "silent" killer because it's not a visible threat like fires and floods.
- Heat stress occurs when your body cannot cool itself enough to maintain a healthy temperature (37 °C).
- Ten years (2006-2016) heat stress assessment based on Apparent Temperature AT (°C) for the Northern Cape show an increase in number of frequencies through the reference risk categories: **Caution (27-31°C), extreme caution (32-38°C), danger (39-50°C) and extreme danger (51+°C)** and well as **normal (>26°C).**

SAWS procured 4 biometeorological stations, Three stations have been deployed in Limpopo, **Northern Cape** and Gauteng. The third station will be deployed in North West.

The stations will measure air temperature (°C), relative humidity (%), wind speed (ms-2) and direction at 2 m above ground, rain (mm), solar radiation (Wm^{-2}), erythemal irradiance (Wm^{-2}) that measure ultraviolet radiation (UVB), as well as a black globe sensor that measure the globe temperature used in the assessment of heat stress. The station also consists of a Vaisala air quality sensor-AQT 420 that measures air quality pollutants, including Nitrogen dioxide (NO_2), Sulphur dioxide (SO_2), Carbon monoxide (CO) and Ozone (O_3), and Particulate Matter ($PM_{2.5}$ and PM_{10}).

Heat Stress & Temperature Extremes

- Northern Cape is one of the regions in the country experiencing temperature extremes.
- Study on temperatures trends (1962-2009) show that Northern Cape (as well as the Northeast) is experiencing stronger warming.



- During the exceptionally warm summer season of 2015/16, the southern African region experienced its warmest summer in recorded history.
- Three temperature records were broken across the Northern Cape, with temperatures exceeding 40 degrees. Augrabiesfalls was 1.4 °C shy from reaching 50°C.

Station Name	No of reoccurrences	Highest Max Temperature record	Latest Date	Provinces
AUGRABIES FALLS	14	48.6 °C	2016-01-05	NC
TWEE RIVIEREN	13	45.6 °C	2016-11-30	WC
TOSCA	11	46.0 °C	2016-01-06	NW
ADDO ELEPHANT PARK	10	46.6 °C	2016-02-01	EC
REDELINGSHUYS AWS	9	46.0 °C	2012-01-16	WC
NGQURA - CD EGA	9	45.0 °C	2017-02-28	EC
LAINGSBURG	8	43.0 °C	2016-02-01	WC
MALMESBURY	7	44.8 °C	2015-12-30	WC
GIYANI	7	42.9 °C	2015-12-12	LMP
UPINGTON WO	7	45.3 °C	2016-01-05	NC
WARMBAD TOWOOMBA	6	43.7 °C	2016-01-07	LMP
CLANWILLIAM	6	46.0 °C	2010-02-20	WC
ROBERTSON	6	44.7 °C	2015-12-30	WC
THABAZIMBI	6	44.7 °C	2016-01-07	LMP
LADISMITH	6	43.6 °C	2010-02-09	WC
MBAZWANA AIRFIELD	6	42.4 °C	2016-02-20	KZN
VREDENDAL	5	48.4 °C	2015-10-27	WC
SKUKUZA	5	45.1 °C	2016-12-22	MP
PATENSIE	5	45.0 °C	2010-02-09	EC
VRYBURG	5	43.7 °C	2016-01-06	NW
PORTERVILLE	5	43.1 °C	2015-12-30	WC
MARKEN	5	42.9 °C	2016-01-07	LMP
LEVUBU	5	42.5 °C	2015-11-02	LMP
OUDESTAD	5	42.5 °C	2016-01-07	LMP
CAPE TOWN - ROYAL YACHT CLUB	5	42.4 °C	2015-03-03	WC
NIEUWOUDTVILLE	5	42.4 °C	2016-02-01	NC

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Conclusion

- The SAWS Research and Development is dedicated to contribute to the mandate of producing state of the art research which are Taylor-made and reaching the 57 million people in South Africa with efforts to creating a WeatherSmart nation.

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