Heatwaves in the future warmer climate of South Africa

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Introduction

- Weather and climate extremes have adverse effects on the society. Climate change has resulted in frequent occurrences of most extreme weather events in recent decades.
- Heatwaves are warm temperature extreme events that have environmental and socioeconomic in many regions across the world. The nature of heatwaves may vary from place to place depending on temperature characteristics of a region.
- Negative impacts of warm extreme temperatures over South Africa necessitate the need to study heatwaves as these events have not received rigorous attention in the whole of southern Africa.

Data and methods: Observations

- A total of 24 SAWS climate stations distributed across the country were used for temperature data over the 30-year period (1983-2012).
- RClimDex version 1.0 software (Zhang and Yang 2004) was used to quality control the data.
- ArcGIS was used to visualize observations.
- Two heatwave characteristics were studied:
  - Frequency
  - Duration

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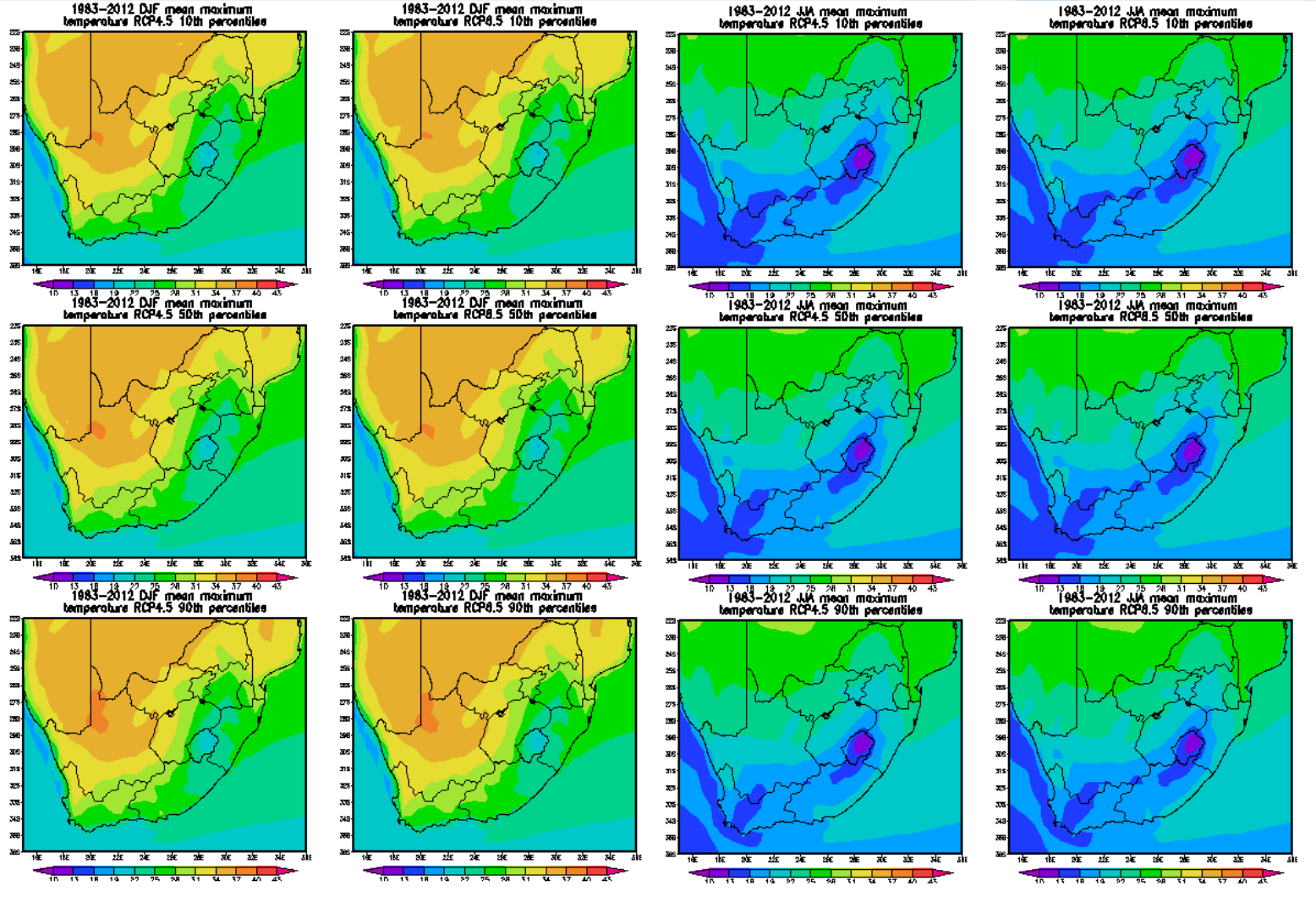
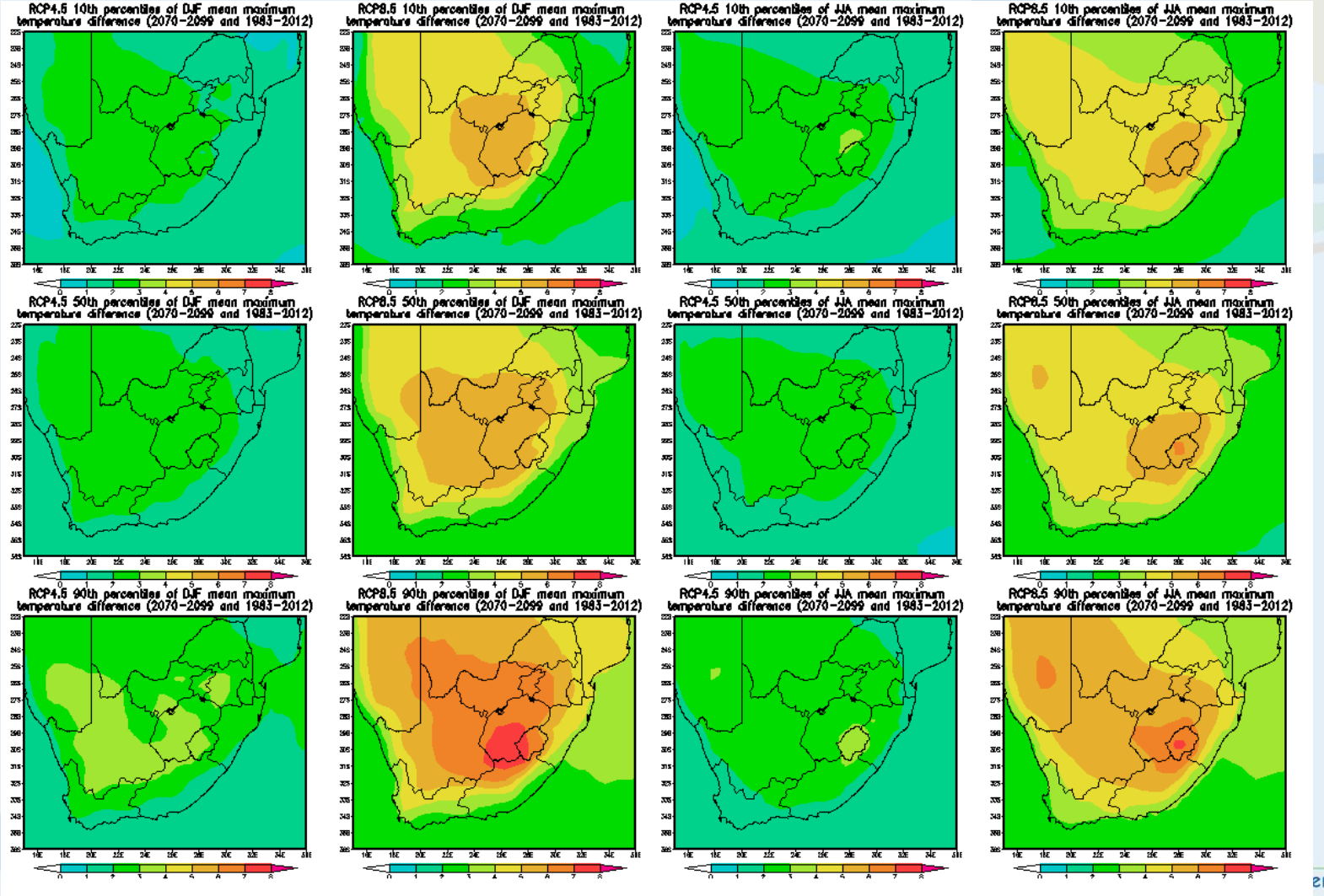
Data and methods: Projections

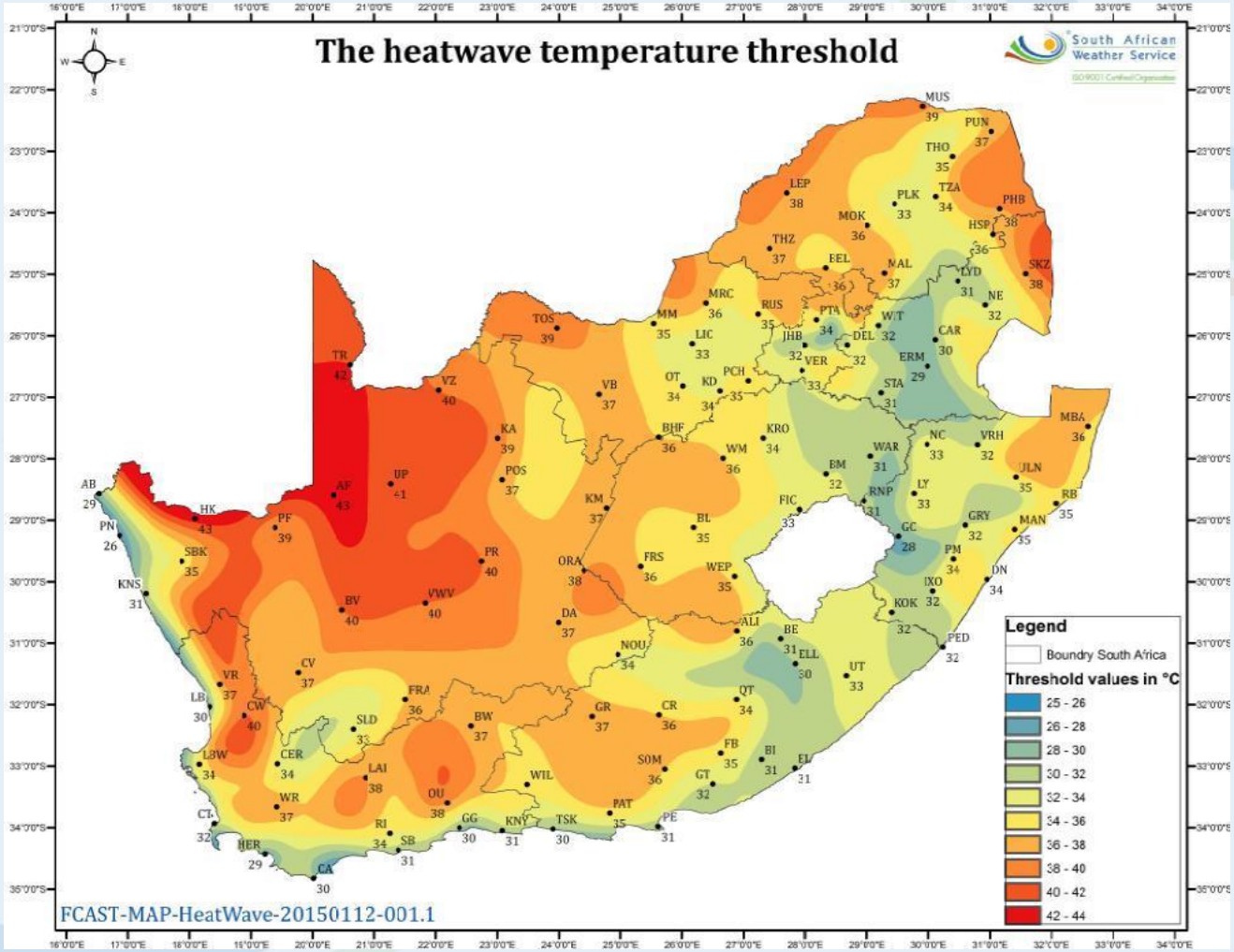
- Future Climate projections were obtained from the Conformal Cubic Atmospheric Model (CCAM) forced with RCP4.5 and RCP8.5 emission scenarios.
- Simulations were performed on the CHPC Lengau cluster
- Present day climate : 1983 – 2012
- Future periods considered: 2010 – 2039, 2040 – 2069 and 2070 – 2099.
- GrADS was used to visualize simulations.
- This work adopted the SAWS definition that a heat wave is “when for at least three consecutive days the maximum temperature of a certain region is five degrees higher than the mean maximum for the hottest month for a particular station”.

Comparisons between simulated RCP4.5 and RCP 8.5 10th, 50th and 90th percentiles of DJF(Left) and JJA (Right) average maximum temperature (°C) during 1983-2012



Comparisons between simulated RCP4.5 and RCP 8.5 10th, 50th and 90th percentiles of DJF(Left) and JJA (Right) average maximum temperature (°C) difference between 2070-2099 and 1983-2012.





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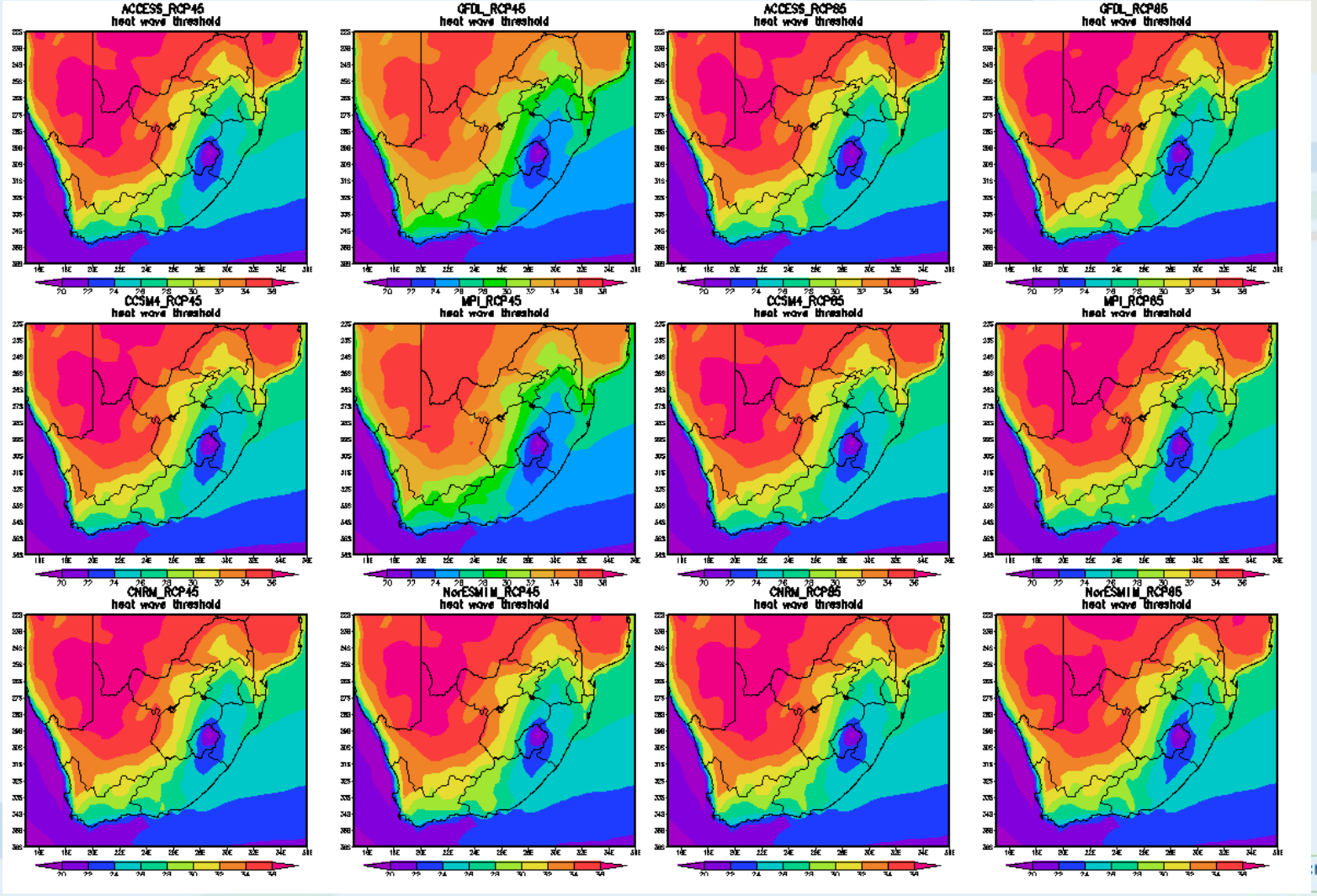
Simulated RCP4.5 (left) and RCP8.5 (Right) heat wave thresholds (°C) of the 6 ensemble members



Results: Observed heat wave frequency

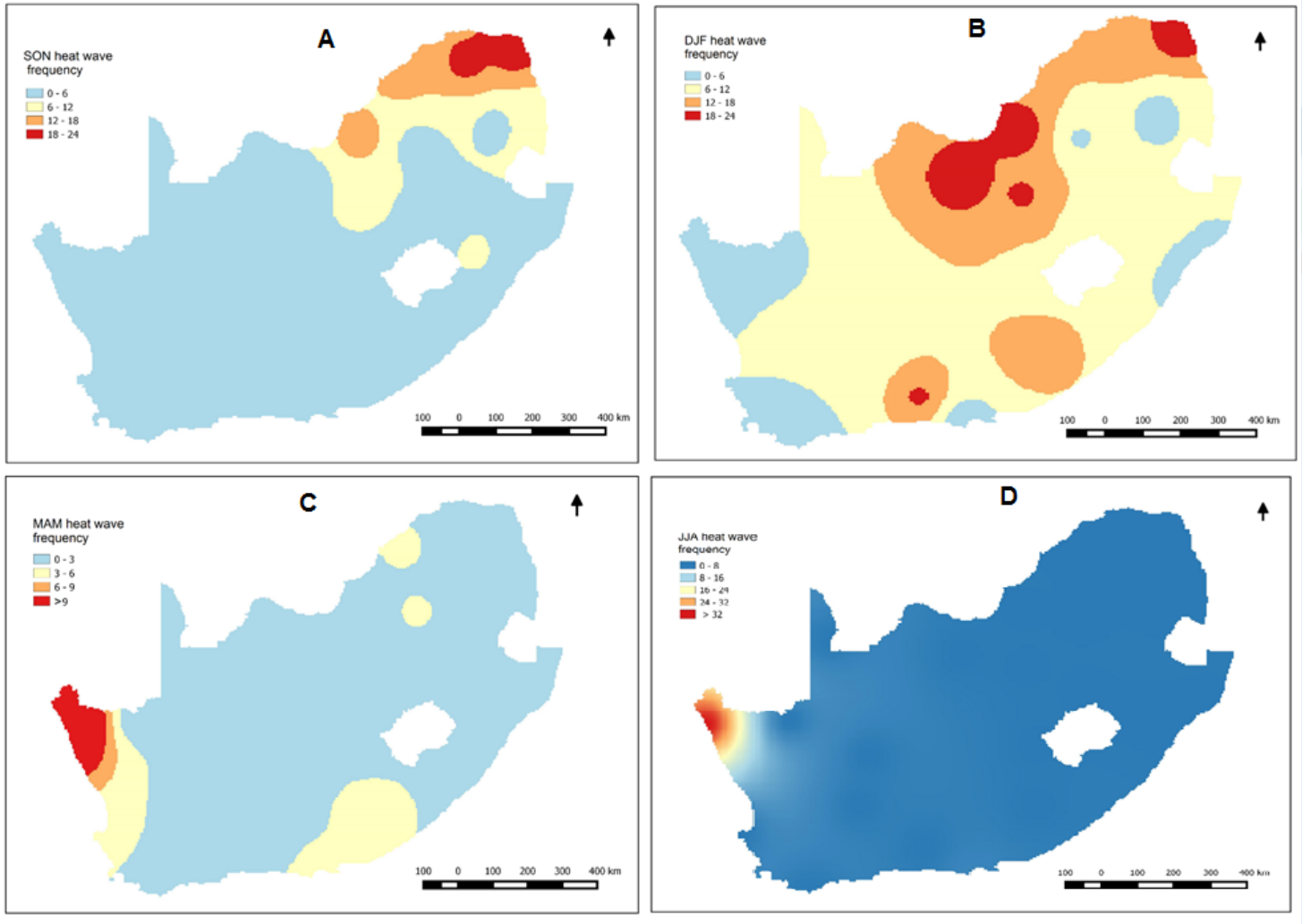


Fig. 1: heat wave frequency (shaded) over South Africa from 1983 to 2012.

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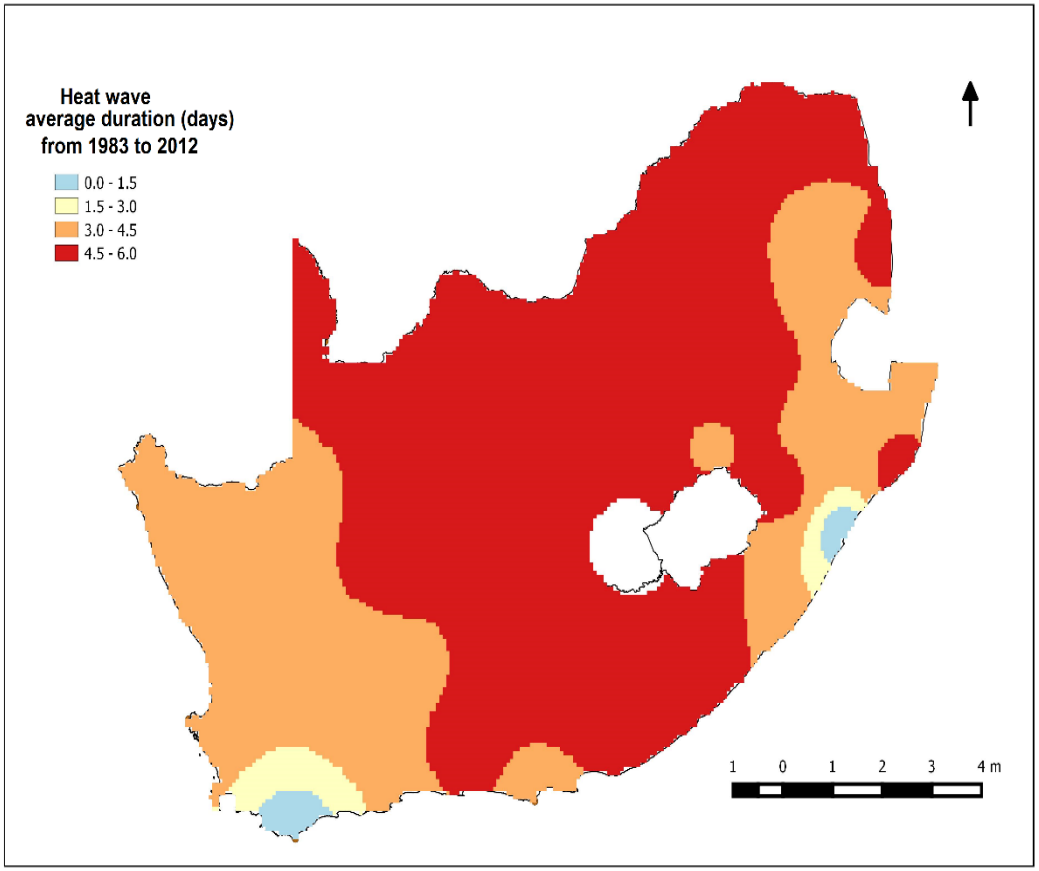

Interpolated heat wave average duration over South Africa from 1983 to 2012. Duration less 3 days should be ignored (an artefact from interpolation process).

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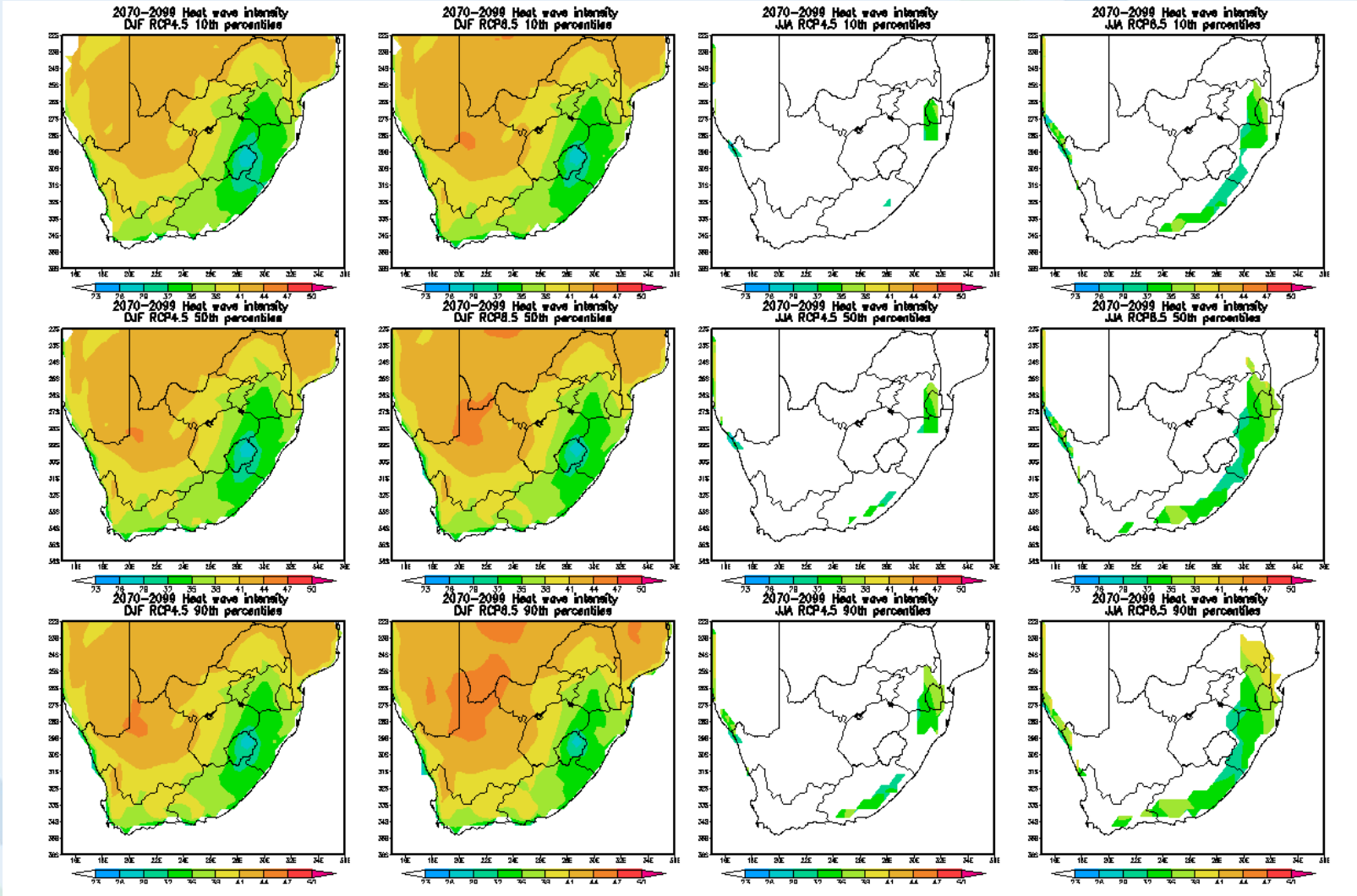
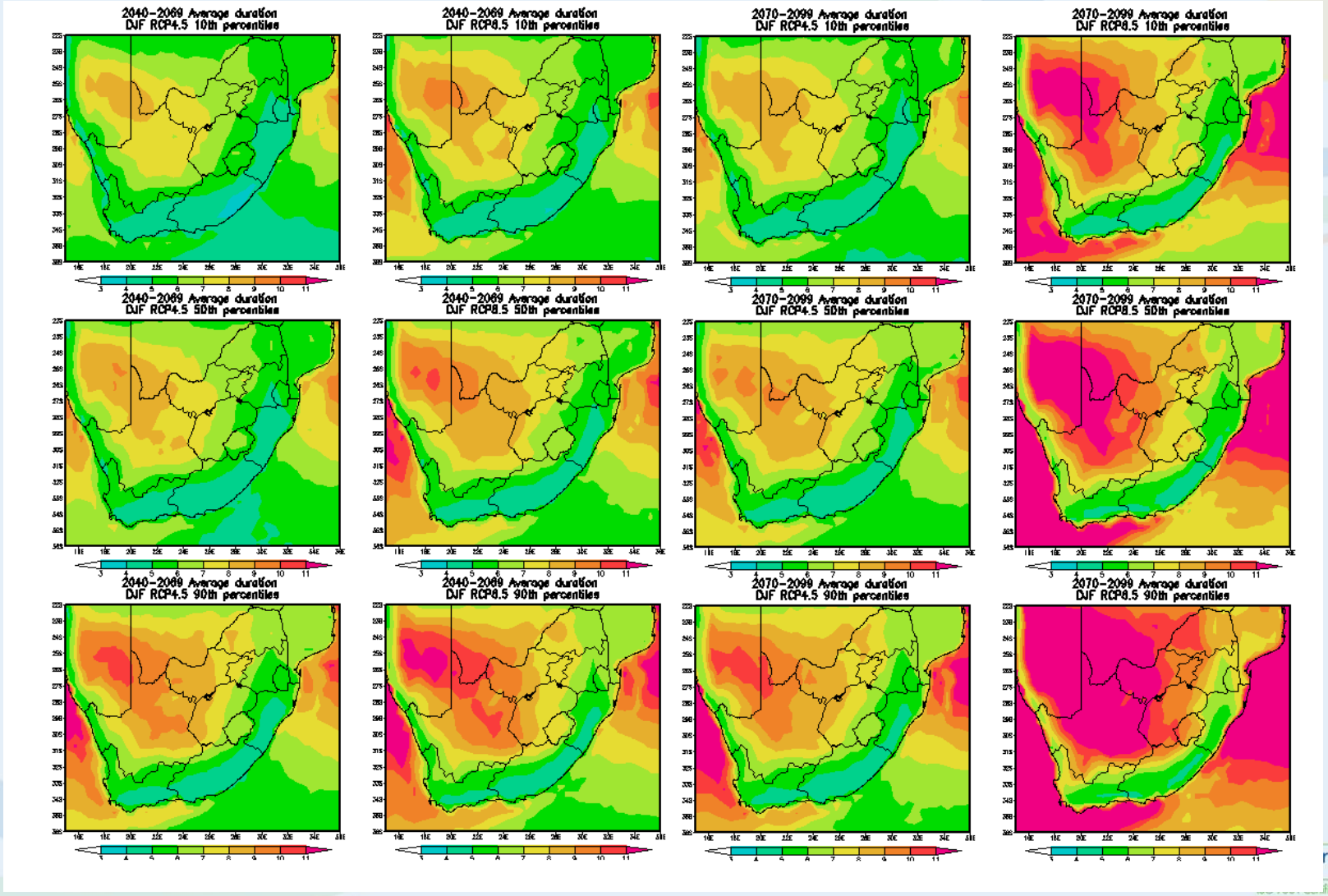
Comparisons between RCP4.5 and RCP 8.5 10th, 50th and 90th percentiles of DJF(Left) and JJA (Right) heatwave frequency during 2070-2099



Comparisons between RCP4.5 and RCP 8.5 10th, 50th and 90th percentiles of DJF average duration (days) during 2040-2069 (left) and 2070-2099 (right).



Summary

- Simulations indicate that maximum temperatures will continue to rise, reaching over 7°C much of the interior throughout the year during the 2070-2099 period.
- Simulated heat wave thresholds are consistent with observed heat wave threshold.
- RCP 4.5 estimates lower number of heat waves and least average duration in future warmer climates when compared to RCP 8.5. RCP 4.5 also estimates lower average maximum temperatures over the country than RCP 8.5.
- Short lasting heat waves (average of 3-4 days) along the coasts are expected to increase in future climates.

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Summary

- Karoo is expected to have the most dramatic increase of heat waves than most inland parts of the country.
- Central interior is not projected to have the most dramatic increase in heat wave frequency, however heat waves over this region are expected to last longer in future climates.
- Least increase is expected for heat waves lasting for longer durations along the coasts compared inland regions.

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Future work?

- To what extent does the co-occurrence of heat waves and droughts affect agricultural yields?
- Is there a direct correlation between heat wave occurrence and mortality rate in South Africa?
- To what extent does the ocean-atmosphere interaction influence the occurrence and intensity of heat waves in the perspective of South Africa?

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Thank you!

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