Trends in extreme indices in 60-year simulations over Australia

Climate Change Research Centre

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INTRODUCTION

Impact of extreme events are of major importance, but large uncertainty exists in their projections at regional scales.

GCMs do not resolve most of the spatial -or even temporal- scale at which extremes occur. Regional Climate Models are useful to this purpose.

They are high-order moments so the uncertainty must be correctly sampled: long climate periods and robust ensembles (independent models)

Various questions arise from the potential use of RCM to study extreme events and their trends:

How do RCMs represent the observed trend?

Do they improve the boundary conditions?

How do they compare with the observational spread ?

EXPERIMENTAL SETUP

- Weather Research and Forecasting (WRF) model.
- Australasia CORDEX domain (~50-km).
- Three WRF configurations (table 1).
- 60 years (1950-2009)
- NNRP1 boundary conditions.
- Bias-corrected using AWAP and histogram equalisation[1].

Study of extreme indices from ETCCDI (4 presented here). Comparison of trends in extremes from NNRP1, WRF, AWAP and GHCNDEX[2]

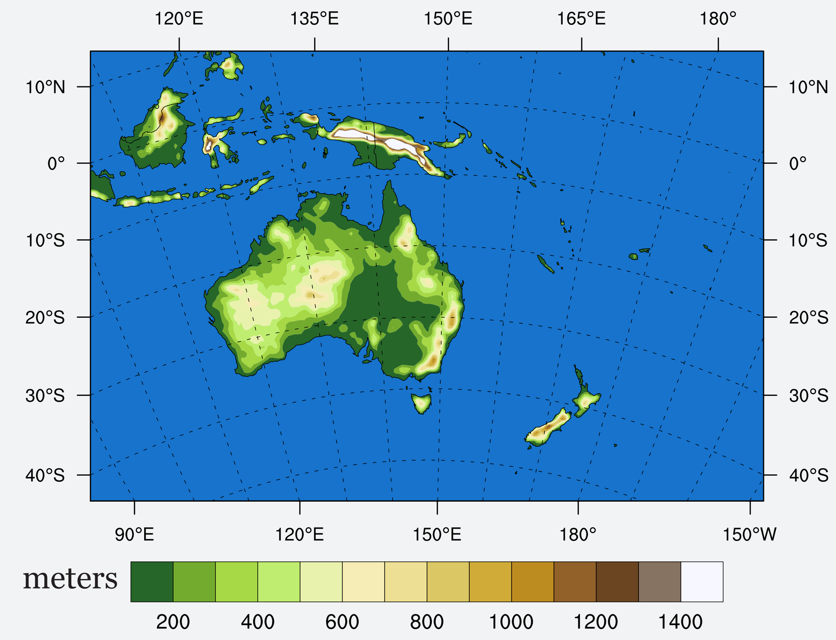

Figure 1. Australasia CORDEX domain and terrain elevation

Ensemble Member	PBL	Cumulus	Microphysics	Radiation (SW/LW)
R1	MYJ	KF	WDM 5	Dudhia/ RRTM
R2	MYJ	BMJ	WDM 5	Dudhia/ RRTM
R3	YSU	KF	WDM 5	CAM/CAM

Table 1. Parameterization choice in each of the WRF configurations

Selected according to: Model performance and model independence[3,4]

TEMPERATURE INDICES

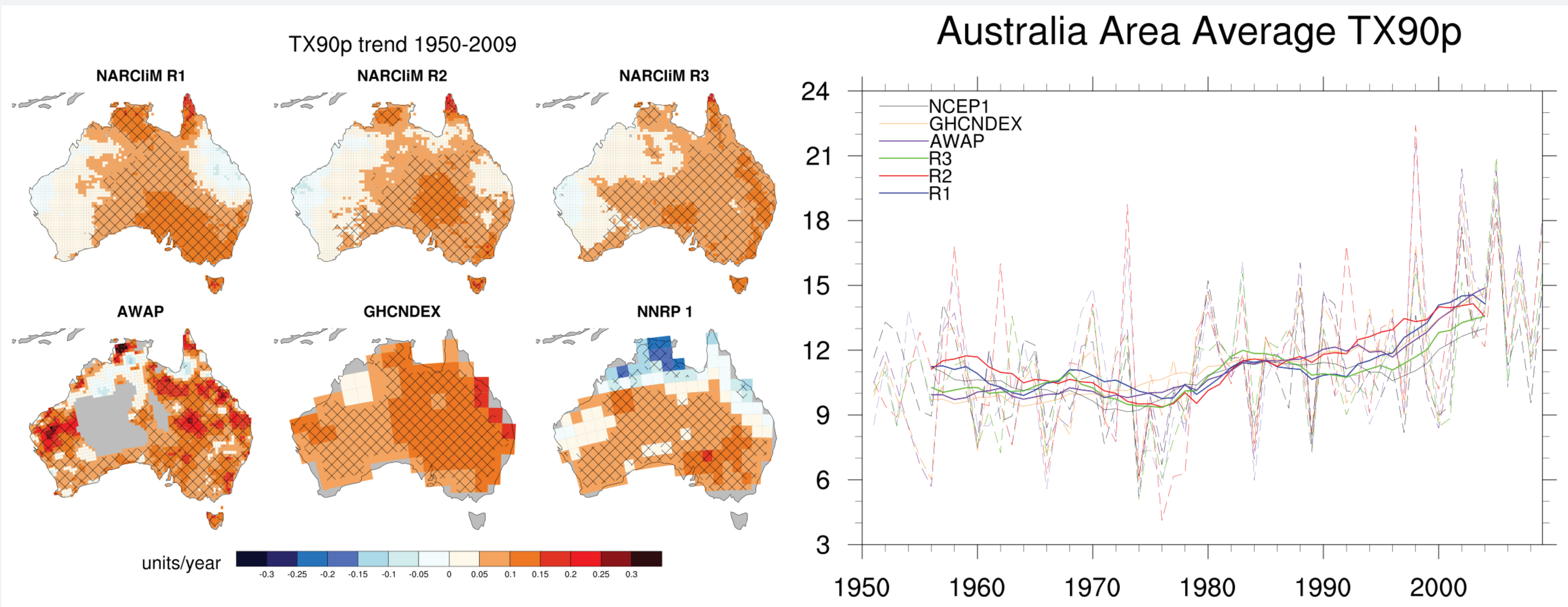

Figure 2. Left: Spatial patterns of trends (1950-2009) for TX90p: percetange of days with maximum temperature above the 90th percentile from the period 1961-1990. Right: Temporal evolution of TX90p averaged over Australia.

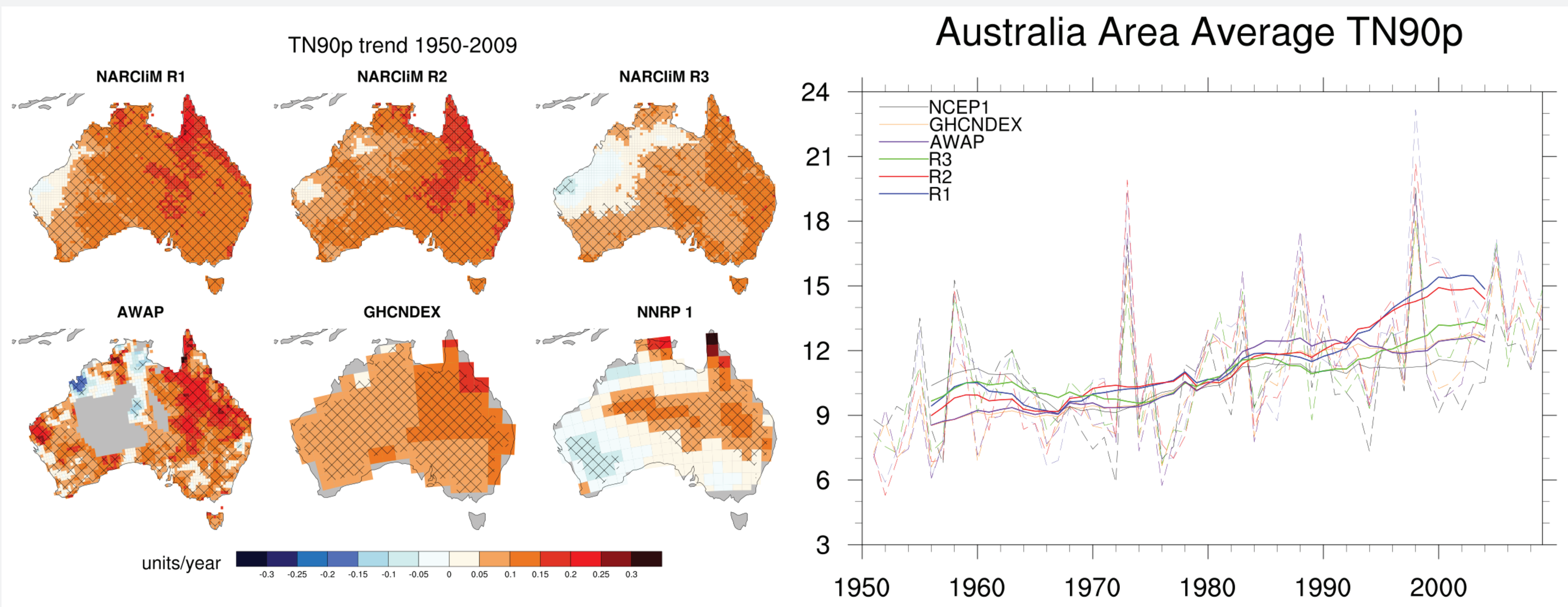

Figure 3. As Fig. 2 but for TN90p (minimum temperature)

- Good agreement spatial pattern (especially TN90p). Some areas of discrepancy: west coast (cloudiness or inherit from boundary conditions)
- Good correlation (TX90p) at continental scale, although stronger warming trends in the last decade (TN90p). Most of the inter-annual to inter-decadal variability reproduced.
- Improvement with respect to boundary conditions - especially in the Tropics (NNRP)

PRECIPITATION INDICES

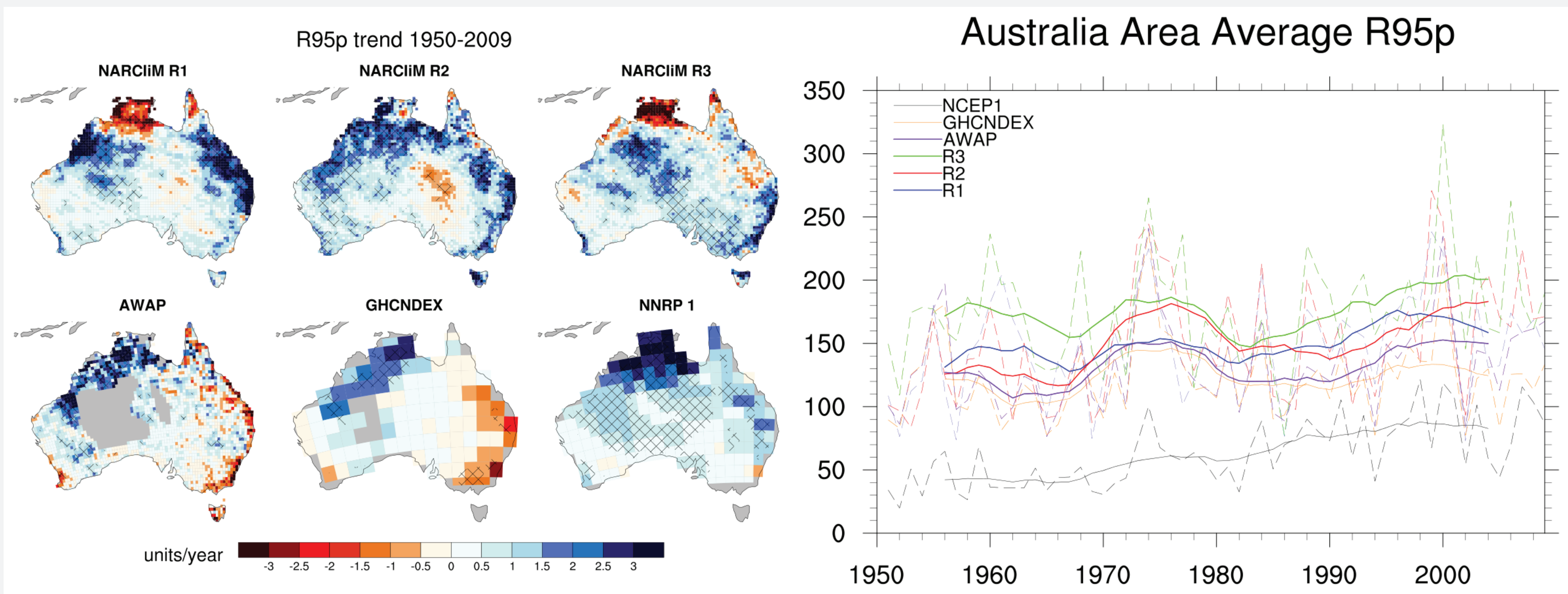

Figure 4. Left: Spatial patterns of trends (1950-2009) for R95p: percetange of precipitation from events of intensity above the 95th percentile from the period 1961-1990. Right: Temporal evolution of R95p averaged over Australia.

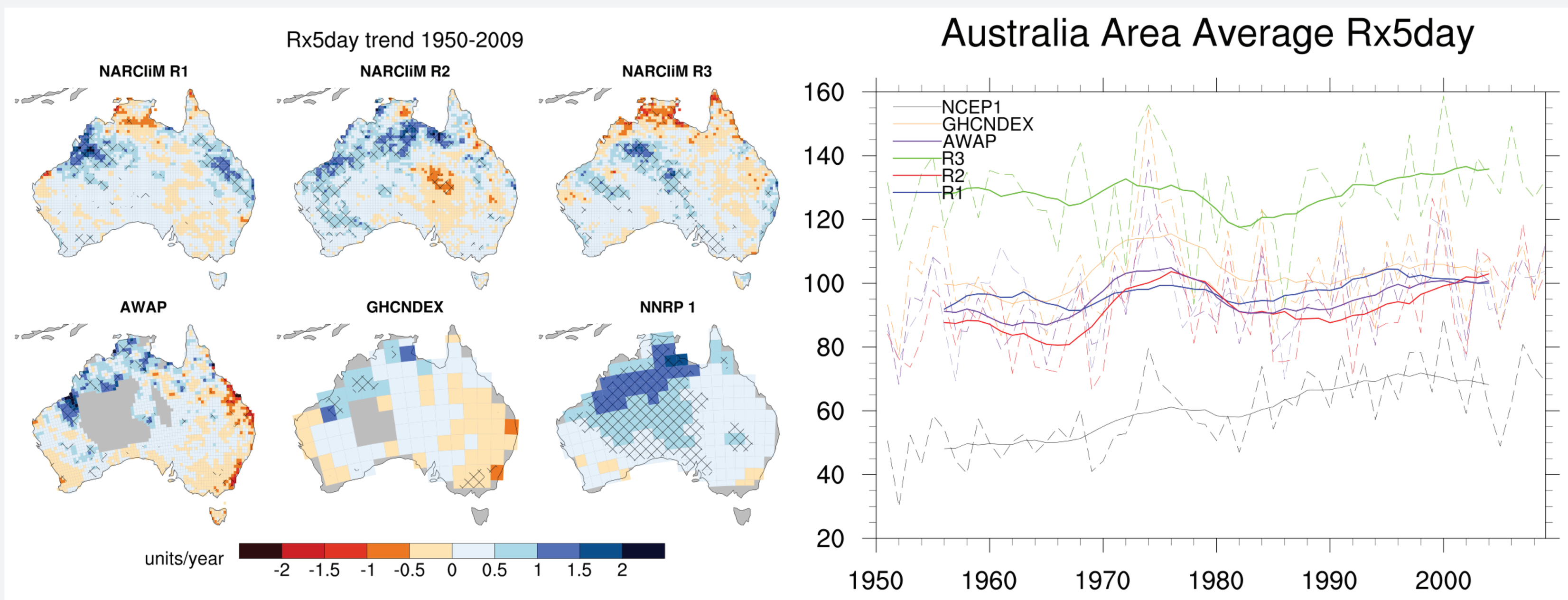

Figure 5. As Fig. 4 but for Rx5day: Annual maximum of precipitation in 5 consecutive days.

- Maximum in the 70s captured by all RCMs, better than NNRP
- Better spatial detail, but also discrepancies: tropics and east coast.
- Rx5day trends closer to observaions. Negative trends in the eastern half begin to appear at 50km resolution.
- At this resolution, little benefit obtained with respect to boundary conditions. Higher resolution likely to provide better results.
- Australia averaged timeseries very well represented by R1 and R2, overestimated by R3. Observational spread comparable to RCMs deviations over the continent (except R3)

CONCLUSIONS

How do RCMs represent the observed trends?

Trends correctly represented by WRF at continental scales for both variables. Temperature spatial patterns captured overall (except west) but larger discrepancies for precipitation.

Do they improve the boundary conditions?

Improvement of temperature indices by RCMs with respect to NNRP. Little benefit for precipitation indices at this spatial resolution, although better match at continental scales.

How do they compare with the observational spread?

Magnitude of RCM trend deviations comparable to observational spread in precip. (except R3). RCMs tend to agree better in temperature, but spread is minor in observations.

REFERENCES

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4. Abramowitz G (2010) Model independence in multi-model ensemble prediction. Australian Meteorological and Oceanographic Journal 59: 3–6