Australian Government
Bureau of Meteorology

Earth Systems and Climate Change Hub
National Environmental Science Programme

The impact of global warming and the El Niño-Southern Oscillation on seasonal precipitation extremes in Australia

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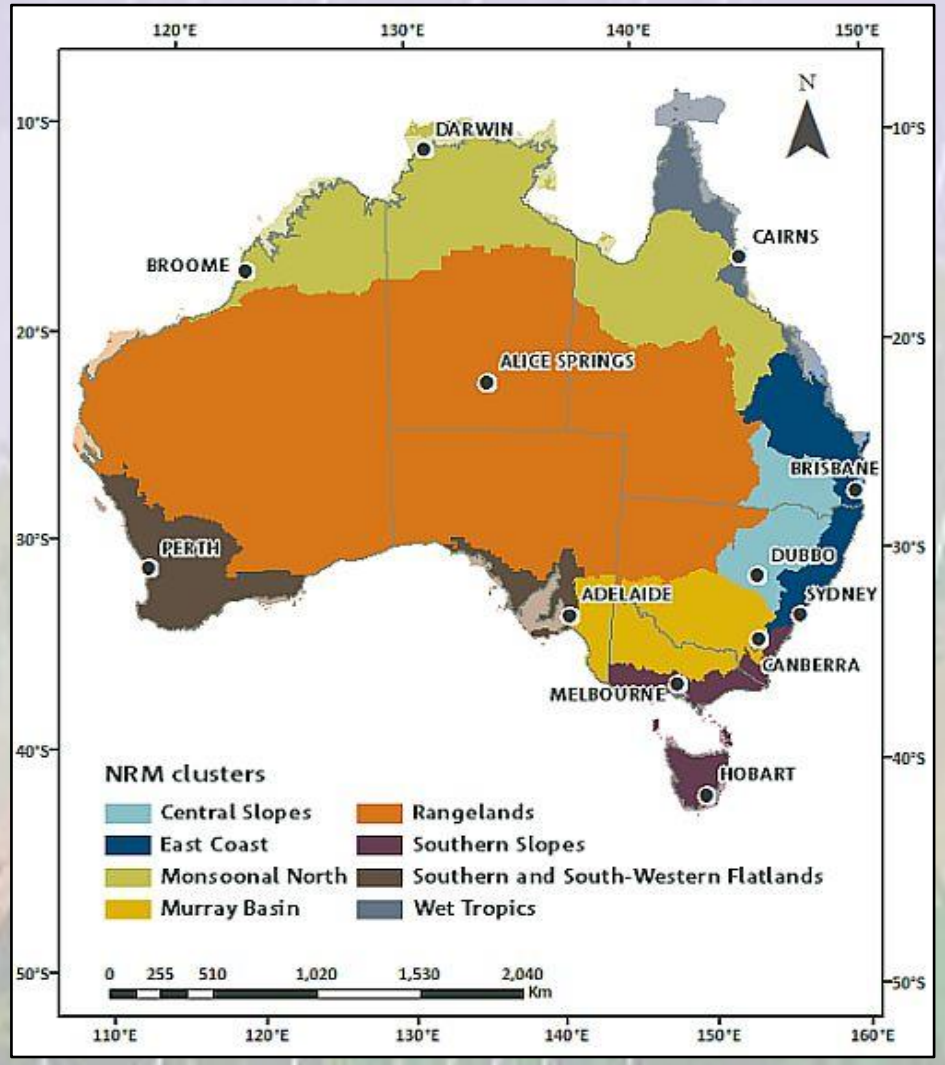
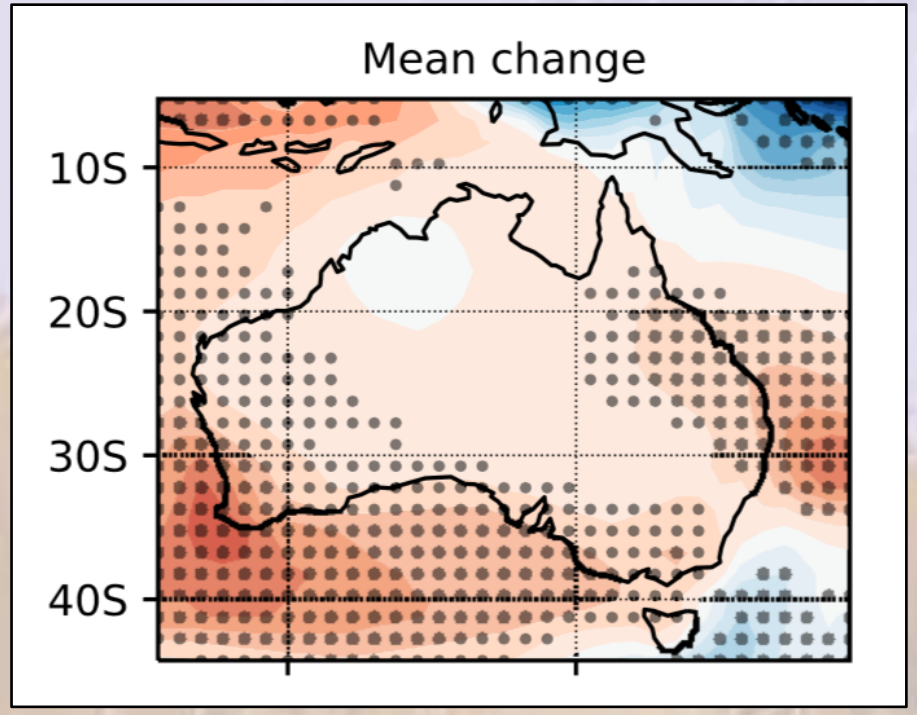
Outline

- Evaluation of ENSO teleconnections in CMIP5 models.
- Combined impact of global warming and ENSO on winter-spring dry conditions in Australia.
- A first look at CMIP6 ?



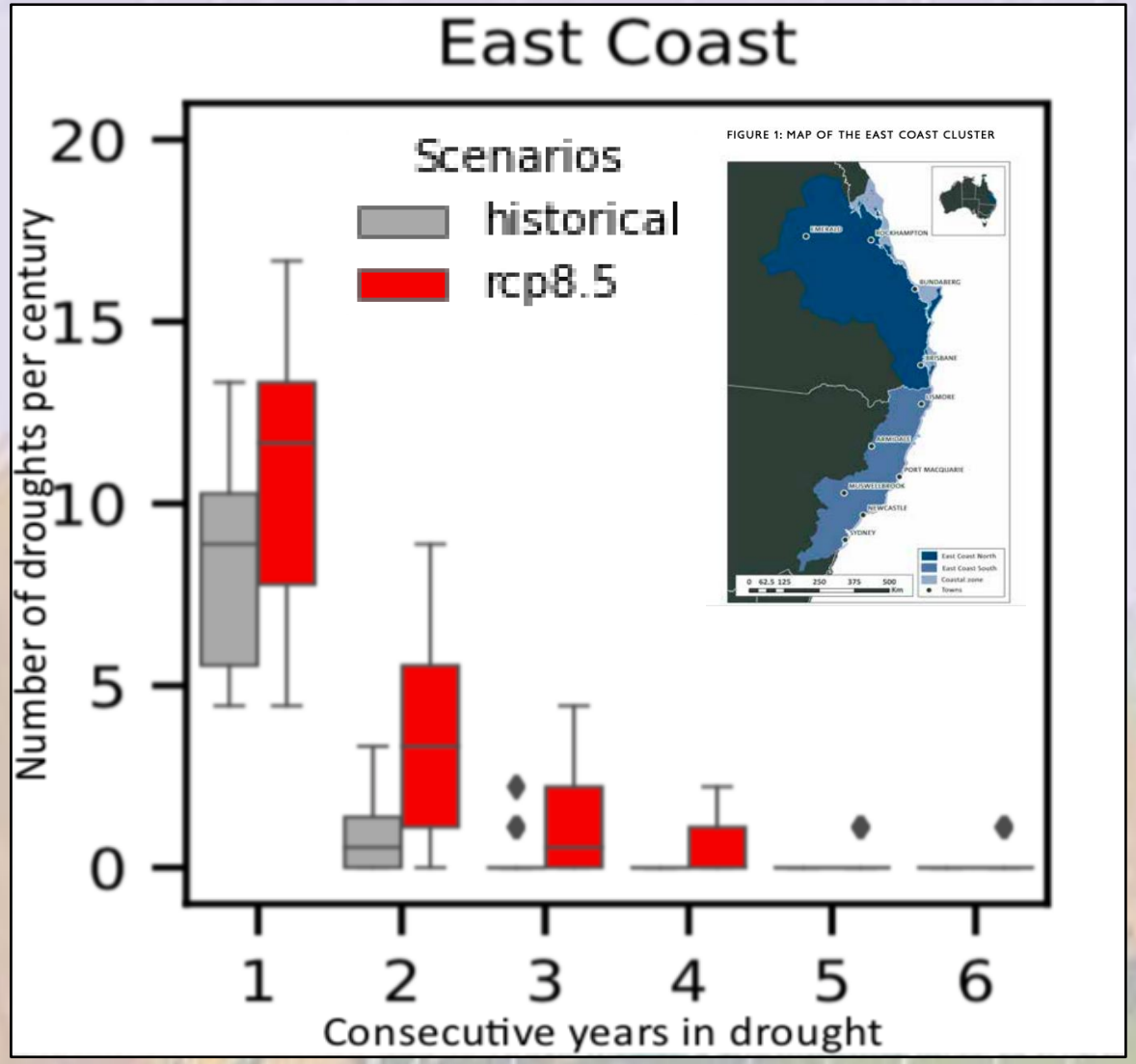
NESP5.2 : The impact of global warming and the El Niño-Southern Oscillation on seasonal precipitation in Australia



- We focus on June to November (i.e., southern hemisphere winter-spring) because precipitation during this period is important for agricultural production and recharging reservoirs in many parts of the country.
- Drought is defined here as being below the Decile 1 threshold obtained under pre-industrial conditions.
- CMIP5 models are evaluated in their capability to simulate the pattern and the strength of ENSO teleconnection to Australia rainfall.

The impact of global warming and the El Niño-Southern Oscillation on seasonal precipitation extremes in Australia
FPD Delage, SB Power - Climate Dynamics, 2020

Consecutive years spent in decile 1

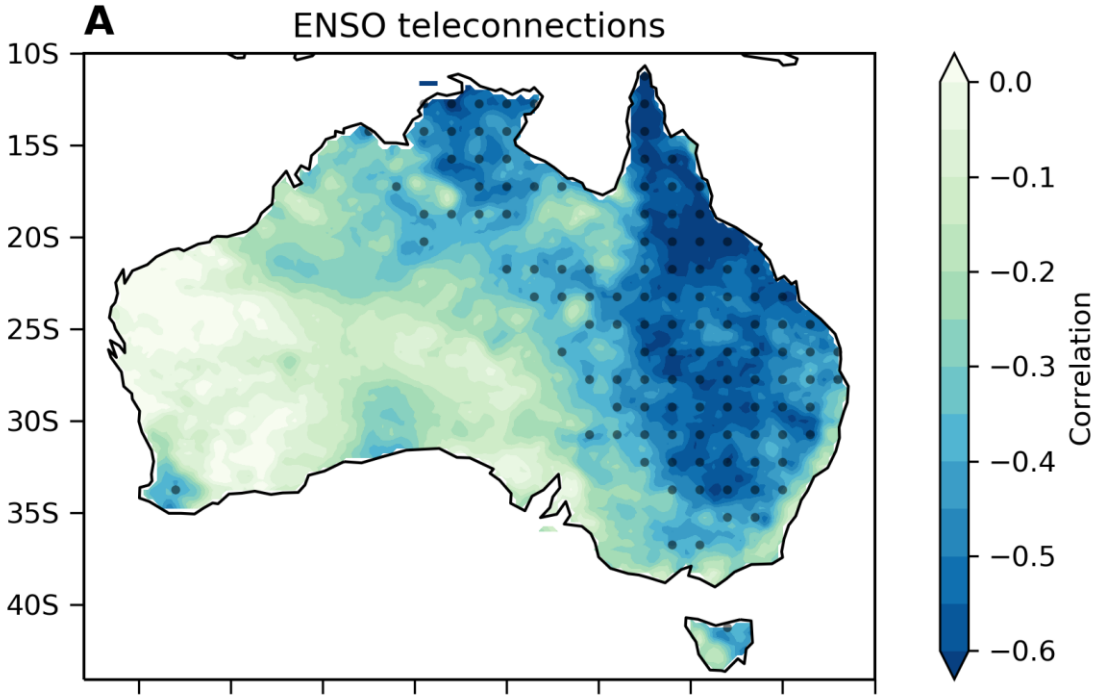


- Multi-model mean number of droughts of duration 1-4 years tends to increase in all of the NRM clusters in the 21st century relative to the twentieth century.

- Main capital cities, % of years that are projected to fall below the preindustrial Decile 1 :
  - Perth, 60%
  - Adelaide, 35%
  - Brisbane, 25%
  - Canberra, 23%
  - Sydney, 19%
  - Melbourne 19%

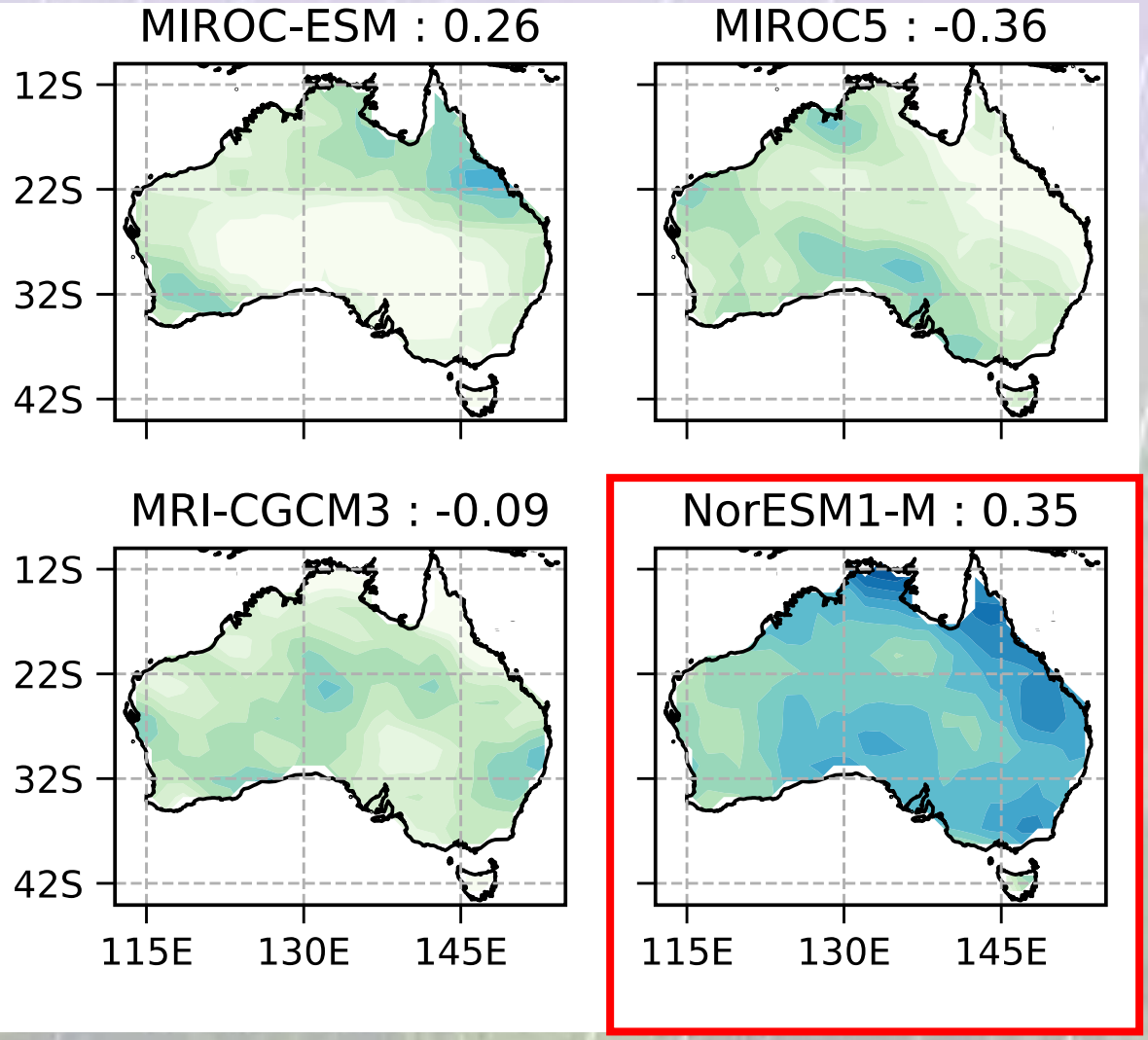
ENSO teleconnection pattern – Australia-wide metric

Observations

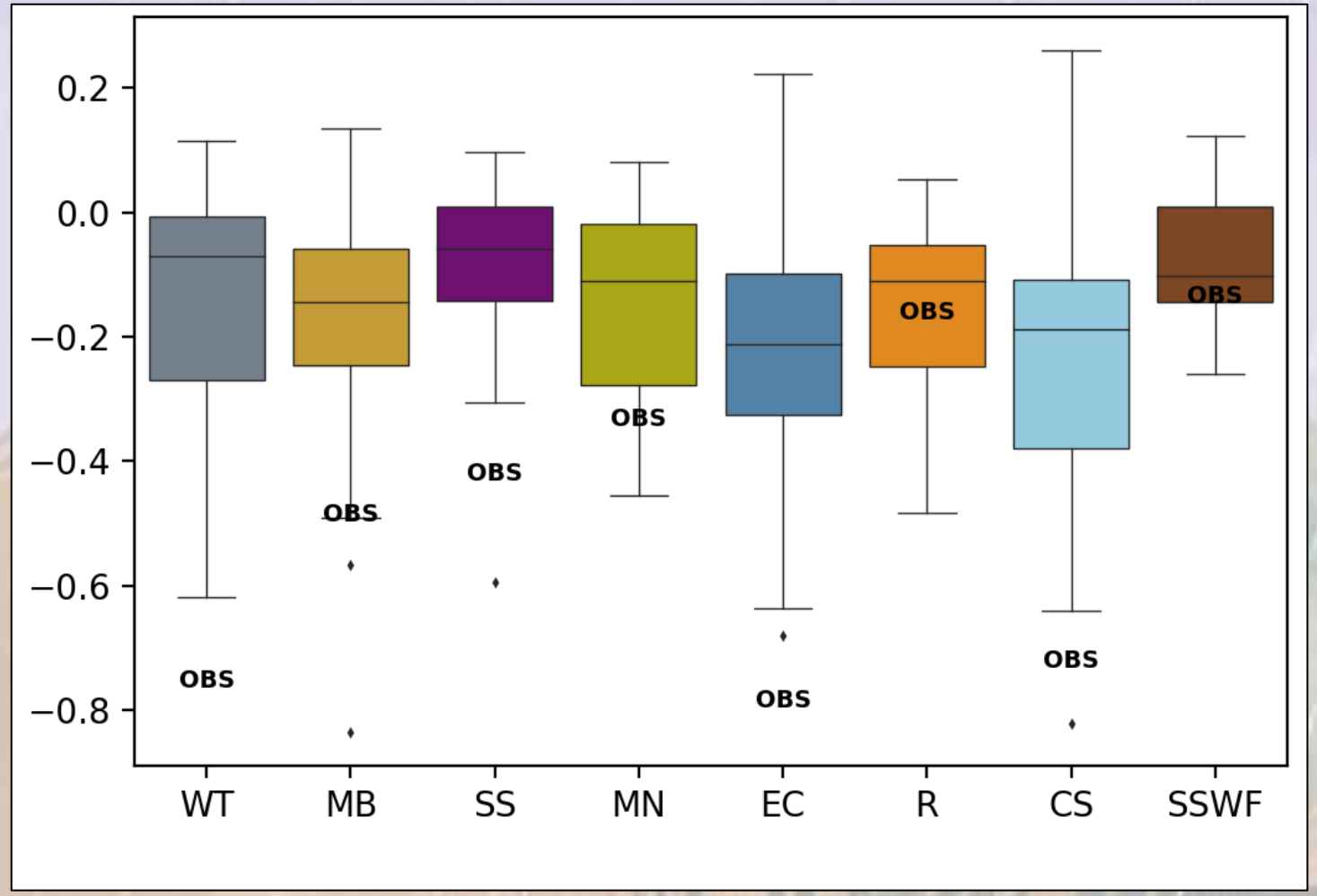


Models with a spatial correlation with AWAP > 0.2 were selected.

Models

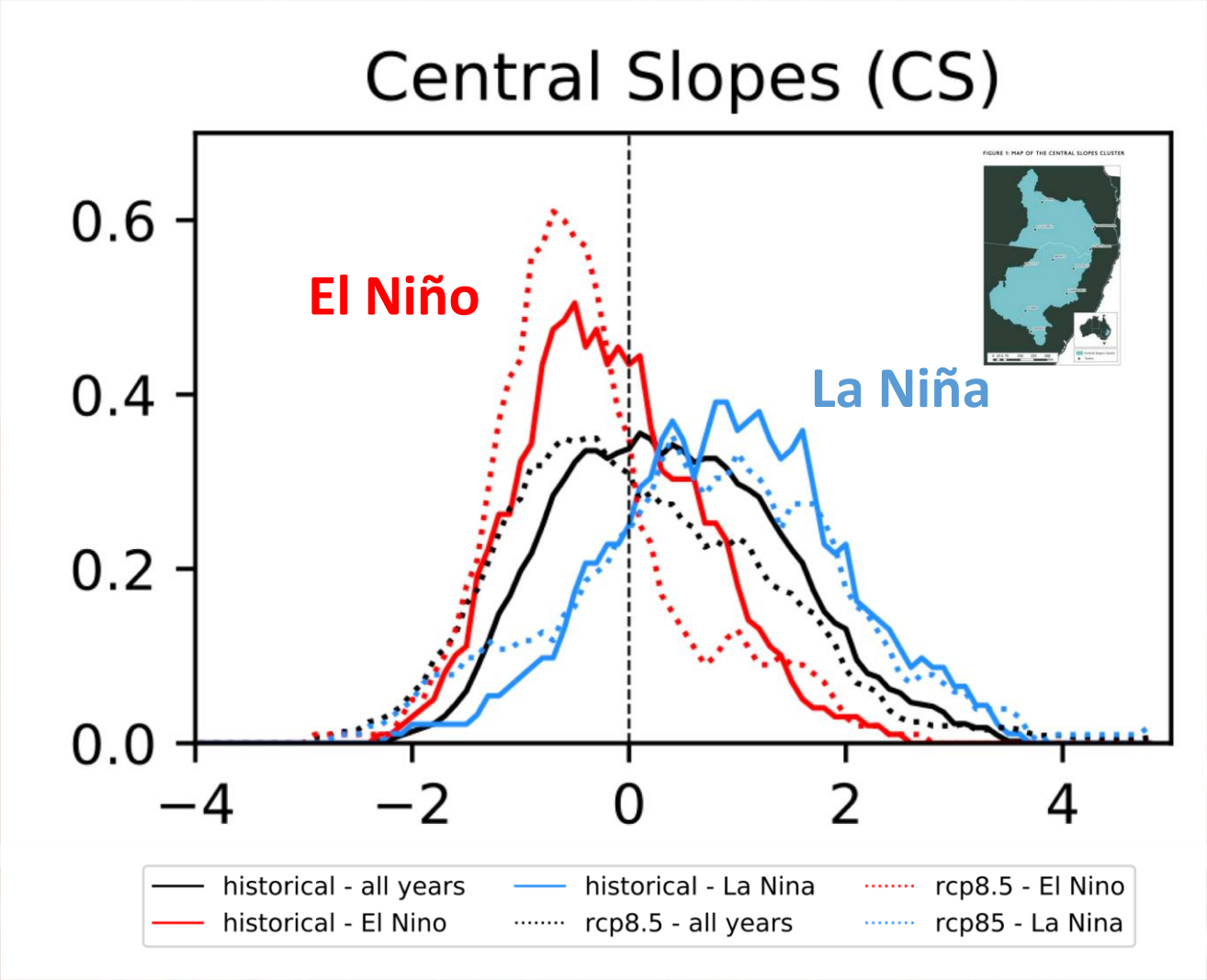


ENSO teleconnections magnitude – regional metric



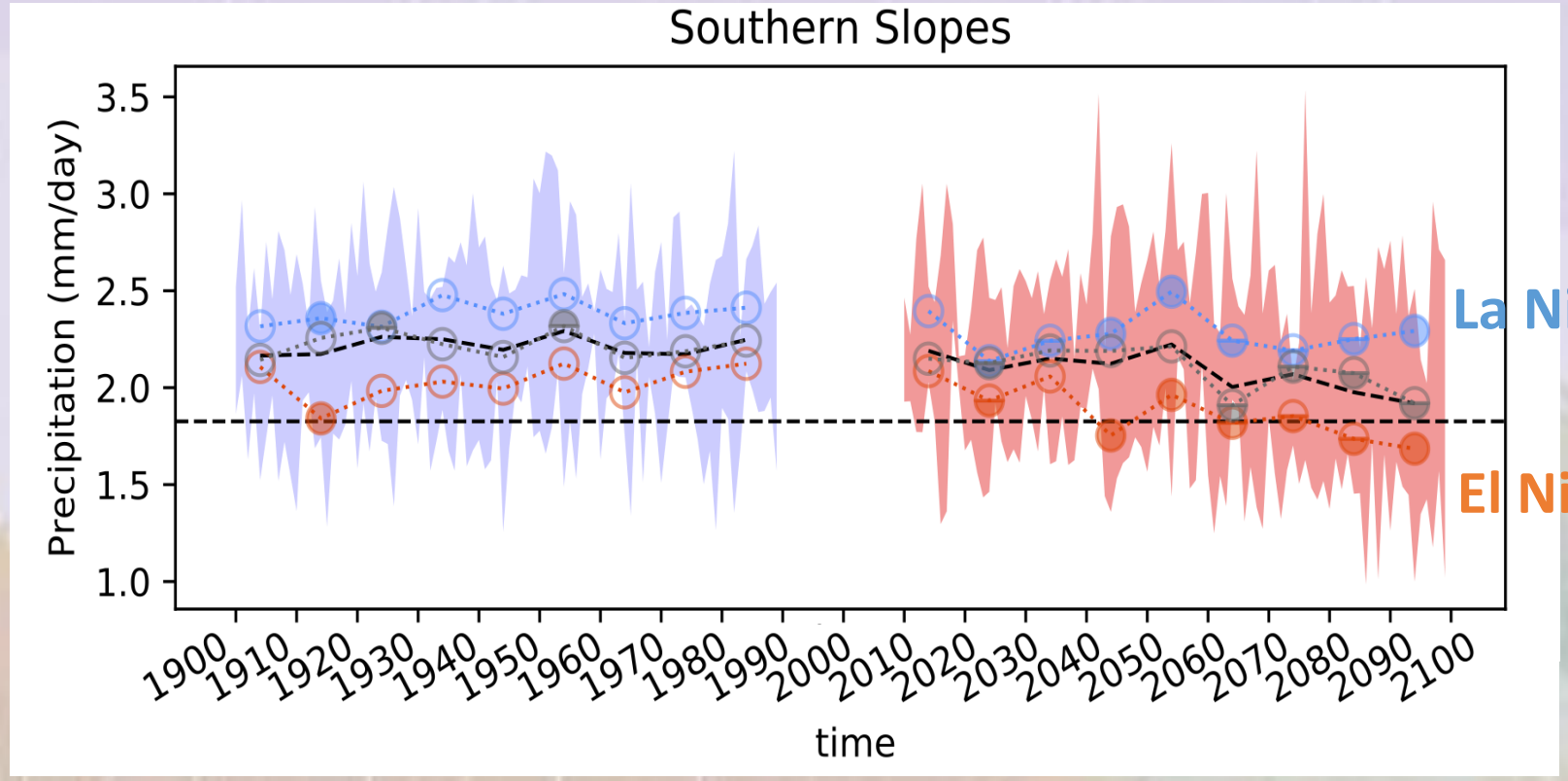
- Models generally do a poor job in simulating the amplitude of ENSO precipitation over Australia.
- Models that can reproduce the magnitude of El Niño – La Niña for at least 4 of the eight NRM clusters were selected.
- 5 models out of 24 were selected ACCESS1-3 , CESM1-BGC, CMCC-CMS, GFDL-ESM2M, NorESM1-M.

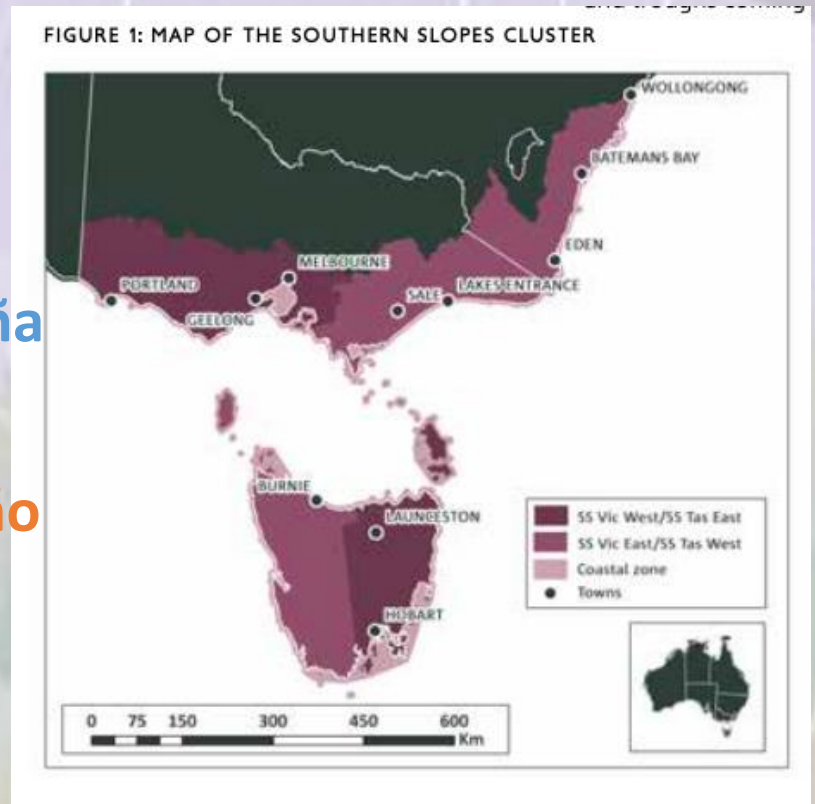
Rela%ve frequency distribu%ons of precipita%on



- The rela' ve frequency distribu' ons of precipita' on shi6 to lower values in all NRM clusters.
- In most loca' ons generally drier condi' ons will be infrequently punctuated by seasons that are just as wet or we@er than the we@est years experienced during the 20th century.

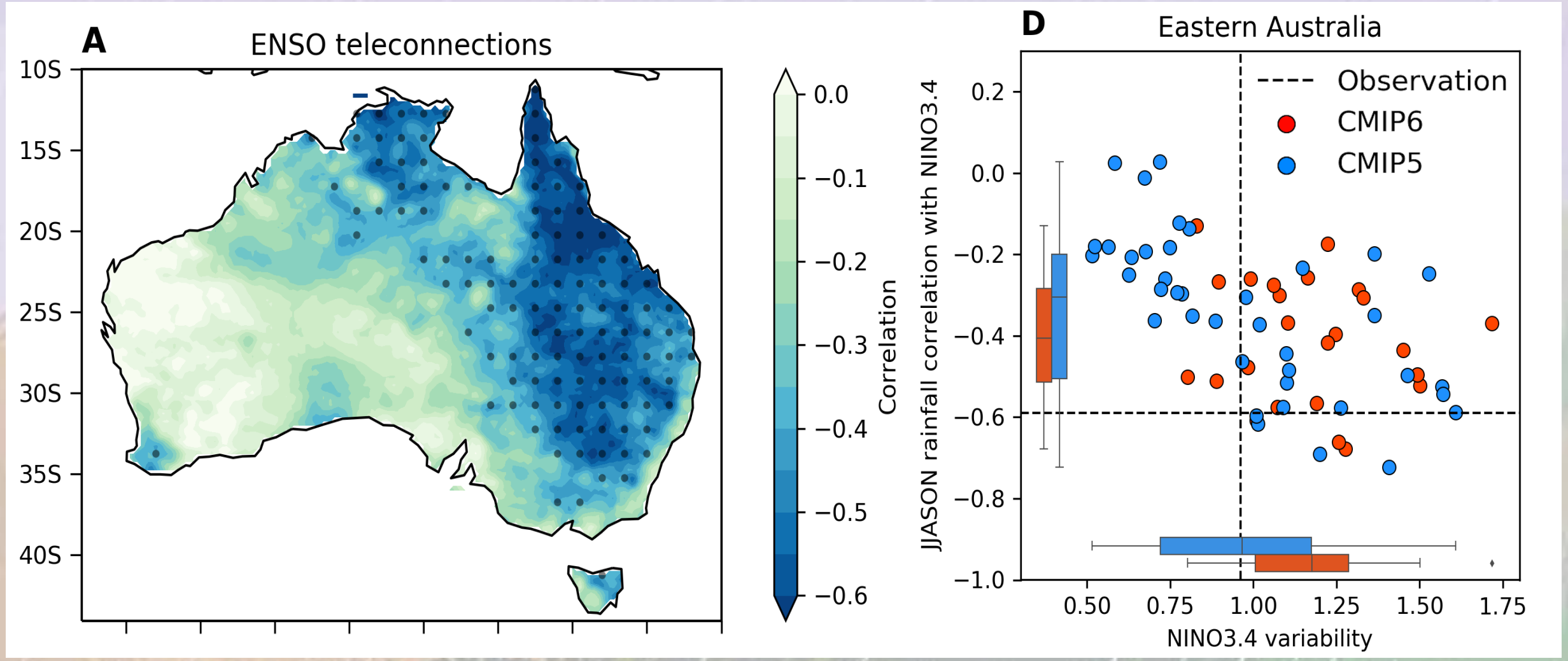
Increase in variability





- An increase in ENSO-driven variability is suggested for the Wet Tropics, the Monsoonal North, the Central Slopes and the Southern and Southwestern Flatlands.
- Limited number of models exhibit skills in simulating ENSO teleconnections.
- These results should be regarded as hypotheses for further testing using CMIP6 models.

CMIP6 vs CMIP5 evaluation



Insights from CMIP6 for Australia's future climate , MR Grose et als - Earth's Future, 2020

Summary

- Multi-model mean number of droughts of duration 1-4 years tends to increase in all of the NRM clusters in the 21st century relative to the twentieth century .
- Models generally do a poor job in simulating ENSO teleconnections to Australia rainfall.
- In most locations generally drier conditions will be infrequently punctuated by seasons that are just as wet or wetter than the wettest years experienced during the 20th century.
- Increase in ENSO-driven variability is suggested for a few regions.
- Early results suggest that simulating ENSO teleconnections to Australia rainfall is improved in CMIP6 models.