Benchmarking of Australian high-resolution ensemble of regional climate projections

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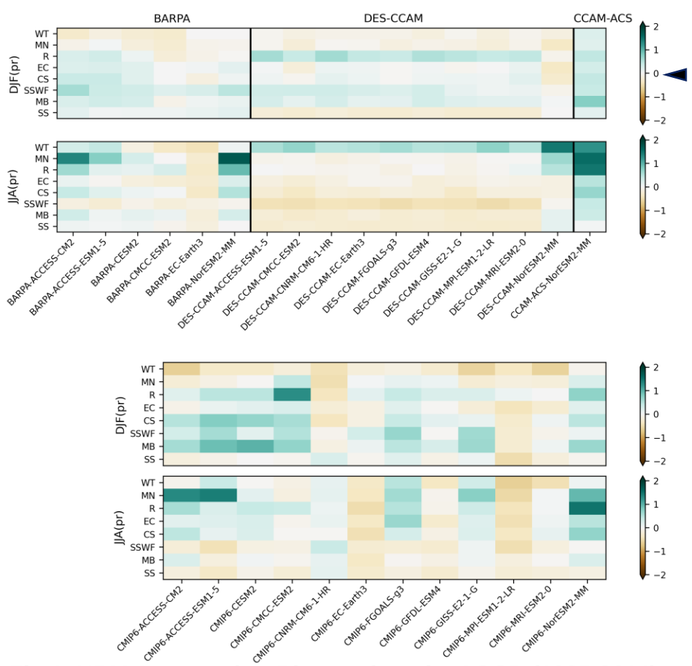
Research question: *How good are Australian high-resolution, regional climate projections?*
Are their/they:

- Biases outperforming/no worse than **CMIP6 (Global Climate Model)**?
- Reproducing broad scale **CMIP6 (GCM)** low frequency trend signals?
- Reproducing the rainfall seasonal cycle?
- Not significantly worse than the rest of the ensembles?

Research Scope

- Regional models (RCM): BARPA, DES-CCAM, CCAM-ACS
- Historical period 1985-2014
- Variables: Precipitation (pr, presented here), Tmin, Tmax
- Australian region, different NRM regions
- Reference: Australian Gridded Climate Data (AGCD) version 1

1. How well do these **RCMs** simulate the rainfall and temperature climatologies of Australia?
2. What are the key biases we need to keep in mind?
3. Are we seeing improvement over the **GCMs**?



NRM Aggregation Bias, Fig 1
In JJA, there are wet biases over northern Australia in both NorESM2-MM GCM and its downscaled runs. The ACCESS-CM2 ensemble also has a wet bias in BARPA and CMIP6.
** Benchmarking Scores: select the RCMs where the magnitude of bias < ½ × observed standard deviation

Nat. Resource Mgmt (NRM) regions
Central Slopes: CS
East Coast: EC
Monsoonal North: MN
Murray Basin: MB
Rangelands: R
Southern Slopes: SS
Southern and South-Western Flatlands: SSWF
Wet Tropics: WT

Fig 1. NRM Aggregation Bias against the AGCD (1985-2014)

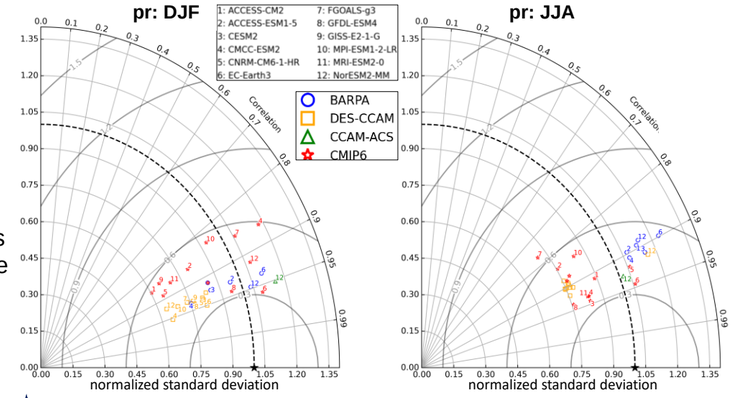


Fig 2. Spatial Taylor Diagrams of pr over domain over Australia over 1985-2014
RCMs perform better than the GCMs at simulating DJF precipitation.
** All indices meet preliminary benchmarks from Isphording et. al. (submitted to JoC): NRMSE [contour] < 0.65 and Spatial Correlation ≥ 0.70

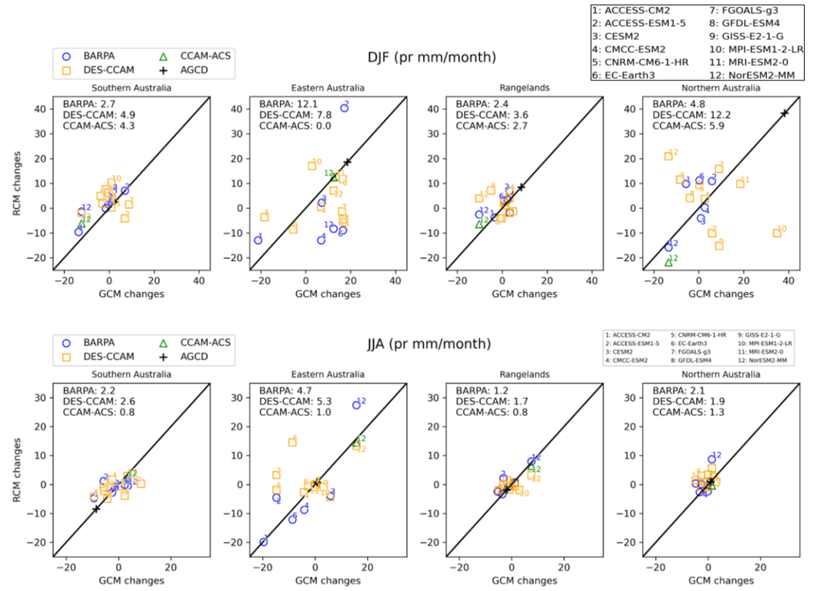


Fig 3. RCM/GCM Consistency. GCM aggregation changes versus RCM aggregation changes of pr between (2005-2014) and (1985-1994) in four super NRM clusters

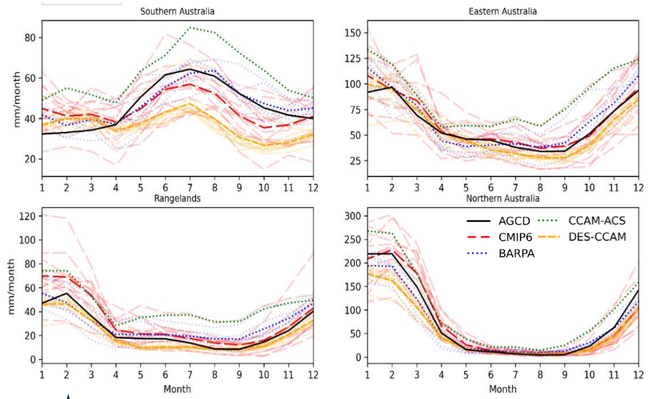


Fig 4. Seasonal Cycle of precipitation

1. In southern Australia, only CCAM-ACS simulates the peak month well, but it overestimates the precipitation.
2. In eastern Australia, BARPA and DES-CCAM perform well in simulating the seasonal cycle.
3. In Rangelands and Northern Australia, the rainfall seasonal cycle is well simulated in all RCMs.

** We will benchmark the seasonal cycle based on the timing of the wettest and driest months

RCM/GCM Consistency: How well do the RCMs preserve the decadal variability in the GCMs?

Aggregation Change = (2005 ~ 2014) - (1985 ~ 1994)

The black line represents the perfect situation (RCM changes = GCM changes)
The numbers in the top left represent the average distance between each RCM and the diagonal black line.
1. The RCMs performs better in austral winter than in austral summer
2. In both winter and summer seasons, the RCM preserves the signal the best over the Rangelands.

** We benchmark the RCM/GCM consistency based on the trends (Theil–Sen estimator) and significance test (Mann-Kendall trends test)

This work focuses on the model evaluation
**** New metrics and thresholds (benchmarking) will be adopted in the future.**
** We will include more ensembles for CCAM-ACS