The Bureau of Meteorology

Preliminary Assessment of BARRA-R2

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Introduction

BARRA-R2 is the new regional atmospheric reanalysis over the Australasian region developed to support the Australian Climate Service (ACS) and the Bureau's Climate Service Group (CSG) and to complement new regional climate projections. This work is funded by the ACS. Here we compare BARRA-R2 to BARRA-R1 and ERA5.

Temperature & Wind Speed Comparison

- **Fig. 1** shows BARRA-R2 has the most skill for wind speed.
- BARRA-R2 is the least biased during the day but slightly fast biased during the night (bias figure not shown here).

- **Fig. 2** shows the temperature RMSE for ERA5 is lowest of all systems, except for 22–23 UTC.
- BARRA-R2 has generally the next best skill in temperature, while BARRA-R1 performs worst except for at 1–2 UTC and 7–8 UTC.
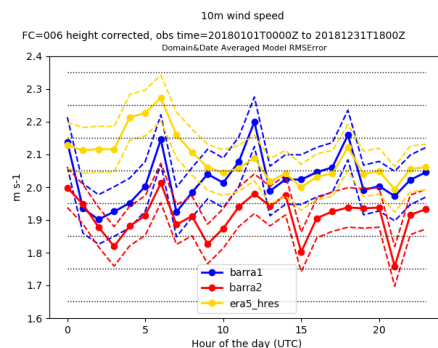

Fig. 1: Surface verification results showing 10m wind speed RMSE by UTC hour.

Added Value Analysis for Extremes

Fig. 3 shows the quantile-quantile (Q-Q) plots comparing frequency distributions of observations and reanalysis estimates. BARRA-R2 shows:

- Improved Perkins Skill score
- Smaller high wind extreme bias
- Better agreement with point observations in five regions compared to ERA5
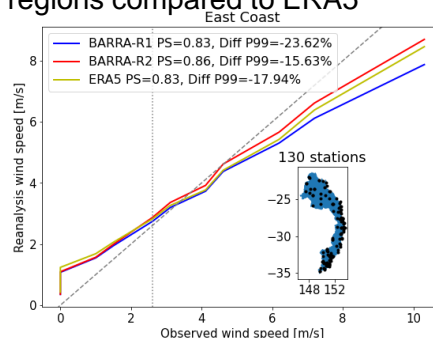

Fig. 3: Q-Q plot (from 1st to 99th percentiles) comparing 10m wind speed observed at surface stations in the East Coast Region, and estimated by BARRA-R1, BARRA-R2 and ERA5 reanalyses during 2008–2018. Perkins skill (PS) and the difference between their 99th percentile values are shown in the legend. Grey dashed line shows the 1:1 line, grey dotted line indicates the 50th percentile of the observed values.
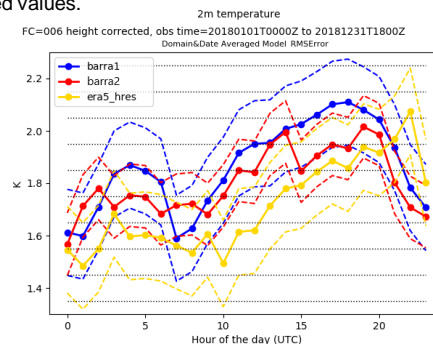

Fig. 2: Surface verification results showing 2m temperature RMSE by UTC hour.

Case Study: Heatwave – December 2018

An extended heatwave over much of Australia started in early December 2018 and continued through January 2019.

- **Fig. 4** shows that BARRA-R2 shows warmer extremes than ERA5, particularly along all the coastlines as BARRA-R2 resolves coastlines and peninsulas, its simulated extremes are in better agreement with AGCD.
- **Fig. 5** shows that both reanalyses capture changes well, in agreement with AGCD however BARRA-R2 generally shows higher daytime warm extremes than ERA5.
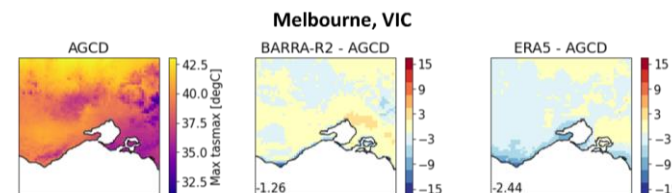

Fig 4: Maximum screen-level temperature during December 2018, from (left) AGCD, over 3×3° region centred on Melbourne. The differences in BARRA-R2 and ERA5 from AGCD are shown in second and third column. The spatial averages of the differences are shown in text.
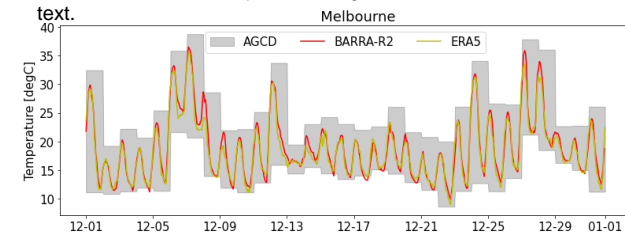

Fig 5: Spatial mean of hourly screen-temperature from BARRA-R2 and ERA5 over a smaller 2×2° region centred on Melbourne. The shading indicates the daily diurnal range from AGCD.

Australian Climate Service