Supporting document for

Spectral Nudging Impacts on Precipitation Downscaling in the Conformal Cubic Atmospheric Model, version CCAM-2504: Insights from Summer 2011

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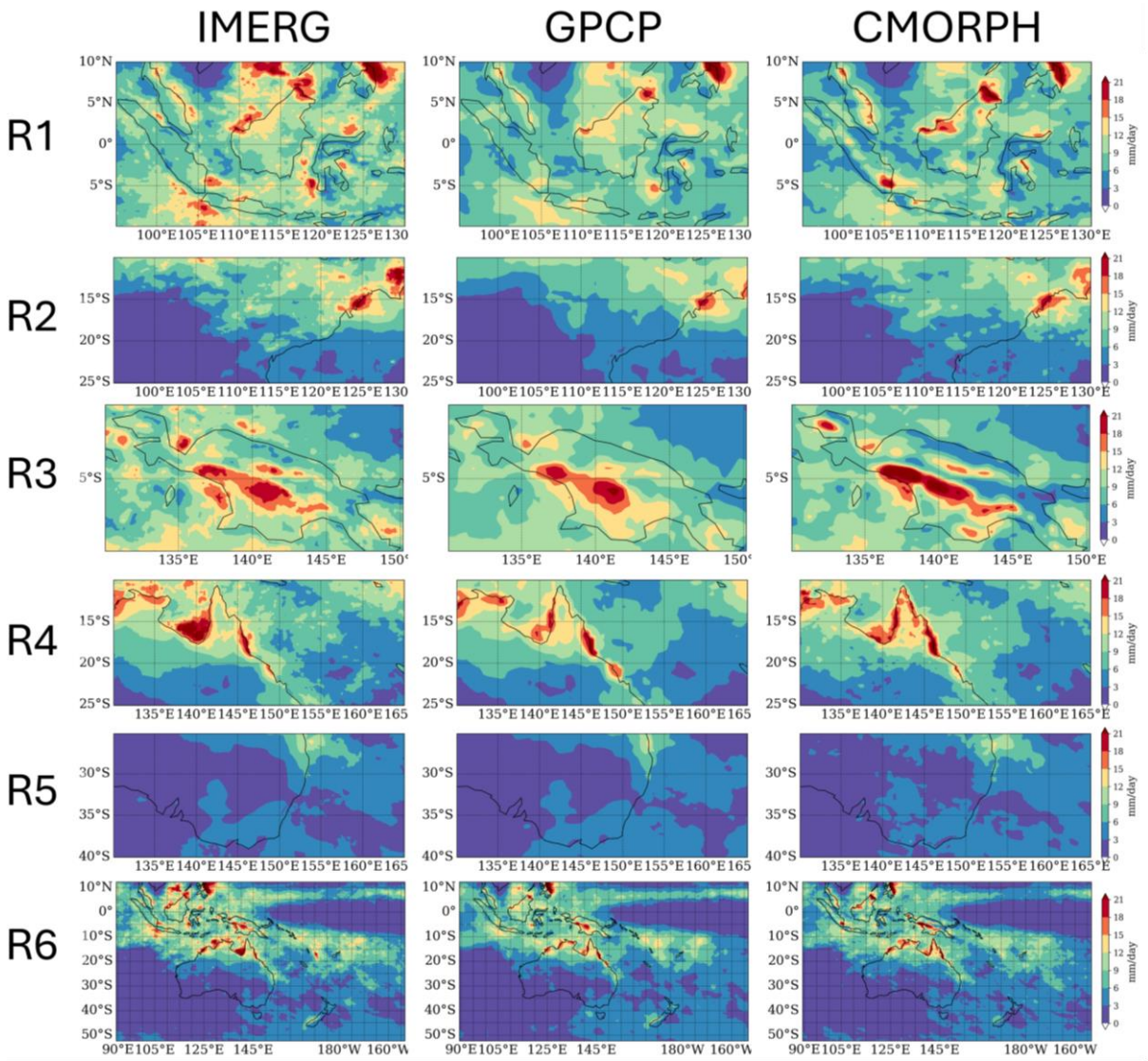

Figure S1: The averaged precipitation from December 2010 to March 2011 over each study domain (mm day^{-1}) for IMERG (left), GPCP (middle) and CMORPH (right).

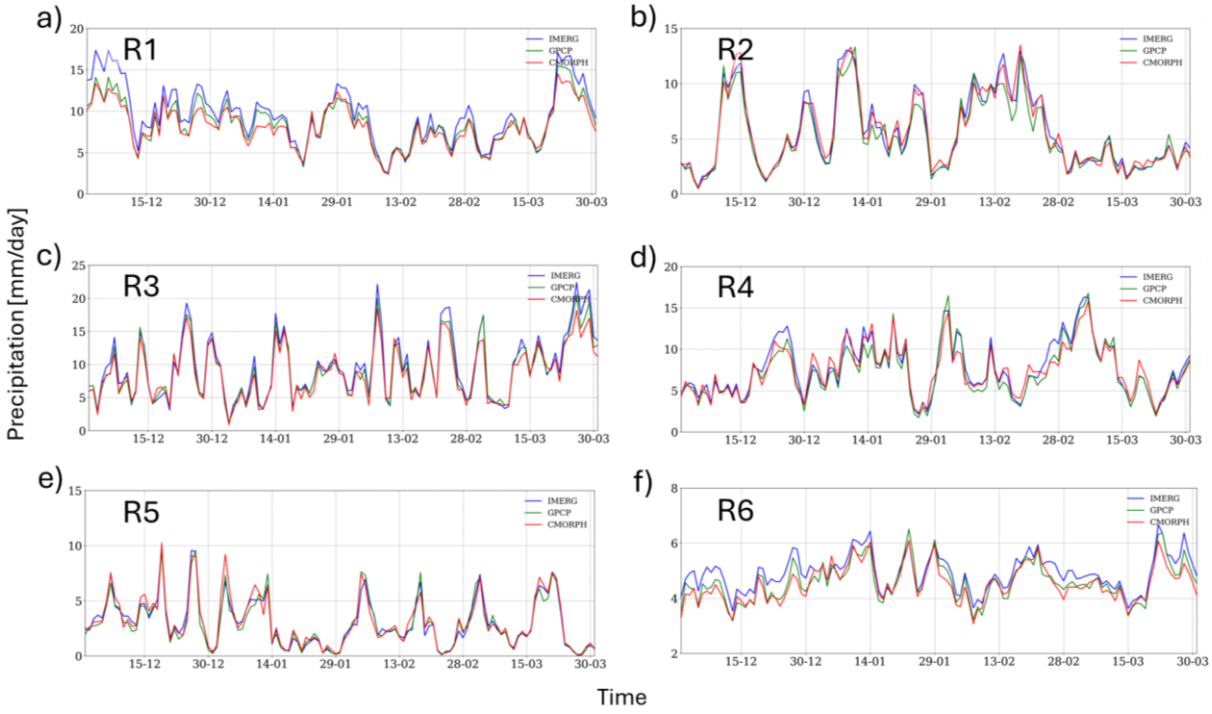

Figure S2: Time series of spatially averaged daily rainfall (mm day^{-1}) for IMERG, GPCP and CMORPH over each domain from December 2010 to March 2011.

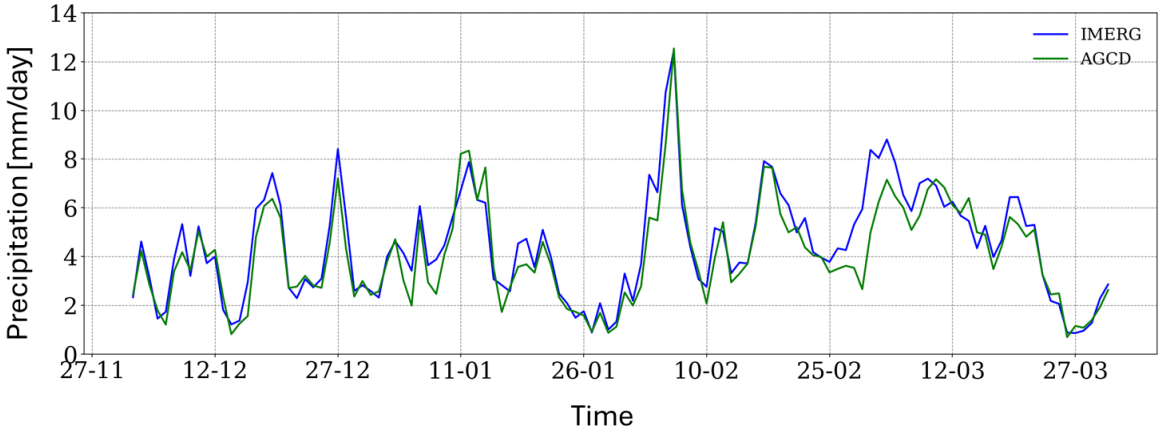

Figure S3: Time series of spatially averaged daily rainfall (mm day^{-1}) for IMERG and AGCD over Australian continent domain from December 2010 to March 2011. The correlation between IMERG and AGCD is 0.94

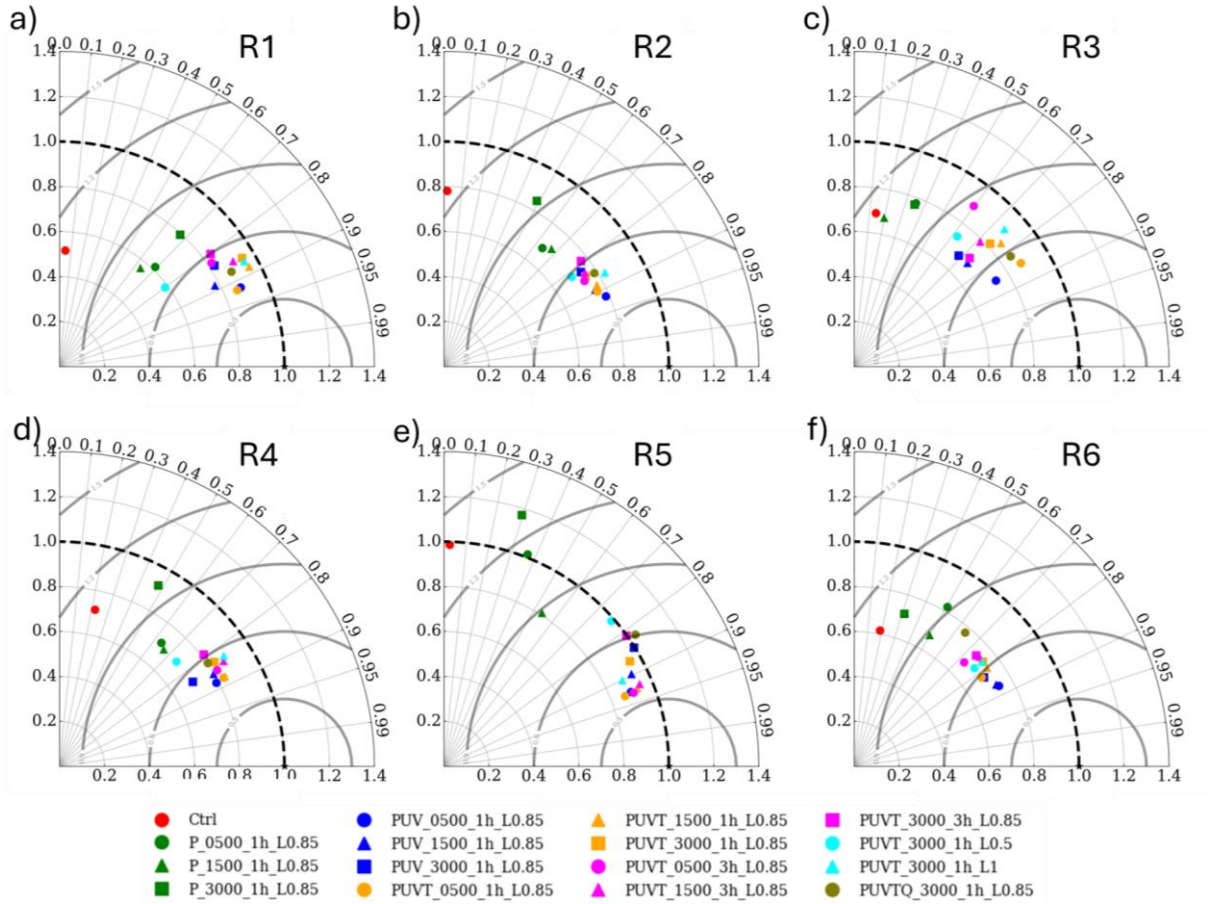

Figure S4. Taylor diagrams of daily precipitation averaged from December 2010 to March 2011 for six subregions (R1–R6), comparing 16 CCAM simulations with GPCP. Radial axis (distance from origin) represents standard deviation of the simulated precipitation (normalized by the observed standard deviation, GPCP). Angular axis (angle from x-axis) represents correlation coefficient between models and GPCP. Solid gray concentric arcs represent the cantered root-mean-square error (RMSE) between model and GPCP [a distance from the reference point on x-axis at (1,0)]. Coloured markers denote simulation groups (legend).

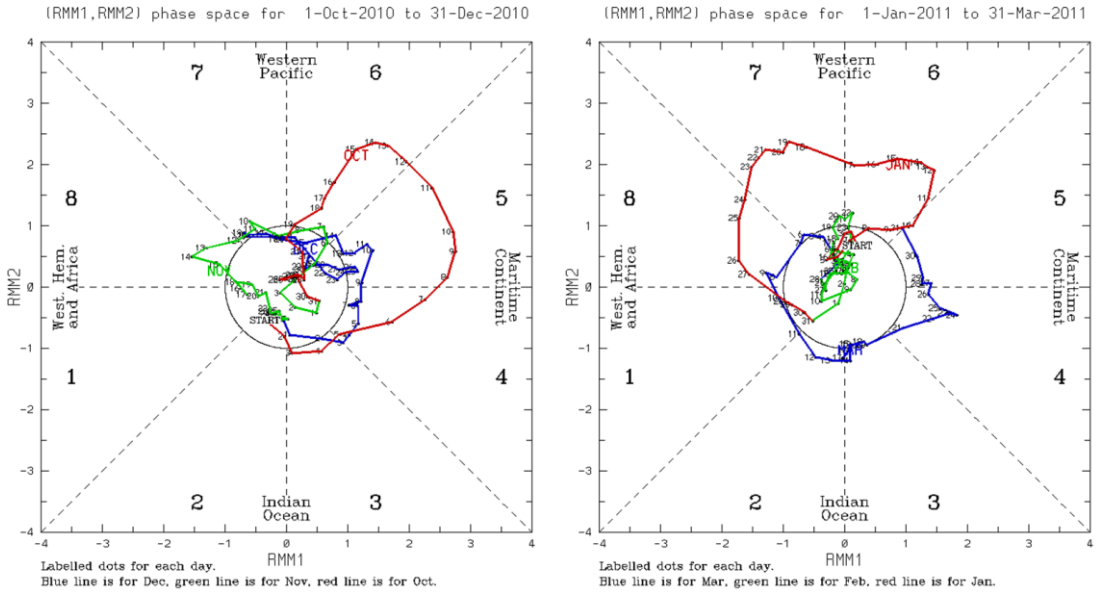

Figure S5: Phase-space diagrams showing the daily MJO location and amplitude for Oct–Dec 2010 (left) and Jan–Mar 2011 (right), from the Australian Bureau of Meteorology. Trajectories are colored by month (Oct/Jan red, Nov/Feb green, Dec/Mar blue) with dots marking days; (Source: https://www.bom.gov.au/climate/mjo/#tabs=Monitoring)

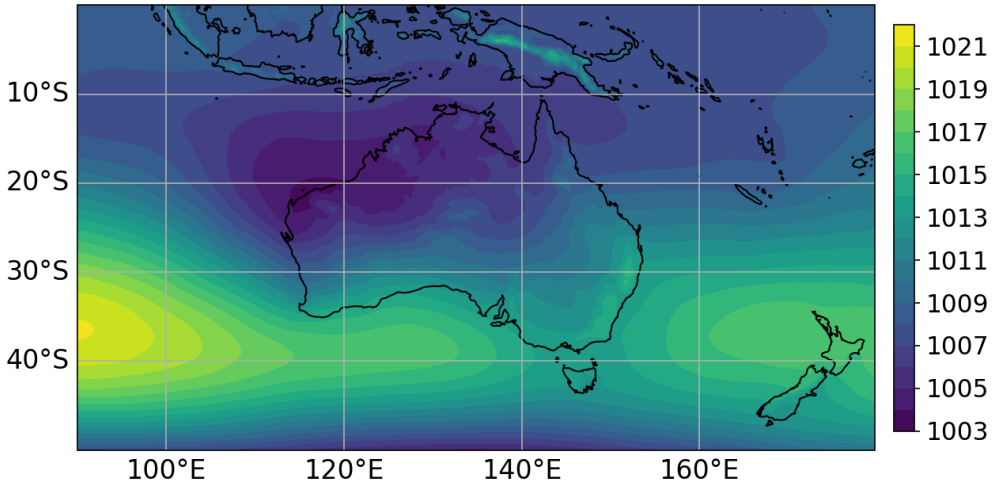

Figure S6: Monthly mean sea-level pressure from ERA5 averaged over October 2010 to March 2011 across Australasia. Shading indicates MSLP in hPa, showing a persistent low-pressure trough over northern Australia and higher pressure to the south during the extreme 2010–11 La Niña