Evaluating CORDEX ERA5-forced 'NARCliM2.0' regional climate models over Australia: performance improvements versus ERA-Interim-forced models

Supporting Information Figures S1-S20

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20°5

30°S

40°5

20°5

30°S

40°S







ERA5 N2.0 Ensemble Mean (DJF) Δ ERA5 N2.0-R1 (DJF) Δ С x |bias| 0.68 *x* bias -0.37





ERA5 N2.0-R2 (DJF) Δ d x | bias | 1.23 x bias -0.74







ERA-I-WRFSWWA (DJF) A

130°E 140°E

x | bias | 0.92

x bias -0.65

120°E

Fig. S1 Summer (DJF) maximum temperature bias with respect to Australian Gridded Climate Data (AGCD) observations for 1981-

2010. Stippled areas indicate locations where an RCM shows statistically significant bias (P < 0.05). **b** Significance stippling for the ensemble mean bias follows Tebaldi et al. (2011) and is applied separately to each of the two RCM ensembles. Statistically insignificant areas are shown in colour, denoting that less than half of the models are significantly biased. In significant agreeing areas (stippled), at least half of RCMs are significantly biased, and at least 66% of significant RCMs in each ensemble agree on the direction of the bias. Significant disagreeing areas are shown in white, which are where at least half of the models are 150°E significantly biased and less than 66% of significant models in each ensemble agree on the bias direction - see main text for additional detail on the stippling regime. Panel boundaries in green (red) indicate the RCMs with lowest (highest) areaaveraged mean absolute biases.

0.0 0.5 1.0 -5.0 -4.5 -3.5-3.0-2.5 -2.0 -1.5-1.0 -0.5 1.5 2.0 2.5 3.0 3.5 5.0 -4.04.0 4.5 DJF mean tasmax (K) model minus obs. A







-4.5

-4.0

-3.5

-5.0





















Fig. S2 Winter (JJA) maximum temperature bias with respect to gridded observations. Stippling and panel boundary colouring as per Figure S1.



5.0

4.5





Fig. S3 RMSE annual cycle for historical maximum near surface temperature (K) as simulated over Australia by the ERA5-forced and ERA-Interim-forced RCMs.



-1.5 -1.0 -0.5 0.0 0.5 1.0 -5.0 -4.5 -4.0 -3.5-3.0 -2.5 -2.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

99th percentile tasmax (K) model minus obs. Δ







0

-5.0

-4.5

20°5

30°S

40°5



-4.0





















Fig. S5 Summer (DJF) minimum temperature bias with respect to gridded observations with stippling and panel boundaries as per Fig. S1.











-5.0









ERA-I-CCLM (JJA) Δ

120°E 130°E 140°E 150°E

x | bias | 2.75

x bias 2.74









ERA5 N2.0-R2 (JJA) Δ







Fig. S6 Winter (JJA) minimum temperature bias with respect to gridded observations with stippling and panel boundary colouring as per Fig. S1.







Fig. S7 RMSE annual cycle for historical minimum near surface temperature (K) as simulated over Australia by the ERA5-forced and ERA-Interim-forced RCMs.





























Fig. S8 Biases in 1st percentile minimum temperatures simulated by the ERA5 and ERA-Interim forced RCMs relative to AGCD gridded observations with stippling and panel boundary colouring as per Fig. S1.













-40

-35

-30













ERA-I CCLM (DJF) Δ

x | bias | 24.05

x bias -17.33

-20

120°E

-25

р



130°E 140°E 150°E

-15



С













20

25

30

35

40



Fig. S9 Summer (DJF) precipitation bias with respect to gridded observations with stippling and panel boundary colouring as per Fig. S1.







Fig. S10 Winter (JJA) precipitation bias with respect to gridded observations with stippling and panel boundary colouring as per Fig. S1.

JJA mean pr (mm) model minus obs. Δ



Fig. S11 RMSE (log-transformed) annual cycle for historical precipitation as simulated over Australia by the ERA5-forced and ERA-Interim-forced RCMs.



99th percentile pr (mm) model minus obs. Δ



Fig. S13 Biases in 99th percentile precipitation simulated over south-eastern Australia (WRF simulation inner domain) by the ERA5 and ERA-Interim forced RCMs relative to AGCD gridded observations with stippling and panel boundary colouring as per Fig. S1.



Fig. S14 Annual, summer, and winter mean near-surface atmospheric maximum temperature bias for ERA5 and ERA-Interim reanalyses data sets with respect to Australian Gridded Climate Data (AGCD) observations (1981-2010).

Fig. S15 As per Fig. S14 but for 2016.

Fig. S16 Annual, summer, and winter mean near-surface atmospheric minimum temperature bias for ERA5 and ERA-Interim reanalyses data sets with respect to Australian Gridded Climate Data (AGCD) observations (1981-2010).

Fig. S17 As per Fig. S16 but for 2016.

Fig. S18 Annual, summer, and winter mean precipitation bias for ERA5 and ERA-Interim reanalyses data sets with respect to Australian Gridded Climate Data (AGCD) observations (1981-2010).

Fig. S19 As per Fig. S18 but for 2016.

Fig. S20 Namelist settings for the CORDEX-CMIP6 NARCliM2.0 ERA5forced RCMs R1-R7: left panel shows physics settings for each RCM; right panel shows settings universal to each of R1-R7.

	Domain	СС	RDEX A	Australa	isia 20 l	km oute	er doma	ain	South	east Au	stralia (inn	Convect er dom	tion-pe	rmitting	g 4 km
	RCM	R1	R2	R3	R4	R5	R6	R7	R1	R2	R3	R4	R5	R6	R7
	mn nhysics	6	6	8	8	8	8	8	6	6	8	8	8	8	8
	ra sw physics	5	4	4	4	4	4	4	5	4	4	4	4	4	4
	ra lw physics	5	4	4	4	4	4	4	5	4	4	4	4	4	4
	sf sfclay physics	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	sf surface physics	2	4	4	4	4	4	4	2	4	4	4	4	4	4
	bl_pbl_physics	1	5	5	5	7	7	7	1	5	5	5	7	7	7
	cu_physics	2	1	2	2	2	6	6	0	0	0	0	0	0	0
	sf_urban_physics	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	radt	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	cudt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	bldt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	prec_acc_dt	60	60	60	60	60	60	60	60	60	60	60	60	60	60
	bucket_mm	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	levsiz	59	59	59	59	59	59	59	59	59	59	59	59	59	59
physics	paerlev	29	29	29	29	29	29	29	29	29	29	29	29	29	29
	cam_abs_dim1	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	cam_abs_dim2	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	istflx	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	urface_input_sourc	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	num_soil_layers	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	sst_update	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	landay	150	150	150	150	150	150	150	150	150	150	150	150	150	150
	idgudy	150	150	150	150	150	150	150	150	150	150	150	150	150	150
	usemonalh	True	True	True	True	True	True	True	True	True	True	True	True	True	True
	rdmaxalb	True	True	True	True	True	True	True	True	True	True	True	True	True	True
	slope rad	1	1	1	1		1	1	1	1	1	1	1		1
	topo shading	1	- 1	- 1	1	- 1	1	1	- 1	1	1	1	1	- 1	1
	shadlen	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000	25000
	dveg		2	2	4	2	2	4		2	2	4	2	2	4
	opt_crs		1	1	1	1	1	1		1	1	1	1	1	1
	opt_sfc		1	1	1	1	1	1		1	1	1	1	1	1
	opt_btr		1	1	1	1	1	1		1	1	1	1	1	1
	opt_run		3	3	1	3	3	1		3	3	1	3	3	1
	opt_frz		1	1	1	1	1	1		1	1	1	1	1	1
	opt_inf		1	1	1	1	1	1		1	1	1	1	1	1
	opt_rad		3	3	3	3	3	3		3	3	3	3	3	3
noah_mp	opt_alb		2	2	2	2	2	2		2	2	2	2	2	2
	opt_snf		1	1	1	1	1	1		1	1	1	1	1	1
	opt_tbot		2	2	2	2	2	2		2	2	2	2	2	2
	opt_stc		1	1	1	1	1	1		1	1	1	1	1	1
	opt_gla		1	1	1	1	1	1		1	1	1	1	1	1
	opt_rst		1		1	1	1	1		1	1	1		1	1
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run_nours	0	
un_minutes run_seconds	0	
start year	2016	2016
start month	5	5
start_day	1	1
start_hour	0	0
start_minute	0	0
start_second	0	0
end_year	2016	2016
enu_month	5	
end_day	/	/
and minute	0	0
end second	0	0
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nput from file	TRUE	TRUE
history_interval	180	180
rames_per_outfile	8	8
restart	TRUE	
restart_interval	1440	
override_restart_timers	TRUE	
write_hist_at_0h_rst	TRUE	
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o_rorm_restart	2	
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rames per auxhist3	6	6
auxhist4 outname	fhrly d <domain> <date>"</date></domain>	ľ
o_form_auxhist4	2	İ
auxhist4_interval	60	60
rames_per_auxhist4	144	144
auxhist8_outname	rfdly_d <domain>_<date>"</date></domain>	
auxhist8_interval	1440	1440
io_form_auxhist8	2	
frames_per_auxhist8	6	6
ofields_filename	"iofields.txt"	"iofields.txt"
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domains		
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max_dom _we _we _sn _sn _sn _sn _sn _sn _sn _sn _sn _sr _stretch_s _top_requested _to_ _top_requested x	1 540 1 363 1 45 50 1000 112 1.05 5000 1155724 1955724 1955724	1 1 616 11 500 1 45
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