



#### Supplement of

### A latitudinally banded phytoplankton response to 21st century climate change in the Southern Ocean across the CMIP5 model suite

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Variable	GFDL- ESMG	GFDL- ESM2M	CESM1- BGC	NorESM1 -ME	IPSL- CM5A-LR	IPSL- CM5A- MR	HadGEM2 -CC	HadGEM2 -ES	GISS-E2- H-CC	GISS-E2- R-CC	MPI-ESM- LR	MPI-ESM- MR	CanESM2	MIROC- ESM- CHEM	MRI- ESM1	CMCC- CESM	
РВ	х	х	Х	х	х	х	х	Х	Х	х	х	х	Х	NA	Х	NA	
РР	Х	х	Х	х	х	х	х	Х	Х	х	х	х	Х	Х	Х	х	-
Nitrate	х	х	х	Х	х	х	х	Х	Х	х	х	Х	х	NA	Х	х	-
MLD	х	х	х	х	х	х	х	Х	х	х	х	Х	х	х	х	х	-
Iron	х	х	х	Х	х	х	х	Х	Х	х	Х	Х	NA	NA	NA	х	-
IPAR	х	х	х	х	Х	х	NA	Х	NA	NA	Х	Х	Х	х	х	Х	-
Cloud cover	х	х	Х	х	Х	х	х	Х	х	х	х	Х	х	Х	NA	Х	-
Wind stress	х	х	х	Х	х	х	х	Х	Х	х	х	Х	х	х	Х	х	-
Sea ice cover	х	Х	х	Х	х	х	х	Х	х	х	Х	Х	Х	х	Х	NA	-
Silicate	х	х	х	х	х	х	х	Х	Х	х	х	Х	х	х	NA	Х	-
SST	х	Х	х	Х	х	х	х	Х	х	х	х	х	Х	х	Х	х	-
Salinity	х	х	Х	х	х	х	Х	х	Х	х	Х	х	х	х	х	х	

Table S1: Variables available across the CMIP5 models. An "X" denotes that a variable was available within the given model, while "NA" denotes that it was not available.

Model	Scenario	30-40°S	40-50°S	50-65°S	S of 65°S	Total
CanESM2	hist	49.005	103.100	47.209	8.503	207.817
	rcp8.5	39.825	97.357	51.527	14.324	203.033
	delta	-9.180	-5.743	4.318	5.821	-4.784
	rel delta	-18.73%	-5.57%	9.15%	68.46%	-2.30%
CESM1-BGC	hist	54.855	191.250	265.320	157.770	669.195
	rcn8.5	47.063	151.320	213,480	158,580	570 443
	delta	-7.792	-39,930	-51.840	0.810	-98.752
	rel delta	-14.20%	-20.88%	-19.54%	0.51%	-14.76%
GEDI-ESM2G	hist	102 850	126 380	140 940	74.096	444 266
	rcn8 5	99 233	130 100	140 910	76 512	446 755
	delta	-3 617	3 720	-0.030	2 416	2 489
	rel delta	-3.52%	2 9/%	-0.030	3 26%	0.56%
GEDI-ESM2M	hist	118 980	128 190	159 780	88 52/	195 171
	rcn9 E	114 220	122.150	152 610	02 670	402 660
	delta	-4 760	3 970	-6 170	A 155	-2 805
	rol dolta	-4.700	2 10%	-0.170	4.135	-2.805
HadCEM2 CC	hist	262 510	471.990	E20 110	147.950	1412 250
Haudelviz-CC	nist nem 0 E	202.510	471.000	550.110	147.650	1412.550
	rcp8.5	220.690	483.040	494.730	177.540	1376.000
	deita	-41.820	11.160	-35.380	29.690	-36.350
	rei deita	-15.93%	2.37%	-6.6/%	20.08%	-2.57%
HadGEM2-ES	hist	259.410	458.830	4/8.690	135.000	1331.930
	rcp8.5	215.440	4/9./00	466.980	170.350	1332.470
	delta	-43.970	20.870	-11.710	35.350	0.540
	rel delta	-16.95%	4.55%	-2.45%	26.19%	0.04%
IPSL-CM5A-LR	hist	103.880	104.970	147.820	82.455	439.125
	rcp8.5	86.633	96.955	136.510	89.627	409.725
	delta	-17.247	-8.015	-11.310	7.172	-29.400
	rel delta	-16.60%	-7.64%	-7.65%	8.70%	-6.70%
IPSL-CM5A-MR	hist	100.580	103.320	131.360	80.698	415.958
	rcp8.5	81.935	102.870	128.610	86.796	400.211
	delta	-18.645	-0.450	-2.750	6.098	-15.747
	rel delta	-18.54%	-0.44%	-2.09%	7.56%	-3.79%
MPI-ESM-LR	hist	382.460	854.660	1841.700	768.960	3847.780
	rcp8.5	310.530	923.440	1629.000	841.910	3704.880
	delta	-71.930	68.780	-212.700	72.950	-142.900
	rel delta	-18.81%	8.05%	-11.55%	9.49%	-3.71%
MPI-ESM-MR	hist	313.000	870.370	1881.200	731.740	3796.310
	rcp8.5	270.730	888.010	1762.300	788.220	3709.260
	delta	-42.270	17.640	-118.900	56.480	-87.050
	rel delta	-13.50%	2.03%	-6.32%	7.72%	-2.29%
MRI-ESM1	hist	64.063	68.103	76.655	25.450	234.271
	rcp8.5	62.270	70.676	75.273	25.507	233.726
	delta	-1.793	2.573	-1.382	0.057	-0.545
	rel delta	-2.80%	3.78%	-1.80%	0.22%	-0.23%
NorESM1-ME	hist	374.630	696.240	797.840	147.620	2016.330
	rcp8.5	317.070	734.930	725.870	218.070	1995.940
	delta	-57.560	38.690	-71.970	70.450	-20.390
	rel delta	-15.36%	5.56%	-9.02%	47.72%	-1.01%
GISS-E2-H-CC	hist	41.006	167.710	431.630	159.420	799.766
	rcp8.5	32.961	144.990	391.390	213.780	783.121
	delta	-8.045	-22.720	-40.240	54.360	-16.645
	rel delta	-19.62%	-13.55%	-9.32%	34.10%	-2.08%
GISS-E2-R-CC	hist	68.378	101.910	251.800	160.360	582,448
	rcn8.5	53,751	103 600	216,500	198,110	571.961
	delta	-14.627	1.690	-35,300	37,750	-10.487
	rel delta	-21.39%	1.66%	-14.02%	23.54%	-1.80%
All-model means	hist	163.972	317 637	513 004	197.746	1192 359
All model means	rcn8 5	139 454	324,225	470.478	225,143	1159,300
	delta	-24 519	6 588	-42 526	27 397	-33 059
	rol dolta	-14 95%	2.07%	-8 29%	13.85%	-2 77%

**Table S2: Surface phytoplankton biomass concentrations (PB) across the CMIP5 models.** PB spatially averaged over each zonal band within each model for the *historical* (1980-99 average) and *rcp8.5* (2080-99 average) simulations. Rows labeled "delta" list 100-year absolute changes (*rcp8.5* minus *historical*) in PB, while rows labeled "rel delta" list 100-year relative changes (absolute change in PB over *historical* PB). Units are mmol m<sup>-3</sup> phytoplankton concentration.

Model	Scenario	30-40°S	40-50°S	50-65°S	S of 65°S	Total
CanESM2	hist	2.133	5.380	0.945	0.073	8.531
	rcp8.5	1.460	5.549	1.129	0.124	8.260
	delta	-0.673	0.168	0.184	0.051	-0.271
	rel delta	-31.57%	3.13%	19.45%	69.73%	-3.17%
CESM1-BGC	hist	4.988	4.440	3.084	0.483	12.995
	rcp8.5	4.819	4.755	3.335	0.590	13.499
	delta	-0.169	0.315	0.251	0.107	0.505
	rel delta	-3.38%	7.10%	8.15%	22.19%	3.89%
CMCC-CESM	hist	4.829	2.599	2.648	0.359	10.434
	rcp8.5	4.699	2.890	2.892	0.457	10.938
		-0.130	0.291	0.244	0.099	0.504
	hist	-2.70%	11.21% 5.220	9.22%	27.54%	4.83%
GFDL-ESIVIZG	rcn8 5	6 307	5.550	3 980	0.970	16.030
	delta	0.113	0 247	-0 170	-0.003	0 187
	rel delta	1.82%	4.64%	-4.09%	-0.32%	1.12%
GEDI-ESM2M	hist	7 793	5 971	4 700	1 164	19 628
	rcp8.5	7.994	6.253	4.567	1.176	19.990
	delta	0.201	0.282	-0.133	0.012	0.362
	rel delta	2.58%	4.72%	-2.83%	1.04%	1.84%
HadGEM2-CC	hist	3.811	6.339	5.900	1.028	17.079
	rcp8.5	3.036	6.043	5.804	1.378	16.261
	delta	-0.775	-0.296	-0.096	0.350	-0.817
	rel delta	-20.34%	-4.67%	-1.62%	33.99%	- <b>4.79</b> %
HadGEM2-ES	hist	3.708	6.153	5.651	0.919	16.431
	rcp8.5	2.993	5.982	5.658	1.325	15.958
	delta	-0.716	-0.170	0.007	0.405	-0.474
	rel delta	-19.29%	-2.77%	0.13%	44.05%	-2.88%
IPSL-CM5A-LR	hist	4.624	3.409	2.650	0.599	11.282
	rcp8.5	4.242	3.641	2.690	0.678	11.250
	delta	-0.382	0.232	0.040	0.079	-0.032
	rei deita	-8.26%	6.80%	1.51%	13.13%	-0.28%
IPSL-CIVISA-IVIR	nist rong E	4.403	3.462	2.650	0.634	11.149
	delta	-0.382	0.405	0.055	0.700	0 144
	rel delta	-8.67%	11 69%	2.08%	10 40%	1 29%
MIROC-ESM-CHEM	hist	4 297	4 539	2 891	0.284	12 011
	rcp8.5	3.650	4.991	3.059	0.519	12.218
	delta	-0.647	0.452	0.168	0.235	0.207
	rel delta	-15.06%	9.96%	5.80%	82.63%	1.72%
MPI-ESM-LR	hist	5.157	7.269	8.027	1.603	22.055
	rcp8.5	4.296	7.350	7.421	1.951	21.017
	delta	-0.862	0.081	-0.605	0.348	-1.038
	rel delta	-16.71%	1.12%	-7.54%	21.70%	-4.71%
MPI-ESM-MR	hist	4.406	7.145	8.161	1.569	21.281
	rcp8.5	3.922	7.289	7.969	1.743	20.923
	delta	-0.484	0.145	-0.192	0.174	-0.357
	rel delta	-10.98%	2.02%	-2.35%	11.07%	-1.68%
MIRI-ESM1	hist	2.842	3.095	1.897	0.215	8.048
	rcp8.5	2.690	3.410	2.123	0.291	8.521 0.472
	rol dolto	-0.131 E 22%	10.20%	11 07%	25 55%	0.473 E 97%
NorESM1-ME	hist	3.965	6 959	/ 385	0.346	15 655
	rcn8.5	3.276	7.048	4.595	0.497	15.416
	delta	-0.689	0.090	0.210	0.151	-0.239
	rel delta	-17.37%	1.29%	4.78%	43.57%	-1.52%
GISS-E2-H-CC	hist	0.466	2.655	2.468	0.325	5.914
	rcp8.5	0.428	2.677	2.921	0.436	6.462
	delta	-0.037	0.023	0.452	0.110	0.547
	rel delta	-8.02%	0.85%	18.32%	33.82%	9.26%
GISS-E2-R-CC	hist	1.776	2.935	2.835	0.550	8.097
	rcp8.5	1.211	3.131	2.935	0.676	7.954
	delta	-0.565	0.196	0.100	0.126	-0.143
	rel delta	-31.80%	6.69%	3.52%	22.84%	-1.77%
All-model means	hist	4.162	4.847	4.215	0.755	13.980
	rcp8.5	3.769	5.011	4.237	0.914	13.931
	delta	-0.393	0.164	0.022	0.159	-0.048
1	rei delta	-9.45%	3.39%	0.52%	21.06%	-0.35%

**Table S3: 100-m vertically-integrated primary productivity rates (PP) across the CMIP5 models.** PP spatially integrated over each zonal band within each model for the *historical* (1980-99 average) and *rcp8.5* (2080-99 average) simulations. Rows labeled "delta" list 100-year absolute changes (*rcp8.5* minus *historical*) in PP, while rows labeled "rel delta" list 100-year relative changes (absolute change in PP over *historical* PP). Units are PgC yr<sup>-1</sup>, or petagrams of carbon per year.

Reference	Studied area	Data collection method	Type of biomass measured	Time period	Trend calculation method	Direction/magnitude of significant trends	Proposed driving mechanism
Atkinson et al., 2004 (A2004)	Southwest Atlantic sector of Southern Ocean (~50- 65°S,~20-60°W)	Net hauls from 9 countries	Summer krill density, which is positively correlated with chl conc	1976- 2003	Spatio-temporal model at each grid cell (SW Atlantic = 10 grid cells)	- <b>38% per decade</b> in krill density	None offered to explain why chl concentrations should decrease
Lovenduski and Gruber, 2005 (LG2005)	Entire Southern Ocean, divided into 4 zones defined by fronts	SeaWiFS	Chl	1997- 2004	Variables were spatially averaged over each of the 4 zones and then temporally correlated/regressed with the SAM index; no actual temporal trends were calculated	Subantarctic zone (SAZ) south of Australia (~50-60°S, ~110-140°E): - <b>0.06 mg m<sup>-2</sup> per</b> standard deviation of SAM	Poleward shift of surface westerly winds during positive SAM $\rightarrow$ increased convergence and downwelling in the SAZ $\rightarrow$ deeper mixed layers and increased light limitation $\rightarrow$ decreased chl in the SAZ during positive SAM
Gregg et al., 2005 (G2005)	Global ocean	SeaWiFS	Chl	1998- 2003	Pixel by pixel; clusters of pixels with significant trends were then isolated as regions of interest and data were then averaged over these regions	Small area just south of Australia (~35- 55°S,~110-150°E): <b>+28.9% over time</b> <b>period of study</b> in chl concentrations	Increase in chl accompanied by 0.56°C increase in springtime SST; warmer SST $\rightarrow$ shallower mixed layer $\rightarrow$ less light limitation
Smith and Comiso, 2008 (SC2008)	Entire SO south of 60°S, with more in-depth analysis for 6 specific small regions	SeaWiFS	Primary production calculated from remotely- sensed ocean color, SST, PAR	1998- 2006	Variables are spatially averaged over the entire SO south of 60°S or over each of the six small regions and temporally averaged both monthly and annually; simple Model I regression analyses to calculate trends	<ul> <li>Annual PP over the entire SO increased significantly between 1998-2006 with much of the increase confined to the months of Jan and Feb</li> <li>Annually over entire SO: +3.85 g C m<sup>-2</sup> yr<sup>-1</sup> decade<sup>-1</sup></li> <li>All Januaries over entire SO: +52.01 mg C m<sup>-2</sup> yr<sup>-1</sup> decade<sup>-1</sup></li> <li>All Februaries over entire SO: +32.78 mg C m<sup>-2</sup> yr<sup>-1</sup> decade<sup>-1</sup></li> </ul>	- Jan and Feb are the months of minimum sea ice concentrations, suggesting that the summer increases in PP are not directly coupled to ice retreat - Instead PP increases are forced by decreasing summer cloud cover, increased iron inputs, and/or increased water column stratification, leading to enhanced irradiance availability
Arrigo et al., 2008 (A2008)	Entire Southern Ocean south of 50°S, divided into 5 geographic sectors at specific longitudes	SeaWiFS	Primary production calculated from remotely- sensed ocean color, SST, sea ice	1997- 2006	Variables are spatially averaged over each different sector; regression coefficient of production vs. year is then computed for each sector	- Ross Sea sector (south of 50°S, 160°E to 130°W): <b>+9 Tg C yr</b> <sup>-1</sup> - South Indian sector (south of 50°S, 20°E to 90°E): <b>-4 Tg C yr</b> <sup>-1</sup>	None offered

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Montes-Hugo et al., 2009 (MH2009)	Western Antarctic Peninsula (WAP)	SeaWiFS, CZCS, in- situ shipboard data	Chl	1978- 1986 to 1998- 2006	Spatial average over the northern and southern WAP subregions of pixel-by-pixel differences in monthly- averaged chl concentration between 1978-1986 and 1998- 2006	- Northern WAP subregion (61.8-64.5°S, 59.0-65.8°W): <b>-1.36 (Dec), -5.43 (Jan), -</b> <b>2.12 (Feb) mg m<sup>-3</sup></b> - Southern WAP subregion (63.8-67.8°S, 64.4-73.0°W): <b>+1.25 (Dec), +0.49 (Jan),</b> <b>+0.02 (Feb) mg m<sup>-3</sup></b>	<ul> <li>Northern WAP subregion: cloudier skies, stronger winds, decreased summer sea ice extent → deeper windmixing and increased light limitation during months most critical for phytoplankton growth (Dec and Jan); perhaps also because of greater advection of chl-poor waters from the Weddell Sea</li> <li>Southern WAP subregion: clearer skies, weaker winds, decreased summer sea ice in areas that were previously sea ice covered most of the year → more favorable light conditions for phytoplankton growth</li> </ul>
Johnston and Gabric, 2011 (JG2011)	Australian sector of the Southern Ocean (40- 70°S, 110- 160°E), divided latitudinally into 5° zones	SeaWiFS	Chl and primary production calculated from remotely- sensed ocean color, PAR, SST	1997- 2007	Variables are spatially averaged over the 5° zones and temporally averaged over spring and summer months; trends in seasonal (summer and spring) time series are then estimated using the non- parametric seasonal Sen slope	- 40-45°S: +1.2E-2 (spring) mg m <sup>-3</sup> yr <sup>-1</sup> and +14.6 (summer) mg C m <sup>-2</sup> day <sup>-1</sup> yr <sup>-1</sup> - 45-50°S: +7.2E-3 (spring) mg m <sup>-3</sup> yr <sup>-1</sup> and +8.4 (summer) mg C m <sup>-2</sup> day <sup>-1</sup> yr <sup>-1</sup> - 55-60°S: -2.7E-3 (spring), -2.7E-3 (summer) mg m <sup>-3</sup> yr <sup>-1</sup>	- 40-50°S: none offered - 55-60°S: decreased Ekman transport of iron → lower chl concs
Takao et al., 2012 (T2012)	Indian sector of the SO (south of 30°S, 110- 150°E), broken up into five frontal zones	SeaWiFS	NPP calculated from remotely- sensed ocean color, PAR, absorption	1997- 2007	Variables are spatially averaged over the frontal zones and temporally averaged over seasons; trends and their significance are then estimated using the non- parametric Sen slope and the Mann-Kendall test	Polar frontal zone (PFZ) (between ~45- 55°S, depending on the longitude): <b>-2.91 mg C m<sup>-2</sup> day<sup>-1</sup> yr<sup>-1</sup> (summer)</b>	<ul> <li>-Decreasing trend in NPP pos. correlated with decreasing diatom abundance</li> <li>-Shifting of ACC fronts could've led to changes in iron availability via alterations in meander-induced upwelling and/or eddy mixing</li> <li>-Decreasing trend in PFZ NPP and diatom abundance could've been due to decrease in iron availability or increase in zooplankton grazing pressure or complex interactions between the two</li> </ul>
Siegel et al., 2013 (S2013)	Global ocean divided up into 3 zones separated by the two mean 15°C SST isotherms	SeaWIFS	Chl and biomass calculated from remotely- sensed ocean color, particulate backscatter, PAR, SST	1997- 2010	Variables were spatially averaged over the 3 regions and temporally averaged over months; type 1 linear regression to calculate trends	SO region where mean SST < 15°C (significant only in regions ~100°E-0°E, ~40-50°S and ~112°E-45°W, ~65°S): - Chl concentration (from classic band ratio algorithm): <b>+0.83% per yr</b> - Chl concentration (with dissolved organic matter and detrital particulate matter taken into account): <b>+1.0981%</b> <b>per yr</b>	- Migration of boundaries between bio-optical provinces in response to regional changes in physical ocean climate

Table S4: Summary of previous studies looking at trends in phytoplankton biomass and productivity within the Southern Ocean (SO).



Figure S1: 100-year changes in maximum annual surface phytoplankton biomass (PB) for all the models with this data available.



Figure S2: 100-year changes in average annual primary production integrated to 100-m depth (PP) for all the models with this data available.

### $\Delta$ Wintertime (maximum annual) surface NO<sub>3</sub> concentrations



Figure S3: 100-year changes in maximum annual surface NO<sub>3</sub> concentration for all the models with this data available. Shaded areas are where PP increases.

#### Δ Wintertime (maximum annual) mixed layer depth (MLD) (m)



**Figure S4:** 100-year changes in maximum annual MLD for all the models with this data available. In single model maps, shading indicates PP increases. In the all-model mean change map, shading indicates that >80% of model realizations agree on the sign of the trend.

#### Δ Summertime (minimum annual) mixed layer depth (MLD) (m)



Figure S5: 100-year changes in minimum annual MLD for all the models with this data available. Shaded areas are where PP increases.



**Figure S6:** 100-year changes in maximum annual surface dissolved iron concentration for all the models with this data available. Shaded areas are where PP increases.



Figure S7: 100-year changes in maximum annual IPAR for all the models with this data available. Shaded areas are where PP increases.

### Δ Average summer (DJF) total cloud area fraction (%)



**Figure S8:** 100-year changes in average summer total cloud fraction for all the models with this data available. In single model maps, shading indicates PP increases. In the all-model mean change map, shading indicates that >80% of model realizations agree on the sign of the trend.



 $\Delta$  Average annual sea ice area fraction (%)

**Figure S9:** 100-year changes in average annual sea ice area fraction for all the models with this data available. In single model maps, shading indicates PP increases. In the all-model mean change map, shading indicates that >80% of model realizations agree on the sign of the trend

#### Δ Average annual zonal wind stress (Pa)



Figure S10: 100-year changes in average annual zonal wind stress for all the models with this data available. Shaded areas are where PP increases.

#### SAM time series in CMIP5 models



**Fig. S11:** Time series of the normalized Southern Annular Mode (SAM) index from the historical (1870-2005) and rcp8.5 (2006-2099) scenarios within each CMIP5 model studied here. The original SAM index time series is calculated as the difference between monthly zonally-averaged sea level pressure at 40°S and 60°S. To normalize, the average monthly SAM index between 1870 and 1950 is subtracted from the original SAM index time series at each month; this difference is then divided by the standard deviation of the SAM index between 1870 and 1950.



**Fig. S12:** Examples of temporal correlations between PB and variables which were not chosen for inclusion in Fig. 2, compared to correlations between PB and the variable which was chosen (chosen plot indicated by a star). Here we plot correlations from model HadGEM2-ES's masked 30-40°S band, but other bands within other models show similar distinctively clear correlations between PB and the chosen driving variable. Plot legend is the same as in Fig. 2.



# Unmasked multiple timescale temporal correlations (unmasked version of Fig. 2)

**Fig. S13:** As in Fig. 2, but using all grid points (both masked and unmasked). Comparison to Fig. 2 suggests that masking does not significantly alter any results. Plot legend is the same as in Fig. 2. \*Wintertime MLD was also significant on all three timescales. \*\*Wintertime iron was also significant on at least 2 of the timescales. \*\*\*Wintertime MLD was also significant on at least 2 of the timescales. \*\*\*\*The y-axis here is PP (umol m-2 s-1) instead of PB to match Fig. 2.

#### Chosen vs. unchosen driving variables for Fig. 3



**Fig. S14:** Examples of spatial correlations between PB and variables which were not chosen for inclusion in Fig. 3, compared to correlations between PB and the variable which was chosen (chosen plot indicated by a star). Here we plot correlations from model GFDL-ESM2G's masked 40-50°S band, but other bands within other models show similar distinctively clear correlations between PB and the chosen driving variable. Plot legend is the same as in Fig. 3.

### Unmasked 100-year change spatial correlations (unmasked version of Fig. 3)



**Fig. S15:** As in Fig. 3, but using all grid points (both masked and unmasked) and showing HadGEM2-ES in the 30-40°S band with absolute rather than relative changes. Comparison to Fig. 3 suggests that masking does not significantly alter any results. Plot legend is the same as in Fig. 3.

# Normalized zonally-averaged 100-year changes in individual models



**Fig. S16:** Normalized zonally-averaged 100-year changes in PP, PB, and other variables of interest (analogous to Fig. 6, but with plots for each model individually). For each variable, normalization was achieved by first computing the mean zonally-averaged 100-year

change within each of the models at every latitude and then dividing these values by the absolute value of the largest of these changes occurring south of 30°S. Some variables are omitted from some models due to lack of data. Plot colors are the same as in Fig. 6.

#### All-model zonally-averaged historical means and 100-year absolute changes



Fig. S17: Zonally-averaged all-model historical means and 100-year changes. Plot colors are the same as in Fig. 6.