Supplement of

Impact of West Antarctic ice shelf melting on the Southern Ocean hydrography

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Table S1. Model parameters used for simulations in this study. Horizontal diffusivity and viscosity are scaled by area. For example, a grid element with an area of 5.8×10^9 m^2 or a 1.5° triangular grid at about 60° latitude yields a viscosity of 6.0×10^4 m^2 s^{-1} and a diffusivity of about 1.8×10^3 m^2 s^{-1}.

Parameter	
Horizontal diffusivity scaling factor (m^2 s^{-1})	1.8×10^3
Background horizontal viscosity scaling factor (m^2 s^{-1})	6.0×10^4
Scaling reference area (m^2)	5.8×10^9
Background vertical diffusivity (m^2 s^{-1})	5.0×10^{-5}
Background vertical viscosity (m^2 s^{-1})	1.0×10^{-3}
Bottom drag coefficient	2.5×10^{-3}
Air/sea ice drag coefficient	2.5×10^{-3}
Sea ice/ocean drag coefficient	5.0×10^{-3}
Sea ice salt concentration	5.0×10^{-2}
Lead closing (m)	0.1
Ice strength (N m^{-2})	1.5×10^4
Sea ice dry albedo	0.75
Sea ice wet albedo	0.68
Snow dry albedo	0.85
Snow wet albedo	0.77

Table S2. Description of sensitivity experiments.

Simulation	
LMELT	Turbulent heat and salt exchange coefficients multiplied by 1 only at ice shelf bases in the AS and BS (Table S3).
MMELT	Turbulent heat and salt exchange coefficients multiplied by 2 only at ice shelf bases in the AS and BS (Table S3).
CTRL	Turbulent heat and salt exchange coefficients multiplied by 3 only at ice shelf bases in the AS and BS (Table S3).
HMELT	Turbulent heat and salt exchange coefficients multiplied by 30 only at ice shelf bases in the AS and BS (Table S3).

Table S3 Antarctic ice shelf basal mass loss from LMELT and HMELT runs and satellite-based estimates [Depoorter et al., 2013, Rignot et al., 2013]. Ice shelf locations are indicated by numbers in Fig. 1. For some ice shelf regions in the Weddell Sea and East Antarctica ((19)-(22) and (24)-(27), respectively), basal melt rates are accumulated for several ice shelves and compared to the satellite-based estimates as indicated in Fig. 1. Turbulent heat and salt exchange coefficients of ice shelves in the AS and BS (bold) are increased for HMELT.

Name	LMELT (Gt yr^{-1})	MMELT (Gt yr^{-1})	CTRL (Gt yr^{-1})	HMELT (Gt yr^{-1})	Satellite-based estimate (Gt yr^{-1})	References
(1) Ross	110.2	110.5	110.3	110.7	14-82	(*16,17*)
(2) Withrow	0.1	0.1	0.1	0.1	-0.1-0.7	(*16*)
(3) Swinburne-Salzberger	16.5	15.6	14.9	12.8	19-26	(*16*)
(4) Nickerson-Land	3.0	2.9	2.8	2.7	5-11	(*16*)
(5) Getz	93.3	139.4	168.3	309.4	117-159	(*16,17*)
(6) Dotson	13.1	19.6	23.2	33.1	41-49	(*16*)
(7) Crosson	3.5	4.7	5.3	5.8	35-43	(*16*)
(8) Thwaites	15.2	22.2	27.0	48.3	91-105	(*16*)
(9) Pine Island	28.3	42.2	52.6	103.4	81-109	(*16,17*)
(10) Cosgrove	10.3	15.9	20.3	37.2	7-11	(*16*)
(11) Abbot	28.5	35.5	39.4	54.5	33-97	(*16,17*)
(12) Venable	2.4	3.6	4.2	7.3	17-21	(*16*)
(13) Ferrigno	0.1	0.1	0.2	0.7	3-7	(*16*)
(14) Stange	23.6	34.6	41.9	79,1	22-34	(*16*)
(15) George VI	104.4	147.7	176.8	298.7	72-160	(*16,17*)
(16) Bach	4.7	7.0	8.9	17.4	9-11	(*16*)
(17) Wilkins	19.3	25.1	28.3	41.4	1-35	(*16*)
(18) Wordie	0.1	0.3	0.4	1.7	4-10	(*16*)
(19) Larsen B-G	36.4	36.6	36.0	35.3	-59-134	(*16,17*)
(20) Filchner-Ronne	108.5	106.9	107.8	109.1	10-200	(*16,17*)
(21) Brunt-Downer	101.3	101.2	101.0	100.1	40-162	(*16*)
(22) Amery-Publication	64.8	64.3	63.8	62.1	12-62	(*16,17*)
(23) West	14.6	14.7	14.8	15.0	17-37	(*16*)
(24) Shackleton-Glenzer	22.1	22.3	22.3	22.2	61-97	(*16*)
(25) Vincennes	1.1	1.1	1.1	1.0	3-7	(*16*)
(26) Totten-Moscow Univ.	9.7	9.6	9.6	9.7	83-99	(*16*)
(27) Holmes-Drygalski	23.4	22.2	21.3	18.4	33-72	(*16*)
Amundsen Sea total (5-11)	192.2	280.0	336.0	591.7	405-573	(*16,17*)
Bellingshausen Sea total (12-18)	130.5	186.0	223.1	385.9	128-278	(*16,17*)
Antarctic total	837.4	976.3	1068.0	1480.1	1263-1737	(*16,17*)

Table S4 Mean Antarctic ice shelf melt rate differences and spatially averaged salinity differences for the last 2 years of model simulations. LMELT fields are subtracted from HMELT, CTRL, and MMELT fields to calculate the differences. We calculate spatial average for the regions indicated in Fig. 1 but using regions shallower than 1000 m and regions deeper than 2500 m for on-shelf 200-m spatially averaged and bottom spatially averaged salinity, respectively (Table S3).

	HMELT-LMELT	CTRL-LMELT	MMELT-LMELT
Total melt rate difference (Gt yr^{-1})	643	231	138
RS continental shelf salinity difference at 200-m depth (g kg^{-1})	-0.14	-0.045	-0.025
Deep RS basin salinity difference at bottom (g kg^{-1})	-0.015	-0.0048	-0.0030
Continental shelf region off Cape Darnley salinity difference at 200-m depth (g kg^{-1})	-0.035	-0.0078	-0.0038
Weddell Sea continental shelf salinity difference at 200-m depth (g kg^{-1})	-0.016	-0.0035	-0.0003

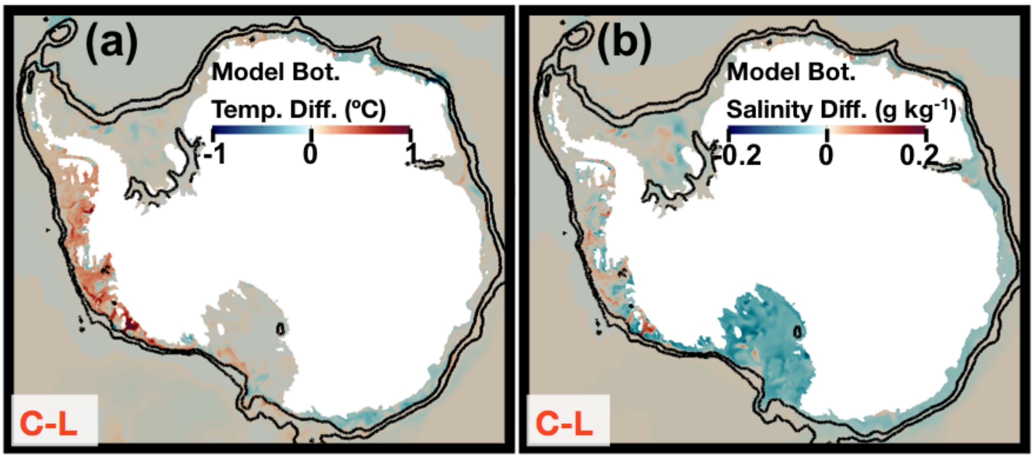

Figure S1

Simulated bottom (a) potential temperature and (b) absolute salinity differences between CTRL and LMELT for year 32.

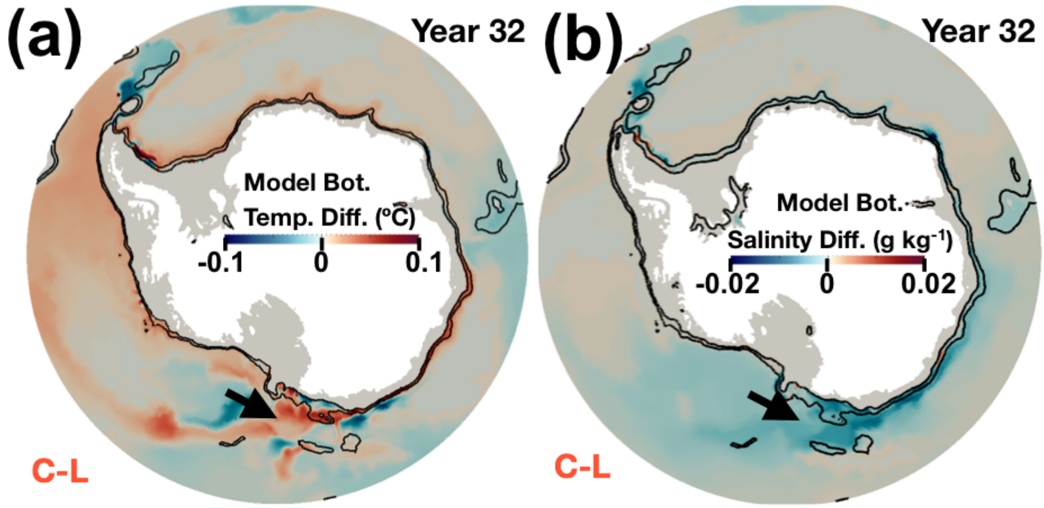

Figure S2

January mean bottom (a) temperature and (b) absolute salinity differences between CTRL and LMELT (H-L) for year 32. Only the region deeper than 1500m is shown. The bathymetry contours of 1000 m and 2500 m are shown as black lines. The black arrow indicates locations of intensified warming and freshening.