Supplementary Material for "The stability of present-day Antarctic grounding lines — Part B: Possible commitment of regional collapse under current climate"

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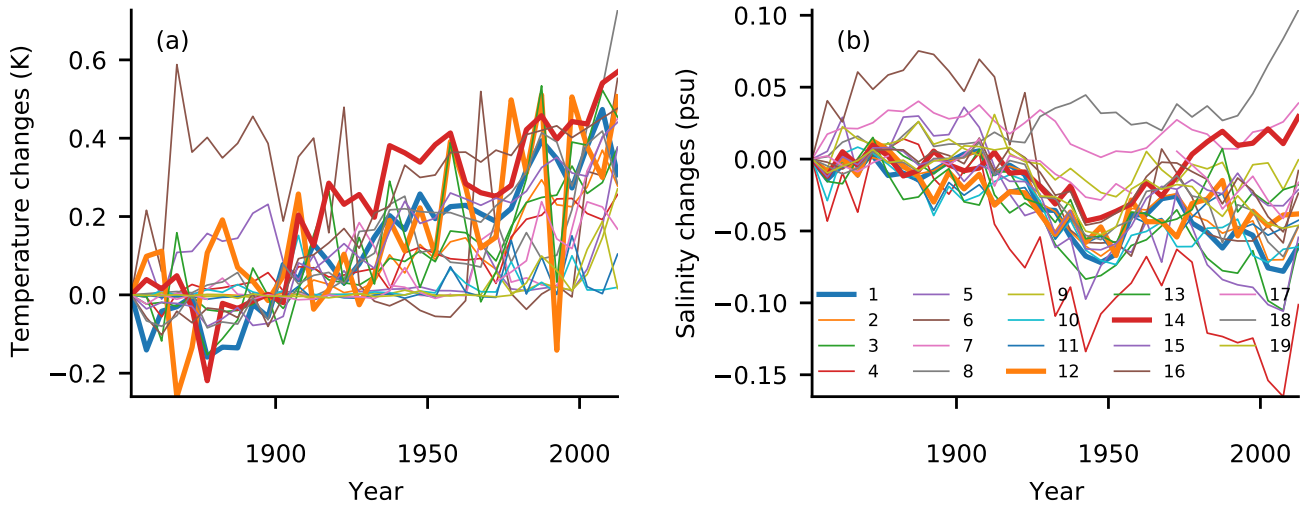

Figure S1. Historic increase in (a) ocean temperatures and (b) salinities as input into PICO box 0. Basin 1 corresponds to Filchner-Ronne Ice Shelf, basin 12 to Ross Ice Shelf and basin 14 covers the Amundsen Sea. All basins are as in Reese et al. (2018).

Table S1. Temperature corrections and melt rates for Antarctic basins with PICO parameters C =2.0 $\mathrm{Svm^3kg^{-1}}$ and $\gamma_T^\star$ =5.5 $\times 10^{-5}\mathrm{ms^{-1}}$.

basin	m_{obs} (Gt/yr)	δTD (K)	m_{PICO} (Gt/yr)	m_{B_1} (m/yr)	m_{B_2} (m/yr)
1	75.2	0.10	77.10	1.05	-0.18
2	38.2	-0.15	36.29	1.80	0.11
3	17.1	-0.34	16.63	1.29	-0.03
4	57.9	-0.23	61.34	2.10	0.33
5	6.8	-0.56	6.60	0.58	-0.23
6	29.3	-0.23	29.07	1.44	-1.57
7	79.2	-0.10	80.92	4.62	1.17
8	89.3	-1.32	91.02	6.44	-0.58
9	24.4	-0.51	24.48	2.15	-0.22
10	7.6	-0.80	6.84	1.25	-1.73
11	7.4	-0.23	6.91	2.37	-0.46
12	135.1	0.25	132.54	1.18	-0.03
13	167.0	-1.30	169.61	4.67	1.37
14	236.4	-1.78	234.56	13.59	6.28
15	68.5	-2.00	359.40	14.06	6.90
16	143.1	-2.00	245.02	12.68	6.05
17	6.5	-2.00	6.45	3.05	2.89
18	67.8	-0.51	66.42	1.89	0.31
19	4.7	-0.21	4.60	0.57	-0.54

We use m_{obs} which are observational melt rates from Adusumilli et al. (2020). The temperature corrections δTD are applied to the input temperature, and m_{PICO}, m_{B_1} and m_{B_2} denote melt rates calculated by PICO for the respective basin and boxes.

References

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Table S2. Temperature corrections and melt rates for Antarctic basins with PICO parameters C =3.0 $\mathrm{Svm^3kg^{-1}}$ and $\gamma_T^\star$ =4.0 $\times 10^{-5}\mathrm{ms^{-1}}$.

basin	m_{obs} (Gt/yr)	δTD (K)	m_{PICO} (Gt/yr)	m_{B_1} (m/yr)	m_{B_2} (m/yr)
1	75.2	-0.10	73.46	1.08	-0.14
2	38.2	-0.18	36.17	1.78	0.23
3	17.1	-0.36	17.55	1.32	0.07
4	57.9	-0.28	54.64	1.83	0.38
5	6.8	-0.55	6.60	0.57	-0.17
6	29.3	-0.32	27.79	1.38	-1.36
7	79.2	-0.10	78.63	4.12	1.48
8	89.3	-1.30	92.01	5.98	0.35
9	24.4	-0.51	20.69	1.79	-0.09
10	7.6	-0.79	8.43	1.29	-1.40
11	7.4	-0.22	7.13	2.14	-0.24
12	135.1	0.05	133.45	1.19	0.01
13	167.0	-1.33	160.73	4.18	1.66
14	236.4	-1.70	235.30	12.53	7.23
15	68.5	-2.00	346.23	12.34	7.28
16	143.1	-2.00	276.66	11.86	7.07
17	6.5	-1.95	6.67	3.13	3.08
18	67.8	-0.53	70.39	2.01	0.47
19	4.7	-0.21	4.61	0.59	-0.53

We use m_{obs} which are observational melt rates from Adusumilli et al. (2020). The temperature corrections δTD are applied to the input temperature, and m_{PICO}, m_{B_1} and m_{B_2} denote melt rates calculated by PICO for the respective basin and boxes.

Table S3. Temperature corrections and melt rates for Antarctic basins with PICO parameters C =1.0 $\mathrm{Svm^3kg^{-1}}$ and $\gamma_T^\star$ =4.0 $\times 10^{-5}\mathrm{ms^{-1}}$.

basin	m_{obs} (Gt/yr)	δTD (K)	m_{PICO} (Gt/yr)	m_{B_1} (m/yr)	m_{B_2} (m/yr)
1	75.2	0.37	72.67	0.83	-0.10
2	38.2	-0.00	38.22	1.73	0.21
3	17.1	-0.19	18.00	1.32	0.05
4	57.9	-0.10	58.29	1.88	0.34
5	6.8	-0.55	6.47	0.54	-0.14
6	29.3	-0.05	28.65	1.19	-1.04
7	79.2	0.02	76.47	4.16	1.18
8	89.3	-1.18	90.94	5.65	0.19
9	24.4	-0.46	25.38	2.01	0.00
10	7.6	-0.78	7.15	1.08	-1.19
11	7.4	-0.19	7.53	2.08	-0.18
12	135.1	0.62	132.34	1.13	0.01
13	167.0	-1.13	162.95	4.33	1.30
14	236.4	-1.43	233.60	13.19	6.43
15	68.5	-2.00	222.14	9.05	3.96
16	143.1	-1.98	142.54	8.03	3.33
17	6.5	-1.95	6.28	2.91	2.68
18	67.8	-0.31	69.28	1.90	0.41
19	4.7	-0.19	4.48	0.48	-0.37

We use m_{obs} which are observational melt rates from Adusumilli et al. (2020). The temperature corrections δTD are applied to the input temperature, and m_{PICO}, m_{B_1} and m_{B_2} denote melt rates calculated by PICO for the respective basin and boxes.

Table S4. Temperature corrections and melt rates for Antarctic basins with PICO parameters C =3.0 $\mathrm{Svm^3kg^{-1}}$ and $\gamma_T^\star$ =7.0 $\times 10^{-5}\mathrm{ms^{-1}}$.

basin	m_{obs} (Gt/yr)	δTD (K)	m_{PICO} (Gt/yr)	m_{B_1} (m/yr)	m_{B_2} (m/yr)
1	75.2	-0.03	75.71	1.20	-0.25
2	38.2	-0.20	39.59	2.05	0.07
3	17.1	-0.39	18.12	1.43	-0.08
4	57.9	-0.30	58.15	2.13	0.27
5	6.8	-0.56	7.01	0.64	-0.30
6	29.3	-0.30	30.06	1.68	-2.05
7	79.2	-0.18	79.67	4.83	0.99
8	89.3	-1.41	85.85	6.84	-1.51
9	24.4	-0.54	22.76	2.20	-0.45
10	7.6	-0.82	6.81	1.44	-2.25
11	7.4	-0.24	7.61	2.85	-0.65
12	135.1	0.10	137.02	1.27	-0.06
13	167.0	-1.40	165.15	4.75	1.28
14	236.4	-1.95	236.03	14.10	6.04
15	68.5	-2.00	489.47	18.77	9.65
16	143.1	-2.00	346.86	17.21	8.70
17	6.5	-2.00	8.30	3.93	3.78
18	67.8	-0.58	70.00	2.03	0.27
19	4.7	-0.23	4.77	0.65	-0.69

We use m_{obs} which are observational melt rates from Adusumilli et al. (2020). The temperature corrections δTD are applied to the input temperature, and m_{PICO}, m_{B_1} and m_{B_2} denote melt rates calculated by PICO for the respective basin and boxes.

Table S5. Temperature corrections and melt rates for Antarctic basins with PICO parameters C =1.0 $\mathrm{Svm^3kg^{-1}}$ and $\gamma_T^\star$ =10.0 $\times 10^{-5}\mathrm{ms^{-1}}$.

basin	m_{obs} (Gt/yr)	δTD (K)	m_{PICO} (Gt/yr)	m_{B_1} (m/yr)	m_{B_2} (m/yr)
1	75.2	0.82	75.84	0.90	-0.20
2	38.2	-0.08	36.28	1.65	-0.02
3	17.1	-0.22	16.36	1.29	-0.12
4	57.9	-0.15	59.14	2.07	0.17
5	6.8	-0.56	6.76	0.61	-0.31
6	29.3	0.10	29.58	1.48	-1.83
7	79.2	-0.10	82.26	4.95	0.33
8	89.3	-1.32	87.84	6.90	-2.20
9	24.4	-0.52	26.03	2.35	-0.54
10	7.6	-0.79	8.49	1.57	-2.23
11	7.4	-0.24	6.97	2.76	-0.93
12	135.1	1.00	136.16	1.15	-0.04
13	167.0	-1.28	164.22	4.59	0.61
14	236.4	-1.80	235.14	15.59	3.93
15	68.5	-2.00	356.27	15.40	4.81
16	143.1	-2.00	168.07	11.42	2.90
17	6.5	-2.00	10.34	4.79	3.90
18	67.8	-0.41	66.18	1.66	0.22
19	4.7	-0.20	5.22	0.55	-0.51

We use m_{obs} which are observational melt rates from Adusumilli et al. (2020). The temperature corrections δTD are applied to the input temperature, and m_{PICO}, m_{B_1} and m_{B_2} denote melt rates calculated by PICO for the respective basin and boxes.

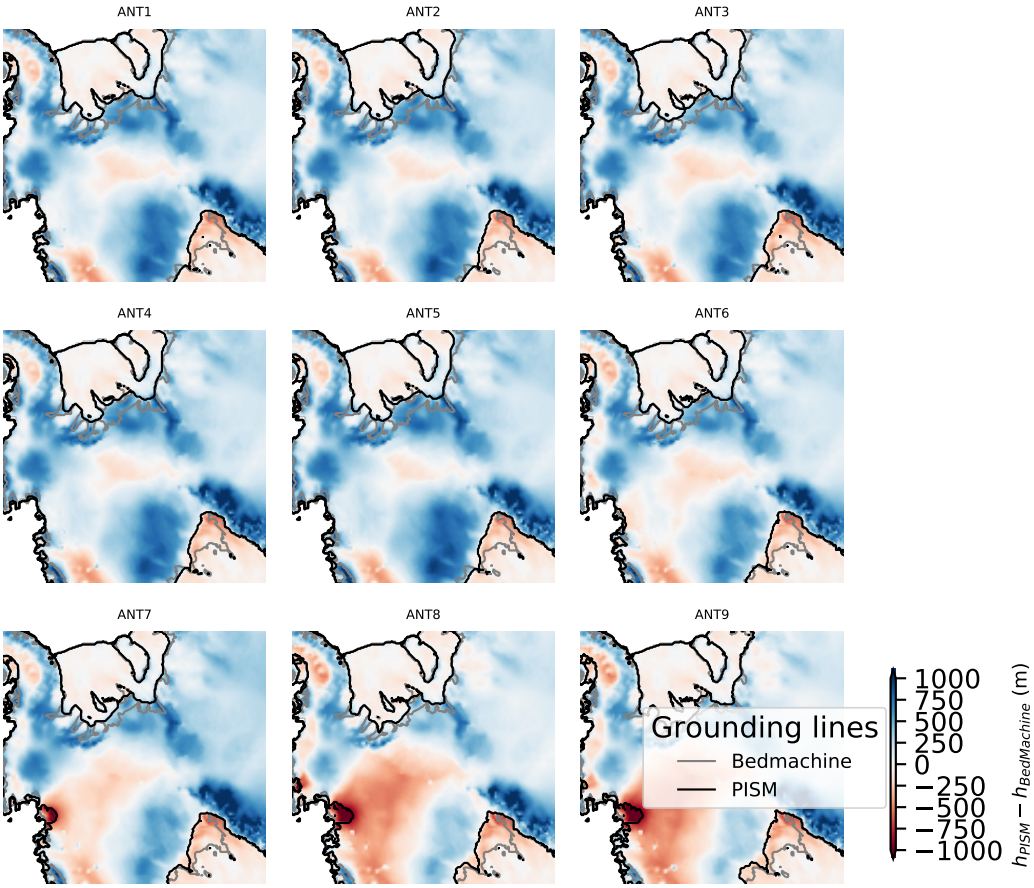

Figure S2. Grounding lines and ice thickness changes relativ to BedMachine in ensemble members in 2015.

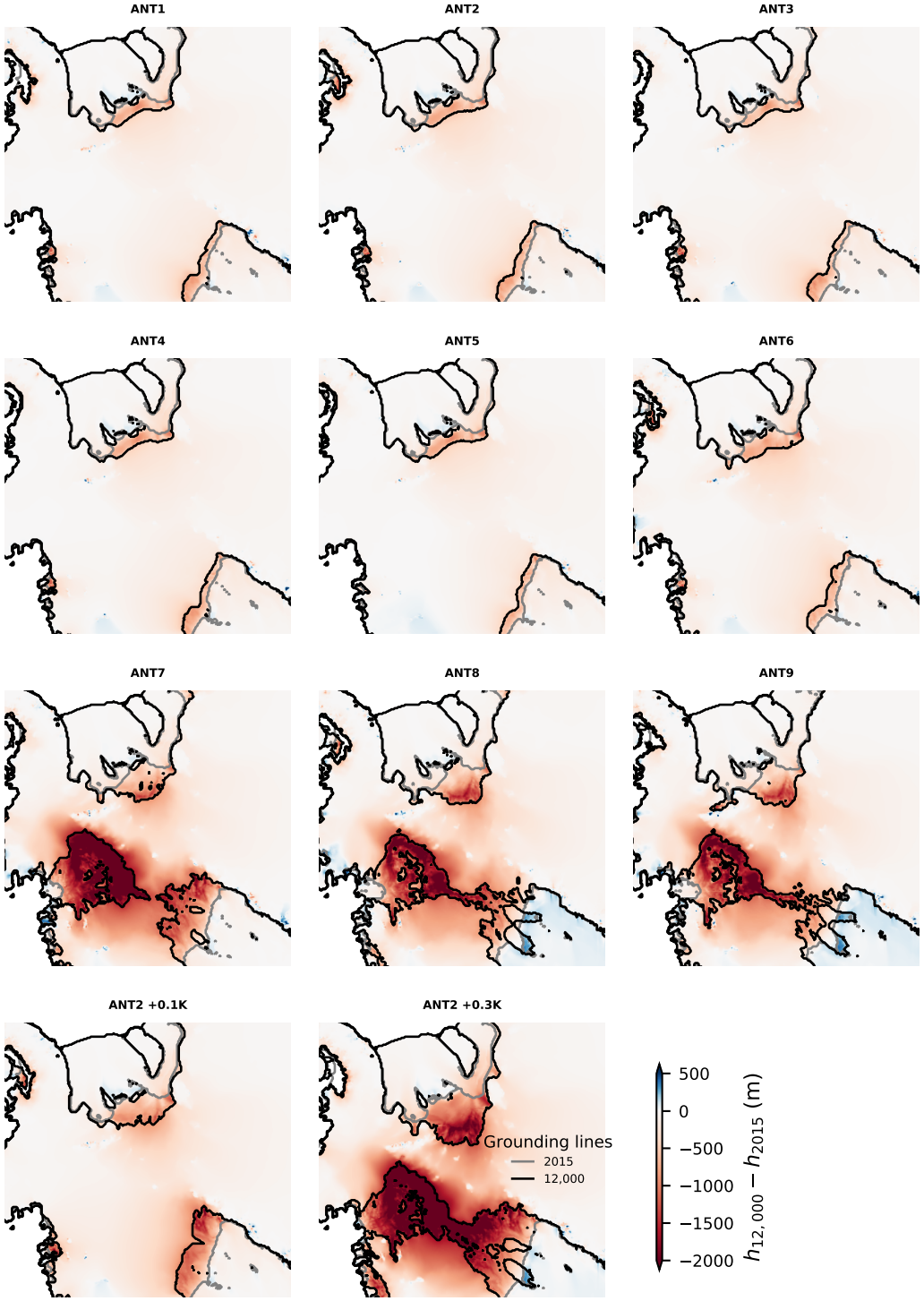

Figure S3. Grounding lines and ice thickness changes between year 2015 and after 10,000 of constant present-day climate conditions for all ensemble members in West Antarctica.

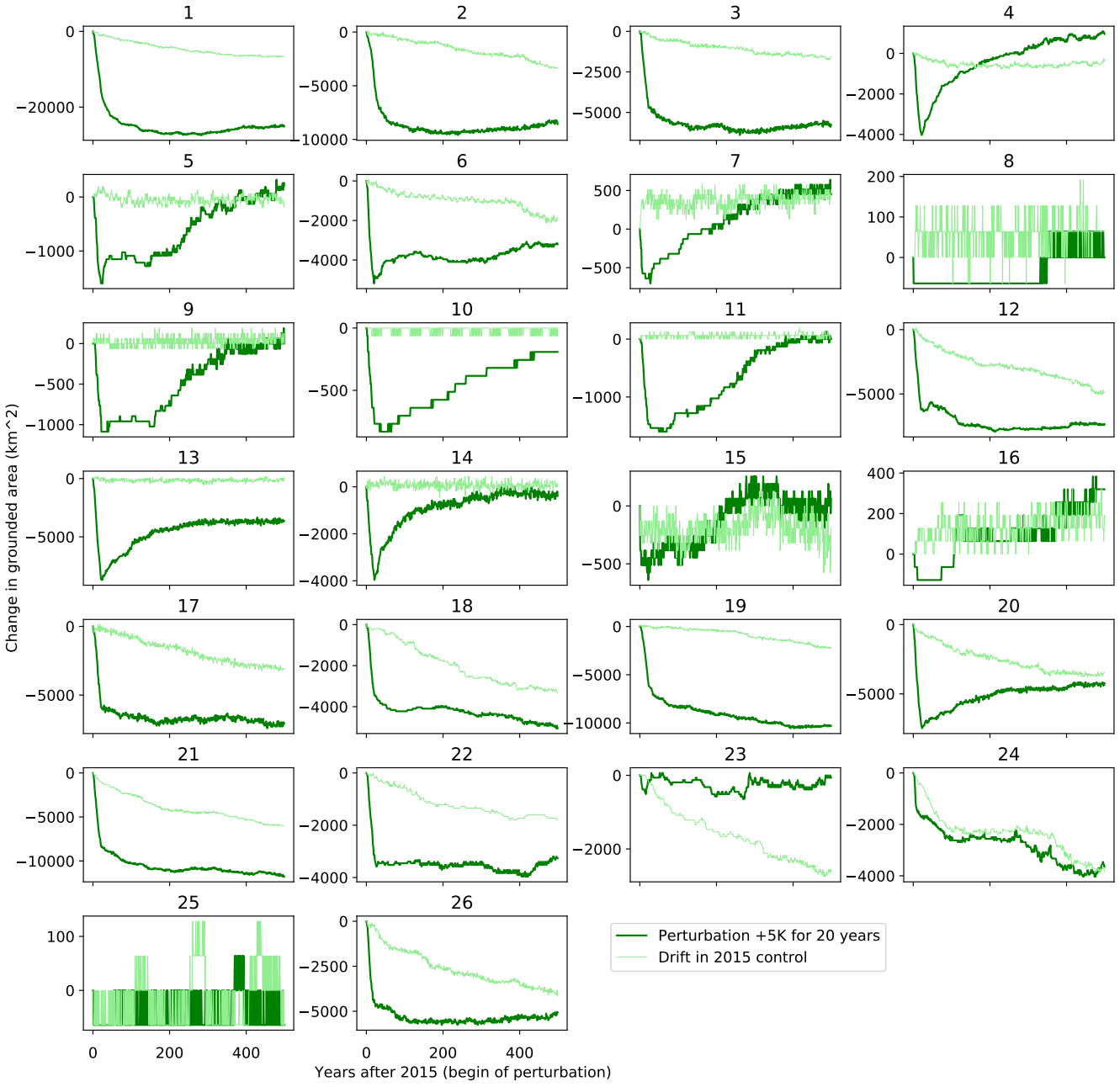

Figure S4. Evolution of grounded area split up into the basins used in Urruty et al. (subm.). We here compare a 5K perturbation for 20 years of the ANT7 state with the drift in a control simulation with constant conditions for 2015. No basin shows an indication of self-enhancing retreat. See the companion paper for more details on the experiments and interpretation.

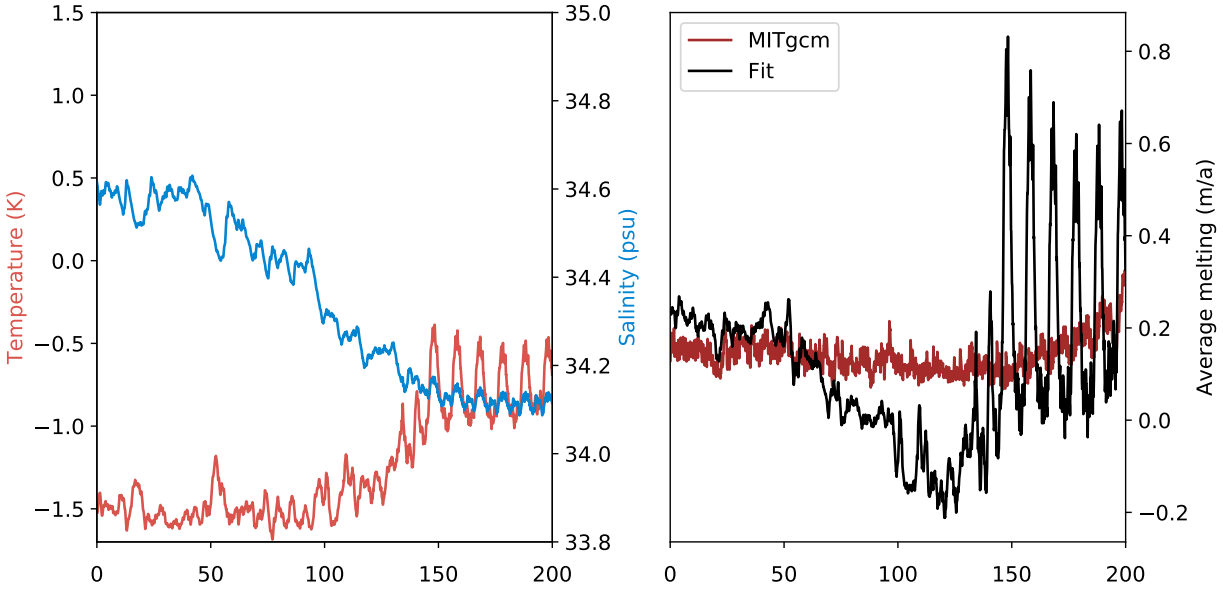

Figure S5. Testing the Filchner-Ronne Ice Shelf melt relationship. Left panel: evolution of average ocean temperature and salinity at the depth of the continental shelf in front of the ice shelf in the ocean simulations of the Weddell Sea in Naughten et al. (2021) for the 1 percent CO2 increase scenario. Right panel: modelled and predicted melt rates using the fitted function from Appendix A1.