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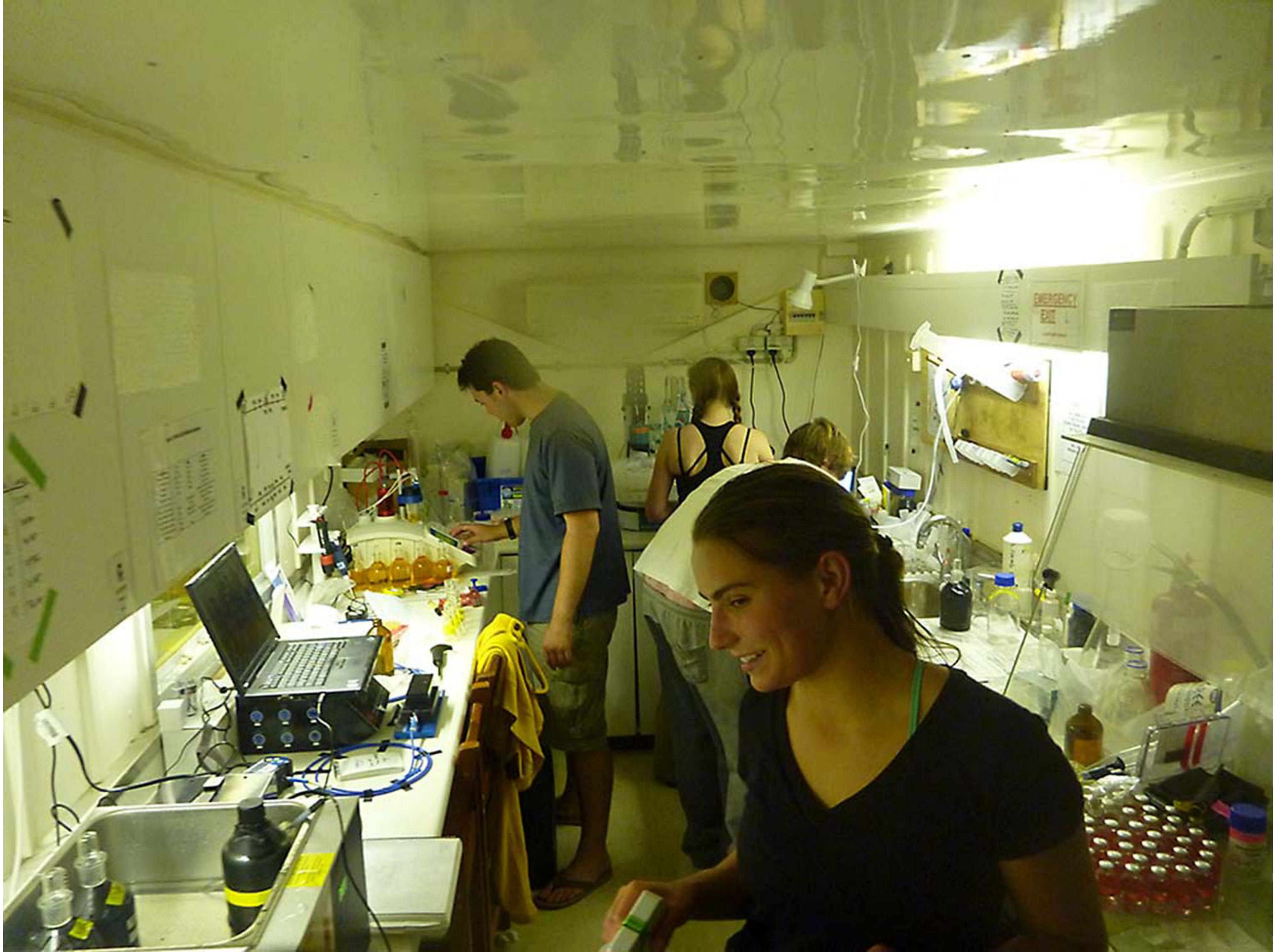
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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
2143	2014-09-27 00:17:20 UTC+10	Cond pH Alk	B26	20140926			2249.739	35.39347	24.632	1.02374	6.3671	2303.137	8.2413	53.5945	59
2144	2014-09-27 00:07:28 UTC+10	Cond pH Alk	B40	20140926			2215.965	35.30896	24.6384	1.02367	6.27111	2268.417	8.2344	53.4808	58
2145	2014-09-26 23:57:34 UTC+10	Cond pH Alk	B40	20140926			2211.864	35.17078	24.6603	1.02356	6.25884	2263.976	8.2371	53.2948	57
2146	2014-09-26 23:47:40 UTC+10	Cond pH Alk	B40	20140926			2218.651	35.10951	24.7083	1.0235	6.27768	2270.792	8.2402	53.2123	56
2147	2014-09-26 23:37:40 UTC+10	Cond pH Alk	B43	20140926			2223.137	35.02786	24.7324	1.02343	6.28995	2275.232	8.2428	53.1023	55
2148	2014-09-26 23:27:45 UTC+10	Cond pH Alk	B43	20140926			2211.881	34.86819	24.7518	1.02331	6.25734	2263.435	8.2395	52.8871	54
2149	2014-09-26 23:17:47 UTC+10	Cond pH Alk	B43	20140926			2221.586	34.48584	24.7984	1.02301	6.28296	2272.701	8.2435	52.3711	53
2150	2014-09-26 23:07:44 UTC+10	Cond pH Alk	B23	20140926			2244.279	34.79827	24.9092	1.02321	6.3484	2296.374	8.2427	52.7928	52
2151	2014-09-26 22:52:40 UTC+10	Cond pH Alk	Dickson CRM Batch 138	20140926	TA: 2221.75		2229.343	33.16864	24.9824	1.02197	6.2985	2278.322	8.0263	50.5865	36
2152	2014-09-26 22:42:44 UTC+10	Cond pH Alk	Dickson CRM Batch 138	20140926	TA: 2221.75		2222.125	33.12979	24.9398	1.02195	6.278	2270.906	8.0136	50.5337	35
2153	2014-09-26 22:32:53 UTC+10	Cond pH Alk	Dickson CRM Batch 138	20140926	TA: 2221.75		2221.358	33.26277	25.0445	1.02202	6.27627	2270.281	8.022	50.7144	34
2154	2014-09-26 22:15:47 UTC+10	Cond pH Alk	B23	20140926			2250	35.186	25.079	1.02346	6.32191	2302.778	8.234	53.3153	51
2155	2014-09-26 22:05:40 UTC+10	Cond pH Alk	B23	20140926			2245.565	35.1756	25.051	1.02346	6.30945	2298.239	8.2298	53.3013	50
2156	2014-09-26 21:55:35 UTC+10	Cond pH Alk	B49	20140926			2205.331	35.16461	24.9956	1.02346	6.19644	2257.076	8.2536	53.2865	49
2157	2014-09-26 21:45:28 UTC+10	Cond pH Alk	B49	20140926			2214.003	35.13877	24.9347	1.02346	6.22079	2265.946	8.2567	53.2517	48
2158	2014-09-26 21:35:22 UTC+10	Cond pH Alk	B49	20140926			2206.824	35.01502	24.8229	1.0234	6.20024	2258.461	8.2637	53.085	47
2159	2014-09-26 21:25:15 UTC+10	Cond pH Alk	B17	20140926			2249.87	34.83215	24.725	1.02329	6.3205	2302.266	8.2325	52.8385	46
2160	2014-09-26 21:15:05 UTC+10	Cond pH Alk	B17	20140926			2253.099	34.08568	24.717	1.02273	6.32612	2304.313	8.2324	51.8301	45
2161	2014-09-26 21:04:55 UTC+10	Cond pH Alk	B17	20140926			2246.406	34.81562	24.7762	1.02326	6.31061	2298.662	8.2339	52.8162	44
2162	2014-09-26 20:54:57 UTC+10	Cond pH Alk	F49 T1	20140926			2249.408	34.71613	24.8551	1.02317	6.31845	2301.517	8.2198	52.682	43
2163	2014-09-26 20:44:54 UTC+10	Cond pH Alk	F49 T1	20140926			2255.773	34.61684	24.9746	1.02306	6.33566	2307.788	8.2181	52.548	42
2164	2014-09-26 20:34:54 UTC+10	Cond pH Alk	F49 T1	20140926			2254.834	34.547	25.0716	1.02298	6.33254	2306.649	8.2225	52.4537	41
2165	2014-09-26 20:24:57 UTC+10	Cond pH Alk	F33 T1	20140926			2261.435	34.3868	25.1615	1.02284	6.35017	2313.075	8.1855	52.2373	40
2166	2014-09-26 20:14:59 UTC+10	Cond pH Alk	F33 T1	20140926			2264.514	34.10866	25.2921	1.02259	6.3573	2315.671	8.1914	51.8612	39
2167	2014-09-26 20:05:03 UTC+10	Cond pH Alk	F33 T1	20140926			2259.036	34.43098	25.3756	1.02281	6.34328	2310.564	8.1925	52.297	38
2168	2014-09-26 19:55:05 UTC+10	Cond pH Alk	F17 T1	20140926			2273.754	34.15064	25.4275	1.02259	6.38321	2325.108	8.1795	51.918	37
2169	2014-09-26 19:45:13 UTC+10	Cond pH Alk	F17 T1	20140926			2268.613	33.70846	25.4985	1.02224	6.3666	2319.056	8.1797	51.3192	36
2170	2014-09-26 19:35:24 UTC+10	Cond pH Alk	F17 T1	20140926			2269.147	33.45691	25.7645	1.02197	6.36647	2319.011	8.1796	50.978	35
2171	2014-09-26 19:25:36 UTC+10	Cond pH Alk	DK13	20140926	335		2257.505	32.66086	25.9582	1.02133	6.32979	2305.651	8.0122	49.8956	34
2172	2014-09-26 19:15:50 UTC+10	Cond pH Alk	DK13	20140926	335		2251.283	32.56383	26.0122	1.02124	6.31181	2299.1	8.0089	49.7634	33

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Meas. Date	Meas. Time [start, end]	Sample Date	Index [0 = sample, 1 = std 1, 2 = std 2, etc]	Bottle number	Cuvette	Raw Fluorescence (ppb)	Fluorescence scale (Med, High)	Temp (C)	Actual [if standard] (ppb)	Cuvette mass [if dilution] (g)	Sample + Cuvette mass [if dilution] (g)	Sample + Cuvette + Dilution fluid mass [if dilution] (g)	Target dilution	Temperatu correcte fluorescer
2	20141005	1428	20141005	1	0	A	0.641	low	25.53	0					0.650
3	20141005		20141005	1	0.5	F	1.03	med	25.27	0.562083					1.037
4	20141005		20141005	1	1	A	1.32	med	25.17	1.026409					1.326
5	20141005		20141005	1	2	F	1.96	med	25.1	2.01665					1.965
6	20141005		20141005	1	4	A	3.28	med	25.29	4.067094					3.305
7	20141005		20141005	1	16	F	11.4	high	25.45	16.630963					11.534
8	20141005		20141005	1	32	A	20.8	high	25.66	31.819597					21.160
9	20141005		20141005	1	64	F	39.4	high	25.66	63.317684					40.082
10	20141005	1428	20141005	0	F17 T1	A	0.665	low	25.47						0.673
11	20141005		20141005	0	F49 T1	F	1.06	med	25.66						1.078
12	20141005		20141005	0	F29 T1	A	0.879	med	25.34						0.887
13	20141005		20141005	0	F37 T1	F	3.53	med	25.4						3.567
14	20141005		20141005	0	F31.5 T1	A	25.1	high	25.48						25.415
15	20141005		20141005	0	F34.5 T1	F	27.4	high	25.4						27.686
16	20141005		20141005	0	F32.5 T1	A	37.7	high	25.42						38.114
17	20141005		20141005	0	F33.5 T1	F	35.2	high	25.35						35.522
18	20141005		20141005	0	F33 T1	A	35.9	high	25.86						36.712
19	20141005	1457	20141005	2	0	F	0.651	low	25.39	0					0.658
20	20141005		20141005	2	0.5	A	0.986	med	25.49	0.562083					0.999
21	20141005		20141005	2	1	F	1.34	med	25.31	1.026409					1.351
22	20141005		20141005	2	2	A	1.93	med	25.65	2.01665					1.963
23	20141005		20141005	2	4	F	3.28	med	25.54	4.067094					3.326
24	20141005		20141005	2	16	A	11.3	high	25.53	16.630963					11.457
25	20141005		20141005	2	32	F	20.8	high	25.38	31.819597					21.007
26	20141005		20141005	2	64	A	39.6	high	25.68	63.317684					40.306

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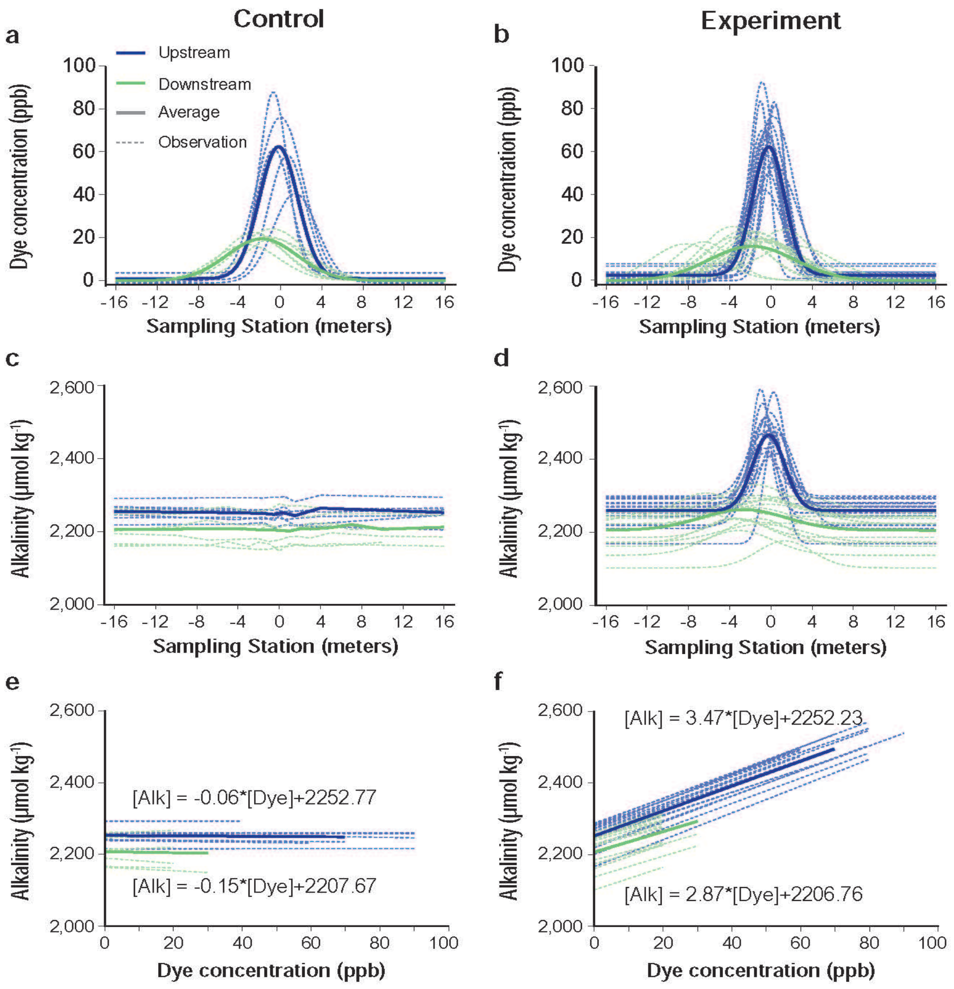


Fraction of added alkalinity taken up by reef, f_{uptake}:

$$f_{uptake} = 1 - \frac{r_{down}}{r_{up}}$$

where r_{up} & r_{down} are alkalinity-dye ratios at upstream and downstream transects

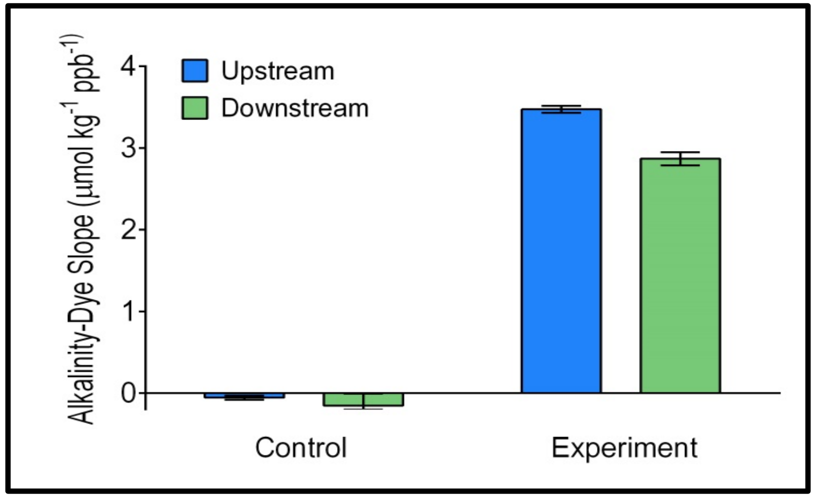
Albright et al. (*Nature*, under embargo)

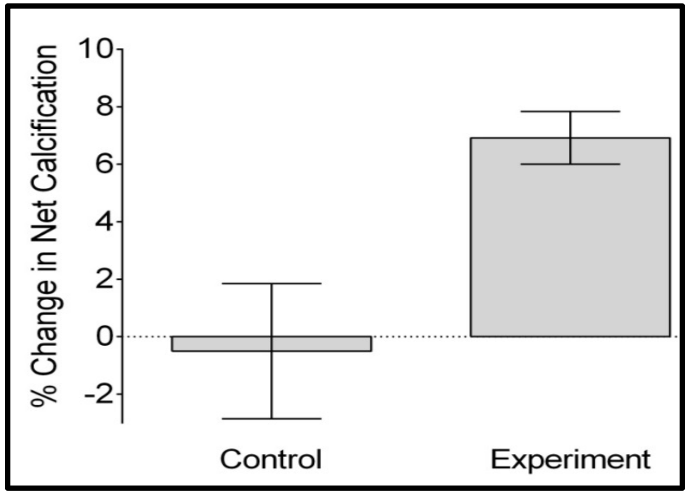
LETTER

doi:10.1038/nature17155

Reversal of ocean acidification enhances net coral reef calcification

Rebecca Albright[1], Lilian Caldeira[1], Jessica Hosfelt[2], Lester Kwiatkowski[1], Jana K. Maclaren[1,3], Benjamin M. Mason[4], Yana Nebuchina[1], Aaron Ninokawa[2], Julia Pongratz[1,5], Katharine L. Ricke[1,6], Tanya Rivlin[7,8], Kenneth Schneider[1,9], Marine Sesboüé[1], Kathryn Shamberger[10,11], Jacob Silverman[12], Kennedy Wolfe[13], Kai Zhu[1,14,15] & Ken Caldeira[1]





An average of 17.3% ± 2.3% of the added alkalinity was taken up by the reef.

Net community calcification was increased by an average of 6.9% ± 0.9%.

NATURE | NEWS

Landmark experiment confirms ocean acidification's toll on Great Barrier Reef

Rising carbon dioxide emissions have significantly reduced coral-reef growth rate.

Jeff Tollefson

24 February 2016

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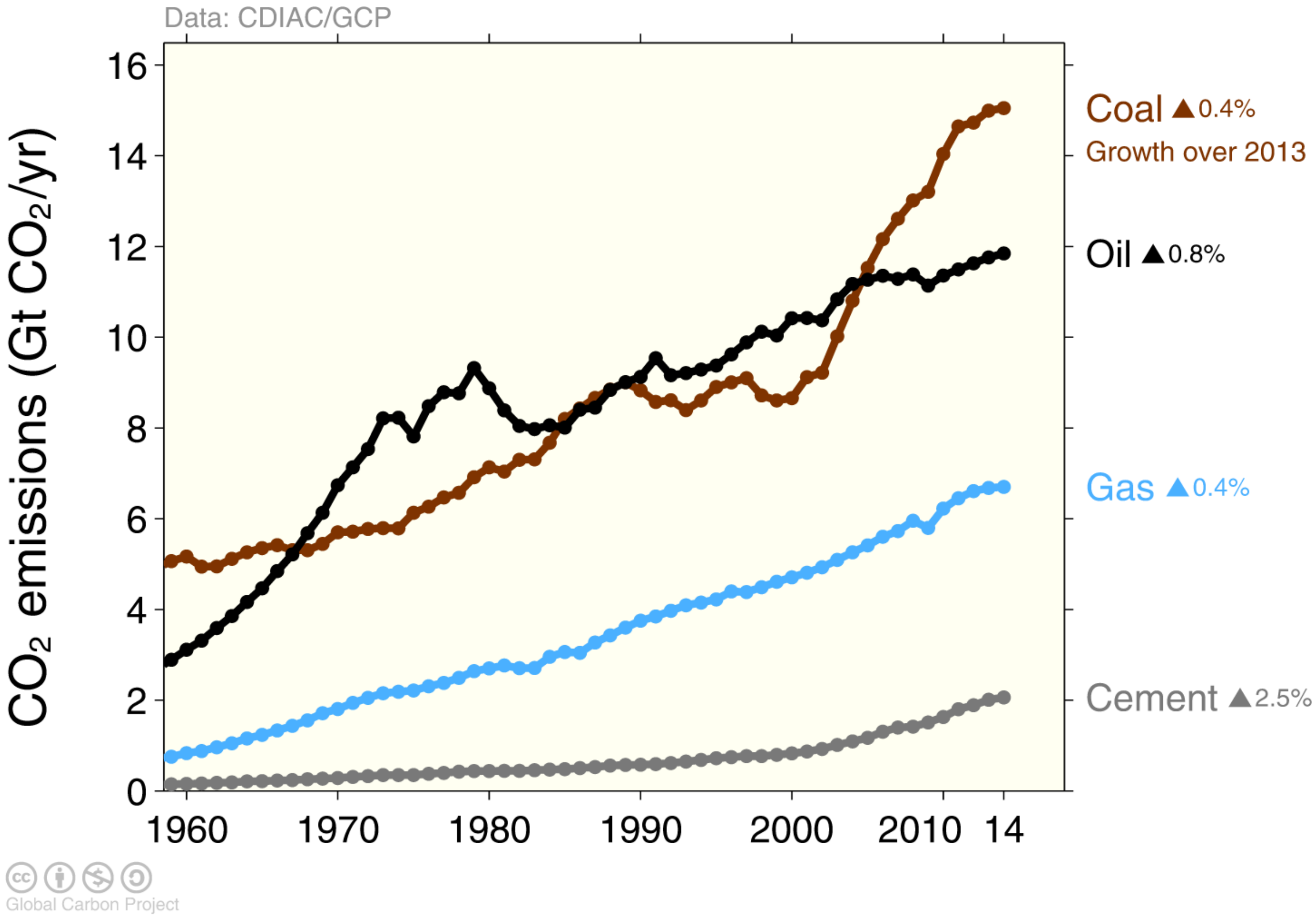
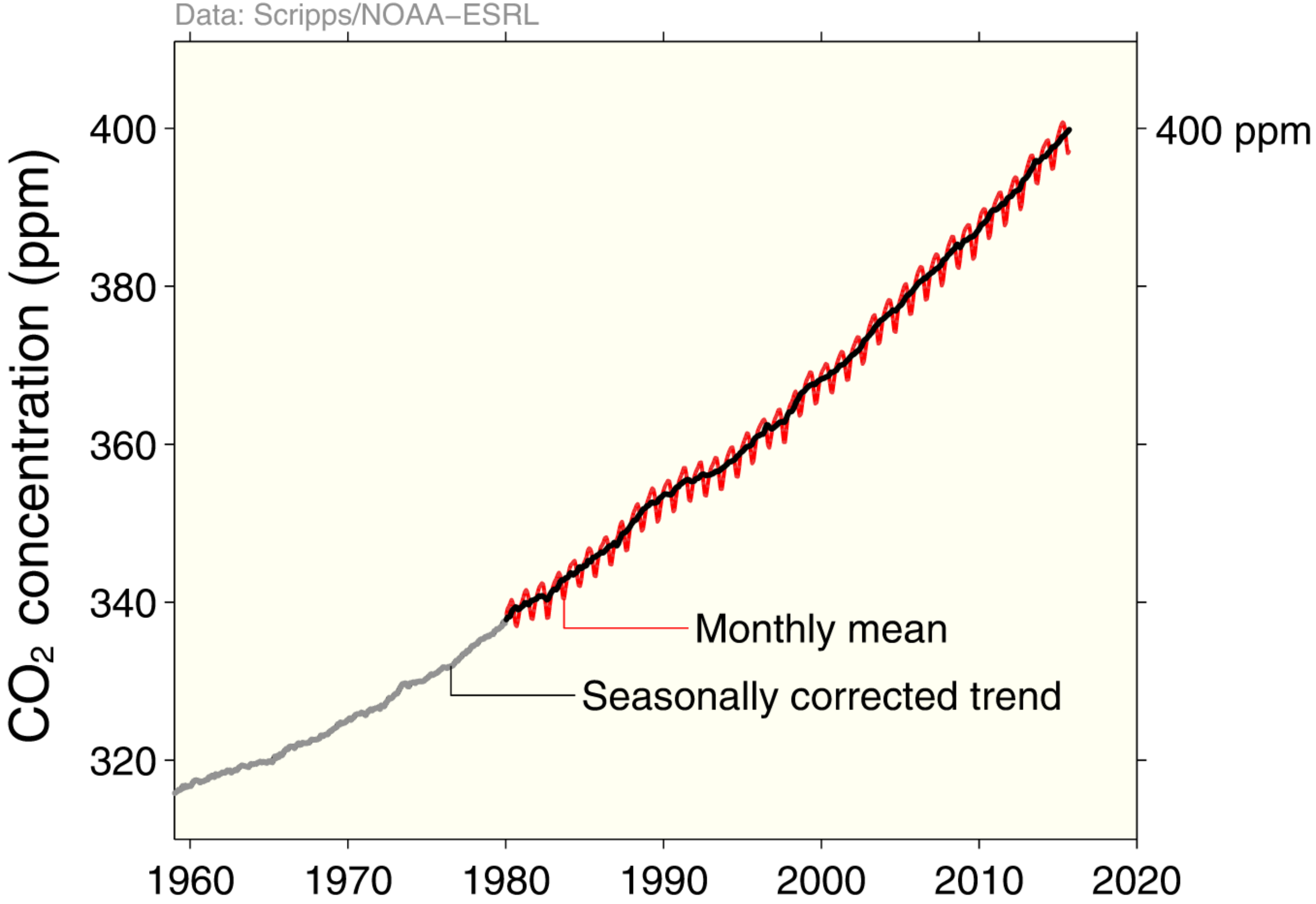
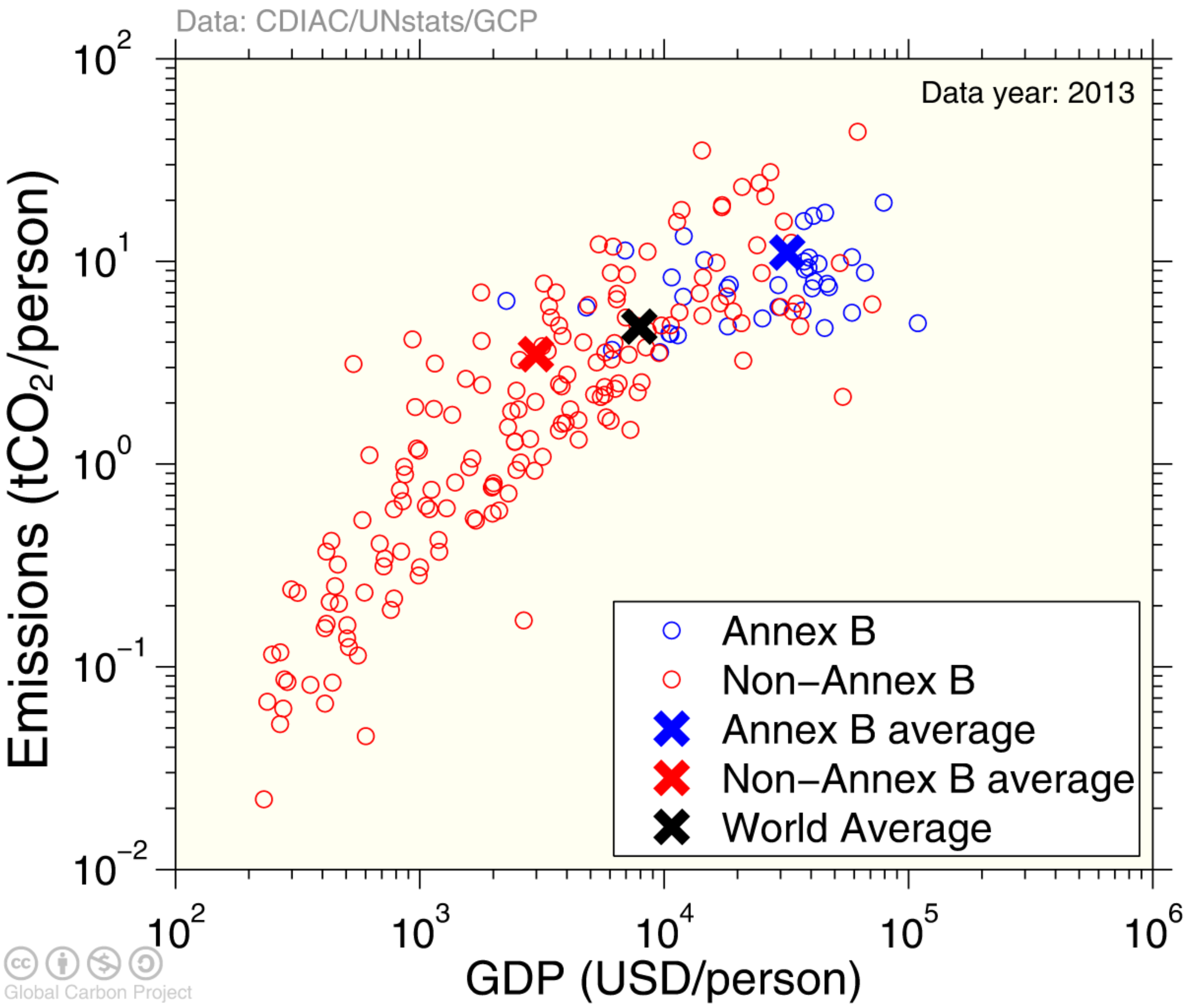
Capricornia Cays National Park
One Tree Island



Source: CDIAC; Le Quéré et al 2015; Global Carbon Budget 2015



Globally averaged surface atmospheric CO_2 concentration. Data from: NOAA-ESRL after 1980; the Scripps Institution of Oceanography before 1980 (harmonised to recent data by adding 0.542ppm)
Source: NOAA-ESRL; Scripps Institution of Oceanography; Global Carbon Budget 2015



GDP is measured here in Market Exchange Rates

Source: United Nations; CDIAC; Le Quéré et al 2015; Global Carbon Budget 2015

RESEARCH ARTICLE

CLIMATE CHANGE

Combustion of available fossil fuel resources sufficient to eliminate the Antarctic Ice Sheet

10.1126/sciadv.1500589

Ricarda Winkelmann,[1,2,3]* Anders Levermann,[1,2] Andy Ridgwell,[4,5] Ken Caldeira[3]

The Antarctic Ice Sheet stores water equivalent to 58 m in global sea-level rise. We show in simulations using the Parallel Ice Sheet Model that burning the currently attainable fossil fuel resources is sufficient to eliminate the ice sheet. With cumulative fossil fuel emissions of 10,000 gigatonnes of carbon (GtC), Antarctica is projected to become almost ice-free with an average contribution to sea-level rise exceeding 3 m per century during the first millennium. Consistent with recent observations and simulations, the West Antarctic Ice Sheet becomes unstable with 600 to 800 GtC of additional carbon emissions. Beyond this additional carbon release, the destabilization of ice basins in both West and East Antarctica results in a threshold increase in global sea level. Unabated carbon emissions thus threaten the Antarctic Ice Sheet in its entirety with associated sea-level rise that far exceeds that of all other possible sources.

How the Antarctic Ice Sheet evolves in response to future emissions of greenhouse gases is of primary importance for coastal populations (*1*) and ecosystems (*2*). Although Antarctica has already begun to lose ice (*3*), the consequences of combustion of the remaining fossil-fuel resources (*4*) to the ice sheet's future mass balance are still unknown. Antarctica's contribution to future sea level is determined by changes in its surface mass balance and dynamic discharge (*5*). Atmospheric and oceanic warming can lead to enhanced ice loss from the Antarctic Ice Sheet or even its disintegration, potentially sped up by positive feedback mechanisms such as the marine ice sheet instability (*6*, *7*) and the surface elevation feedback (*8*, *9*). Enhanced snowfall over Antarctica, on the other hand, might offset or exceed this ice loss (*10*). The interaction of these processes is still insufficiently understood so that the evolution of the Antarctic Ice Sheet remains unclear, particularly for the long term.

We examine the ice-sheet evolution over the next ten thousand years

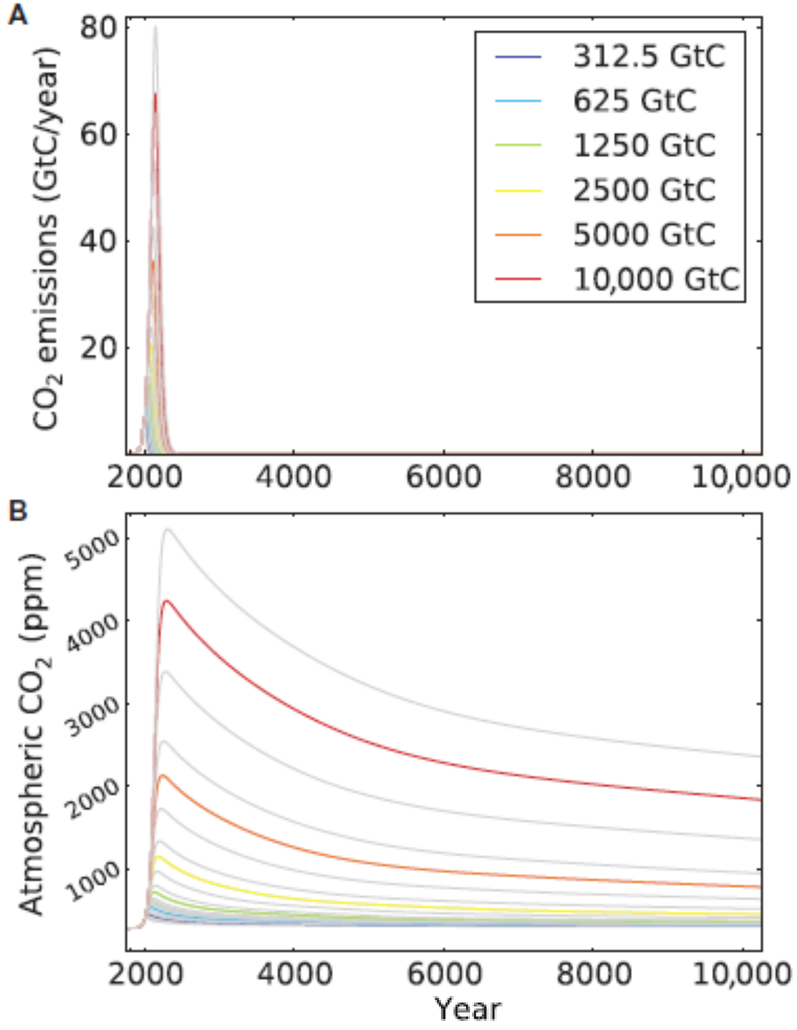
years under the higher emissions scenarios (Fig. 1B). We find that this long lifetime of perturbations to atmospheric CO_2 concentrations in conjunction with the logarithmic nature of the warming versus CO_2 relationship means that global mean temperatures decline by less than 5% per thousand years once more than about 5000 GtC have been emitted. Instead, temperatures remain close to the maximum level corresponding to the total amount of carbon released (*18–20*) (Fig. 1C).

The long-term global warming scenarios generated by the Earth system model are downscaled to surface and ocean temperature anomalies for Antarctica, using ratios that were derived from long-term simulations with ECHAM5/MPIOM (*21*) (fig. S1). These regional warming scenarios are then used to force PISM and result in long-term sea-level rise as depicted in Fig. 1D.

Over the next century, the projected sea-level contribution is consistently within the range of −6 to 14 cm given for century-scale IPCC-AR5 (Intergovernmental Panel on Climate Change Fifth Assess-

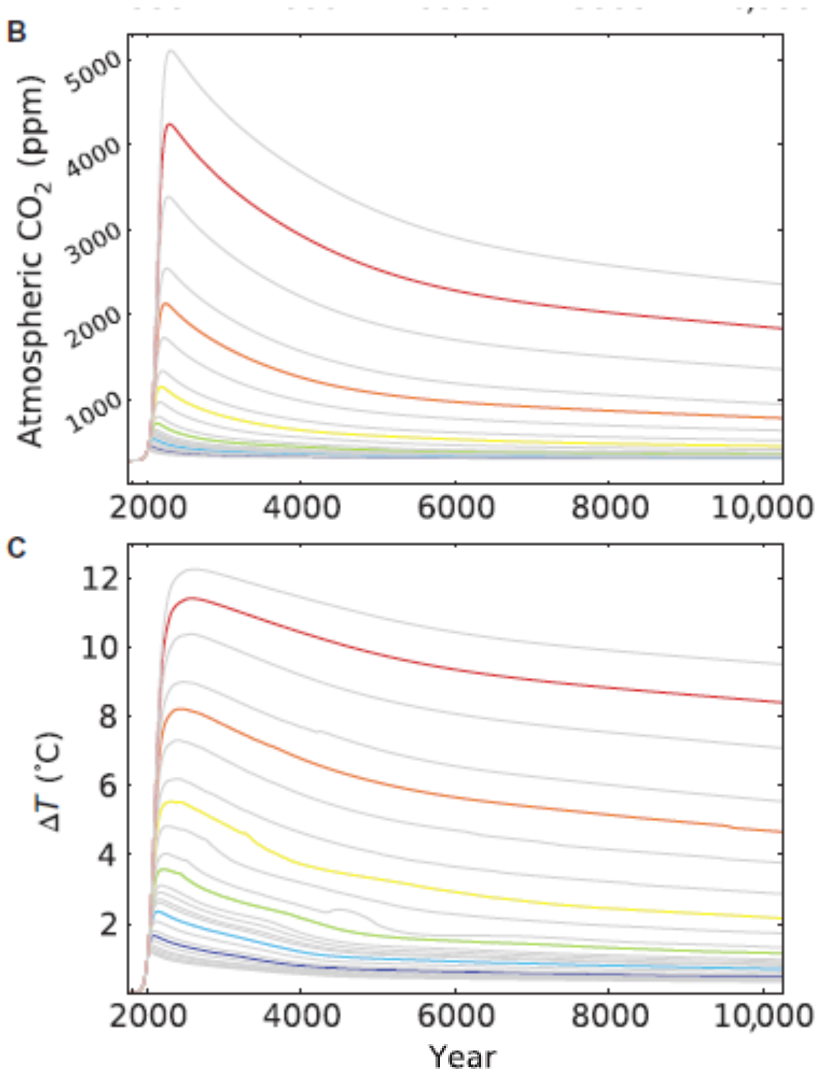
Global CO_2 emissions

Atmospheric CO_2



Atmospheric CO_2

Global mean temperature



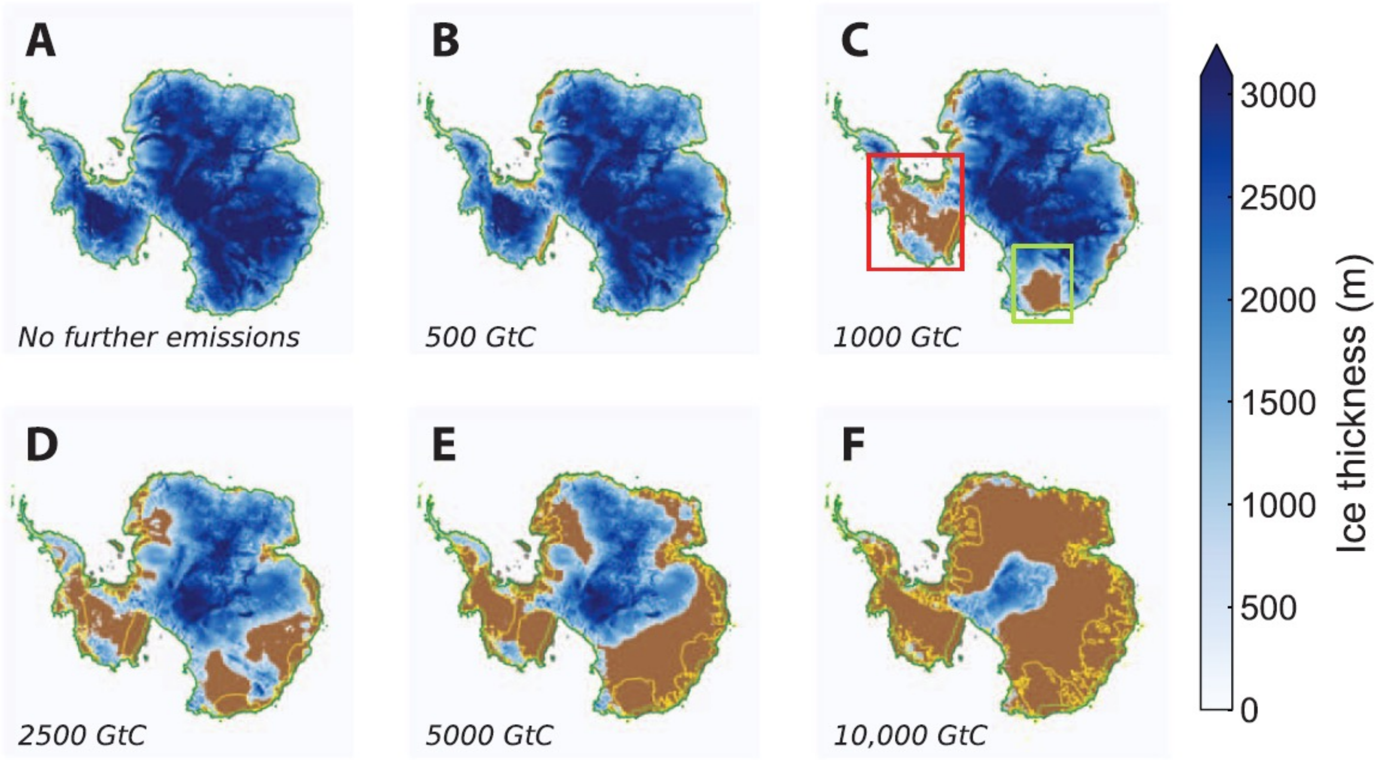
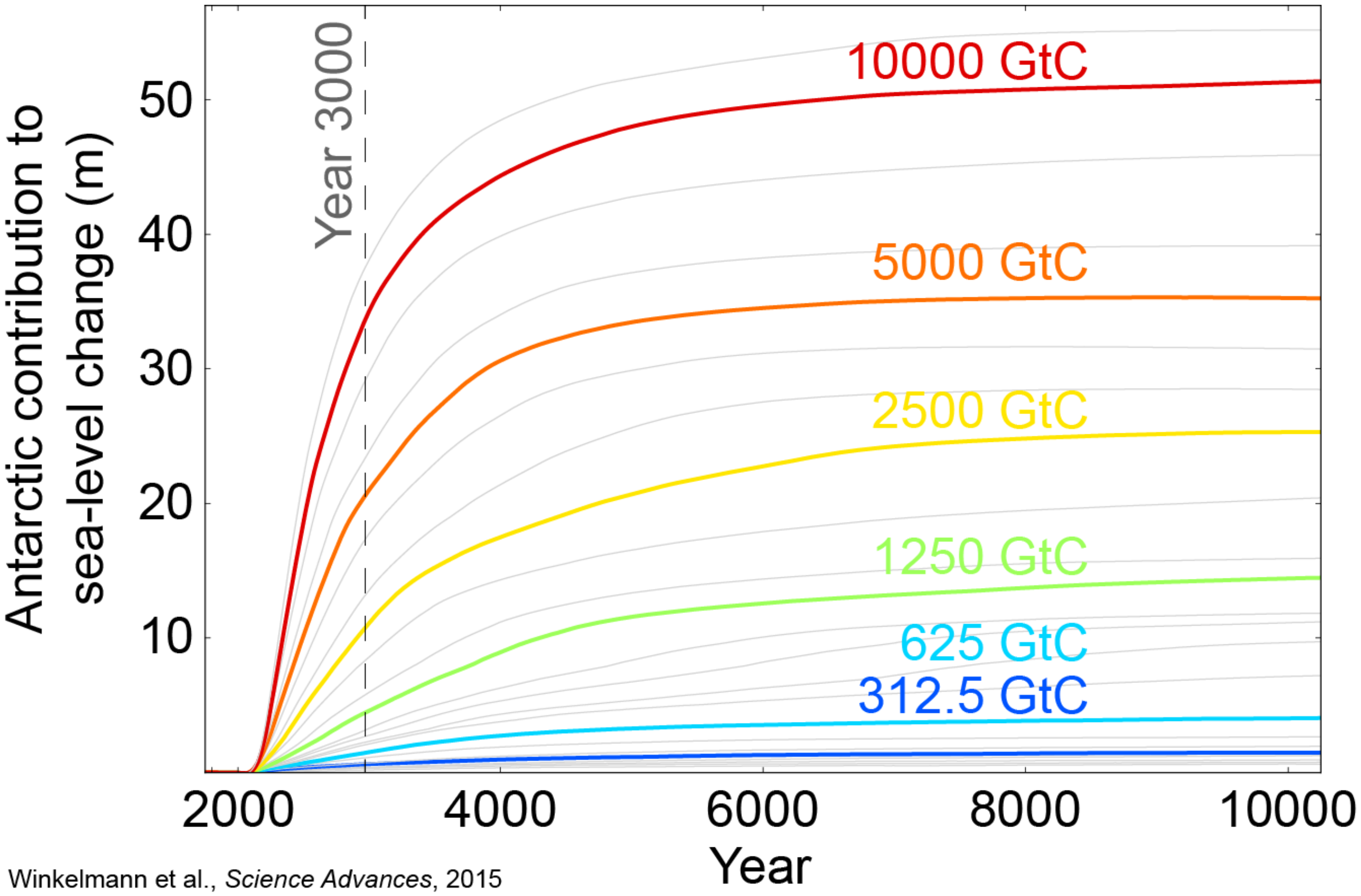
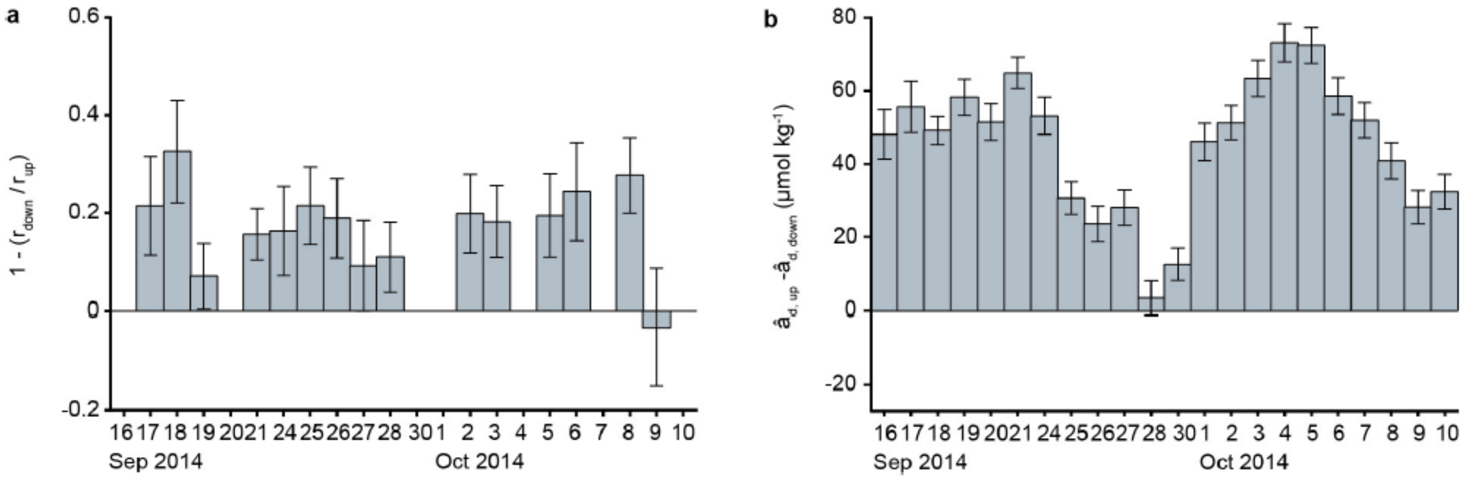


Fig. 4. States of the Antarctic Ice Sheet after 10,000 years. (**A** to **F**)



Winkelmann et al., *Science Advances*, 2015

Alkalinity Addition Increases Net Reef Calcification



Extended Data Figure 7 | Results of the multivariate regression were used to calculate the additional alkalinity uptake (that is, $G_{increase}$) and background alkalinity uptake (that is, $G_{background}$) by day. a, Fraction of added alkalinity taken up by the reef by day, given by $(1 - (r_{down}/r_{up})$, equation (1) of main text). **b,** Background reef uptake by day, given by $(\hat{a}_{d,\,up} - \hat{a}_{d,\,down})$. Error bars represent standard errors. See Supplementary Information.