Supplement

This supplement contains a detailed list of LGM d18O values used in the manuscript. All data has been published in the given publications.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
DGKS9603	28.15	127.27	1100	–0.78 (~18–21ka)	Li et al. (2001)
EN32-PC6	26.95	-91.35	2280	0.13 (~18–21ka)	Leventer et al. (1982)
G5-6-149P	-9.35	127.82	1500	–1.1 (~18ka)	Ganssen et al. (1989)
K12	2.69	127.74	3500	–0.4 (~18ka)	Barmawidjaja et al. (1993)
M12-309	26.50	-15.06	2820	1.45 (~18-23ka)	Sarnthein et al. (1994)
M12-328	21.08	-18.34	2778	0.84 (~18-23ka)	Sarnthein et al. (1994)
M12-347	15.50	-17.52	2576	1.16 (~18-23ka)	Sarnthein et al. (1994)
M12-379	23.08	-17.44	2136	1.25 (~18-23ka)	Sarnthein et al. (1994)
M13-289	18.04	-18.01	2490	0.99 (~18-23ka)	Sarnthein et al. (1994)
M15-637	27.00	-18.59	3849	1.51 (~18-23ka)	Sarnthein et al. (1994)
M15-672	34.51	-8.07	2455	1.85 (~18-23ka)	Sarnthein et al. (1994)
M16-004	29.58	-10.38	1512	1.81 (~18-23ka)	Sarnthein et al. (1994)
M16-006	29.14	-11.29	796	1.84 (~18-23ka)	Sarnthein et al. (1994)
M16-030	21.14	-18.03	1500	0.49 (~18-23ka)	Sarnthein et al. (1994)
MD98-2162	-4.69	117.90	1855	-1.54 (~18-21ka)	Visser et al. (2003)
ODP124-769A	8.79	121.29	3656	-1.81 (~18-21ka)	Linsley and Thunell (1990)
ODP 806B	0.32	159.38	2520	-1.26 (~18-21ka)	Medina-Elizalde and Lea (2005)
ODP 819A	-16.62	146.32	600	-0.24 (~18ka)	Alexander et al. (1993)
ODP 820A	-16.64	146.30	400	-0.98	Peerdeman et al. (1993)

				(~18ka)	
ODP 821A	-16.65	146.29	600	-0.59 (~18ka)	Kroon et al. (1993)
ODP 817C	-18.16	149.76	1000	-0.11 (~18ka)	Swart (1993)
ODP 818B	-18.06	150.04	1100	-0.13 (~18ka)	Haddad et al. (1993)
PC17	21.36	-158.19	503	-0.61 (~20-22ka)	Lee et al. (2001)
PC20	21.34	-158.17	640	-0.64 (~20-22ka)	Lee et al. (2001)
RC8-102	-1.42	-86.85	2180	-0.45 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
RC11-238	-1.52	-85.82	2573	-0.29 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
RC12-357	8.97	120.23	2000	-1.5 (~18ka)	Linsley et al. (1985)
RC13-140	2.87	-87.75	2246	-0.96 (~18-24ka)	Koutavas and Lynch-Stigliz (2003)
RC14-78	8.43	118.43	1600	-1.8 (~18ka)	Linsley et al. (1985)
SHI-9014	5.78	126.97	3200	-1.05 (~18ka)	Ahmad et al. (1995)
SO49-KL82	8.16	121.64	4900	-0.9 (~18ka)	Kudrass et al. (1991)
SO58-KL69	8.83	121.60	4700	-0.9 (~18ka)	Kudrass et al. (1991)
TR163-19	2.26	-90.95	2348	-0.54 (~18-21ka)	Lea et al. (2000)
V19-27	-0.47	-82.00	1373	-0.67 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V19-28	-2.37	-84.65	2720	-0.27 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V21-40	-5.52	-106.77	3182	-0.48 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V24-135	7.35	120.35	4300	-1.5 (~18ka)	Linsley et al. (1985)
V28-322	7.97	120.18	4100	-1.4 (~18ka)	Linsley et al. (1985)

Table S1a The oxygen isotope ratios in *G.ruber* obtained from the published data. The definitions of LGM used in these published papers are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
GeoB1008-3	-6.58	10.32	3124	-0.23 (~18-21ka)	Schneider et al. (1995)
GeoB1016-3	-11.77	11.68	3411	-0.31 (~18-21ka)	Schneider et al. (1995)
GeoB1028-5	-20.10	9.19	2209	1.27 (~18-21ka)	Schneider et al. (1995)
GeoB1031-4	-21.88	7.10	3105	0.82 (~19-22ka)	Wefer et al. (1996)
GeoB1032-3	-22.92	6.04	2505	0.89 (~18-21ka)	Wefer et al. (1996)
GeoB1105-4	-1.67	-12.43	3225	-0.06 (~18-21ka)	Hale and Pflaumann (1999)
GeoB1112-4	-5.78	-10.75	3125	-0.34 (~18-21ka)	Wefer et al. (1996)
GeoB1220-1	-24.03	5.31	2265	0.62 (~19-23ka)	Wefer et al. (1996) (pangaea)
GeoB1417-1	-15.54	-12.71	2845	0.13 (~19-23ka)	Meinecke (1992)
GeoB1701-4	1.95	3.55	4162	-0.07 (~19-23ka)	Hale and Pflaumann (1999)
GeoB3104-1	-3.67	-37.72	767	-0.27 (~18-21ka)	Arz et al. (1998)
GeoB3117-1	-4.30	-37.09	800	-0.31 (~18-21ka)	Arz et al. (1999)
GeoB3176-1	-7.01	-34.44	1385	-0.12 (~18-21ka)	Arz et al. (1999)
GIK12328-5	21.15	-18.57	2798	1.00 (~18-21ka)	Sarnthein et al. (1994)
GIK16017-2	21.25	-17.80	812	0.15 (~18-21ka)	Sarnthein et al. (1994)
GIK16415-1	9.57	-19.11	3841	0.52 (~18-21ka)	Sarnthein et al. (1994)
GIK16867-2	-2.20	5.10	3891	-0.3 (~18-21ka)	Sarnthein et al. (1994)
GIK17939-2	19.97	117.46	2474	-1.26 (~18-21ka)	Wang et al. (1999)
GIK17940-2	20.12	117.38	1727	-1.28 (~18-21ka)	Wang et al. (1999)
M35003-4	12.09	-61.24	1299	-0.38 (~18-21ka)	Rühlemann et al. (1999)
MD76-125	8.35	75.20	1877	-1.13	Sirocko (1989)

				(~18-21ka)	
MD76-131	15.32	72.34	1230	-0.24 (1.9m)	Duplessy (1982) (LGM depth is defined in Mix et al. 1999)
MD76-135	14.27	50.31	1895	-0.24 (~18-21ka)	Sirocko (1989)
MD77-169	10.13	95.03	2360	-1.03 (1.5m)	Duplessy (1982) (LGM depth is defined in Mix et al. 1999)
MD77-171	11.46	94.09	1760	-0.96 (2.6m)	Duplessy (1982) (LGM depth is defined in Mix et al. 1999)
MD77-194	10.28	75.14	1222	-0.60 (3.1m)	Sirocko (1989) (LGM depth is defined in Mix et al. 1999)
MD77-202	19.13	60.41	2427	-0.09 (2.0m ~19ka)	Sirocko (1989)
MD77-203	20.42	59.34	2442	0.05 (~18-21ka)	Sirocko (1989)
MD90-963	5.04	73.53	2446	-0.83 (~18-21ka)	Bassinot (1994)

Table S1b The oxygen isotope ratios in *G.ruber* averaged from raw data in the Pangaea data pool. The average time period (in Ka), depth intervals (in m) or the single depth values (in m) under the relative LGM definition in the reference are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
ERDC-92	-2.23	157.00	1598	-0.41 (~18-21ka)	Palmer and Pearson (2003)
ERDC 93P	-2.24	157.08	1600	-0.78 (~18ka)	Le and Shackleton (1992)
ERDC 113P	-1.63	159.22	2200	-0.59 (~18ka)	Herguera (1994)
ERDC 128	0.00	161.43	3700	-0.73 (~18ka)	Berger and Killingley (1977)
GGC-4	12.65	117.93	3500	-1.05 (~18ka)	Thunell et al. (1992)
GGC-6	12.15	118.07	3000	-1.40 (~18ka)	Thunell et al. (1992)
GGC-9	11.63	118.63	1500	-1.80 (~18ka)	Miao et al. (1994)
GGC-10	11.72	118.51	1600	-1.63 (~18ka)	Thunell et al. (1992)
GGC-11	11.89	118.33	2100	-1.4 (~18ka)	Thunell et al. (1992)
GGC-12	11.93	118.21	2500	-0.89 (~18ka)	Thunell et al. (1992)
GGC-13	10.60	118.29	1000	-1.72 (~18ka)	Miao et al. (1994)
GGC-23	8.15	118.57	1000	-1.0 (~18ka)	Miao et al. (1994)
GGC-27	8.50	118.25	2000	-1.1 (~18ka)	Miao et al. (1994)
ODP 806B	0.32	159.36	2500	-0.85 (~18ka)	Berger et al. (1993a)
ODP 818B	-18.06	150.04	1100	-0.13 (~18ka)	Haddad et al. (1993)
ODP 828A	-15.79	166.28	3100	-0.33 (~18ka)	Martinez (1993)
RC8-102	-1.42	-86.85	2180	-0.29 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
RC10-131	-14.53	157.97	2933	-0.32 (Max value in the upper 0.5m)	Anderson et al. (1989)
RC11-238	-1.52	-85.82	2573	-0.09 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
RC12-109	-25.88	157.87	2930	0.08 (Max value	Anderson et al. (1989)

				in the upper 0.5m)	
RC12-113	-24.88	163.52	2454	0.20 (Max value in the upper 0.5m)	Anderson et al. (1989)
RC12-350	6.55	111.22	1900	-0.7 (~18ka)	Jian (1992)
RC13-140	2.87	-87.75	2246	-0.50 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
RC17-177	1.75	159.45	2600	-0.64 (~18ka)	Le and Shackleton (1992)
SCS-15A	10.42	114.23	1800	-0.40 (~18ka)	Wang et al. (1995)
SO49-8KL	19.18	114.2	1000	-0.76 (~18ka)	Wang et al. (1995)
SO50-29KL	18.33	115.98	3800	-0.07 (~18ka)	Wang et al. (1995)
V19-27	-0.47	-82.00	1373	-0.35 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V19-28	-2.37	-84.65	2720	-0.21 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V21-29	-1.00	-89.35	712	-0.49 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V21-30	-1.22	-89.68	617	-0.32 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V21-40	-5.52	-106.77	3182	-0.13 (~18-24ka)	Koutavas and Lynch-Stieglitz (2003)
V24-109	0.43	158.80	2400	-0.37 (~18ka)	Le and Shackleton (1992)
V24-157	-14.95	147.92	1212	-0.24 (Max value in the upper 0.5m)	Anderson et al. (1989)
V24-161	-18.20	151.45	1670	-0.19 (Max value in the upper 0.5m)	Anderson et al. (1989)
V24-166	-16.52	150.78	781	-0.52 (Max value in the upper 0.5m)	Anderson et al. (1989)
V24-170	-13.52	146.88	2243	-0.58 (Max value	Anderson et al. (1989)

				in the upper 0.5m)	
V24-184	-12.87	146.2	2992	-0.56 (Max value in the upper 0.5m)	Anderson et al. (1989)
V28-235	5.08	160.50	1700	-0.7 (~18ka)	Broecker (1986)
V28-238	1.00	160.48	1700	-1.3 (~18ka)	Shackleton and Opdyke (1973)
V28-239	3.25	159.30	3500	-0.88 (~18ka)	Shackleton and Opdyke (1976)
V36-3	19.02	116.1	2800	-0.37 (~18ka)	Wang et al. (1995)
WP 1	13.78	125.57	2200	-0.8 (~18ka)	Thunell et al. (1994)
WP 2	6.33	126.43	1600	-0.5 (~18ka)	Thunell et al. (1994)

Table S2a The oxygen isotope ratios in *G.sacculifer* obtained from the published data. The definitions of LGM used in these published papers are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
GeoB1041-3	-3.48	-7.60	4033	0.62 (~18-21ka)	Wolff (1998)
GeoB1105-4	-1.67	-12.43	3225	0.53 (~18-21ka)	Wolff (1998)
GeoB1112-4	-5.78	-10.75	3125	0.64 (0.58m)	Meinecke (1992)
GeoB1501-4	-3.68	-32.01	4257	0.27 (0.33-0.38m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004)
GeoB1503-1	2.31	-30.65	2306	-0.17 (0.23-0.33m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB1508-4	5.33	-34.03	3682	0.32 (0.28m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004b)
GeoB1515-1	4.24	43.67	3129	0.10 (~18-21ka)	Rühlemann et al. (1996)
GeoB1523-1	3.83	-41.62	3292	0.05 (~18-21ka)	Mulitza et al. (1998)
GeoB1701-4	1.95	3.55	4162	0.67 (0.98-1.08m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2109-1	-27.91	-45.88	2504	0.36 (0.38-0.63m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2117-1	-23.04	-36.65	4045	0.54 (0.23m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2125-1	-20.82	-39.86	1503	0.64 (0.33-0.38m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2202-4	-8.20	-34.27	1156	-0.02 (0.73-0.83m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2204-2	-8.53	-34.02	2072	0.14 (0.28-0.33m)	Dürkoop et al. (1997) (LGM depth defined in Niebler, H. S.,2004a)
GeoB2215-10	0.01	-23.50	3711	0.62 (0.43m)	Wolff (1998) (LGM depth defined in Niebler, H. S.,2004b)
GeoB3104-1	-3.67	-37.72	767	0.18 (~18-21ka)	Arz et al. (1998)

GeoB3117-1	-4.30	-37.09	800	0.32 (~18-21ka)	Arz et al. (1999)
GeoB3176-1	-7.01	-34.44	1385	0.18 (~18-21ka)	Arz et al. (1999)
GIK13521-1	3.02	-22.03	4504	0.26 (~18-21ka)	Sarnthein et al. (1994)
GIK16457-1	5.39	-21.72	3291	0.48 (~18-21ka)	Sarnthein et al. (1994)
GIK16458-1	5.34	-22.05	3518	0.59 (~18-21ka)	Sarnthein et al. (1994)
GIK16458-2	5.34	-22.06	3518	0.65 (~18-21ka)	Sarnthein et al. (1994)
GIK16772-2	-1.35	-11.96	3912	0.75 (~18-21ka)	Sarnthein et al. (1994)
ODP130-805C	1.23	160.53	3188	-1.10 (~18-21ka)	Berger et al. (1993b)
V15-168	0.20	-39.90	4219	0.30 (1.55m)	Mix (1986) (LGM depth estimated from Mix et al., 1999)
V22-38	-9.55	-34.25	3797	0.10 (0.375m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V22-177	-7.75	-14.62	3290	0.22 (0.63-0.69m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V22-182	-0.55	-17.27	3776	0.48 (0.72m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V23-110	17.63	-45.87	3746	-0.42 (0.26m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V25-56	-3.55	-35.23	3512	0.03 (0.8-0.95m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V25-59	1.37	-33.48	3824	0.22 (0.675-0.7m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V25-60	3.28	-34.83	3749	0.07 (0.41-0.475m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V25-75	8.58	-53.17	2743	0.02 (1.2m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V29-144	-0.20	6.05	2685	0.3	Mix (1986)

				(0.85m)	(LGM depth defined in Mix et al., 1999)
V30-36	5.35	-27.32	4245	0.07 (0.38-0.4m)	Mix (1986) (LGM depth defined in Mix et al., 1999)
V30-40	-0.20	-23.15	3706	0.30 (0.66m)	Mix and Ruddimann (1985) (LGM depth defined in Mix et al., 1999)
V30-49	18.43	-21.08	3093	0.48 (0.84m)	Mix (1986 (LGM depth defined in Mix et al., 1999)

Table S2b The oxygen isotope ratios in *G.sacculifer* averaged from raw data in the Pangaea data pool. The average time period (in Ka), depth intervals (in m) or the single depth values (in m) under the relative LGM definition in the reference are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
6706-2	42.16	124.94	1120	2.79 (~16–22ka)	Ortiz et al. (1997)
M12-309	26.50	-15.06	2820	1.32 (~18-23ka)	Sarnthein et al. (1994)
M12-328	21.08	-18.34	2778	1.53 (~18-23ka)	Sarnthein et al. (1994)
M12-347	15.50	-17.52	2576	1.23 (~18-23ka)	Sarnthein et al. (1994)
M12-379	23.08	-17.44	2136	1.55 (~18-23ka)	Sarnthein et al. (1994)
M13-289	18.04	-18.01	2490	1.40 (~18-23ka)	Sarnthein et al. (1994)
M15-637	27.00	-18.59	3849	1.88 (~18-23ka)	Sarnthein et al. (1994)
M15-672	34.51	-8.07	2455	2.31 (~18-23ka)	Sarnthein et al. (1994)
M16-004	29.58	-10.38	1512	1.83 (~18-23ka)	Sarnthein et al. (1994)
M16-006	29.14	-11.29	796	1.56 (~18-23ka)	Sarnthein et al. (1994)
M16-030	21.14	-18.03	1500	1.44 (~18-23ka)	Sarnthein et al. (1994)
W8709A-01BC	41.54	131.96	3680	2.19 (~16–22ka)	Ortiz et al. (1997)
W8709A-13PC	42.12	125.75	2717	2.97 (~16–22ka)	Ortiz et al. (1997)
W8809A-21GC	42.14	126.91	2799	2.70 (~16–22ka)	Ortiz et al. (1997)
W8809A-29GC	41.80	129.00	3136	2.28 (~16–22ka)	Ortiz et al. (1997)
W8809A-31GC	41.68	130.01	3136	2.67 (~16–22ka)	Ortiz et al. (1997)
W8809A-53GC	42.75	126.26	2408	3.16 (~16–22ka)	Ortiz et al. (1997)
W8809A-57GC	41.58	130.62	3330	2.52 (~16–22ka)	Ortiz et al. (1997)
W8809A-08PC	42.26	127.68	3111	2.81 (~16–22ka)	Ortiz et al. (1997)
W8909A-48GC	41.33	132.67	3670	1.82 (~16–22ka)	Ortiz et al. (1997)

Table S3a The oxygen isotope ratios in *G.bulloides* obtained from the published data. The definitions of LGM in the published papers are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{PDB}$	reference
DSDP 594	-45.52	174.95	1204	3.70 (~18-21ka)	Nelson et al. (1993)
GeoB1008-3	-6.58	10.32	3124	1.03 (~18-21ka)	Schneider et al. (1995)
GeoB1016-3	-11.77	11.68	3411	0.61 (~18-21ka)	Schneider et al. (1995)
GeoB1028-5	-20.10	9.19	2209	1.33 (~18-21ka)	Schneider et al. (1995)
GIK17045-3	52.43	-16.67	3663	2.94 (~18-21ka)	Sarnthein et al. (1994)
GIK17049-6	55.26	-26.73	3331	2.57 (~18-21ka)	Jung (1996)
GIK17050-1	55.47	-27.89	2795	2.16 (3.7m ~18.3ka)	Jung (1996)
GIK17051-3	56.16	-31.99	2295	2.77 (~18-21ka)	Jung (1996)
GIK23419-8	54.96	-19.76	1487	2.75 (0.4m ~18.3ka)	Jung (1996)
KN708-1	50.00	-23.75	4053	3.09 (1m ~18.3ka)	Ruddiman and McIntyre (1981)
ODP167-1014	32.83	-119.98	1166	2.30 (~18-21ka)	Hendy and Kennett (2000)
PAR87A-01	54.42	-149.43	3480	2.72 (~18-21ka)	Zahn et al. (1991)
PAR87A-10	54.36	-148.47	3664	2.99 (~18-21ka)	Zahn et al. (1991)
SU81-18	37.77	-10.18	3135	2.58 (~18-21ka)	Bard et al. (1989)

Table S3b The oxygen isotope ratios in *G.bulloides* averaged from raw data in the Pangaea data pool. The average time period (in Ka), depth intervals (in m) or the single depth values (in m) under the relative LGM definition in the reference are listed under the isotope values.

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{V\text{-}PDB}$ (18-21.5ka)	reference
BOFS 5k	50.68	-21.87	3345	4.17	Maslin (1992)
BOFS 8k	52.50	-22.04	4045	4.21	Maslin (1992)
BOFS 14k	58.62	-19.44	1756	3.94	Maslin (1992)
BOFS 16k	59.28	-23.14	2502	4.26	Vogelsang (1990)
BOFS 17k	58.00	-16.50	1150	4.17	Maslin (1992)
CH 67-19	45.75	-3.95	1982	3.57	Labeyrie and Duplessy (1985)
CH 69-12	46.02	-4.69	3642	3.65	Duplessy et al. (1991)
CH 69-32	45.40	-5.18	4777	3.56	Duplessy et al. (1991)
CH 72-101	47.47	-8.56	2428	3.51	Labeyrie and Duplessy (1985)
CH 72-104	46.90	-8.08	4590	3.25	Labeyrie and Duplessy (1985)
CH 73-108	58.08	-10.73	2032	4.18	Duplessy et al. (1991)
CH 73-110	59.50	-8.93	1365	4.00	Weinelt (1993)
CH 73-116	55.75	-14.47	2201	4.18	Keigwin and Boyle (1989)
CH 73-139	54.63	-16.35	2209	3.99	Bard et al. (1987)
CH 73-141	52.86	-16.52	3489	4.00	Duplessy et al. (1991)
CH 77-07	66.60	-10.52	1487	4.62	Ruddiman and McIntyre (1981)
DSDP 609	50.00	-24.00	3884	4.25	Bond et al. (1993)
ENAM 93-21	62.74	-4.00	1020	4.48	Rasmussen et al. (1995)
FRAM 1/4	84.50	-8.95	3820	4.41	Zahn et al. (1985)
FRAM 1/7	83.88	-6.96	2990	4.61	Zahn et al. (1985)
HM 25-09	63.05	4.79	600	4.49	Jansen and Erlenkeuser (1985)
HM 31-33	63.63	4.78	1580	4.44	Jansen and Erlenkeuser (1985)
HM 31-36	64.25	0.53	2620	4.75	Jansen and Erlenkeuser (1985)
HM 52-43	64.25	0.73	2781	4.51	Veum et al. (1992)
HM 57-07	68.25	-13.53	1668	4.48	Sarnthein et al. (1995)
HM 71-12	68.43	-13.87	1547	4.69	Sarnthein et al. (1995)
HM 71-14	69.98	-18.08	1624	4.65	Sarnthein et al. (1995)
HM 71-19	69.48	-9.51	2210	4.81	Vogelsang (1990)
HM 80-30	71.78	1.60	2821	4.57	Sarnthein et al. (1995)
HM 80-42	72.25	-9.23	2416	4.44	Sarnthein et al. (1995)
HM 80-60	68.90	-11.86	1869	4.69	Sarnthein et al. (1995)
HM 94-13	71.63	-1.62	1946	4.66	Sarnthein et al. (1995)

HM 94-18	74.50	5.70	2469	4.58	Sarnthein et al. (1995)
HM 94-25	75.60	1.32	2469	4.68	Sarnthein et al. (1995)
HM 94-34	73.77	-2.54	3004	4.71	Sarnthein et al. (1995)
HM 100-7	61.67	-4.72	1125	4.39	Sarnthein et al. (1995)
K 11	71.78	1.60	2900	4.66	Ruddiman and McIntyre (1981)
KN708-1	50.00	-23.75	4053	4.11	Ruddiman and McIntyre (1981)
KN708-6	51.57	-29.57	2469	4.46	Keigwin and Boyle (1989)
KN714-15	58.77	-25.78	2598	4.23	Keigwin and Boyle (1989)
M 17045	52.43	-16.65	3663	4.01	Winn et al (1991)
M 17048	54.30	-18.16	1859	4.02	Sarnthein et al. (1995)
M 17049	55.28	-26.73	3331	4.29	Jung (1996)
M 17051	56.17	-31.98	2300	4.34	Jung (1996)
M 17701	68.53	11.68	1421	4.34	Sarnthein et al. (1995)
M 17719	72.15	12.57	1823	4.46	Sarnthein et al. (1995)
M 17724	76.00	8.33	2354	4.63	Weinelt (1993)
M 17725	77.47	4.58	2580	4.41	Weinelt et al. (1996)
M 17728	76.52	3.95	2485	4.69	Sarnthein et al. (1995)
M 17730	72.05	7.31	2769	4.60	Weinelt (1993)
M 17732	71.62	4.23	3103	4.75	Sarnthein et al. (1995)
M 23041	68.68	0.22	2258	4.70	Sarnthein et al. (1995)
M 23043	70.27	-3.35	2133	4.56	Sarnthein et al. (1995)
M 23055	68.42	4.10	2311	4.76	Vogelsang (1990)
M 23056	68.50	3.83	2665	4.68	Weinelt et al. (1996)
M 23057	68.40	3.31	3157	4.70	Sarnthein et al. (1995)
M 23059	70.30	-3.12	2283	4.72	Vogelsang (1990)
M 23062	68.73	0.16	2244	4.73	Vogelsang (1990)
M 23063	68.75	0.00	2299	4.76	Vogelsang (1990)
M 23064	68.67	0.33	2571	4.66	Sarnthein et al. (1995)
M 23065	68.50	0.81	2804	4.72	Vogelsang (1990)
M 23068	67.83	1.50	2230	4.74	Vogelsang (1990)
M 23071	67.08	2.93	1308	4.73	Vogelsang (1990)
M 23074	66.67	4.92	1157	4.62	Vogelsang (1990)
M 23254	73.12	9.63	2273	4.70	Sarnthein et al. (1995)
M 23256	73.18	10.95	2061	4.73	Sarnthein et al. (1995)
M 23258	75.00	13.98	1768	4.52	Sarnthein et al. (1995)
M 23259	72.03	9.25	2518	4.68	Weinelt (1993)
M 23260	72.13	11.46	2089	4.71	Weinelt (1993)
M 23261	72.17	13.11	1628	4.60	Weinelt (1993)
M 23262	72.23	14.43	1130	4.33	Weinelt (1993)
M 23269	71.45	0.68	2872	4.83	Weinelt (1993)
M 23294	72.37	-10.59	2224	4.71	Weinelt (1993)

M 23323	67.77	5.93	1286	4.42	Sarnthein et al. (1995)
M 23351	70.36	-18.21	1672	4.40	Völker (1999)
M 23354	70.33	-10.63	1747	4.50	Völker (1999)
M 23415	53.17	-19.20	2472	4.13	Jung (1996)
M 23419	54.97	-19.74	1491	3.96	Jung (1996)
M 23519	64.80	-29.60	1893	4.53	Hohnemann (1996)
MD2010	66.68	4.56	1226	4.61	Dokken and Jansen (1999)
MD2011	66.97	7.64	1048	4.42	Dreger (1999)
MD2012	72.15	11.43	2094	4.58	Dreger (1999)
MD2284	62.37	-0.98	1500	4.34	Jasen and Meland (2001)
MG 123	79.27	0.81	3050	4.65	Morris (1988)
NA 87-22	55.50	-14.57	2161	4.06	Duplessy et al. (1992)
NO 77-14	62.45	-20.42	1531	4.65	Duplessy et al. (1991)
NO 79-06	54.52	-36.89	2734	4.45	Labeyrie and Duplessy (1985)
NO 79-25	46.98	-27.28	2826	4.10	Duplessy et al. (1992)
NP 90-12	78.41	9.42	628	4.65	Dokken (1995)
NP 90-36	77.62	9.94	1360	4.60	Dokken (1995)
NP90-39	77.26	9.90	2119	4.48	Dokken (1995)
OD 41:4:1	84.03	11.24	3344	4.76	Nørgaard-Pedersen et al. (2003)
PS 1171	68.20	-18.07	935	4.49	Lackschewitz et al. (1994)
PS 1230	78.86	-4.78	1235	4.28	Nørgaard-Pedersen et al. (2003)
PS 1294	78.00	5.37	2668	4.75	Hebbeln and Wefer (1997)
PS 1295	78.00	2.43	3112	4.63	Jones and Keigwin (1989)
PS 1308	80.02	-4.83	1444	3.95	Nørgaard-Pedersen et al. (2003)
PS 1314	80.00	4.50	1382	4.22	Nørgaard-Pedersen et al. (2003)
PS 1498-2	-73.49	-35.51	2818	4.80	Melles (1991)
PS 1533	82.03	15.18	2030	4.60	Köhler (1992)
PS 1535	78.75	1.85	2557	4.60	Köhler (1992)
PS 1730	70.12	-17.7	1617	4.29	Stein et al. (1996)
PS 1894	75.81	-8.30	1975	4.39	Nørgaard-Pedersen et al. (2003)
PS 1919	75.00	-11.90	1876	4.39	Stein et al. (1996)
PS 1922	75.00	-8.77	3350	4.40	Stein et al. (1996)
PS 1927	71.50	-17.12	1734	4.35	Stein et al. (1996)
PS 1951	68.84	-20.82	1481	4.48	Stein et al. (1996)
PS 2122	80.39	7.55	705	4.20	Kines (1994)
PS 2123	80.17	9.86	571	4.43	Kines (1994)
PS 2129	81.37	17.47	861	4.68	Kines (1994)

PS 2206	84.28	-2.51	2993	4.60	Stein et al. (1994)
PS 2208	83.64	4.60	3681	4.60	Stein et al. (1994)
PS 2210	83.04	10.70	3702	4.65	Stein et al. (1994)
PS 2212	82.07	15.85	2550	4.26	Vogt (1997)
PS 2423	80.04	-5.45	829	3.80	Notholt (1998)
PS 2424	80.04	-5.74	445	4.20	Notholt (1998)
PS 2613	74.18	-0.48	3259	4.71	Völker (1999)
PS 2644	67.87	-21.77	778	4.50	Völker (1999)
PS 2837	81.23	2.38	1023	4.72	Nørgaard-Pedersen et al. (2003)
PS 2876	81.91	-9.43	1976	4.55	Nørgaard-Pedersen et al. (2003)
PS 2887	79.60	-4.61	1411	3.33	Nørgaard-Pedersen et al. (2003)
PS 16396	61.87	-11.25	1145	4.08	Sarnthein et al. (1995)
PS 16397	61.87	-11.18	1145	4.00	Sarnthein et al. (1995)
PS 21291	78.00	8.70	2400	4.54	Weinelt (1993)
PS 21736	74.33	-5.17	3460	4.65	Jünger (1993)
PS 21842	69.45	-16.52	982	4.44	Sarnthein et al. (1995)
PS 21900	74.53	-2.32	3538	4.45	Jünger (1993)
PS 21906	76.93	-2.15	2990	4.25	Nørgaard-Pedersen et al. (2003)
PS 21910	75.62	1.32	2454	4.50	Weinelt (1993)
PS 23199	68.38	5.24	1968	4.76	Vogelsang (1990)
PS 23205	67.62	5.76	1411	4.62	Vogelsang (1990)
PS 23243	69.38	-6.54	2715	4.71	Vogelsang (1990)
PS 23246	69.40	-12.86	1858	4.58	Vogelsang (1990)
RC 9-225	54.89	-15.40	2334	3.99	Keigwin and Boyle (1989)
SO 82-5	59.18	-30.90	1416	4.43	van Kreveld et al. (2000)
SU 90-32	61.78	-22.42	2200	3.98	Sarnthein et al. (1995)
SU 90-33	60.57	-22.08	2370	4.22	Cortijo et al. (1997)
SU 90-39	52.57	-21.93	2900	4.25	Cortijio (1995)
SU 90-106	59.98	-39.45	1615	4.40	Weinelt et al. (1996)
SU 90-107	63.08	-28.08	1625	4.17	Sarnthein et al. (1995)
V 23-23	56.80	-44.55	3292	4.34	Mix and Fairbanks (1985)
V 23-42	62.18	-27.92	1514	4.52	Keigwin and Boyle (1989)
V 23-81	54.03	-16.14	2393	3.82	Jansen and Veum (1990)
V 23-82	52.59	-21.93	3974	4.34	Keigwin and Boyle (1989)
V 23-83	49.87	-24.26	3971	4.31	Keigwin and Boyle (1989)
V 27-17	50.08	-37.31	4054	4.42	Keigwin and Boyle (1989)
V 27-19	52.10	-38.79	3466	4.46	Keigwin and Boyle (1989)
V 27-60	72.17	8.58	2525	4.72	Labeyrie and Duplessy (1985)

V 27-86	66.60	1.12	2900	4.72	Labeyrie and Duplessy (1985)
V 27-114	55.05	-33.07	2532	4.42	Keigwin and Boyle (1989)
V 27-116	52.83	-30.33	3202	4.52	Keigwin and Boyle (1989)
V 28-14	64.78	-29.58	1855	4.60	Shackleton (1974)
V 28-38	69.38	-4.40	3411	4.82	Keigwin and Boyle (1989)
V 28-56	68.03	-6.12	2941	4.67	Kellogg et al. (1978)
V 29-180	45.30	-23.87	3049	3.80	Keigwin and Boyle (1989)
V 29-183	49.14	-25.50	3629	4.10	Keigwin and Boyle (1989)
V 29-206	64.90	-29.28	1624	4.37	Keigwin and Boyle (1989)
V 30-108	56.10	-32.50	3171	4.52	Keigwin and Boyle (1989)
V 30-164	69.83	8.97	2901	4.83	Duplessy et al. (1991)

Table S4a The oxygen isotope ratios in *N.pachyderma* obtained from the published data. The definitions of LGM is 18-21.5ka (Meland et al, 2005).

Core no.	Latitude	Longitude	Water depth(m)	$\delta^{18}O_{V\text{-}PDB}$	reference
GIK16396-1	61.87	-11.24	1145	4.07 (~18-21ka)	Sarnthein (1995) (age depth defined in Vogelsang et al., 2001)
GIK16397-2	61.87	-11.18	1145	4.03 (~18-21ka)	Sarnthein (1995) (age depth defined in Vogelsang et al., 2001)
GIK17045-3	52.43	-16.67	3663	4.01 (~18-21ka)	Sarnthein et al. (1994) (pangaea)
GIK17049-6	55.26	-26.73	3331	4.36 (~18-21ka)	Jung (1996)
GIK17051-3	56.16	-31.99	2295	4.35 (18.3-21.8ka)	Jung (1996)
GIK17724-2	76.00	8.33	2354	4.57 (~18-21ka)	Weinelt (1993)
GIK17725-2	77.46	4.58	540	4.31 (0.35m ~21ka)	Weinelt (1993)
GIK23056-2	68.50	3.83	2665	4.79 (0.3m ~19ka)	Vogelsang (1990)
GIK23065-2	68.50	0.83	2804	4.69 (~18-21ka)	Vogelsang (1990)
GIK23071-3	67.09	2.91	1308	4.49 (~18-21ka)	Vogelsang (1990)
GIK23074-1	66.67	4.91	1157	4.65 (~18-21ka)	Vogelsang (1990)
GIK23262-3	72.23	14.42	1131	4.36 (2.01m ~18.3ka)	Weinelt (1993)
GIK23294-4	72.38	-10.59	2215	4.15 (~18-21ka)	Weinelt (1993) (Age depth determined in Peatsch, 1991)
GIK23351-1	70.36	-18.21	1672	4.40 (0.55m ~18.3ka)	Völker (1999)
GIK23354-6	70.33	-10.63	1747	4.50 (0.7-0.8m ~18ka)	Völker (1999)
GIK23415-9	53.18	-19.15	2472	4.20 (~18-21ka)	Weinelt (2003)
GIK23419-8	54.96	-19.76	1487	4.79 (0.4m ~18.3ka)	Jung (1996)

GIK23519-5	64.80	-29.60	1893	4.55 (~18-21ka)	Millo (2006)
HU73-031-7	42.98	-55.25	4055	3.16 (~18-21ka)	Keigwin and Jones (1995)
HU87-033-008	62.65	-53.88	2424	4.41 (~18-21ka)	Hillarie-Marcel et al. (1994) (LGM depth defined in Pflaumann et al., 2003)
HU90-013-013	58.21	-48.37	3380	4.60 (~18-21ka)	Hillarie-Marcel et al. (1994)
MD80-304	-51.04	67.44	1930	4.42 (~18-21ka)	Labeyrie and Duplessy (1985)
MD84-527	-43.49	51.19	3262	3.48 (~18-21ka)	Pichon et al. (1992)
MD88-769	-46.07	90.11	3420	3.39 (~18-21ka)	Rosenthal et al. (1995)
PAR87A-01	54.42	-149.43	3480	3.37 (~18-21ka)	Zahn et al. (1991)
PAR87A-10	54.36	-148.47	3664	3.18 (~18-21ka)	Zahn et al. (1991)
PS 1388-3	-69.03	-5.92	2526	4.87 (0.8m, ~18ka)	Mackensen et al (1989)
PS 1648-1	-69.74	-6.52	2519	4.71 (1.10m ~18ka)	Grobe and Mackensen (1992)

Table S4b The oxygen isotope ratios in *N. pachyderma* averaged from raw data in the Pangaea data pool. The average time period (in Ka), depth intervals (in m) or the single depth values (in m) under the relative LGM definition in the reference are listed under the isotope values.

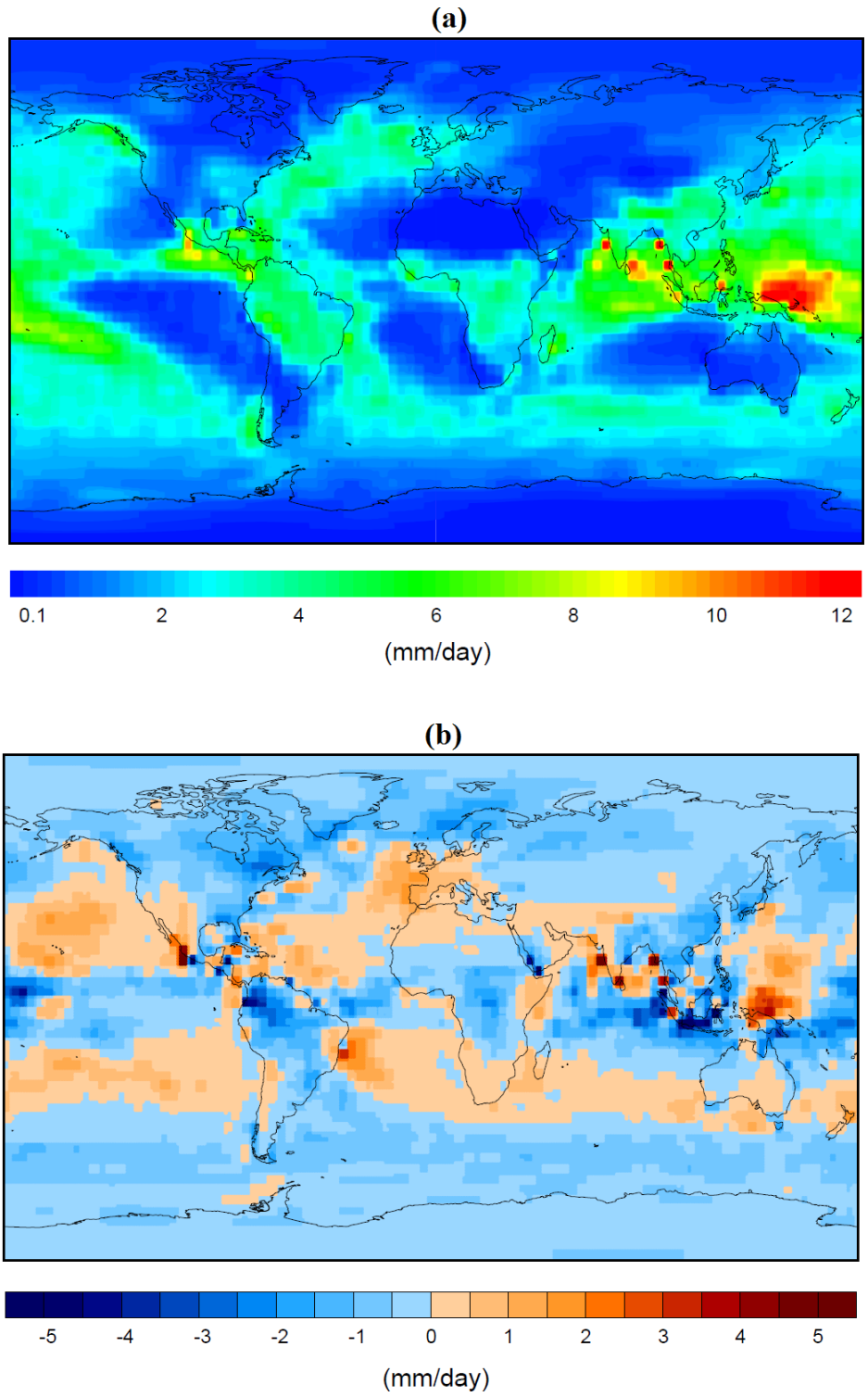

Figure S1 (a) The LGM global annual-mean precipitation rates of H_2O obtained from ECHAM-wiso (Werner et al., 2011) simulation under LGM climate condition. (b) The normal precipitation anomaly between the LGM and present day simulations from ECHAM-wiso.

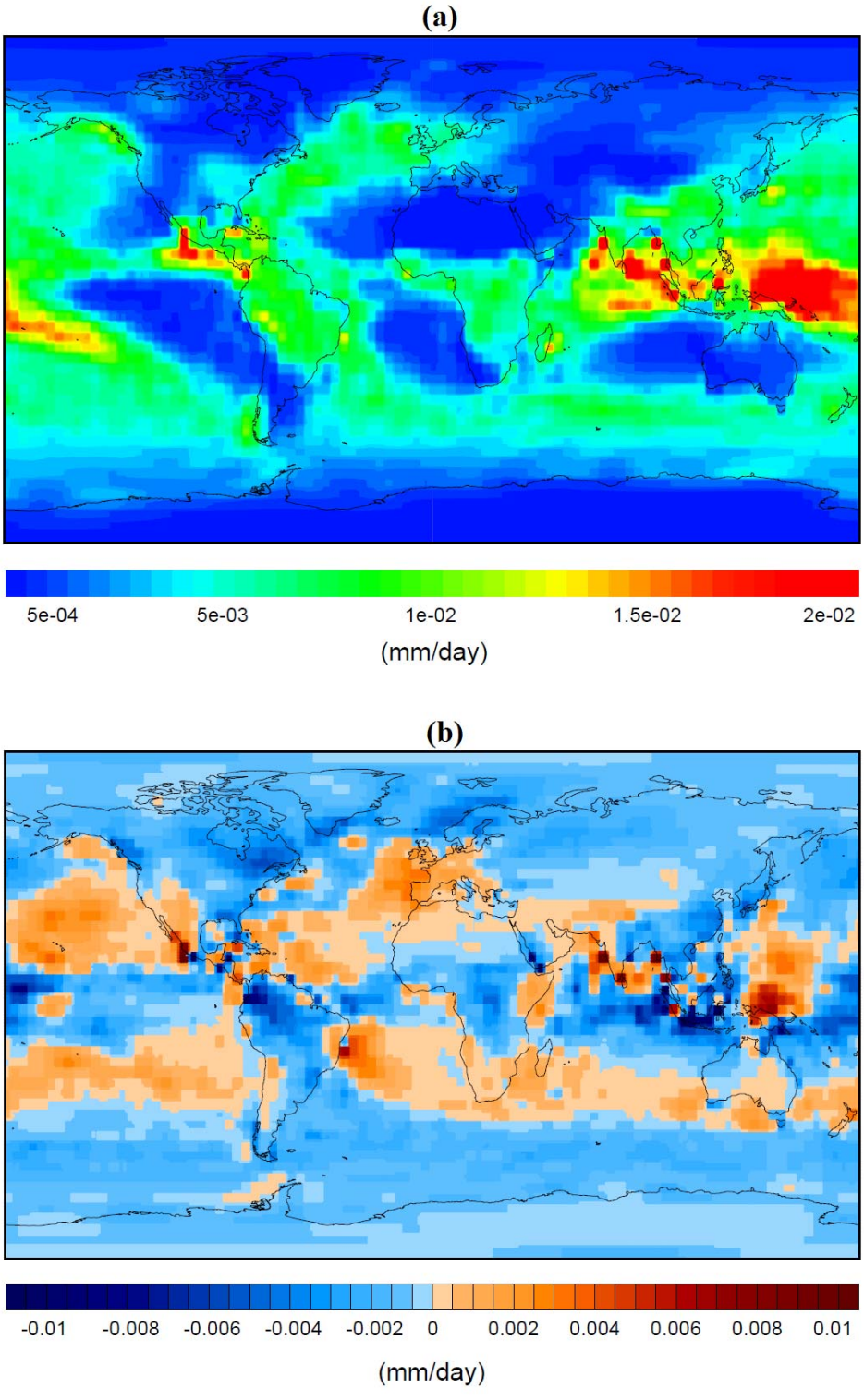

Figure S2 (a) The LGM global annual-mean precipitation rates of $H_2{}^{18}O$ from ECHAM-wiso (Werner et al., 2011) simulation. (b) The isotopic precipitation anomaly between the LGM and present day simulations from ECHAM-wiso.

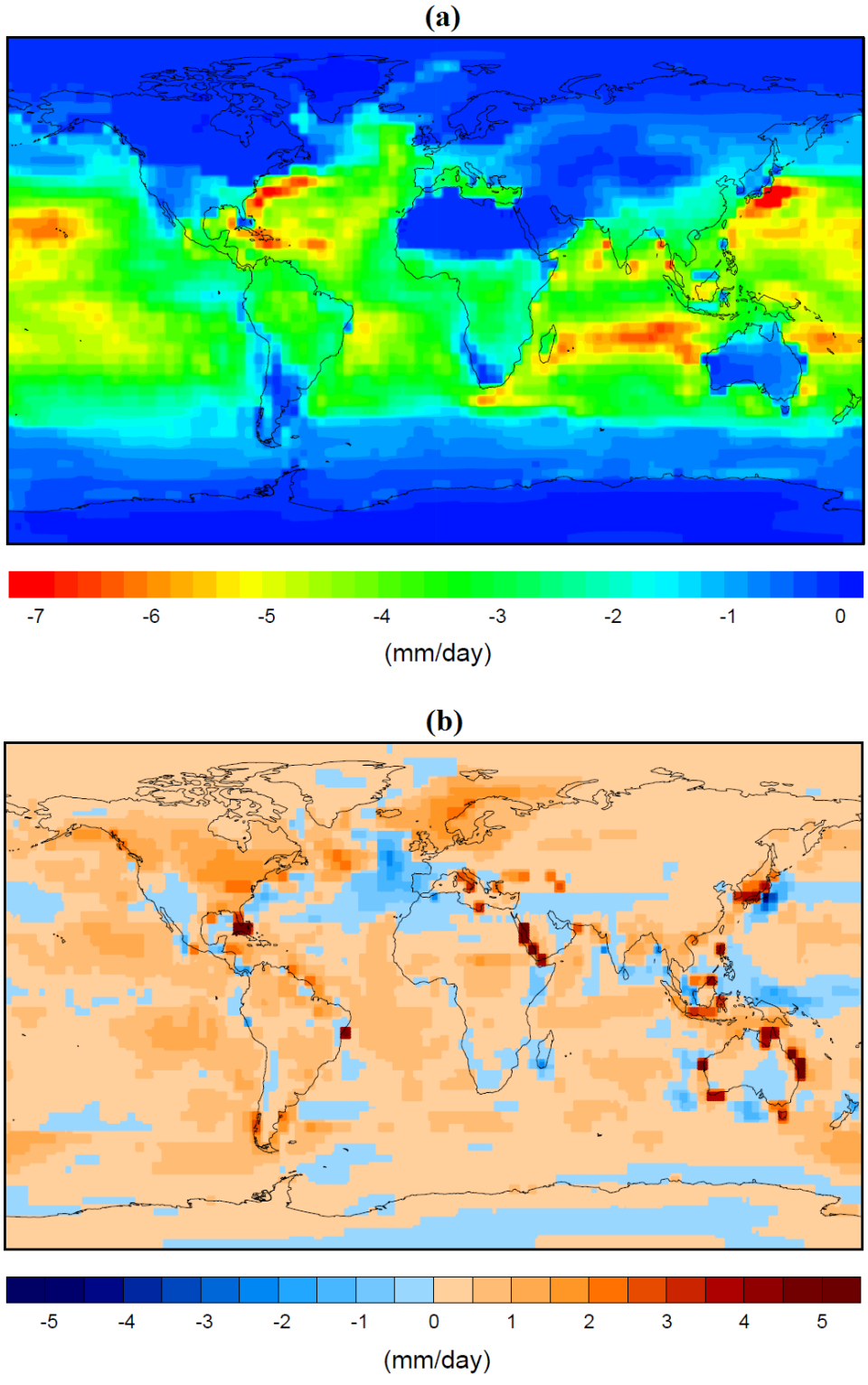

Figure S3 (a) The global annual-mean evaporation rates of H_2O obtained from the ECHAM-wiso (Werner et al., 2011) LGM simulation. (b) The normal evaporation anomaly between the LGM and present day simulation from ECHAM-wiso.

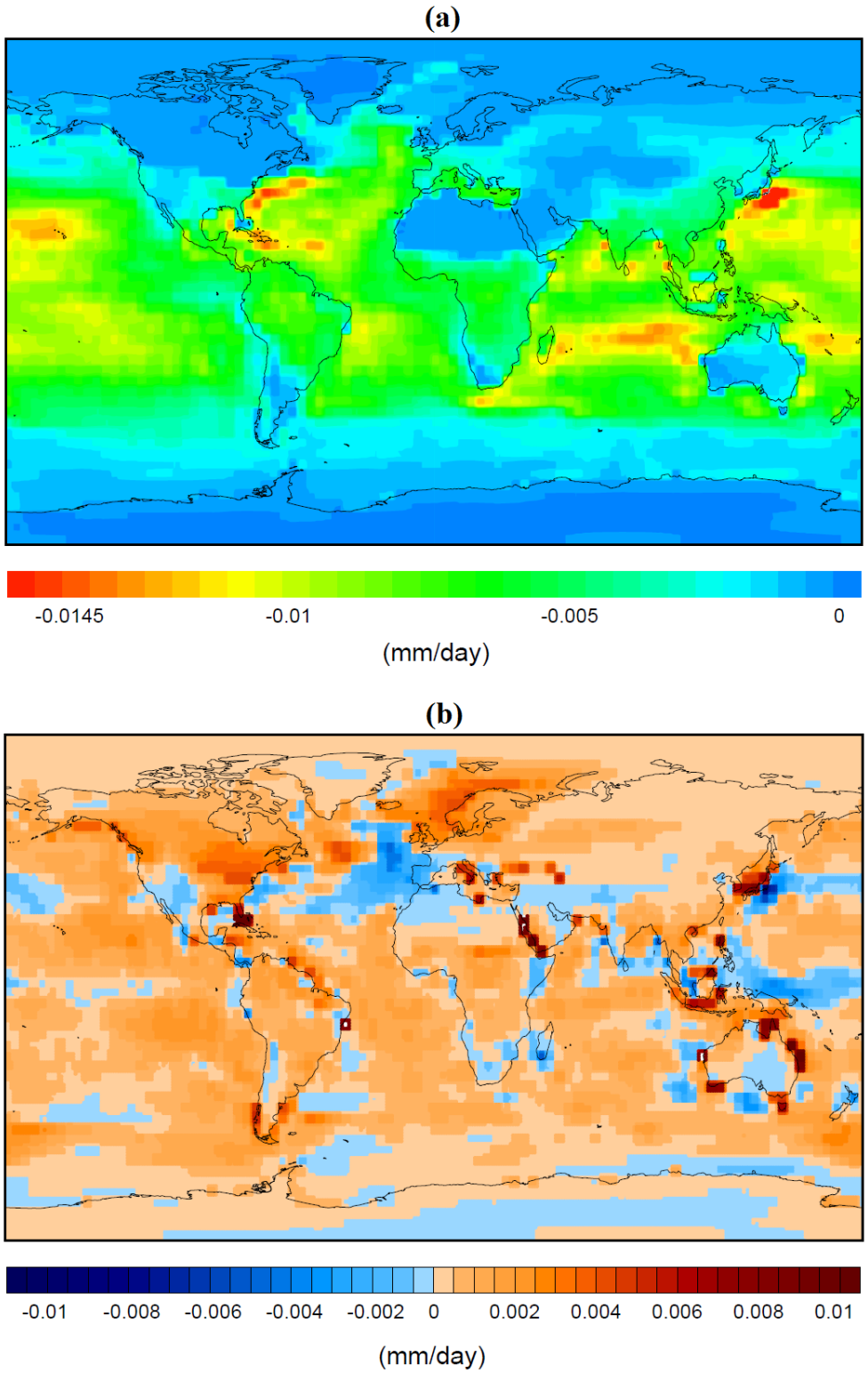

Figure S4 (a) The LGM global annual-mean evaporation rates of $H_2{}^{18}O$ from the ECHAM-wiso (Werner et al., 2011) simulation. (b) The isotopic evaporation anomaly between the LGM and present day simulation from ECHAM-wiso.

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