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Supplementary Materials for

Geodetic measurements reveal similarities between post–Last Glacial Maximum and present-day mass loss from the Greenland ice sheet

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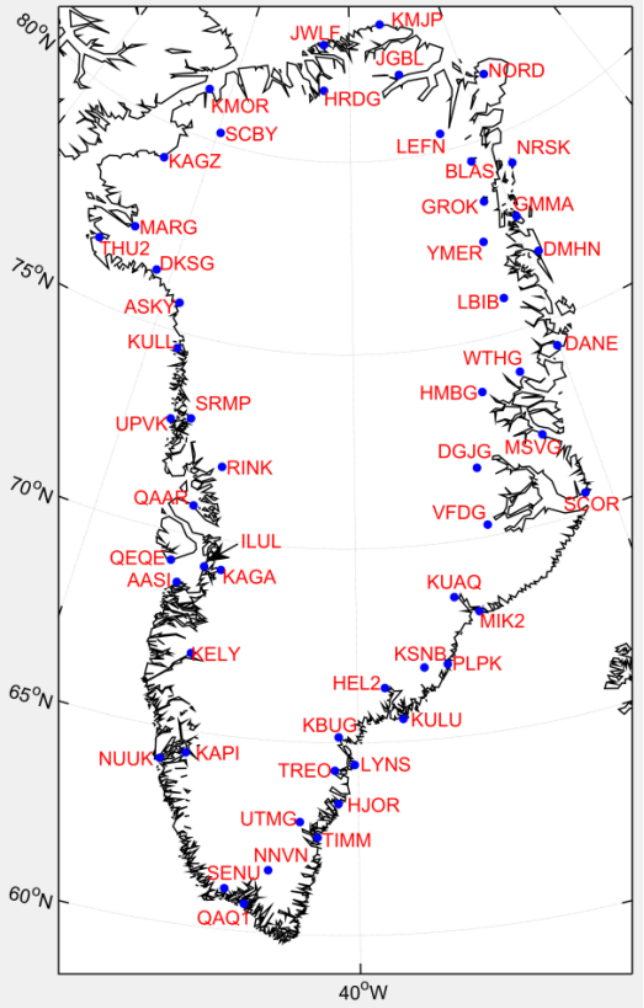

fig. S1. Locations of the permanent GPS stations in Greenland.

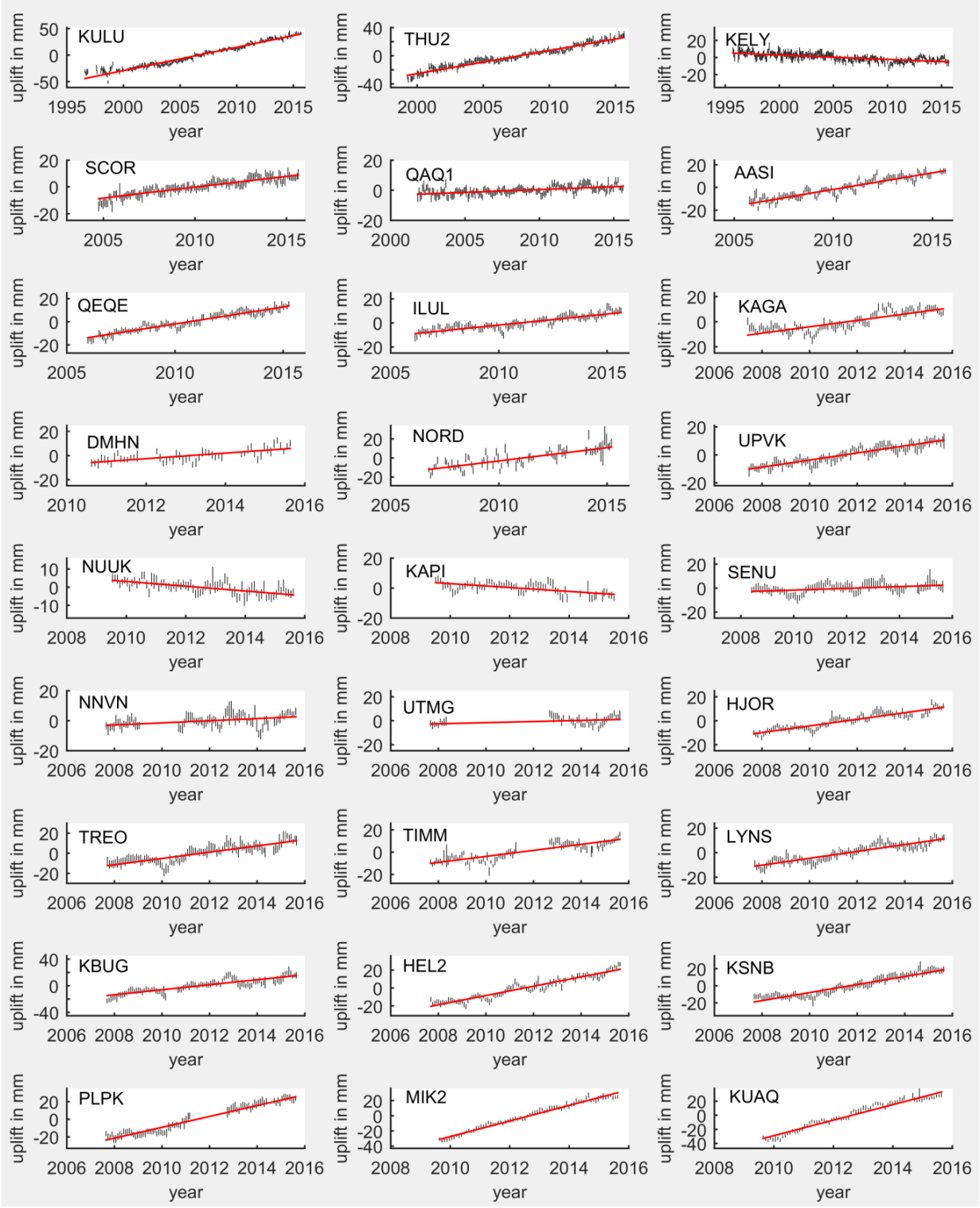

fig. S2. Monthly mean values of vertical GPS solutions after removing the annual, semiannual, and elastic vertical displacement. The red line represents the best fitting linear term.

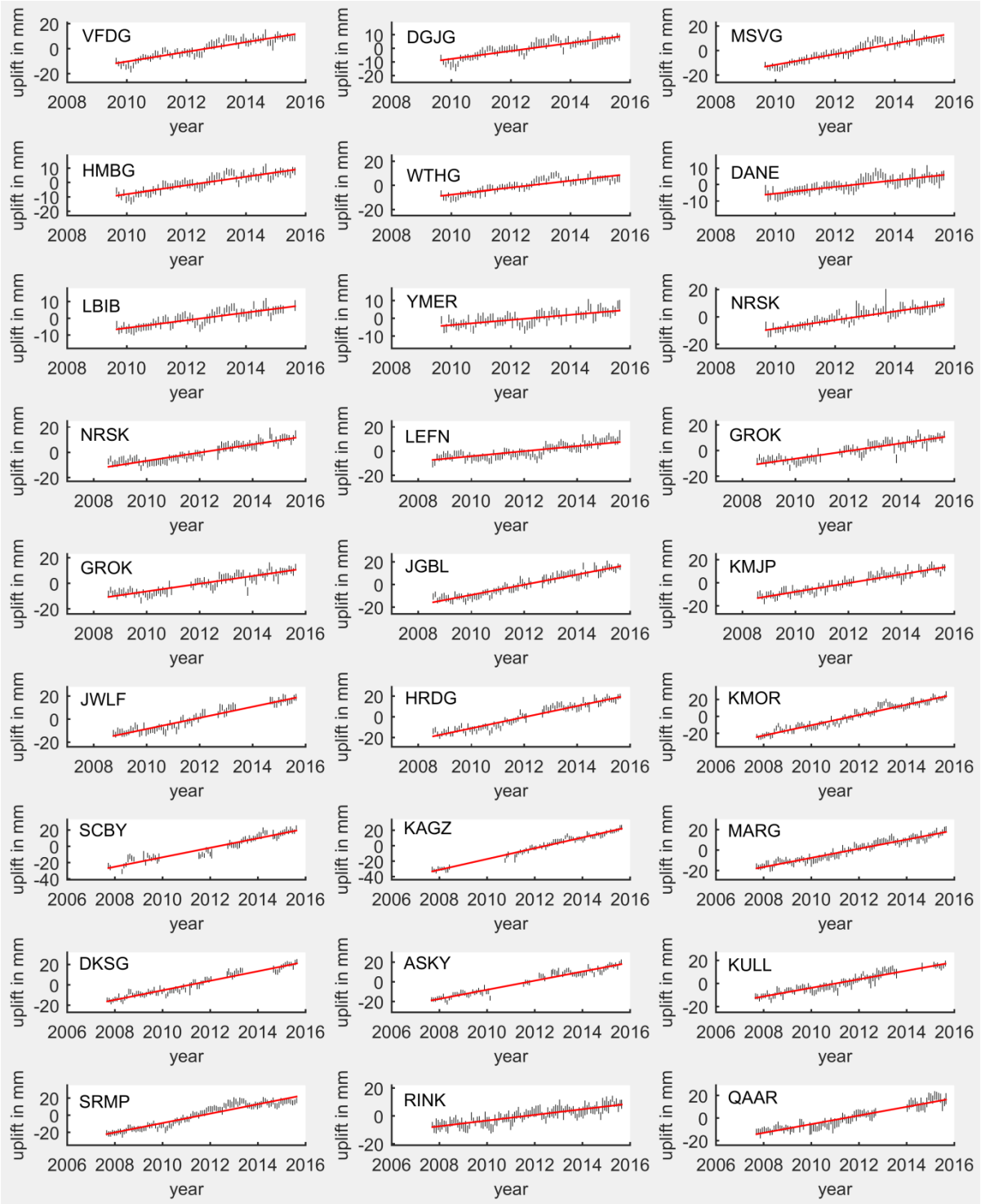

fig. S2 (continued). Monthly mean values of vertical GPS solutions after removing the annual, semiannual, and elastic vertical displacement. The red curve represents the best fitting linear term.

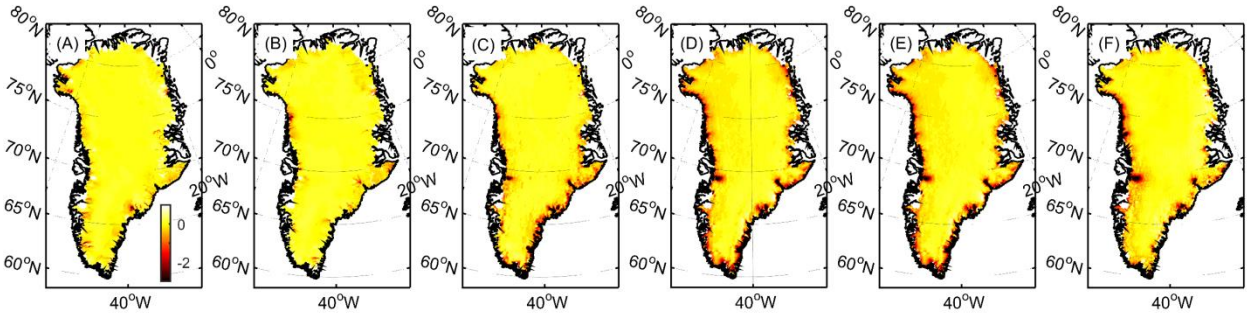

fig. S3. Elevation change rate during 1997–2015. (**A**) 1997–2000, (**B**) 2000–2003, (**C**) 2003–2006, (**D**) 2006–2009, (**E**) 2009–2012, and (**F**) 2012–2015.

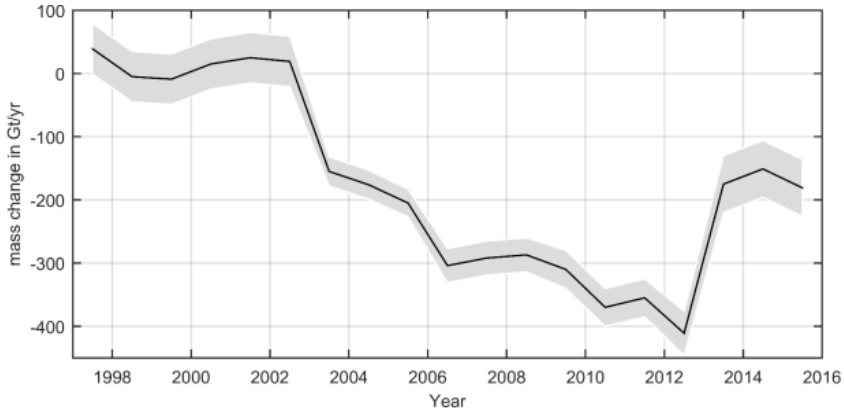

fig. S4. Time series of GrIS mass loss rate.

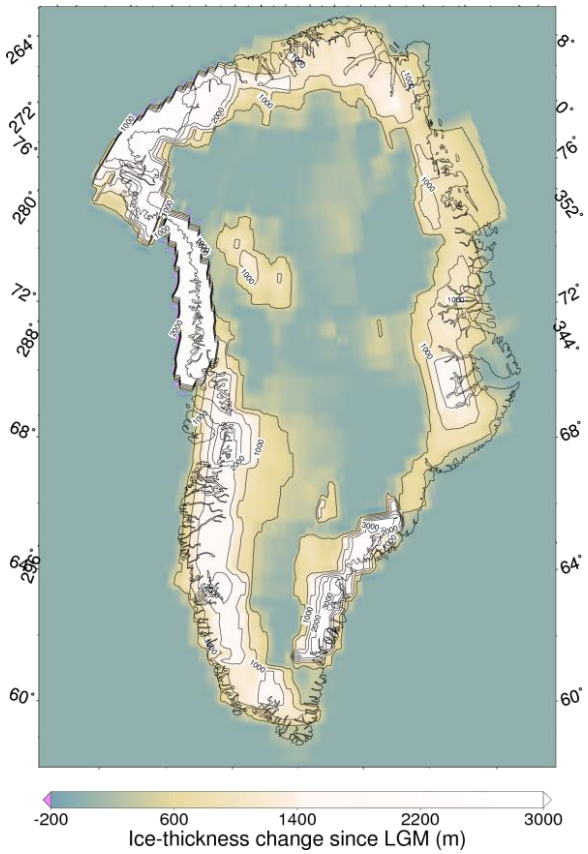

fig. S5. Ice thickness change since the LGM as represented by the Green1 VM-GPS.

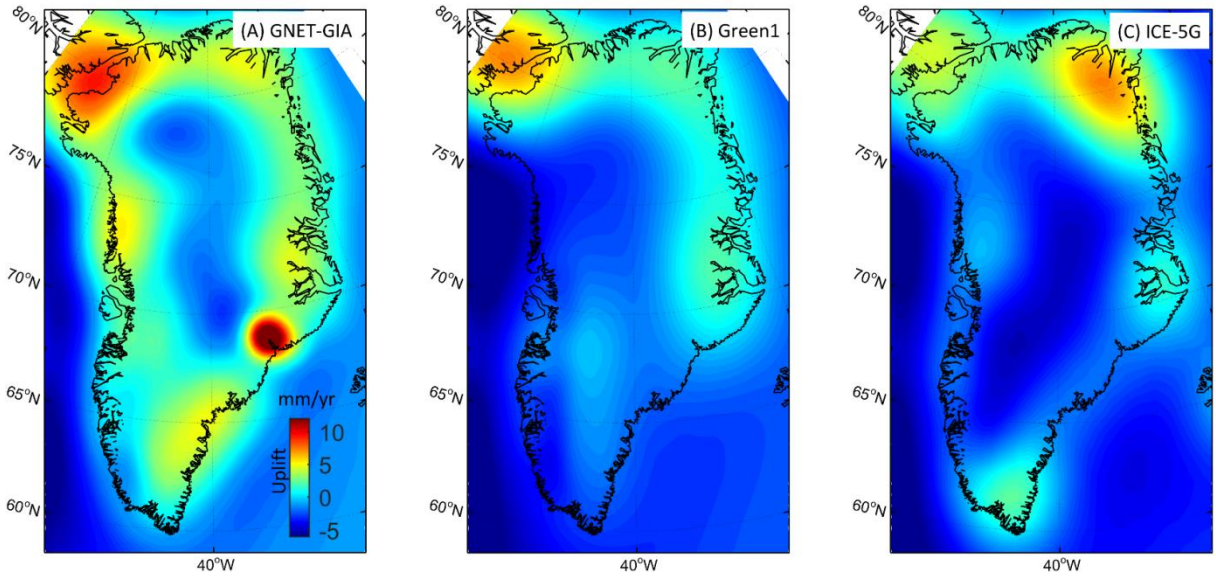

fig. S6. GIA rates. (**A**) GIA vertical displacement rates from new model "GNET-GIA", (**B**) Green1 GIA rates. (**C**) ICE-5G GIA rates.

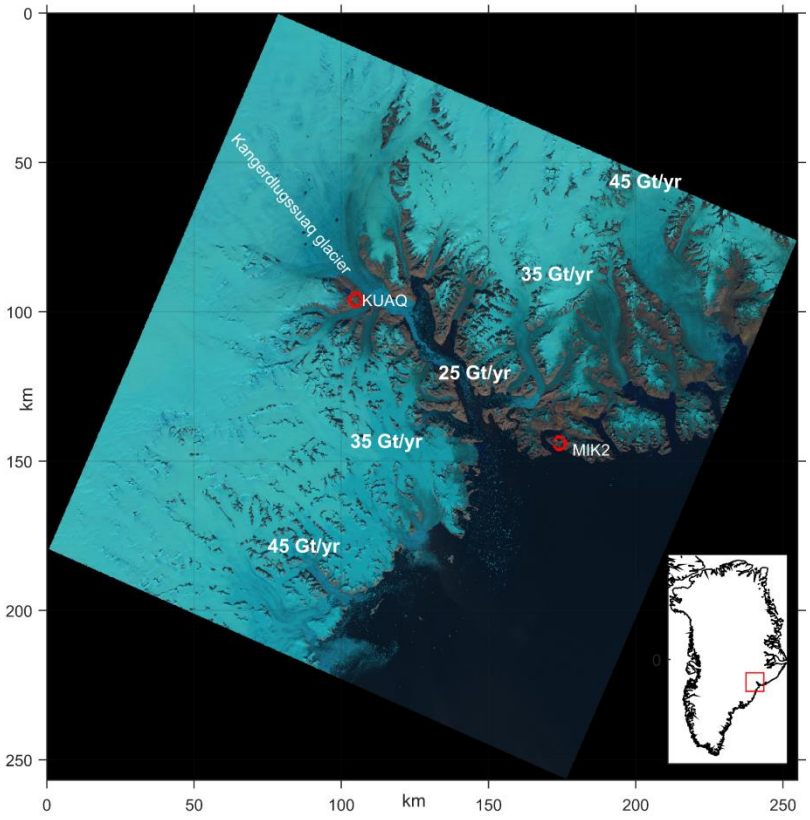

fig. S7. Landsat image of southeast Greenland. The red circles denote the locations of GPS sites MIK2 and KUAQ. The numbers in Gt/yr denote the locations of areas of potential mass loss required to explain the observed uplift at KUAQ and MIK2 as an elastic signal.

table S1. Location of GPS sites, data time span, observed uplift rates, predicted elastic uplift rates, and observed GIA uplift rate.

Site	Latitude	Longitude	t_start	t_end	Up rate	Elastic Up rate	GIA Up rate	Basin #
	Deg	deg	Year	Year	mm/yr	mm/yr	mm/yr	
BLAS	79.53861 N	22.97472 W	2008.5	2015.6	7.6 ± 0.2	4.3 ± 0.5	3.3 ± 0.5	1
LEFN	80.45668 N	26.29346 W	2008.5	2015.6	6.3 ± 0.2	4.3 ± 0.2	2.1 ± 0.3	1
JGBL	82.20876 N	31.00420 W	2008.5	2015.6	6.0 ± 0.2	1.5 ± 0.2	4.5 ± 0.3	1
KMJP	83.64324 N	33.37708 W	2008.5	2015.6	4.7 ± 0.2	0.9 ± 0.1	3.8 ± 0.2	1
JWLF	83.11165 N	45.11983 W	2008.5	2015.6	5.9 ± 0.2	1.1 ± 0.2	4.8 ± 0.3	1
HRDG	81.87983 N	44.51737 W	2008.5	2015.6	7.5 ± 0.2	2.1 ± 0.2	5.4 ± 0.3	1
KMOR	81.25271 N	63.52739 W	2007.7	2015.6	8.0 ± 0.1	1.9 ± 0.1	6.1 ± 0.1	1
SCBY	80.26013 N	59.59362 W	2007.7	2015.6	8.0 ± 0.2	2.2 ± 0.3	5.8 ± 0.4	1
KAGZ	79.13196 N	65.85295 W	2007.7	2015.6	10.4 ± 0.1	3.4 ± 0.3	7.0 ± 0.3	1
NORD	81.60014 N	16.65545 W	2006.7	2015.2	4.0 ± 0.3	1.3 ± 0.2	2.8 ± 0.4	1
DMHN	76.77107 N	18.65568 W	2010.6	2015.6	3.4 ± 0.3	1.2 ± 0.2	2.3 ± 0.4	2
LBIB	75.89380 N	23.85294 W	2009.6	2015.6	4.0 ± 0.2	1.7 ± 0.4	2.3 ± 0.4	2
YMER	77.43289 N	24.32633 W	2009.6	2015.6	3.3 ± 0.2	1.8 ± 0.5	1.5 ± 0.5	2
GMMA	77.80943 N	19.65212 W	2009.6	2015.6	5.3 ± 0.2	2.1 ± 0.1	3.2 ± 0.2	2
NRSK	79.15503 N	17.72542 W	2008.5	2015.6	6.2 ± 0.2	2.2 ± 0.1	4.0 ± 0.2	2
GROK	78.44270 N	22.90376 W	2008.5	2015.6	7.9 ± 0.2	4.9 ± 0.5	3.0 ± 0.5	2
SCOR	70.48534 N	21.95032 W	2004.7	2015.6	3.8 ± 0.1	2.2 ± 0.1	1.6 ± 0.1	3A
VFDG	70.29992 N	29.81764 W	2009.6	2015.6	8.8 ± 0.2	4.9 ± 0.5	3.9 ± 0.5	3A
DGJG	71.78653 N	29.85020 W	2009.6	2015.6	7.1 ± 0.2	4.2 ± 0.5	2.9 ± 0.5	3A
MSVG	72.24082 N	23.91286 W	2009.6	2015.6	5.6 ± 0.2	1.3 ± 0.1	4.3 ± 0.2	3A
HMBG	73.67598 N	28.12907 W	2009.6	2015.6	4.1 ± 0.2	1.1 ± 0.5	3.0 ± 0.5	3A
WTHG	73.95520 N	24.30892 W	2009.6	2015.6	4.9 ± 0.2	2.0 ± 0.4	2.9 ± 0.4	3A
DANE	74.31195 N	20.19983 W	2009.6	2015.6	3.1 ± 0.2	1.1 ± 0.1	2.0 ± 0.2	3A
MIK2	68.14030 N	31.45180 W	2009.6	2015.6	15.4 ± 0.2	5.1 ± 0.1	10.3 ± 0.2	3B
KUAQ	68.58700 N	33.05270 W	2009.6	2015.6	23.8 ± 0.3	11.8 ± 1.3	12.0 ± 1.3	3B
KULU	65.57933 N	37.14935 W	1996.6	2015.6	7.7 ± 0.1	3.3 ± 0.1	4.4 ± 0.1	4
UTMG	62.92721 N	43.30641 W	2007.6	2015.6	8.8 ± 0.7	8.2 ± 1.2	0.6 ± 1.4	4
HJOR	63.41821 N	41.14787 W	2007.6	2015.6	7.8 ± 0.1	5.0 ± 0.1	2.8 ± 0.1	4
TREO	64.27707 N	41.37508 W	2007.7	2015.6	10.2 ± 0.2	7.1 ± 0.5	3.1 ± 0.5	4
TIMM	62.53554 N	42.28616 W	2007.6	2015.6	8.2 ± 0.2	5.5 ± 0.1	2.7 ± 0.2	4
LYNS	64.43048 N	40.19806 W	2007.7	2015.6	8.7 ± 0.2	5.9 ± 0.1	2.8 ± 0.2	4
KBUG	65.14368 N	41.15755 W	2007.7	2015.6	13.5 ± 0.2	11.4 ± 0.8	2.1 ± 0.8	4
HEL2	66.40116 N	38.21570 W	2007.6	2015.6	15.3 ± 0.1	10.1 ± 1.3	5.2 ± 1.3	4
KSNB	66.86328 N	35.57632 W	2007.6	2015.6	14.5 ± 0.1	9.8 ± 0.5	4.7 ± 0.5	4
PLPK	66.89773 N	34.03347 W	2007.6	2015.6	12.0 ± 0.1	5.8 ± 0.2	6.2 ± 0.2	4
SENU	61.06958 N	47.14131 W	2008.4	2015.6	10.7 ± 0.1	10.7 ± 0.6	0.7 ± 0.6	5
NNVN	61.63188 N	44.90105 W	2007.6	2015.6	6.8 ± 0.4	6.1 ± 0.1	0.7 ± 0.4	5
QAQ1	60.71526 N	46.04776 W	2001.8	2015.6	4.3 ± 0.1	3.9 ± 0.1	0.4 ± 0.1	5
KELY	66.98742 N	50.94483 W	1995.7	2015.6	3.2 ± 0.1	3.7 ± 0.1	-0.5 ± 0.1	6
AASI	68.71932 N	52.79334 W	2005.7	2015.6	7.9 ± 0.1	5.0 ± 0.1	2.9 ± 0.1	6
QEQE	69.25263 N	53.52232 W	2005.9	2015.6	7.9 ± 0.1	5.0 ± 0.1	2.9 ± 0.1	6
ILUL	69.24041 N	51.06075 W	2006.1	2015.6	10.3 ± 0.1	8.5 ± 0.2	1.8 ± 0.2	6
KAGA	69.22230 N	49.81463 W	2006.4	2015.6	22.1 ± 0.1	19.5 ± 1.1	2.6 ± 1.1	6
NUUK	64.18355 N	51.73116 W	2009.0	2015.6	3.3 ± 0.3	4.6 ± 0.1	-1.3 ± 0.3	6
KAPI	64.43235 N	50.27121 W	2009.5	2015.6	6.8 ± 0.3	8.0 ± 0.5	-1.2 ± 0.6	6
THU2	76.53705 N	68.82503 W	1999.2	2015.6	6.4 ± 0.1	3.1 ± 0.1	3.3 ± 0.1	7A
MARG	77.18704 N	65.69462 W	2007.7	2015.6	9.2 ± 0.1	4.7 ± 0.5	4.5 ± 0.5	7A
DKSG	76.35162 N	61.67767 W	2007.6	2015.6	16.0 ± 0.1	11.3 ± 0.6	4.7 ± 0.6	7B
ASKY	75.72613 N	58.25735 W	2007.6	2015.6	15.8 ± 0.1	11.2 ± 0.6	4.6 ± 0.6	7B

KULL	74.58062 N	57.22706 W	2007.6	2015.6	10.5 ± 0.2	6.8 ± 0.2	3.7 ± 0.3	7B
SRMP	72.91068 N	54.39370 W	2007.6	2015.6	17.9 ± 0.1	12.5 ± 1.2	5.4 ± 1.2	7B
RINK	71.84850 N	50.99396 W	2007.7	2015.6	10.9 ± 0.2	8.9 ± 1.1	2.0 ± 1.1	7B
UPVK	72.78829 N	56.12800 W	2007.4	2015.6	8.3 ± 0.1	5.8 ± 0.1	2.5 ± 0.1	7B
QAAR	70.74041 N	52.68837 W	2007.7	2015.6	9.1 ± 0.2	5.3 ± 0.1	3.8 ± 0.2	7B

table S2. 1D viscosity profiles for Greenland.

Parameter	Unit	Lower limit	Upper limit	Nominal	VM-GPS
Lithosphere thickness	km	50	100	80	60
Upper mantle viscosity	x 10^{20} Pas	2	5	4	5
Lower mantle viscosity	x 10^{22} Pas	0.5	2	1	2

table S3. 1D viscosity profiles assigned to each region in Greenland. Shading indicates the calibration regions (see text).

Basin	Viscosity profile		
	LT (km)	AV (10^{20}Pas)	UMV (10^{20}Pas)
1	60	5	5
2	60	5	5
3A	50	4	5
3B	40	0.1	5
4	50	4	5
5	40	1	5
6	60	5	5
7A	90	11	11
7B	90	11	11
Total	-	-	-

table S4. Uncertainty of the scaling parameter caused by the load and Earth model parameters. The uncertainties represent relative uncertainties with respect to the unperturbed models.

Rel. unc. (%)	**VM-GPS (1D)**				**VM-GPS (3D)**			
Basin	Δt_{end}	Δh_{LT}	ΔAV	Total	Δt_{end}	Δh_{LT}	ΔAV	Total
1	8.1	14.4	10.2	25.7	8.2	14.9	11.1	26.4
2	7.4	13.6	7.1	23.9	7.7	13.9	7.7	23.9
3A	5.3	13.5	4.6	23.2	6.8	15.8	14.0	28.5
3B	1.4	4.6	3.6	16.3	0.9	5.1	3.2	16.2
4	8.4	11.7	5.9	21.6	10.1	16.4	15.5	28.8
5	25.1	5.1	20.6	28.2	14.1	10.0	67.5	166.8
6	22.2	14.4	21.4	45.7	22.6	15.7	23.9	47.5
7A	7.0	12.1	10.5	23.6	3.6	3.0	3.2	17.2
7B	6.5	14.8	4.5	22.7	2.9	8.9	7.4	20.2

table S5. Ratio of inferred scaling factor for the 3D viscosity profiles versus the 1D viscosity profile (VM-GPS). Shading indicates the calibration regions (same viscosity profile; see text).

Basin	Scale factor 3D/1D
1	1.01
2	1.07
3A	1.04
3B	1.08
4	1.01
5	-0.69
6	0.99
7A	1.18
7B	1.30

table S6. SLE mass change per basin since LGM.

Site	GPS rate	Elastic rate	GPS - elastic
MIK2	15.4 ± 0.2	8.4	7.0
KUAQ	23.8 ± 0.3	22.6	1.2

table S7. SLE mass change per basin during 1900–1983. Adopted from Kjeldsen el al, 2015 (*14*).

Basin	Green 1 SLE
	mm
1	0.30 ± 0.65
2	-0.65 ± 1.06
3A	0.21 ± 0.32
3B	2.91 ± 0.36
4	3.37 ± 0.58
5	1.84 ± 0.30
6	2.58 ± 1.61
7A	1.52 ± 0.32
7B*	5.23 ± 1.22
Total	17.29 ± 6.42