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Supplement of

Greenland Ice Sheet seasonal and spatial mass variability from model simulations and GRACE (2003–2012)

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Table S1. Timing of the seasonal cycle maximum and minimum for cumulative mass change (January 2003 – December 2012) for GRACE-LM, MAR v3.5.2, ISSM forced by MAR v3.5.2, and MAR v3.5.2 + ISSM, within the different regions of the ice sheet defined in Figure 12a, as well as the high (above 2000 m) and low (below 2000 m) elevation regions defined in Figure 1a. The 2.5 % and 97.5% bounds and median value for GRACE-LM are provided.

	< 2000 m	>2000 m	Reg 1	Reg 2	Reg 3	Reg 4	Reg 5	Reg 6	Reg 7	Reg 8	Reg 9
Maximum:											
GRACE (2.5 %)	22 Mar	20 Feb	7 Dec	7 Dec	21 Jan	20 Jun	11 Apr	2 Mar	18 Oct	28 Sep	11 Jan
GRACE median	21 Apr	22 Mar	27 Dec	21 Jan	1 Apr	30 Jun	11 May	11 Apr	20 Feb	11 Jan	10 Feb
GRACE (97.5%)	31 May	21 Apr	11 Jan	11 Apr	1 May	10 Jul	31 May	21 May	1 Apr	2 Mar	11 Apr
MAR v3.5.2	30 Apr	11 May	30 Apr	30 Apr	30 Apr	10 May	21 Apr	30 Apr	21 May	21 May	30 Apr
MAR v3.5.2 + ISSM	21 Apr	10 May	30 Apr	30 Apr	30 Apr	10 May	21 Apr	30 Apr	21 May	11 May	30 Apr
ISSM	21 Oct	1 Oct	10 Oct	10 Oct	1 Oct	1 Oct	21 Oct	10 Oct	1 Oct	10 Sep	1 Oct
Minimum:											
GRACE (2.5 %)	29 Aug	19 Aug	30 Jul	30 Jul	20 Jul	19 Aug	8 Sep	29 Aug	1 May	21 Apr	10 Jul
GRACE median	18 Sep	18 Sep	19 Aug	19 Aug	29 Aug	18 Sep	8 Oct	28 Sep	21 May	21 May	30 Jul
GRACE (97.5%)	28 Oct	27 Nov	8 Oct	8 Sep	28 Sep	18 Oct	28 Oct	17 Nov	30 Jul	9 Aug	18 Sep
MAR v3.5.2	30 Sep	31 Aug	20 Sep	21 Sep	20 Sep	20 Sep	1 Oct	20 Sep	21 Aug	11 Aug	10 Sep
MAR v3.5.2 + ISSM	30 Sep	31 Aug	20 Sep	20 Sep	20 Sep	20 Sep	1 Oct	20 Sep	21 Aug	11 Aug	10 Sep
ISSM	1 Jun	20 Jun	21 May	21 May	1 Jun	22 May	31 May	10 Jun	1 Jun	1 Jun	1 Jun

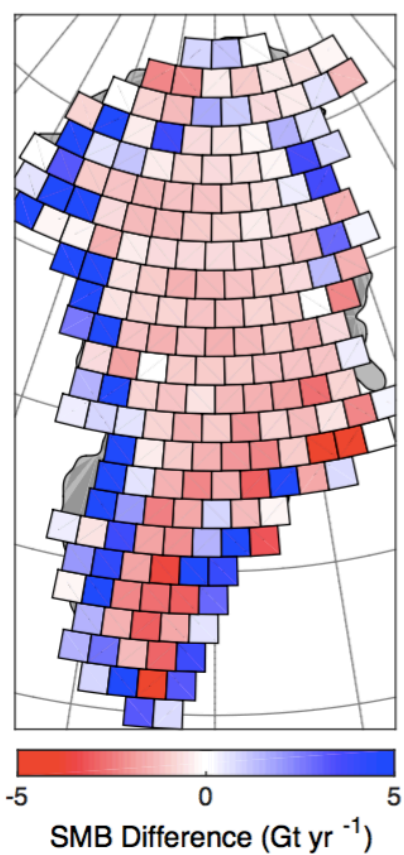


Figure S1. MAR v3.5.2 – MAR v2.0 average SMB, aggregated to the GRACE-LM grid, with no filtering applied, for the period January 2003 – December 2010.

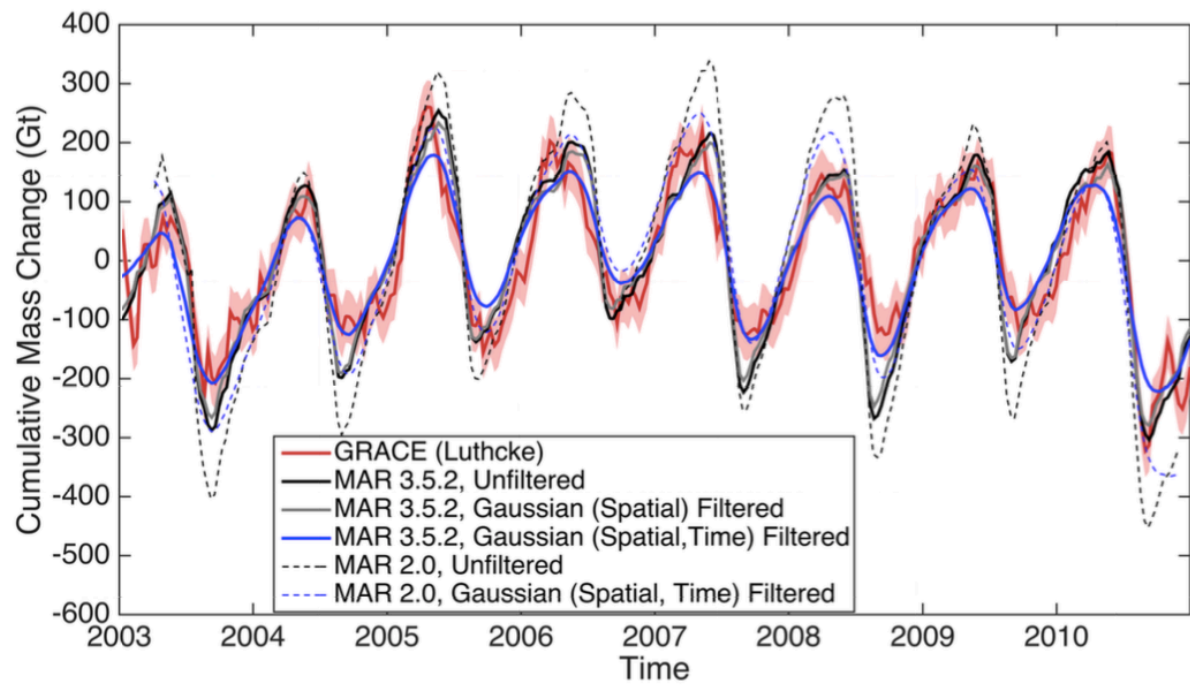


Figure S2: Same as Figure 4, but for MAR v3.5.2. Dashed lines show the MAR v2.0 detrended unfiltered and Gaussian-filtered timeseries for comparison with MAR v3.5.2.

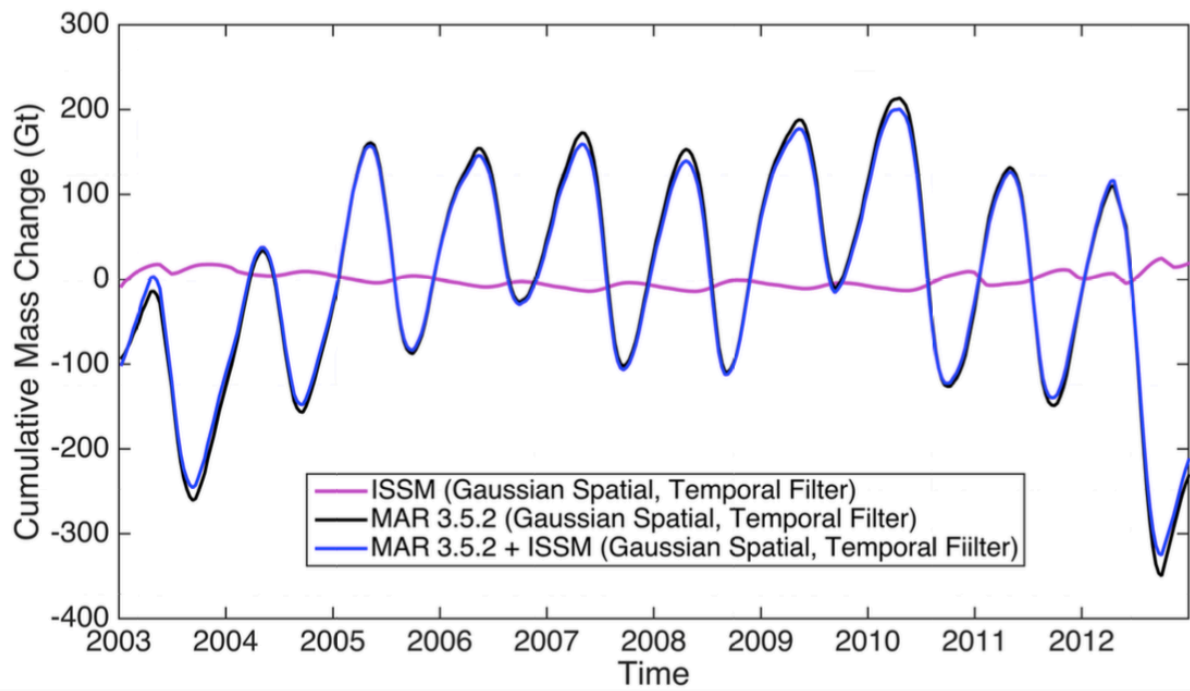


Figure S3: Detrended cumulative timeseries of Greenland mass change for MAR v3.5.2, ISSM, and MAR v3.5.2 + ISSM. Spatial and temporal Gaussian filtering has been applied to the model outputs.

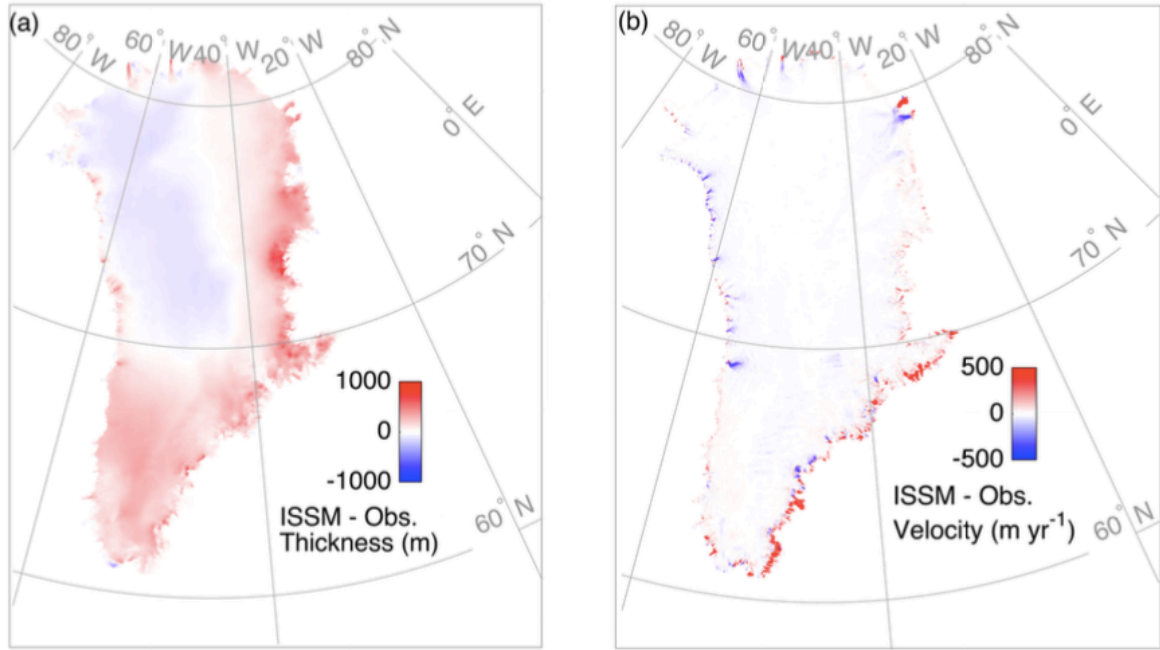


Figure S4: Difference between ISSM and observations for (a) Greenland Ice Sheet thickness (m), and (b) Annual ice velocities, for the year 2003. Thicknesses are obtained from Morlighem et al. (2015), and velocities are those of Rignot et al. (2012).

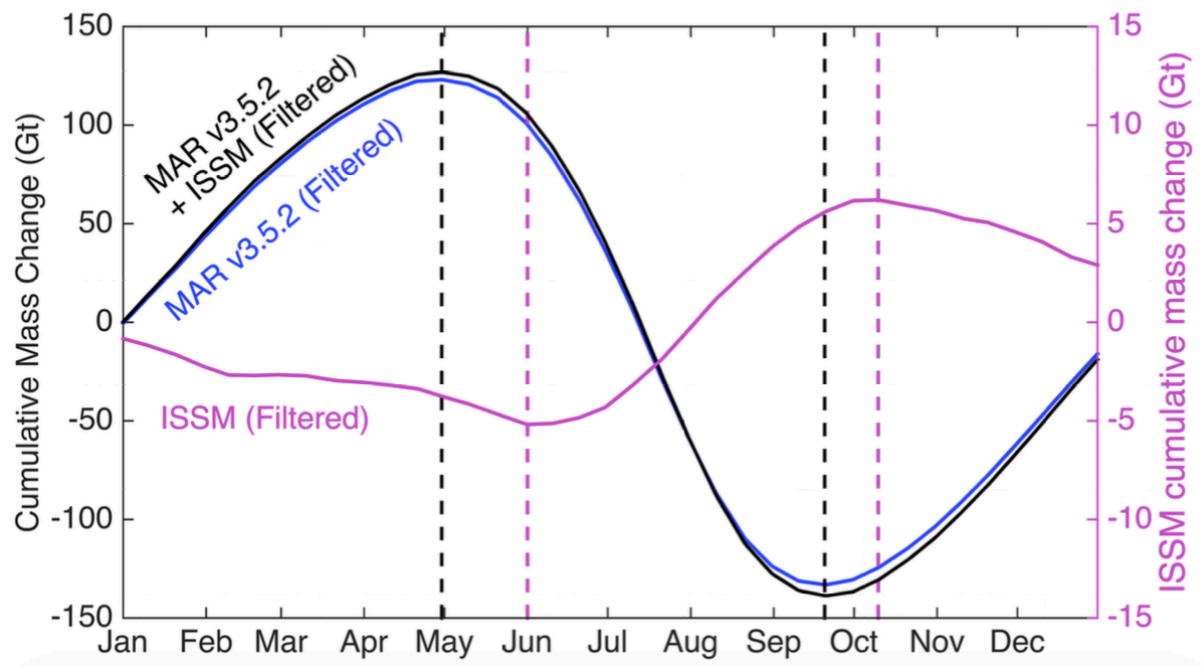


Figure S5: Same as Fig. 8b for MARv 3.5.2 + ISSM, MAR v3.5.2 and ISSM. Note a different axis is used for ISSM data.

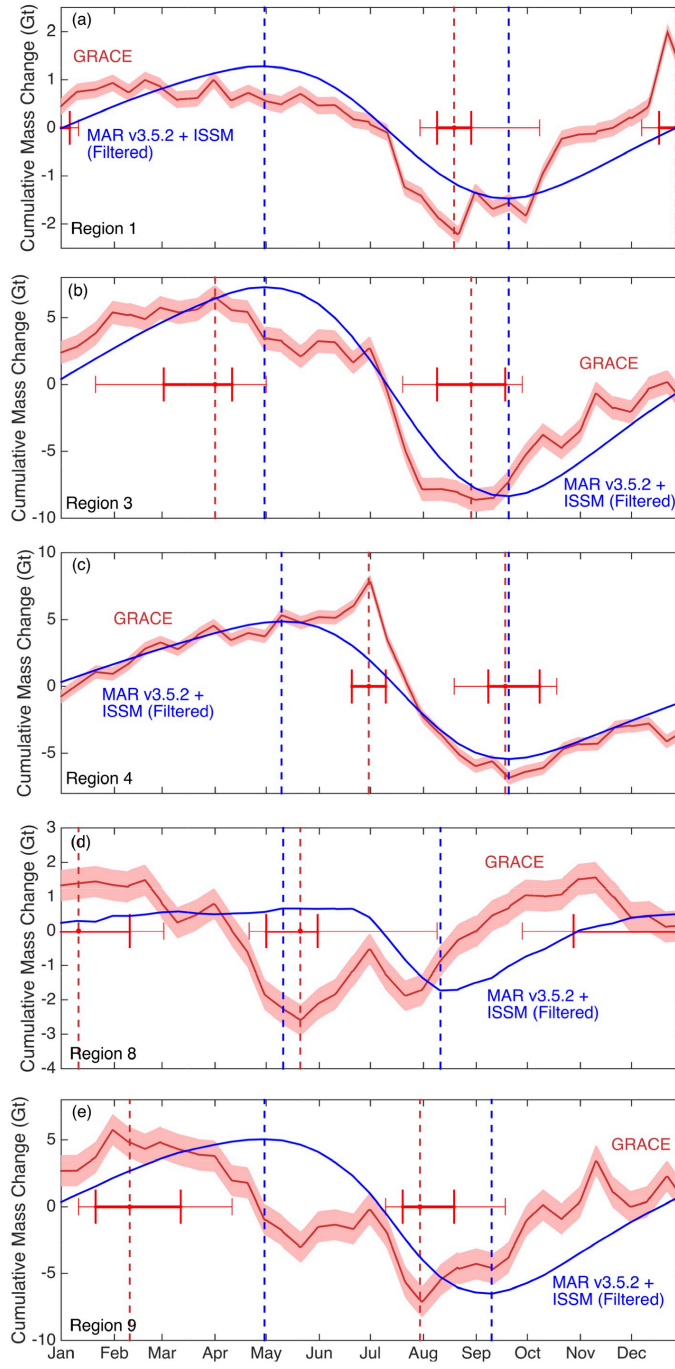


Figure S6: Same as Fig. 11b-e, but for additional regions shown in Fig. 11a: (a) Region 1, (b) Region 3, (c) Region 4, (d) Region 8, and (e) Region 9

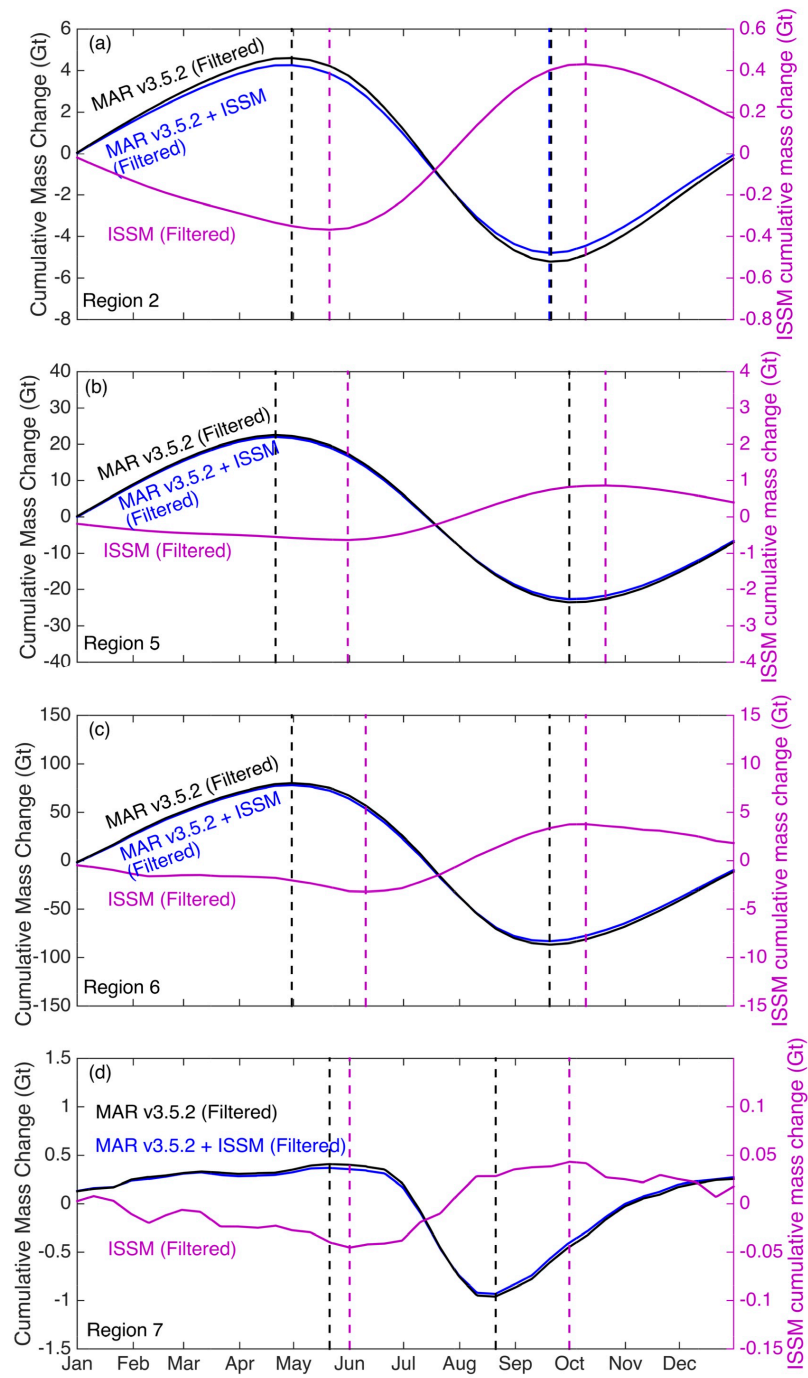


Figure S7: Same as Fig. 11b-e, but showing seasonal cycles for MAR v3.5.2, ISSM and MAR v3.5.2 + ISSM. Note the different axis for ISSM.

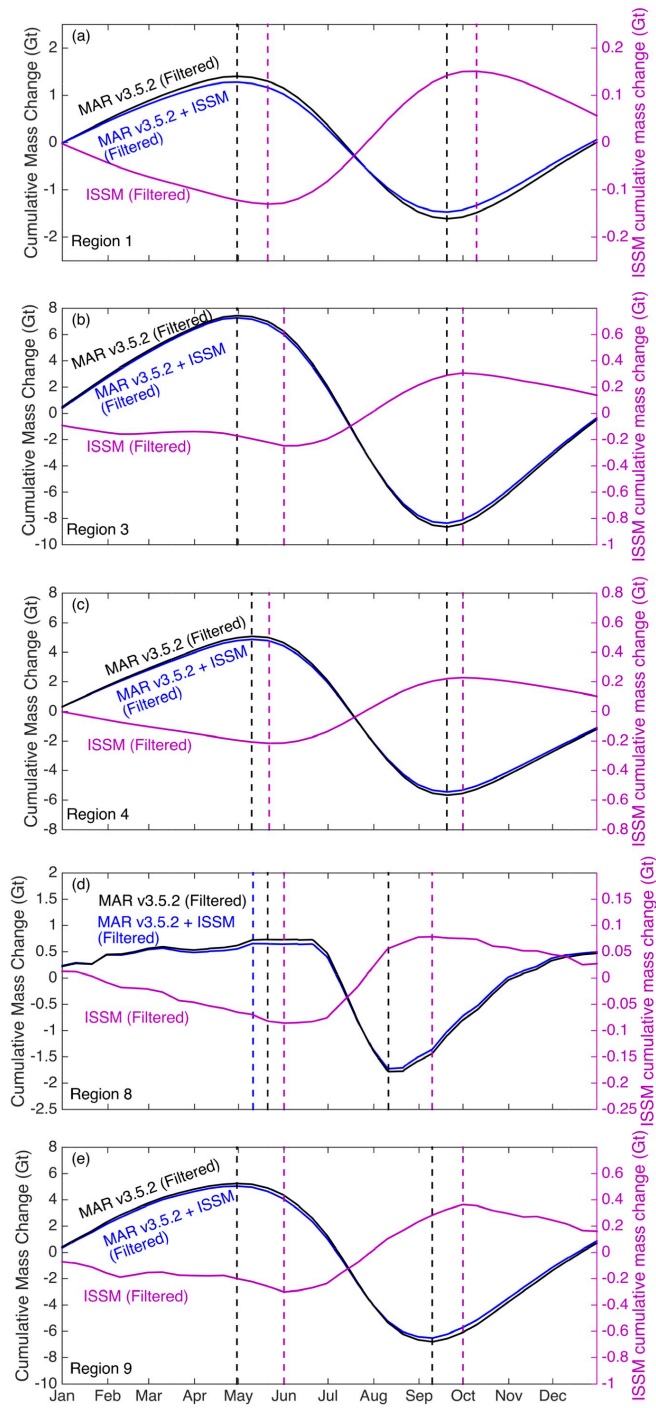


Figure S8: Same as Fig. S6, but showing seasonal cycles for MAR v3.5.2, ISSM and MAR v3.5.2 + ISSM. Note the different axis for ISSM.

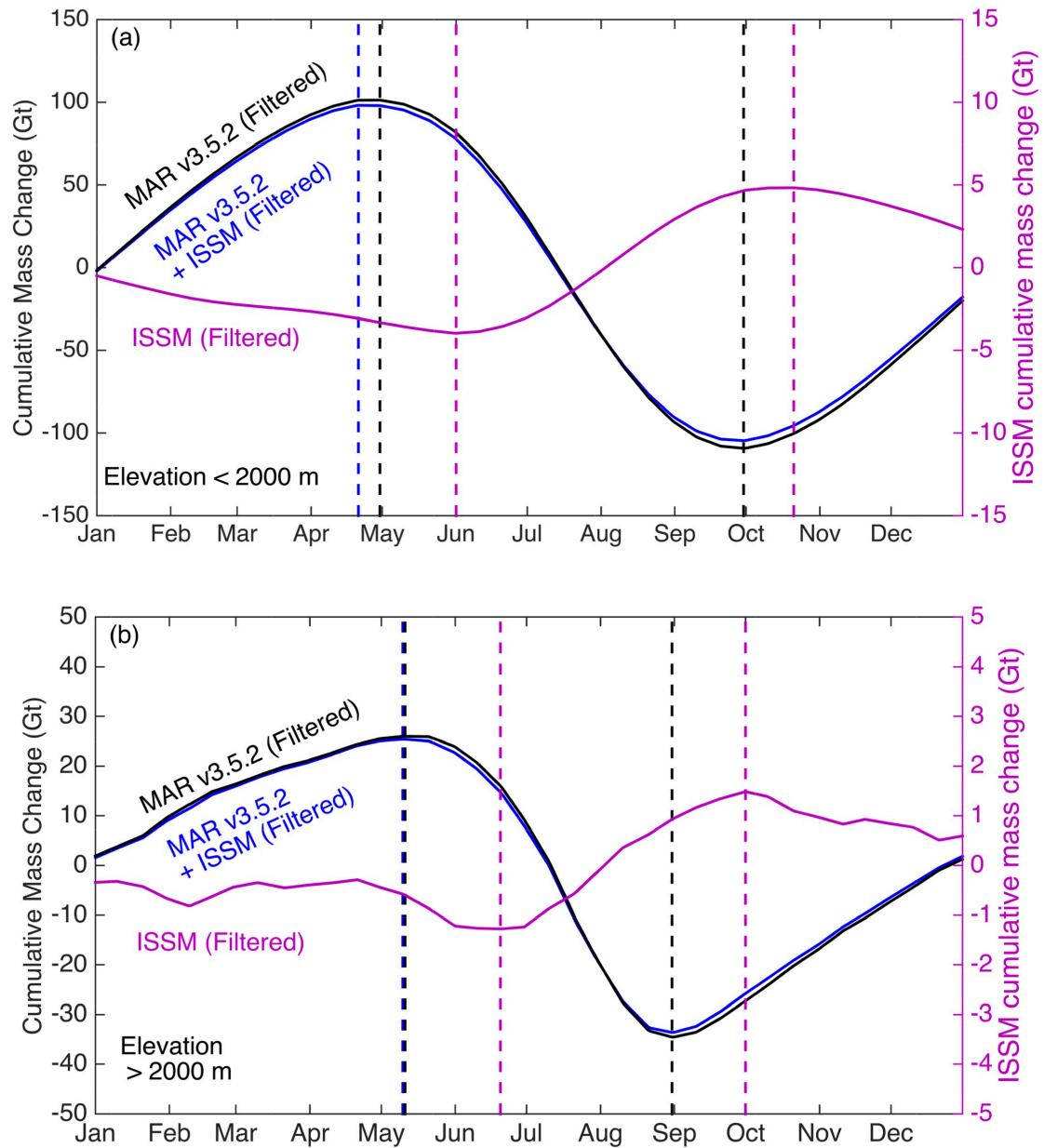


Figure S9: Same as Fig. 12, but showing seasonal cycles for MAR v3.5.2, ISSM and MAR v3.5.2 + ISSM. Note the different axis for ISSM.