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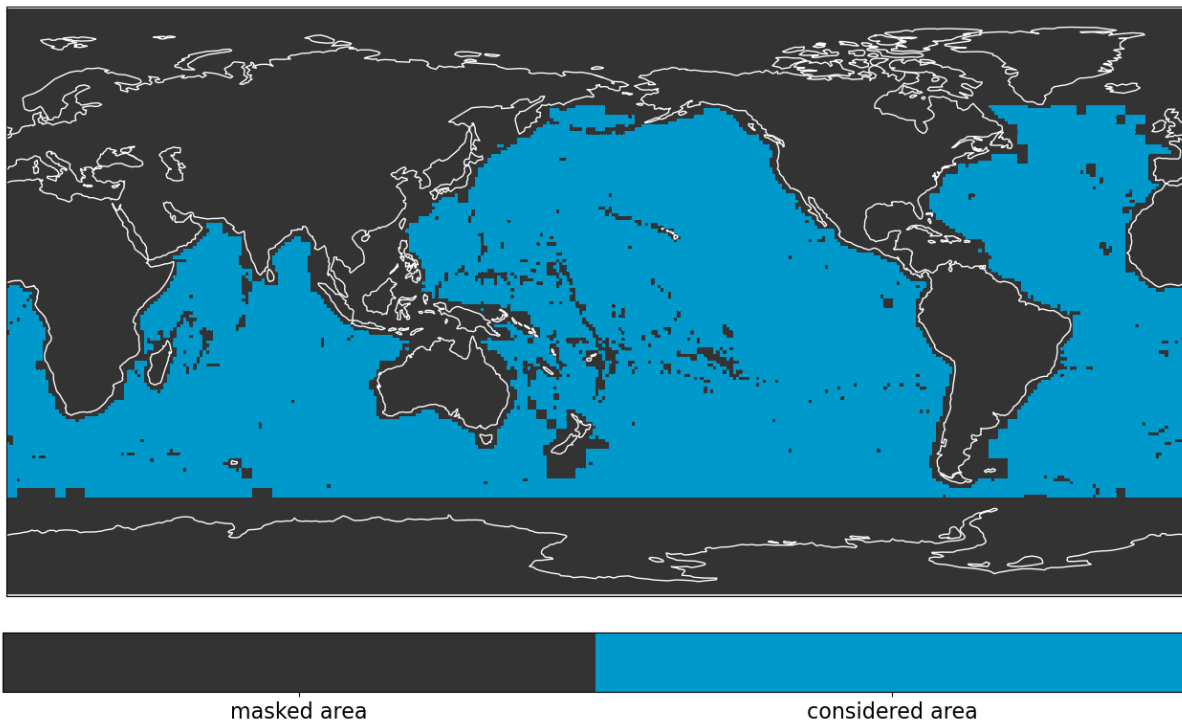
- Table S1 with the linear trends of all individual datasets, ensemble means, sum of contributions and budget residuals used in the study;
- Figure S1 showing the geographical mask applied to compute the global mean time series from gridded data,
- Figure S2 comparing the mascon and spherical harmonics GRACE/GRACE-FO datasets,
- Figure S3 comparing a gravimetry-based Greenland and Antarctic ice-sheet contributions from Velicogna et al. (2020) with the ensemble mean,
- Figures S4 and S5 showing the budgets presented in the main text using the mascon ensemble and the spherical harmonics ensemble separately (corresponding to Figures 5 and 6 of the main text respectively).

**Table S1: Linear trends of time series of datasets used in this study, ensemble means, sum of contributions and budget residuals. The last column indicates the figures to refer to.**

Time series	Linear trends (mm/yr)				Figures
	2005-2014	2015-2018	2005-2018 *2005-2016	2005-2020	
GMOM JPL MSC	1.92 ± 0.04	-0.05 ± 0.18	2.23 ± 0.03	2.13 ± 0.02	Fig. 1
GMOM CSR MSC	1.92 ± 0.04	-0.05 ± 0.18	2.23 ± 0.03	2.13 ± 0.02	
GMOM GSFC MSC	2.03 ± 0.04	0.46 ± 0.18	2.35 ± 0.03	2.26 ± 0.02	
GMOM JPL SH	1.88 ± 0.04	-0.23 ± 0.18	2.27 ± 0.03	2.20 ± 0.02	
GMOM CSR SH	1.93 ± 0.04	-0.36 ± 0.18	2.29 ± 0.03	2.20 ± 0.02	
GMOM GFZ SH	1.89 ± 0.04	-0.58 ± 0.18	2.18 ± 0.03	2.13 ± 0.02	
GMOM MSC and SH ensemble mean	1.93 ± 0.04	-0.13 ± 0.18	2.26 ± 0.03	2.17 ± 0.02	
GMOM MSC only ensemble mean	1.95 ± 0.02	0.12 ± 0.14	2.27 ± 0.02	2.17 ± 0.02	Fig. S2
GMOM SH only ensemble mean	1.90 ± 0.03	-0.39 ± 0.17	2.25 ± 0.02	2.17 ±	
GMOM MSC-SH difference	-0.05 ± 0.03	-0.51 ± 0.19	-0.03 ± 0.03	0.00 ± 0.02	
GIS Velicogna et al., 2020 (input-output)	0.83 ± 0.03	0.54 ± 0.11	0.76 ± 0.02	0.75 ± 0.02	Fig. 2
GIS IMBIE, 2021 (3 methods)	0.75 ± 0.03	0.39 ± 0.11	0.67 ± 0.02	0.67 ± 0.01	
GIS Simonsen et al., 2021 (altimetry)	0.87 ± 0.03	0.28 ± 0.11	0.74 ± 0.02	0.74 ± 0.02	
GIS Mankoff et al., 2021 (input-output method)	0.64 ± 0.03	0.96 ± 0.11	0.73 ± 0.02	0.74 ± 0.02	

GIS ensemble mean	$0.77 \pm 0.03$	$0.54 \pm 0.11$	$0.73 \pm 0.02$	$0.71 \pm 0.01$	
AIS Velicogna et al., 2020 (input-output method)	$0.34 \pm 0.02$	$0.00 \pm 0.10$	$0.35 \pm 0.02$	$0.30 \pm 0.02$	
AIS IMBIE, 2021 (3 methods)	$0.38 \pm 0.02$	$0.26 \pm 0.10$	$0.39 \pm 0.02$	$0.39 \pm 0.01$	
AIS ensemble mean	$0.36 \pm 0.02$	$0.13 \pm 0.10$	$0.35 \pm 0.02$	$0.36 \pm 0.01$	
GIS Velicogna et al., 2020 (gravimetry)	$0.84 \pm 0.03$	$0.44 \pm 0.11$	$0.75 \pm 0.02$	$0.73 \pm 0.02$	Fig. S3
AIS Velicogna et al., 2020 (gravimetry)	$0.33 \pm 0.02$	$0.02 \pm 0.10$	$0.31 \pm 0.02$	$0.34 \pm 0.01$	
Glaciers (Hugonnet et al., 2021)	$0.60 \pm 0.01$	$0.70 \pm 0.16$	$0.63 \pm 0.01$		Fig. 5
TWS ISBA-CTrip	$-0.11 \pm 0.13$	$-0.28 \pm 0.13$	$0.17 \pm 0.13$		Fig. 3
TWS WGHM GPC 100% irrigation	$0.41 \pm 0.20$	$0.81 \pm 0.20$	$0.62 \pm 0.20^*$		
TWS WGHM GPC 70% irrigation	$0.30 \pm 0.20$	$0.69 \pm 0.20$	$0.50 \pm 0.20^*$		
TWS WGHM CRU 100% irrigation	$0.43 \pm 0.20$	$0.90 \pm 0.20$	$0.61 \pm 0.20^*$		
TWS WGHM CRU 70% irrigation	$0.31 \pm 0.20$	$0.76 \pm 0.20$	$0.49 \pm 0.20^*$		
TWS WGHM mean	$0.36 \pm 0.20$	$0.79 \pm 0.20$	$0.56 \pm 0.20^*$		
TWS ISBA-CTrip - WGHM mean	$-0.47 \pm 0.24$	$0.23 \pm 0.24$	$-0.41 \pm 0.24^*$		
TWS ISBA-CTrip + HIC WGHM - WGHM mean	$-0.10 \pm 0.28$	$0.60 \pm 0.28$	$-0.04 \pm 0.28^*$		
GMSL C3S	$3.16 \pm 0.33$	$2.53 \pm 0.64$	$4.05 \pm 0.24$	$4.21 \pm 0.22$	Fig. 6
GMSL C3S - J3 CORR	$3.16 \pm 0.33$	$1.68 \pm 0.71$	$3.94 \pm 0.25$	$4.05 \pm 0.22$	
GMTSL EN 4.2.2 G10	$1.35 \pm 0.03$	$1.22 \pm 0.13$	$1.62 \pm 0.02$	$1.66 \pm 0.02$	Fig. 4
GMTSL IAP	$1.19 \pm 0.03$	$0.72 \pm 0.13$	$1.30 \pm 0.02$	$1.41 \pm 0.02$	
GMTSL IFREMER	$0.93 \pm 0.03$	$1.33 \pm 0.13$	$1.29 \pm 0.02$	$1.41 \pm 0.02$	
GMTSL Ishii	$1.24 \pm 0.03$	$0.98 \pm 0.13$	$1.50 \pm 0.02$	$1.57 \pm 0.02$	
GMTSL JAMSTEC	$1.34 \pm 0.03$	$1.16 \pm 0.13$	$1.58 \pm 0.02$	$1.59 \pm 0.02$	
GMTSL NOAA	$1.09 \pm 0.03$	$0.84 \pm 0.13$	$1.40 \pm 0.02$	$1.46 \pm 0.02$	
GMTSL SIO	$0.93 \pm 0.03$	$0.99 \pm 0.13$	$1.46 \pm 0.02$	$1.53 \pm 0.02$	
GMTSL ensemble mean	$1.15 \pm 0.03$	$1.03 \pm 0.13$	$1.45 \pm 0.02$	$1.52 \pm 0.02$	
Sum GIS+AIS+GLA+TWS	$1.99 \pm 0.03$	$1.46 \pm 0.16$	$2.24 \pm 0.02$		Fig. 5

<b>Residuals GMOM-(GIS+AIS+GLA+TWS)</b>	<b>-0.06 ± 0.06</b>	<b>-1.60 ± 0.36</b>	<b>0.03 ± 0.05</b>		
Sum GMSL-GMTSL	2.01 ± 0.05	1.50 ± 0.19	2.60 ± 0.03	2.69 ± 0.03	Fig. 6
Residuals GMOM-(GMSL-GMTSL)	-0.08 ± 0.33	-1.62 ± 0.69	-0.31 ± 0.25	-0.52 ± 0.22	
Sum GMSL <sub>J3C</sub> -GMTSL	2.01 ± 0.55	0.65 ± 0.20	2.49 ± 0.03	2.54 ± 0.03	
<b>Residuals GMOM-(GMSL<sub>J3C</sub>-GMTSL)</b>	<b>-0.08 ± 0.34</b>	<b>-0.90 ± 0.78</b>	<b>-0.24 ± 0.26</b>	<b>-0.38 ± 0.23</b>	
Sum GMTSL+GIS+AIS+GLA+TWS	3.14 ± 0.04	2.41 ± 0.18	3.69 ± 0.03		Fig. 7
<b>Residuals GMSL<sub>J3C</sub>-(GMTSL+GIS+AIS+ GLA+TWS)</b>	<b>0.02 ± 0.09</b>	<b>-0.81 ± 0.39</b>	<b>0.25 ± 0.06</b>		



**Figure S1: Mask used to compute the global means from gridded datasets. Blue areas are taken into account in the global mean.**

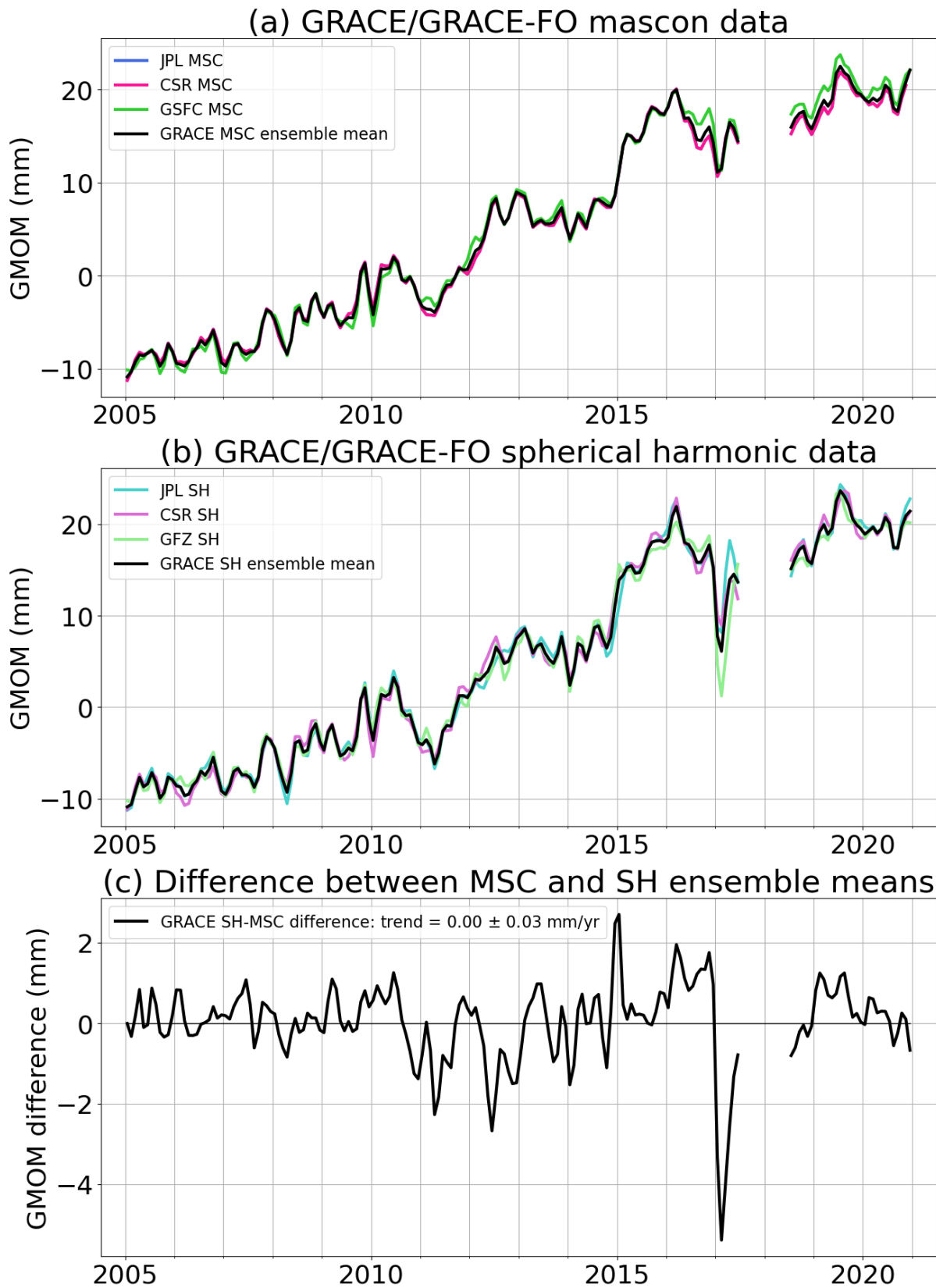


Figure S2: Comparison of GRACE/GRACE-FO mascon (MSC) and spherical harmonics (SH) GMOM time series. Linear trends over different periods of time are provided in Table S1. (a) MSC-based time series used in this study. (b) SH-based time series used in this study. (c) Difference between the MSC ensemble mean and the SH ensemble mean.

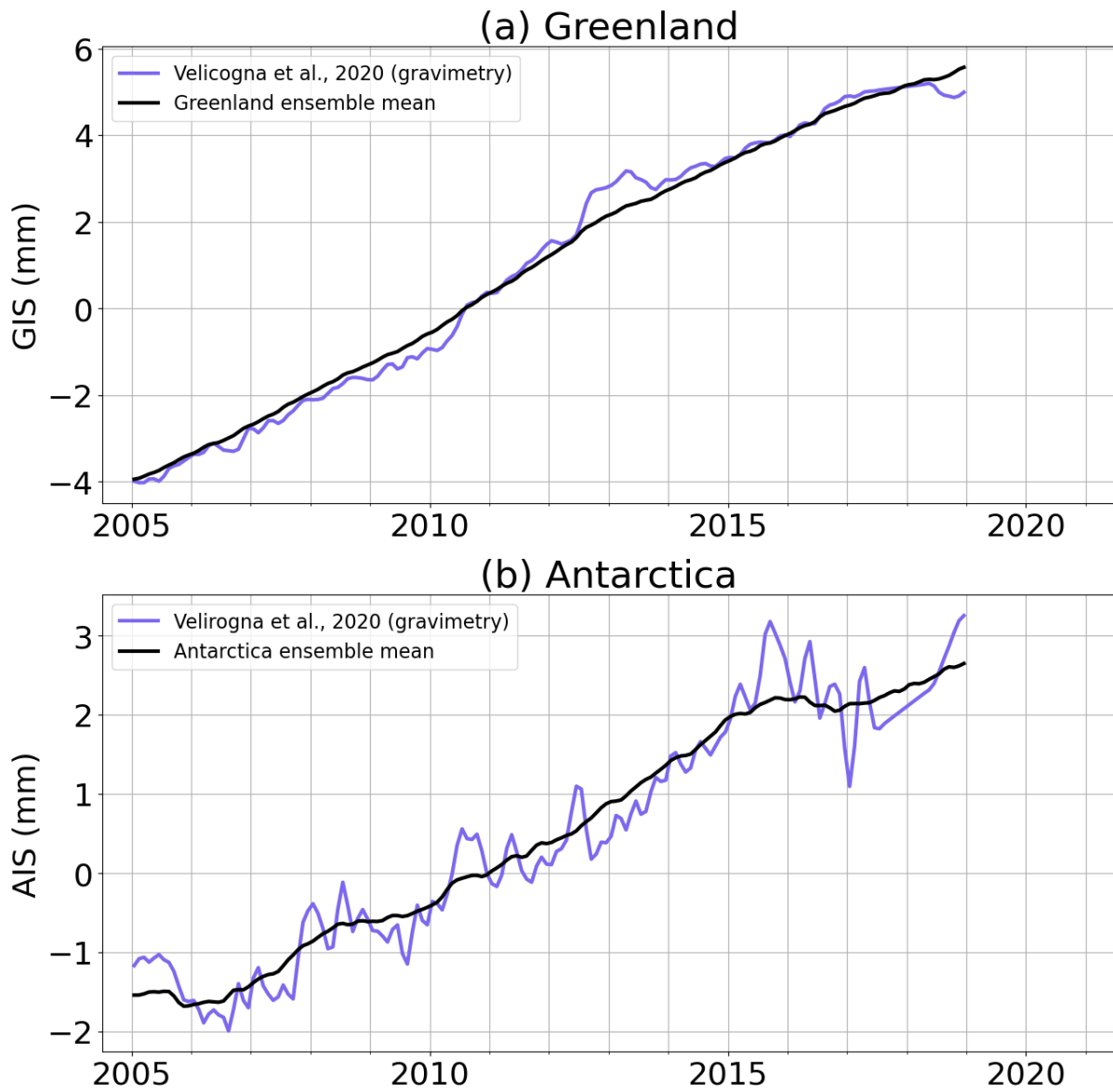
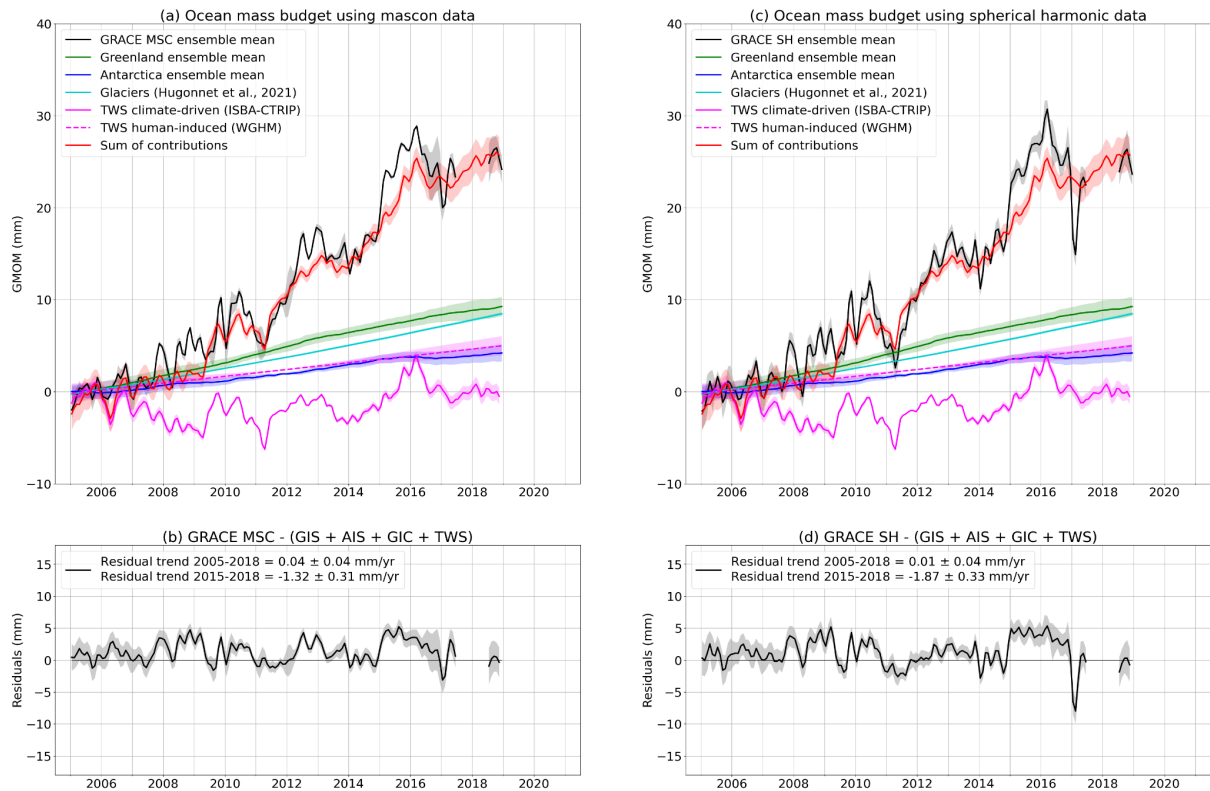
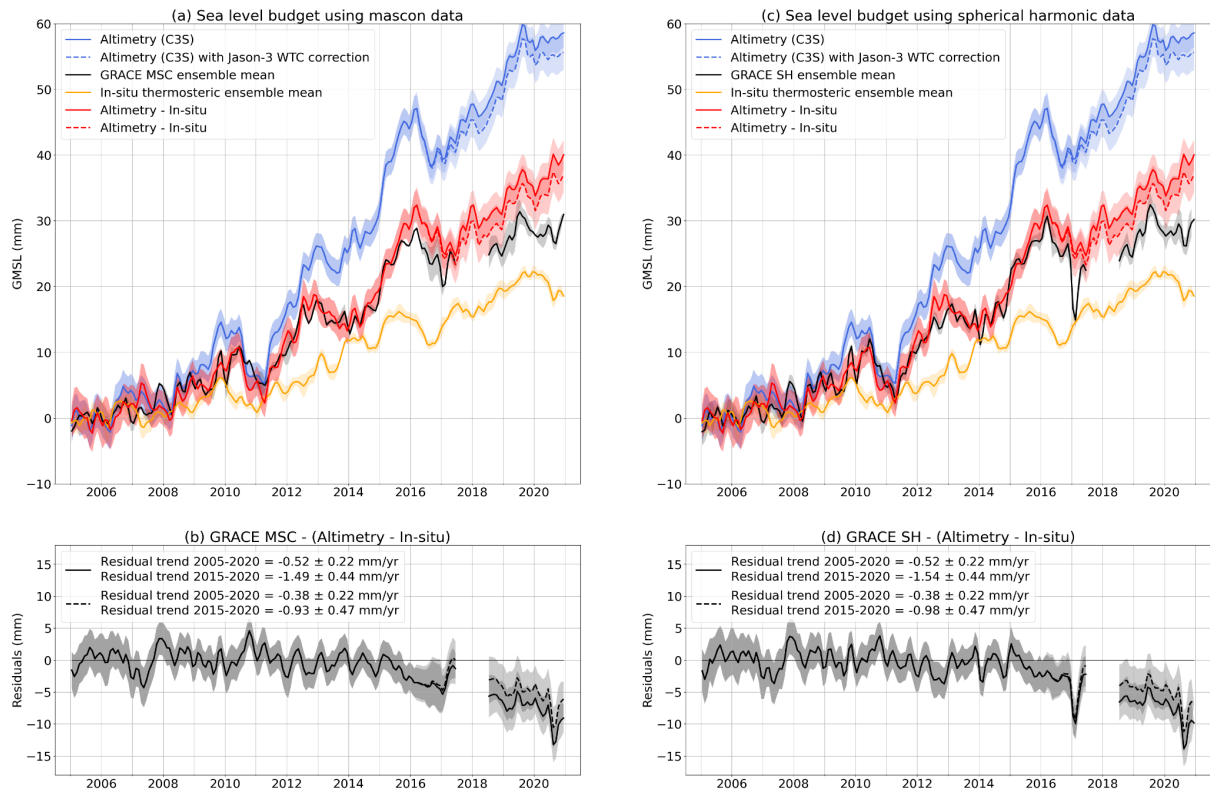


Figure S3: Comparison between the ensemble mean and the GRACE and GRACE-FO-based estimate from Velicogna et al. (2020) of ocean mass contributions of Greenland and Antarctica. Linear trends over different periods of time are provided in Table S1. (a) Greenland contribution. (b) Antarctica contribution.



**Figure S4: Ocean mass budget, same as figure 4 of the main text but using independently the mascon-based ensemble mean (a-b) and the spherical harmonics-based ensemble mean (c-d). (a) Budget with GRACE/GRACE-FO mascon-based global mean ocean mass (GMOM) variations and the sum of its contributions from Greenland, Antarctica, land glaciers and terrestrial water storage (TWS) variations. (b) Budget residuals. (c) Budget with GRACE/GRACE-FO SH-based global mean ocean mass (GMOM) variations and the sum of its contributions from Greenland, Antarctica, land glaciers and terrestrial water storage (TWS) variations. (d) Budget residuals. The budget and residuals are assessed without (solid lines) and with (dashed lines) adding an estimate of the human-induced contribution to the ISBA-CTRIP TWS estimate.**



**Figure S5: Sea level budget, same as figure 5 of the main text but using independently the mascon-based ensemble mean (a-b) and the spherical harmonics-based ensemble mean (c-d). (a) Budget with GRACE/GRACE-FO mascon-based global mean ocean mass (GMOM) variations compared to altimetry-based GMSL and Argo-based GMTSL. (b) Budget residuals. (c) Budget with GRACE/GRACE-FO SH-based global mean ocean mass (GMOM) variations compared to altimetry-based GMSL and Argo-based GMTSL. (d) Budget residuals. The budget and residuals are assessed without (solid lines) and with (dashed lines) correcting for the Jason-3 radiometer drift.**