Supplement of Ocean Sci., 19, 321–334, 2023
https://doi.org/10.5194/os-19-321-2023-supplement

Ocean Science Open Access EGU

Supplement of

Revisiting the global mean ocean mass budget over 2005–2020

Anne Barnoud et al.

Correspondence to: Anne Barnoud (anne.barnoud@magellium.fr)

This document contains:

- Figure S1 showing the geographical mask applied to compute the global mean time series from gridded data,
- Table S1 with the linear trends of all individual datasets, ensemble means, sum of contributions and budget residuals used in the study,
- 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,
- Figure S4 showing the deep ocean contribution to the global mean thermosteric sea level change as estimated from ORAS5 data,
- Figures S5 and S7 showing the budgets presented in Figures 6 and 7 respectively of the main text using the mascon ensemble and the spherical harmonics ensemble separately,
- Figure S6 showing the sea level budget comparing the altimetry-based GMSL to the GRACE-based GMOM and the Argo-based GMTSL without and with correcting for the Jason-3 WTC drift,
- Figure S8 showing the sea level budget comparing the altimetry-based GMSL to the Argo-based GMTSL and the sum of the individual mass contributions (equivalent to Figure 10 of the main text but using Argo instead of ORAS5).

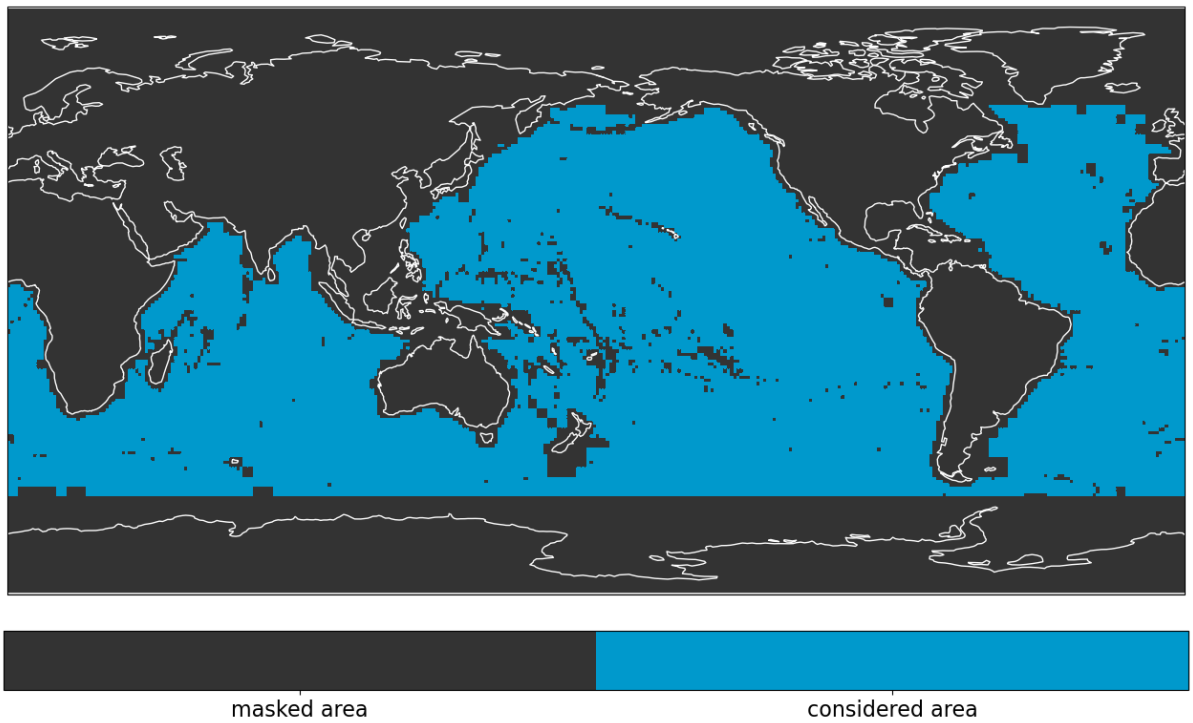

Figure S1: Mask used to compute the global means from gridded datasets. Blue areas are taken into account in the global mean.

Table S1: Linear trends of time series of datasets used in this study, ensemble means and budget residuals. The last column indicates the figures to refer to. Trends are computed from 1st January to 31st December of the specified years.

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	2.00 ± 0.04	-0.15 ± 0.18	2.34 ± 0.03	2.24 ± 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	1.94 ± 0.04	-0.15 ± 0.18	2.28 ± 0.03	2.19 ± 0.02	
GMOM MSC only ensemble mean	1.98 ± 0.03	0.09 ± 0.17	2.31 ± 0.02	2.21 ± 0.02	Fig. S2
GMOM SH only ensemble mean	1.90 ± 0.03	-0.39 ± 0.17	2.25 ± 0.02	2.17 ± 0.02	
GMOM MSC-SH difference	-0.08 ± 0.04	-0.48 ± 0.20	-0.06 ± 0.03	-0.03 ± 0.02	
GIS Velicogna et al., 2020 (input-output method)	0.83 ± 0.02	0.54 ± 0.11	0.76 ± 0.02		Fig. 2
GIS IMBIE, 2021 (3 methods)	0.75 ± 0.02	0.39 ± 0.11	0.67 ± 0.02		
GIS ensemble mean	0.79 ± 0.02	0.46 ± 0.11	0.72 ± 0.02		
AIS Velicogna et al., 2020 (input-output method)	0.34 ± 0.02	0.00 ± 0.12	0.31 ± 0.02		
AIS IMBIE, 2021 (3 methods)	0.38 ± 0.02	0.26 ± 0.12	0.39 ± 0.02		
AIS ensemble mean	0.36 ± 0.02	0.13 ± 0.12	0.35 ± 0.02		
GIS Velicogna et al., 2020 (gravimetry)	0.84 ± 0.02	0.44 ± 0.12	0.75 ± 0.02		Fig. S3
AIS Velicogna et al., 2020 (gravimetry)	0.33 ± 0.02	0.02 ± 0.12	0.35 ± 0.02		
Glaciers (Hugonnet et al., 2021)	0.60 ± 0.01	0.70 ± 0.16	0.63 ± 0.01		Fig. 6
TWS ISBA-CTRIP	-0.11 ± 0.13	-0.28 ± 0.13	0.17 ± 0.13		Fig. 3
TWS WGHM GPCC 100% irrigation	0.41 ± 0.20	0.81 ± 0.20	0.62 ± 0.20*		
TWS WGHM GPCC 70% irrigation	0.30 ± 0.20	0.69 ± 0.20	0.50 ± 0.20*		
TWS WGHM CRU 100% irrigation	0.43 ± 0.20	0.90 ± 0.20	0.61 ± 0.20*		
TWS WGHM CRU 70% irrigation	0.31 ± 0.20	0.76 ± 0.20	0.49 ± 0.20*		

TWS WGHM mean	0.36 ± 0.20	0.79 ± 0.20	0.56 ± 0.20*		
TWS ISBA-CTRIP - WGHM mean	-0.47 ± 0.24	0.23 ± 0.24	-0.41 ± 0.24*		
TWS ISBA-CTRIP + HIC WGHM - WGHM mean	-0.10 ± 0.28	0.60 ± 0.28	-0.04 ± 0.28*		
AWV ERA5	-0.04	0.08	-0.08		Fig. 6
GMSL C3S	3.16 ± 0.33	2.53 ± 0.64	4.05 ± 0.24	4.21 ± 0.22	Fig. S6
$GMSL_{J3D}$ C3S (corrected for Jason-3 WTC drift)	3.16 ± 0.33	1.68 ± 0.71	3.94 ± 0.25	4.05 ± 0.22	Fig. 7
GMTSL EN 4.2.2 G10	1.35 ± 0.06	1.22 ± 0.23	1.62 ± 0.04	1.66 ± 0.03	Fig. 5
GMTSL IAP	1.19 ± 0.06	0.72 ± 0.23	1.30 ± 0.04	1.41 ± 0.03	
GMTSL IFREMER	0.93 ± 0.06	1.33 ± 0.23	1.29 ± 0.04	1.41 ± 0.03	
GMTSL Ishii	1.24 ± 0.06	0.98 ± 0.23	1.50 ± 0.04	1.57 ± 0.03	
GMTSL JAMSTEC	1.34 ± 0.06	1.16 ± 0.23	1.58 ± 0.04	1.59 ± 0.03	
GMTSL NOAA	1.09 ± 0.06	0.84 ± 0.23	1.40 ± 0.04	1.46 ± 0.03	
GMTSL SIO	0.93 ± 0.06	0.99 ± 0.23	1.46 ± 0.04	1.53 ± 0.03	
GMTSL Argo ensemble mean	1.15 ± 0.06	1.03 ± 0.23	1.45 ± 0.04	1.52 ± 0.03	
GMTSL ORAS5	1.48	1.25	1.67	1.77	
GMTSL CERES (with ORAS5 trend)	1.59	2.27	1.77	1.77	
Residuals GMOM-(GIS+AIS+GLA+TWS+AWV)	-0.03 ± 0.06	**-1.56 ± 0.37**	0.014 ± 0.05		Fig. 6
Residuals GMOM-(GMSL-$GMTSL_{Argo}$)	-0.07 ± 0.35	**-1.64 ± 0.88**	-0.29 ± 0.27	-0.50 ± 0.23	Fig. S6
Residuals GMOM-($GMSL_{J3D}$-$GMTSL_{Argo}$)	-0.07 ± 0.36	**-0.92 ± 0.95**	-0.23 ± 0.27	-0.36 ± 0.23	Fig. 7
Residuals GMOM-($GMSL_{J3D}$-$GMTSL_{ORAS5}$)	0.26 ± 0.34	**-0.66 ± 0.76**	0.01 ± 0.26	-0.09 ± 0.22	Fig. 8
Residuals GMOM-($GMSL_{J3D}$-$GMTSL_{CERES}$)	0.33 ± 0.34	**0.31 ± 0.76**	0.05 ± 0.26	-0.06 ± 0.24	Fig. 9
Residuals $GMSL_{J3D}$-(GMTSL+GIS+AIS+GLA+TWS+AWV)	0.02 ± 0.09	**-0.81 ± 0.39**	0.25 ± 0.06		Fig. S8
Residuals $GMSL_{J3D}$-($GMTSL_{ORAS5}$+GIS+AIS+GLA+TWS+AWV)	-0.29 ± 0.08	**-1.06 ± 0.37**	0.12 ± 0.06		Fig. 10

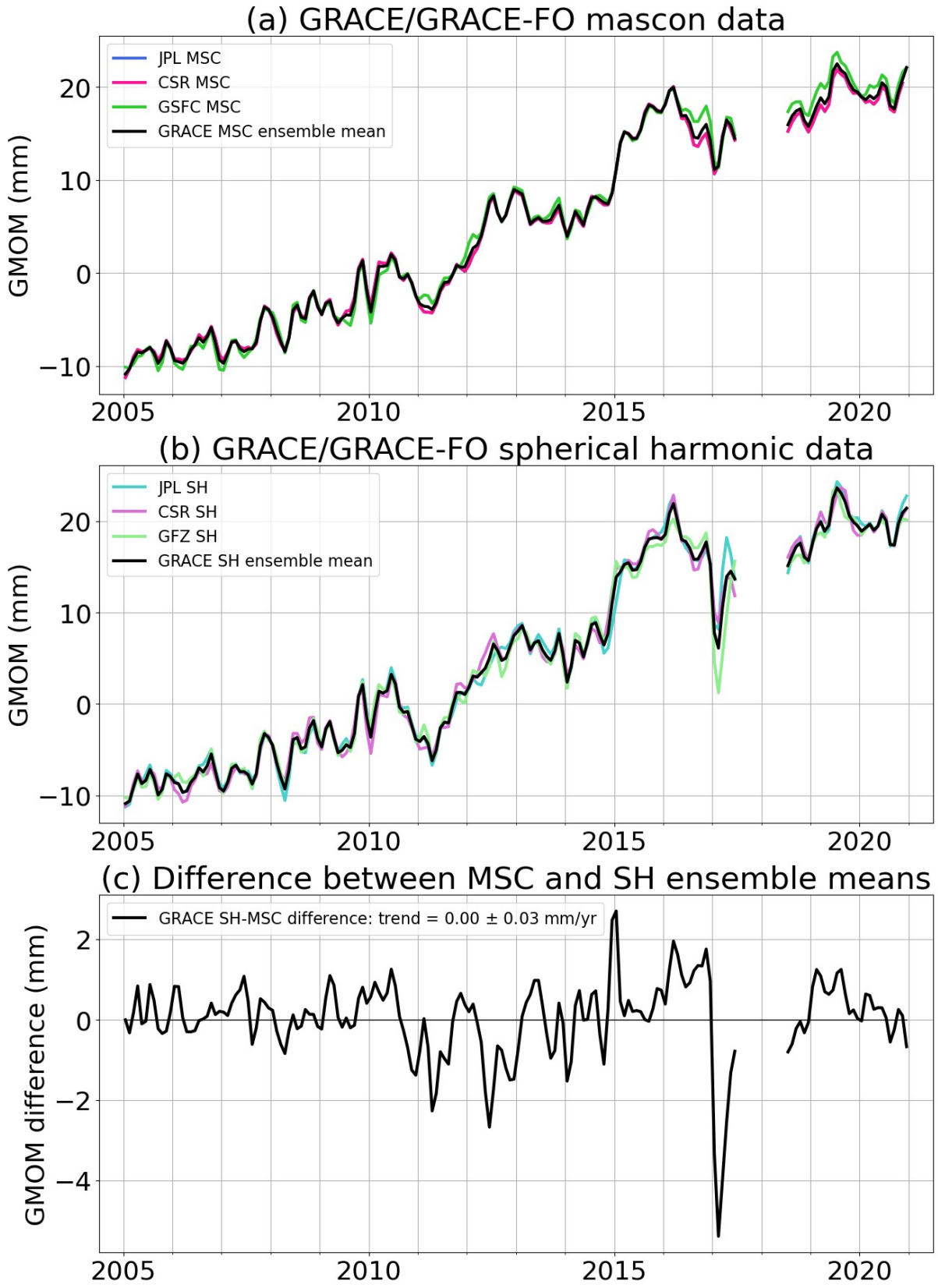

Figure S2: Comparison of GRACE/GRACE-FO mascon (MSC) and spherical harmonics (SH) GMOM time series. Linear trends over different periods of time are provided in Table S1. (a) MSC-based time series used in this study. (b) SH-based time series used in this study. (c) Difference between the MSC ensemble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

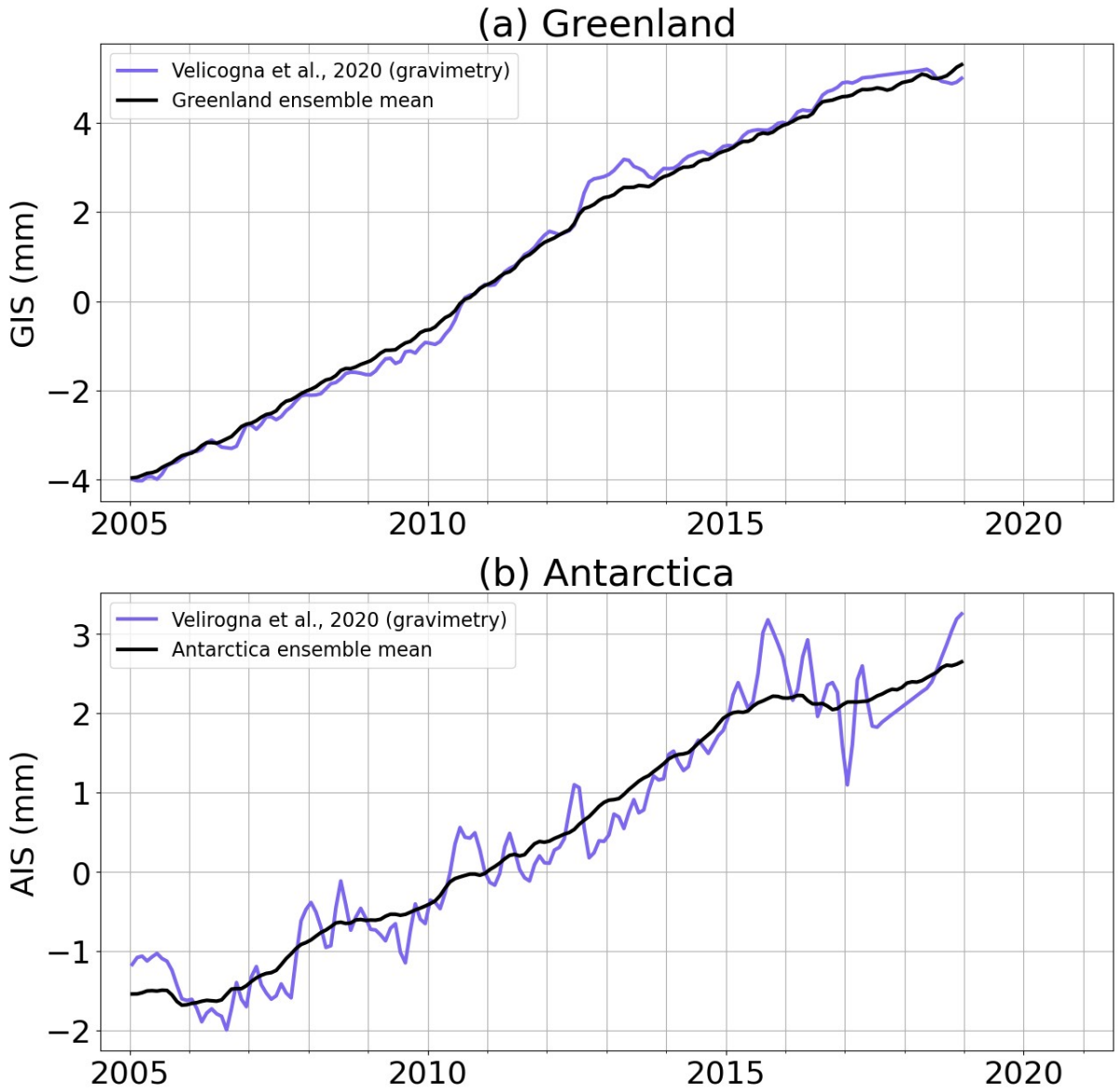

Figure S3: Comparison between the ensemble mean and the GRACE and GRACE-FO-based estimate from Velicogna et al. (2020) of ocean mass contributions of Greenland and Antarctica. Linear trends over different periods of time are provided in Table S1. (a) Greenland contribution. (b) Antarctica contribution.

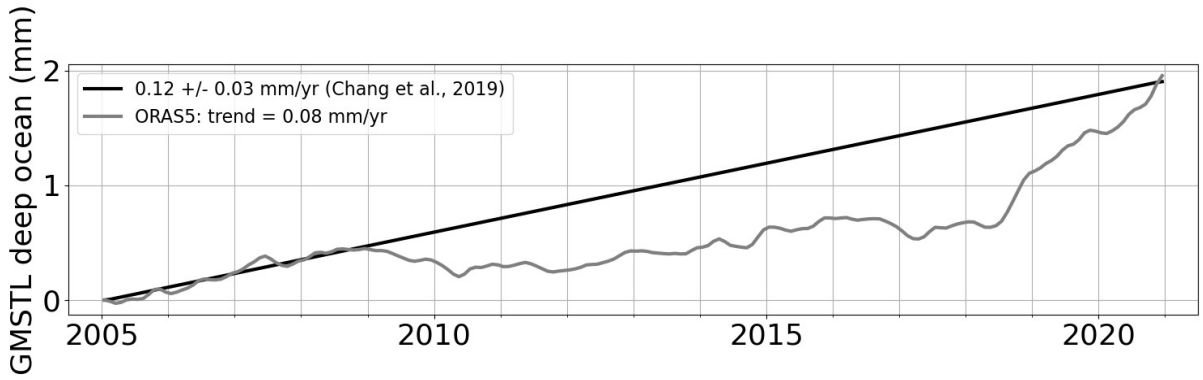

Figure S4: Deep ocean contribution to the global mean thermosteric sea level (GMTSL): comparison between the ORAS5 data computed between 2000 and 6000 m depth and the linear estimate from Chang et al. (2019).

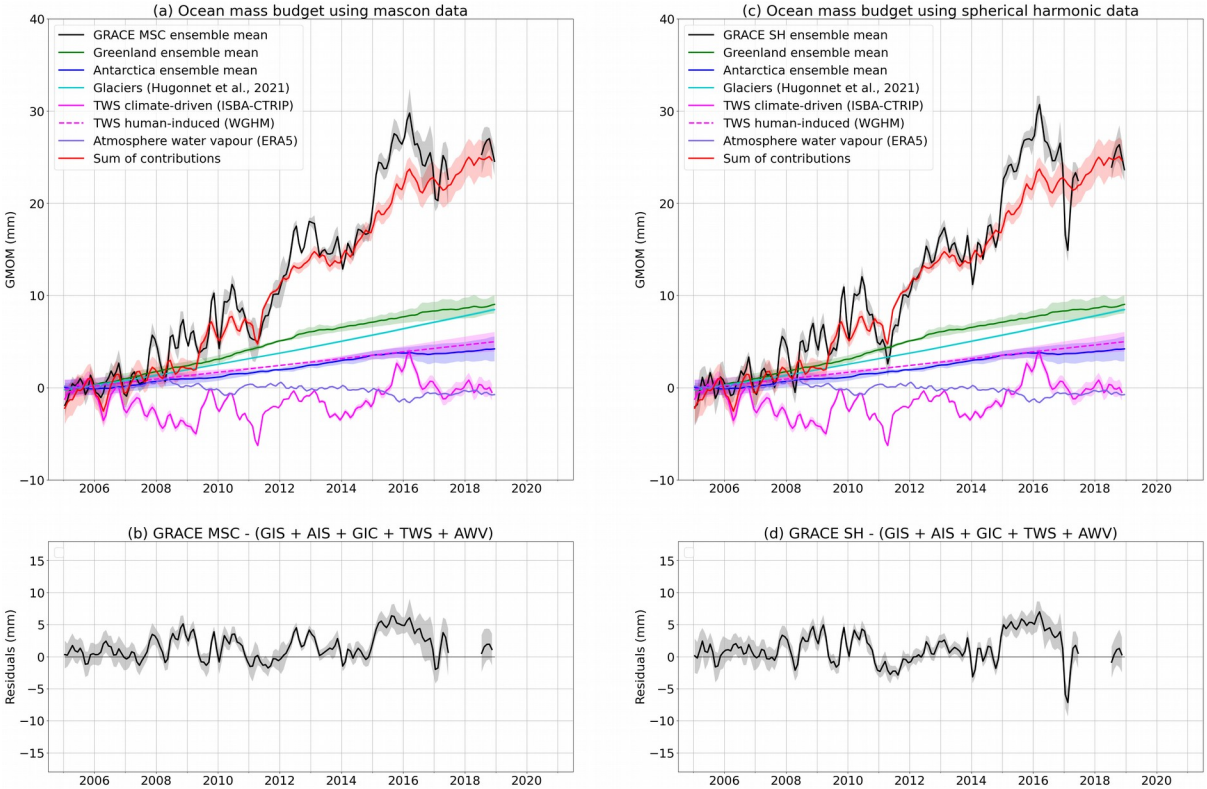

Figure S5: Ocean mass budget, same as figure 4 of the main text but using independently the mascon-based ensemble mean (a-b) and the spherical harmonics-based ensemble mean (c-d). (a) Budget with GRACE/GRACE-FO mascon-based global mean ocean mass (GMOM) variations and the sum of its contributions from Greenland, Antarctica, land glaciers, terrestrial water storage (TWS) and atmospheric water vapour 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, terrestrial water storage (TWS) and atmospheric water vapour 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.

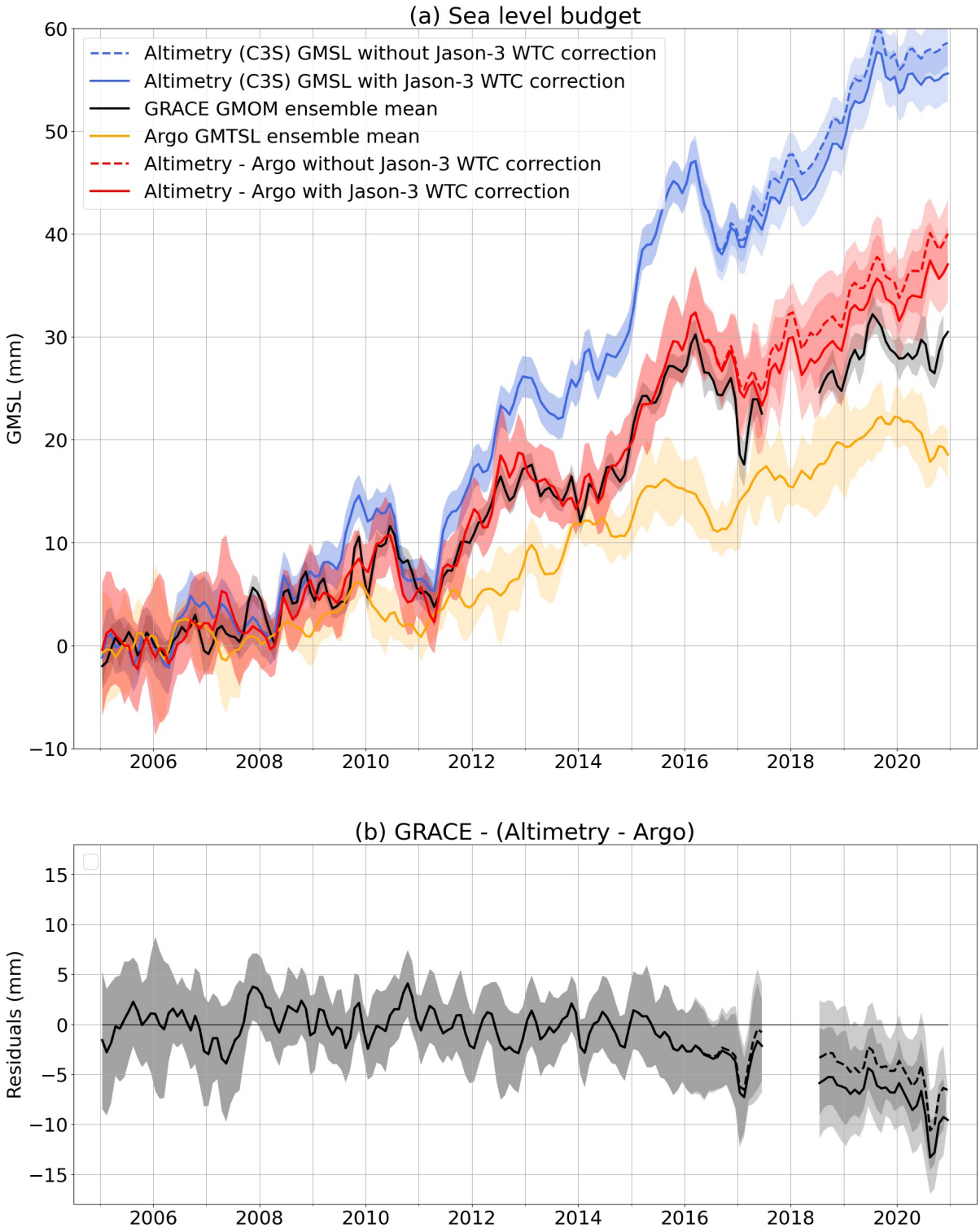

Fig S6: Comparison of the sea level budget without and with the Jason-3 WTC correction. (a) Budget with GRACE/GRACE-FO based global mean ocean mass (GMOM) variations compared to altimetry-based GMSL and Argo-based GMTSL. (b) Budget residuals. The budget and residuals are assessed without (dashed lines) and with (solid lines) correcting for the Jason-3 radiometer WTC drift.

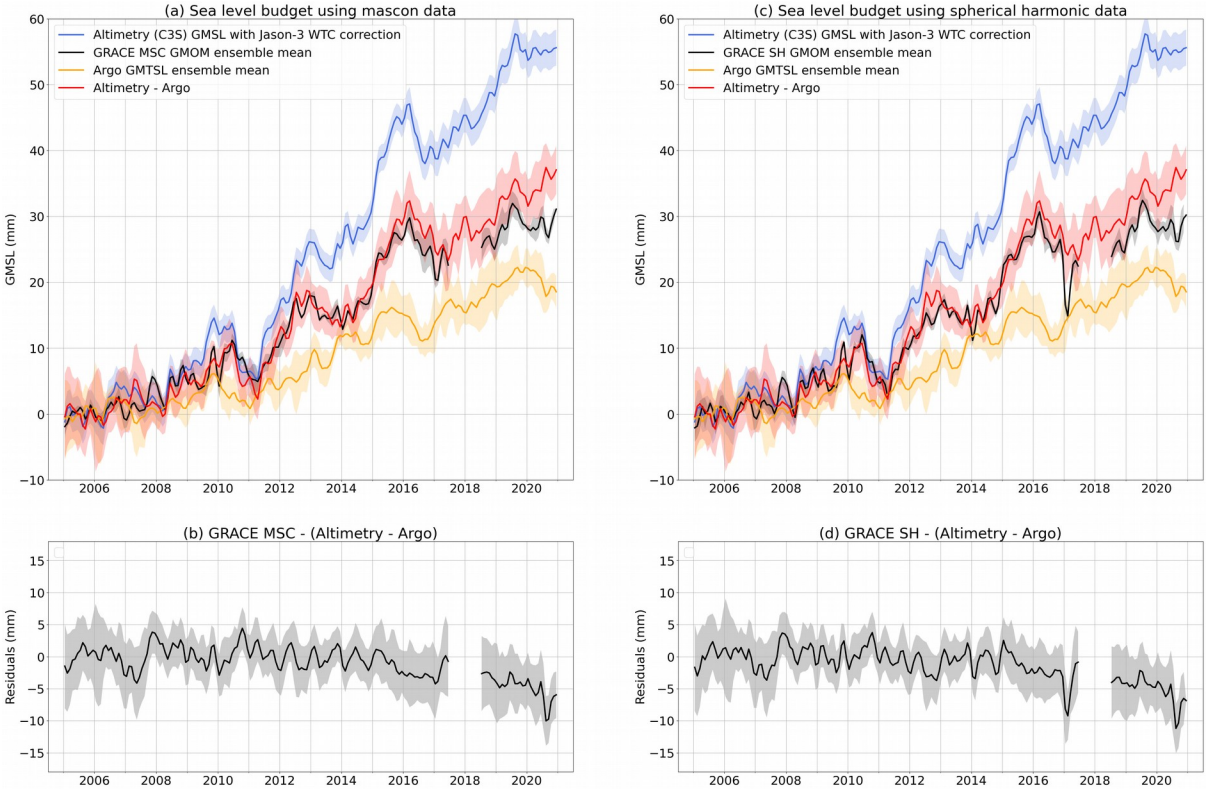

Figure S7: Sea level budget, same as Figure 6 of the main text but using independently the mascon-based ensemble mean (a-b) and the spherical harmonics-based ensemble mean (c-d). (a) Budget with GRACE/GRACE-FO mascon-based global mean ocean mass (GMOM) variations compared to altimetry-based GMSL (corrected for the Jason-3 WTC drift) 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 (corrected for the Jason-3 WTC drift) and Argo-based GMTSL. (d) Budget residuals.

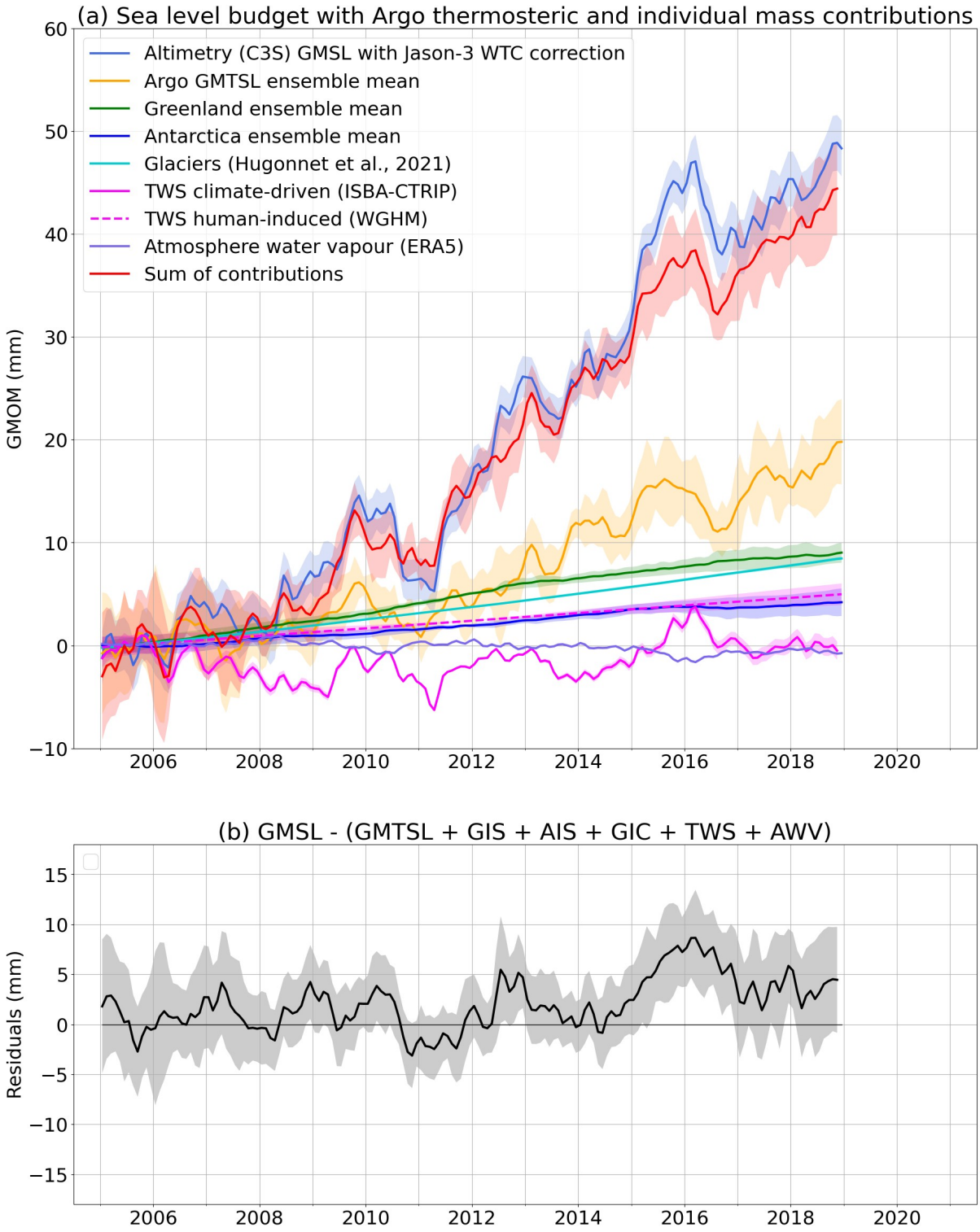

Fig S8: Sea level budget comparing the altimetry-based GMSL with the Argo-based GMTSL and the sum of the individual mass contributions. (a) Sea level budget using the Argo-based GMTSL and taking into account the Jason-3 radiometer drift correction. (b) Budget residuals. Linear trends of all components over different periods of time are provided in Table S1.