Sea level rise and variability : How accurate is accurate enough?

Benoit Meyssignac, A.Blazquez, J.Chenal et de nombreux autres coauteurs

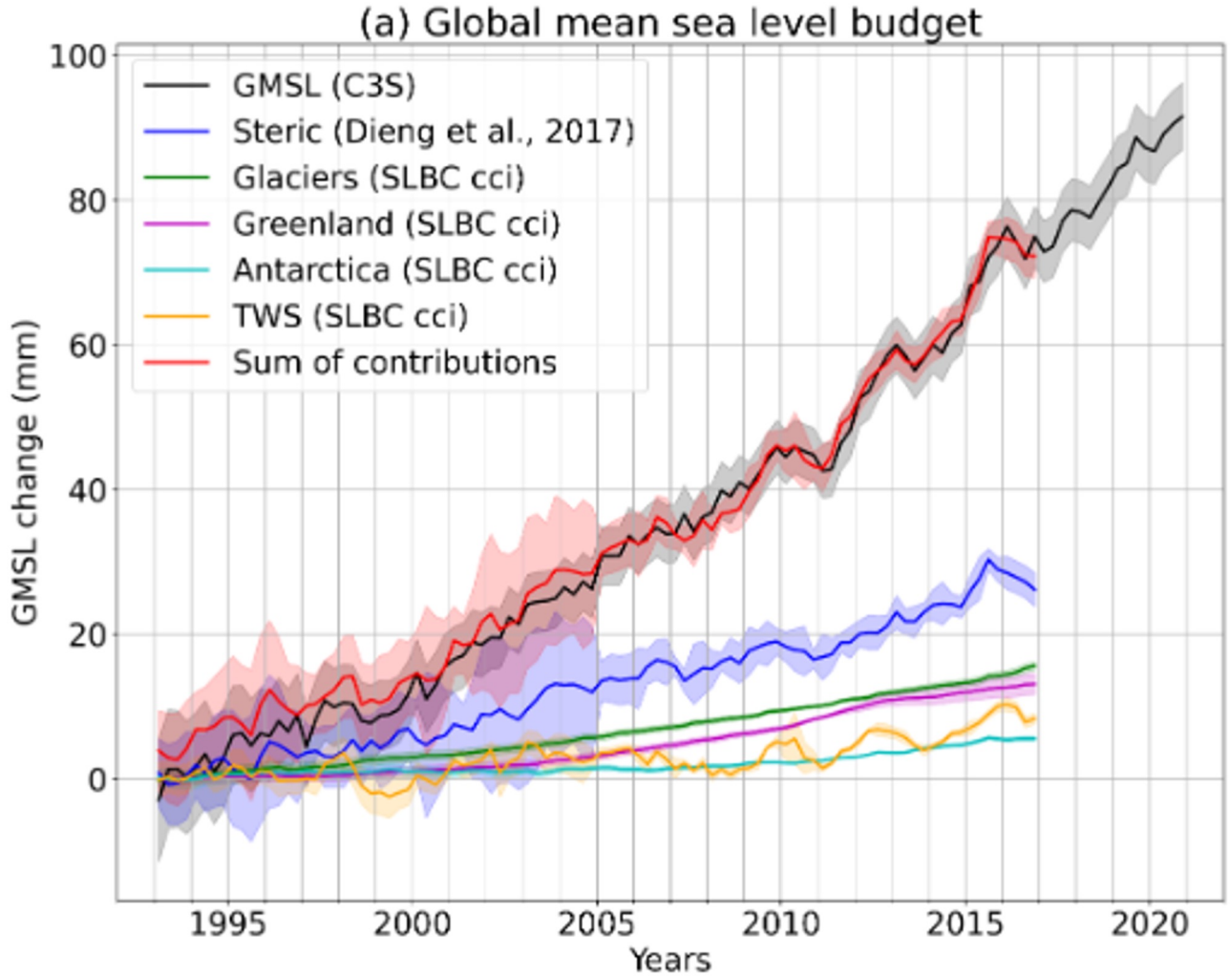
How accurate is accurate enough?

GMSL changes measured by

satellite altimetry (black curve) from the Copernicus Climate Change Service (C3S) vDT2021 data with uncertainties at 10 days (5-95% CL, black shaded area)

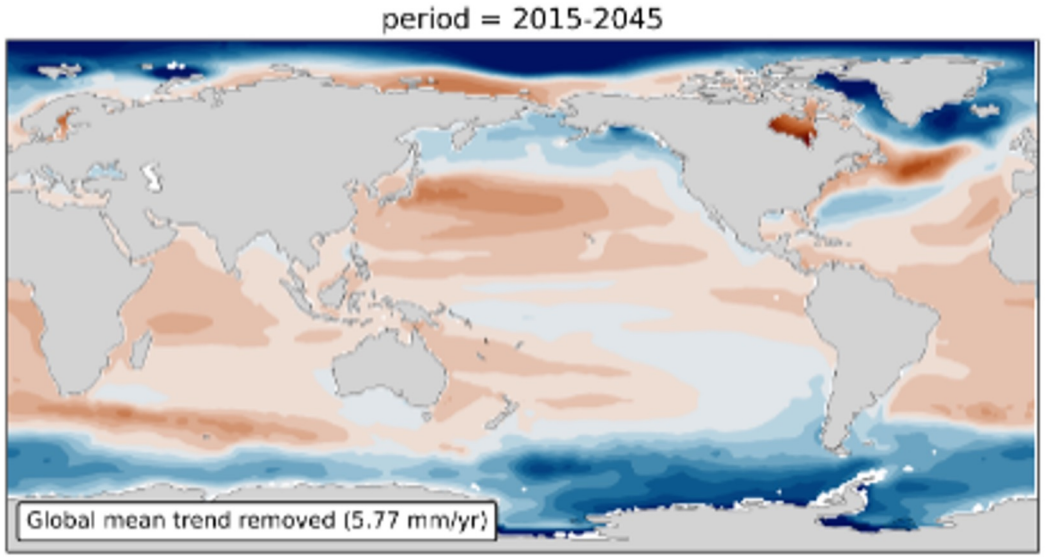
different contributions to sea level changes from the Sea Level Budget Closure climate change initiative (SLBC cci)

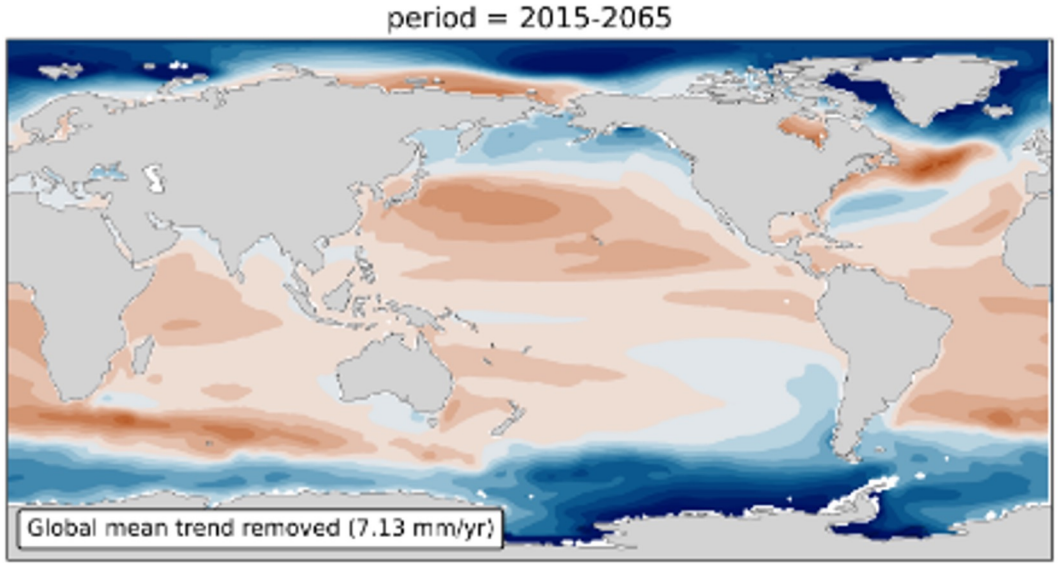
The red curve is the sum of the contributions to sea level rise.

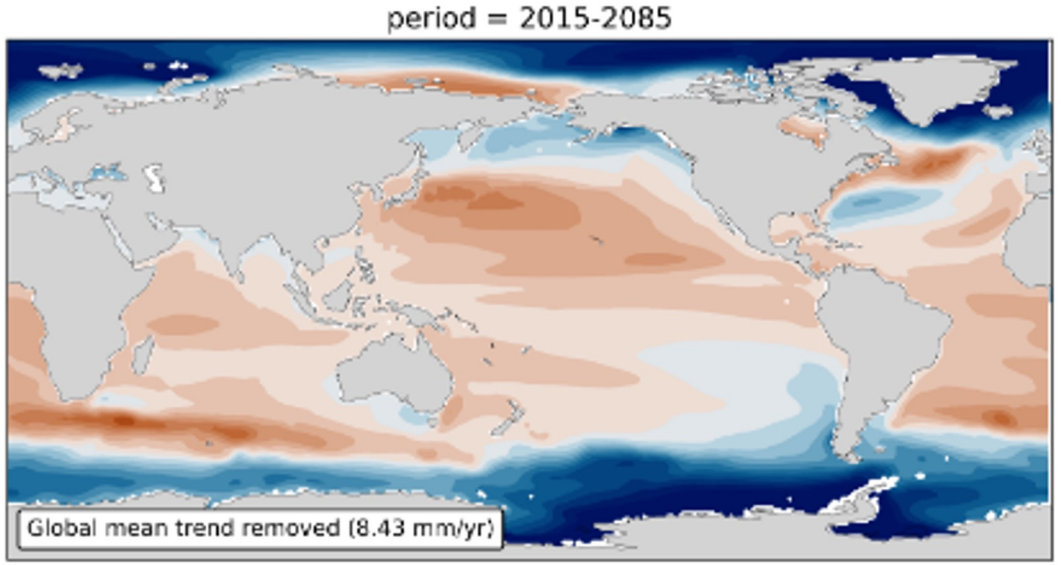


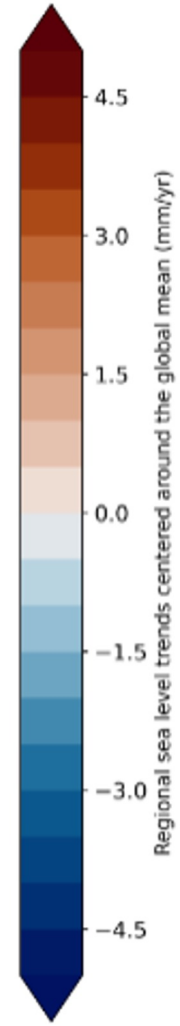
How accurate is accurate enough?

Regional Trends in Forced sea level response the IPCC AR6 report (retrieved from the IPCC AR6 Sea Level Projection Tool of NASA) over 2015-2045, 2015-2065, 2015-2085.









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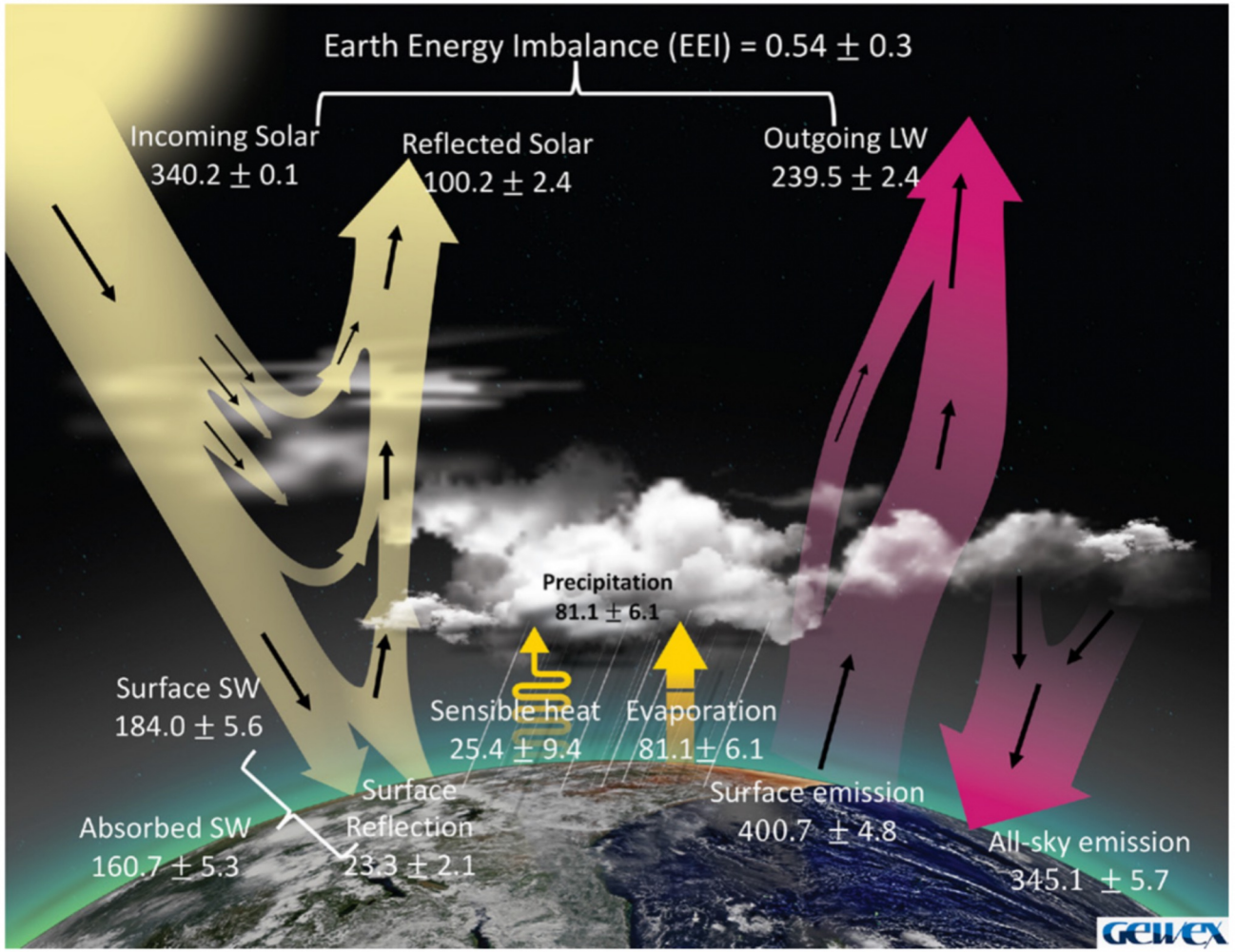
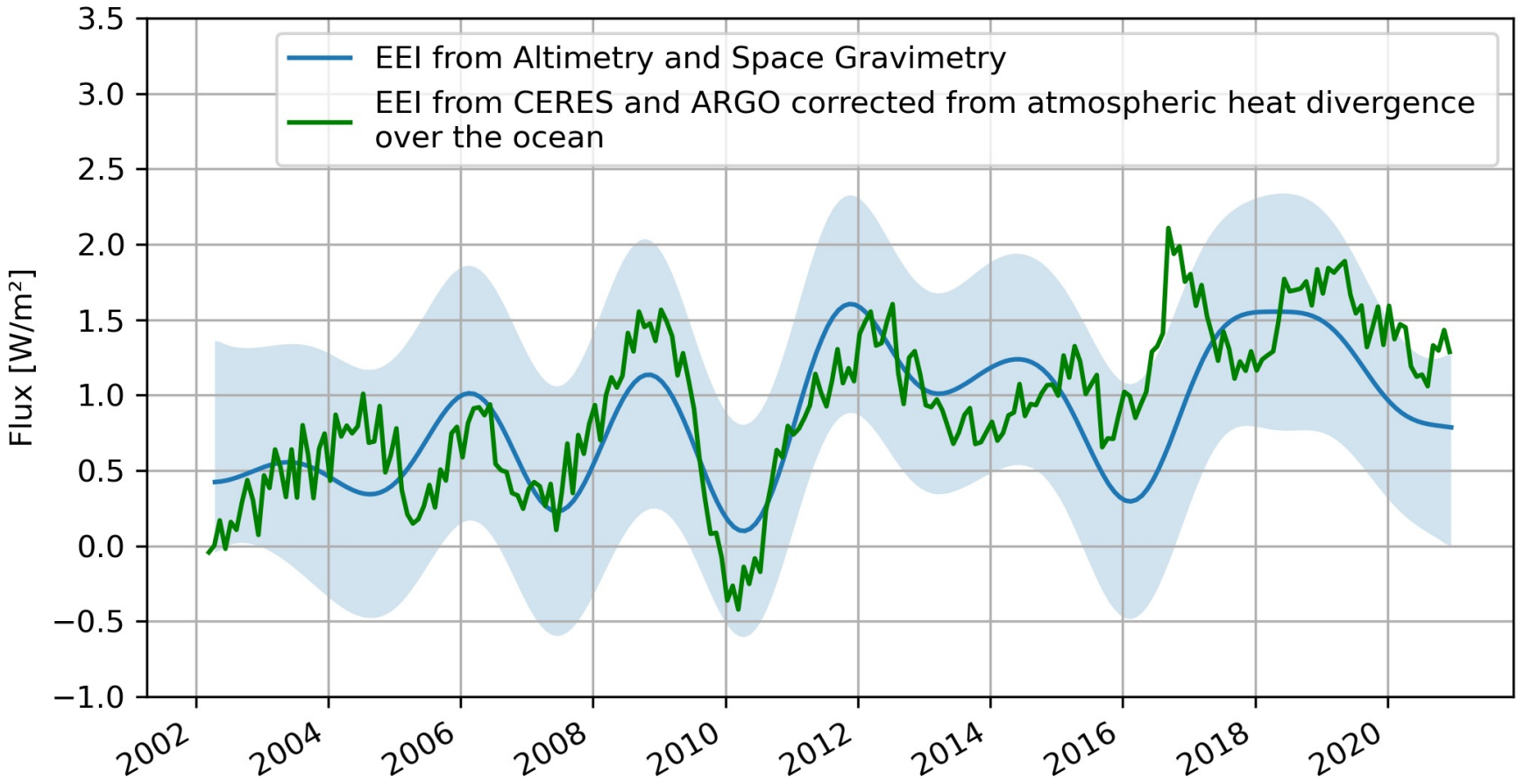


From Stephens et al. 2023
BAMS

An update on the mean annual fluxes of the global energy budget (all in W m−2) for the first decade of the millennium. This budget was achieved using a "global" optimization described in L'Ecuyer et al. (2015) with Satellite altimetry and space gravimetry estimate of the EEI.

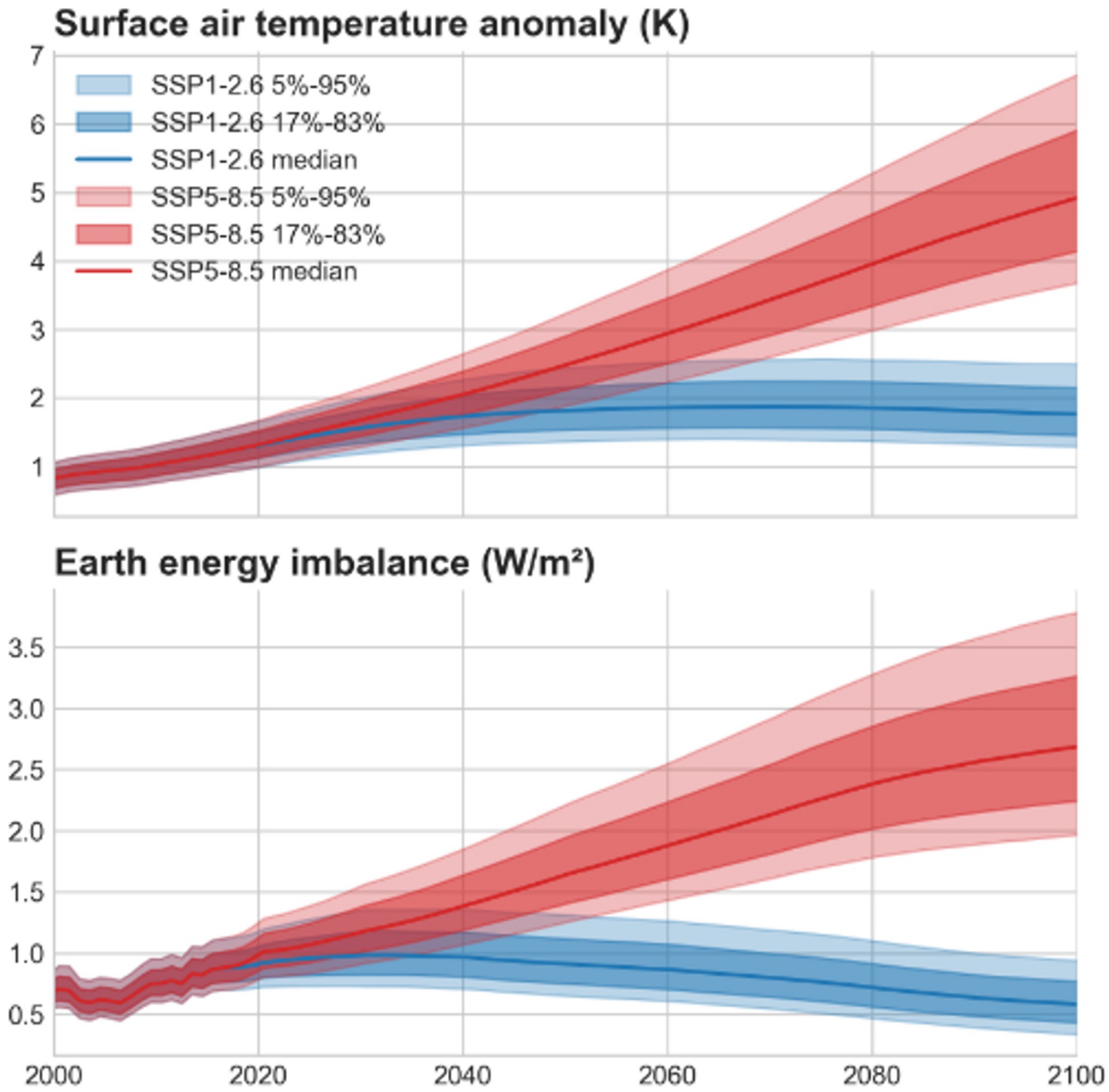
How accurate is accurate enough?



Earth energy imbalance derived from satellite altimetry and space gravimetry ata (called the geodetic method, black curve) at the 5-95% CL (shaded area) compared to CERES estimate (blue curve from April 2002 to December 2020, updated from Marti et al. (2022).

How accurate is accurate enough?

Surface air temperature and Earth energy imbalance over 2020-2100 with the uncertainty envelop at 17-83% CL and 5-95% CL for the SSP1-2.6 scenario (blue) and the SSP5-8.5 scenario (red) of the IPCC AR6 report.



How accurate is accurate enough?

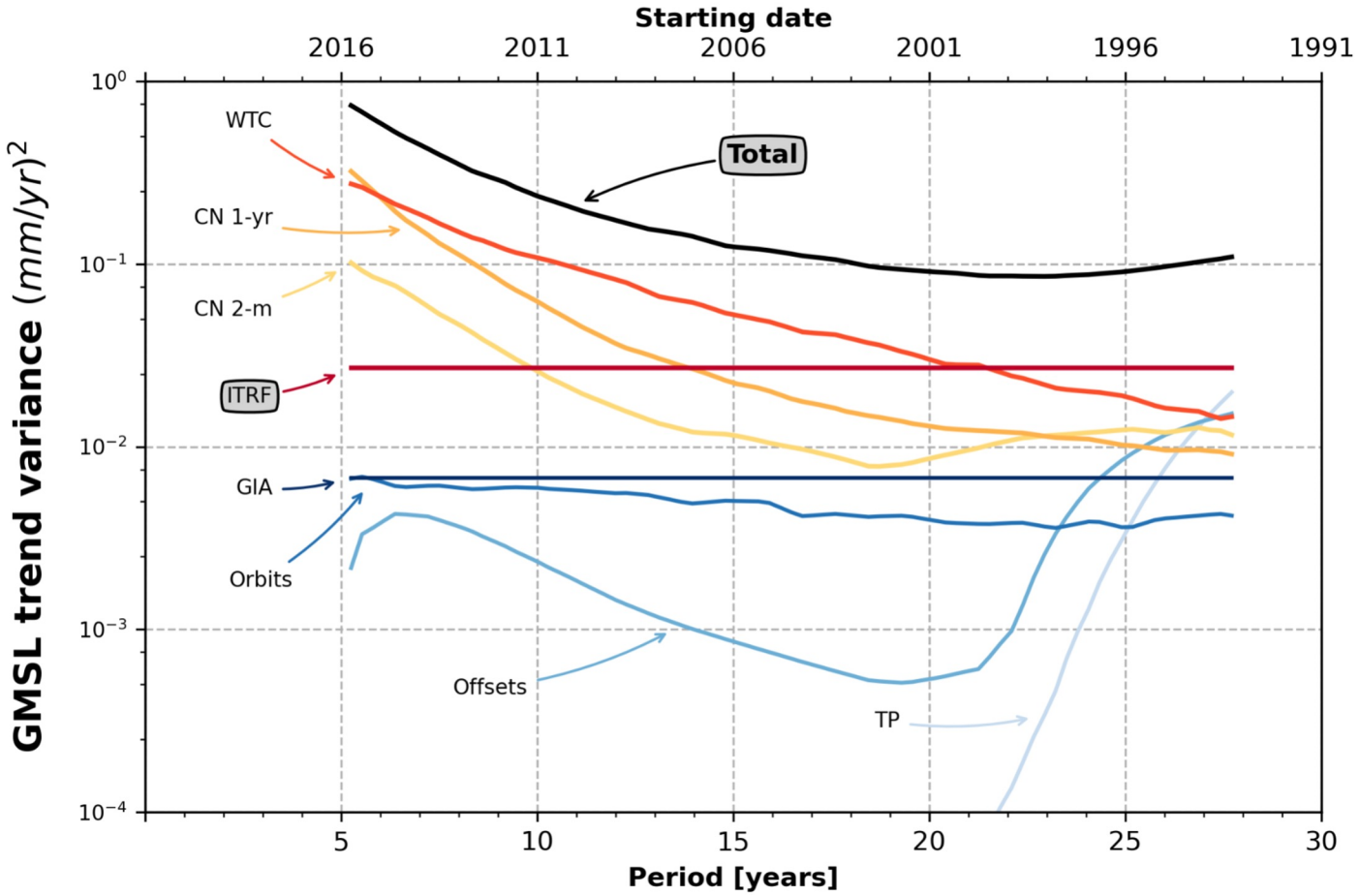
State of the art VS requirements
(90 % confidence level, i.e. 1.65 standard uncertainties)

		Current Sea Level uncertainty [2001-2020]	Sea Level Stability requirements over 20 years
Global scale Ablain et al., 2019	**GMSL trend**	**0.3 mm/yr**	**0.1 mm/yr**
	GMSL acceleration	**0.08 mm/yr²**	**0.05 mm/yr²**
Regional scale 1993-2019 Prandi et al., 2021	**MSL trend**	**0.8 -1.2 mm/yr**	**0.5 mm/yr**
	MSL acceleration	**0.06 - 0.12 mm/yr²**	Not defined

Incertitudes du MSL

➔ Estimation of the relative contribution of uncertainties sources to SLR-SUB : at global scale

- Uncertainty in global mean sea level **trends** over different time period lengths ending in 2020.
- The uncertainty (variance) is partitioned in different sources:
  - 2-month and 1-year Correlated Noises (CN 2-m/1-yr)
  - the radiometer wet troposphere correction (WTC)
  - the inter-mission offsets
  - the GIA and the POD including the orbits' CN and the ITRF drift.



Incertitudes du MSL

➔ **Estimation of the relative contribution of uncertainties sources to SLR-SUB : at global scale**

- Uncertainty in global mean sea level **acceleration** over different time period lengths ending in 2020.
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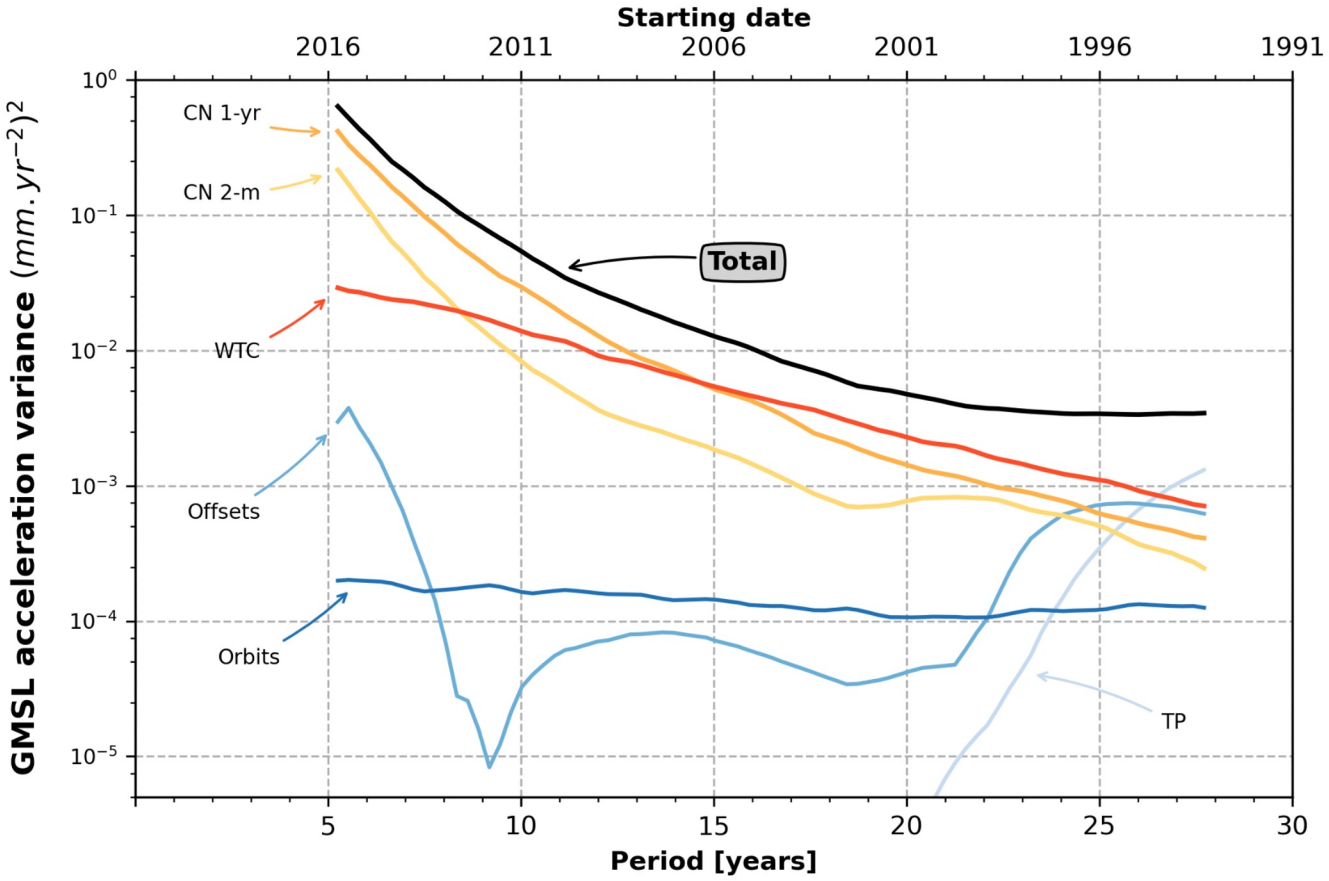

Besoin pour le niveau des mers et le bilan d'énergie de la Terre:

Objectif : ameliorer la **caractérisation des erreurs du niveau de la mer et du champ de gravité** en cherchant comment propager les incertitudes depuis l'ITRF et les orbites jusque dans la mesure du niveau de la mer par altimètre et la mesure du champ de gravité par GRACE, et GRACE-FO.

1) est il possible de fournir **une incertitude associée à le réalisation de l'ITRF** qui contienne l'information de corrélation des erreurs dans le temps et dans l'espace? Quelle forme pourrait prendre cette information ? une matrice de variance covariance? un ensemble ?

2) Il n'est probablement pas possible de fournir a court terme une description complète des incertitudes de l'ITRF et des orbites. Peux on commencer par **identifier les principales sources d'erreur** et faire une description grossière de l'incertitude qui prenne en compte ces principales sources d'erreurs.

3) Peux t'on les propager les incertitudes de l'ITRF à travers les orbites. Peut on développer **une méthode simple** (par géométrie par exemple) **pour évaluer "rapidement " l'impact d'une d'un biais ITRF et de sa propagation à travers les orbites** sur les mesures de niveau de la mer? sur le champ de gravité?