Supplementary Material - Consolidating Global Estimates of Ocean Heat Content: Toward a Consistent Earth Heat Inventory

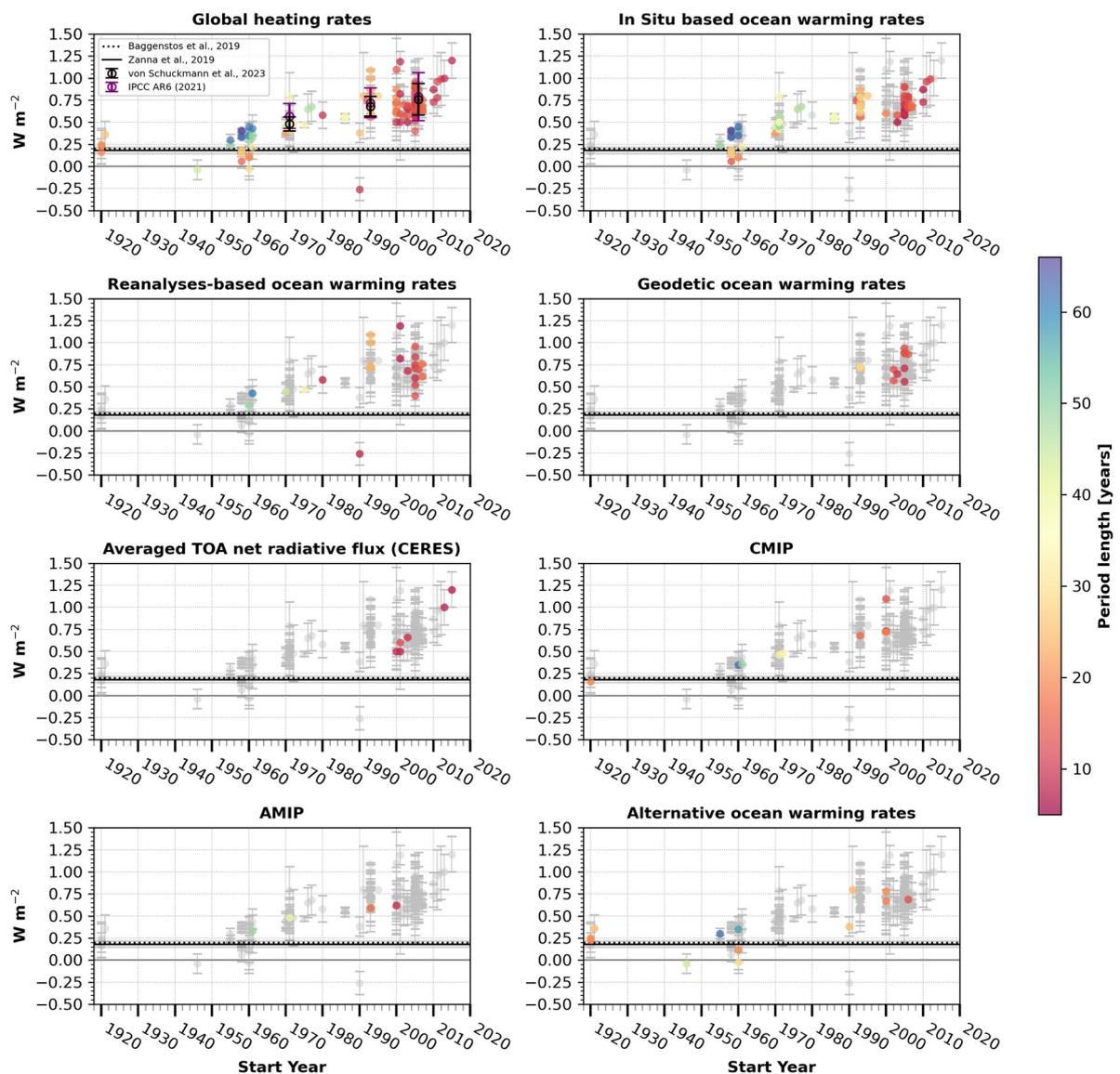Audrey Minière[1], Karina von Schuckmann[2] and Sabrina Speich[1]

[1]Laboratoire de Météorologie Dynamique, 24 rue Lhomond, 75005 Paris, France
[2]Mercator Ocean International, 2 Av. de l'Aérodrome de Montaudran, 31400 Toulouse, France

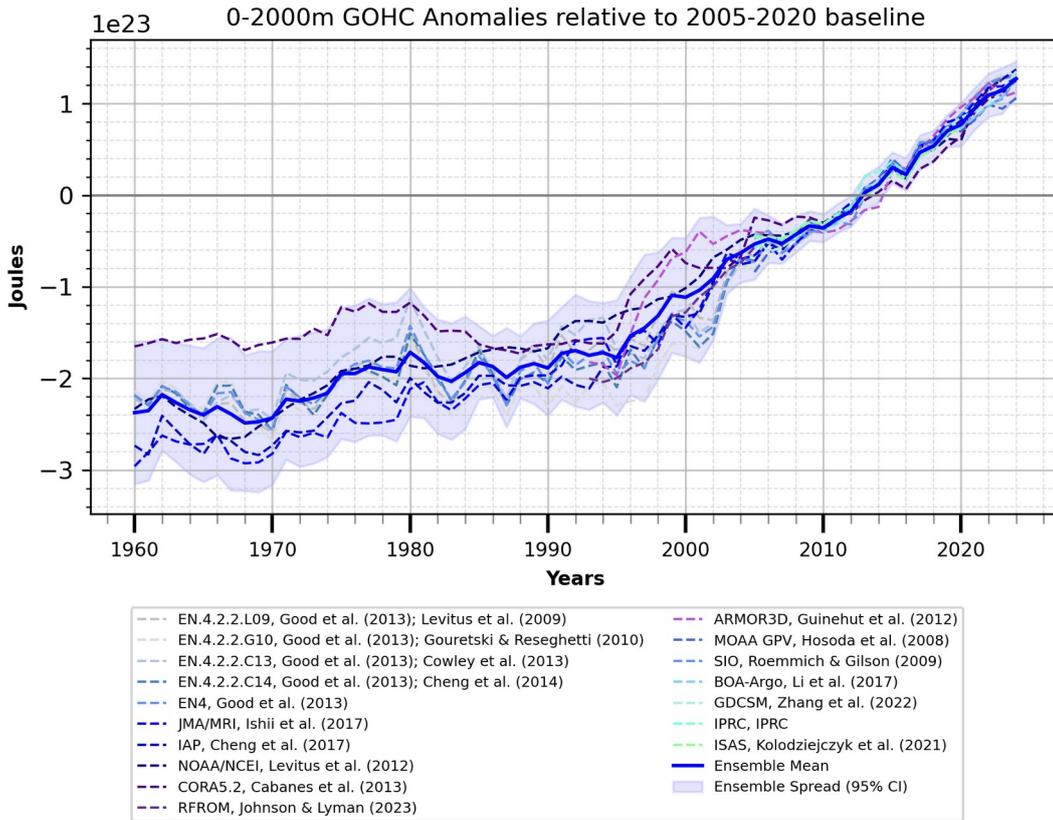*Correspondence to*: Audrey Minière (audrey.miniere@lmd.ipsl.fr)

Figure S1 | Published estimates of the Earth's Energy Imbalance classified by methodological approach.

10 In situ–based ocean warming estimates correspond to ocean heat content (OHC) rates derived from in situ
11 subsurface temperature products. Reanalysis-based estimates rely on subsurface temperature fields from ocean
12 reanalyses. Geodetic ocean warming rates are inferred from satellite observations, combining altimetry and
13 gravimetry. Averaged top-of-atmosphere (TOA) net radiative flux estimates represent EEI measured directly by
14 the CERES satellite mission. CMIP and AMIP estimates include ocean warming rates and EEI derived from
15 climate model outputs. Alternative ocean warming estimates rely on other approaches, such as neural networks
16 or indirect methods for estimating OHC or EEI. See the Code and Data Availability section for more details.
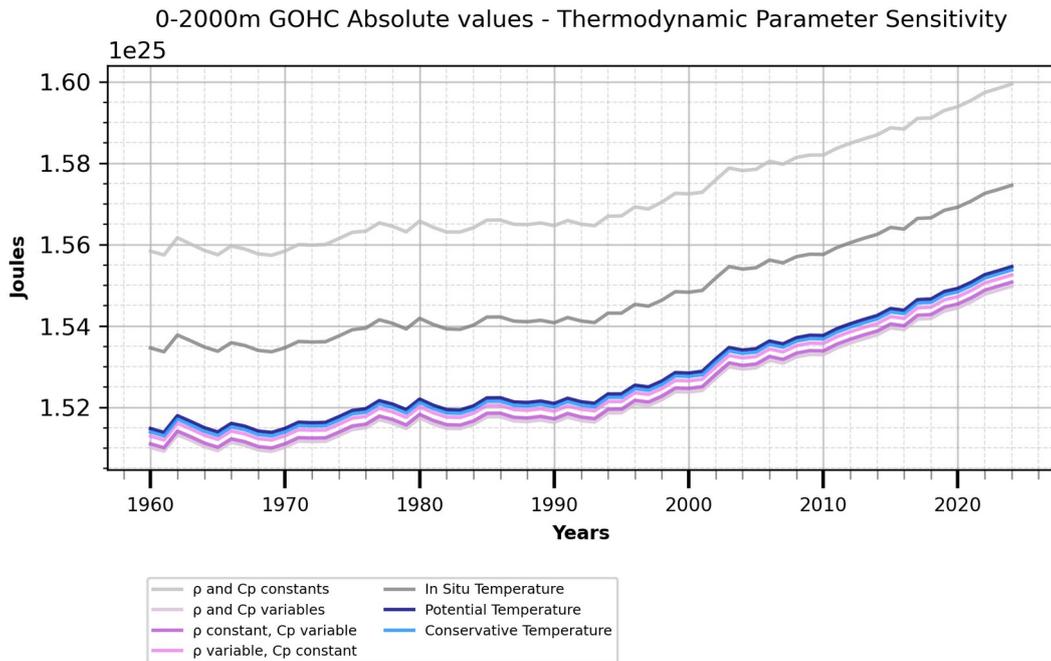17
18
19
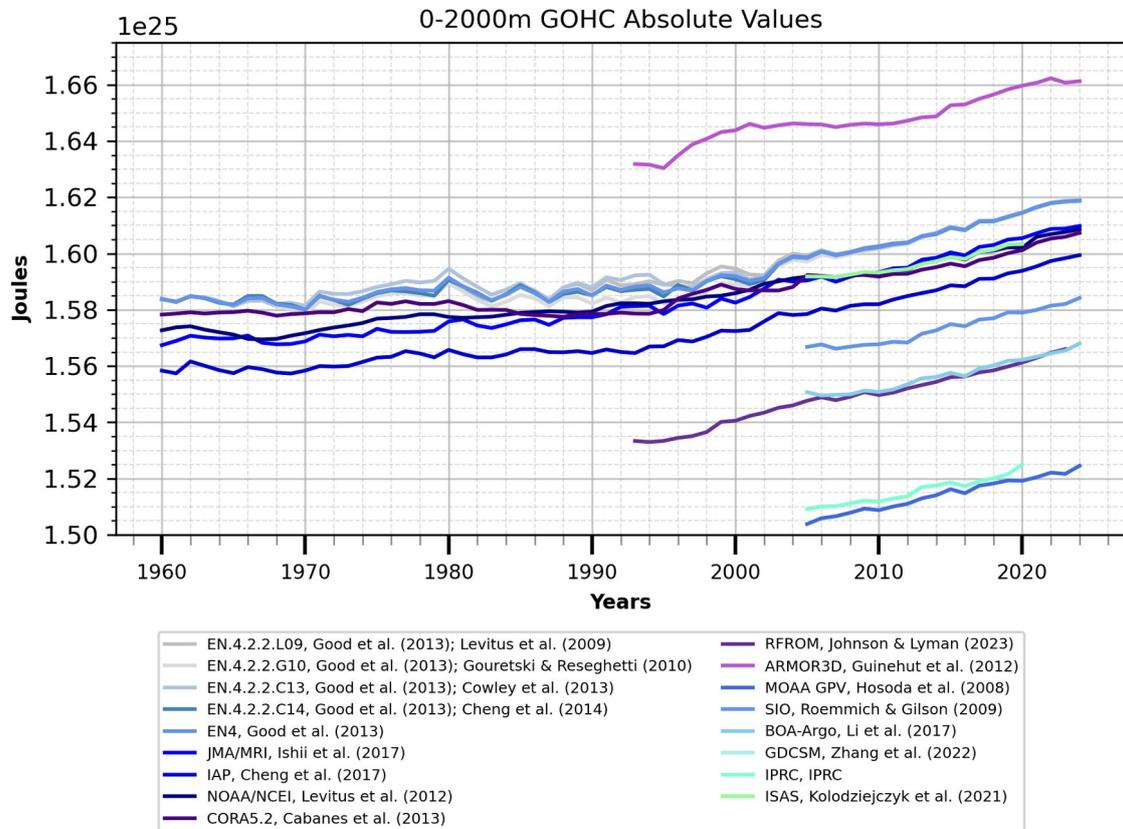
20 **Figure S2 |** Absolute values of Global Ocean Heat Content timeseries for different subsurface temperature-
21 based products.
22

2

0-2000m GOHC Anomalies relative to 2005-2020 baseline

Legend:
- EN.4.2.2.L09, Good et al. (2013); Levitus et al. (2009)
- EN.4.2.2.G10, Good et al. (2013); Gouretski & Reseghetti (2010)
- EN.4.2.2.C13, Good et al. (2013); Cowley et al. (2013)
- EN.4.2.2.C14, Good et al. (2013); Cheng et al. (2014)
- EN4, Good et al. (2013)
- JMA/MRI, Ishii et al. (2017)
- IAP, Cheng et al. (2017)
- NOAA/NCEI, Levitus et al. (2012)
- CORA5.2, Cabanes et al. (2013)
- RFROM, Johnson & Lyman (2023)
- ARMOR3D, Guinehut et al. (2012)
- MOAA GPV, Hosoda et al. (2008)
- SIO, Roemmich & Gilson (2009)
- BOA-Argo, Li et al. (2017)
- GDCSM, Zhang et al. (2022)
- IPRC, IPRC
- ISAS, Kolodziejczyk et al. (2021)
- Ensemble Mean
- Ensemble Spread (95% CI)

Figure S3 | Global ocean heat content anomalies relative to the 2005–2020 baseline. The thick solid line and shaded envelope indicate the ensemble mean and its spread, respectively, computed from the individual products shown as dashed lines.


0-2000m GOHC Absolute values - Thermodynamic Parameter Sensitivity

Legend:
- ρ and Cp constants
- ρ and Cp variables
- ρ constant, Cp variable
- ρ variable, Cp constant
- In Situ Temperature
- Potential Temperature
- Conservative Temperature

Figure S4 | Sensitivity of GOHC absolute values to the choice of different temperature types, and values for density and specific heat capacity. IAP product has been used.
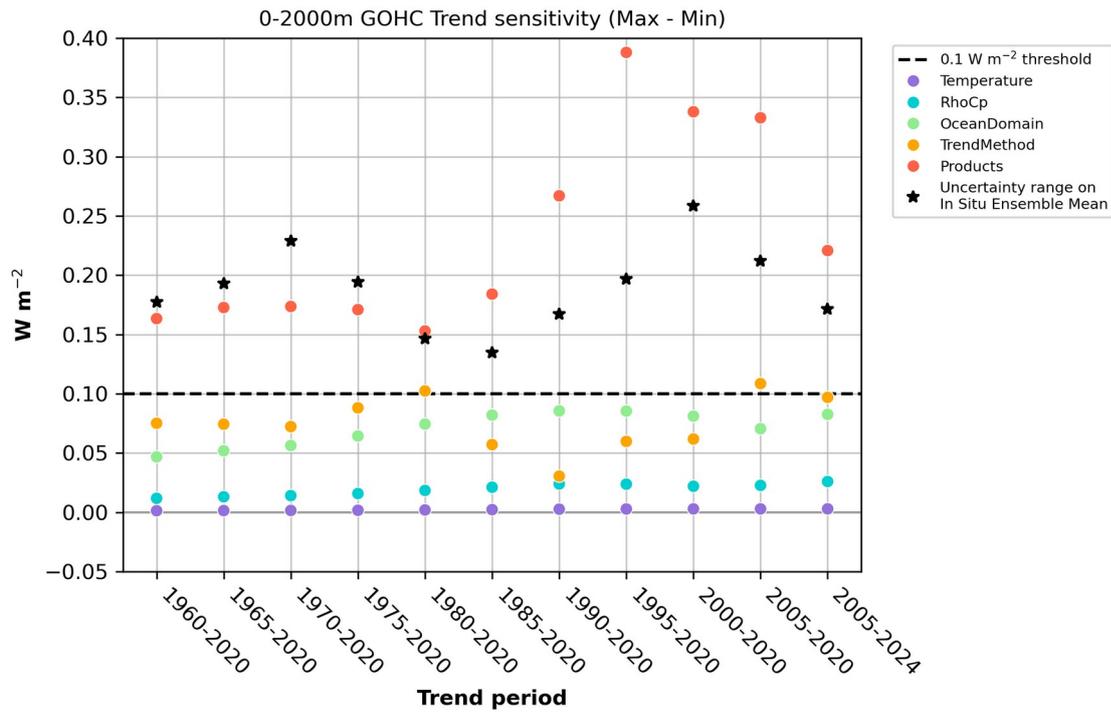
Figure S5 | Sensitivity of GOHC trends for different periods. GOHC trends are estimated over several periods to assess the robustness of the results. As in Fig. 4, five categories of sensitivity tests are performed: (i) sensitivity to the temperature product used (salmon dots), (ii) sensitivity to the temperature variable definition (in situ, potential, or conservative, purple dots), (iii) sensitivity to the treatment of seawater density (ρ) and heat capacity (Cp) as either constants or spatially varying fields (blue dots), (iv) sensitivity to the definition of the ocean domain used for integration (green dots), and (v) sensitivity to the regression method applied for trend estimation (orange dots). For each period and sensitivity category, the values shown correspond to the difference between the maximum and minimum trend estimates. A threshold of 0.1 W/m² is indicated for illustration, and the black star represents the spread associated with the ensemble analyzed in this study.