Text S1

In our analysis we vertically align observations and tide gauge records from PSMSL and GESLA-3. We here analyze the uncertainty of this vertical alignment depending on the fraction of available data in the tide gauge records. To that end we analyzed 136 stations from PSMSL with uninterrupted records for the alignment period 1993-2012 and 155 stations from the GESLA-3 dataset with uninterrupted records for the alignment period 2011 to 2015.

We introduced randomness by selectively omitting data, ensuring specific proportions of valid data ranged from a minimal 10 percent to 90 percent. We removed data in blocks, mimicking real-world scenarios where data gaps often appear in consecutive clusters. The number of blocks with missing data was randomly chosen between 1 and 10. Size and position of blocks of missing data were also randomly chosen in a way that persists the total number of valid data.

For each tide gauge we computed two key metrics:

1. The mean value of the retained observed water levels
2. The mean difference between observed and modeled water levels

To comprehend the variability in these metrics, we replicated the data omission process 100 times for each fraction, each cycle choosing different randomized indices. Figure S1 displays the standard deviation across these repetitions for both metrics. The standard deviation is generally much lower for the mean difference between the tide gauge record and HCC compared to the mean sea level of the tide gauge record. That is why we use this mean difference for the vertical alignment.

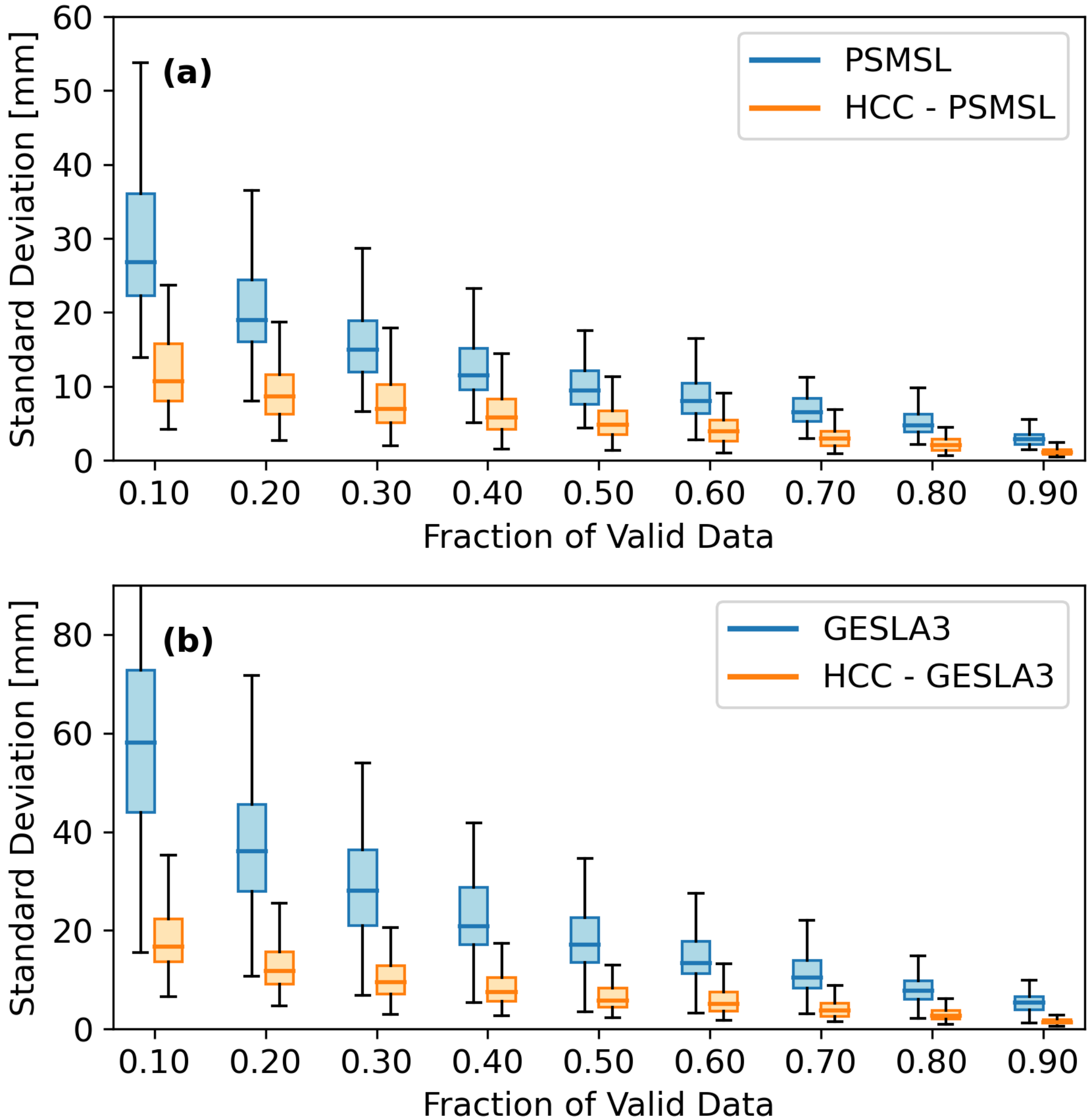

Figure S1: Fluctuation in the mean sea level of tide gauge records (blue boxes) and the mean differences between modeled water levels and tide gauge records (orange boxes), based on various scenarios of missing data. The x-axis represents the percentage of retained valid data from the original time series. The box plots indicate the standard deviations of the mean sea level across different tide gauge stations, derived from 100 unique data omission patterns for each tide gauge record. Panel a shows mean sea level from 1993 to 2012 for PSMSL tide gauge records and the monthly HCC dataset. Panel b shows mean sea level from 2011 to 2015 for GESLA3 tide gauge records and the hourly HCC dataset.

Text S2

We use a quadratic trend to estimate counterfactual water levels from 1900 to 2015. To evaluate the robustness of this method we utilize the moving block bootstrap method as described for climate data in (Mudelsee, 2019). The block length was determined based on the autocorrelation factor for each time series independently. We assessed the trend's robustness across 2000 bootstrap samples.

We find that the sensitivity of total sea level rise, as estimated by a quadratic trend, varies depending on the location with standard deviations ranging from 3.4 mm to 16.7 mm and an average standard deviation of 8.1 mm. The 99 percent confidence interval for all selected grid points is shown in Fig. S2a ordered by ocean basin and latitude (Fig. S2b). Our analysis focused on a global subset of grid points depicted in Fig. S2c.

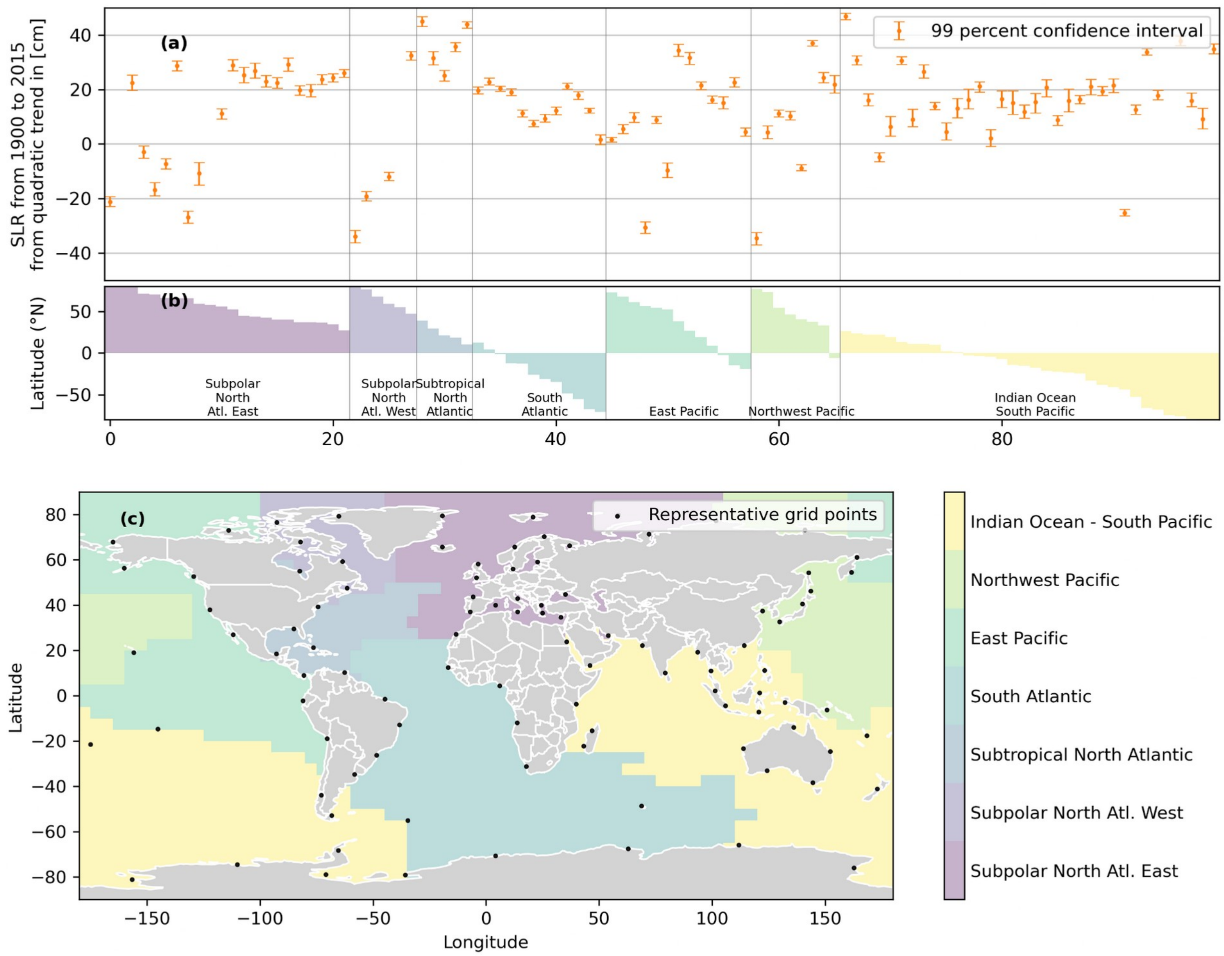

Figure S2: Robustness of the quadratic trend estimate and derived SLR from 1900 to 2015. Panel a: The SLR estimate based on HCC water levels along with the 99 percent confidence interval from 2000 bootstrap samples. Panel b: Latitude of tide gauge locations sorted by ocean basin. A progressive integer of the considered tide gauge is plotted on the x-axis. Outliers are not plotted. Panel c: Representative subset of grid points used for this evaluation. The grid is divided into 100 clusters of grid points using the k-means clustering algorithm. Within each cluster the grid point nearest to the cluster's centroid is selected.

References

Mudelsee, M.: Trend analysis of climate time series: A review of methods, Earth-Sci. Rev., 190, 310–322, 2019.