Reviewer 2:

This paper investigated global tidal features using 3591 high-frequency tide gauges, which is helpful for improving our understandings of global tidal dynamics and the validation of tidal models. I want to express my gratitude to the authors for their long-term efforts in establishing the tidal observation dataset and the harmonic constant dataset, from which the whole tidal community benefits. The paper I think is well-written, thus, it can be accepted after minor revisions.

Specific comments:

Line6, Abstract, 'Dodginess' is not a common concept, which may need some further explanation

We have removed the term dodginess from the abstract, as it is mentioned later and defined.

Line60,Section 2 'Data and methodology' can be divided into two sub-sections.
We have divided this into "*Data*" and then "*Tidal analysis.*"
Line65, may be a table can better show the improvement and differences of different versions of GESLA.
A manuscript is in progress describing the GESLA-4 updates, as the differences between versions is not the focus of this manuscript, we do not feel such a table fits. We refer readers to the future GESLA-4 manuscript for detailed comparisons.
Line85, Eq.(1),classical harmonic analysis model uses ordinary least squares (OLS) to solve unknown tidal parameters, which are sensitive to outliers. Leffler and Jay (2009) introduced iteratively reweighted least squares (IRLS) to replace OLS in harmonic analysis, which can effectively eliminate the influences of background noises. Pan et al. (2025, doi: https://doi.org/10.1007/s10236-024-01652-5) identified significant timing errors in 35 tide gauges from the UHSLC, with these errors potentially altering tidal amplitude estimates of main constituents by more than 10 mm. Notably, at specific tide gauges, such as Tanjong Pagar and Manila, abnormal tidal amplitude changes caused by timing errors can be larger than 50 mm. The use of IRLS can remove the interference from timing errors. Since parts of GESLA data are obtained from UHSLC, such timing errors are also inherited. It is suggested that you can use IRLS rather than OLS in performing harmonic analysis.
As described in the text and in the TICON-4 manual, we already account for changes in timing through an yearly iteration of the phases but we have added a reference to the Pan and Thompson manuscripts that discuss this in detail. We have added to Line 127-130:

"*The estimation of tides is susceptible to timing changes or errors, which are attempted to be resolved within TICON-4 using an iterative procedure (see the user manual of Hart-Davis et al., 2024). Despite this effort, it is possible that some errors can still occur and may* *influence our findings (Pan et al 2025, Thompson et al 2025)*."

L114, inter-annual tidal variability can be driven by climate modes, such as ENSO (see Devlin et al. 2014, doi: https://doi.org/10.1007/s10236-014-0741-6 ; Pan et al., 2025, doi:https://doi.org/10.1016/j.pocean.2024.103410).

We have added the reference to Devlin et al 2014.

L124, although astronomical tides in the Baltic Sea and Black Sea are generally weak, it is suggested that these tide gauges should be retained for two reasons: First, tides in parts of these sea areas may be significant. Second, local radiational tides such as S1 and S2 may be significant, which can also provide important tidal information.

We removed these regions from our discussions as tides are not significant in this region, and it is therefore dominated by the long-period tides, as confirmed by earlier analysis. However, in the datasets, both TICON-4 and the linked data of this manuscript these data are provided for users to interpret themselves.

Figure 1, not MKS, but MKS2.

Amended thanks for noticing.

L160-162, Figure 2, it is interesting that at some tide gauges, K2, P1 and Q1 have the largest amplitudes, which are unusual. I suggest that you can list tidal constants (as well as the uncertainties) of major constituents at these unusual tide gauges in tables (may be in the Appendix). Although K2 and P1 amplitudes are large, they may not past the significance test. Nevertheless, it is necessary to further explore these tide gauges.

Thank you for noting. On further examination of the gauges, the majority of these cases occur along the Gulf of Mexico within swamplands and in regions likely having no tidal influence. In fact, the occasions when these occur the tidal amplitudes do not exceed 2 mm. Outside of this region, the occasions of these tides being the largest only occur 5 more times, where on closer inspection, these gauges are either within lagoons or ports that are sheltered from the tides. To account for this, we have removed gauges from this analysis within the swamplands and written a sentence about the instances of the P1 being the largest and updated the Figure 2. To line 125 we address the removal of swampland gauges:

"The extensive GESLA-4 dataset contains several gauges along the Gulf of Mexico coast, which we observe are located within swamplands. For the analysis within this manuscript, these gauges are removed as they do not have significant tidal signals (amplitudes typically smaller than 2 mm), and they bias the mean statistics."

Regarding P1 being the largest constituent, we rewrote line 173 to:

"To knowledgeable tidal enthusiasts, this is noted with the P1 tide being the largest. In our analysis, we determine 5 tide gauges where this occurs, but in all occasions these gauges are within lagoons or in protected coastlines, such as ports, where no significant tidal signal is observed, with tidal amplitudes not exceeding 5 mm in these locations."

Figure 4B, revise title ‘Tidal band’ as ‘Dominant tidal band’. Also, how do you define ‘dominant’? Are there any quantified numerical values?

This is described in lines 229-231: “*the sum of tidal constituent amplitudes within each respective tidal band provides an approximation for which band contributes most to high and low water (Figure 4B).*” We have adjusted the title as recommended.
Figure 5A, in the colorbar, the maximum value of tidal form factor (FF) is set as 5, which may mislead the readers that the maximum FF among 3591 tide gauges is only 5. However, this is not true, for example, FF at Hon Dau (UHSLC ID: 650a) can exceed 14.
We have adjusted the colorbar to be extended within Figure 5A to reduce this confusion and account for this.

L228, it is better to provide a map of tidal level variations at these tide gauges, to illustrate dodgy tidal regimes. Also, how the definition of ‘dodginess’ (namely, Eq.2) is proposed?

These concepts are now demonstrated in Appendix Figure A2 and explained Table B2 for clarification, and referred to in line 149-150.

L359-361, it is important to provide the uncertainties (95% confidence intervals) of amplitude trends.

A discussion on this has been added to lines 397-404 based on this comment and that of reviewer 1. We have also used the uncertainties to remove some tide gauges from Figure 8 that have larger uncertainties than trends. Note the data of trends and uncertainties is available in the provided dataset. The added text is as follows (to line 397-404):

“*Yearly amplitude trends were estimated by fitting an ordinary least squares linear regression to the annual amplitude values, after excluding values outside one standard deviation from the median. To account for any potential temporal autocorrelation in the tide gauges, we utilized Newey-West Heteroscedasticity and autocorrelation-consistent standard errors. The trend was quantified as the mean annual change in the fitted values. The uncertainty was estimated as the mean width of the 95% observation confidence interval from the adjusted regression predictions. In the provided dataset, available at: the trend and the uncertainty for each constituent are provided. However, in Figure 8, the trends are only shown when the trend exceeds the uncertainty value, with the gauge marked with a small white dot when this is not the case.***”**

L376, the title of section 7 ‘A note on river tides’ may be not suitable, you can change as ‘A note on tides in fluvial estuaries’ since tide gauges along the river channel are excluded in your analysis.
This section has been significantly reduced to account for the comments of Reviewer 1. Note, that the discussion is unrelated to the tide gauges mentioned in the manuscript and is just a discussion on river tides and their relevance to tidal

research from in-situ observations. The changed text is as follows to lines 450 onwards:

“7 A note on river tides

Tides in rivers, deltas, and estuaries are greatly influenced by river flow, geometry, and shallow water effects (e.g., Le Provost, 1991; Kästner et al., 2019; Hoitink and Jay, 2016). The complex nonlinear interactions between tides, river flow, and shallow-water topography mean that using the harmonic method may be insufficient to provide in-depth characterisations of tidal characteristics within rivers. Multiple methods have been developed to characterize river-tide interactions, such as the response-based RTide approach (Monahan et al., 2025), a modified harmonic analysis approach that includes r non-stationary effects (NS_Tide; Matte et al., 2013) and the continuous wavelet transform method (CWT_multi; Lobo et al 2024). However, a global dataset of river tide gauges is currently unavailable within GESLA-4, though river and deltaic systems within some countries (such as The United States, The Netherlands, and Germany) are reasonably well-covered. An effort to characterize river tides globally, similar to this effort, would clearly be of high value to the community, especially considering the importances of these system to communities (Hart-Davis et al., 2026; Beemster et al., 2026). Our synthesis motivates such an effort, but is beyond the scope of this current work.”

L401, NSTIDE, not subscript

Corrected.

In Eq.2, A means tidal amplitudes. But in Eq.(1), you use H to denote amplitudes. To keep consistency, I suggest you use H in Eq.2.

We have moved this to H throughout, thank you for noticing.