

## ***Interactive comment on “Storm surge forecasting: quantifying errors arising from the double-counting of radiational tides” by Joanne Williams et al.***

**Joanne Williams et al.**

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Thank-you for your helpful review. Please see inline comments

### *General Comments*

*The paper covers a topic that is interesting scientifically and important for storm surge modelling and forecasting, in particular for forecasts systems where the surge plus tidesurge interaction are added to tidal predictions. The paper describes the magnitude of errors that may arise from different processes omitted from some forecasting systems. The methodology is clear and valid. I recommend accepting the paper for*

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*publication following minor revisions, which are mostly structural and grammatical.*

### *Specific Comments*

*The title implies the primary focus for the paper is the effect of radiational tides on surge forecasts, but the paper covers a number of considerations for storm surge forecasting and navigational chart datums (LAT, HAT). There are inconsistencies in the ‘message’, for example in the abstract and headings discussing HAT, when in fact a discussion of HAT and LAT is made. I recommend amending the title to cover the full content of the paper; for example “Errors arising from the treatment of radiational tides in storm surge forecasting and tide-based datums”.*

We have amended the title to

"Radiational Tides: their double-counting in storm surge forecasts and contribution to the Highest Astronomical Tide."

Including LAT in the title as well felt a bit clumsy, but it is now explicitly in section headings.

*Also, given the structure of the paper follows a report style, a walk through the paper structure at the end of the Introduction (Page 2, Ln 11) would be very useful.*

Added some links to specific sections and a little more detail is given about the connection to HAT.

*The numerical model is forced by ECMWF ERA-Interim wind fields with a resolution of 6 hours. It is my understanding that the storm surge numerical model will therefore lack some of the ‘peakiness’ in surge and high-frequency oscillations in the modelled tide+surge total water level (Ws) compared with tide gauge observations (at hourly or higher frequency sampling; Wg). Can the authors comment on the effective frequency of the surge signal by their use of a numerical model and can they quantify the effect on tide magnitude and phase estimation, e.g. quarter-diurnal shallow-water tidal constituents? I would imagine, since the numerical model will underestimate the total*

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*power in the signal, versus observations, that the double-counting of meteorological effects in the harmonic prediction are even larger than presented here. This extra work is not necessary for publication but would be interesting.*

There is more detail about the effect of the 6-hourly forcing on capturing surges in the model validation paper (Irazoqui et al 2018, in review). With the 6-hourly forcing there is some underprediction of surges due to tropical cyclones which is improved by the ERA-5 reanalysis (available too recently for the model runs carried out in this paper.) However, it should not contradict the main results a great deal, since tropical cyclones at any given location are sufficiently rare that the tidal coefficients fitted over a year should not be very different if the surges are slightly underestimated. A note on this has been added to the description of the model. "We make the assumption that tropical cyclones at any given location are sufficiently rare that the tidal coefficients fitted over a year should not be very different if the surges are slightly underestimated."

*Pg 5 Ln 8: Please explain what Byrne and Flowerdew were pointing out, and hence why this fortnightly periodic error is important.*

They both observed a similar error in forecast high-water levels compared to observations. It is very clear in the Byrne report, but unfortunately that is only in the grey literature.

*Minor typographical and grammatical notes*

*Please be consistent with "tide gauge", "storm surge" or "gauge", "surge".*

It is now consistently the longer form on first usage in a section and the shorter form is used for brevity where no confusion is likely.

*Pg 2 Chapter 2: The notation is quite confusing. A notation table as an Appendix would be useful, clarifying what denotes total water level, tide and surge from what denotes numerical model or tide gauge observations and harmonic predictions.*

The notation is now changed to be clearer (see response to review 1) and hopefully

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this is now not necessary.

*For much of Chapter 2, the authors are clearly discussing the UK system. Can you make it clear 'we use' is specifically referring to the operational system in the UK. Where a methodology is typically followed by the sea level community, make that clear; for example, on Page 2 Ln 29+, "The choice and number of tidal constituents determined by harmonic analysis are typically chosen according to the length and frequency of data available" Reworded. "Similar procedures are implemented elsewhere in the world, as noted above, so in this paper we replace the shelf model with GTSM to examine results globally."*

All other minor notes are accepted and corrected accordingly.

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