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Comment on egusphere-2022-1048

Anonymous Referee #2

Referee comment on "Enabling dynamic modelling of coastal flooding by defining storm tide hydrographs" by Job C. M. Dullaart et al., EGUsphere,
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The manuscript present a methodology to generate storm tide hydrographs at global scale by combining tidal cycles (average and spring) with an average storm surge hydrograph. The average storm surge hydrograph is developed by selecting first extreme storm surges, normalizing the time series of these events, calculating their average value at each time step and the duration before and after the storm peak. On the other hand, two average tidal cycles are calculated, namely the average and spring tidal cycles. The effect of the tide-surge interaction can also be included when combining the storm surge and tidal hydrographs by including the mean time offset between the two peaks.

The manuscript is well written and structured; the topic is relevant and the results and findings are interesting and relevant. However, I think that there are a couple of points that should be addressed and I also have some minor comments.

Main comments:

- My main concern with this methodology is that it only focus on generating average hydrographs and thus the variability at other time steps rather than the peak is neglected/lost. Based on the examples that the authors show, it can be seen that historic storm surge hydrographs and tidal cycles show a large variability at times before and after the peaks. The variability of the water levels at times before and after the peak can largely affect the resulting flooding (see e.g. *Quinn et al.*, 2014; *Santamaria-Aguilar et al.*, 2017). The authors briefly discuss this issue regarding TCs, ETCs and mixed semidiurnal tidal regimes in the discussion, but I miss a more detailed discussion or quantification of the variability of the hydrographs related to the mean. For example, how much can vary a hydrograph in a region with a mixed semidiurnal regime (large tidal variability) and affected by TCs and ETCs? Are there regions where the variability of the hydrograph can largely exceed the one of the peak?
- The authors state that one of the main objectives of this study is to enable dynamic

flood modeling at global or large scales by providing storm tide hydrographs. I differ on this as I think that the main limitation for dynamic flood modeling at global scales is still the computational effort required, even by simplified hydrodynamic models like LISFLOOD and SFINCS. However, this methodology contributes to dynamic flood modeling at any other scale as hydrographs are commonly neglected in EVA. Therefore, I think this work would benefit by changing the focus to the limitations of EVA models that neglect the hydrograph information, regardless of the scale of the flood assessment.

Minor comments

L11- Coastal flooding can also arise from other drivers such as waves, precipitation, and river discharge in estuarine regions or a combination of all these drivers.

L12- Missing “cyclones” at the end of the sentence.

L16 & L24- At global scale, the main constrain regarding the flood model used (static vs dynamic) is the computational effort. Even simplified hydrodynamic flood models such as LISFLOOD or SFINCS still require huge computational resources compared to bathtub models. In my opinion, the main focus should be placed on losing the hydrograph information when doing the EVA, as most EVA models focus only on storm surges peaks. Therefore, information about the hydrograph or temporal evolution of the event is lost although it is required as boundary conditions for dynamic flood models, even at local scales.

L27- Exposure increases because of the increase in population, not the opposite way.

L30- Global coastal flood risk assessments can help identifying…

L32-Coastal flooding is generally driven by “storm surges” generated from strong winds…

L47- Authors can cite here Ramirez et al., 2016; Vousdoukas et al., 2016

- Some lines of the introduction do not connect very well (are not smooth) e.g. L30 to L35. I'll suggest revising it trying to better connect the points between sentences.

L88- I think authors should cite all different methods available in the literature (or most of them) even if they only describe in more detail a subset of them.

L100-Why that threshold and duration are selected? Was a sensitivity analysis performed in Chbab (2015)? I think this point has to be mentioned and the sensitivity of the approach to these parameters (i.e. threshold and duration of the event) discuss. In addition, several normalized hydrographs are generated from this approach, which one is used for estimating any desired RP hydrograph? The mean normalized hydrograph? How the variability of these extreme hydrographs can affect the resulting design hydrograph? See e.g. Santamaria-Aguilar et al., (2017) and Quinn et al., (2014)

L121- Although this is true for most of the places, a dependency between skew surges and high tidal levels is observed at some locations, se Santamaria-Aguilar and Vafeidis (2018).

L122- How sensitive is this method (i.e. the 15 events selected) to the series length? Is there any limitation of this approach to a minimum length of data?

L157. A similar method than MacPherson et al., (2019) was developed by Wahl et al., (2012) for the German North Sea coast (macrotidal)

L161. The method of Vousdoukas et al., (2016) overestimates the WLs of the hydrograph assuming the maximum high tidal level along the entire duration of the event (i.e. neglecting the tidal variations/cycle), and this issue can significantly overestimate the WLs in those places of large tidal variability (e.g. places with macrotidal range). I think this point needs to be mentioned here or when the approach is described.

L167. I'm missing a bit of a discussion about the variability of hydrographs and why this is important.

L183-Is this comparison/validation based only on the peaks? How well these modeled data represent the hydrographs?

L207- i.e. dividing each surge level by the peak

Average tide signal and spring tide signal. Although it is briefly discuss later, I think authors should mention the issues of this approach in places with different tidal regimes, e.g. mixed semidiurnal regimes in which the variability of high tidal levels is large and the spring cycle cannot really be defined?

L256. Storms

L262. Differences in the time evolution of storms can also contribute to the differences/variability observed at the different time steps of the hydrographs, not only the effects of the tide-surge interaction. This can be particularly true in those places that are affected by TCs and ECs, as the characteristics of the two types of storms differ, but the authors analyze together the storm surges hydrographs that arise from TCs and ECs. (It is discussed later in section 5, but I think it should be at least mentioned here too).

L283. I would like to see how much the finding are affected by this.

L294. What are the differences at other time steps and their potential effects?

L330- The previous study of Wahl et al., (2011) showed that the peak of the hydrograph can show a dependency to the intensity of the hydrograph. I think this issue should be mentioned here as e.g. a dependency of the shape of the hydrograph shows a dependency to the threshold in the case of Marco Island.

L334- The dependency of the storm surge peak and tidal levels not only can change the duration of the event due to the time offset, but also the magnitude of the event. Not accounting for this time offset overestimates the peak water levels as the NTR peak magnitude might not be the same at high tidal levels (i.e. for the same atmospheric forcing, the NTR magnitude is larger at lower tidal levels than at higher tidal levels). This issue should be mentioned here.