Interactive comment on "Spatial distribution of water level impact to back-barrier bays" by Alfredo L. Aretxabaleta et al.

Anonymous Referee #1

Response to Reviewers, comments in plain text, response in bold

5   The authors have proposed a novel approach to combine observed data and numerical model results for spatial characterization of water level transfer inside Barnegat Bay. They use dimensional characteristics of the bay to ensure this combination occurs in a physically consistent way. The idea is interesting and the manuscript is generally well-written, so I think it deserves publishing in NHESS after a major revision. Details are provided below:

Major:

10   - In page 5, with a harmonic assumption for water level and velocity, jumps into a giant equation (I wish there was an equation number I could refer to!). There is no way I can evaluate the robustness of approach, without knowing the exact steps and detailed assumption made here. I suggest, either providing enough details to enable proving the accuracy of equations, or if there is not enough room in the main manuscript (which I think is the case) add supplementary materials and provide the detailed steps in that document.

15   **The development of the equations will be provided in an appendix. Originally, we decided to exclude them as they take up a lot of space. Also, the equation numbers will be added to the text.**

- M2 is taken as a proxy for internal frictional effects (Page 7, Line 2). As far as I understand, overtides (i.e. M4) are better proxies for internal frictional effects. It's already been mentioned in the manuscript (Page 7, line 17) that remaining frequency bands exhibit smaller fluctuations, but their variability given forcing still contains useful information. Please,

20   revise or justify this approach.

The M_4 tidal constituent is generated as a non-linear response to M_2 tidal forcing. The magnitude of the M_4 is partially a result of the energy loss from M_2 through friction but also associated with other nonlinearities. In general, the M_4 is a result of asymmetries in the duration of ebb and flood. There is no external solar or lunar forcing at the M_4 frequency. Thus, as the Reviewer mentions, the M_4 and other overtides might be related to internal frictional

25   **effects in terms of where the M_4 is generated. In fact, the tidal constituent more associated with frictional generation is M_6 rather than M_4. The issue is that the M_4 also propagates as a normal tidal wave and the magnitude at a specific location can be the result of either local generation or propagation and it will also be subject to attenuation by friction. The spatial changes in the M_2 tidal constituent inside the bays are a direct consequence of the frictional dissipation of tidal energy through friction (Redfield, 1980). Therefore, the changes in M_2 amplitude are a better**

30   **metric for the frictional effects inside the bay.**

Minor:

- In Page 1, Line 33: there are many more recent citations to be cited here, including the revised version of this report in 2013. Also, see the followings for example:

* Rahmstorf (2017) Rising hazard of storm-surge flooding, PNAS, https://doi.org/10.1073/pnas.1715895114

5   * Wahl et al. (2017) Understanding extreme sea levels for broad-scale coastal impact and adaptation analysis, Nature Communications volume 8, Article number: 16075.

We will be adding the references mentioned by the Reviewer.

- In Page 2, Line 32: The following paper may be cited to define the term nuisance flooding for interested readers. * Moftakhari et al. (2018) What is nuisance flooding? Defining and monitoring an emerging challenge, Water Resources

10 Research 54 (7), 4218-4227.

The reference will be added to the text.

- In Page 3, lines 3-4: cite more recent literature, as you are pointing to the gap and we need to make sure the gap has not been filled since 2000.

We will add recent references to the text to show the continuing coastal focus. For instance:

15   • **Neumann, B., Vafeidis, A.T., Zimmermann, J. and Nicholls, R.J.: Future coastal population growth and exposure to sea-level rise and coastal flooding-a global assessment. PloS one, 10(3), p.e0118571, 2015.**

        • **Vitousek, S., Barnard, P.L., Fletcher, C.H., Frazer, N., Erikson, L. and Storlazzi, C.D.: Doubling of coastal flooding frequency within decades due to sea-level rise. Scientific reports, 7(1), p.1399, 2017.**

20 - Please use different notation in harmonic assumption for amplitude and actual fluctuating variable (i.e. saying u=u*exp(iwt) is confusing)

We will improve the notation accordingly and differentiate between the amplitude and the fluctuating variable

- In Page 5, Line 3: please be specific what kind relationship would be described by phi parameter (linear? nonlinear?...)

The relationship that the parameter phi represents is a linear relationship that is consistent with the linear equation

25 **described in the text. We will clarify this characteristic in the text.**

Reference:

Redfield, A.C., 1980. "The tides of the waters of New England and New York", 109 pp., doi:10.1575/1912/1136,

30 **https://hdl.handle.net/1912/1136**

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