"The role of tidal modulation in coastal flooding on a micro-tidal coast during Central American Cold Surge events"

by Wilmer Rey et al.

ANSWER TO COMMENTS OF REVIEWER #1

Major points

1) The English of the paper needs to be thoroughly revised. Many typos, awkward and incorrect sentences can be found in the text and should be fixed. The help of a native speaker could be beneficial.

Authors response: You are right. The new version of draft paper was reviewed by a professional native English speaker.

2) The paper actually deals with coastal flooding in a specific location. It does not assess, in general terms, the role tidal modulation in coastal flooding. Please consider to revise the title, as tidal modulation is only one aspect of the overall process analyzed in the paper. I'm thinking of something as "Assessment of coastal flooding in the Yucatan coast during Central American Cold Surge Events".

Authors response: We propose "Assessment of coastal flooding and associated hydrodynamic processes on the Yucatan coast during Central American Cold Surge Events".

3) The presentation of the paper is very confused. Different type of data, validation of model results and of input data (i.e., water residuals and wind data), characterization of CACS events and analyses of the entire 30-tears time series, etc. are mixed together. The Authors should re-order, and possibly shorten, the paper, which needs to be less dispersive to the reader attention. Rather than being a vast report of all the analyses carried out by the Authors, a scientific paper should lead the reader to clear

Authors response: You are right. We shortened significantly the draft paper. Figures 2 and 3 were joined, lower panel of Figure 5, figure 8 and figure 9 and their respective paragraphs of explanation were removed. Figures 10 and 11 were joint in two panels of a single figure. Based on this, we tried to focus only on the assessment of the inundation threat from CACS. In addition, the pertinent references you suggested were included in the manuscript, except #5 of your list (see list at the end of this document).

4) The Introduction is too long; many specific information should be moved from Introduction to Section 2.

Authors response: We moved information from Introduction to section 2 and indeed improved clarity and readability.

5) Although an interest topic per se, I do not understand the role of hydrogeology in coastal flooding. How can an aquifer discharge affect the sea level? This question needs to be clearly assessed (if aquifer discharge actually plays some roles), or otherwise, being not even mentioned in the paper.

Authors response: We acknowledge your comment. We assessed the contribution of the Yucatan aquifer to the sea level during CACS passes over the Yucatan Peninsula through a constant discharge along the coast. The model results indeed suggest that this contribution is not relevant (although the total discharge of the aquifer is estimated to be 4900822 m³.d⁻¹ along 208 km of coast line (Weidie, 1985)) and then, as you suggest, was removed from the manuscript. Maybe in future studies, this can be analyzed in more detail.

6) The "References" section contains many typos and missing/wrong information (the formatting of conference proceedings and book chapter has problems with the conference/book title and with the number of pages). Please check carefully all the details of each bibliographic item.

Authors response: Thank you. This was done. However, there are some conference proceeding that do not have book title, such as:

Rey, W., Salles, P., Mendoza, E. T., Trejo-Rangel, M. A., Zhang, K., Rhome, J. and Fritz, C.: Hurricane Storm Surge Risk Assessment for the Yucatan State Coastal Area, in Proc. 32st Conference on Hurricanes and Tropical Meteorology, p. 1, American Meteorology Organization, San Juan, Puerto Rico., 2016.

Torres-Freyermuth, A., Puleo, J. A., Ruiz de Alegría-Arzaburu, A., Figlus, J., Mendoza, T., Pintado-Patino, J. C., Pieterse, A., Chardon-Maldonado, P., DiCosmo, N. R., Wellman, N., Garcia-Nava, H., Palemón-Arcos, L., Roberts, T., López-González, J., Bravo, M., Ojeda, E., Medellín, G., Appendini, C. M., Figueroa, B., González-Leija, M., Enriquez, C., Pedrozo-Acuña, A. and Salles, P.: Nearshore Coastal Dynamics on a Sea-Breeze Dominated Micro-Tidal Beach (NCSAL), in Proc. American Geophysical Union, AGU Fall Meeting Abstracts, San Francisco, USA., 2014.

They are found on the following websites:

- http://adsabs.harvard.edu/abs/2014AGUFMOS11A1266T
- https://ams.confex.com/ams/32Hurr/webprogram/Paper293952.html

We used the Copernicus style with default values for the references.

Minor points

-Check for the presence of double consecutive spaces into text.

Authors response: Ok. Done.

-The use of acronyms and abbreviations should be limited, as it makes difficult to follow the text for those readers that are not already familiar with them. Finally, make sure that all the abbreviations are properly introduced when they first appear.

Authors response: Ok. Done.

-Abstract: the reason why hindcast sea level time series was used (i.e., the lack of Interactive measurements) has to be stated. Rather than reporting specific numerical data, please specify the locations object of the study (Progreso and Chelem lagoon) and clearly outline the analyses carried out and the main results.

Authors response: You are right. We made the corresponding changes on it.

-page 1, line 11: an "...occurrence probability" cannot be performed.

Authors response: That sentence was change to: "To diagnose the mechanisms controlling the water levels, the two worst storms in terms of maximum residual tide (Event A), and maximum water level (Event B) were identified".

-p. 1, I. 16: "inlet" of what?

Authors response: We refer to "lagoon inlet". The study area included a coastal lagoon, this is mention on the new version of abstract.

-p. 1, I. 17: "despite micro-tidal conditions" what does this means? What is the difference between the tide (mentioned just before) and these "micro-tidal conditions"?

Authors response: the term "microtidal" refers to tidal ranges less than 2 m (see, e.g., Pugh, 1987). If needed, it can be removed. In that same sentence, the difference between tide (noun) and micro-tidal (adjective) is obvious for us.

-p. 1, I. 34: "passing over the GoM"

Authors response: That paragraph was deleted based on your major point # 3.

-p. 2, I. 4: "methodology" pertains to the "study of methods", use "method" instead.

(see also p.6, l. 14).

Authors response: That paragraph was deleted based on your major point # 3.

-p. 2, I. 14: replace "induced by..... on the sea surface and" with "enhanced by"

Authors response: Ok. Done.

-p. 2, l. 15: Shorten the sentence as "Consider that the effect of pressure field is relatively small during high-pressure atmospheric systems as CACS (Flather, 2001)."

Authors response: That sentence was change as "Considering that the effect of atmospheric pressure is relatively small (Massey et al., 2007) especially during CACS events, the storm surge is mainly due to the shear stress of the wind, principally in shallow waters in the coastal zone (Flather, 2001)".

-p. 2, I. 19: which currents?

Authors response: littoral currents.

-p. 2, I. 22: ":flood hazard is defined..."

Authors response: Ok, Done.

-p. 2, I. 23: "...and period; it depends on...."

Authors response: "it" was added to the sentence

-p. 2, I. 24: delete "However"

Authors response: Ok. Done.

-p. 2, I. 25: The year is missing in the reference to Dorrestein

Authors response: Sorry, it is Dorrestein, 1961

-p. 3, l. 13: delete "However"

Authors response: Ok, Done.

-p. 3, I. 28: "back-barrier lagoon of Chelem, behind Progreso"

Authors response: Ok. Done.

-p. 3, l. 32: Start a new paragraph with "In terms of hydrogeology..." (see also major point n. 5)

Authors response: You are right, all of this paragraph was removed based on your major point # 5.

-p. 3, l. 34: delete "in"

Authors response: that sentence was removed based on your major point # 5.

-p. 4, l. 17: units: remove periods from within units' expressions (e.g., m³s instead of m³.s). Please check throughout the text.

Authors response: Ok, period was removed.

-p. 4, l. 17: put a reference to Fig. 2 after "Holbox".

Authors response: Ok. Done

-p. 4, I. 22: please define "HD"

Authors response: Ok. Done.

-p. 4, I. 23: "shallow water equations", not "shallow waters equations"

-p. 4, I. 23) Authors response: Ok. Done.

-p. 4, I. 25-26: awkward sentence

Authors response: That sentence was change to: "By means of the integration of the horizontal momentum equations and the continuity (1) equation over $h = \eta + d$, the following two-dimensional shallow water equations are obtained."

-Eq. (1), (2), and (3): What kind of discharge is S, whose units are 1/s? How are the components of the "lateral stress" evaluated? Are these Reynold/dispersion stresses?

Authors response: S is a discharge in m³ s⁻¹, but first vertically integrated, and then per unit area.

"The lateral stress terms include viscous friction, turbulent friction and differential advection. These are estimated using an eddy viscosity formulation based on the depth-averaged velocity gradients."

-p. 5, l. 4: delete "studying". This sentence seems incomplete.

Authors response: That sentence was change to: "The wave model used to compute the wave conditions and associated radiation stresses was the MIKE 21 third generation spectral wave (SW) model. This model has been used for several spectral wind-wave modeling applications (Strauss et al., 2007; Appendini et al., 2013, 2015)."

-p. 5, l. 10: After "wave action equation" please put a reference (bibliographic or to an equation reported in the paper).

Authors response: The DHI (2014b) reference was added to that sentence.

-eq. (4) is correctly written?

Authors response: Yes, it was literally copied from the Spectral Wave manual.

-p. 5, I. 15: the sentence ": the directionally ...formulation" is duplicated

Authors response: Ok. Done.

-p. 5, I. 18: "as described in"

Authors response: Ok. Done.

-p. 5, I. 21: what's the meaning of "(10-10 km)"?

Authors response: Sorry, it is 10-100 km.

-p. 5, I. 22: "and both swell and combined...are not important"

Authors response: Ok, it was corrected.

-p. 5, I. 27: I don't see S in the equation

Authors response: The energy source term, *S*, represents the superposition of source functions describing several physical phenomena. " $S = S_{in} + S_{nl} + S_{ds} + S_{bot} + S_{surf}$ " was added to that sentence.

-p. 6, I. 9: "as reported"

Authors response: Ok. Done.

-p. 6, I. 14: Does the last sentence refer to the previously described treatment of the boundary condition? In this case, this sentence should be moved before the description of the boundary condition.

Authors response: Ok, this sentence was moved before the description of the boundary condition.

-p. 6, I. 19: "according to Arcement and Schneider (1989)", "of the Yucatan sand"

Authors response: Ok. Done

-p. 6, I. 22: what is the result of the further calibration of Cd?

Authors response: The "further calibration" consisted on: (a) varying (up and down) the Lin and Chavas (2012) values and selecting the best combination that resulted in the smallest WSL error. As in that paper, the Cd used varies linearly with the wind speed, as in other studies (e.g., Bryant, K. and Akbar, M.: An Exploration of Wind Stress Calculation Techniques in

Hurricane Storm Surge Modeling, J. Mar. Sci. Eng., 4(3), 58, doi:10.3390/jmse4030058, 2016). If needed, we can include details in the manuscript.

The following minor points (p. 6, l. 37 to p. 7, l. 16) correspond to a section of the manuscript that was removed, addressing your suggestion of shortening the paper (see "Major Point #3".)

-p. 6, I. 37-ff: This paragraph should be reorganized. The risk of coastal flooding is only associated with the total sea level, not directly with the sea residual. Clearly, the analysis of the sea residual is crucial, e.g. in order to improve sea level forecasts, since the sea residual is affected by major uncertainties than the astronomical tide (e.g., Met et al., 2014).

Authors response: That paragraph was removed (see above)

-p. 7, I. 5-10: D1 and D2 are datasets, i.e. sets of data, but they are described as actions/procedures ("consisted in identifying", "consisted in adding"). In D1 the astronomical tide is removed, in D2 is added again...Please make the description of the two datasets clearer.

Authors response: That paragraph was removed (see above).

-p. 6, l. 13 (in deep is p. 7, l. 13) : datasets have to be denoted with D1 and D2, not with (a) and (b).

Authors response: That sentence was removed (see above).

-p. 6, I. 16 (in deep is p. 7, I. 16): "selected and then analyzed"

Authors response: That sentence was removed (see above).

-p. 6, I. 26 (in deep is p. 7, I. 26): "At the peak". Remove the comma after "were"

Authors response: Ok, corrected.

-p. 6, l. 31 (in deep is p. 7, l. 31): "while" is a temporal expression, use "whereas for Event B.." instead. In addition, "closer to the normal to the coast".

Authors response: Ok, corrected.

-p. 8, l. 15-16: It is not clear to me how this goal was pursued. By shifting the astronomical tide for the entire 30-years' time series?

Authors response: No, only for Event A.

-p. 8, I. 27-ff: As for what I understand, a hypothetical scenario (TSSE) is compared with a measured (reanalyzed) wind field. Does this make sense?

Authors response: We were trying to compare/correlated the increase of the sea level with the increase of the offshore wind speed. However, that paragraph was removed from the draft based on the major point # 3.

-p. 9, I. 27 Figure 10, not Figure 9.

Authors response: That sentence and figure were removed from the draft addressing your suggestion of shortening the paper (see "Major Point # 3.")

-sect. 4 and sect. 5 are quite long. I suggest a sensibly shortening of these sections.

Authors response: These sections were shortened significantly as you suggested.

-p. 14, I. 11: "consist in using the... assuming that...and performing..."

Authors response: Ok. Done.

-p. 14, l. 16: "events"

Authors response: Ok. Done.

-p. 14, I. 23: A study cannot perform anything...

Authors response: Right, it was change to: "This study has developed a thirty-year sea-level hindcast."

-p. 14, l. 24: "to identify extreme water levels and characterize their probability of

occurrence using...."

Authors response: Corrected.

-p. 14, I. 27: "different". "conditions", not "configurations".

Authors response: Corrected.

-p. 14, I. 31: The fact that an area is more populated cannot be a cause of more Flooding.....Rather, it can cause greater damages...

Authors response: Right, it change by "Since the wind stress over the lagoon was stronger for Event A, this event caused larger flooding than Event B over the back barrier lagoon of Progreso."

-p. 14, I. 33: "producing large set-up"; and waves? See, .e.g., Carniello et al. (2005).

Authors response: No, inside this small lagoon, the waves are not large (for the Event A, the biggest waves did not reached highs of 1 m. inside the lagoon).

-p. 14, l. 33: "Chelem lagoon". "were" in place of "occurred".

Authors response: Ok. Done

-p. 14, I. 34-35: "The passage of CACS, besides affecting water exchange with the sea and renewal dynamics inside the Chelem Lagoon (Viero & Defina, 2016a,b), is show to produce significant wind and wave set-up, characterized by nonlinear interactions between meteorological forcings and the astronomic tide.

Authors response: We totally agree about this. Your references were included.

-p. 15, l. 1: "Based on modeling results from..."

Authors response: "modelling" was added.

- p. 15, l. 2: "total flooded area"

Authors response: flooded was added.

-p. 15, I. 5: delete "is"

Authors response: "is" was added.

-p. 15, I. 6: awkward (and quite obvious) sentence.

Authors response: The sentence was change to: "However, the maximum flooding occurs when the CACS peak coincides with rising tide near zero level or high tide (TS4 and TS1 scenarios)". We do not consider that this is obvious, in particular during rising tide (near MWL).

-p. 15, I. 14: "storm surge, and set-up due to both wind and wave".

Authors response: Corrected

-Figure 3: I suggest putting the text in magenta on a white box to improve readability.

Authors response: Figure 2 and Figure 3 were joined.

-Figure 9, top panel: change the labels "Progreso" and "Progreso" with "Wind speed" and "Residual tide".

Authors response: this figure was removed based on your "major point #3".

-Figure 9, bottom panel: as for the top panel, labels should indicate the kind of data, not the location. "Reading (1992) method" is redundant here.

Authors response: this figure was removed based on your "major point #3".

-Additional References Interactive.

Authors response: Thanks for these suggestions.

- Carniello L., Defina A., Fagherazzi S., D'Alpaos L., 2005. A combined wind wave-tidal model for the Venice Iagoon, Italy. Journal of Geophysical Research – Earth Surface, 110, F04007, doi:10.1029/2004JF000232.
- Mel R., Viero D.P., Carniello L., Defina A., D'Alpaos L., 2014. Simplified methods for real-time prediction of storm surge uncertainty: The city of Venice case study, Advances in Water Resources 71, 177-185, doi:10.1007/s00193-013-0452-9.
- 3. Vousdoukas M. I., Voukouvalas E., Mentaschi L., Dottori F., Giardino A., Bouziotas
- 4. D., Bianchi A., Salamon P., Feyen L., 2016. Developments in large-scale coastal flood hazard mapping, Natural Hazards and Earth System Sciences 16(8), 1841-1853, doi:10.5194/nhess-16-1841-2016.
- Viero D.P., Defina A., 2016. Water age, exposure time, and local flushing time in semienclosed, tidal basins with negligible freshwater inflow, Journal of Marine Systems 156, 16-29, doi:10.1016/j.jmarsys.2015.11.006. Viero D.P., Defina A., 2016. Renewal time scales in tidal basins: climbing the Tower of Babel. In "Sustainable Hydraulics in the Era of Global Change", Proceedings of the 4th IAHR Europe Congress, 27-29 July 2016, Eds: Erpicum et al., 338-345, Liege, Belgium.
- Woodruff J. D., Irish J.L., and Camargo S.J., 2013. Coastal flooding by tropical cyclones and sea-level rise, Nature 504, 44-52, doi:10.1038/nature12855.

"The role of tidal modulation in coastal flooding on a micro-tidal coast during Central American Cold Surge events"

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ANSWER TO COMMENTS OF REVIEWER #2

Referee#2: Research investigates coastal flooding in Mexico from storm tides. I found the text/descriptions are confusing and could do with improvement please; e.g., if high-pressure cold front event induced flooding I would expect, due to the inverse barometer effect, that storm surge is small and driven exclusively by wind stress? By improving the text will reduce reader fatigue. As the writing needs much improvement to improve readability, it may be easiest to simply resubmit. Moreover, I have a number of concerns with the method and results that I think ought to be addressed before resubmission:

Authors response: Thanks for your comment. On p. 2, I. 15 we mentioned something about it. However, we made some changes in that paragraph. The new paragraph says: "The storm surge is enhanced by the wind shear stress on the sea surface and perturbations in the atmospheric pressure (Lin and Chavas, 2012). Since the inverse barometer effect contribution to storm surge is small during low pressure storm systems (Massey et al., 2007), the storm surge is mainly driven by wind stress especially in shallow waters in the coastal zone (Flather, 2001). Considering that CACS are high-pressure systems, the storm surge is essentially driven by the direct wind effect". The effect of the pressure is relatively small; the rule of thumb is that for every 1 mb drop in pressure there is a 1 cm rise in ocean surface level (Massey et al., 2007). Besides, looking into the Figure 9 (removed from the paper based on major point # 3 of reviewer 1), it is shown that the peak of the residual tide occurs after the peak of the wind intensity (roughly 2 h) and after the minimum pressure (roughly 6 h). It means that the maximum residual occurred when the atmospheric pressure was around 1013 hPa (neutral pressure). By the time the CACS high pressure reached the Peninsula, the residual tide had already decreased. We assumed that this behavior might happen most of the time when CACS reach the Peninsula. In conclusion, the CACS storm surge is mainly driven by the direct wind effect.

On the other hand, we shortened the draft paper significantly and had it reviewed by a technical native English speaker reviewer (please see the answer to reviewer 1 for major point #3).

Referee#2: (1) Tide-surge interaction means that "wetting and drying" is likely to be extreme important in the model - yet this is not discussed/perhaps not included in the model?

Authors response: Wetting and drying are included in the model following the work by Zhao et al.(1994) and Sleigh et al. (1998). The user predefines the wetting and drying values so that the elements/cells are considered in the calculation only if the wetting threshold is surpassed. The elements/cells are removed from the calculations when the depth goes below a certain threshold, so that the momentum fluxes are set to zero and only considers the mass fluxes. The depth in each element/cell is monitored, and the elements are classified as dry, partially dry or wet. Besides, the element faces are monitored to identify flood boundaries.

The MIKE 21 wetting-and-drying algorithm performs skillfully inland to the east part of the back-barrier lagoon at Progreso. The inundation area calculated for Event A was of 8 and 149 blocks for the sea and lagoon side, respectively, as shown in Table 1 (blocks of Progreso affected as a function of tidal phase during Event A). We have included this on the discussion part.

Referee#2: 2) Why are waves included in the method if not included in the model for the 30 year run? This could be done easily uncoupled - as coupled modelling likely to not be necessary?

Authors response: The 30-year sea level hindcast was developed as the basis for the extreme level analysis, which is not possible from measurements due to the lack of tide gauge records. Unfortunately, the computational cost prohibits the modeling of coupled waves and hydrodynamics for that long period. For instance, for a given period of 3 weeks, and the computational domain is shown in Figure 2, the computational time for the uncouple model was 12 h, but increased drastically (up to 2 weeks) for the coupled model version (with waves). Given the computational resources available at that moment, it was not possible to carry out a sea level hindcast including waves. Nevertheless, we considered necessary to do coupled modeling to include wave setup, and wave-current interaction, in the particular cases presented in the study.

We then considered that to know the importance of taking into account the wave setup contribution on the total flood, the two worst storms in terms of maximum residual tide (Event A), and maximum water level (Event B) were chosen to assess the inundation threat on Progreso by means of running the hydrodynamic model in a coupled model. From this, we concluded that at least for Event A the wave set-up was significant given the no linear interaction wave-currents, which induced a relevant wave setup on the Chelem lagoon.

However, the wave setup contribution is usually not taken into account for some inundation modelers mainly because of the computational time cost and because most of the time it is not comparable with the storm surge contribution.

Referee#2: 3) The resolution and time-step of the CFSR forcing data needs to be discussed (hourly, 3hourly etc) - including a sensitivity test please.

Authors response: Thank you for the question. On p.6 I. 12 something related to this topic is mentioned, and we made some changes in that paragraph. The new version says "On the surface the model was forced with wind and pressure fields from the CFSR database, which has a global atmospheric resolution of 38 km (T382) with 64 levels extending from the surface to 0.26 hPa. The global ocean resolution is 0.25° at the equator, extending to 0.5° beyond the tropics, with 40 levels from the surface to a depth of 4737m. NCEP (National Centers for Environmental Prediction) has created time series products at hourly temporal resolution by combining either 1) the analysis and one- through five-hour forecasts, or 2) the one- through six-hour forecasts, for each initialization time. When using this data product, it has to be kept in mind that only the 0000, 0600, 1200, and 1800 UTC fields are actually analysis, while the in-between hourly data are model forecast. NCEP only created time series for parameter/level combinations that were thought to be most useful to users (Saha et al., 2010, 2014). Time series that do not exist in this dataset can be created from the full 6-hourly products dataset.

Given that the spatial resolution of the CFRS grid is not regular, and the hydrodynamic model only accepts wind and pressure data varying in space from a regular grid, CFSR wind and pressure fields were linearly interpolated from a T382 Gaussian grid resolution to a regular grid with spatial resolution of 0.3125°, which is coincident with the longitude of the T382 grid

and close in latitude for the Gulf of Mexico. We assumed this resolution to be adequate to reproduce the CACS storm surge based on the work of Appendini et al. (2013), who showed that the resolution of NCEP/NCAR, ERA-interim and NARR is sufficient for wave modeling of CACS over the Gulf of Mexico. Indeed, given that CFSR data is superior to the above NCEP reanalyses regarding (a) finer resolution, (b) advanced assimilation scheme as well as (c) atmosphere-land-ocean-sea ice coupling, it is expected to be a good compromise for this application. Moreover, the hourly resolution of CFSR allow this dataset to capture extremes, such as storm peak, which other reanalyses may miss, according to Sharp et al. (2015), who found a good correlation between the hourly CFSR dataset and both onshore and offshore in situ measurement for the U.K. For instance, NCEP FNL (Final), ECMWF ERA-Interim (European Centre for Medium Range Weather Forecasts e European Reanalysis) and NCEP-NCAR (National Centre for Atmospheric Research) provide data at 6 hourly intervals (Jørgensen et al., 2005), which may not be too long to capture storm peaks, and from that maximum flooding areas.

On the other hand, the MIKE 21 hydrodynamic model uses a dynamic time step to optimize simulation speed while ensuring stable model runs. Hence, the time step may change during the simulation (large time step under calm conditions, smaller time step when flow becomes stronger). The user is allowed to set the minimum and maximum time step in the model setup. The actual dynamic time steps used are found to be in the range from 5 to 7.5 s. Then, since the time step for the CFSR is 1 h (three orders of magnitude longer than the hydrodynamic model time step), the hydrodynamic model interpolates the CFSR data linearly to its own time step.

Referee#2: (4) More model validation please: "In general, a good agreement can be seen for the sea surface elevation during the storms the Pearson correlation ranges from 0.78 to 0.87 and the root mean square error (RMSE) ranges from 0.11 to 0.17" This model validation seems very poor. What is the RMSE as a percentage of the signal (NRMSE) ? Especially as a micro-tidal site and only a few validation locations (and limited time-length) appears to be used for validation.

Authors response: We acknowledge your comment. First, as mentioned before, one of the main problems on the study zone is the lack of long tide gauge records. That is the main reason why we made the sea level hindcast. In fact, we only have raw tide gauge records for 5 years and for one location (Progreso port) in the study area. For the model validation, we presented two different events (see figure 6). We calibrated the model based on the Drag Coefficient Cd to reproduce the maximum sea level during the CACS passing (please see for more details the answer to Reviewer 1 for the minor point mentioned on p.6, l.22).

We acknowledge that use of the term "ranges" in the sentence:

"In general, a good agreement can be seen in the sea surface elevation during the storms the Pearson correlation ranges from 0.78 to 0.87 and the root mean square error (RMSE) ranges from 0.11 to 0.17"

is confusing. Probably, based on this, you suggest that the validation is poor. Let us explain that Figure 6 as follows:

For the event shown on the top panel of Figure 6, the Pearson correlation is 0.78 and the RMSE is 0.1 m., which corresponds to the 20.9 % and 16.6 % of the measured and modeled sea level range, respectively. For the other event shown in the lower panel of Figure 6, the Pearson correlation is 0.87 and the RMSE is 0.17 m., which corresponds to the 16.6 % and 18.3 % of the measured and modeled sea level range, respectively. Based on the above, we considered that model validation is acceptable. For instant, the SLOSH model, which is the

only model used by the National Hurricane Center (NHC) to provide real-time hurricane storm surge (Massey et al., 2007) for over two decades, the accuracy of the predicted surge heights is +/-20% when the tropical cyclone is adequately described (Jelesnianski et al., 1992).

References cited:

Appendini, C. M., Torres-Freyermuth, A., Oropeza, F., Salles, P., López, J. and Mendoza, E. T.: Wave modeling performance in the Gulf of Mexico and Western Caribbean: Wind reanalyses assessment, Appl. Ocean Res., 39, 20–30, doi:10.1016/j.apor.2012.09.004, 2013.

Flather, R. A.: Storm Surges, in Encyclopedia of Ocean Sciences, edited by J. H. Steele, S. A. Thorpe, and K. K. Turekian, pp. 2882–2892, Academic, San Diego, California., 2001.

Jelesnianski, C., Chen, J. and Shaffer, W.: SLOSH: Sea, lake, and overland surges from hurricanes, NOAA Tech. Rep. NWS 48, United States Dep. Commer. NOAA/AOML.Library, Miami, Florida, 71, 1992.

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