Response to comments of Referee 1: "Runup parameterization and beach vulnerability assessment on a barrier island: a downscaling approach"

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Anonymous Referee #1:

A well written paper on an important topic.

RESPONSE:
We thank the reviewer for his/her comments that will contribute to clarify the results presented in the manuscript and hence improve its presentation.

It would be useful if some calibration data had been obtained for the run-up. This does not require much data since parameterisations are robust on individual beaches.

RESPONSE:
We agree with the reviewer that it would be useful to use some calibration data for the assessment of the numerical model simulations. Unfortunately, runup data at the study area location is not available and collecting these data will be part of our ongoing work. The revised manuscript will include the following sentence at the end of the conclusions section:

"Future work will be devoted to conduct the model calibration using runup measurements and the inclusion of the storm surge contributions in the extreme water levels. These two aspects need to be addressed in order to achieve a more reliable analysis of beach vulnerability in this area."

Some differences are observed on figure 3 - why?

RESPONSE:
The wave forcing is obtained from a 30-year wave hindcast conducted by Appendini et al. [2013, 2014] for the Gulf of Mexico and the Caribbean Sea. Differences between model and observations in shallow water depths in Figure 3 might be ascribed to the lack of high-resolution bathymetry for the study area (ETOPO1 [Amante and Eakins (2009)]), and the fact that local winds fields (i.e., sea-/land- breezes) are not well resolved by the NARR. Figures R1.1 and R1.2 illustrates clearly the wave hindcast potential and limitations under different wave conditions.

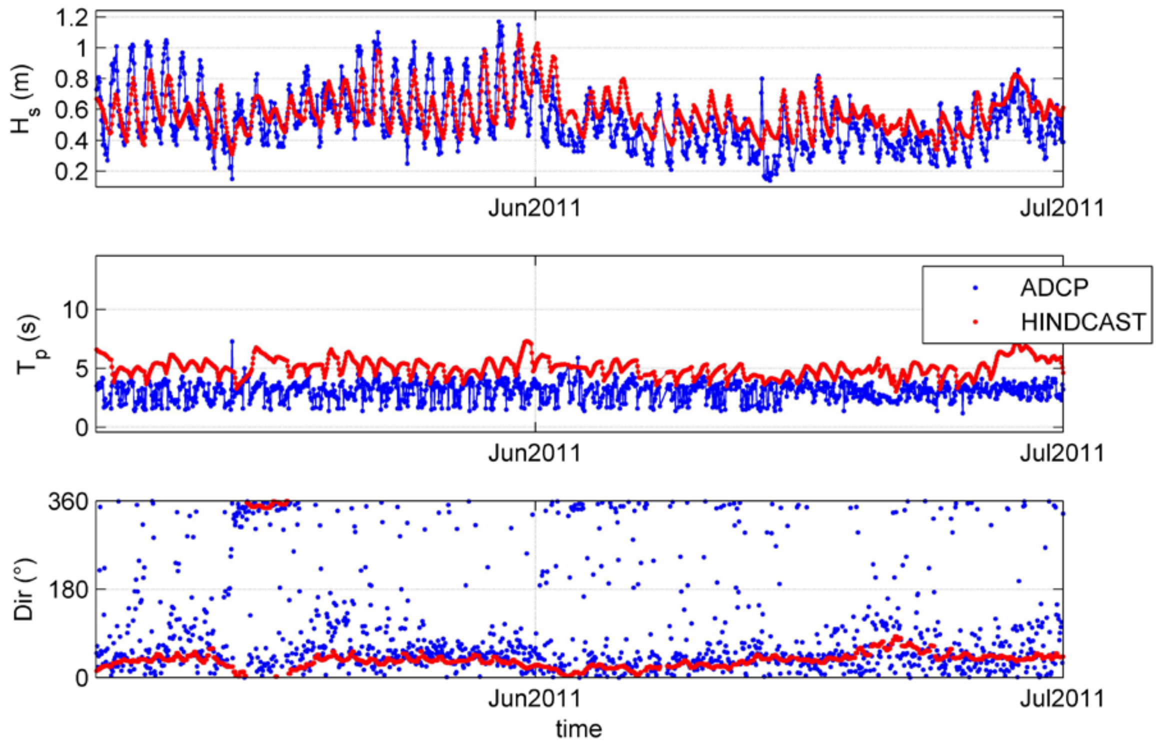

Figure R1.1.- Mean wave conditions associated with sea breezes in the study area.

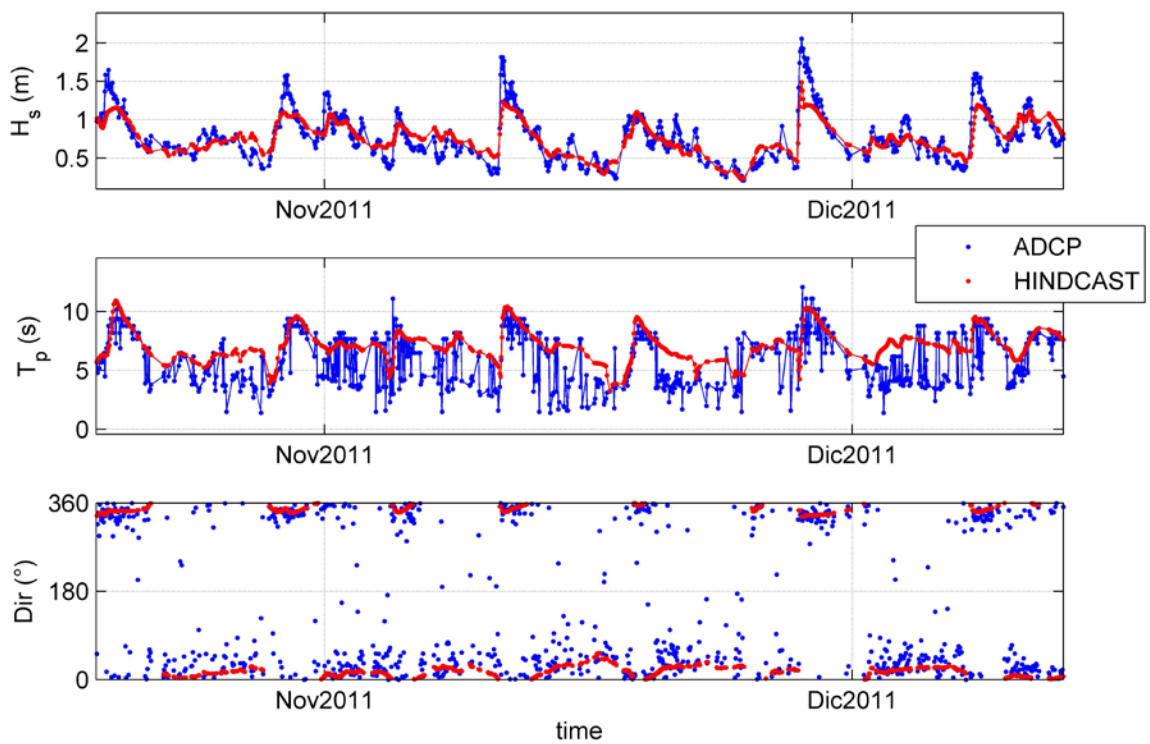

Figure R1.2.- Storm wave conditions associated with passage of Nortes in the study area.

Figure R1.1 shows the model-data comparison at the ADCP location during mean sea-breeze conditions associated to local winds. Wave height, peak period, and wave direction are poorly reproduced by the wave hindcast information due to the aforementioned limitations. For instance, the peak period is systematically over-predicted (Figure R1.1, mean panel) and wave directions corresponding to seaward wave propagation during land-breezes (Figure R1.1, lower panel, are not resolved by the wave hindcast. However, for wave conditions associated to large-scale events as winter storms (Nortes), which occur regularly in this area, the wave hindcast improves the prediction for wave height, peak period, and wave direction (see Figure R1.2), but maximum wave heights are systematically under-predicted during the peak of the storms (Figure R1.2, upper panel).

In order to evaluate the impact associated to driving the model with wave hindcast information, we employed the same methodology followed in this work but using the ADCP wave data. We selected 60 conditions from the 3-year measurement period in order to conduct beach runup simulations. The same analysis is conducted using wave hindcast information during this period. A summary of the extreme runup statistics is shown in Table R1.1 for both all wave conditions and storm conditions. The correlation coefficient for the whole period is very poor (r2=0.43 and rmse=0.23) due to a limited wave hindcast resolution for resolving local processes (i.e., sea/land-breezes). On the other hand, the correlation increases significantly (r2=0.80 and rmse=0.16) when constraining the analysis to storm waves only. For storm conditions, relative errors of the runup statistics between hindcast and measured data are smaller than 20% with a relative error of only 4% for the maximum R2%. The latter suggests that the methodology employed in the present work is valid, since we are focused on the study of extreme events. However, the use of high-resolution wind fields for driving wave generation models is necessary for the study of wave runup under mean conditions.

Table R1.1.- Extreme runup statistics for measured and hindcasted wave conditonsduring a 3-year time period (2011-2013). The error analysis and statistics correspond to all wave conditions and only storm conditions.

Ru2% STATISTICS	**(a) All wave conditions**		**(b) Storm (“Norte”) conditions only**	
	ADCP	**Hindcast**	**ADCP**	**Hindcast**
r2 (rmse)	0.43 (0.23)		0.80 (0.16)	
Maximum	1.72	1.65	1.72	1.65
Mean	0.25	0.43	0.46	0.55
Median	0.24	0.40	0.45	0.52
STD	0.31	0.30	0.36	0.35

The revised manuscript will include a new subsection in the Discussion section presenting this analysis.

The downscaling approach looks for disimilarity in the offshore wave data. While this is sensible, it may not lead to similar disimilarity in the run-up data. How could this affect the results?

RESPONSE:
We agree with the reviewer that dissimilarity in the offshore wave data may not lead to similar dissimilarity in the runup data. In this work we assume a strong correlation between runup and offshore forcing. This is consistent with previous studies devoted to the parameterization of wave runup as a function of offshore wave characteristics. Nevertheless, we believe that it is important to point out such assumption in the methods section and hence the following sentence will be included in the manuscript:

"This methodology assumes that the dissimilarity in offshore wave conditions leads to similar dissimilarity in the runup-data. This assumption is supported by the strong correlation between runup and offshore wave conditons found in previous research (e.g. Stockdon et al., 2007), only small differences in dissimilarity could arise when runup height saturates under extreme conditions."