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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Assessing storm surge hazard and impact of sea level rise in Lesser Antilles-Case study of Martinique" *by* Yann Krien et al.

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"Chapter 1 and 2: Dean as the most recent hurricane had strong impacts even though it was only category 2. Add a table that lists the main parameters of Dean and other recent (e.g. Hugo) or major historical hurricanes (e.g. 1780) that affected Martinique. Include parameters such as the distance of track from the shore, wind speeds and category and wave heights at closest position to the island, surge height, duration of inundation, inundation distance and height on land, flow speeds,... How many of the recent or historical hurricanes actually made landfall on Martinique? Are more storms passing north or south of the island? Add a map that depicts recent and historical

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hurricane tracks. https://coast.noaa.gov/hurricanes/"

=> Following your advice, we included a figure displaying historical hurricane tracks. This should help the reader finding the answer to most of the questions you ask (distance of track from the shore, wind speeds/category, number of hurricanes making landfall on Martinique, frequency of storms north and south of the island, etc). As for the other information (surge height, duration of inundation, inundation distance, height on land, flow speeds), they are unfortunately largely unknown. The only few data available are either described directly in the text (e.g lines 230-240 for DEAN) or in other papers mentioned in the manuscript (e.g. Krien et al., 2015; Krien, 2013).

"Setting: reefs and mangrove forests should be addressed in more detail, as they have a significant influence as natural coastal protection. Reef type (fringing, patch)? Add the location of the reef and the mangroves in Fig. 1. In order to get an idea of the inundation risk: how wide are coastal plains on Martinique (max., min.)? A profile showing the bathymetry and onshore topography would be helpful, especially as the nearshore bathymetry has a significant influence on the potential storm surge and wave setup."

=> Again, we followed your advice and: 1-added the location of reefs and mangroves in figure 1 , 2-displayed profiles showing bathymetric and topographic features in a few areas of interest (figure 1).

"Lines 17-18 (page 1): the importance of operational storm surge warning systems is stressed - are there plans for or already operating systems on Martinique? Have there been any evacuation trainings? How gets the population currently alerted? Are there any evacuations routes assigned?"

=> As far as we know, there is no already operating system for the whole Martinique. As for evacuation routes or trainings, the situation seems to be quite different from one municipality to the other, and evolves quickly with time. It is indeed a very interesting subject, but giving a precise overview of this matter in Martinique would require a

specific study, and is well beyond the scope of the present paper.

"Line 13 (page 3): development is probably not the right term here -recolonization?"

=> The sentence was reworded (lines 97-98...)

"Line 16 (page 3): add a reference for the 1780 event."

=> We added a reference (lines 103-104)

"Chapter 3: Which hurricane categories were used? You mention cat 4-5 in chapter 5, but it should already be stated here."

=> We stated this in chapter 3 in the new version

"Line 39 (page 4): add a reference for the database"

=> There seem to be a misunderstanding: we did not use an already existing database, we developed one specifically for this study. We made this point clearer in the new version (line 169).

"add a table with the input data used to set up your predictions."

=> Are you referring to input data relative to synthetic extreme events? If so, most of the information is given at the beginning of section 3, but for the sake of clarity, we also included a table in section 5.1 in the new version. On the other hand, if you are referring to the database and the atmospheric model, information can be found in Emanuel et al (2006) and Emanuel et al. (2004).

"Line 46 (page 4): global mean sea level change (1 m) is cited which is very general. Are there any studies that predict a more local sea level? For a global or more local sea level: what are the max, average or min predictions?"

=> We already quoted the work of Palanisamy et al., 2012 in the first version of the paper. This works shows that the sea level trend in the Lesser Antilles is very similar to the global mean rate. We are not aware of any study giving predictions for 2100 at

the local scale. In any case, uncertainties are large, from a few tens of centimeters to several meters in the worst cases. The value we chose (1m) is, as you say, very frequently considered by scientists or coastal planners when the trend is similar to the global mean sea level rise, as it is the case here. We tried to make this clearer in the new version.

"Chapter 4: Is there any wave height data of Dean available? Which max heights and speeds were observed / measured? Line 32 (page 5): observations are mentioned but not explained – what was observed? Better add this to chapter 2."

=> Yes indeed, there are wave height data available for Dean. We give greater details on this matter in the new version, and (generally speaking) reformulated the whole paragraph to make things clearer to the reader.

"Why did the authors not select any additional scenario with an east-west track?"

=> We performed several sensitivity tests on the track angle. Results show almost no sensitivity to this parameter. As a consequence, we did not consider a purely east-west track here. As for west-east tracks (maybe it was your point here?) we did not study specifically the impact of this kind of event for several reasons:

1- As far as we know, a west to east track hurricane passing nearby Martinique has never been observed (according to historical data). Events passing farther from Martinique were recorded (e.g Lenny, or Omar), but they induced very low surges in low-lying and vulnerable areas (such as bay of Fort-de-France). Hence, the probability that the extreme levels presented here will be significantly exceeded in low-lying areas by this kind of event can be considered very low.

2-Most of the damages due to hurricanes such as Lenny or Omar where due to wave impacts (overtopping) at the shoreline along the north-western coast. The study of these processes are beyond the scope of this paper, which essentially concentrate on low-lying (surge prone) areas.

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"Chapter 5: Add a table that lists and compares the results of the 13 different scenarios. Include parameters like the modeled surge height, wave height, inundation distance, category, distance of storm track from the shore, and any other simulated parameters."

=> We added a table in chapter 5 that lists and compares the results of all the scenarios. Inundation distances are not given since the resolution is not good enough to represent this parameter with a satisfactory accuracy.

"Chapter 6: Divide this chapter into separate chapters for the discussion and the conclusions."

=> We modified the paper accordingly

"The discussion is far too short. For example it lacks a discussion on a Haiyanlike bore. The setting with a step bathymetry and reefs may allow the set up of infragravity waves on Martinique."

=> We added a paragraph on IG waves in the new manuscript. Generally speaking, the discussion as a whole has been consolidated.

Line 11 (page 10): the role of mangroves and reefs as potential natural coastal protection has not been mentioned before. It should be discussed in greater detail. Also see comments to chapter 1 and 2.

=>The role of mangroves and reefs is now mentioned in chapter 2. It is also discussed in greater details in the concluding remarks.

âĂć Fig. 1 a and b have a bad resolution. White yellow and cyan lines can hardly be seen. Location of reefs and mangroves should be added.

=> Figure 1 was modified accordingly

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-148/nhess-2017-148-

AC1-supplement.pdf

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2017-148, 2017.

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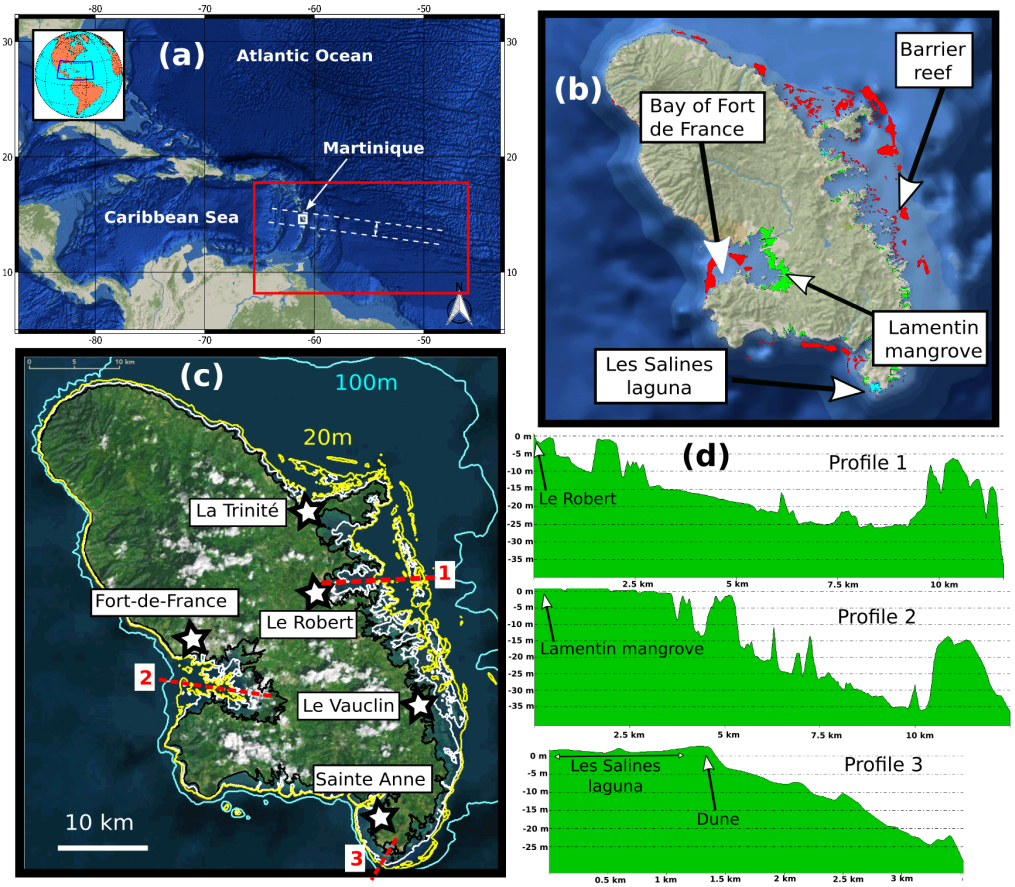

Fig. 1. New figure 1 with location of coral reefs, mangroves, and bathymetric profiles

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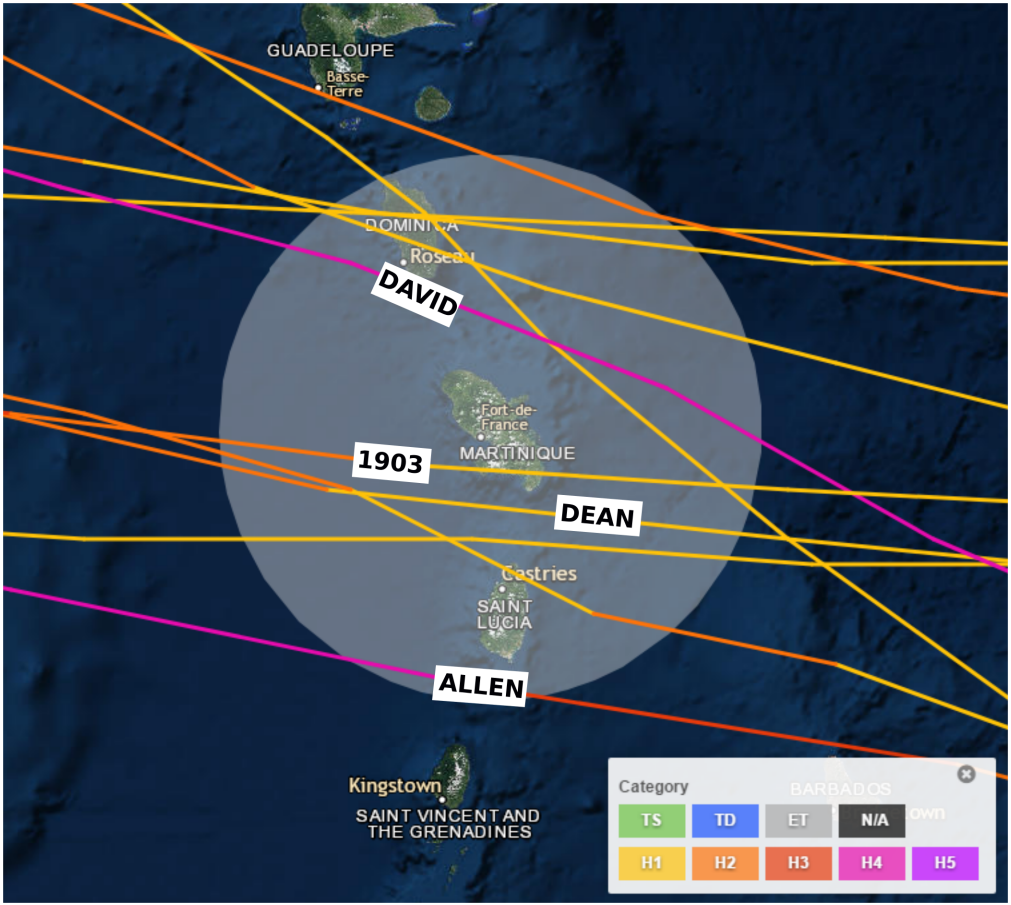

Fig. 2. and intensities of historical hurricanes passing within 65 nautical miles from Martinique, since 1900.

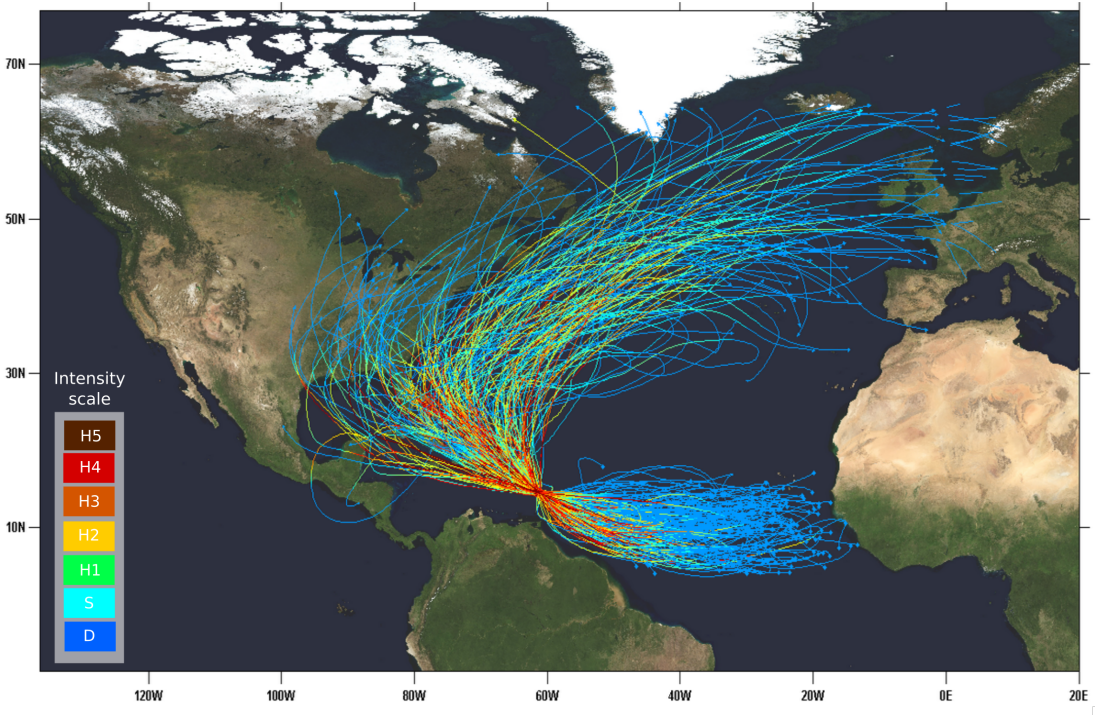

Fig. 3. A few examples of synthetic hurricanes generated for this study, using the statistical-numerical approach of Emanuel et al. (2006).

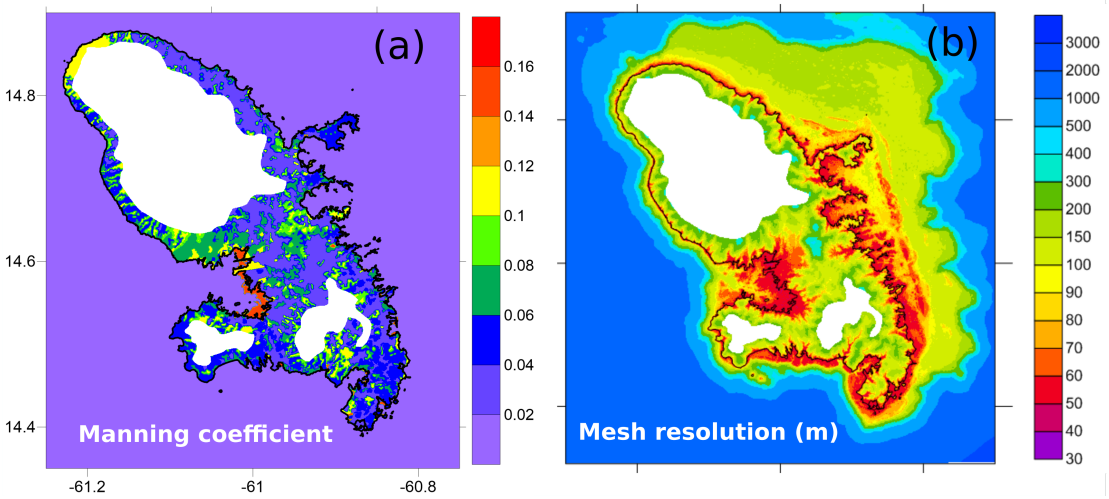

Fig. 4. (a): spatial variation of the Manning coefficient n, based on land cover data (Union Europeenne, 2006). (b): spatial variation of the mesh resolution in the vicinity of Martinique.

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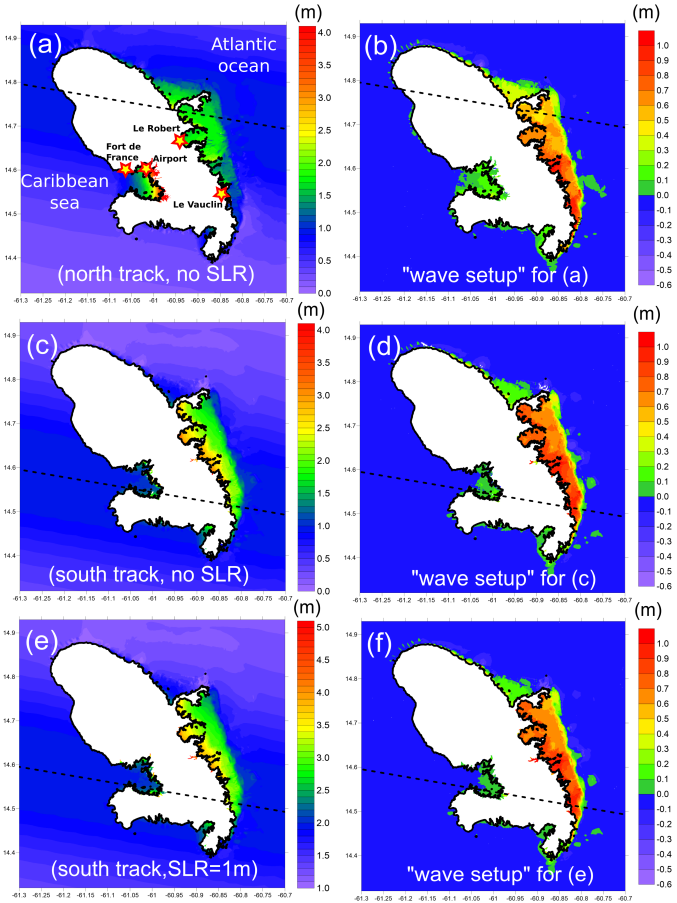

Fig. 5. Modified version of the figure displaying maximum water levels and wave setup for synthetic extreme events

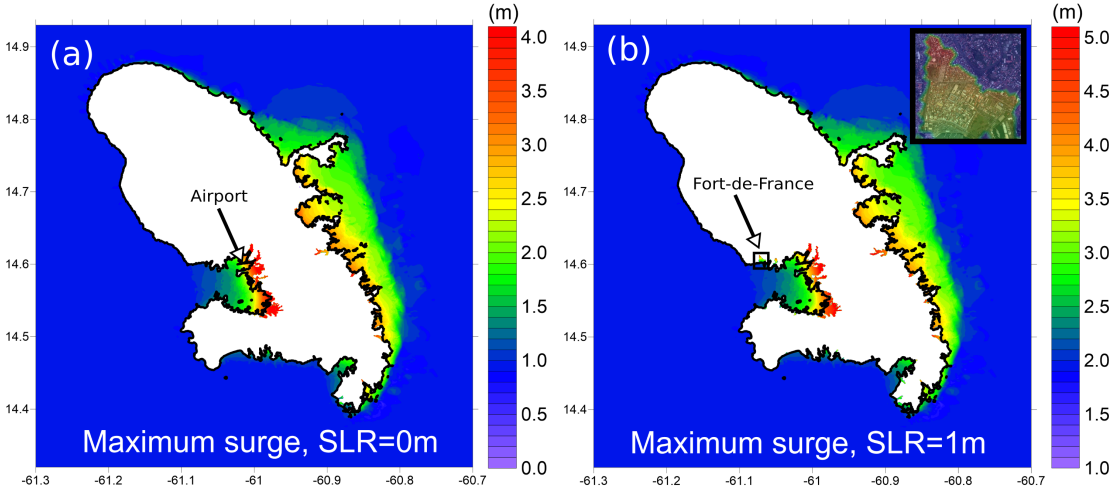

Fig. 6. Maximum surges obtained by considering Âń worst case Âż (category 4-5) hurricanes hitting Martinique, without (a) et with (b) sea level rise.

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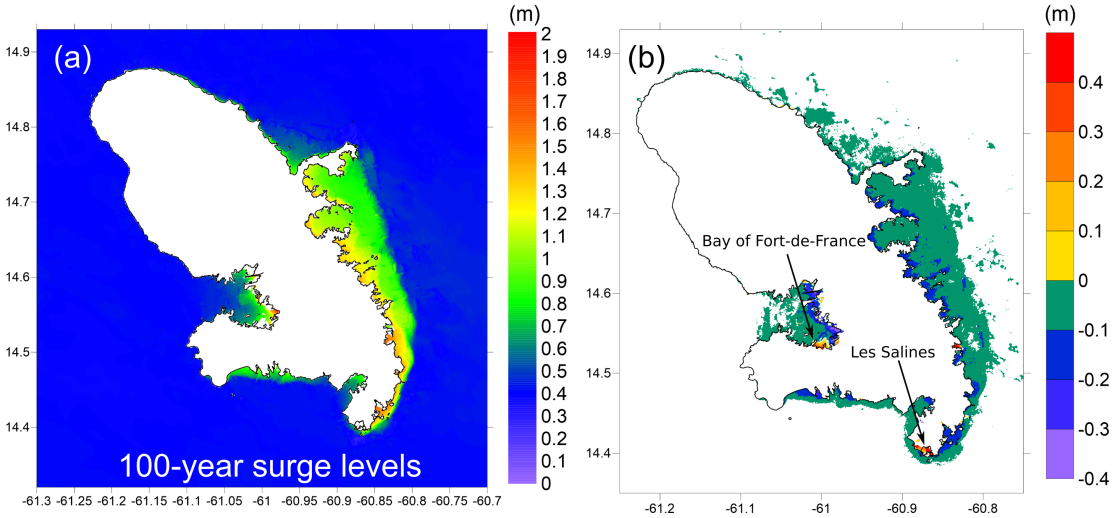

Fig. 7. 100-year surge levels for present climate and no SLR (a), as well as difference between 100-year surge levels for present climate when considering a 1m-sea level rise (b).

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