Replies to the Interactive Discussion on **"A paradigm of extreme rainfall pluvial floods in complex urban areas: the flood event of 15 July 2020 in Palermo (Italy)."**

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RC2: 'Comment on nhess-2021-61', Anonymous Referee #2, 26 Apr 2021

Dear Antonio Francipane,

We are pleased to inform you that Anonymous Referee #2 posted a new Referee comment in the interactive discussion of the following NHESS manuscript:

Title: A paradigm of extreme rainfall pluvial floods in complex urban areas: the flood event of 15 July 2020 in Palermo (Italy)
Author(s): Antonio Francipane et al.
MS No.: nhess-2021-61
MS type: Research article
Special Issue: Future risk and adaptation in coastal cities

Please access the discussion at: https://nhess.copernicus.org/preprints/nhess-2021-61/#discussion

To log in, please use your Copernicus Office user ID 210012.

In case any questions arise, please do not hesitate to contact me.

Kind regards,

The editorial support team
Copernicus Publications
editorial@copernicus.org

Referee: ***Specific comments.*** *See attached commented PDF.*

Response: We really thank the Referee for his/her effort in such a deep analysis and for his/her useful indications that have surely improved the quality of our manuscript. The Referee can find our corrections in the following.

Referee: *line 1. not clear which paradigm you are referring to.*

Response: The Referee is referred to our first general answer.

Referee: *line 6. "In the last years … are witnessing". Check correct tense.*

Response: We have changed "are witnessing" with "*have witnessed*"

Referee: *line 22. "Gone up to unprecedented levels". Check language.*

Response: We have changed "gone up to" with "*reached*".

Referee: *line 42. "The increasing severity of flooding events is demonstrated by the analysis of extreme events". Check language and content.*

Response: After the significant changes in the Introduction, this sentence has been modified as changed as follows: "*As a result of the above said, in recent times, many areas of the island have experienced some very intense rainfall events, usually concentrated between the end of the summer and the fall, that caused urban floods and flash floods with consequent economic damages and, sometimes, human lives losses.*".

Referee: *line 49. "a series of some heavy". Check language.*

Response: We have changed "a series of some heavy rainfalls" with "*some heavy rainfall events*".

Referee: *lines 54-55. Delete "As it is possible to notice from the few aforementioned examples,".*

Response: Done.

Referee: *line 58. Delete "the so called".*

Response: Done.

Referee: *line 71. "and heaviest". Check language.*

Response: We have changed "more frequent and heaviest" with "*more frequent and heavier*".

Referee: *line 72. "based on the new concepts of "design with nature" and "resilience paradigm"". Avoid redundancy, this was just introduced.*

Response: After the significant changes in the Introduction, this sentence has been removed.

Referee: *lines 88-92. "Even though the city of Palermo has suffered many flooding events in the past, the event occurred on 15 July 2020 is particularly significant, since it represents a perfect example of extreme rainfall pluvial floods in complex urban areas that many cities, especially in the Mediterranean region, have been experiencing in recent years and that, most probably, will have to face even more frequently in the near future due to the combined effects of an intensification in extreme rainfalls and an always more rapid urban growth.". This was already said earlier.*

Response: We have removed this redundancy in the new version of the manuscript.

Referee: *line 97. "the modeling framework here reported". See general comment n.1 about the scientific question and novelty of this work.*

Response: The Referee is referred to our first general answer.

Referee: *line 127. Change "hydraulic sections of channels" with "channel cross sections".*

Response: Done.

Referee: *line 129. "channels above mentioned". Check english.*

Response: We have changed "*channels above mentioned*" with "*above mentioned channels*".

Referee: *line 130. "covered parts of channels". I advise authors to be consistent either using culverts, sewer systems or any terms they prefer, but I'd use one term, provide a definition and stick to it for the entire manuscript.*

Response: We thank the Referee for this advice. We have slightly changed the sentence to define the covered parts of channels as "culverts" and then used this last term in the entire manuscript.

"*The outlets of the four contributing catchments (yellow circles in Figure 3) match with the start points of the covered parts of channels (**i.e., culverts**) Mortillaro, Celona, Borsellino, and Luparello*".

Referee: *line 152. Delete "that caused the above-mentioned flooding events".*

Response: Done.

Referee: *lines 157-158. Delete "Despite all the events reported in Figure 5 have caused considerable events within the district Uditore – Passo di Rigano".*

Response: Done.

Referee: *lines 173-176. "Figure 6 shows the self-healing thunderstorm cell observed around the 17:00 on the city of Palermo from the visible channel of Meteosat-11 project satellites and provided by the EUropean organisation for the exploitation of METeorological SATellites (EUMETSAT) of the UK Met Office.". Not sure this figure is helpful for the manuscript. It may be moved to the supplementary material.*

Response: Following the Referee's suggestion, we have moved the Figure 6 to the supplementary material. The Figure is now numbered and referred to as S1.

Referee: *line 222. "Depth of about 5 m". How this measure was obtained? Observations?*

Response: The depth and the volume were measured and estimated, respectively, by the Fire Department. We have added this information in the sentence as follows: "*In the underpass Da Vinci, **as measured by the Fire Department**, the water level reached a depth of about 5 m, with an estimated water volume of 28,000 m3 entrapping many drivers within their cars thus causing the prompt intervention of the firefighters*".

Referee: *line 235. "main". I would not say MAIN, but the ones of interest for this sort of flooding?*

Response: We have changed the sentence as follows: "*The TOPography-based Probability Distributed Model - TOPDM (Liuzzo et al., 2015; Noto, 2014) is a lumped conceptual model that allows the simulation, at the basin scale, **of all the hydrological processes of interest for the sort of flooding here studied***."

Referee: *lines 255-256. "Distributed Unit Hydrograph". Why capital letters? Is this an acronym?*

Response: Yes, it is the acronym of D-UH from Noto & La Loggia (2007). We have now added the reference to Noto & La Loggia (2007) in the manuscript.

Noto, Leonardo & la Loggia, Goffredo. (2007). *Derivation of a Distributed Unit Hydrograph Integrating GIS and Remote Sensing*. Journal of Hydrologic Engineering - J HYDROL ENG. 12. 10.1061/(ASCE)1084-0699(2007)12:6(639).

Referee: *line 271. I'd add a sentence or two to describe the hydrologic modelling output of the TOPDM model.*

Response: As suggested by the Referee, we have added the following part before the final sentence of the section: "*The model returns in output, in addition to the hydrograph at the outlet of the basin, different hydrological state variables, such as the mean level of soil moisture within the watershed, the percentage of saturated area, the groundwater storage, and the potential and actual evapotranspiration.*".

Referee: *line 274. "reconstruction". Simulation?*

Response: We have changed the word "*reconstruction*" with "*simulation*".

Referee: *lines 297-298. "Generalized Delaunay". Why capital?*

Response: We have eliminated capital letter for the word "generalized".

Referee: *lines 304-305. "so simulated". Check English.*

Response: We have deleted this part.

Referee: *line 307. "Hydrological Simulation". Be consistent with the title of 3.1 "hydrological modelling".*

Response: We have changed the title of this section as suggested by the Referee.

Referee: *lines 308. "digital elevation model". Here capital are needed.*

Response: Done.

Referee: *line 310. "single-flow direction". Capital letters for the acronym.*

Response: Done.

Referee:

lines 320-321. "the simulated hydrographs were reduced of a value equal to their discharge capacity". Please explain better this step.

lines 324-325. "The subtracted volumes were supposed to be delivered downstream the study area by the underground channels". What is subtracted volumes?

Response: We have changed the whole sentence as in the following: "*The Passo di Rigano drainage system was supposed to be in perfect condition of maintenance, even though its actual state is not known because of its complexity. The information provided by the Municipality of Palermo was used to set the maximum discharge (i.e., channel capacity) for the Borsellino, Celona, Luparello, and Mortillaro channels equal to 40, 14, 25, and 11 m3/s, respectively.* ***These channel capacities were then subtracted from the simulated hydrographs and supposed to be conveyed downstream the study area by the culverts***.".

Referee: *line 339. "to force the hydraulic model". Not sure this is the proper way to say it.*

Response: We have changed the whole sentence as follows: "*The discharge hydrographs of the basins named Borsellino, Celona, Luparello, and Mortillaro simulated with the TOPDM (Figure 9) were assigned as inlet boundary conditions and then propagated within the domain of study with the hydraulic model*".

Referee: *line 345. "the goodness of hydraulic simulations, especially when these regard urban floods". Check english.*

Response: Also following a comment from the Referee #1, we have changed this sentence as follows: "*…one of the main difficulties to evaluate the reliability of hydraulic simulations in urban areas is the …*". Also, as suggested by the Referee in the next comment, we moved this part in the Material and Methods section.

Referee: *lines 346-355. This part on the crowdsourced data should be moved to the Materials section*

Response: As suggested by the Referee and following what said in his/her 2nd general comment, we have added a new subsection in Material and Methods section entitled "Crowdsourced data".

Referee: *line 356. "maximum flood depths". Those depths are estimated at peak time (max of hydrograph) or the maximum simulated at different time steps?".*

Response: The maximum flood depths are those simulated at different time steps.

Referee: *line 365. With regard to the numerical simulation results".*

Response: A specific comment on this part is missing in the Referee's file (it is just highlighted). By the way, we have decided to delete this part, since it seems to be redundant.

Referee: *lines 371-372. Delete "once again".*

Response: Done. Moreover, we have modified the sentence as follows. "*With reference to the underpass Michelangelo, instead, the model returned a water depth of about 1.5 m in points 1 and 2 and about 2.3 m in point 3 of Figure 13,* ***which are compatible with the water levels shown by the pictures***".

Referee: *lines 411-420. I'd stress the importance of using crowdsourcing to post-event analyses, considering satellite data (see supplementary) are not adequate as well as difficult to obtain observations during such critical events. See general comment n.2.*

Response: We have added the following point to the bulleted list.

"*use crowdsourcing data also considering that satellite data are not always adequate to obtain observations during (or after) such critical events (see, for instance, the Figure S3 in the supplementary material) and that are often not timely available because of the satellite orbit revisit time;*".

Referee: *line 625 (Figure 1). The raster DEM should have ranges in the legend, not single values.*

Response: Done.

Referee: *line 636 (Figure 3). "covered part of channels". Culverts or the sewer system.*

Response: As reported in a previous answer, we have used the term "culverts".

Referee: *line 660 (Figure 9). "Computational mesh". Of what?*

Response: We have modified the whole caption as follows: "*Computational mesh of WEC-FLOOD model. The vertices of each cell (black dots) are the computational centers of the cells (i.e., the points where the water surface is computed for the cell) and are obtained as the circumcenters of the generalized Delaunay triangulation*".