Review of the paper "Hydro-meteorological reconstruction and geomorphological impact assessment of the October, 2018 catastrophic flash flood at Sant Llorenç, Mallorca (Spain) submitted to NHESS by Jorge Lorenzo-Lacruz, Celso Garcia, Enrique Morán-Tejeda, Arnau Amengual, Víctor Homar, Aina Maimó-Far, Alejandro Hermoso, Climent Ramis, Romualdo Romero

General Comments

The paper focus on the hydrometeorological diagnostic of a catastrophic flash flood event that affected a small semi-arid and torrential basin in Mallorca on October 2018. Rainfall evolution has been estimated from radar data, while the discharge has been obtained applying FEST-WB and the hydraulic simulation has been done through HEC-RAS. of the event and mapping of affected areas.

It is an interesting case of study and a deep study that merits be published. The main problem is the hydrological model that the authors have used, that is not the more adequate to be applied in flash floods events in little catchments that the case of study. Authors should justify better the suitability of this model.

Besides other changes that I expose a continuation, the entire paper needs a careful revision of the English language by a native and official translator. Some paragraphs of the present version have great difficulties to be understood.

Abstract:

Besides the language revision, some information should be added in the abstract: the date in which the event was produced, the hydrological model, the time step used in this model, the hydraulic model, the spatial resolution for modelling the flooded area. They should indicate the data source. Authors also say that the flooded area exceeded the extension for a 500-year return period flood, but they should indicate the source of this flood hazard map that they use for the comparison.

Introduction

The Introduction doesn't reflect the deep knowledge on heavy rainfalls and floods in Mediterranean Areas of some of the co-authors. It should be improved, both from the meteorological point of view and hydrological point of view. It offers a poor and non-updated knowledge of the state of the art about heavy precipitation events and flash floods in Mediterranean Areas, while the authors are experts on the matter. The own authors have important contributions on this matter that would be useful for this paper. For instance, in this paper, authors state the importance of the intrusion of cold polar air masses aloft, when this factor is not present in the major part of the cases. On the contrary, they do not say anything about the important role played by mesoscale or synoptic lows.

Besides this they do not say anything about the hydrological approaches that are usually applied to this kind of events, mainly if we consider the transport of solid material that can affect considerably the estimation of the discharge. This is an important problem when they decide to use a non-usual hydrological model.

As example of literature to improve this Introduction I recommend (besides other publications of some of the co-authors):

Martínez, C. et al, 2008. Heavy rain events in the Western Mediterranean: an atmospheric pattern classification. Adv. Sci. Res., 2, 61–64, 2008 www.adv-sci-res.net/2/61/2008/

Lumbroso, D., Gaume E., 2012. Reducing the uncertainty in indirect estimates of extreme flash flood discharges, Journal of Hydrology, doi:10.1016/j.jhydrol.2011.08.048

Ducrocq V. et al., 2014. HYMEX-SOPI The Field Campaign Dedicated to Heavy Precipitation and Flash Flooding in the Northwestern Mediterranean. Bulletin of the American Meteorological Society, 95(7): 1083.

Gaume, E. et al, 2016. Mediterranean extreme floods and flash floods. Into Hydro-meteorological extremes, chapter 3, The Mediterranean Region under Climate Change. A Scientific Update (coordinated byAllEnvi).133-144. IRD Éditions Institut de Recherche pour le Développement, Marseille, 2016, ISBN : 978-2-7099-2219-7

Llasat, M.C. et al., 2016. Trends in flash flood events versus convective precipitation in the mediterranean region: the case of catalonia. Journal of Hydrology, 541, 24-37, http://dx.doi.org/10.1016/j.jhydrol.2016.05.040 0022-1694

Hally et al, 2015. Hydrometeorological multi-model ensemble simulations of the 4 November 2011 flash flood event in Genoa, Italy, in the framework of the DRIHM project. Nat. Hazards Earth Syst. Sci., 15, 537–555, 2015

Catchment description:

Add more information about the radar (temporal and spatial resolution, number of vertical scans, products that you have used). Clarify if you have worked with the raw echo radar imagery provided by AEMET without any correction of if you have worked with corrected images or precipitation products provided by AEMET.

Atmospheric modelling and convective precipitation predictability

The statement "An initial numerical exploratory study was performed after it was ascertained that no operational system forecasted 135 precipitation rates over eastern Mallorca anywhere near the recorded rainfall rates (Figs. 2c and 2d) in their operational cycles" is a very serious denounce that is not enough justified. As instance, authors mention Figure 2 to justify this accusation but Figure 2 shows results from WRF when the forecast made by AEMET was with another model. If you want to maintain this statement you need to be stricter and show all the operational models that you are referring.

In line 147 you speak again about "the WRF runs were nested in the 00 UTC October 9 operational cycle", but which operational cycle?

All the paragraphs where authors present the methodology to modify the WRF simulation should be moved to **Methodology.** It will be better to move the entire section 2.3 to Methodology

Hydrological modelling

The Flood Event–Based Spatially Distributed Rainfall–Runoff Transformation–Water Balance (FEST-WB) model is not adequate for flash-flood events. Evapotranspiration do not play any role in these cases. Authors justify it by the reference by Rabuffetty but in this case it was applied to

Po River, that has a major catchment. Please, look for more references on the use of this model in cases of flash-floods. The better models for this kind of event are DRiFT, RIBS or HBV.

Results

Authors state that radar-derived rainfall estimates showed very high agreement with rain gauge data. Usually radar data products are calibrated and corrected with measures in surface provided by raingauge networks. Do the authors know if they had work with the **** radar products or corrected products? They should clarify this in the paper.

Authors say that hydraulic simulation showed that water reached a depth of 3 m at some points, and modelled water depths highly correlate ($R^2 = 0.91$) with in-situ after-event measurements. They should indicate the number of measures and location.

Authors indicate that the flash flood eroded and transported woody and abundant sediment debris, changing channel geomorphology. How had they considered this transport in the hydrological simulation? I would recommend them to read the paper by Martin Vide and Llasat (2018) were this kind of problem is analysed in detail for another flash flood event that was produced in a neighbouring region.

> Martín-Vide, J.P., M.C. Llasat, 2018. The 1962 flash flood in the Rubí stream river (Barcelona, Spain). Journal of Hydrology 566, 441–454.

Discussion

Authors say that the development of a successful flash flood warning system for the region will require of a hydro-meteorological forecasting system that combine sub-kilometric precision in the precipitating systems, decametric precision in the hydrological modelling and metre or sub-metre precision in the hydraulic component of the forecasting chain. I am afraid that this last part related with this precision in hydrological modelling is not needed and non-realistic. For this case of events, where heavy precipitation plays the most important role in a catchment with high flood risk, an improvement of QPF by using blending techniques plus the improvement of the mesoscale models and radar nowcasting will provide a good advancement.

Minor changes:

Lines 14-16. The text is the same that this one of lines 55-58. Please, modify. Besides this, it doesn't contain all the required information

Line 30. Please, indicate for which period had Spain reported more than 20 floods per 10,000 km2, with 652 fatalities.

Line 34. Please, indicate the dates and regions in which flash floods were produced between October 9 and November 9, 2018.

Line 40. The greatest part of heavy precipitation events that produced flash floods in Mediterranean Region are not related with the intrusion of cold polar air masses aloft. Please, don't include this condition in the new Introduction.

Line 43. Authors say that “High precipitation rates can remain during several hours over individual catchments.” This is correct but it should be important to clarify that some important flash floods are produced by heavy precipitations that last less than 1 hour

Line 61. Please, substitute “Meteorology-based prediction methods” by “the operative mesoscale meteorological model”.

Line 78. Add a reference to justify this sentence about Hortonian flows during intense rainfall episodes.

Line 85. “In this study,…” About which study are the authors speaking?

Lines 134-135. Indicates to which operational system are you referring (mesoscale model, resolution, data provider)

Line 148. Substitute Oct by October

Line 178. The sentence “distribution of accumulated radar-derived precipitation (Fig. 2c and 3a)” is not true. Figure 2c provides WRF results.

Line 185. What is the meaning here of “land mass”?

Line 186. The expression “pluviometric density of 29.4 km²” is not correct. Modify it or modify the units

Line 339. Synoptic conditions are not the responsible of the stationarity of the convective system that generated a succession of convective nuclei.

Figures

Figure 1. Some legends of Figure 1 are not enough clear to be reproduced. Add the location of the radar.

Figure 2. Indicate the meaning of CC BY-NC) write in the text. Add to which WRF Model are you referring and the resolution, as well as the provider of these images

Figure 3. Add a radar imagery showing the structures that affected the catchment. Correct “ 2018 flashflood.”