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Dr. Mario Parise
Scientific Editor, NHESS
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Dear Dr. Parise,

A revised version of the manuscript NHESS-2023-130 entitled: "*Hydrometeorological controls and social response for the 22 October 2019 catastrophic flash flood in Catalonia, north-eastern Spain*" by A. Amengual, R. Romero, M.C. Llasat, A. Hermoso and M. Llasat-Botija is attached. In the next pages, the authors include a point-by-point response to the comments and concerns risen by the reviewer.

The authors express their gratitude to the scientific editor and all the reviewers for their valuable comments, which greatly improved the quality and presentation of the revised version of this study. Specifically, the geology of the study area and the role of karst in predisposing the catchment to flash floods are described and discussed more extensively, with references to the relevant international literature.

Sincerely,

Dr. Arnau Amengual

REVIEWER 3

General comments

The manuscript is a highly interesting study about a catastrophic flash flood that occurred in 2019 in Catalonia. It examines the event as concerns the hydro-meteorological controls, adding also considerations about the social response to this type of natural phenomena. The work is well presented, with good amount of data and detailed analysis.

The authors express their gratitude to the reviewer for his/her insightful comments provided during the revision process. The revised manuscript addresses all concerns raised by the reviewer, notably expanding the discussion on the geology of the study area and the influence of karst in predisposing the catchment to flash floods. This extension includes references to the available international literature on the subject.

Specific comments

My main concern is on the few lines dedicated to geology of the study area. In the description of the catchment area, it appears that, given the presence of gypsum and limestone, karst may have had a role in predisposing the catchment to flash floods. Some sentences would be needed to highlight the role of karst in this sense, also referring to the available international literature at this regard.

The authors acknowledge the need for a more detailed presentation of the geology in the study. In response, section 2.1.1 of the manuscript has been rewritten (lines 131-152).

Well, heavy precipitation mainly affected the western headwaters of the Francolí river basin, on which the flash flood developed. The karst terrain is located in the southern part of the Brugent tributary, downstream from the most affected drainage areas. Consequently, this region experienced less intense rainfall. However, the karst significantly influenced the hydrological response to the precipitation over the Brugent tributary. Most of surface runoff rapidly infiltrated into the deep calcareous aquifers. Analysis of the observed hydrograph at the Tarragona stream-gauge indicated that subsurface flow played a relative minor role in this event, disregarding a rapid flow through fractures and conduits before discharge through springs and/or gaining streams into the Brugent river.

Recognizing the importance of highlighting the role of karst in flash flooding, the authors have included a new paragraph in section 4.3.3 (lines 520-527) to address this issue, also citing relevant international literature.

Even in section 4.3.3 (Sensitivity tests) the issue comes back, but nothing is said at all about the karst nature of the land. In karst terrains, water is typically scarce, if not absent, at the surface, and it infiltrates underground to create complex networks of caves and conduits (see Gutierrez et al., 2014, and the extensive references therein about floods in karst). This is an important issue, since the lack of surface water for most of the year may also have an effect in the low awareness of the community about the possibility of having flood problems. And, as a consequence, it could have a role in the social impacts dealt with by the Authors in this work. I strongly suggest the Authors to improve the quality of their work by adding a more detailed geological description (for instance, how much of the basin is karst?), and some reference to karst, and to the peculiarity of such an environment (especially as concerns flash events). At this goal, I suggest some reference below, with particular regard to the work by Gutierrez et al., where the flash floods in karst area dealt with, and there is a wide set of references in the final bibliographic list.

The authors agree with the reviewer's concerns regarding the role of karst in flash-flooding. However, the spatial extent of karst in the Francolí river is mainly confined to the southern part of the Brugent tributary, a drainage area that experienced less intense rainfall during the episode. Nevertheless, the hydrological response to the precipitation over the Brugent tributary was certainly influenced by the presence of karst, as discussed in the previous point.

The authors have not found the exact extent of karst over the Francolí basin in the available literature. The digital maps provided by the Spanish Institute of Geology (IGME) suggest an approximate area of 50-100 km². The authors are grateful for the wealth of international references supplied by the reviewer on this topic. The revised manuscript now better contextualizes this aspect by incorporating references to the relevant to the international.

The authors appreciate the reviewer's observation regarding that the scarcity of surface flow for most of the year may contribute to the community's low awareness regarding potential flood risks. This observation has been included into the revised manuscript in section 6.2, lines 753-756.