Natural Hazards
and Earth System
Sciences
Discussions

Interactive comment on "The relationship between precipitation and insurance data for flood damages in a region of the Mediterranean (Northeast Spain)" *by* Maria Cortès et al.

Maria Cortès et al.

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Manuscript: nhess-2017-278 "The relationship between precipitation and insurance data for surface water floods in a Mediterranean region (Northeast Spain)".

Responses to reviewer #3:

Reviewer #3 (Article summary): The article analyses the correlation between extreme rainfall events and compensation costs triggered by flash floods, which are drawn from insurance records. The correlation coefficient is used to draw conclusions on the causal effect between precipitation and damage magnitude, using different scales

of aggregation as tests.

Response: We wish to thank the anonymous referee for his/her useful and constructive comments. Each specific point has been addressed in the manuscript as explained below.

Referee's Comment: The topic is of great importance and the use of empirical data is a plus, however the thinking behind the paper is a bit too much straightforward. Indeed precipitation is a major driver of flash flood damage; but it is not the only factor. The paper do not take in account other factors influencing damage (slopes, land cover and soil sealing, vegetation), and explains the effect (damage) by stating the cause (heavy rainfall); the conclusion uses correlation values to confirm the hypotesis.

Response: We would like to thank you for this very important comment. To address it, we applied a logistic regression model to gauge the probability of large damaging events given a certain precipitation amount, an approach that is frequently used for this kind of modelling study (Kim et al., 2012; Wobus et al., 2014). Since most of floods that affect this region are caused by in situ precipitation (surface water floods), our hypothesis is that precipitation is the main cause. We agree with the reviewer that other factors can influence the insurance compensations for floods. For this reason we now consider three damages categories: (i) total damages (D), (ii) damage per capita (DPC) and (iii) damage per unit of gross domestic product (DPW). In this way the relative impacts of socio-economic factors on damage can be estimated, while taking into account population and wealth (Zhou et al., 2017).

Referee's Comment: The statistical analysis needs to go deeper and to add more insights in relation to the distribution of damage along different typologies of exposure. The analysis uses 4 different aggregation scales based on admistrative units; most commonly in these kind of studies the scale would be smaller than the municipality. A projection of the data over built-up areas from land cover, building units or a regular grid cells would improve the analysis by linking the variables at a more detailed and

homogeneus unit compared to the administrative boundaries. I would suggest then to present only the results relative to the better performing aggregation method, as the comparison on administrative units do not produce added value for the conclusions.

Response: We have taken into account these useful comments on the methodology of our study. Our current model includes exposure in the damage data, as mentioned before. Following the suggestion of the reviewer, we have also aggregated the data on a basin level. In the supplementary material we also include the results based on the warning areas used by the Spanish State Meteorological Agency (AEMET). Our aim is not to estimate the precise amount of insurance payments made, but to estimate when a damaging event will occur given a certain precipitation amount. For this reason, we have applied a logistic model for different precipitation thresholds and types of damage in order to know when a damaging event occurs.

Referee's Comment: The difference between different kind of floods and to which kind exactly the compensatory records refer is not clearly stated in the paper. Overall, both the record data and the spatial data needs to be presented more precisely and clearly.

Response: In our model we have used all the flood events recorded in the INUNGAMA database. This database records the flood events that have affected Catalonia, most caused by in situ precipitation (surface water floods). For this reason, our hypothesis is that precipitation is the main cause of damaging floods. However, bearing in mind the possibility of having insurance data related with river floods, we used different precipitation thresholds in the model. In order to clarify this point, we added this sentence to the revised manuscript: "Most floods that have affected the region of study, Northeast Spain, are surface water floods. This type of floods can be regarded as coming under the most general definition of rainfall-related floods (Bernet et al., 2017), including pluvial floods but also flooding from sewer systems, small open channels, diverted watercourses or flooding from groundwater springs (Falconer et al., 2009). River floods that affect great distances are very rare in the region, and are only related to catastrophic and extended floods (for the analysed period only the October 2000

C3

floods were of this type). Nevertheless, these are usually absorbed by reservoirs. It is therefore expected that flood insurance data will correlate strongly with precipitation and surface water floods."

Referee's Comment: Maps can be easily reduced in numbers and made more readable: figure 1 "a" and "b" can be combined by showing only the necessary information (river, basins, population, scores). Same goes for figure 3, it could be combined into 1 or 2 showing the information (dots) in different shapes/colors.

Response: We have followed the suggestion made by the reviewer and have changed the figures in the manuscript in order to make the paper more readable.

Referee's Comment: Finally, I agree with the insightful comments by reviewer 1 and 2 and suggest to majorly revise the paper by rethinking its objectives and methods.

Response: Taking into account all the comments and suggestions made by the reviewers, we have completely rewritten the manuscript, and we are confident that these major changes have improved the statistical significance of the analyses.

References:

Bernet, D. B., Prasuhn, V. and Weingartner, R.: Surface water floods in Switzerland: What insurance claim records tell us about the damage in space and time, Nat. Hazards Earth Syst. Sci., 17(9), 1659–1682, doi:10.5194/nhess-17-1659-2017, 2017.

Falconer, R. H., Cobby, D., Smyth, P., Astle, G., Dent, J. and Golding, B.: Pluvial flooding: New approaches in flood warning, mapping and risk management, J. Flood Risk Manag., 2(3), 198–208, doi:10.1111/j.1753-318X.2009.01034.x, 2009.

Kim, Y. O., Seo, S. B., & Jang, O. J. (2012). Flood risk assessment using regional regression analysis. Natural hazards, 63(2), 1203-1217.

Wobus, C., Lawson, M., Jones, R., Smith, J., & Martinich, J. (2014). Estimating monetary damages from flooding in the United States under a changing climate. Journal of

Flood Risk Management, 7(3), 217-229.

Zhou, Q., Leng, G. and Feng, L.: Predictability of state-level flood damage in the conterminous United States: the role of hazard, exposure and vulnerability, Sci. Rep., 7(1), 5354, doi:10.1038/s41598-017-05773-4, 2017.

Please also note the supplement to this comment: https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-278/nhess-2017-278-AC3-supplement.zip
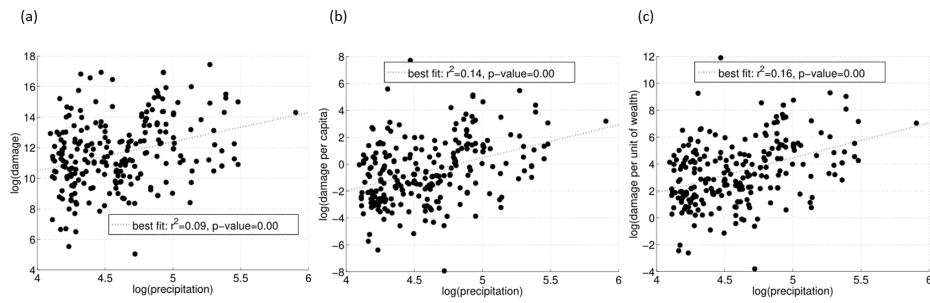
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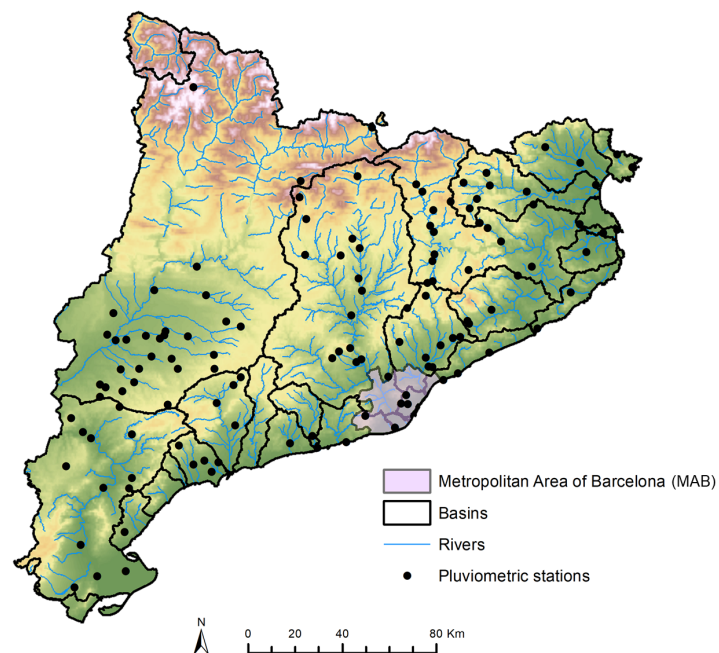
Fig. 1. Map of Catalonia showing the aggregated basins, the Metropolitan Area of Barcelona (MAB), the main rivers and the pluviometric stations used.

Fig. 2. Scatter plot between basin-aggregated maximum precipitation in 24 h and (a) total damages (D); (b) damage per capita (DPC); and (c) damage per unit of wealth (DPW), for flood events recorded in Catalo

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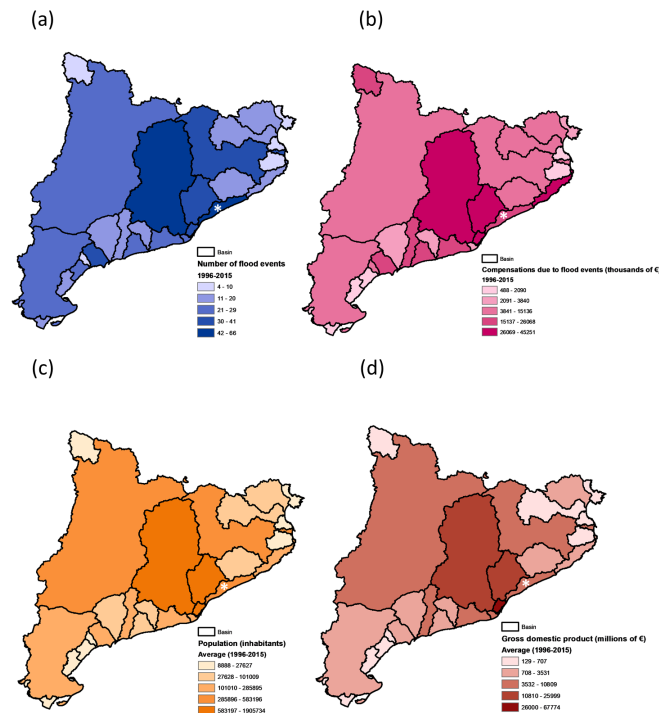
Fig. 3. Basin distribution of (a) flood events (1996-2015); (b) total insurance compensations for floods made by CCS (1996-2015); (c) average total population; and (d) average gross domestic product. Asterisk
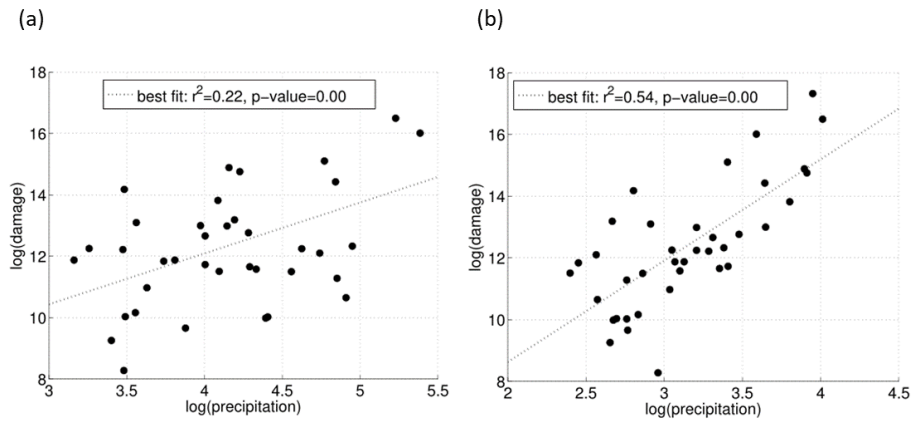
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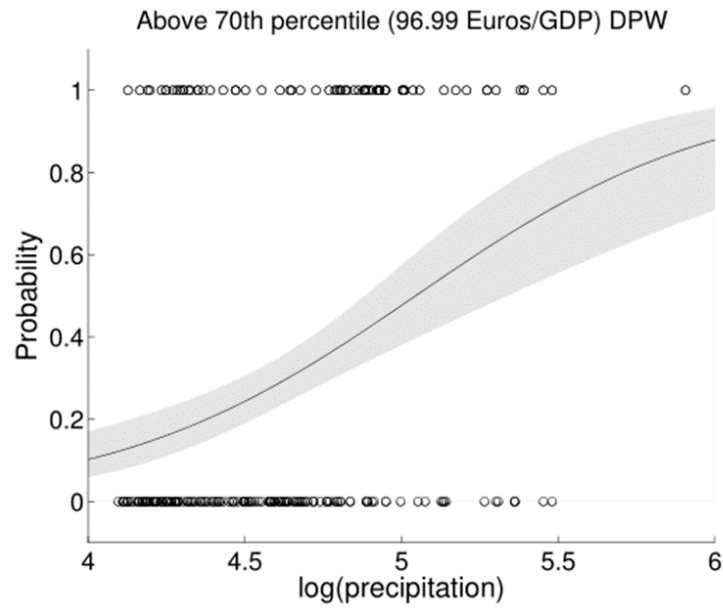
Fig. 4. Example of logistic regression result to model DPW damages above the 70th percentile as a function of precipitation (log-transformed). The solid line indicates the best estimate while the shaded band
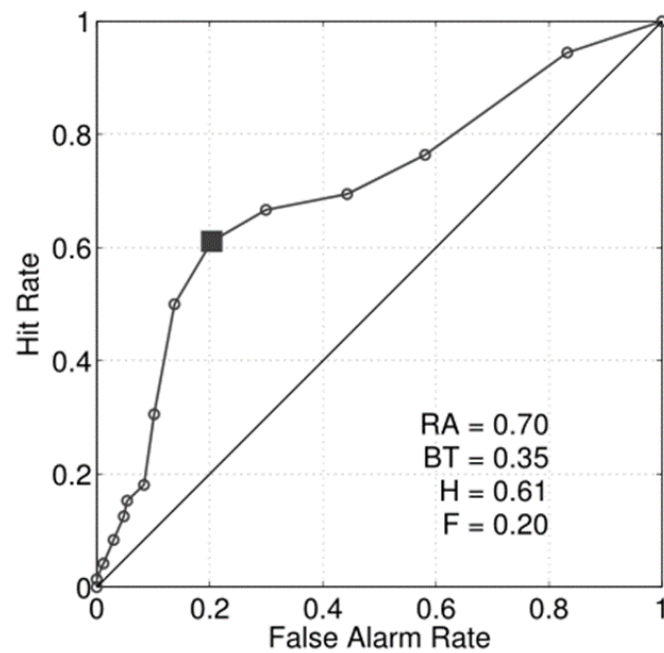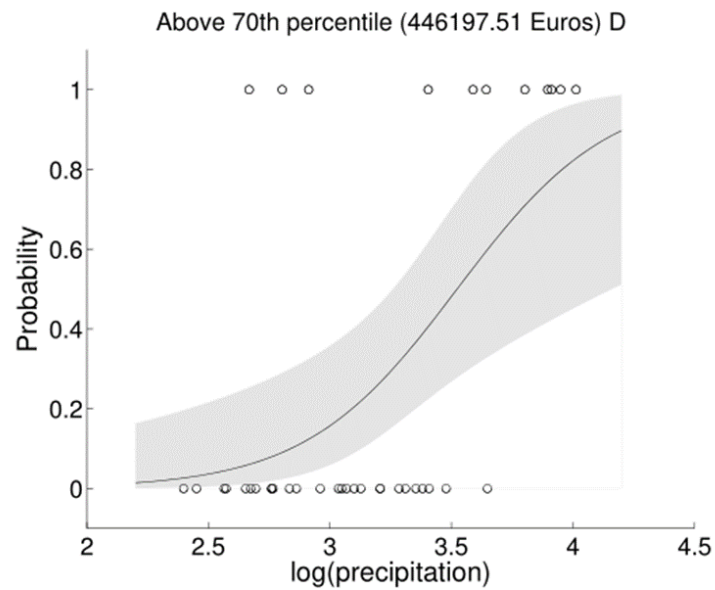
Fig. 5. Relative operating characteristic (ROC) diagram for above 70th DPW predictions using the logistic regression of Eq. (1). The open dots indicate a set of probability forecasts by stepping a decision th

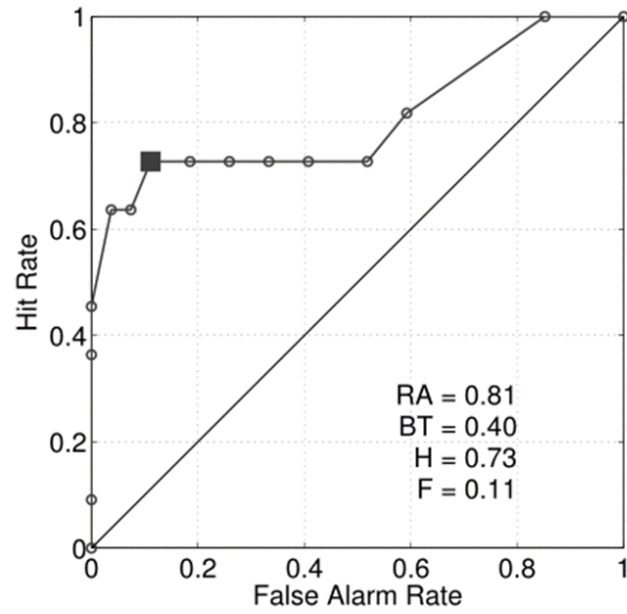(a)   (b)

Fig. 6. Scatter plot (a) damages (D) versus 24 h precipitation and (b) damages (D) versus 30 minute precipitation.

C11

Fig. 7. Example of a logistic regression result to model damages (D) above the 70th percentile as a function of 30 minute precipitation for the MAB. The solid line indicates the best estimate while the shaded

C12

Fig. 8. Relative operating characteristic (ROC) diagram for predictions for damage indicator D above the 70th percentile for the MAB using the logistic regression of Eq. (1). The open dots indicate a set of p

C13