

# ***Interactive comment on “The role of climatic factors in evolving flood patterns in a Mediterranean Region (1301–2012)” by A. Barrera-Escoda and M. C. Llasat***

## **Anonymous Referee #1**

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Review of “The role of climatic factors in evolving flood patterns in a Mediterranean region (1301-2012)” by Barrera-Escoda and Llasat.

1. General comments. The manuscript is an interesting work on the frequency of floods in Catalonia (northwest Iberian Peninsula) from the 14th century to the present. The authors use databases previously published and update them to 2012. They search relationships with possible forcing factors, such as the North Atlantic Oscillation and solar variability. In relation to historical data, although they reference previous works, it is necessary a more detailed explanation, in particular on the information density in past. The classification of floods is based on the impacts they provoked. This feature

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may be misleading, taking into account the changing vulnerability of human infrastructures in time. The discussion on the forcing factors is in my opinion very speculative (more details in specific comments). In this sense, I suggest to change the title of the manuscript to “Evolving flood patterns in a Mediterranean region (1301-2012) and climatic factors”.

## 2. Specific comments.

1) Abstract. Page 9146. Lines 5-6. Authors summarize their results for catastrophic and extraordinary floods, but these categories are not defined yet. 2) Table 1. Flood chronologies. Periods are different for the different river basins. In what way this feature may affect the results? What is the information density for past centuries? In historical climatology is always possible to find new evidences that compel to refine the analyses. What criteria have used the authors to trust in their reconstructions? In other words, historical data are sufficient to try statistical analyses? 3) Page 9150. Lines 26-29. Please, include a reference on the annual mean average areal precipitation series. 4) Page 9151. Lines 15-25. Classification of floods is based on impacts. Vulnerability of river basins may change in time due to human activities (cleaning of river beds, irrigation channels, dams, etc.). Information on these changes in Catalonian rivers is necessary. In statistical terms, this is a homogeneity problem. Have the authors investigated the homogeneity of their time series? 5) Page 9152. Line 8. Why the reference period is 1901-2000? Have you compared with the results using other reference periods, as the usual 30 yr period 1971-2000? 6) Page 9152. Lines 21-28. “The anomalous values were those with a flood index greater than or equal to 0.1 (Llasat, 2005)”. “Anomalous values” means “extreme values”? Although this item is referenced, the index is defined in standard deviations units, and in my opinion this threshold value is very low to establish “anomalous” or “extreme” values. 7) Figure 3. Time period is common to all the chronologies? Only 3 chronologies begin in 1301 (Table 1). How have you averaged to obtain this figure? 8) Page 9152, trends and figure 5. In the search of trends, linear regression is used. In my opinion there are methods more reliable, as the non-parametric

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tests (Mann-Kendall, Sen). In any case, if you use linear regression, you must evaluate the residuals before accepting the model. Residuals must be a random series, and behave as a white noise with null mean. Is this the case? 9) Page 9154. Line 16 and Figure 6. The authors comment an abrupt change in the middle of the 19th century. First, abrupt changes may be statistically assessed by using tools as the sequential version of the Mann-Kendall test, or the Pettitt test. In this case, it seems a qualitative statement obtained from the visual inspection of the figure. In second place, it is possible that this change is due to a higher density data since this date (curiously the significant increase of extraordinary floods from 1850 onwards 'coincide' with the daily rainfall series for Barcelona from 1854 onwards). Again, information on density data in past centuries is needed. Are they enough to compare with modern data? 10) Page 9154. Lines 18-19. In relation with "notable urban changes in the city", although the authors include a reference, more details are necessary. For instance, these changes are related to the expansion of the city to the river flanks? Please, explain. 11) Page 9156. Lines 6-21. This is a confusing discussion. Authors search correlations between floods frequency and rainfall for different time periods, arbitrarily chosen. It would be more interesting, for example, to show moving correlations with a 31-yr window. 12) Page 9158. Lines 3-9. Have you searched correlations between flood index and NAO for the 'beginning' of the LIA and the 'modernist' period? Again, moving correlations may help in this case. Your comments seems a qualitative statement from the visual inspection of the figure 10. This is speculative, taking into account that some important negative phases of the NAO are not related to high floods frequency (for instance in the 18th century, around 1701 and 1751). 13) Page 9159. Line 16 onwards. The discussion on the possible relationship between flooding and solar activity is again highly speculative. Although the authors recognize the scientific discussion on the problem, they try to search relationships using a method that in my opinion is incorrect. They search correlations using smoothed data, and no raw data. But the use of filters (as, for instance, moving averages), may introduce spurious cycles and trends in the series, that is, mathematical artifacts without physical sense. In consequence, relationships

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found are very doubtful. 14) Other important forcing is the volcanic activity. There are interesting studies relating volcanic eruptions with climate, for instance Wagner and Zorita (2005), The influence of volcanic, solar and CO<sub>2</sub> forcing on the temperatures in the Dalton Minimum (1790-1830): a model study. *Climate Dynamics*, 25: 205-218, or Brázdil et al, (2010) European floods during the winter 1783/1784: scenarios of an extreme event during the 'Little Ice Age'. *Theor Appl Climatol* 100: 163-189. The role of volcanic eruptions may be important, modulating or amplifying the effects of other forcing. Have you considered the possibility of including them in your study?

3. Technical comments.

1) Figures 1 and 2 may merge in a single figure. 2) Figure 4. Include not smoothed data.

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Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, 11, 9145, 2014.

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