

## ***Interactive comment on “Recent floods in the Middle Ebro River, Spain: hydrometeorological aspects and floodplain management” by S. Domenech et al.***

**Anonymous Referee #2**

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General Aspects:

The declared objective of this paper is to “examine the recent trends and discuss their possible causes from the point of view of hydro-meteorology, flood management through the use of reservoirs and floodplain management”. Thus, the reader expects to find an extensive study including different type of data and a multi-site analysis due to the heterogeneity of a such a large basin. The last paragraph in the Conclusions chapter declares, “In every event it is extremely difficult to identify the role of each hydro-meteorological, anthropic and environmental factors. . .” and, it is definitively right. The

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feeling of this referee about the paper is that the aim of the authors is beyond the proposed methodology, data availability and, in general the high flow events analysis. Thus, the conclusions of the paper are not solid, nor consistent; the discussion of the “clear” hydrometeorological trends in the Middle Ebro are based in a methodology which is not sufficient clear, statistical trends are hard to understand in the way they are described and presented in the paper. The consistency of the method should be justified in more detail in order to identify and conclude that the trends really exist. High water frequency analysis is based on a threshold exceedance methodology and the seasonality factor is explored. Three different periods are selected in the analysis in order to find correlations with factors like reservoir existence and flood management. Solid correlations are difficult to identify using only the type of plots presented in Fig. 4. Additional information is needed in order to give conclusions and explain correlations. Large doubts appear for the 2000-2008 period, because the commented “change of trend” in the seasonality of high waters is based on a very reduced and selected number of years. The implications of reservoir management in high water events are not absolutely clear in the “change of trend”, nor even the land use changes or the flood defence affects. In this sense, more data and info should be presented and correlated in order to produce more solid conclusions. In spite of the amount of basin available real time data (SAIH-SAD system) which is commented in the text, very scarce discharge information is showed in the description of the 2003 and 2007 flood events. The use of observed normalized hydrographs in the Zaragoza flowgage as the only reference in the analysis of hydrological trends is too limited. Reservoir management effects upstream Zaragoza (i.e.dams outflows) is certainly a key point to be analysed (in detail) in order to conclude changes in the processes of generation (land use changes) and propagation (defence infrastructures and river training) of hydrographs along the whole basin. Proposed conclusions for the hydrograph change in Zaragoza are beyond the simple observation of Fig.12 and more additional data would be needed in the justification. The description of the 2003 and 2007 events is not very precise and extensive in terms of spatial distribution and quantification of rainfall or peak discharges (maps

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of reservoirs locations are absolutely needed in order to understand the dynamics of the Ebro Basin). In resume, the scope of the problem overpasses the efforts of the authors, presented data is very limited and difficult to correlate, and the conclusions are not so evident to this referee. A more intense work in the methodological aspect of the paper should be attained, and, specially, a more detailed description of the basin dynamics (which should include reservoir management strategy and their impact in the flooding events). The existence of change of trends should be revised and reforced. In my opinion, some work should be done in the paper before publishing. Finally, the english grammar should be corrected in order to avoid typical, unfair spanish forms and structures which are easily identified along the text.

Particular Aspects: PP 5941: The description of typical concentration time of the basin and subbasins in the Ebro watershed would be an interesting information for the further analysis. The reference to Figure 3 and the conclusion of line 25 “ which seems to have changed during the years of the 21 th century. . .” is not so clear to me and it is introducing a message, an idea which is repeated and used along the text. PP 5942: The estimation of contributive area, concentration time and lag time for the Zaragoza streamflow gauge is important to identify the space and time scales of the processes. PP 5943: GIS information and tools are very useful but does not “solve” any problem related to spatial correlation and lack of data. Numerical models (and reanalysis techniques) are interesting in order to describe the past events atmospheric conditions and variables state, but difficultly the ECMWF models will reproduce the rainfall accumulation and spatial distribution and adequate resolution in order to be applied into an hydrologic model with an accurate result in terms of flooding reconstructions.

PP 5944: The meteorological classification and typical synoptic scenarios described between lines 3 and 22 should be followed by a bibliographic reference, in order to bring more consistency to the description. PP 5945: Line 5. A brief description of the estimated peak discharges from the historical events Estimated return periods for these events (if the exist) or merely the description of the field discharge estimation

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techniques (watermarks, hydraulic reconstruction, Manning formulae. . .) would be very appreciated. It would be recommended to write down in the text the mean annual discharge in the Zaragoza streamgauge because it its an important reference. Along the paragraph the quantification of the mentioned discharges are missed. No mention of the upstream regulation dams is present, and it is obviously a capital factor in the high waters description in Zaragoza. Please include it. PP 5946: How the Statistical distribution of Maximum discharges (Q discharge –T return period, historical relation) is been affected because the proposed increment of peak frequency in the last 8 years? This could be a suitable analysis in order to support the general theory in the paper. Line 9 to 13: A very strong result is not explained in terms of reservoir management, snow balance. etc The strong seasonal nature “change” is not well explained and causes are not described herein. Line 16. The “said precipitation” is a terrific grammar expression translated directly from Spanish. Be careful. PP 5947: The description of the “alleviation” process is not simple and complex factors are included in the propagation hydrographs. The reduction of peak is due to loss of energy in the wave front propagation. The reduction of peak front velocity is maybe due to the increase of the flooding extension and river superficial width, so the celerity of the information wave is decreased. To be analyzed not only commented. PP 5949: The Spearman’s rho bivariate correlation technique is very important in the trends analysis and final conclusions, so, a more detailed description of the statistical method and its application to the Ebro river would be suitable, as well as the presentation of results in Table 2. PP 5951: Line 25 : naive expressions like “ Maybe the water withdrawal pace at reservoirs and hydraulic works has something to do with this” should be appreciatively avoided in a scientific paper when the influence has not been studied.

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