

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

Anonymous Referee #1

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General evaluation:

First of all my apologies to the authors and the editors for this late review. This manuscript presents a study of the evolution of the floods of the middle Ebro river in relation to the development of storage reservoirs – mainly in the 50s and 60s. It is mainly based on the analysis of the existing measured discharge time series. The topic is very interesting but the analysis remains too superficial to be really convincing. In its present form, the manuscript presents many weaknesses that have absolutely to be improved (see also the detailed comments):

- The conclusions are drawn from purely descriptive analyses. Very few statistical tests are used to confirm the trends and when they are used (part 5.1) no justification for their choice are proposed and almost no reference exist on the abundant literature about the trend detection methods in hydrology. The power and limits of the method selected is not discussed. What to think about a trend identified on a 10-year period where a single isolated event may have a major influence (table 2)? - The authors have a tendency to sort out the data that confirm their theory, neglecting information that is not consistent with it (see comments on fig 4). - The analysis is based exclusively on the discharge series. Meteorological data and trends, and the data concerning the management of the reservoirs that could support or infirm the conclusions are absolutely not considered. This is hardly understandable in a scientific paper. - A recent previous paper has been published on a similar topic (Batalla, 2004). The added value of this manuscript should be clearly explained. - Finally, the manuscript contains too much information which has few if no link with its main issue like the description of the development of the embankments or the flood plain management and presents data that is not really valued: development of the irrigated surfaces, volumes of reservoirs. It should be much more focussed.

For all these reasons, I do not recommend its publication in HESS in its present form. Its improvement necessitates a significant additional analysis work (see my additional comments).

Detailed comments:

P5938, L.10: “Ebro River has entered into new dynamics with bigger and more frequent floods”. This idea is not supported by the presented data. The largest floods occurred in 1961 and 1966 (table 1) and in 1966 almost all the reservoirs were already in operation. The average number of days with large discharge values does not seem to have significantly increased in the 21st century (fig. 4).

P5938, L.11: “Change in seasonal nature”. According to the short period of time con-

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sidered in fig. 4c and to the high correlation between the discharge values observed during the same flood event, are the differences between figures 4c and 4b statistically significant? The shape of fig 4c is determined by a limited number of flood events. A seasonal shift due to the filling up of the reservoirs in the winter season is likely but not clearly revealed here. It should already be noticeable on fig 4a and 4b since most of the reservoirs were already built in the sixties, but it is not the case. How is this explained by the authors? The statistical significance of differences observed should be tested. Moreover, the authors should not sort out the information supporting their conclusions and ignore the rest.

P5938 to P5940: long introduction mentioning various topics that do not seem directly linked to the objective of the manuscript which seems to reveal trends in flood dynamics in relation the development of reservoirs and meteorological trends. The paragraphs on the Eutopean flood directive or flash floods (the studied floods can not be considered as flash floods with response time less than 6 hours) are not necessary. Some elements are missing in the introduction: a) a paper has already been published on the impact of reservoirs on the Ebro river hydrology (Batalla et al, 2004), the added value of this manuscript to this previous paper should be explained, b) what is known about the meteorological and especially the pluviographic trends in this part of Spain in the considered period, has the end of the 20th century not been particularly dry?, c) some comments could be done on the possible impact of the existing reservoirs on the hydrology of the Ebro and on the floods: what is the reservoir filling up period ? What represents the total storage capacity if compared to the Ebro water budget? 1600 hm³ upstream Zaragoza (fig 9) represents about 20% of the average annual runoff volume in Zaragoza: 8 to 10000 hm³ (fig.3)! This is enormous and should be commented.

P5942-5943: The methodology is not really presented. Which will be the criteria used to reveal trends in the time series and why? What are the references to similar previous studies? What is the statistical power of the selected tests? “Pools together hydrometeorological and historical data”. I did no see any analysis of meteorological data except

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the useless fig 5 and 7. It is exclusively the existing time series of discharges of the Ebro river which are studied.

P5945: “return period of 84yr”. This is surprisingly accurate. How has it been estimated? How is it possible to compute a return period of a discharge on a non-stationary series due to the increasing reservoir volume? Strange last sentence of the paragraph: there is no link between the Ebro discharges and the existence of embankments!

P5945: Please explain what is the “mean annual discharge”. Is it computed every year or over the whole period of time for which data is available? According to the influence of the reservoirs on the runoff volumes (fig. 3), this piece of information is absolutely necessary.

P5946: Conclusion of part 4.3: again, what is the statistical significance of the differences observed? Are there some autumn floods over the recent periods that were totally stored by the reservoirs that could confirm the conclusion?

P5946-5949: the detailed description of the two recent floods is not useful to the reader. An analysis of the management of the reservoirs, an estimation of the stored volumes and the impact on the flood shape – through the reconstruction of a flood wave uninfluenced by the reservoir for instance – could have helped the readers. But this is completely missing!

P5949: the figures showing the trends in maximum discharges are missing. The trends are not significant for the winter period when long periods of times are considered. They are in winter and summer, but it is not a surprise according to the irrigated surfaces as mentioned on P5952-5953. The winter trend is significant when the last 10 years are considered. Is this consistent with a meteorological trend? What is the influence of a single large event on the selected test if a short period is considered?

P5952: 8000 km² irrigated surfaces for a total watershed area of about 50000 km²: this is enormous. Please comment! What impact on the summer water budget? What

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is the corresponding river water consumption? “Interception” by forests is neglectable, what makes a difference is the increase of evapotranspiration.

P5954: Can real conclusions be drawn on 4 flood hydrographs? The conclusions should be supported by an in depth analysis of the reservoir management which is not the case? Ideally an attempt should be realized to reconstruct reservoir-free theoretical flood hydrographs to reveal the impact of these reservoirs.

P5954-5955: what is the relation of part 5.3 with the main topic of the paper: hydrology of the Ebro river?

P5956: “it is obvious”: I do not agree (see my previous comments). If a real time control system exists, it would have been necessary to study in detail the management rules to have a clear idea of their effect on the flood wave shapes. This is clearly missing here. Moreover, this real time management is certainly more adapted to low water periods than flood periods. . . This reservoirs were clearly not build to control winter floods. Is there really an attempt to use them for flood mitigation or is the objective as in many countries, that the reservoirs are as transparent as possible to floods?

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