

Hydrol. Earth Syst. Sci. Discuss., author comment AC3
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Reply on RC2

Gerardo Benito et al.

Author comment on "Enhanced flood hazard assessment beyond decadal climate cycles based on centennial historical data (Duero basin, Spain)" by Gerardo Benito et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-320-AC3>, 2021

We would like to thank Dr. Elleder for his comments and notes that we have incorporated in the updated version. Below are the one by one response to his comments:

General comments:

The article "Enhanced flood hazard assessment beyond decadal climate cycles based on centennial historical data" presents very a complex study on extreme floods of the Duero River in Zamora. 69 floods including 15 catastrophic ones were identified for time span of 651 years (1250–1871). This count of 15 catastrophic floods represents one catastrophic flood per 41 years on average, which is a realistic assessment. The count of 16 extraordinary floods with discharge maximum over $1900 \text{ m}^3 \cdot \text{s}^{-1}$ (perception threshold until 1871) were identified. In other words, in 1250–1871 this discharge was exceeded on average every 20 years. The largest floods were identified before onset of LIA (1258) and on the end of LIA (1860).

The authors used complex statistical analyses. The flood frequency analyses based on Expected Moments Algorithm (EMA) and Maximum Likelihood Estimator (MLE) methods were combined with five datasets (based on various temporal frameworks). The authors discussed the meteorological framework as well. They present the major floods in context of NAO oscillation. With special interest I have read the chapter on atmospheric rivers influence.

RESPONSE:

We appreciate very much this positive general comments and the interest of the reviewer on the different parts of the paper, moreover knowing the reviewer expertise on quantitative historical hydrology.

Specific comments

I have noticed a very interesting similarity in condition in old Zamora city and Prague regarding the flood reconstruction.

1/ For both cities, Prague and Zamora, the data gaps occur before the onset of LIA.

2/ For both cities the pictorial documentations were made by (various) Dutch painters

(Anton van der Wyngaerde and Egidius Sadeler) in the 16th century.

3/ The hydrological situation was stable from ca 13th or 14th century to the 1870s.

4/ The perception threshold of ca 1900 m³. s⁻¹ is similar for period before systematical records.

5/ For Both Zamora and Prague the negative NAO is important.

6/ Some important flood marks were destroyed.

RESPONSE:

We agree on the similarities between Prague and Zamora, and in terms of flood frequency in relation to climate cycles and it shows the influence of the atmospheric circulation changes at European scale. These similarities open an opportunity to analyse the links and connections in terms of seasonal atmospheric patterns.

SPECIFIC COMMENT:

7/ Is the old one bathygraphy of the river channel from 19th century in Zamora at disposal?

RESPONSE: No, there is not an old bathymetry of the river channel, only some individual cross-sections at the bridge locations.

8/ Some articles with similar topic should be noticed, discussed and referenced to:

Macdonald, N. 2013. Reassessing flood frequency for the River Trent, Central England, since AD 1320. *Hydrology Research* 44 (2), 215–233.

Elleder, L., Herget, J., Roggenkamp, T., and Nießen, A.: Historic floods in the city of Prague – reconstruction of peak discharges. *Hydrology Research* 44, 202–214, 2013.

Wetter, O., Pister, C., Weingartner, R., Luterbacher, J., Reist, T. & Trösch, J. 2011 The largest floods in the High Rhine basin since 1268 assessed from documentary and instrumental evidence. *Hydrol. Sci. J.* 56, 733–758.

Aldrete, G. S., 2007. *Floods of the Tiber in ancient Rome*. Baltimore: John Hopkins University Press 338 pp.. ISBN 0-8018-8405-5

England, J. F. Jr., Jarrett , R. D., Salas, J. D., 2003. Data-based comparisons of moments estimators using historic and paleoflood data. *Journal of Hydrology* 278, s. 72–196. ISSN 0022-1694

RESPONSE:

Thanks for the suggestions. Some of the suggested references are now included in the

manuscript, namely the followings:

Minor comments

1/ Line 20: AEP is without explanation.

RESPONSE:

Done. Now is included as follow: "The most consistent results were obtained using the HISTO dataset, even for high quantiles (0.001% annual exceedance probability, AEP)."

COMMENT:

2/ Please consider if the "land mark" (first time line 235) expression is suitable: Might be "flood mark" should be more clear.

RESPONSE:

The term "landmark" is more general than flood mark, as it means "a reference point" in our case because it was cited by documents or there may contain flood marks which is a physical gravings or plates made to indicate the flood stage.

We agree that this term may lead to confusion. Therefore, we have change in the case of line 235 to "flood marks" as it is more appropriated in this case. We have went through the manuscript and change most of the landmarks term by flood marks.

COMMENT:

3/ The authors use 2 categories of floods, i.e. catastrophic and extraordinary. Please, use it also in Table 1.

RESPONSE:

The descriptor of the flood category was now added in Table 1.

4/ Line 580 LIE. What does it mean?

RESPONSE:

Thank you to note the mistake. It should say LIA, that it is an abbreviation for for Little Ice Age. It was changed and also in the previous sentence was written in full as follow:

"In terms of flood magnitude, the Duero data suggest that the largest floods occurred at the onset and final stages of the Little Ice Age (LIA)."

5/ Please, check the figures and enlarge the letters to make the figures better readable.

RESPONSE:

Thanks. We will enlarged the letters on the figures for the final submission.

7/ Abbreviation FFA (flood freq. an.) is explained on line 630, but mentioned earlier for the first time. Please, revise.

RESPONSE:

Thanks for alert on this problem. It was now added in full in the first sentence that appears in the text (line 506)