

EGU21-9424

<https://doi.org/10.5194/egusphere-egu21-9424>

EGU General Assembly 2021

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Assessment of techniques to include historical information in flood frequency distributions for hydrological dam safety assessment

Enrique Soriano Martín¹, Antonio Jiménez², and Luis Mediero¹

¹Department of Civil Engineering: Hydraulics, Energy and Environment, Universidad Politécnica de Madrid, Spain

²Centre for Hydrographic Studies, CEDEX, Madrid, Spain

Flood peak quantiles for return periods up to 10 000 years are required for dam design and safety assessment, though flood series usually have a record length of around 20-40 years that leads to a high uncertainty. The utility of historical data of flooding is generally recognised for estimating the magnitude of extreme events with return periods in excess of 100 years. Therefore, historical information can be incorporated in flood frequency analyses to reduce uncertainties in high return period flood quantile estimates that are used in hydrological dam safety analyses.

This study assesses a set of existing techniques to incorporate historical information of flooding in extreme frequency analyses, focusing on their reliability and uncertainty reduction for high return periods that are used for dam safety analysis. Monte Carlo simulations are used to assess both the reliability and uncertainty in high return period quantile estimates. Varying lengths in the historical ($N_h = 100$ and 200 years) and systematic ($N_s = 20, 40$ and 60 years) periods are considered. In addition, a varying number of known flood magnitudes that exceed a given perception threshold in the historical period are also considered ($k = 1-2$). The values of N_h , N_s and k used in the study are the most usual in practice.

The reliability and uncertainty reduction in flood quantile estimates for each technique depend on the statistical properties of flood series. Therefore, a set of feasible combinations of L-coefficient of variation (L-CV) and skewness (L-CS) values should be considered. The analysis aims to understand how each technique behaves in terms of flood quantile reliability and uncertainty reduction depending on the L-moment statistics of flood series. In this study, L-CV and L-CS regional values in the 29 homogeneous regions identified in Spain for developing the national map of flood quantiles by the Centre for Hydrographic Studies of CEDEX are considered.

The results show that the maximum likelihood estimator (MLE) and weighted moments (WM) techniques show the best results in the regions with small L-CS values. However, the biased partial probability weighted moments (BPPWM) technique shows the best results in the regions with high L-CS values. While the expected moments algorithm (EMA) tends to underestimate flood quantiles for high return periods, the unbiased partial probability weighted moments (UPPWM) technique tends to overestimate them. In addition, including historical information of flooding in flood frequency analyses improves flood quantile estimates in most cases regardless the technique that is used. Uncertainty reduction in high return period flood quantile estimates are higher for short

systematic time series, regions with high L-CS values and long historical periods.

Acknowledgments: This research has been supported by the project SAFERDAMS (PID2019-107027RB-I00) funded by the Spanish Ministry of Science and Innovation.