Hydrology and Earth System Sciences
Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/hess-2021-47-RC1, 2021

Comment on hess-2021-47

Anonymous Referee #1

Referee comment on "Impact of detention dams on the probability distribution of floods" by Salvatore Manfreda et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-47-RC1, 2021

This is a well-written paper and easy to follow that highlights the need to update flood mitigation plans in a changing world. The topic is relevant and timely and suitable for HESS. I enjoyed reading the paper and there are not much to add, thus I will provide a brief review. The key idea is to provide a theoretically derived distribution to describe the flood peaks affected by reservoirs. Deriving theoretically such a distribution is not easy given the many factors affecting flood attenuation. Thus, the authors wish to form a mathematical framework to interpret functional relationships among variables such as flood wave shape and duration, storage capacity and geometric parameters of the detention basin.

The authors are very honest stressing the strong simplifying assumptions used and this is clear throughout the text. Yet as reader I strongly felt that these assumptions and their effects should be discussed in more detail. Starting with equation 4 (I might be missing soothing here) it is not clear to me why Equation 3 cannot be used, meaning that is not much more complicated. Would the use of Eq.3 complicate that much the analytical calculations and make impossible the analytical formulations?

Could you please offer more details on the impacts of the rectangular hydrograph assumption? Yes, it can significantly overestimate the flood volume but how much and under what conditions? How strong in the linearity assumption leading to the same exponent values (eq. 7)?

The symmetric assumption leading to equation 10 how realistic can it be? It is well-known if I am correct the volume is not symmetrically distribution around the peak.

Could you provide some extra details on the nature of the tails of the derived distribution in Eq 15? It is well accepted in the literature that floods peaks are described by heavy tails (see for example Vogel & Wilson (1996), Villarini and Smith (2010) and recently Miniussi et al. (2020) and Zaghloul et al. (2020)).

Finally, I believe the readers would be very curious to see how the results would be modified if a heavy-tailed distribution was used instead of the Gumbel which has exponential tail. The exponential tails offer "no surprises" in the generation of random discharge values and thus the good results shown might be case specific and only for the Gumber distribution. What would be the performance if really heavy tailed distributions were used, e.g., a GEV with shape parameter close to 0.5?

Please double check your equations, for example, Equation 13 is not correct, it should be dg^-1(y)/dy f(g^-1(y))

Overall, I believe this is a good paper and deserves publication pending some corrections, additional discussion and clarifications, and maybe an extra analysis with a heavy-tailed distribution.

References

Miniussi, A., Marani, M., Villarini, G., 2020. Metastatistical Extreme Value Distribution applied to floods across the continental United States. Adv. Water Res. 136, 103498. https://doi.org/10.1016/j.advwatres.2019.103498

Villarini, G., Smith, J.A., 2010. Flood peak distributions for the eastern United States. Water Resour. Res. 46 (6). https://doi.org/10.1029/2009WR008395

Vogel, R.M. , Wilson, I. , 1996. Probability distribution of annual maximum, mean, and minimum streamflows in the United States. J. Hydrol. Eng. 1 (2), 69–76.

Zaghloul, M., Papalexiou, S.M., Elshorbagy, A., Coulibaly, P., 2020. Revisiting flood peak distributions: A pan-Canadian investigation. Advances in Water Resources 145, 103720. https://doi.org/10.1016/j.advwatres.2020.103720