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Discussions

Interactive comment on "Climate elasticity of streamflow revisited – an elasticity index based on long-term hydrometeorological records" *by* V. Andréassian et al.

F.H.S. Chiew (Referee)

francis.chiew@csiro.au

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This is a nicely presented paper exploring empirical elasticity of streamflow to precipitation and potential evaporation, using an extensive dataset from 519 catchments across France.

The main contributions are (i) description and demonstration of the empirical methodology, (ii) showing (and quantifying) the obvious importance of jointly considering (the cross/inverse correlation between) precipitation and PET inputs (OLS2 and GLS2 performing best), and (iii) presenting the streamflow elasticity to precipitation and to PET

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for the French catchments.

Below are some comments/suggestions that the authors may wish to address and/or clarify.

(1) Comparing against the Turc-Mezentsev formula (or other top-down water-energy balance equations like the Budyko equation or Fu's adaptation of Budyko) may be interesting, but one would expect the much bigger variation of results as presented in the paper (compared to theoretical empirical equations), which also reflects the different catchment characteristics, spatial-temporal variability and other interacting factors.

(2) It may be worth exploring if accounting for the seasonality in precipitation and temperature/PET may give better estimates of elasticity, particularly in the regions with a clear cold season and/or precipitation/runoff seasonality. The temperature may be a better indicator than PET in snow dominated catchments.

(3) The OLS and GLS are not strictly empirical or distribution-free like the median estimate of elasticity of Sankarasubramaniam. It may be worth looking at bi-variate elasticity analysis of (Fu et al., WRR, 2007, 43, W11419) and other distribution-free methods.

(4) It may be worth exploring if the elasticities estimated more simplistically using the semi-empirical method here are similar to those estimated using a hydrological model, like GR4J that has been used to model these catchments.

(5) How strong is the P versus PET correlation in the different catchments? Do catchments with strong P-PET correlations exhibit greater importance in considering the bi-variate relationship of runoff versus P and PET jointly versus considering the runoff versus each of the climate variables independently?

(6) Figure 9 presents a nice summary of the elasticity in catchments across France. It is worth spelling out the definition in the captions (for example is percentage/absolute change in precipitation amplified in the percentage/absolute runoff, or the other way

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round). It is also worth plotting against a background of average precipitation or temperature or terrain, and perhaps also explore the relationship between the elasticity and catchment characteristics.

(7) The method presented here is interesting, and possibly more interesting when applied to regions exhibiting higher spatial variability, where there will be a larger range of elasticity values and perhaps relationships between the elasticities and hydroclimate and physical catchment characteristics.

(8) As the authors pointed out, there are limits to the applicability of this method (or for that matter, hydrological models) as we extrapolate to the future with potentially changing runoff-climate relationship under higher temperature and CO2, probably less so for precipitation (as historical records are likely to show high and low values) but more so for temperature (as we move to a warmer future).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 3645, 2015.