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Interactive comment on "Three parameter based Streamflow elasticity model: Application to MOPEX basins in USA at Annual and Seasonal Scale" *by* G. Konalapa and A. K. Mishra

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General comments

In this manuscript a three-parameter elasticity model is described and applied to 245 MOPEX catchments. Starting point was the elasticity model of Arora (2002) which has been extended by adding an elasticity value for storage change. This extended model was first compared with that of Arora (2002) at annual time scales after which elasticities at seasonal scale were investigated: A time scale which is too short to investigate with the model of Arora (2002).

However, in my opinion this manuscript is not ready for publication yet. The main points

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Discussion paper

are listed below:

1) It is correct that at seasonal time scales, storage cannot be neglected, but I have some problems with how this is incorporated in Eq. (4). In this equation Q, PET and P are long term average fluxes, which are not very sensitive when long time series are one year longer or shorter. However, storage change (DS) is a state variable and is given by DS = S(t=n) – S(t=0), where n denotes the length of the time series. Because storage oscillates around zero (in a steady climate), DS is relatively large if n = x years + 6 months and small if n = x year + 0 months: In fact each year there will be a moment in time when DS is zero. This shows that DS is very sensitive to the exact length of the time series. And if it is zero, the last term in Eq (4) is divided by zero leading to infinity. A possible way to overcome this sensitivity to n may be to use the standard deviation of DS (although this may give problems on seasonal time scales since the sign of the change disappears in standard deviations).

2) The seasons are defined as 3 month averages, which is indeed a logical thing to do. However, I am missing a sensitivity analysis on the effect of changing these three month averages with a couple of days or weeks. Also, how do the separation of the seasons correspond to the (start of the) hydrological year of each catchment.

3) A thorough discussion is missing: Especially about the meaning of all the seasonal elasticities: Why is it useful to know them, what do they say about the hydrology of a certain catchment, how sensitive are they to measurement errors, what is the influence on snow, etc. Please couple back to the (in my opinion main-) goal of the paper, which is listed on page 3, Line 1: “[it] would serve the purpose of understanding the climate and physical controls”.

Specific comments

1) I do agree with the comment posted by Wouter Berghuijs

2) Section 3.4: The description of all results reads as a long list of numbers. I suggest

highlighting the meaning of the individual results and instead of stating that a certain region (e.g. western part of USA) has a certain elasticity, cluster these results in more hydrological terms, such as e.g. the snow dominated catchments have an elasticity of ...

3) P9, L12-13: “this increase ... the same season”. This is a strong statement: is there any proof for this?

4) P12, L12-13: “This suggests ... of the basins”. This is a strong statement: is there any proof for this?

5) Conclusions: only point a) is a conclusion. Point b,c and d just summarize the ‘observations’.

Technical corrections

1) P4, L11: To me it is not an empirical formula, but simply the definition of elasticity

2) For all symbols: use only one letter plus subscripts, since e.g. PET can also be interpreted as P times E times T.

3) P7, L4: What is meant with ‘irrespective of the sign’

4) P7, L22: refer to figure 5 instead of 4

5) the paragraph “Streamflow elasticity due to Potential evapotranspiration:”starting at page 11, contains several sloppy typos. Please check carefully.

6) add units to all axes and colour bars of the figures.

References

Arora, V. K.: The use of the aridity index to assess climate change effect on annual runoff, Journal of Hydrology, 265, 164-177, 2002.

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