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Hydrology and Earth System Sciences
Discussions

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

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The manuscript by Andréassian, Coron, Lerat and Le Moine assesses how elasticity of streamflow, driven by changes in precipitation and potential evaporation, can be computed using 4 alternative regression models (in addition to the 'standard' approach). The methods were tested on dataset of 519 catchment well spread over France. Results are interesting and this is likely to be a valuable contribution to the field, however, I do have a main concern and seek clarification on a few points as outlined below.

Allen et al. (1998) describes a crop reference evapotranspiration (ETo) this is NOT

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a formulation of potential evapotranspiration (ETp). They are different concepts, and cannot be equated. ETo is used for water scheduling of irrigation areas and uses key prescribed (or fixed or reference) land surface parameters for crops. ETo, like ETp, does provide an estimate of atmospheric evaporative demand (AED); in comparison pan evaporation (Epan) is a measurement of AED. AED is umbrella term under which ETo, ETp and Epan all sit, however this does not mean they are equivalent terms.

The most obvious way to check that ETo is not a ETp formulation is to consider the surface resistance (rs). In Allen et al.'s (1998) ETo the rs has a prescribed value of 70 s/m, this is much larger that what is implied in the meaning of a ETp, where rs = 0 s/m. Hence, there is some confusion regarding the concepts of crop reference evaporation and potential evaporation; this need improvement. As a scientific discipline we must be very clear about definitions, and must ensure that clarity comes to this currently muddied subject. We all have a role to play to achieve this goal, and it only comes through careful thinking about the fundamental (or underpinning) conceptual definitions. Nowhere in (Allen et al., 1998) does it suggest that ETo replaces estimates of ETp. After downloading the FAO56 report from http://www.fao.org/docrep/X0490E/x0490e00.htm please searched for the term 'potential evaporation' and it is only found twice in the body text and in these two instances the authors are not equating crop reference evaporation with potential evaporation. Additionally in Chapter 1 of (Allen et al., 1998) they state (on page 30 of the PDF file) "The use of other denominations such as potential ET is strongly discouraged due to ambiguities in their definitions." This can be found by searching for the word 'potential' in the FAO56 report.

If you have the date to calculate ETo then you have the data to calculate Penman's (1948) formulation, as provided by Shuttleworth (1993), of ETp which Donohue et al (2010) showed to be the most appropriate form of ETp when considering a changing climate. The Penman formulation of ETp is also a physically-based form of ETp, meaning that all the key variables that govern the evaporative process are explicit in

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the formula (McVicar et al 2012a), which is important when considering the widely reported reductions in: (1) AED estimates (via ETp and ETo); and (2) AED observations (via Epan). While I know it could be argued that the formulation of ETp has a small influence when assessing elasticity of catchment response, you need to ensure that a form of ETp is used (not ETo).

P3659L16-18, you write "This result was expected because the catchments considered here are energy-limited with few cases where actual evaporation reaches its potential value." However, in energy-limited landscapes actual evaporation reaches its potential value (as the rate of actual evaporation is limited by energy not water), so I think you mean water-limited here, which is why actual evaporation does not reach its potential value. Or the expression of the sentence highlighted needs improvement. Plus you might wish to consider how elasticity varies for 'equitant' catchments / landscapes that straddle the water-limited / energy-limited divide at a sub-annual time-scale (McVicar et al 2012b).

In addition to Donohue et al (2011; JoH that you cite), you may wish to know about paper by Liu and McVicar (2012) who assessed impacts of changing climate and changing catchment conditions in the water-limited Yellow River Basin, China.

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