Hydrology and Earth System Sciences Discussions

Interactive comment on "A process-based typology of hydrological drought" *by* A. F. Van Loon and H. A. J. Van Lanen

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Dear Editor, dear Authors,

I rewieved the article entitled "A process-based typology of hydrological drought".

The Authors make an effort in defining a classification of hydrological droughts based on the underlying processes. The classification is further enriched by means of considerations on the role of climate and catchment characteristics in matching a certain catchment in the classification scheme.

The analyses are conducted on five catchments located in Europe. Four of them have an area of approx. 100 Km2, the last is much larger, with an area of 16000 Km2.

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The hydrological processes occurring in each catchment are reconstructed by means of hydrological modelling. The model chosen is the HBV, which is run in a semidistributed configuration.

The relevant state and flux variables are processed for identifying drought events by means of a seasonal threshold fixed as the value being overpassed the 80% of the time. Then a pooling algorithm is applied and deficit volumes or maximum deviation are calculated.

Based on the analysis of the data obtained, the Authors distinguish the following hydrological drought types:

– classical rainfall deficit drought.

– rain-to-snow-season drought, where a meteorological drought starts during the warm season and ends during the cold season, but with precipitation falling as snow and no recovery of the corresponding hydrological drought.

– wet-to-dry-season drought, where a hydrological drought starting during a poor wet season continues during the dry season because of the high evaporation rates.

– cold snow season drought, with an earlier start of the snow season and/or a later start of the snowmelt.

– warm snow season drought, with earlier snowmelt affecting the groundwater recharge and anticipating the spring discharge maxima.

– composite drought.

The development of a certain drought type depends on both catchment and climate control.

The different droughts occurring in the study catchments are classified according to the typology proposed and the processes causing the most severe events are discussed.

I found the paper rather interesting for the basic idea of the definition of a hydrological drought typology, for the characterisation of the typological classes by considering both climatic and hydrological processes, as well as for the rich literature review.

However, I have some concerns related to the way the work is presented. As I understand, the part related to the hydrological modelling on the five catchments is meant to be used as a case study. Instead, it seems to have a quite relevant role within the article, being as important as the typology definition. This is in contrast with the little number of catchments considered, which could be enough for providing some examples, but it is not for drawing relevant conclusions. Try to reshape the article structure for giving the right weight to your major goal.

The choice of using modelling is quite common for gathering information on state and flux variables for drought assessment. However, the number of catchments considered is reduced because of the wealth of efforts needed for performing the analysis. For massive processing, which would give much more control points in figure 14, do you believe that it is feasible to tackle the modelling problem by means of simplified methods, i.e., for base flow separation and snow assessment?

Moreover, is it possible to check literature data for populating figure 14? Perhaps the material usually published doesn't allow to assess the occurrence od the different drought types.

As I understand, you have inspected the data implementing an expert-based drought type classification. What about defining the drought typology by means of some logical formulations? A piece of code allowing other researchers to classify their own droughts would be an asset, also considering the previous point of discussion!

I appreciated the description of your drought detection algorithm (threshold, pooling, deficit, etc.). Starting from a well defined basis is important for avoiding misunderstanding on an issue that is far from being a solved problem!

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Some minor issues.

Have you considered the role of catchment area when dealing with drought duration and deficit? In this work Upper Guadiana is 100 times larger than the other catchments and it is the only one with semi-arid climate and a relevant number of composite and wet-to-dry-season droughts.

Figure 5 and similar: consider to add the grey line also for precipitation, soil moisture, groundwater, and discharge. This would help in understanding how large is the variability of each parameter, i.e., how far is the average line for groundwater in figure 5, panel C?

Some parts of the text sound a bit rough or not that fair, such as the following examples. Have a further reading and try to clean such expressions.

- "Hydrological (groundwater and discharge) drought" (p. 11414, line 22)

- "Droughts in developed countries primarily result in economic loss: in the USA on average 6 to 8 billion USD per year (Andreadis et al., 2005; Below et al., 2007) 5 and in the EU more than 100 billion EUR in the period 1976–2006 (EU, 2006, 2007)." (p. 11415, lines 3-6)

- "finding the best drought index" (p. 11416, line 6)

Best regards,

Giovanni Laguardia