Hydrol. Earth Syst. Sci. Discuss., 10, C6908–C6913, 2013
www.hydrol-earth-syst-sci-discuss.net/10/C6908/2013/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Development of streamflow drought severity- and magnitude-duration-frequency curves using the threshold level method" *by* J. H. Sung et al.

Anonymous Referee #1

Received and published: 26 December 2013

General comments

The authors propose two types of curves for streamflow-based drought analysis. The first type is the severity-duration-frequency (SDF) curve and the second type is the magnitude-duration-frequency (MDF) curve. They define severity as the total water deficit volume and magnitude as the daily average water deficit for each drought event. To calculate the water deficit, they employ the threshold level method through using four different approaches for the determination of threshold levels. Last, they apply the proposed methodology to a Korean basin.

The subject treated in this paper is of high interest to hydrological sciences and certainly falls within the scope of HESSD. With regard to the proposed methodology the following observations can be made: (1) the severity-duration-frequency (SDF) curve for drought analysis has been proposed by Dalezios et al. (2000); (2) those researchers have used the GEV distribution as the authors of the current paper do; (3) since drought is a slowly developing phenomenon it needs to be analyzed only at coarse time scales (e.g., greater than a month); as a result, daily deficit is of no practical use in drought analysis; (4) a direct consequence of the previous statement is that the use of the proposed MDF curve is not expected to contribute to drought analysis; (5) the approaches used to determine thresholds are known. In view of the above, the originality of the SDF curve cannot be claimed while the MDF curve cannot yield any meaningful information for drought analysis.

The authors adopt the approach of the drought event in which each event is determined by the time of onset, duration, total deficit and average deficit. This is a theoretical approach to analysing droughts since, at the operational level, requirements are different: the question is whether a drainage basin is at drought for a specific time period (e.g., the first trimester of 2013). Thus, the drought onset and duration become meaningless. To respond to the operational requirements a systems-based approach has been proposed by Tsakiris et al. (2013). Within the frame of that approach, the two types of curves examined in this paper loose their usefulness.

Given the above information the authors are invited to clearly identify their contribution with respect to the existing knowledge and revise their manuscript by bringing forward their contribution.

Specific comments

Page 14676, lines 5-6: The phrase "(e.g., a rainfall intensity-duration-frequency curve)" is, in my view, inappropriate here; a phrase such as "which is analogous to the well-known intensity-duration-frequency curve used for rainfall." would be better.

Page 14676, line 10: In cases that the threshold varies per month one normally would expect a family of twelve curves; to prevent confusion an epigrammatic comment on this is needed.

Page 14676, line 11: The term “desired yield” cannot be assumed known to readers; it requires a brief definition.

Page 14676, lines 15-16: The statement “These SDF and MDF curves are useful in designing water resources systems for streamflow drought and water supply management” is rather vague since: (1) unlike the IDF curves for rainfall, no practical use of the SDF and MDF curves is established so far, and (2) the authors avoid proposing any framework for the usage of these curves; a revision of this phrase is, in my view, necessary to remove vagueness.

Page 14676, line 18: The qualifier “multi-dimensional” is left unexplained; adding the dimensions of the phenomenon would help; it is noted that the spatial dimension is ignored in the paper.

Page 14676, lines 19-20: The phrase “Droughts have dramatically increased in number and intensity over the last few decades (ComEC, 2007)” is too categorical; first, we recall the subtle difference between drought and water shortage (Tsakiris et al., 2013), i.e. that drought is the natural form of temporary water scarcity, while water shortage is temporary and human induced water scarcity; second, the population growth and the subsequent increase of water demand leads to much more frequent water scarcity episodes the causes of which are difficult to identify in all cases; hence, unless the natural causes of water scarcity episodes are known, speaking of dramatic increase in drought episodes is too categorical. I would tend to suggest removing the word “dramatically”.

Page 14676, line 22: Here the authors say that “water scarcities have occurred”, while in line 23 the term “drought risk analysis” appears; again the difference between “drought” and the general term “water scarcity” is ignored which causes serious confu-

sion.

Page 14677, lines 9-12: The drought components listed here are often referred to as forms or expressions of drought; these are however ambiguous since it is unclear what part of the hydrological cycle these characterize; a clarification of the subject is provided by Tsakiris et al. (2013); in my view, saying “Based on these definitions, various indices have been proposed over the years to identify drought” is sufficient.

Page 14678, line 3: Saying “Based on the reported drought definitions” is ambiguous; a clarification is necessary.

Page 14678, lines 13-14: According to the definition of “daily average water deficits (or magnitude)” the “magnitude” is functionally related to severity as: (magnitude) = (severity)/(duration); a clear explanation is needed regarding the reason why the MDF curve conveys information which is different from that of the SDF curve.

Page 14678, lines 15-16: The phrase “the best-fitted probability distribution functions of annual maximum SDF and MDF” causes confusion; a step is missing here which will refer to the calculation of annual maxima; also, it is absolutely necessary to name the variable on which the annual maxima are taken.

Page 14678, line 16: After “...using L-moment ratio diagrams” a reference to this method is needed.

Page 14678, line 16: Step 4 involves two calculation steps: threshold calculation and construction of curves; please consider inserting an extra step by augmenting also the numbers of subsequent steps.

Page 14678, line 21: Here the authors say “to estimate a hydrological drought” thus creating the impression that they will focus on this drought form; yet, reference to SPI (line 23) and PDSI (line 24) creates confusion since these two indices refer to meteorological and agricultural droughts respectively;

Page 14679, lines 11-12: The phrase “the ratio between the inter-event excess volume

zc" is unclear; the numerator and the denominator should be indicated.

Page 14680, line 4: Symbols "Q70" and "Q95" have to be defined.

Page 14683, sub-section 4.1: The material of this sub-section is confusing; it is suggested to describe the steps for the calculation of thresholds in a more rigorous and analytical manner.

Page 14683, line 26: The result announced in the phrase "The daily threshold displays the highest number of drought events" is expected; it is however of no practical significance since, as already said, drought analysis at the daily time scale has no meaning.

Page 14684, lines 19 – 20: The phrase "To confirm the consistency of our approach, the correlation coefficients among the four results were calculate" announces a test within the results section for the first time; since this reduces readability, it is suggested to create a new sub-section titled "Description of tests" (sub-section 2.5) in section 2, where all tests will be described and justified.

Page 14684, lines 25 - 26: The term "two-way approaches" is too general and creates confusion.

Page 14685, lines 2 – 10: The whole material "The L-moment ... the best-fit distribution" normally belongs to the methodology section and should therefore be moved there.

Page 14685, lines 10 -11: What do the authors mean by "To develop an SDI MDF curve"? Also, SDI needs to be defined.

Page 14685, lines 16-18: The expression "... and of those three distributions, fewer than half of the observations approached the GEV line." creates the impression that the GEV distribution will be rejected; yet, the text that follows ("Thus, the GEV distribution was selected as a representative distribution.") reveals the opposite conclusion; a clarification is necessary on this.

Page 14685, line 24: The selected values for duration ("10, 20, 30, and 40 day durations") are not of practical significance in drought analyses. Durations of three, six or more months would be appropriate.

Page 14687, lines 10 – 11: The statement "This study can be applied to various hydrologic analyses and water resources management systems, such as desired yield and dam safe yield." needs to be supported by evidence on existing methods which can potentially exploit the proposed curves.

Technical corrections

It is suggested to keep verbs in present for new developments and results and use past and present perfect for previous works.

Page 14678, line 7: Please change "levels" into "level".

Page 14679, line 17: Please change "This" into "These" to read "These numbers ...".

Page 14684, line 8: Please change "large" into "larger" to read "became larger when the duration was longer".

References

Dalezios, N., Loukas, A., Vasiliades, L., Liakopolos, E., Severity-duration-frequency analysis of droughts and wet periods in Greece, Hydrological Sciences Journal, 45(5), 751-769, 2000.

Tsakiris, G., Nalbantis, I., Vangelis, H., Verbeiren, B., Huysmans, M., Tychon, B., Jacquemin, I., Canters, F., Vanderhaegen, S., Engelen, G., Poelmans, L., De Becker, P., Batelaan, O., A System-based Paradigm of Drought Analysis for Operational Management, Water Resources Management, 27(15), 5281-5297, 2013.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 14675, 2013.