Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC3
https://doi.org/10.5194/hess-2021-64-RC3, 2021

Comment on hess-2021-64

Anonymous Referee #3

Referee comment on "Improved understanding of regional groundwater drought development through time series modelling: the 2018–2019 drought in the Netherlands" by Esther Brakkee et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-64-RC3, 2021

Review comments on the manuscript *Spatiotemporal development of the 2018–2019 groundwater drought in the Netherlands: a data-based approach* by E. Brakkee et al.

The manuscript presents an approach of using impulse-response time series modelling to estimate groundwater heads covering several regions in the Netherlands during a recent drought event. The model results are used to calculate the standardized groundwater level index (SGI) during the drought event in order to analyze the spatial variability, severity and development of the groundwater drought. The manuscript combines several data pre-processing steps, groundwater head estimation, drought analysis and drought estimation based on solely precipitation data for more than 2500 groundwater observation wells. The topic of the manuscript is overall interesting and important for both researchers and stakeholders, which – based on personal experience - in cold and temperate climate countries are still not always well aware of this topic.

Applying impulse-response time series modelling on so many groundwater observation wells in order to analyze the drought pattern on a regional scale is an impressive work. However, I am not really convinced by the necessity and the advantages of the presented approach in the analysis of a drought event. This is partly connected to missing or sometimes rather vague explanations/justifications partly to the approach itself. To overcome the first issue, it might be advisable to focus either on a) the analysis of the drought event or b) the drought prediction.

My detailed comments are listed below.

Main Comments

In general, I think impulse-response time series modelling can be a useful tool in the analysis of groundwater systems. As you point out, the approach is able to give site-specific information (e.g. response time) and might also be a powerful tool in forecasting groundwater heads. However, reading the manuscript I am still not convinced by the advantages of this approach in connection with the SGI in the analysis of a drought event. Most of the following statements are related to the question of how much information you gain or lose before calculation SGI values.

L177: Why do you use 20% as a cutoff, please elaborate.

L179: Data cleaning step 2 in combination of using the model results of PASTAS based on time series of precipitation and evapotranspiration to remove outliers homogenizes the time series. Don't you lose specific features in the time series especially those related to dry conditions? Is this what you mean by 'over-filtering' (L211)?

L196-200: What are the reasons for 'atypical behaviour'? Could site-specific characteristics, i.e. hydrogeology, play a role? In general, I think it would be good for the reader to see either some of the original groundwater head time series or the model outcome.

L201: Why do you use 60%? It seems to be very low. The distribution (histogram) of the models' EVP would be interesting. It might also be interesting to compare time series with different EVPs, e.g. 60% and 80%. Where are the differences – extremes/timing etc.?

L254: How do you aggregate the daily data? Do you really need a time series lengths of 30 years in a daily resolution to calculate the SGI values for 2018? Is it not efficient enough to use time series with a coarser temporal resolution and a time series length shorter than 30 years? How many measured data sets out of the 2722 fulfill weaker requirements in terms of measurement frequency and length, e.g. at least weekly data from the past 20 years? How would the SGI values (using normal score transformation) and their spatial distribution look like for these time series. How much extra information do you get of using your approach? This kind of analysis would be interesting in order to show the advantages of this approach.

Secondary Comments

L159: How do you define short-term disturbance? Depending on the aquifer system, human disturbance is able to result or magnify groundwater droughts, for example by increased short-term(?) water consumption as a consequence of high temperatures/evapotranspiration rates, or?

L188: Why do you use a threshold of 4 years missing data?

L211: *some errors, overremoved* are very vague expressions. Please clarify.

L212: *over-filtering*? Please elaborate or even better show an example.

L221: What about factors influencing groundwater recharge on different time scales, e.g. long-lasting frost seasons, land-use change, or anthropogenic influences changing the boundary conditions, e.g. pilling, water abstraction?

L255: Is this a typo or do you intentionally use different values than the ones in Bloomfield and Marchant (2013): 1/(2n)?

Table 2: Add abbreviation in section 3.1 or even better, write the words out here. You might consider adding percentage here (in brackets).

L321: Are the terms dry, normal and wet conditions based on the percentiles (L227-229)? How do you define 'more extreme groundwater levels'?

Figure 3: Why do you show midpoints instead of regions? How is the midpoint defined?

L390-395: 3 cm sounds indeed acceptable but an average absolute SGI error of 0.34...What does this mean for the prediction of droughts using the presented method also in terms of thresholds etc. for stakeholders? Remember: The 2018 drought was an extreme drought.

L404: Please elaborate. Is depth to groundwater or vadose zone thickness not a site-specific characteristic?