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Hydrology and Earth System Sciences
Discussions

Interactive comment on "The 2018 northern European hydrological drought and its drivers in a historical perspective" *by* Sigrid J. Bakke et al.

Anonymous Referee #1

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The manuscript "The 2018 northern European hydrological drought and its drivers in a historical perspective" by Sigrid J. Bakke et al. presents an analysis of the 2018 drought and its historical extremeness with a focus on northern European countries. With the analysis of the relationship between large-scale atmospheric circulations and summer streamflow, the assessment of the meteorological situation for the northern region and the resulting meteorological and hydrological drought on a region scale, the study gives a broad and detailed analysis of the 2018 drought for Northern Europe not only in different time- but also spatial scales. The study highlights that there is more need to assess drought in different components of the hydrological cycle, especially due to the complexity and large variability in drought characteristics that can be seen across different spatial scales and hydroclimatic regions, nicely show with this case

study for Norther Europe. In general I found the paper was well written and provided a good analysis of the 2018 drought. Therefore I would like to recommend publication after minor revisions. My comments for improvement can be found below.

Major comments:

The paper has a very clear structure and additional division of the assessment into different scales, making it clear which data and methods are used for which scale and analysis. The combination of datasets (including not only meteorological but also hydrological ones) on various scales gives the chance to assess the drought situation of 2018 for this region in more detail. The results of the analysis are explained and discussed in detail (which is good in general) but can lead to difficulties to follow all the information presented and taking away the key findings. Adding a small subchapter at the end of Section 5 with parts of the conclusion, where all the results are placed together, would help to connect the different discussion parts already earlier and leave more space for an even more concise conclusion. The figures used are nicely selected and interesting, especially Fig.8 including the groundwater response to precipitation and Fig.1 and 2 to highlight the streamflow and groundwater regimes, allowing the reader to get a better understanding of the hydroclimatological characteristics of the case area.

The introduction is giving an overview of the general drought situation and impacts for this region, elaborating on the study area and setting the stage for the study by recapping the general definition of drought, drought studies and their difficulties in regards to appropriate data selection and use. Further, a section on the large scale atmospheric drivers is giving, which is part of the later assessment. An additional elaboration on the other methods included and the reasoning behind using them would help prepare the reader for the following analysis and results and would strengthen the introduction and emphasizing why this paper is special in its own way and closing current research gaps. Adding more information on this and mentioning more similar studies might also help setting the scene for a deeper discussion later on.

The analysis is focused on the extremeness of the months May-August 2018, as mentioned in the abstract and introduction, highlighting the situation on conditions for northern European countries in that period. Despite stating the aim of the study clearly in the introduction, the title can lead to a slight misunderstanding. Nevertheless, having done such an extensive analysis of various aspects of the hydrological cycle for the whole year (as given by the information in the supplement), I personally think including some more lines on the results and observation in early spring until the end of the year, besides the extreme events observation in the period of May-August 2018, would create an even better base to start a wholesome discussion. Especially, as the findings are currently discussed within the light of the whole annual cycle (Sec.5.2) and it is mentioned that antecedent water storage (initial conditions) play an important role in the occurrence, timing and development of hydrological droughts and drought propagation. Extending the results and discussion to months where drought characteristics were also observed in April and autumn months (e.g. Fig A6 (SPI3), A7 (SPEI3), A9 and Fig.8 (groundwater ranks and groundwater response to precipitation)), could help to create an even better understanding of the drought situation of 2018. This in the end might help to create an even stronger discussion and to put the work into more context by being able to connect it to other drought studies of 2018 throughout Europe, bringing together other strains of research and closing the picture of the drought 2018.

Minor comments:

Table 1: adding an additional column for the observed impact category (e.g. agriculture, energy sector, etc.) would make table even more complete and could reduce effort to write all examples out in text;

p5 line21: 3 stations within mountain regimes mentioned which were highly influenced by glaciers, were they treated differently in the analysis or just included in the average?;

p5 line34: has instead of have (twice);

Data and methods section in general: focus on historical analysis: In regards to human

influence there was a careful selection of near natural groundwater wells but to what extend was climate change reconsidered in the analysis and the trend that might have been included automatically in the datasets used?;

Results and discussion section in general: also include beginning and end of the year results next to extremeness of summer months if mentioned later on in discussion (for example HGT500 from April might already indicate how situation in May could look like);

Fig. 4 and Fig. A3 using the same range for HGT500 values for all months presented would allow to compare values between months more easily. Additional question to Fig.4: why aggregate over May-August (as most other results presented are shown separately per month)?;

General comment on ranking system: nice to highlight extremes (as it is one of the goals mentioned in the introduction) but additional information and figures on mean historical temp vs 2018 temp would help to put this into place in regards to absolute values, also helps to understand precipitation observations as not that many low extremes were recognised but in SPI3 drought is indicated;

Fig10: what was the reasoning to switch to months June-August for this analysis, compared to the other results that have been heavily focused on period May-August?;

Discussion, section about annual hydrological cycle: more information and figures about initial conditions (e.g. snowfall) in supplement (e.g. annual averaged timeseries and 2018 situation, similar to Fig.1 and 2) and citations would support and help to follow the explanation of the specific observations and putting them into more context (some good starting information was already given in introduction about the hydroclimatological characteristics, streamflow and groundwater regimes);

p16 line2: citations or other examples to underline this assumption?;

p16 line14-16: could you elaborate a bit more (e.g. references to figures where this is

observed). If I look at Fig A9, A8, A7 for example I see overlapping areas and stations with indicate drought occurrence?;

p16 line24: would you say this is already the effect of drought propagation one can observe (with the ongoing dry conditions until the end of the year (e.g. seen in SPEI3 results)?;

p17 line8-9: maybe include this reference already in introduction to set the stage for the discussion; p 17 line25, spelling error: wells instead of well;

Appendix: A1 mountain regime: why not include December as winter month for classification criteria for streamflow regime?;

A1 line7: missing point after class

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