Reply to Patrick Ludwig

We thank Patrick Ludwig for his positive assessment of our manuscript and appreciate the suggested improvements. Please find our responses to the comments below in blue.

Review of egusphere-2022-954 '*The 2018 west-central European drought projected in a warmer climate: how much drier can it get?*' by Aalbers et al.

General comments:

In their paper `*The 2018 west-central European drought projected in a warmer climate: how much drier can it get?´*, the authors investigate the impact of global warming on soil moisture drought severity for the year 2018 in west-central Europe. With this aim, pseudo-global warming (PGW) experiments with a regional model were performed, forced by three GCMs for three different global warming levels (+1.5K, +2K, +3K). Their results show, that under global warming the 2018 drought episode experiences strongly enhanced summer temperatures, but a fairly modest soil moisture drying response compared to the change in climatology as evaporation is already strongly moisture-constrained during present-day condition. In more general, the authors show that the drought risk in west-central Europe is strongly enhanced under global warming.

This work provides is a valuable contribution to our understanding of the consequences of global warming on extreme events (here drought) observed so far. The methods, techniques and the experimental setup applied in this study are sound and state of the art; the use of different GCMs (considering an ensemble mean for each GCM) to create the perturbations under global warming provides robust estimates of how global warming might modify the 2018 drought event. Beside some minor comments, this study is a very valuable contribution to NHESS.

Minor Comments

L62: What does the abbreviation SPEI stand for?

SPEI is the Standardized Precipitation - Evaporation Index. We will clarify this in the revised manuscript.

L135ff: Usually, global warming levels (GWL) are defined based on the pre-Industrial reference period (1850-1900). In the IPCC AR6 report, the global warming between 1850-1900 and 2011-2020 is estimate with 1.09K, thus meaning roughly GWL1. Based on the Paris agreement, the long-term temperature goal is to keep the rise in mean global temperature to well below 2K (GWL2) above pre-industrial levels, and preferably limit the increase to 1.5K (GWL1.5). To avoid any confusion, between the IPCC based and your GWLs (based on the 1991-2020 period), a short note might be helpful.

We will add a sentence to emphasize this in the revised manuscript.

L144ff: Can you comment briefly about the model quality of the 3 GCMs in comparison with observation? Is for example the temperature bias of the reference period you use (1991-2020) the same for all models? Or are the GCMs that already show enhanced global warming for this period in comparison with the observational record?

We will. Note however that the impact of model biases in the reference period in the GCM is limited to the impact on the perturbations, since the RCM reference run is driven by ERA5.

L258: Should read '*over the British Isles*'

Thanks, we will change this.

L393: The 2011 spring drought is not indicated in Figure 6b. Could you add this year to the graphs?

Yes, we will add the 2011-label to the plots.

Figure1: E_p is missing in the list of variables in (a); the orange lines for the observations (obs) for 2018-2019 are hard to see; consider to use a more striking color.

Thanks for noting, we will add E_p and do our best to find a better color.

Figure2: Consider moving the column with JFM as the first column; would better reflect the course of the year.

We chose to start with April as the start of a hydrological year, but we don't have a strong preference and can indeed show JFM in the first column.