

Hydrol. Earth Syst. Sci. Discuss., referee comment RC1
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Comment on hess-2021-123

Anonymous Referee #1

Referee comment on "Storylines of UK drought based on the 2010–2012 event" by Wilson C. H. Chan et al., Hydrol. Earth Syst. Sci. Discuss.,
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General comments:

The submitted manuscript addresses a very relevant topic for water risk management, (i.e. low likelihood/high impact events) and does so using storylines, a novel approach that allows the investigation of plausible but unrealized high impact events. The selected storylines are based on the 2010-2012 UK drought event and explore imposed changes to 1) Precondition severity, 2) Temporal drought sequence, and 3) Climate change. The implications of such changes are assessed by quantifying changes to streamflow maximum intensity, mean deficit, and duration. The results do not only facilitate the realization that it could have been worse/it possibly will be worse but also sheds light on physical catchment properties that play a key role in the propagation of a multi-year drought event. In general, the manuscript is well written and structured and the results are relevant to a broad community interested in novel approaches that tackle environmental risk management and future climate change impacts. I have few minor concerns that I share in what follows:

Specific comments:

I understand plausibility to be a key property of the designed storylines. The first storyline proposes varying 3- and 6- months prior precipitation conditions to the 2010-2012 drought event independently of other climatic variables used in the model simulation. Such manipulations do not consider correlation structures in the data. I find that not completely justified and slightly weakening the plausibility assumption. For example, the potential presence of autocorrelation among successive monthly precipitation values or the correlation between precipitation and temperature are not considered. The authors can potentially mention these concerns in their discussion to further strengthen the plausibility argument. I see that some consideration is given in the paragraph starting at Line 516, nevertheless, I find that rather short and in itself not fully convincing. If I

understand correctly, the authors address plausibility for the precondition storylines by comparing the resultant 12-month precipitation deficits to outputs of high-end climate change scenarios. They argue that the preconditioning storylines are plausible as these are contained within the range of outputs from high-end climate change scenarios. Nevertheless, I expected that plausibility concerning these particular storylines should address whether such conditions are possible in the current climate.

The authors state that they apply the delta approach in its standard form (line 189) where historical variability is retained. This formulation confuses me a bit as I am not sure what a non-standard form for the delta approach is. Can the authors expand on this in their discussion to address limitations associated with the method they chose and possibly elaborate on other potential methods that can be used to answer questions such as: How would that particular event look like in a warmer world? (e.g. Wehrli et al. 2020).

It is clear to me why storylines are relevant as complementary information to already existing approaches that rely on GCM projections to quantify the hydrological impacts of climate change. I also do understand how these two approaches are very much different in scope. Nevertheless, the authors use the terms "scenario-driven approach" as a particular feature of GCM driven assessments in an attempt to contrast their approach and I find that slightly misleading. Storylines are still very much scenarios to my understanding, event-based in that case, and with a focus on plausibility rather than probability. I don't see why they wouldn't qualify as scenario-driven. The authors themselves state that (i.e. line 143): "storylines follow similar methodologies employed in previous studies to create scenarios". I, therefore, recommend revisiting specifically this phrasing to reduce confusion and facilitate the understanding of what is meant by storylines.

Another point related to terminology: Can the authors explain their use of the term "counterfactual" when discussing future impacts of climate change. As the climate change storyline refers to a hypothetical event in the future, I find it a bit unclear why that would qualify as a counterfactual.

Technical corrections:

I am slightly confused by this sentence: Line 373, "The drought is estimated to worsen for the "Dry year before" storyline for all clusters except for mean drought deficit for Cluster 4 for SSI-6". I believe something along the lines of: "The drought defined by SSI-6 is estimated to worsen for the "Dry year before" storyline for all clusters except for mean drought deficit for Cluster 4 " is a bit more clear.

Line 378: *is* -> *are*

Line 381-382: I believe something in the punctuation of the phrase is incorrect. Please check that.

References:

Wehrli, K., Hauser, M., and Seneviratne, S. I.: Storylines of the 2018 Northern Hemisphere heatwave at pre-industrial and higher global warming levels, *Earth Syst. Dynam.*, 11, 855–873, <https://doi.org/10.5194/esd-11-855-2020>, 2020.