

Interactive comment on “A Methodology for Attributing the Role of Climate Change in Extreme Events: A Global Spectrally Nudged Storyline” by Linda van Garderen et al.

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The authors thank the reviewer for the time and effort in providing us with comments, they are very helpful. In the text below you will find our responses to each comment.

I find the paper very clear and interesting and just have a few minor questions and comments for the authors that I list below.

Response: Thank you for your input and positive view on our paper. This is very much appreciated.

l.57-59 I get your point about type 1 and type 2 error because I have read Lloyd and

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Oreskes' paper. However, I feel that this sentence does not fit very well in this paragraph and will be very confusing for someone who has not read the paper. I would delete the sentence or move it elsewhere and develop it a bit more.

Response: We believe that the type 1/type 2 error issue is a major motivation for the storyline approach, so we feel that it needs to be mentioned here. We understand that the Lloyd & Oreskes paper might be a bit philosophical for some readers, so we have added a reference to Trenberth et al. 2015 who make this point in a more informal way.

I.205 Why did you choose a three years spin-up? How do you know this is enough?

Response: We chose three years because it takes roughly three years for soil moisture to balance out towards the new normal (counterfactual), which is important for studying heat waves. We have tested the soil moisture levels in each of the spin-up years and found that between the second and third year there is almost no more difference found. We chose not to show this in the paper. We have added a sentence to the methodology section explaining that we found, through testing, the three year spin-up to be sufficient.

I.209 Is there a reason behind the choice of three runs? Do you have any idea whether the results would be different if you added more runs? I understand that it takes computational time to add more runs for a global model but if you could comment on this (maybe as a limit of your study), the number of runs would look more justified.

Response: We agree that more explanation of why we chose a three-member ensemble would be helpful. It was done just to provide a first check on the robustness of our results, following the precedent of other studies. If the signal is already clear from three ensemble members, then that is enough. If three members are not enough, then the signal is anyway going to be small. Constructing a larger ensemble would use computational resources for no apparent gain, and we prefer to use our computational resources to look at longer time periods. Note that we already used the ECHAM_SN simulation as an out-of-sample test of the representativeness of our factual ensemble, and we have now performed a sensitivity test using altered SIC values which provides

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an out-of-sample test of the representativeness of our counter-factual ensemble. We have added some additional text to mention this.

I.213 Could you add a reference for this statement? I know you comment on this later in the paper, but I think you should put the reference here first.

Response: We have added a reference to Wehrli et al., 2019 to support this claim.

I.266 to 279 I find this whole paragraph very interesting and original. Do you have an interpretation to explain the spatial variability of the differences between factual and counterfactual simulations?

Response: Thank you. However, we do not have an interpretation of this variability, and prefer not to speculate.

I.311-313 that's an interesting interpretation. Do you have a reference about the direct radiative effect of GHG?

Response: We have added the Wehrli et al., 2018 paper as a reference.

I.334 You could link that statement to the results presented in Hauser, M., Orth, R., and Seneviratne, S. I. (2016), Role of soil moisture versus recent climate change for the 2010 heat wave in western Russia, *Geophys. Res. Lett.*, 43, 2819– 2826, doi:10.1002/2016GL068036.

Response: Thank you for bringing this paper to our attention. We have added a sentence to point out that our results are in agreement with the results of Hauser et al., 2016 despite a different methodology.

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