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Earth System Dynamics
Discussions

Interactive comment on "Weather extremes over Europe under 1.5 °C and 2.0 °C global warming from HAPPI regional climate ensemble simulations" *by* Kevin Sieck et al.

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I write this comment because I want to address some aspects that I believe the authors should consider, and would significantly improve the quality and usefulness of their findings.

1. I find there is some lack of context of how the simulations used in this paper compare to those widely used in previous studies. It would be very beneficial to show some type of evaluation of the simulated climate in the two ensembles used here, for example in terms of mean temperature and precipitation anomalies and changes at 1.5 and 2 degrees with respect to preindustrial. Moreover, the authors should describe how the

simulated climates in these ensembles compare to those in previous studies; e.g.., Perkins-Kirkpatrick et al, 2017; Sanderson et al. 2017; King et al. 2017; Suarez-Gutierrez et al., 2018; Wehner et al, 2018. These studies are based on a variety of types of ensembles, from CMIP5 to fully coupled ESM large ensembles, and the paper should include a discussion on how these simulations differ in terms of both climate conditions and fundamental design. In particular highlighting both the advances (i.e. higher resolution, targeted to 1.5 and 2 degrees) and shortcomings (i.e. atm only runs, no fully coupled ocean, SST prescribed from short periods) of these data is in my opinion crucial.

2. The paper does not address the implications of using atmosphere only runs with prescribed SST based on relatively short time periods sufficiently. A finite set of prescribed SST patterns offers a limited range of climate states that does not completely sample ocean-driven variability (see Sanderson et al., 2017; Fischer et al., 2018). In contrast, large ensembles from fully-coupled climate models sample a wider range of ocean states and include the influence of the ocean-borne variability (Hawkins et al., 2016). Furthermore, fully-coupled large ensembles also offer a more realistic representation of heat extremes over land than atmosphere-only large-ensembles, even if the later offer a larger number of independent simulations (Fischer et al., 2018). These issues should be addressed in the main text.

3. The authors argue that the improved resolution from using a regional model combined with the large ensemble size are mayor improvements. However, previous studies analyze the changes at 1.5 and 2 degrees using similarly large ensembles of fully coupled ESM (100 members x 250 years; Suarez-Gutierrez et al., 2018), so what are the differences or biases that higher resolution vs. no coupled ocean introduce?

Minor Comments:

What do the gray areas over land in figures 2, 3, and 4 represent? I thought maybe the white shading was meant to be transparent but there is white in some parts I think?

References:

Fischer et al. (2018): Biased Estimates of Changes in Climate Extremes From Prescribed SST Simulations. Geophysical Research Letters 45.16, pp. 8500–8509. https://doi.org/10.1175/JCLI4288.1

King and Karoly (2017): Climate extremes in Europe at 1.5 and 2 degrees of global warming. Environ. Res. Lett. 12 114031. https://doi.org/10.1088/1748-9326/aa8e2c

Perkins-Kirkpatrick, S.E. and Gibson, P.B. (2017): Changes in regional heatwave characteristics as a function of increasing global temperature. Sci Rep 7, 12256. https://doi.org/10.1038/s41598-017-12520-2

Sanderson et al. (2017): Community climate simulations to assess avoided impacts in 1.5 and 2âĂŕâĂĽ°C futures, Earth Syst. Dynam., 8, 827–847, https://doi.org/10.5194/esd-8-827-2017

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Wehner et al. (2018): Changes in extremely hot days under stabilized 1.5 and 2.0âĂĽ°C global warming scenarios as simulated by the HAPPI multi-model ensemble, Earth Syst. Dynam., 9, 299–311, https://doi.org/10.5194/esd-9-299-2018.

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