Natural Hazards and Earth System Sciences Discussions

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# Comment on nhess-2021-66

Anonymous Referee #1

Referee comment on "Using high-resolution regional climate models to estimate return levels of daily extreme precipitation over Bavaria" by Benjamin Poschlod, Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-66-RC1, 2021

In the presented study, the author chose two different regional climate models (CNRM and WRF) in three different spatial resolutions (12km, 5km, and 1.5km) driven with two different reanalysis data sets (ERA-Interim and ERA5). The author pointed out the difficulty of a correct and spatial representative estimation of return levels from observational data sets due to their limitations and uncertainties. Using RCM data could fill this gap as return levels of precipitation are of great importance for stakeholders or the insurance industry, also with respect to possible changes in the future regarding climate adaptation. The author used different types of extreme value approaches and validated each by comparing model output with observations and theoretical quantiles which is adequate as each method has specific pros and cons.

Nevertheless, I have some major concerns with the quality of the current version of the manuscript which are listed below followed by minor comments and questions.

Major comments:

1) In the conclusions the author clearly stated the uncertainties arising from different model setups regarding internal climate variability, parametrizations, and further assumptions. Saying so, why did you then choose different RCMs and not only a single one with similar setups, e.g., a COSMO-CLM version in the given (slightly different) resolutions? Furthermore, why did you use ERA-Interim and ERA5 as forcing data and not only the higher resolved and newer ERA5 data for all simulations?

2) The author put lots of effort into the homogenization of pointwise observational data sets. There are several high-res gridded precipitation data sets on the market like REGNIE/HYRAS for Germany (1km, Rauthe et al., 2013), RADOLAN (DWD, 1km), or SPARTACUS (Austria, 1km, Hiebl and Frei, 2017). I agree that even at this high resolution these data sets have limitations when it comes to convection. Nevertheless, DWD and ZAMG put a lot of effort into calibrating these data sets not only with ground measurements but also with radar data and vise versa in the case of RADOLAN. So, I assume these data sets have a higher quality than the homogenized point observations by the author and they have a higher resolution which made the validation of the 1.5km WRF model more robust.

3) When it comes to different extreme value techniques, a proper validation would use every method with every data set and not only a couple of possible combinations like currently presented.

4) The authors conclude that RCMs are better in terms of spatial representativeness of return levels. Saying so I expect cross-validation with existing products like KOSTRA for Germany to clearly point out the benefit of RCMs compared to raw or existing gridded observations.

5) The author concentrated on the return level of 10 years and stated that this is the most important value for the targeted applications. At least for the insurance industry, minimum the 100-year return level better the 200-year values (PML200) are the relevant levels. As all results are specifically related to the 10-year level, I am wondering if the methodology can be adapted/used for higher return levels or if further validation/calibration is necessary in that case. I miss some statements on that in the discussion and conclusions sections.

Additionally to the major comments above, I have some minor comments [page-line/paragraph]:

[Sect. 1] I recommend clearly state the key research questions you are focusing on in this study. For me, it is not clear what the main aims are.

[P3 L81ff] Schröter et al. (2015) analyzed three major flood events in Germany during the past 70 years (1954,2002,2013), which also partly affected your investigation area, concluding that it is not daily/multi-day precipitation amount that triggers major flood events.

[P3 L88ff] "RCM can bridge the gaps" – what about stochastic weather generator or other approaches? Ehmele and Kunz (2019), for example, introduced a semi-physical, 2D, and high-resolved precipitation model mainly based on orographic precipitation which in a statistical sense, gives good results in terms of return levels even for higher return periods.

[Sect. 2] I recommend a reordering of the paragraphs in this section. As your investigation area is restricted to the given data sets, I suggest first describe the data sets and the investigation area afterward.

[Fig.1] Is the study area equal to the model domain? If so, how do you deal with boundary effects?

[P4 L97f] In Fig.2 you give the reference for the data set, I suggest giving it in the text, too.

[Fig.2] Do you have an explanation for the strong "drying" signal in the main Alpine valleys? Please use discrete color separations. See also https://www.nature.com/articles/s41467-020-19160-7

[Sect. 2.2] So I understand that you estimate daily precipitation or at least 24h sums in the moving window by hourly station data, right? If so, please clarify in the text.

[P7 L133] "24h RLs are adjusted to daily values using a reduction". I do not understand what this reduction is about. Please clarify this in the text.

[Sect. 2.3] Why did you choose exactly these models and not others? There is a huge variety of RCM in 0.11° resolution within the CORDEX project and also high-resolution

simulations mainly Germany and Alpine region in the CORDEX FPS convection project. Furthermore, you used WRF v3.6.1 for the 5km and v4.1 for the 1.5km simulations. Are there major differences between the versions? For consistency, the same model version would be better.

[P8 L161ff] For WRF 1.5km, you have 30 simulations with a 1-year length each. Does this have an impact on the comparability with the continuous simulations at coarser resolution?

[Sect.3] I suggest a reordering here, too. Instead of first describing strategies and distributions and then how they are applied in this study, I recommend a structure like 3.1 BM; 3.2 POT, 3.3 MEV each with a short introduction to the method and then directly saying how you will apply it in this study.

[P9 L180ff] It would be helpful for the reader if you can give typical values or magnitude orders of t_wet and t_decluster.

[P9 L192] G is also a CDF, right? Please indicate it.

[P12 L242] Can you explain why the low-res simulations have higher return values than the high-res?

[P13 L277] You mean Fig.5d instead of 5b?

[P15 L289] The 5km WRF seems to have a much stronger orographic signal than the 1.5km, especially the "drying" in the main valleys. Is there any explanation for that?

[P15 293] Fig.5b and later 5e?

[P15 L301] Sure you mean Fig 3d here?

[P15 L305] Fig.5c and 5f, I guess

[P19 L394-398] Maybe I miss something, but I do not get the message from these two paragraphs

[Fig. S5+S6] There is data missing for Switzerland and Austria. Why? I thought you have the data for that regions and time periods.