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Earth System Dynamics
Discussions

Interactive comment on "Euro-Atlantic winter storminess and precipitation extremes under 1.5 °C versus 2 °C warming scenarios" *by* Monika J. Barcikowska et al.

Anonymous Referee #1

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1 General Comments

The manuscript "Euro-Atlantic winter storminess and precipitation extremes under 1.5 °C versus 2 °C warming scenarios" by Barcikowska et al presents comparisons between storminess and precipitation in the 20th century and in the early 22nd century using newly available model simulations from the HAPPI project in different horizontal resolution. They first evaluate model results through comparing results from the model runs on different horizontal resolutions with ERA-Interim (circulation-type variables). Here, they conclude that the 0.25 degree resolution provides the best results, where atmospheric features are presented superior to the lower horizontal resolution model

simulations. In the following, 0.25 degree model precipitation is compared with data from the EOBS and GHCN datasets, where the authors find very good agreement. Afterwards, the authors investigate the differences between the scenarios under 1.5 and 2 °C warming, whereby they present changes in the mean-state of the large-scale atmospheric circulation and precipitation, in daily and sub-daily precipitation and wind extremes, and in storminess for the 0.25 degree run.

Overall, the manuscript deals with an important subject and combines different aspects of how storminess and precipitation changes under 1.5 and 2 °C warming, also with regard to making the model simulation finer. The manuscript clearly conveys this subject, but nevertheless suffers from several major aspects that need improving and/or further clarification, before it is ready to be published.

2 Specific Comments

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1. The HAPPI ensemble consists of several model runs from different modelling centers (not mentioned in the text). I understand that you concentrate on the CAM5-simulations, but give no reason why the other simulations are discarded.
2. Regarding the model resolution: The implications found for the large-scale atmospheric circulation cannot be overstated enough and put the model into the sphere of dynamically downscaled regional models with corrections for the larger scales. I agree with section 3.4 that there is room for some kind of sensitivity study here.
3. I also find it very interesting to see the differences between the present climate and 1.5 °C vs 2 °C warming. Your results suggest (as you wrote) that there

seems to be a threshold in between, that once crossed, exacerbate storminess conditions.

4. Why is ERA Interim the reference for midlatitude atmospheric circulation? How does ERA Interim compare to other reanalyses with regard to circulation?

5. The changes of the SLP gradient are interesting. As you mention the NAO in the beginning of section 3, what are the consequences for the NAO index caused by the increasing SLP gradient difference? You could compute the NAO index and show how it changes as it should be a stationary process centered around 0 in the long-term.

6. This one is very important: The question of statistical significance has not been dealt with properly and currently is rather imprecisely given (sections 2.2, 3.2 and S4).

   S4 and p.12 l18 ("which defies statistical significance“): What you actually show is the distribution of differences, from which you can infer a confidence interval. What you do not get are real implications about statistical significance as written.

   If you want to use bootstrapping to determine statistical significance, the proper way to do it is to generate a null distribution first with a sample size large enough (under H0: zero difference) and then compare your difference with critical values from the null distribution that correspond to your alternative hypothesis (e.g. H1: difference > 0). Using figure S4a (difference in the meridional pressure gradient), I guesstimated a standard deviation of about 2 hPa and generated a normal null distribution for zero differences in R. Comparing your 3 hPa difference with that normal distribution yields significance at least at the 0.9-level. Results may be different for your application as you use a non–parametric approach, depend on the sample size and the test method involved. If the outcome is not significant at any level, there is also room for discussing type-I and type-II errors.

   Please repeat your analysis here. Also: please move the detailed description of your method into the method-section without repeating the details later.

   Regarding S4: The figure looks very choppy. Either it is showing some kind of histogram sampled for specific blocks of differences (then it should be stated clearly), or it demonstrates undersampling in your bootstrapping approach. Either way, it would be good to redo the bootstrapping with a bigger sample than just 1000. The computation is cheap and very likely results in a better representation of the distribution of differences.

7. The meridional SLP gradient and its differences: Sections 3 and 3.2 write about the SLP gradient, but only refer to figures 4 and 5 showing the respective MSLP plots. I, as a reader, am not able to estimate the gradient and gradient differences from such plots. As you define the gradient in section 2.2, it is very difficult to relate the Azores-Icelandic pressure difference to plots of MSLP or MSLP differences, even though I know about the related atmospheric patterns. Why not just give the gradient as a number somewhere? (also for 1.5 °C and 2 °C scenarios, and the differences).

   Another note to the SLP gradient: It suddenly appears at the end of section 2.2 without prior mentioning. It should be introduced a little earlier along with the other variables (p6 l 32ff) including the reason to do so.

8. For section 3, can you provide spatial statistics, such as the pattern correlation when you describe the resemblence of simulations with observational datasets?

9. Section 3.2, p. 12, l 19 "time-average over 1979-2005“: Do you take care of any secular trend, which might be imminent in 26 years of data, but may disappear in a shorter time period? I am asking, because just from looking at the station-based NAO index at https://climatedataguide.ucar.edu/climate-data/hurrell-north-atlantic-oscillation-nao-index-station-based, I see that the average over 1979-2005 is positive, but from 2005-2015 it might average out to 0.

3 Technical comments

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Some passages of the manuscript are not concise (e.g. repetition of methods in the text, when such details belong to the method section). Sometimes the manuscript does not read well.

1. Please check the references. There are references clearly missing, for instance Barcikowska et al, 2017 or Gilleland and Katz, 2014; or misleading like Feser et al., 2014 (did you mean Feser et al., 2015?). There might be more that I have overlooked.
2. Section 3.1 feels a little superfluous and could easily be merged into the method section.
3. p 1 l 32: the British Isles
4. p 4 l 21: Zappa et al. (2014) have shown
5. p 6 l 4: provided by the C20C+ Detection and Attribution Project
6. p 6 l 7: the CAM5-1-1degree run [...] and the CAM5-1-0.25degree run (missing articles)
7. p 6 l 9: add an "and“ before 0.3125°x0.234°
8. p 6 l 10: remove the last ")“
9. p 6 l 18: do you need commas in front and after the subclause "using atmosphere-only models?"
10. p 6 l 22: remove comma after offset

11. p 6 l 35: zonal wind; what about meridional winds or wind speeds in general?
12. p 7 l 17: Wilcoxon signed rank test, can you add a reason why you use it?
13. p 7 l 21: a block (seasonal) maximum
14. p 7 l 22: The whole sentence with "Assumptions that our analyzed data..." needs rewriting.
15. p 7 l 26: there is something wrong with (1-1/T)th (you accidently inserted a comma)
16. p 7 l 33-35: please add a reference
17. p 9 l 24: will presumably lead to a
18. p 9 l 37: either from the model bias or from obervational bias
19. p 10 l 4: high-resolution runs provide a more accurate representation
20. p 10 l 20: provided for the years
21. p 10 l 20: internal SST variations being in a different phase
22. p 11 l 18-21: reflect, generally after reductions, CO2 increase
23. Section 3.4: This one reads very well (also applies to section 2.3).
24. Figure 7: What is a fractional difference?
25. Figure 9: The caption talks about 50 years. As far as I understood the manuscript, shouldn’t it be less years? Maybe I did not get, where the 50 years sample comes from?

26. Figure S2: There is either something wrong with the figure caption or there is a whole figure missing.

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