

Biogeosciences Discuss., referee comment RC2  
<https://doi.org/10.5194/bg-2022-74-RC2>, 2022  
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## Comment on bg-2022-74

Anonymous Referee #2

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Referee comment on "Bioclimatic change as a function of global warming from CMIP6 climate projections" by Morgan Sparey et al., Biogeosciences Discuss.,  
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In this study Sparey et al. analyse model output from six state-of-the-art earth system models to estimate the changes in land bioclimate classes under different degrees of global warming. First they find the multi-model ensemble mean of historical runs compares favourably with observations-based bioclimate changes, and second they use scenario-based model runs to estimate potential future bioclimate changes. They are able to summarise their findings with a single equation that shows model agreement and is useful to communicate potential consequences of global warming. The study uses a modelling approach that fits within the scope of BG. The manuscript has a clear motivation and is well outlined. However, I think it could be improved by addressing the following specific comments. Additionally, I list some technical details that could be corrected.

### Specific comments

- I think the most critical point the authors should address is the lack of a scientific "discussion". There is no single reference to other works in Section 3. For instance, how do these results compare with Kim and Bae (2021)? Are these results far away from similar works with CMIP5 like Rahimi et al. (2020)? Here I only refer to those citations in the Introduction, but perhaps there exists more literature that can be discussed. Keeping together "Results and Discussion" is possible, but in this case I think Section 3 only includes a description of the outcome of the author's own analyses.
- Also, besides using references for the discussion section, I think the authors should revise the use of references throughout the manuscript. For instance in the Introduction there are no references about CMIP6 or the Paris climate targets. Also when the authors say in line 60 that the scheme has had many alterations, they could provide a list of some publications in parentheses with as e.g..
- Is Table 1 and the modifications described in lines 62-65 the same as in Peel et al. (2007)? Or are these the author's own modifications to what Peel et al. (2007) do? Please also consider including a citation in the caption of Table 1 if this is indeed taken from the reference.

- Authors should motivate better their model selection process. This is especially important since the 6 chosen models include repeated model components. How different are, for instance, CanESM5 and CanESM5-CanOE in terms of simulated (atmospheric variables) monthly precipitation and temperature values? What are the "data management" reasons that lead to these 6 models being selected over other models?
- Along with the previous comment, please include a table with the specifications of the data used. Since the model output data is a critical component of this study, it is important that some characteristics (e.g., spatial resolution, time step, citation to technical paper) can be readily seen and compared in a table.
- Please discuss possible shortcomings of downscaling model output to a finer grid (0.5°), in case this was done when the model output is at a coarser scale. This is why a table with some specifications of the data could be useful.
- Please consider providing maps like those in Appendix A but using the "streamlined" version.
- In multiple occasions the word "significant" is used. I think that with the data the authors have it should be possible to perform some statistical significance tests. I think such tests could increase the strength of the results. Without the tests, please consider alternating with synonyms like "substantial", "marked", "large" or alike.

## Technical details

- Please consider re-organising some paragraphs in the Introduction. Paragraph starting on line 35 may fit better after the description of the classification systems. As a side note, this paragraph does not mention any references about CMIP6.
- I would recommend to move the sentence about previous applications of KG (line 43) to the end of Section 2.1.
- Abstract contains references. Are they urgently required?
- Consider prefixing "ensemble mean" with "multimodel", because some times "ensemble" could be referring to a group of runs or data.
- Please include spaces between numbers and their units, and use units in exponential notation (e.g., cm month<sup>-1</sup>)
- I think authors should mention vegetation in some places. At least when explaining the KG classification system on line 32.
- Perhaps Section 2.4.1 should actually be a subsection of or follow the Section on the traditional KG scheme (Section 2.1).
- Please expand on what the anomaly corrections are.
- Consider using "averaging" instead of "meaning".

In the following I refer to specific lines (L):

- L3: "hinder" -> maybe "limit" is an alternative. Many detailed assessments can be made in spite of inter-model spread.
- L4: why capitalisation in "Earth System Models".
- L4: remove "very".
- L5: "will" -> "would".
- L21: Is it correct "regional areas"?

- L31: missing umlaut in Köppen name.
- L43: maybe this "most popular" should be referenced. Otherwise "popular" should suffice.
- L50: review "more intuitive".
- L52: review this sentence.
- L60: check citation is \textcite, not \parencite.
- L72: please use active voice: "we do not expect".
- L76: check if "correctly" can be replaced by "following observations".
- L80: is it above pre-industrial levels or above the reference period 1901--1931?
- L81: remove "model" after "CMIP6".
- L90: review this sentence.
- L110: remove period after "Figure 1".
- L116: (and Fig. 1 and 2 captions) consider "averaging process" instead of "meaning".
- L117: 'lagging' as in having lower values?
- L119, L120: check use of "correctly", that can always be related to "according to observation-based KG".
- L129: check "real world climate".
- L134: use cross-referencing with the appendices (e.g., Appendix A).
- L135: "shows" -> "suggests". "will be" -> "could be".
- Fig. 3 caption: maybe place "reference period" before CMIP6 ssp585 runs.
- L162: "will" -> "could".