

Biogeosciences Discuss., referee comment RC1
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Comment on bg-2022-74

Anonymous Referee #1

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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The authors present an analysis of Köppen-Geiger climate classification for several different levels of global warming using CMIP6 runs from six GCMs and investigate how the land area covered by different climate types changes as the degree of warming increases. The novelty of this work is the use of CMIP6 runs and the focus on degree of warming rather than a particular future point in time. The development of an equation to estimate the % land area that changes climate type as temperature increases is a nice simple metric for communicating projected changes in climate type and associated bioclimatic impacts.

One potential additional improvement to the manuscript would be to develop equations, like that in Equation 1 for the % land area changing climate type, for each streamlined classification climate type of Table 2. As warming increases from 0K to 4K some of the streamlined climate types will increase in % land area covered and others will decrease. An equation for each streamlined climate type could be very interesting / useful as some climate types will expand and reduce at different rates compared to the global land area change in Equation 1. Adding an extra column to Table 2 with the equation for each climate type would be very useful additional information. This would allow researchers interested in particular bioclimates to use these results for their research.

The work presented is well written, interesting to a wide audience and is very appropriate for this journal. I highlight some comments below that should be addressed.

Specific comments

Line 53: change "data to to" to "data to".

Table 1: while the following differences from Peel et al (2007) are largely minor and most likely do not impact the end results significantly, it is important to note them. The Ds climate correction is likely to be the most important and should be corrected.

- Criteria for C climate: change from " $0^{\circ}\text{C} \leq T_{\min} < 18^{\circ}\text{C}, T_{\max} \geq 10^{\circ}\text{C}$ " to " $0^{\circ}\text{C} < T_{\min} < 18^{\circ}\text{C}, T_{\max} \geq 10^{\circ}\text{C}$ ".
- Criteria for Cs climate: change from " $P_{\text{wet}} \geq 3 * P_{\text{dry}}, P_{\text{dry}} < 4$ " to " $P_{\text{wet}} > 3 * P_{\text{dry}}, P_{\text{dry}} < 4$ ".
- Criteria for D climate: change from " $T_{\min} < 0^{\circ}\text{C}, T_{\max} \geq 10^{\circ}\text{C}$ " to " $T_{\min} \leq 0^{\circ}\text{C}, T_{\max} \geq 10^{\circ}\text{C}$ ".
- Criteria for Dw climate: change from " $P_{\text{wet}} \geq 10 * P_{\text{dry}}$ " to " $P_{\text{wet}} > 10 * P_{\text{dry}}$ ".
- Criteria for Ds climate: change from " $3 * P_{\text{dry}} < P_{\text{wet}}$ " to " $3 * P_{\text{dry}} < P_{\text{wet}}, P_{\text{dry}} < 4$ ".
- Criteria for ET climate: change from " $0^{\circ}\text{C} \leq T_{\max} < 10^{\circ}\text{C}$ " to " $0^{\circ}\text{C} < T_{\max} < 10^{\circ}\text{C}$ ".

Line 63: change "First, C and D climates follow a 0°C threshold instead of 3°C " to "First, C and D climates follow a 0°C threshold instead of -3°C ".

Line 75: I know data can now be considered as singular or plural, but I recommend changing "model and observational data is smoothed" to "model and observational data are smoothed".

Line 85: what do you mean by "anomaly corrected fields"? Not all readers will understand this term or what it means, so more explanation is required.

Table 2: In Table 1 all second letters were capital (for example CFa rather than Cfa). However, in Table 2 a mixture of second letter capitalisation is used (see Subtropical). Please be consistent.

Figure 3: It would be better to increase the size of these four maps as it is very hard to see the differences when the maps are so small. Rather than one column of four maps, try two columns of two maps. Also, why are these KG maps called anomaly plots?

Figure 5a & 5b: the right column of numbers next to the colour bar is labelled "% Land-area 4K" in both 5a and 5b. I think this should be "% Land-area 1.5K" for 5a and "% Land-area 2K" for 5b.

Line 142: You refer to Figure 5a, but don't you mean Figure 5c? Figure 5a shows the 1.5K results, whereas Figure 5c shows the 4K results. Hence the comment about Arctic Tundra should be updated to 75% less land-area.

Equation 1: you provide an equation, but no measure of how well this model fits the data. I realise there are only nine data points supporting this model fit, but a metric like R^2 would be useful to indicate how well the model fits the data.