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Atmospheric Chemistry and Physics Discussions

Interactive comment on "How aerosols and greenhouse gases influence the diurnal temperature range" *by* Camilla W. Stjern et al.

Anonymous Referee #2

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The paper uses data from Precipitation Driver and Response Model Intercomparison Project (PDRMIP) to investigate how different climate drivers influence changes in diurnal temperature range (DTR) seasonally and regionally. The study is on a topic of broad interest and high relevance. I have a couple of general and specific comments and questions outlined below. Until these points are dealt with I do not think the paper is ready to be published in ACP.

General comments:

1. My main issue with this paper is the number of maps and panels in the figures that are never commented on in the manuscript. My philosophy is that if a figure is not commented on it can be removed. Many sections can be improved by discussing more of what is presented in the figures.

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Discussion paper

2. The language of the paper can be improved as it contains many very long sentences that makes it difficult to read. It might help to have a native English speaker look over the text.

Specific comments:

3. Figure 1: The caption states this is the baseline concentrations of BC and SO4, while the text (line 95) and figure itself states it shows the perturbed aerosol concentration. Is this figure made based on the models that had concentration perturbations, and not emission? Please give a short explanation of how this will give inter-model differences, and make it clearer in the figure caption what is actually shown.

4. Figure 2: a) The explanation of what years are shown for the models are difficult to read. b) the comma after “same years” make it slightly confusing if you mean the same years as a) CRU or models. Please make even clearer.

5. Figure 3: The caption states that the region called “LND” in the manuscript is average of all land regions, this should not be a figure text but might belong in the methods section instead, where the regions are presented.

6. The author states the regions chosen for investigating were selected based on populated areas, previous findings regarding DTR, and areas where future interest is large. The introduction does not state any regions where previous findings point to large changes in DTR, only regions where anthropogenic aerosol emissions were large (the shift from Europe to Asia). I suggest to either include regions with historically large changes in DTR in the introduction which you can refer to in the methods section, and/or include that regions were chosen based on areas of large anthropogenic emissions of aerosols, as this becomes very important later in the paper.

7. In section 3.1 first paragraph the crude test in inter-model variability might belong in the method-section, or at least before you introduce figure 2. As it stands now it seems unnaturally placed between analysis of Figure 2. Also the introduction of CRU and the

averaging method regarding observations and model grid resolution should have been presented in the methods section rather than results.

8. In section 3.2 the first paragraph states that the perturbation results have been normalized to the temperature change per experiment, which makes both sulfate and BC harder to interpret. I am therefore unsure that this normalization is useful. Please convince the reader why the pros of the normalization outweighs the cons.

9. Figure 3 contains a lot of information that is hardly mentioned in the text. I suggest that if a map is shown but not mentioned in the manuscript it can be moved to supplementary.

10. Please prepare the reader for that China and India is not included in section 3.2.1 and 3.2.2 - analysis of winter- and summer time DTR responses. write clearly that they will be analysed in a later section.

11. The first time you mention China and India as high aerosol emission regions are in the last paragraph of section 3.2.2. This is important information that should have been presented in the introduction.

Minor comments:

line 54: “This effect..” please rewrite this sentence as it is hard to read as it stands.

line 67: The linking of mediterranean drying is unclear if is presented as a cause or effect of the shift in emission. Please rewrite more clearly.

line 75: “these simulations include..”, do you mean “these” as the ones in this paper or the typically historical ones? Please rewrite more clearly.

line 97: Do you mean “current” as in present day? Please write more clearly.

Line 125: Standard deviations has the same unit as the original data. Add K throughout the text when standard deviations are presented.

line 138: The text states that atmospheric models misrepresent atmospheric boundary layer in the arctic, and line 141-142 states that the models of this paper have lower agreement in the Arctic than for other regions. Are these two statements related and how? The first statement relate to model/observation comparison, but the second to model/model comparison. Please make clearer in the text.

line 143: The text stated “T_min tends to be too cold in China and India”. Please state clearly if you are referring to the “T_min model mean”. It reads to me from the figure that model mean T_min in India is not much colder than CRU.

line 145: A specific point is made about USA having four models overestimating and four models underestimating T_max, as USA does not differ largely from the other regions in Figure 2a) for T_max this example is not needed. The inter-model spread is well presented in Figure 2a.

Line 158: to make it easier to read maybe write on the format “2.6 [1.5 to 3.7] K for CO2x2” instead of parentheses. Also the number 5 is missing in the perturbation representation for sulfate (SO4x5).

line 243: Please state clearly what figure you are referring to with this statement.

line 249-250: what are the units of the number in parenthesis?

line 271: should say cloud cover - not only cloud.

line 273: cloud amount or cloud cover? These are two different metrics.

line 275: “cloud increases” should say cloud amount/cover increases.

line 278: “strongest link” between aerosol-radiation and DTR? please rewrite more clearly what is linked and how.

line 280: “As cloud responses to the strong BC perturbations are so substantial, especially in India, the BC response in DTR stands out here.” please rewrite more clearly what you want to say with this sentence.

line 287-291: Divide this long sentence into smaller ones.

line 314: Please add citation for the “previous studies”.

line 324: “Moreover,..” please rewrite this sentence, as it is hard to read as it stands.

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