

***Interactive comment on* “Surface temperature response to regional Black Carbon emissions: Do location and magnitude matter?” by Maria Sand et al.**

Anonymous Referee #2

Received and published: 3 October 2019

This study explores the dependency of emissions-normalized radiative forcing and regional temperature response to the location and magnitude of black carbon emissions, using numerous simulations with the NorESM model. Given the struggles of past efforts to reliably quantify climate impacts from small emissions of short-lived species, this study provides very useful information that can be applied to inform future efforts, such as those of the AMAP expert group on short-lived climate forcers. I recommend publication of this article in ACP after the following minor issue are addressed.

Minor issues:

Abstract: I suggest including a statement on your findings of the ARTP approach, or

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namely that this approach (when used with DRF) rather accurately reproduces the fully-coupled temperature response of NorESM.

It is a bit surprising to me that the ITCZ can shift in fixed-SST simulations. If you are aware of other studies that have shown this behavior (especially any of the studies cited on lines 104-105), I suggest noting this.

It is mentioned that the BC-on-snow effect is included in NorESM, but is it included in the estimates of DRF? Please clarify and comment on any associated implications.

Section 2.2: More details are needed on the experimental set-up. Specifically: Were annually-repeating or annually-changing boundary conditions (GHGs, SSTs, etc) used in the runs, and from which years do the conditions represent? How long were the ERF fixed-SST runs and what time frame was used for the analysis? (line 93: "after the atmosphere is allowed to respond to the forcing" needs precision). The text indicates that the final 80 years of 100-year fully-coupled runs were analyzed. Is 20 years sufficient for equilibration to occur? Perhaps for BC it is, but a brief discussion on this should be added.

Please describe the baseline emissions that are used, e.g., which inventory are they from and what are the global BC emissions? I also suggest adding the annual emissions for each experiment/region to Table 1.

line 189: Sentence beginning "For South Asia..." - Does this South Asia response occur only with emissions from South Asia, or is it also seen with emissions from elsewhere that transport to South Asia?

Technical issues:

line 14: "a rate of" -> "a factor of"

line 17: "BC emitted in South Asia shows a different geographical pattern by changing..." - This sentence needs clarification. Geographical pattern of which variable(s)?

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line 75: "according different" -> "according to different"

line 84: "perturbed by 10 and 20" -> "perturbed by factors of 10 and 20"

line 128: "global BC burden": This is the <emissions-normalized> global BC burden, correct?

line 132: Please clarify the meaning of "emission-driven vs. concentration-driven BC"

line 144-145: Sentence beginning "For the Arctic..." is unclear. Please rework this.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-604>, 2019.

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