

***Interactive comment on* “Source attribution of Arctic aerosols and associated Arctic warming trend during 1980–2018” by Lili Ren et al.**

Anonymous Referee #3

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Review of “Source attribution of Arctic aerosols and associated Arctic warming trend during 1980-2018” by Ren et al.

This paper presents a modelling study of the impacts of changing SO₄ and BC on the Arctic atmospheric composition, radiative forcing, and temperature. Modelled and measured SO₄ and BC are presented in the Arctic from 1980-2018 at a handful of surface measurement sites. A tagged version of CAM5 is used to quantify the source contributions from different continental geographic regions to the Arctic BC and SO₄ concentrations both at the surface and in the vertical column. The paper present interesting results that are important for understanding the rapidly warming Arctic. The authors conclude that about 20% of Arctic warming can be attributed to the combination of BC and SO₄. I suggest only the following minor revisions below before publishing:

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lines 130-131: is there a primary reference for CAM5 and CESM that you can reference here?

lines 143-144: what is the source for the specified sea surface temperatures, sea ice concentrations, etc?

lines 209-210: was the modelled precipitation compared to measured precipitation? Was wet deposition of model validated against measurements?

Fig 5/line 241: it needs to be clarified that Fig 5 is the model average in the Arctic (>66.5°N).

line 252: was that rise in BC seen in the observations? e.g., consistent with BC seen at Alert?

line 263: “in the Arctic” ... and Russia?

line 316: is the effect of BC deposition on snow/reduction of albedo included in this? I think not because that effect is discussed later, but could clarify here that this value is just for atmospheric BC effect.

Section 5/line 400: Can you add some discussion as to how the model bias affects your conclusions? E.g. would your estimates of SO₄ and BC temperature impacts be greater or lesser if the model were corrected to accurately reflect the measurements?

Data availability: please add where the Arctic BC & SO₄ measurements can be found in this section (e.g., EBAS database link).

Figs 1-2, and 5-7: please make sure the regional colours are consistent in all of these plots. e.g., colour X for RBU, colour Y for EUR, etc, in all 5 figures the same.

Fig 3 (4): Clarify in the caption that the black is from measurements, and the blue and green are modelled. E.g., “*Measured* seasonal means are denoted by...”. “Stacked contours represent the *modelled* Arctic...”

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Fig 3: why is Barrow not shown? Fig 4: why is St Nord not shown? Fig 5: specify that this is the Arctic ($>66.5^{\circ}\text{N}$) average. As mentioned above, use the same regional colour scheme here as in Fig 1(a) & Fig 2. Fig 6 & 7: match the regional colours to Fig 5.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-3>, 2020.

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