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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #3

Received and published: 20 March 2020

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:

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..."

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°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.

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