

Interactive comment on “The importance of the representation of air pollution emissions for the modeled distribution and radiative effects of black carbon in the Arctic” by Jacob Schacht et al.

Anonymous Referee #1

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This study concerns modeling black carbon (BC) aerosols in the Arctic using the new version of the ECHAM-HAM aerosol model. Simulations of BC is compared with a comprehensive dataset of observations from surface stations and flight campaigns in the Arctic and mid latitudes. The authors run the model with four different emission datasets. All datasets are considered ‘present-day’, but there are substantial differences in the resulting BC burden and radiative forcing due to differences in the temporal representation of bio mass burning and the chosen emission year for anthropogenic emissions (2005 vs. 2017). This is an important finding. The paper is well-written and clear, and I recommend the manuscript for publication. I have a few minor comments below that I wish the authors could address.

In the introduction the authors present their study in a nice and clear way. Since the study concerns the representation of emissions; could you write a few more sentences on the other studies that have looked at the importance of emissions in representing BC in the Arctic?

L12, page 5, L18, page 6 and L15, page 17: I am a bit puzzled by the authors claiming that the Russian BC emissions from Huang et al (2015) is 'the best source available' and 'the best estimate of global emissions' just because it is a newer estimate compared to e.g. the ECLIPSE data set. The Huang et al chose an emission factor of 2.27 g/m³ in flaring compared to 1.6 g/m³ in ECLIPSE. In the paper, Huang et al admits their value is probably on the high end, and that there are no measurements in Russia confirming such high value being a representative average. It might be the case that the emissions are that high, but we do not know, and given the large uncertainties in estimating BC emissions from flaring, it is hard to say which data set is 'the best'. I am not suggesting that the authors should not use this data set as their base line, but I miss a discussion about uncertainties in the data sets and not just claim that one data set is the best.

L25-28, page 6: I am not sure if I understand this sentence? Contributing to layers?

L28, page 11: isn't also the difference because Zeppelin station is located on the mountain while the New Ålesund station is a ~0 m altitude?

Figure 9: I like this figure, but it is possible to make the circles a bit bigger?

How did you compare the flight campaigns data with your model data in time?

L14, page 18: Can you add the numbers?

L30, page 18: (if possible) Is there any improvement(s) in the parameterization in the new model version you can highlight, that has led to better seasonality and vertical distribution of Arctic BC? I understand this is outside the scope of the study, but it would be interesting to know for other modelers if the information is available.

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