The manuscript by Stohl et al. presents a sensitivity study on black carbon where authors try to solve the BC modeled underestimation by more detailed description of emissions. This is very important topic, since lots of models are struggling with BC underestimation in high latitudes, especially in winter and early spring, which, in turn, influence the radiation balance calculations.

To my opinion, the goal to "only
explore the sensitivity of Arctic BC to changes in the emission treatment" is achieved. Manuscript is well structured and written.

However, I would like to clarify points mentioned below.

p. 9568, line 13
You say that "In March, flaring even accounts for 52 % of all Arctic BC near the surface.
" What is the seasonality in gas flaring contribution to Arctic? Those plots, together with footprints (for case studies 3.3.2) will help for better understanding the modeled peaks.

p.9569, line 24
Meinander at al. (Atmos. Chem. Phys., 13, 3793–3810, 2013) "Spectral albedo of seasonal snow during intensive melt period at Sodankyla , beyond the Arctic Circle" is an interesting work, which might be refereed to.

p. 9570, line 3
Dou et al. (Atmos. Chem. Phys., 12, 7995–8007, 2012) mentioned model underestimating BC concentrations in the middle and lower troposphere.
They suggested to run the model for the case of possibly lowest number of forest fires.

p.9570, line 8
there are opposite opinions on the role of wet scavenging in BC underestimation. Liu et al. (Geosci. Model Dev., 5, 709–739, 2012) say that " The model still underestimates observed BC median mixing ratios in the Arctic
in spring, which suggests a model bias of wet scavenging for the accumulation mode aerosol and/or underestimated local
emissions in the model during the spring season.

However, Heinola et al. (Atmos. Chem. Phys., 13, 4033–4055, 2013) studied the reason for the BC underestimation in REMO-HAM by further examination of the precipitation data from both measurements and model and showed that there is no correlation between REMO's excessive precipitation and BC underestimation. Based on the case studies, Heinola et al. (2013), concluded that the excessive wet removal is not the main cause of the low black carbon concentration output.

p.9573, line 15 (cont. from point p. 9568, line 13)
please, write a bit more about the gas flaring database (temporal, spatial resolution). Do you operate with annual numbers only? How could you then estimate the contribution to Arctic in March? Using the annual average and transport model? If flaring monthly data available, would be interesting to see the annual variability

p.9574, line 10
In the case study there is a class "biomass burning". Which emissions does it include? Is it combination

of agricultural and open biomass burning classes? What is the vertical structure for that class?

p.9575, line 7
according to figures 8 and 9, gas flaring contribution to BC is much less than 80%. Is that because of the changes in contributions of BC components on the way to the recipient? Please, explain

p.9583, line 2
How strong (in numbers) is that increase? Would be interesting to see the difference (yearly-daily) maps

p.9585, line 25
I personally do not see the reason and possibility to compare the cleaned-for-biomass-burning measurement data with modeled (including biomass burning component) data. Excellent that you compared the model with "not-cleaned" data. That comparison should be on Figure 8.

p.9585, line 27
"by" instead of "bye"

p.9586, line 21
It is not only that "the model fails to capture March peak". There is an opposite trend in BC between modeled and measured values in January-April and no explanation to it.

p.9587, line 10
I disagree that it makes sense to verify model on the measured dataset, which includes inter-annual variation (here : not controlled - varied from year to year - biomass burning). It might bring the extra computation costs, but for the comparison with measured data the same period should be modeled.

p.9587, line 20
I disagree with the statement "quite well". There are lots of disagreements which are not enough discussed and explained.
It would be interesting to see the difference between different model runs:
- annual domestic combustion vs daily resolved
- no flaring vs flaring included
and comparison to the measured BC. In that case, the model enhancement will be seen more clearly

p.9588, line13
Is there a seasonality in flaring activity, or this is mainly the vertical structure of the atmosphere and transport paths, which result in enhanced flaring component in winter and early spring?

p.9588
would be interesting to see the footprints for "low" and "high" BC episodes

Figures:
Fig. 1. Short-cuts from figure titles (e.g. Ene, Ind, ets.) should be in the capture.
Fig. 7. Suggest to keep the same scale for x-axis (for easier comparison)
In current version, fonts for titles and colorbars are not easy to read