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Comment on acp-2021-341

Anonymous Referee #3

Referee comment on "Overview: Recent advances in the understanding of the northern Eurasian environments and of the urban air quality in China – a Pan-Eurasian Experiment (PEEX) programme perspective" by Hanna K. Lappalainen et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-341-RC3>, 2021

This long review paper present the research progress of Pan Eurasian Experiment (PEEX) program, as well as that of urban air quality in China. It is an extremely comprehensive summary paper that includes the land ecosystem processes, thawing permafrost, ecosystem structural change, atmospheric composition and chemistry, urban air quality in megacities, weather and atmospheric circulation, changing water systems, snow, sea ice and ocean sediments, marine ecology, lake and rivers, anthropogenic and environmental impact on society, and natural hazards. Given its wide scope and my limited expertise, I focused mainly on the air quality part. In general, the review appropriately summarized the relevant work of PEEX, and it is well organized and presented. I only have some minor concerns. While it stressed the PEEX, however, some more information could be provided for further explanation of changed air quality in mega cities. Relatively long-term trends in atmospheric composition should also be provided. Details follow

1. Section Northern Eurasian carbon monoxide (from line 566). Why was the CO elevated? As it is an indicator of energy efficiency, does it mean the energy efficiency went down in recent years?

2. Section Northern Eurasian Ozone (from Line 576). This paragraph stated the important chemical species of O₃ formation in different regions. I would suggest the authors collect more information and provide a relatively long-term trend in O₃ concentration in Northern Eurasia. Moreover, the driving forces of O₃ change should also be analyzed.

3. Section Black carbon and dust in the atmosphere and snow (from line 668). Similarly, could you reveal the long-term change of black carbon in Arctic and Northern Europe/Asia, and provide the main reasons for the changes.

4. Section Air quality in China-recent observations (from line 846). There are a lot of studies stressing the changed air quality (i.e., reduced PM2.5 and increased O3) since 2013. However, very limited papers were selected in the review. The authors need to explain their strategy in literature review. Moreover, the reasons for the air quality change should also be well presented. For example, the implementation of national plan of air pollution control is considered to be the most important reasons for the improved air quality. It should be reviewed and presented here.

5. The same section as Question 3. Why include only the NPF studies conducted at SORPES in YRD region? How about studies in other regions or sites? Is it because of the limited scope of PEEX?

6. Section anthropogenic emissions and environmental pollution in Russia (from 916). Given the different development stages and air pollution control plans between China and Russia, it would be interesting to compare the long-term trends in emissions and air quality for the two countries.

7. Some language errors need to be corrected. Line 501, section 3.1.1 or section 2.1.1? You don't need to give the full name of NPF as it appeared earlier.