

Interactive comment on “Responses of Arctic Black Carbon and Surface Temperature to Multi-Region Emission Reductions: an HTAP2 Ensemble Modeling Study” by Na Zhao et al.

Anonymous Referee #1

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The manuscript by Zhao et al. analyzed model simulation results from the 2nd phase of The Task Force Hemispheric Transport of Air Pollution (HTAP2). Six global models were chosen and model ensemble results are used in the analysis. The contributions of 20% emission reductions from six source regions to the Arctic region are focused, including surface concentrations, vertical profiles, and temperature response. The focus on Arctic based on the HTAP international initiative is a useful addition to AMAP. Overall, this paper is clearly structured with methodology sound and generally well written. However, the following comments should be addressed before the acceptance of the manuscript.

C1

Major comments: 1. Abstract: The abstract is not very clearly written. Line 35: The abbreviation “EAS” should be deleted. Are the percentages monthly contributions? Line 36: “Russia Belarus Ukraine” is better changed to Russia/Belarus/Ukraine. Line 38-39: It is not clear how different transport pathways affect the vertical profiles. Overall, the abstract is suggested to be more informative.

2. Line 281 – 282 shows higher BC concentrations in summer than in winter. While in Section 3.3.1 (Line 300 - 301), source region contributions to BC showed higher concentrations in winter. This seems contradictory to me and please explain in details.

3. Line 419 – 425: In Figure 6, it seems that the contribution from East Asia to BC at different latitudes remained almost constant while that from Europe decreased obviously from lower latitudes to the Arctic pole. Please double check and make explanations when applicable.

Other comments: 1. Section 2.1: What’s the data source of European emissions?

2. Figure 1: the unit of Figure 1 doesn’t show correctly. The labels of (a) – (g) are missing in the figure.

3. Table 1: The 20% emission reductions in January are missing in the table.

4. Line 142: change “indicated” to “showed”

5. Line 158: add “spatial” in front of “distribution”

6. Line 161- 162: Please state why the six models are chosen since more models have been used in HTAP

7. Line 163: change “of the” to “from”

8. Line 249: change “temporal” to “monthly”

9. Line 254: Stohl et al., 2013 also showed that appropriate temporal allocation of the residential emissions can improve the model simulation results.

C2

10. Line 269 – 270: More discussions on the performance of model ensemble results should be added.
11. Line 282-283: It is hard to see “BC concentrations over the polar sea ice region in winter were much higher than that in summer.” from the contours in Figure 2.
12. Line 328-331: Are these values annual average or seasonal average?
13. Line 332: The sentence is suggested to rephrase as “The response of Arctic near-surface BC concentration. . . .”
14. Line 337: Do you mean “at low altitudes”? And what altitudes?
15. Line 359: delete “low”
16. Line 431: change “concentrations” to “profiles”
17. Line 446: “section 3.3” may be wrong
18. Line 450: It is not clearly what does lower layer mean here
19. Line 463-465: It is not clearly stated about the difference of temperature response between EUR and SAS.
20. Line 485-486: This sentence is misleading. Do you mean the Arctic temperature response was more sensitive than the global temperature response?

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