

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-42

Anonymous Referee #2

Referee comment on "Long-range transport of Asian dust to the Arctic: identification of transport pathways, evolution of aerosol optical properties, and impact assessment on surface albedo changes" by Xiaoxi Zhao et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-42-RC2>, 2022

This manuscript presents an interesting study to reveal the transport pathway of wind-blown dust from East Asia to the Arctic, and evaluate snow surface albedo change due dust and elemental carbon. The manuscript focused on an important topic as it's necessary to understand how the rest of the world affect the Arctic due to its vulnerable environment and ecosystem. The authors applied multiple tools including the trajectory modeling, reanalysis data, and several observational database to investigated dust events during 2011-2015, with sufficient details demonstrated and in-depth discussions made. The manuscript presented a very interesting integrated data analysis with observations from different platforms but focused on one same event. In general the manuscript is well organized with solid method and clear description of the analysis and conclusions. Therefore I would recommend this manuscript to be accepted with a few minor revisions, if the following comments could be properly addressed.

Comment#1. Fresh dust particles will gradually go through aging process during the long-range transport, which may result in a different optical property of aged dust particles. Therefore I would recommend to include a brief discussion regarding how this may affect the conclusion about dust impact on snow albedo.

Comment#2. line98-102. These two sentences have the same meaning as aerosol loading is surely equivalent to the instantaneous forcing. Therefore I would recommend remove either one to be concise.

Comment#3. line102. "the deposition of dust ... for almost all of the bottom of ... forcing" unclear description, please consider rephrase it.

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Comment#4. line108. "dust from China" Part of Gobi desert was outside China, I would recommend to mention dust from East Asia or dust from Taklamakan and Gobi deserts.

Comment#5. sec2.1. Is there any judgement why these two sites are selected but not other sites?

Comment#6. line197. "Cma" should be "CMA"

Comment#7. sec3.1. Dust in East Asia has shown a significant decreasing trend during the past decade, so is this study period 2011-2015 representative for this study?

Comment#8. "Shaanxi" is this a typo?

Comment#9. line227. Please explain why the forward trajectory were computed at three specific height (500, 1000, 1500m)?

Comment#10. Sec3.2. It is necessary to briefly mention that the air mass traveling from desert carry along dust particles will be discussed later in sec3.5.

Comment#11. line301. The Barrow observation site is at ground surface, please explain why configure the backward trajectory at 6km?

Comment#12. lin468-470. Is it possible the AOD change was due to variations in an existing source (e.g., anthropogenic emission), rather than due to the mixing of dust and other particles?

Comment#13. 523-525. Particles in snow should be cumulative increasing through deposition even airborne concentration is decreasing, please briefly explain the judgement for the ratio used in this section.