

## ***Interactive comment on “Snow albedo reduction in seasonal snow due to anthropogenic dust and carbonaceous aerosols across northern China” by Xin Wang et al.***

**Anonymous Referee #1**

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This paper uses snow sample observations across northern China in January 2014 and aerosol radiation models to examine the reduction of snow albedo due to black carbon, organic carbon and anthropogenic dust. The study suggests different contributions to the snow albedo reductions from these aerosols and suggests that biomass burning may be a major contributor at most snow sampling sites. It also evaluates the model simulations based on the observations. In general, this paper provides useful information, particularly the different performance in snow albedo reduction by three types of aerosols. However, there are still a few limitations. The small sample volume observed over short period at limited sites could make the results questionable. At least discussions about the uncertainties and potential issues in this study are neces-

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sary. Corresponding to the limited data, reliable or strong quantitative conclusion is hard to obtain. The authors could provide more quantitative results and discuss the reliability of the findings in the study.

Comments:

(1) Are the snow samples fresh or aged snow?

(2) Snow albedo reduction due to these kinds of aerosols is well known, more quantitative results are needed and more valuable, which could be summarized in the abstract. At current version, it is a little hard for me to summarize the findings I can learn from this paper.

(3) Page 3, line 11-14, why is Ginoux et al. 2010 cited two times in one sentence (begin and end). This is repeated description and one should be deleted.

(4) Page 4, line 4-5, you use “larger” and “more intense” in the sentence, but I did not see any comparison descriptions around this sentence. What you are comparing?

(5) Page 4, Line 12-13, why is Light et al. 1998 cited two times in one sentence (begin and end). This is repeated description and one should be deleted.

(6) Page 5, line 15-24, you mentioned several campaigns for snow collection. What are the differences or similarities for the findings among them? Also, it shows that there is a snow campaign over the examined region in 2010 carried out by Huang et al. 2011. Why do not you also include the observation from this campaign so that you have enough data samples and you can also compare the differences/similarities in two winters?

(7) Page 7, line 1-3, is this data criteria enough to prevent contamination? And why do you include site 101 if it does not fit your data criteria?

(8) Page 7, line 5-10, what is the uncertainty introduced due to your visual inspection and data processing method?

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- (9)Page 8, line 1-9, what do some variables (not all) stand for?, such as Ss?
- (10)Page 8, line 17, why do not you introduce Fe when iron is first used in paper?
- (11)Page 9, line 4-6, How do you know Microtops II is reliable, or more reliable than CE318?
- (12)Page 9, Line 22, do you mean “in 2014”?
- (13)Page 10, line 4-5 and line 19-20, why do the observations and models calculate the albedo at different height (1 m above snow vs at surface)? Also, the downwelling solar radiation in the real sky includes diffuse radiation. How does the model consider the diffuse radiation (such as the contribution from aerosols and clouds in the sky)?
- (14)Page 11, line 15, the symbol should be  $\mu$ , please explain its meaning.
- (15)Page 15, line 7-10, both AOD from MODIS and ground are retrieved, please describe clearly.
- (16)Page 15, line 16, colder -> cold
- (17)Page 15, line 23, This sentence is not complete. I believe what you want to say is “..., which with ...”
- (18)Page 16, line 2-4, “Because less snow fell during the 2014 snow survey period, the surface snow grain radius varied considerably from 0.07 to 1.3 mm.”. First, I do not understand this causal relationship, please clarify. Second, what does it compare when using ‘less’, the same period of other years or other locations?
- (19)Page 16, line 19-24, why the variations (BC and snow spatial distribution) you found were much higher than the findings from other studies?
- (20)Page 17, line 1-8, I cannot catch the main points you would like to deliver here.
- (21)Page 17, Figure 5, the sample volume is too small. How reliable are the relationships found here?

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- (22)Page 17, line 22-24, I do not understand from Figure 6 how you got this range in OC/BC ratio.
- (23)Page 18, line 1-16, it is hard to conclude due to limited data and sites.
- (24)Page 18, line 18-22. How did you get the observation regarding land-cover type when the land is covered by snow?
- (25)Page 19, Line 17-20, why is Wang et al. 2015 cited two times in one sentence (begin and end). This is repeated description and one should be deleted.

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