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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of light-absorbing particles on snow albedo darkening and associated radiative forcing over High Mountain Asia: High resolution WRF-Chem modeling and new satellite observations" *by* Chandan Sarangi et al.

Anonymous Referee #1

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Based on model simulations and recent satellite observations, the authors examine the skill of high resolution WRF on the impact of snow albedo darkening on radiative forcing. They evaluate the model simulation with various obsevations. The authors also discussed the benefit of high resolution model, by comparing with coarser resolution model simulation, in aerosol and snowpack distribution over HMA. Lastly, spatial/temporal variation of radiative response are also discussed. This is well organized and clearly written manuscript. I would like to suggest this work for publication subject

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Discussion paper

to a revision to address following concerns.

1) Snow albedo: How was snow albedo estimated when snow cover fraction is less than 1? For example, is albedo difference between WRF-HR and WRF-CR (Fig. 5) due to snow cover fraction or aerosol concentration (LAP)? If snow cover fraction is an important factor, can model snow albedo be compared with STC-MODDRFS?

2) Season: Winter and summer are defined as DJF and AMJ in main text while NDJF and MAMJ are used in supplementary material. Spring is more appropriate for AMJ as well as MAMJ.

3) Line 336: 16:00LT → 14:00LT

4) Validation of LAP (Lines362-370): What would be the effect of using LAP data observed in different year and different glaciers?

5) Lines 416-418: It seems obvious, but any thought why model overestimate snow cover fraction in DJF and underestimate in AMJ? Does model simulate reasonable surface temperature and precipitation over the region?

6) Line 461: Is “and 4F” typo?

7) Lines 498-503: Hard to read. Are “13” and “14” day of the month?

8) Lines 509-512: It’s hard to follow the argument. Would you get the same conclusion if a different grid is used?

9) Line 515: Fig. 4 → Fig. 5

10) Fig. 4 has a wrong caption

11) Fig. 5 has a wrong caption

12) Fig. 7A: What cause the high LAP in the south of Taklamakan desert?

13) Spatial pattern of LAP(Fig. 7) doesn’t seem to highly correlated with albedo (Fig. 5) distribution.

14) AOD is higher in CR, but LAP is higher in HR. Yet, albedo is higher in HR in general. It is probably due to higher snow cover (See also my comment #1) and more snowfall (Lines 654-657) in HR. If so, additional simulation (with similar climatology) may be required to discuss the impact of snow darkening.

15) Fig. 9C & Lines 866-868: What cause the bias? Does model has local source of dust over HMA?

16) Same emission databases on relatively coarse resolution are used for both simulations. How about actual emission of dust and BC? Are they comparable in HR and CR?

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