Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-476-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Black carbon-induced snow albedo reduction over the Tibetan Plateau: Uncertainties from snow grain shape and aerosol-snow mixing state based on an updated SNICAR model" *by* Cenlin He et al.

Anonymous Referee #1

Received and published: 18 June 2018

General Comments:

The manuscript investigates the effects of snow grain shape and BC-snow mixing sates on the snow albedo and surface radiative forcing over the Tibetan Plateau. To achieve the goal, the authors improve the SNICAR model parameterization by introducing non-spherical snow grain shape and BC-snow mixing states based on their previous work, and the parameterization is systematically compared with observations of both pure and polluted snow. Furthermore, the BC observation in the TP is well reviewed, and the uncertainties related to the snow shape and BC-snow mixing are studied. The

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Discussion paper

topic is interesting and important for snow albedo studies, and the manuscript is well organized and written. It can be published on ACP after minor revision.

Specific Comments:

Title: The title of the manuscript is not very clear, and the main focus of the paper cannot be clearly obtained through the title. The snow grain shape effects are not related to the BC.

Line 278-287: There are significant uncertainties on BC MAC. The difference between He et al. (2017b) and Bond and Bergstrom (2006) can be simply explained by natural variations. However, the authors made unrealistic adjustment on BC density and size. Is this really necessary, and how would a different MAC in the model influence the final results?

Table 1: The authors made some assumptions to evaluate the new parameterization, and Table 1 list most parameters for comparison with observations. The detailed assumptions should be indicated in the manuscript, e.g., which parameters are assumed, and which parameters are observed. Meanwhile, are the parameters adjusted to match the observations, or realistic parameters that are picked independent of observations lead to the great agreement.

Figure 6: It seems that most observations give an albedo slightly less than 1 around 400nm, whereas most model results overestimate the albedo. Is there any explanation?

Figure 8: The effects on the snow albedo and surface radiative effects are illustrated in the figure. The two variables are closely related, and, from the figure, it seems that there is a strong correlation between them.

The manuscripts show significant influences of snow shape and BC-snow mixing on surface albedo. During the discussion, the albedo reductions, which are relatively small, are used to evaluate the influence. The surface albedos under different circum-

stances can directly compared to indicate the influences. Furthermore, considering the variations on the models and input parameters, the uncertainties on the albedo may be quite significant, and this may greatly influence the conclusions.

The manuscript includes a lot of information and leads to a few quite important conclusions. The conclusion section seems simply a list of the work done and conclusions obtained. A lot of details are included in the section, but it is not well organized. It should definitely be re-organized to better summary the focus of the manuscript.

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