Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-1059-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Deposition of light-absorbing particles in glacier snow of the Sunderdhunga Valley, the southern forefront of Central Himalaya" *by* Jonas Svensson et al.

Anonymous Referee #1

Received and published: 24 November 2020

Remarks to the Authors

Review of "Deposition of light-absorbing particles in glacier snow of the Sunderdhunga Valley, the southern forefront of Central Himalaya" by Jonas Svensson et al.

Manuscript Number: acp-2020-1059

General comments: This paper reports in-situ data for mass concentrations of light-absorbing particles (LAP) in snow such as black carbon, organic carbon, and dust collected at the Sunderdhunga Valley, the southern forefront of Central Himalaya dur-

Printer-friendly version

Discussion paper

ing in October 2016. By comparing the data with in-situ surface meteorological data collected also by the authors, mechanisms that controlled the vertical redistribution of black carbon and dust within the near-surface snow are discussed. The methods to obtain these data are reliable. So, the data themselves are valuable for the community: e.g., the data tell us the current mass concentrations of LAPs within snow in the study area; and the data can be used for evaluation of chemical transport models. However, this reviewer would like to suggest that the authors should provide clear answers to the following major concerns before considering its publication:

1. The discussion on the redistribution of LAPs in "melt layers" is not enough to me. At least, the effects of dry deposition should be examined before considering the possibility of the lateral transport of LAPs in the near-surface snow.

2. What is the main factor that induced higher concentration of MD (mineral dust) in the "melt layers"?

Specific comments

P. 1, L. 20: What do the authors mean by "scheme"? "Scheme" is often related to a sub-program of a numerical model. Therefore, using "state" may be better here.

P. 1, L. 28: "similarities": Can the authors describe quantitatively?

P. 3, L. 43: "scheme": same as above.

P. 3, L. 57: "ppb" -> "ppbw" or "ppbv"?

P. 3, L. 64 $\sim$ 65: Observations are ground truth, so that it is not necessary for observations to be supported by modelling studies. On the other hand, observations can support the reliabilities of numerical models. Please reformulate this sentence.

P. 5, L. 109: "hard layer": The "hardness" considered here may depend on the tools that the authors used to dig the pits. What kind of tools did the authors use to dig?

P. 5, L. 115 ∼ 117: Please show a figure showing profiles for snow density at these 2016 pits. Then, explain/indicate the layers where the dark, white, and gray snows can be found.

P. 5, L. 116 ∼ 117: “a relatively thin (on the order of centimeters) very dark layer was separated by white snow above and more grey appearing snow below.”: Is this sentence OK? Please check it again.

P. 5, L. 118: Strictly speaking, “melt layer” should be recognized from its grain shape. See the international snow classification method for more detail (Fierz et al., 200). Consider using another word instead of “melt layer” throughout the manuscript.

P. 5, L. 132: Please indicate the position and altitude of the AWS.

Figure 1: It is better to put this figure in another figure showing the entire High Mountain Asia and India. At least, latitude and longitude should be indicated in the present figure. An explanation of dashed lines and accompanied numbers is also needed.

P. 5, L. 134 ∼ 135: “up” -> “upward”, “down” -> “downward”

P. 5, L. 135 ∼ 136: Please indicate sensor types and manufactures not only for the snow depth sensor but also for all the instruments.

P. 5, L. 140 ∼ 141: “the incoming SW radiation is greater than outgoing SW radiation”: This situation indicates the normal situation; the sentence should be revised.

P. 5, L. 142: The minimum snow albedo of 0.2 sounds extremely low to me. Please justify the value.

P. 6, L. 145: “100 kg m-3”: Please justify the value.

P. 6, L. 155: Can the authors briefly explain the characteristics of the EUSAAR_2 protocol? Kuchiki et al. (2015) used the Interagency Monitoring of Protected Visual Environments (IMPROVE) thermal evolution protocol (Chow et al., 2001) to analyze snow samples with the Sunset OCEC analyzer. What is the key difference between

the EUSAAR_2 protocol and the IMPROVE protocol?

Figure 2: In my opinion, ECacc and SWEacc should be set in x-axis and y-axis, respectively. I believe such a figure may be intuitive for readers. Also, please consider changing colors for dashed lines and dashed-dotted lines; at present, it is a bit difficult to distinguish them from each other.

P. 7, L. 208 $\sim$ 209: The process to obtain the "suitable constants" (explained in the supplementary material) is not easy to follow. Because I assume this part may be an important part of this study, I recommend including this part in the main text. Also, adding figures showing scatter plots for different EC*constants may be nice.

P. 8, L. 245 $\sim$ 248: The assumption made here and the following discussion in this paragraph suggest that the authors consider most of the light-absorbing particles deposited through the wet deposition process in the study area. How about the dry deposition? Before suggesting the lateral transport (P. 9, L. 276 $\sim$ 278), the authors should consider the effects of dry deposition.

Figure 4: Like Figure 2, please consider setting equivalent precipitation and relative depth in x-axis and y-axis, respectively.

P. 10, L. 298 $\sim$ 307: So, what is the reason for the higher MD (mineral dust) fraction in the "melt layers"? Detailed discussion is needed.

P. 12, L. 376: "summers of 2015 and 2016": Do the authors mean that the melt layer formed as a result of the merge of the 2015 and 2016 summer melt layers? This point may not be explained in the Results and discussion section. Please explain more in detail at an appropriate place in the text.

References Chow, J. C., J. G. Watson, D. Crow, D. H. Lowenthal, and T. Merrifield (2001), Comparison of IMPROVE and NIOSH carbon measurements, Aerosol Sci. Technol., 34(1), 23–34.

Fierz, C., Armstrong, R. L., Durand, Y., Etchevers, P., Greene, E., McClung, D. M.,

Nishimura, K., Satyawali, P. K., and Sokratov, S. A.: The International Classification for Seasonal Snow on the Ground, IHP-VII Technical Documents in Hydrology N_83, IACS Contribution N_1, UNESCO-IHP, Paris, viii, 80 pp., 2009.

Kuchiki, K., T. Aoki, M. Niwano, S. Matoba, Y. Kodama, and K. Adachi, 2015: Elemental carbon, organic carbon, and dust concentrations in snow measured with thermal optical method and filter weighing: variations during 2007-2013 winters in Sapporo, Japan, J. Geophys. Res. Atmos., 120, 868-882, https://doi.org/10.1002/2014JD022144.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1059, 2020.

Printer-friendly version

Discussion paper