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Interactive comment on "Identification of blowing snow particles in images from a multi-angle snowflake camera" *by* Mathieu Schaer et al.

Anonymous Referee #2

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This article introduces a new method to distinguish automatically between blowing snow particles and precipitation particles obtained with MASC. Authors selected four descriptors carefully and classified the images obtained in Davos and Antarctica with utilizing the two components GMM. Then it showed the good performance. Cohen's Kappa score achieved 98.8%; the score of 75% is known to be satisfactory reliable. Further, the mixture of blowing snow and solid precipitation are also discussed. Since the classification of blowing snow and solid precipitation is troublesome, particularly in the strong wind area like in Antarctica. Subjects are topics of conversation on these days and the idea described in this manuscript is also very attractive. Thus, the attitude should be highly evaluated. However, throughout the manuscript, questions arose as shown below. These should be satisfactorily addressed before the paper

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Discussion paper

can be accepted for the publication. Perhaps it is not crucial, but I am a bit anxious that advanced knowledge of statistics are required to follow the whole contents of this manuscript. In fact, classification procedures are explained considerably careful and I have also learned a bit with the textbook. However, it was still far from satisfactory to follow all of them. They are highly professional and large number of technical terms appears. I appreciate very much if the authors kindly consider the readers who are not so familiar with statistics. Probably it is a good idea to add following two references, such as in the introduction part.. Naaim-Bouvet, F. et al., Detection of snowfall occurrence during blowing snow events using photoelectric sensors, CRST, 106, 11-22, 2014. Nishimura, K., and Nemoto, M., Blowing snow at Mizuho station, Antarctica, Philosophical Transactions of the Royal Soc. of London, A, 363 1647-1662, 2005. The former tried to measure the snowfall amount under the blowing snow condition and the latter showed the snow particle size distribution with SPC and mentions the possibility to detect snowfall. Page 2, Line 6: "The present study focuses on ..... more than 2m above ground." This means when the measurements height is getting lower or much higher, new criteria for classification should be set at each time? Page 2, Line 22: I wonder the resolution of 33.5 ïĄm is enough to detect the small particles? It is well known that as the position is getting higher, smaller particles will be dominant in the blowing snow. Although the minimum bin in Figure 12 looks 100 ïĄm, measurement in Antarctica indicates diameter less than 100 ïĄm shows the maximum even at the height of 10 cm (Nishimura, K., and Nemoto, M.: 2005). Page 2, Line 34: I am a bit anxious whether manually-built validation set is satisfactory accurate. Possible error included should be also discussed. Page 3, Line 13: Same questions listed above. Subsets of pure precipitation and pure blowing snow images were manually selected. I appreciate the authors' efforts very much, but is it perfect? Figure 1: Not only the pictures but also a schematic picture of MASC which shows the basic will be helpful. Page 4, Line 5: Explanations about the MASC should be done before "2. Data sets". Particularly, it should be mentioned here that images are captured when the motion of particles are detected in the field of vision. Otherwise, readers are not able to recognize

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the meaning of “MASC image frequency” and the importance as one of the descriptors. Figure 3: I don’t understand what do you mean by this figure, probably because I did not follow the procedure precisely. Yellow points shown in “Raw image” and “Median filter” do not corresponds to the blowing snow particles? Then, no particles are shown in the “Binary image”; that is blowing snow particles disappear in the final image. Is this correct? On the other hand, precipitation particles remain in the final image as shown in Figure 4? Figure 4: This figure looks similar to Figure B1. Are there any different meanings? Figure caption of B1 is much clearer than the one of Figure 4. Same explanation should be done in Figure 4 as well. Page 10, Equation (2): Notations of D, T andïĂăïĄ■ïĂăshould be definedïĂőïĂăI supposeïĂăïĂăïĄ■ïĂăis not the same as the one in equation (1). Figures 5, 6, 7, 8, 9 and 12; Please make the label of both axes much lager and clearly. It is hard to recognize what is specified respectively. Page 13, line 20: Perhaps/“850’000” should be expressed as “8.5x10ˆ4”. Page 13, line 24: Similar particle size distributions are found Nishimura and Nemoto (2005) as well. However, the measurements with SPC revealed that the population of smaller particles than 100 ïĄ■m shows the maximum. Page 13, line 18; In accordance with the procedures newly introduced in this manuscript, MASC images are classified and results are shown in Figures 9 and 10, and Table 3. Are they reasonable and are there any specific features derived with this analysis? Have you got any new findings? In other words, what sort of contributions you could achieve to the geophysical and cryospherical research field? Or, you would like to remain in just the introduction of the methodology? Figures 6 and 8: No explanations were found in the text. Further, in general, descriptions about the figure are rather brief both in figure captions and text. More detailed explanation is recommended, that will be help to deepen the understandings.

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