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Atmospheric Measurement Techniques Discussions

Interactive comment on "Analysis Algorithm for Sky Type and Ice Halo Recognition in All-Sky Images" *by* Sylke Boyd et al.

Anonymous Referee #1

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This paper describes an algorithm to infer the type of sky and the presence of halos produced by pristine ice crystals from all sky imagery. In my view, the algorithm is unique and innovative. The paper presents an evaluation of the algorithm for a limited dataset. Its application to more ARM TSI data would provide a very valuable dataset.

The paper is reasonably well written, although there are quite a few technical issues that are listed below. Also, the introduction needs to be improved, as the relevancy of halo detection is largely missing and many of the references are not the most relevant ones.

Below are my comments that need to be addressed in the revised paper before it can be accepted for publication.

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Discussion paper

Introduction

General: The introduction is missing one important motivation for detecting halos. One main reason why detection of halos is relevant is that the pristine crystals that produce them have scattering phase functions with less pronounced backscattering than those of the amorphous or roughened crystals that do not produce halos (Yang et al 2015). As crystal roughness or distortion increase, their phase functions are characterized by decreasing halo features (van Diedenhoven 2014) and decreasing asymmetry parameters (van Diedenhoven et al. 2014; Yang et al 2015). Ice particle surface roughening has a significant influence on the global cloud radiative effect (Yi et al. 2013). Some text along these lines, with the relevant references needs to be included in the introduction.

Page 2, lines 7 and 11: Replace Knobelspiesse et al., 2015 with Waliser et al. (2009).

Page 2, line 12: Here it is stated that "Cloud particle sizes can range from 0.1 microns to a few millimetres (Cziczo and Froyd, 2014)." I think few microns to a few millimetres (or even centimeters) is more realistic. Also, I suggest to replace the reference with Heymsfield et al. (2013).

Page 2, line 12: Replace the reference to Delene, 2011 with Heymsfield et al. (2013)

Line 15: add Hong et al. (2016) to the reference on lidar/radar.

Line 20: I suggest to replace all references here with Bailey and Hallet (2009); Baran (2009) and Yang et al (2015).

Line 21: It is not very clear what is meant with "observable symmetric scattering patterns", but it seems that "halo displays" may be more appropriate. Also note in the sentence that smooth crystal surfaces are needed for halos. Please add references to Um and McFarquhar (2015) and van Diedenhoven (2014)

Line 24: In reference to the "additional ice halo features" cite the book of Tape and Moilanen (2006).

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Line 26: Add “forward” before “scattering”

On line 27, discussing the corona, refer to Sassen (1991). Also a more realistic size for corona producing ice crystals is “a few microns”.

Line 31: The presentation at the Gordon Research Conference on Radiation and Climate in 2015 cannot be considered a published result, so please remove the reference. In any case, I thought this sentence was very confusing as I thought this was referencing to the results presented in this paper. I suggest to remove this part.

Line 32: The reference to Seefeldner is incorrect and should be Forster et al. 2017.

Section 1

Page 4: line 14: I suggest to replace “start the master table” with “train the algorithm”, as the master table is not introduced yet.

Section 2.1

Page 5, line 12: A value for pre-factor C_0 is given, but the X is not defined yet. I suggest to give a value for C_0 later.

Page 5: equation 3: Do the absolute values of the elements in x need to be similar so they are weighted equally? Please explain in the text.

Section 2.2

Page 5;, line 26: What are the units for BGR? Is that one byte?

Page 6: line 13: Add “to” between “and” and “then”.

Page 6 (and elsewhere): Use equation numbers for each equation and expressions throughout the paper.

Page 6: line 5, what is “B” here? In the previous it references to Blue, but the expression is used for all colors. Please clarify in the text.

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Page 6: line 7: Remove the brackets and make the text explaining alpha into a proper sentence.

Figure 2: Define RAI, TL, TR, BL, BR in caption.

Section 2.3

Page 7: line 6: What are the units of $I(s)$?

Page 7: line 12: Replace “A cloudy sky” with “An overcast sky”.

Page 7: line 19: Use italics for “s”

Figure 3 (and 6): Please add proper x-axis labels. There is an “s” in the corner. Please spell out “radial distance” and place in the center. I also suggest to add the labels to the bottom of the bottom figures and add a dotted line indicating the zero deviation.

Page 8: line 11: replace CLR with “clear”.

Page 8: line 16: It is noted that the “mechanism described in section 2.1” is used. Be explicit about the properties discussed here are inserted in X? Also, I suggest to provide the value of C_0 here.

Figure 4: Please add y-axis labels. AST in the caption should be ASD.

Figure 5: Black arrows are used to match the images to the timeline, but these arrows are not visible on the black indicating CS. I propose pointing the arrows of the top images to the top of the timeline plot, so that they are visible.

Page 9: line 30: It is mentioned that “if a radial sequence is found in one colour channel, it should be found in the same locations in all colour channels”. Should the angular difference between colors of the halo not be taken into account? The red part of the halo is closer to the sun.

Section 3

Page 11, line 23: Some caution is rightfully raised about the visual classification. Some

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more information on the method would be helpful to include in the text (here or above at the start of section 3). For example, who was doing the classifications? Is that one person, all of the authors, other people? Also, my guess is that the person (or persons?) evaluating the images are not doing this blindly, so they might already be biased towards the classification of the algorithm.

Page 13, line 3-4: For clarity add “in Table 6” after the “second set of numbers”. I suggest to remove the part “, which may be a little easier to interpret”.

Page 13: It might be good to discuss the results somewhat more in comparison to Forster et al. 2017.

References (please adjust the format to the one used in the manuscript)

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