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Atmospheric Measurement Techniques Discussions

Interactive comment on "Halo ratio from ground based all-sky imaging" *by* Paolo Dandini et al.

Anonymous Referee #2

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The manuscript describes an interesting approach to automated halo observations using an all-sky camera. Even more important, it includes an automated processing of the data to derive a halo ratio which could be used in further work to retrieve information about shape and size of ice crystals. There is a number of points, however, which need to be clarified before publication.

Major points:

- The term "scattering phase function" is misleading, as I already mentioned in the quick review. The scattering phase function a clearly defined single scattering property, in particular the probability of scattering into a certain direction. What the authors determine here is a normalised radiance distribution. In case of optically very thin clouds (tau«1, single scattering), the radiance distribution would be close to the scattering phase function if there was no additional molecular scattering. Please avoid the

term because it is misleading!

- After the two case studies, I am not sure if the brightness temperature fluctuation threshold provides any useful information. Nearly all shown data points are clearly above the threshold.It would be good to see examples where the values are actually below the threshold.

- Conclusions, page 12, line 26: Where do the numbers (20%) concerning smooth crystal fractions come from? I do not see any evidence in the manuscript, neither any reference. If there is no quantitative evidence, please remove the statement.

- How was the halo ratio determined from the images? Maybe I missed it, but it isn't clear to me if the average over the full circle around the transformed image center was taken, or if only a sector was used, or ... And how does the (admittedly small) angular error affect the halo ratio?

Minor points:

Page 2, line 20: This is not really a sentence and the level of detail could be reduced, since it is anyway not sufficient to understand the technique without having to read the referenced paper.

Page 3, line 23: "previous" findings are contrasted to more recent results. However, these two papers describe observations in completely different locations on the globe which might be one cause for differences.

Page 4, line 3: Since the reader might now be familiar with the details of image vignetting at this point in the text, this section might be moved after the "all-sky-camera" section.

Page 4, line 16: What are these "2.52%"? Fraction of the solid angle? Please define.

Page 4, line 21: I am not sure how many readers are still familiar with kbaud. One might use kbit/s instead.

Page 4, line 25: The shadow disk for the daytime camera is meant to reduce stray light. Isn't the same necessary for the night time camera? The moon is certainly six orders of magnitude darker than the sun, but the lunar halo is as well. Or in other words, the ratio of the brightness lunar halo / moon should be the same as the ratio solar halo / sun. The straylight problem should be the same during day and night.

Page 5, line 27: Could you provide the formula of the bi-cubic function and the order of magnitude of the deviation from the ideal camera model? From statements in the following section I infer that it was actually not used? If so, why mention it at all?

Page 6, line 8: I assume, the test image here was different from the one in the previous section which was used for the geometric calibration?

Page 7, line 16:Could you briefly (one sentence) explain what vignetting is and how it is caused?

Page 7, line 24: Explain acronym LOWESS

Page 7, line 27: with "the presence of a peak located roughly 8°" you mean that the maximum of the function is at 8° rather than at 0° where you would expect it?

Page 8, line 1: Could you please explain why the average between the original and the mirrored curve was used, rather than shifting the curve by 8°?

Figure 8, caption: This is confusing and contradicts the text: The caption says "stretched", while the curve is obviously shifted. The text on the other hand says "mirrored" rather than shifted.

Page 8, line 8: The purpose of the airmass correction is not clear to me. Is it to make the brightness distribution more "flat"?

Page 8, line 19: To assume single scattering the slant optical thickness has to be smaller than 1. For a viewing zenith angle of 70° the slant optical thickness would be about three times the vertical optical thickness, and thus the assumption of single

scattering would only be true for clouds with vertical optical thickness smaller than 0.3. I am sure many of the observed cirrus clouds had a larger optical thickness. Also, the vertically integrated Rayleigh optical thickness in the blue is about 0.2 which adds to the cirrus optical thickness. This once more confirms that you don't observe the scattering phase function but the sky radiance which is caused by cloud scattering plus molecular scattering.

Page 8, line 27: How was the threshold determined empirically? From "manually" deciding if an image is cloud/cloudless and looking at the corresponding fluctuation?

Page 9, line 8: With "irradiance due to the direct emission of cirrus corrected for the atmospheric attenuation" you actually mean after correction to brightness temperature assuming Stephan-Bolthmann? The large deviation from -38°C results from the fact that your broadband instrument integrates over water vapor absorption as well as the atmospheric window? At first glance I expected it to be closer to -38°C, but that would only be the case for a narrowband instrument measuring in the atmospheric window.

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