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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Intercomparison of snowfall estimates derived from the CloudSat Cloud Profiling Radar and the ground based weather radar network over Sweden" *by* L. Norin et al.

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**Response to Anonymous Referee #2**

We thank the referee for his/her constructive comments and suggestions that have led to clear improvements in the manuscript. Below, please find a point-by-point reply to the comments (reproduced in italics).

*The manuscript presents a quantitative assessment of snowfall estimation from two*



*observing systems: one based on a ground radar network over Sweden and the other based on a space-based profiling radar (CloudSat). Method of assessment is by statistical analysis and evaluation of each system with reference to the other. Unfortunately, there is no superior independent ground truth reference to evaluate each system's performance. To compensate for this natural limitation, the authors perform an extensive statistical analysis that overall leads to convincing and correct inferences and results. The conclusion that each system has problems with light or shallow snowfall identification has important implications since light snowfall is a common ocurrence, or that CloudSat profiling radar is insensitive to heavy snowfall, or that distance to radar station significantly impacts the quality of radar observations of snowfall. Based on these general strengths the manuscript would be important to the scientific community dealing with this very challenging problem and thus should be considered for publication.*

*A weakness of the manuscript that I think the authors can fix is poor English in some instances. Overall, the manuscript reads well, but here and there there are grammatical errors that need to be fixed.*

In the revised version, we have tried our best to improve the language in the manuscript. Several sentences have been rewritten.

*Another general weakness is that sometimes it is hard to understand the fact that the performance statistics, e.g., false alarm, hit rate, etc, are relative, but to which system are they relative to? The authors should make very clear when they describe these metrics, that for instance "false alarm" rate of ground-based radar (please specify!) is with respect to CloudSat and vice versa. Here, there is no "ground truth". Again, it is hard to find a better ground truth for snowfall rate than radar-based systems, but the authors need to emphasize this when they refer to performance metrics. Or, they should clarify this head-on.*

In the revised version, it is clearly mentioned which observing system is used as the reference when describing metrics. Hopefully this will avoid any confusion. We have

also emphasised the lack of ground truth.

*Also, I noticed that the authors refer to "clear"sky statistics. Do they mean "no-snow", the latter including cloudy and non-cloudy atmospheres?*

We do indeed mean no-snow. This has been clarified in the manuscript.

*Question/suggestion to the authors" Would it be possible to also include in the manuscript general meteorological conditions of the dataset? Surface temperature, relative humidity, etc? These are important since "cold snowfall" and "warmer" snowfall regimes for example have different responses - See the paper of "kongoli et al. 2015 in JGR, Atmospheres".*

Thanks for the useful reference. Following the reviewer's suggestion, we have added a histogram showing 2 m temperatures for all included CloudSat measurements in a supplement to the manuscript (also shown below). While performing a more detailed classification of snowfall with respect to temperature would be very interesting, we believe it is out of scope of the present manuscript. We are planning a separate detailed study to investigate various snowfall regimes and how their classification can benefit forecast applications.

*I would also have liked to see one or two cases of specific snowfall storms analyzed in more detail. That would have provided more depth and insight to the manuscript to make the points the authors rightfully make. Despite all this, the manuscript has publication merit and quality and therefoe is reccocmmended for publication.*

This is indeed a good point. To be able to accurately monitor snowfall storms is important for a high latitude country like Sweden. We are in fact currently in the process of establishing software architecture that would enable extraction and monitoring of extreme events such as convective snowbands (so-called lake-snow effect).

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Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8157, 2015.



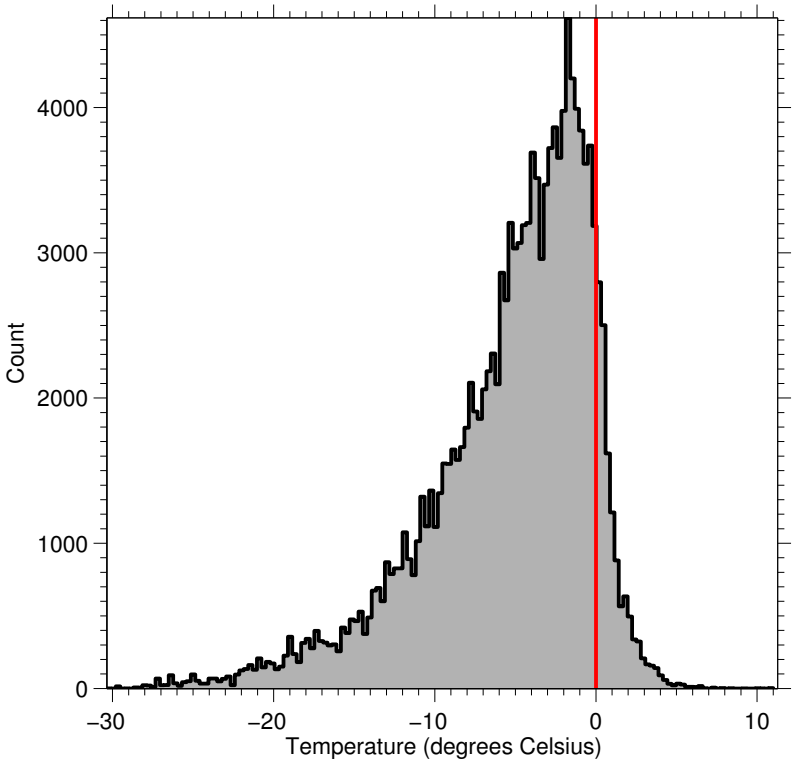


**Fig. 1.** Histogram showing the 2 m temperature corresponding to the CloudSat snowfall measurements