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The Cryosphere Discussions

Interactive comment on "Evaluation of the CloudSat surface snowfall product over Antarctica using ground-based precipitation radars" *by* Niels Souverijns et al.

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Dear Dr. Philip Marsh,

I have reviewed the manuscript "Evaluation of the CloudSat surface snowfall product over Antarctica using ground-based precipitation radars" by Niels Souverijns and colleagues, submitted for publication in The Cryosphere.

The paper explores various parameters of the CloudSat snowfall climatology proposed by Palerme et al., 2014, such as its temporal sampling rate and its spatial resolution. This climatology is evaluated by way of a comparison with observations from three

different ground micro-rain radars. It is also compared with ERA-Interim reanalysis, which is designated as a reference in regards with the simulated Antarctic snowfall. The authors conclude that the CloudSat snowfall climatology, at a resolution of 1^o latitude by 2^o longitude, represents well the snowfall climatology of each MRR site and is more effective than ERA-Interim reanalysis, but cannot be considered for individual snowfall events.

The topic of the paper is certainly appropriate for The Cryosphere, and assesses the CloudSat climatology as an effective tool for validating climate models. The manuscript is presented clearly, however, after reviewing this article, I have a few scientific questions that I will explain below.

Sincerely,

Florentin Lemonnier

Science questions

- Page 5, 15^{th} line. It is mentioned that the difference between CloudSat (1200 m a.g.l.) and the MRRs (300 m a.g.l) is valued by 9-11%, according to Maahn et al., 2014, at the PE station while at DDU it equals 13%. According to recent studies (such as Grazioli et al., 2017b), coastal areas, such as the DDU and MZ stations are blown by sudden strong katabatic winds. The authors could have compared snowfall rates at the vertical MRR level corresponding to CloudSat first bin. Afterwards they could have evaluated the discrepancies of each MRR between 1200 m and 300 m a.g.l. by studying their vertical profiles, instead of considering an estimated value of the gap between CloudSat and ground radars.
- Page 5, 20^{th} line. The difference in snowfall rate between the first bin of the MRRs and the surface is not considered in this study. It has been simulated by ECMWF IFS (Grazioli et al., 2017b) that 35% of the snowfall is sublimating in

the lower kilometer of the atmosphere over the Nov-2015 to Oct-2016 period, where the surface is lower than 1 km above sea level. By studying the average vertical profiles of each MRR over their corresponding periods of observation, can the authors establish a trend from this sublimation to the surface, quantify it and estimate its effect on their ground snowfall estimations ?

- Page 13, 27^{th} line. When the authors mention that "CloudSat is not able to capture individual snowfall events adequately at a single location", I think the authors should be more specific about that assertion. Indeed for specific precipitation cases, when the satellite overpasses a station closely, if the ground-radar and the CloudSat radar are properly calibrated and their Ze-Sr relations well-established, they should capture a similar precipitation rate.

- Page 14, 1^{st} line. ERA-Interim reanalysis provides surface snowfall. Is it relevant to compare this surface product with 1200 m a.g.l and 300 m a.g.l observations ? Do you take into account the effects of the low level sublimation processes on the first bin CloudSat and the first bin MRR measurements ?