

Interactive comment on “Blowing snow in East Antarctica: comparison of ground-based and space-borne retrievals” by Alexandra Gossart et al.

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We thank the two Referees and the Editor for their comments on our paper. We regret that the manuscript was not considered for publication to The Cryosphere Journal.

We believe that this paper presents the first comparison of blowing snow retrievals by the CALIPSO satellite with ground-based observations from ceilometers. The satellite algorithm, blowing snow frequencies, transport and sublimation fluxes, as well as blowing snow climatology have been published in three different papers (Palm et al., 2011, 2017 and 2018) and a book (Palm et al., 2019). These products are extremely valuable and widely used by the cryospheric community since they offer a continen-

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tal wide assessment of blowing snow, which is an important but unknown component of the surface mass balance of the Antarctic ice sheet. Therefore a comparison with ground truth is – in our view – of very high importance. The second reviewer acknowledges the importance of the study. The main argumentation of both reviewers is that Princess Elizabeth and Neumayer station are not the right location for doing this evaluation, due to the frequent occurrence of blowing snow in cloudy conditions. Indeed, we already acknowledged in the original manuscript the frequent occurrence of blowing snow under cloudy conditions at these sites.

However, we do not think this would be a reason to reject the paper due to the reason outlined below:

Blowing snow during precipitation and cloudy conditions is a frequently occurring phenomenon (not only at these two sites) and therefore an important contributor to the snow transport and sublimation over the entire Antarctica: While the reviewers say this has been already in Gossart et al 2017 paper, the present paper extends the work comparing to the satellite-based algorithm, thus highlighting the potentially important process of blowing snow during cloudy/precipitation for the satellite-derived products. Of course the limitation of satellite detection to clear sky conditions is an already known issue, but a quantification of this effect has not been performed earlier. Therefore, our intent here is to quantify the percentage of time that blowing snow occurs during cloudy conditions that result in the satellite not being able to render a decision. Moreover, the paper demonstrates that blowing snow frequencies under clear sky conditions are not at all representative for the all sky blowing snow frequencies. These results can subsequently be used in further studies to improve the satellite estimates of blowing snow under clouds. This has not been addressed in the Gossart et al., 2017 paper. A second point raised by reviewer 1 is that the number of events detected at both station is too low (2 at Princess Elisabeth and none at Neumayer). However, this is only the number of events detected by both methods (satellite and ceilometer). There are in total 438 and 130 comparisons at Neumayer and Princess Elisabeth stations, respectively, which

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did not result in concurrent detection of blowing snow. Some were blocked by clouds, some were disagreements. We therefore do not agree with this point raised by the reviewer. Based on these 438 and 130 comparisons, the important findings - unrelated to the cloud issue – were presented in the paper: A percentage of 10% (4%) of the measurements at Princess Elisabeth (and Neumayer) are identified as blowing snow by the satellite but not by the ceilometer – relevant information for the remote sensing and the user community in our opinion. This indicates that the satellite retrieval can be hampered in the case of rough terrain (at Princess Elisabeth station). The paper shows that cloud detection remains a research challenge for deriving blowing snow conditions from space: At Princess Elisabeth (Neumayer), during 6% (18%) of the cases, the satellite detects a cloud which is not detected by the ceilometer and during 8% (28%) of the cases the ceilometer detects a cloud which is not detected by the satellite. In retrospect, perhaps indeed we framed this work too much as an Antarctic wide validation of the satellite algorithm and re-framing would be needed, but we do strongly feel that it would be very regrettable not to use the ceilometer ground truth for improving the satellite products in this very sparse data region. At the moment the ceilometer-derived blowing snow products are only available for Neumayer and Princess Elisabeth station. In the future, - as already argued in the paper – the methodology of this paper could also be used in interior regions once more ceilometer-derived blowing snow products would become available to identify how well the satellite products perform for regions that have less influence of synoptics systems.

References

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