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Interactive comment on "Drifting snow measurements on the Greenland Ice Sheet and their application for model evaluation" *by* J. T. M. Lenaerts et al.

Anonymous Referee #3

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The paper introduces autonomous drifting snow observations performed on the Greenland icesheet recorded in the fall of 2012. It consists in one month of unique dataset, including meteorological variables (snow height, friction velocity, wind direction and velocity, humidity) and drifting snow flux and snow particle size distribution measured thanks to a Snow Particles Counter set up at 1 meter. This dataset is used to evaluate the regional atmospheric climate model RACMO2, which includes the PIEKTUK-B drifting snow model. It was shown that the model is able to simulate the near surface climate and to capture the observed drifting snow event. Nevertheless the drifting snow transport is significantly overestimated. It is a well-written and interesting paper introducing new data. But different points, including data processing and numerical

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simulations, still require further clarifications before the paper is published.

p 22 / line 25 : drifting snow sublimation (Suds) instead of drifting snow erosion Could you shed more light on individual SMB components in the SMB equation as it was done in (Leanarts et al., 2012b). The equation and a schematic illustration will be useful. I suppose that in the present paper Snow erosion (ERds) is the transport divergence (div.Trds) representing a net mass loss at the surface ? Otherwise, at first reading, it is not clear how account is taken of the snow accumulation. Moreover the variable was later used without being introduced (p 31/ line 8)

p 23 / line 17 : I did not understand why (Cierco F-X., F. Naaim-Bouvet and H. Bellot, 2007. Acoustic sensors for snowdrift measurements: How should they be used for research purposes? Cold Regions Science and Technology, 49, 74-89.) is reflective of the sentence “the contribution of drifting snow sublimation and erosion to the SMB remains poorly constrained.

p 23 / line 19 :S PC was not deployed by (Gallée, H., Trouvilliez, A., Agosta, C., Genthon, C., Favier, V. and Naaim-Bouvet, F. Transport of Snow by the Wind: A Comparison Between Observations in Adélie Land, Antarctica, and Simulations Made with the Regional Climate Model MAR, Boundary-Layer Meteorol., 146, 133–147). It is the case now but it was not introduced in this paper. You can replace the reference by (Nishimura and Nemoto, 2005)

p.25 line 23 : It is not clear for me if the electric motor is controlled by SR50. I suppose it is the case but please could you clarify and indicate the position of SR50 in Figure 3.

p. 26 / line 6 : It is not necessary to introduce measurements which are not later used.

p. 25 / line 18 : 917 kg.m-3 instead of 917 g.m-3

p. 26 / line 3 : How is calculated the friction velocity shown in figure 6a. Thanks to ultrasonic anemometer (direct eddy covariance measurements) or vertical wind speed profile ? Do the two methods match?

p. 28 / line 14 : How is the snow density estimated? Is there any measurement available?

p 29 / line 5 : The snow-particle sensors are very sensitive and return a signal even if only one snowflake crosses the sampling area: the SPC-S7 is able to detect trace precipitation. The value of 350 μm obtained for SW direction is quite high and may be not representative due to a low particle number. What is the particle number and the associated wind speed for these values.(figure 5d)

figure 7 : Why is the observed number of snow particles per particle size not drawn in figure 7 during the snowfall event ? There should be a sudden increase in the detection of larger snow particles as observed in figure 12d.

p 30 / line 26 : it is written that the simulated particle sizes are underestimated (figure 10). That is probably true. Nevertheless you must emphasize the fact that SPC is not able to detect particles smaller than 50 μm. Moreover the number of particles with a median diameter of 44.82 μm is generally underestimated. This is one limit of this sensor, even if it is probably the most efficient drifting snow sensor on the market.

p 31 / line 8 : The variable Trds has not been introduced.

p 33 / line 26, you could also add “close to 3-4 the French Alps” (Naaim-Bouvet F., Naaim M., Bellot H., Nishimura K., Wind and drifting-snow gust factor in an Alpine context, Annals of Glaciology 52(58) 2011, 223-230.

p 34 / line 1 : It is written that the time-integrated Trds were not significantly altered by the introduction of a variable alpha that increases with height. But what’s happen with a alpha value set at 5 or 7 instead of 2 ?

You have a very nice and unique dataset but you only compare measurements with the final output values of the models, i.e. drifting snow fluxes, temperature, humidity and wind speed. But what about u*t and z0? Some effects may balance each other and may lead to a positive assessment of the model even if the physics of phenomena is not fully represented. It would be a little bit hazardous to state that the threshold friction velocity in RACMO2 is universally applicable (p 29 line 15) because timing and frequency of drifting snow events qualitatively agree for one event. Sure it is a nice result but it is still a first step : you can compare directly the threshold friction measured thanks to ultrasonic anemometer or vertical wind speed profile and SPC and to drawn them in Figure 6a. These new data will reinforce previous conclusions. How is calculated zo in the model ? Is there any feedback due to presence of particles or the formation of sastruggi, ripples ? It could be also interesting to compare measured and calculated z0. It seems (it is difficult to see in Figure 6) that snowfalls detected on 24th and 26th December did not lead to a decrease in u*t.u*t is always greater than 0.4 m.s-1. According to Guyomarc'h and Merindol (1998), Ut10m could be 4-5 m.s-1 for fresh snow. What is the value of z0 in your experimental site ?

References

Van Wessen et al., 2013 is missing.

Please check the references and correct typographical errors : Van de Wal instead of van de Wal, Vionnet V., Guyomarc'h G., Naaim-Bouvet F., Martin E., Durand Y., Bellot H., Bel C. and Pugliese P instead of Vionnet V., Guyomarch G., Bouvet F.N., Martin E., Durand Y., Bellot H., Bel C. and Puglise P. . . ..

Interactive comment on The Cryosphere Discuss., 8, 21, 2014.