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Interactive comment on “Hoar crystal development and disappearance at Dome C, Antarctica: observation by near-infrared photography and passive microwave satellite” by N. Champollion et al.

Anonymous Referee #1

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Review of Hoar crystal development and disappearance at Dome C, Antarctica: observation by near-infrared photography and passive microwave. by N. Champollion, G. Picard, L. Arnaud, E. Lefebvre and M. Fily

- Summarize: This paper deals with the events of hoar crystal presence at the snow surface at Dome C, in Antarctica. The objective is to describe and characterize the hoar evolution. Little is known about this while it plays a important role on several topics : surface mass balance, energy budget, albedo, snow settling or snow chemistry. They use a long time photography series (18 months) to characterize the hoar evolution

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and statistics and show that such events occur almost half of the time. They show a good correspondence between hoar presence and microwave polarization ratio that allows us to extend the temporal series and to better understand the cause of these events. These results are original and give interesting new understanding of surface mechanisms.

- Material: In situ data: They use hourly pictures of the surface in near-infrared in order to facilitate the snow grain size estimation, with a texture-based approach and image filtering. The methodology, explained in five steps is robust and seems to be accurate for almost 95% of the pictures. Satellite data: They use polarization ratio of brightness temperatures at 19 and 37 GHz, in order to be more sensitive to the air-snow interface. They show that this ratio is mostly sensitive to snow density near the surface. To finish, they use air temperature, wind speed and direction, pressure and humidity from the automatic weather station of Dome C. → The data and methodology lies on robust previous experiences. The team knows very well the dome C area and is specialist of both in situ measurements and of ice sheet remote sensing. We can have a good confidence in their methodology.

- Results and discussion. The first significant result is that they point into out of the high variability of the snow surface and that hoar are present 45% of the time either in summer or in winter suggesting different snow processes. They show that the development takes few days while disappearance is quite rapid. They point out an impressive correlation between hoar events and high snow density. This correlation allows them to show that hoar disappearance is due to change in the wind, either in speed or in the prevailing direction. In some cases, it can be due the capture of snow particles by hoar. → These results are important for several scientific topics (snow surface metamorphism, albedo, surface mass balance, interpretation of microwave remote sensing. . .). Moreover it opens new fields of research. Because of the numerous new and important results, this paper should be accepted with minor corrections.

I suggest to the authors to clarify few points. - About hoar and remote sensing. Is

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the hoar really transparency to microwave data ? How to be sure that the relation between presence of hoar and polarization ratio is only due to the snow density ? Do the authors try to use higher frequency, to see the difference ? - The characterization of surface state : why use a threshold for hoar presence ? If I have well understand, the surface state (see Figs 5 and 6) is estimated with the "C" of Eq. 7. This parameter can probably be greater than 0.94. It could be interesting to see the evolution of this parameter during hoar presence. The value of this parameter may be given for the four pictures of Fig 3. - It think that the two histograms of C values (for summer and winter) could be shown. Why do not use artificial light even for the summer period (as it is done for winter period) ? In order to be less sensitive to cloud and to be reduce the difference of detection between both periods.

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