Referee comment responses on the manuscript:

The surface mass balance and near-surface climate of the Antarctic ice sheet in RACMO2.4p1

by C.T. van Dalum et al.

We would like to thank the referee to take a final look at our paper and provide a comment. In orange the response, in blue the changes that we would implement in the manuscript. All line numbers refer to the last manuscript version.

Review

General comments:

I would like to thank the authors for considering my earlier comments. I have found that most of the authors' responses to my earlier concerns are convincing. I suggest that this paper can be published once the authors address the following minor issue.

Regarding the MODIS white-sky snow albedo shown in Fig. 12, the authors' response indicates that "We deemed the white-sky MODIS albedo product to be the closest to what we have available in RACMO." Related to this point, in the revised manuscript, it is indicated that "The MODIS white-sky albedo is closest to the only albedo available in RACMO, which is calculated by dividing the outgoing with the incoming solar radiation at the surface and includes both direct and diffuse radiation." (L. 192 ~ 194, manuscript v2) However, I would like to note that the description is insufficient because some readers may still struggle to understand the differences between the RACMO albedo and the MODIS white-sky albedo. I think the authors should explain more specifically that the broadband snow albedo under overcast conditions, when the most direct beam disappears and the snow surface is illuminated diffusely, loses solar zenith angle dependence and the snow albedo value becomes higher than those at any solar zenith angle for a clear-sky condition (Liljequist, 1956; Aoki et al., 1999), which implies that the MODIS white-sky albedo shown in Fig. 12d can be higher than the actual snow albedo.

References:

Aoki, T., Aoki, T., Fukabori, M., and Uchiyama, A.: Numerical simulation of the atmospheric effects on snow albedo with multiple scattering radiative transfer model for the atmosphere-snow system, J. Meteorol. Soc. Jpn., 77, 595–614, 1999.

Liljequist, G. H.: Energy Exchanges of an Antarctic Snow-Field: Short-Wave Radiation, Norwegian-British-Swedish Antarctic Expedition (Maudheim, 71°03' S, 10°56' W), 1949–52, Scientific Results, Vol. 2, Part 1A, Norsk Polarinstitutt, Oslo, 107 pp., 1956.

Thank you for your comment. You are right that some more explanation is appropriate. Based on your comment, we have changed L192-L194 and added the following in the manuscript (based on manuscript v2):

L192: Under overcast conditions, radiation loses its solar zenith angle dependence, as the direct radiation component is lost and the snow surface is illuminated diffusely. In addition to a spectral shift towards visible light that typically occurs for cloudy conditions, for which the spectral albedo is high (Dang et al., 2015), the resulting broadband albedo increases with cloud cover and is higher than those at any solar zenith angles for clear-sky conditions (Liljequist, 1956; Aoki et al., 1999). These effects are not included in the MODIS white-sky albedo product, and some discrepancies are therefore expected when comparing with the only albedo available in RACMO, which is calculated by dividing the outgoing with the incoming solar radiation at the surface and includes both direct and diffuse radiation.

L525: Note, however, that for RACMO both direct and diffuse radiation are used to calculate the albedo, while MODIS white-sky albedo is determined in the absence of a direct component. This case study shows the importance of the albedo feedback on melt, and in particular the refreezing grain size that is a key parameter in modeling the snow melt-albedo feedback.