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The Cryosphere Discussions

Interactive comment on "Diagnosing the extreme surface melt event over southwestern Greenland in 2007" *by* M. Tedesco et al.

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Interactive discussion TDC:

Contribution of the Glaciological Seminar Innsbruck (MS, PhD and PostDocs).

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'Diagnosing the extreme surface melt event over southwestern Greenland in 2007'

M. Tedesco, M. Serreze, and X. Fettweis

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We very much welcome the approach by Tedesco et al. for putting a complex and process orientated view on the recent mass balance developments on the surface of the

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Discussion Paper

Greenland ice sheet. The authors clearly go beyond the simple approach of correlating the mass balance with air temperature and precipitation only and look into the driving energy and mass fluxes instead.

1. Comments on the content:

2.1. General comments

The paper analyses different drivers for the seasonal melting on the Greenland Ice Sheet surface. Both surface and atmospheric information stem from remote sensing and modelling approaches and no link to measured data at and near the ground is provided. We identify this as a crucial gap in the presented study. Although their approach is slightly different and the target is the calculation of mass balance, e.g. Box et al. (2004) also provide information on fluxes contributing to the mass balance, based on measurements and regional scale climate modelling (MM5). It is necessary to refer to these findings and to respectively discuss the new results. Also energy and mass balance studies carried out by several authors at individual points or over limited sections of the Greenland Ice Sheet need to be implemented or discussed. Introduction: p. 385, l. 4-5: 'Variations in the extent and duration of summer melt over Greenland reflect a suite of processes intimately tied to air temperature and the surface energy balance.' The sentence is not appropriate. The only process of concern is melting and this is exclusively the result of the respective energy balance. To allow for a better evaluation of the rather interpretative findings in this paper, a quantitative discussion about the uncertainties of the calculated results is needed. Moreover, the melt indices should be quantitatively assigned to different energy fluxes by statistical measures, e.g. in terms of the coefficient of determination.

An outline of the main features of the regional climate model MAR as well as the mass balance model used should be given. How is the mass balance modelled from MAR output data? In contrast to the definition of MAR on p 385, stating that MAR is a regional climate model, on Page 391, line 19, MAR is used as a synonym for a mass

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balance model. Additionally, it would be helpful to explain the parameterization of e.g. LW_IN, surface albedo and other parameters (p. 388).

2.2. Detailed comments

P. 390, l. 2: The 1000-500 hPa thickness provides information only about the lower troposphere while 'tropospheric warmth' refers to the entire troposphere.

P. 391, l. 17-18: 'While melting at high elevations is not contributing to this process, it leads to a reduction in ice sheet albedo.' Which processes are meant?

'Southerly airflow' is mentioned in the abstract and the conclusion, but it is not addressed in the main body of the paper. Consequently, the statement remains unclear and its meaning is not shown to the reader.

2. Terminology

Surface albedo:

Generally, 'surface albedo' determines the albedo at the earth's surface. Two statements in the article are irritating if we interpret the term this way, namely p. 385, l. 10-12:'Surface albedo is key, through both influencing solar radiation absorbed by the surface and by modulating cloud radiative forcing.' and p. 389, l. 2-3: '...dominant effects of reductions in surface albedo over cloud cover...' We are questioning how the surface albedo can 'modulate the cloud radiative forcing', and what is meant by 'surface albedo over cloud cover". The two statements would, however, make sense if we consider the albedo at the top of the atmosphere (TOA) instead.

Constructive metamorphism:

P. 385, l. 10-12: 'Albedo can be highly variable, and tends to decrease through the melt season as snow grain sizes increase as a consequence of constructive metamorphism.' Maybe 'melt metamorphism' is meant here. In case both are meant, we propose to use 'metamorphism' only.

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P. 390, l. 2: Instead of the term 'pressure layer' either 'pressure level' or 'air layer', depending on what is meant, should be used instead.

3. Figures

Fig. 2:

Labels in the second row: we assume 'anomaly' is missing.

Fig. 3 and 4:

Datum strings are not uniform. Displaying both the absolute values and anomalies within the same graph does not introduce any extra information and is therefore unnecessary here. Fig. 3b: Right axis: 'surface air temperature' instead of 'surface temperature'. Text font is to small

Reference:

Box, J., Bromwich, D.H. and Bai, L.-S., 2004. Greenland ice sheet surface mass balance 1991–2000: Application of Polar MM5 mesoscale model and in situ data. Journal of Geophysical Research, 109(D16105).

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