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Supplement of

Brief communication: An ice surface melt scheme including the diurnal cycle of solar radiation

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Mean surface temperture and wind speed of melt periods from observations

T_a is the monthly mean temperature and thus also includes temperatures outside of the daily melt period. The strategy in our paper is to only consider that part of the day, when the ice is warm enough to melt. We thus need to estimate the mean temperature during this melt period. To illuminate the relation between T_a and T_{MP}, we analyzed hourly climate data from PROMICE (**?**) weather stations: 2m air temperature T_a, surface temperature T_{surf}, albedo A and short wave radiation SW. In analogy to the dEBM, we determine the melt period for each month by identifying those hours which comply with the conditions

$$\overline{(1-A)SW} > 71.9 W m^{-2}$$

and

$$\overline{T_{surf}} > -0.01^o C$$

. The bars denotes hourly data taken from the monthly mean diurnal cycle. We analyzed 18 PROMICE stations which cover a period of up to ten years (2008-2017) and identified 390 monthly mean diurnal cycles which exhibit a melt period acording to our above definition. We don't need to resort to a minimum elevation angle here, as hourly radiation is available. Likewise the background melting condition is replaced by the condition, that hourly surface temperature data must be near melting point. Indeed, the PROMICE data indicate that PDD is quite a good proxy for the monthly mean temperature of the melt period T_{MP}. Using a constant standard deviation of $3.5\,^{\circ}\mathrm{C}$ exhibits a particularly good fit (Fig. S1).
Furthermore analyzing the mean wind speed during the above melt periods, we find on average a wind speed of $u_{MP} = 3.8\,\mathrm{m\,s^{-1}}$ (Fig. S2).

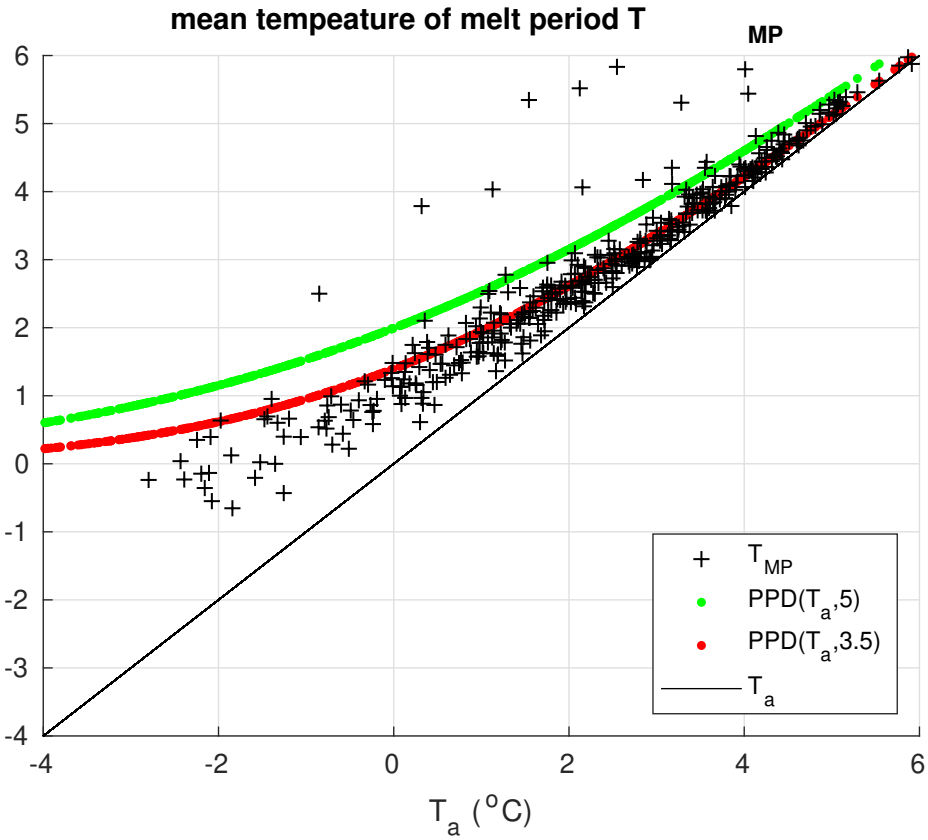

Figure S1. Monthly mean melt period temperature T_{MP} and PDDs as functions of monthly mean near surface air temperature T_a. Crosses reflect monthly mean T_{MP} as calculated from hourly near surface air temperature data of 18 PROMICE stations. Red and green points reflect PDD calculated from T_a assuming a constant standard deviation of 3.5^oC and 5^oC respectively.

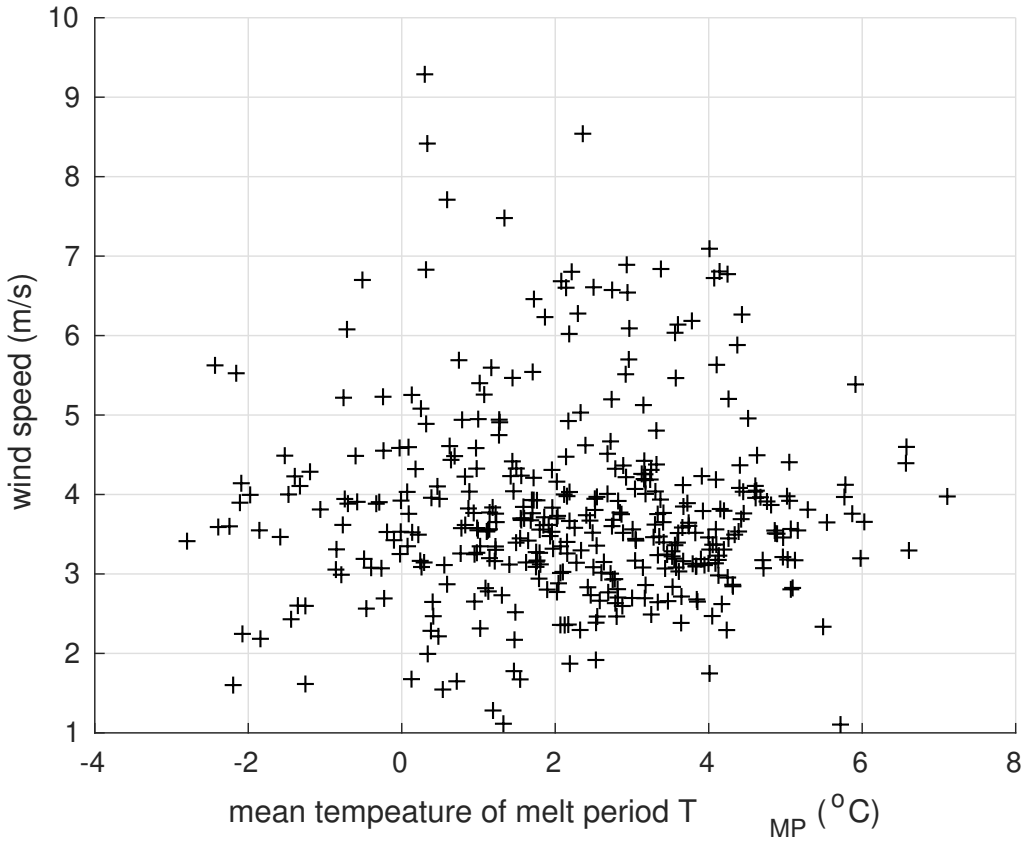

Figure S2. Monthly mean wind speed during melt periods u_{MP} as a function of monthly mean near surface air temperature T_a.

Hindcast of vear-to-vear evolution of the total Greenland surface melt from the MAR-simulation

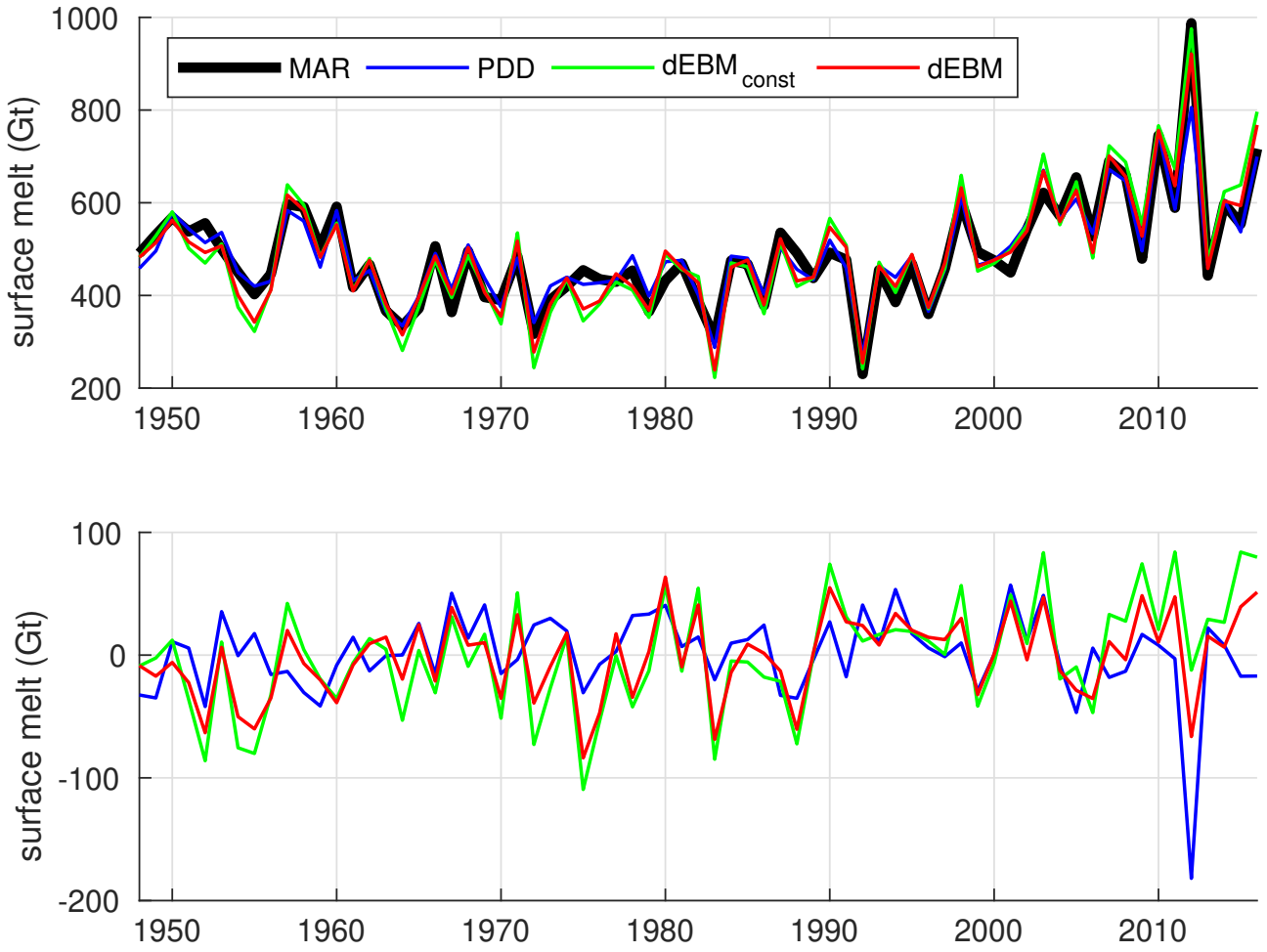

Figure S3. Upper panel: total yearly surface melt of the years 1948-2016 from MAR (black) and as predicted a) Total Greenland surface melt from 1948 to 2016 as simulated by MAR (black) and predicted from PDD-scheme (blue), $dEBM_{CONST}$ (green) and dEBM (red). Lower panel: yearly bias of total yearly surface melt predicted by PDD-scheme (blue), $dEBM_{CONST}$ (green) and dEBM (red) for the 1948–2016 period relative to MAR.