Dear Referee,

thank you very much for reviewing our manuscript.

General remark

In the discussion paper, we used m^2/kg for the unit of the specific surface area of ice. However, the parameterisation by Gardner and Sharp (2010) used cm^2/g, and we overlooked the different units when we prepared the discussion paper. Our apologies for this mistake!

The value for the specific surface area we now use (2 cm^2/g; see Table 1) is based on Dadic et al. (2013). As a result, the clean ice albedo is higher, and the albedo reduction due to BC is less (Figure S4a). The conclusions of the paper are still the same, although the numbers have changed and will be corrected throughout the text. Also, Figures 5, 6, 7, 8, 9, 10 and S2, S3, S4 will be redone.

Response to the comments (referee's comments are repeated in red)

Is this x-direction in the model representative of a South-North or West-East profile? This should be stated more clearly in the text.

The information will be included in the sentence in section 3.1: "The EISMINT boundary conditions are symmetrical around x_{su} and roughly mimic conditions of a west-east cross section of Greenland."

What about spatial distribution of particles? This study is applied to a profile and the proportions are assumed to hold for the whole ice sheet. However, if particles are deposited in concentrated areas, for example, the impact on ice sheet melting overall would be comparably small. Can you comment on this in the discussion?

When particles are concentrated in a smaller area, they are also confined to a smaller area in the ablation zone when they melt out. The effect of additional aerosols on the ice surface is lower on an ice surface with an already high concentration. This can also be seen in Figure S4.

We will add two sentences in section 5.2 about this: "However, if this were not the case, and aerosols were deposited in smaller patches rather than uniformly, then they would also be released in smaller areas in the ablation zone. Owing to the reduced response when aerosols are added to an already dark surface (Fig.S4 in the Supplement), the effect of aerosols would then be smaller."

Additional minor comments

P 2567, line 3: Extra parenthesis in i_n,englacial. Why is this specified in square brackets?

The square brackets are a notation for concentration that has been used in order to be consistent with Goelles and Bøggild (2015).

We will change the first sentence in section 2.4 to: "The aerosol concentration $[\iota_{n,englacial}]$ of every grid point can be derived from the aerosol time series $f(t_d)$ and the depositional time $t_d(t,x,z)$ via the relationship …"

P 2567, line 3: which depends on

The new sentence reads: “This is calculated via a tracer transport module which depends on the aerosol time series, velocities and ice sheet dimensions (Fig. 2).”

P 2574, line 21: These numbers refer to additional ice volume loss, correct? This should be stated clearly, since it looks like only 0.66/1.59% of the ice sheet melts in total for RCP4.5.

Yes, the numbers refer to additional ice volume loss, and we will change the text accordingly: “Considering only BC (RCP4.5 BC only) leads to 0.42 %, and dust alone to 1.16 % additional ice sheet volume loss in the year 3000, compared to the simulation RCP4.5 without aerosols.”

The other additional minor changes will be done in the revised version of the manuscript.

Sincerely,

T. Goelles, C. E. Bøggild and R. Greve

References

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