

## ***Interactive comment on “Diagnosing the decline in climatic mass balance of glaciers in Svalbard over 1957–2014” by Torbjørn Ims Østby et al.***

### **Anonymous Referee #2**

Received and published: 12 October 2016

The authors propose a very high resolution reconstruction of the recent past and present climatic mass balance of glaciers in Svalbard. I agree with the remark of reviewer#1 on the conclusions of this paper but would like to add that the fact that this model allows the use of a higher spatial resolution than highly computationally expensive physically based climate models is an advantage here since it is able to resolve the very alpine topography of Spitsbergen much better.

Downscaling precipitation is also not a straightforward task and the authors paid attention to the choice of their method.

The paper is generally well written but too much grammatical or spelling mistakes and typos remain. I have listed a series of corrections (see below) but a careful check by a native speaker would improve the readability of this manuscript a lot. Please also

C1

check thoroughly the consistency of the units and the captions of the figures and tables (for example, you almost systematically leave a space after a left parenthesis in your tables).

I agree with the other remarks of reviewer#1 and mine are very minor changes or clarifications. I therefore encourage the publication of this paper.

P1, line 1: Longterm mass balance reconstruction/assessment

P1, line 13: 10-year period

P1, line 15: relatively to

P2, line 9: Radić

P3, lines 18 – 19: (Nordli et al., 2014; see also Supplement (Fig. S1-S2)).

P3, line 19: increase in

P3, line 20: have occurred

P3, line 26: in southern Spitsbergen

P3, line 28: remove “in” before (see Fig. 1)

P3, line 30: retreating

p4, line 3: in central Spitsbergen

P4, line 11: slope and aspect were

P8, line 2: to constrain

P8, line 3: are likely incorporated

P8, line 8: please specify it is the Bayelva location since you already have another Ny-Alesund one.

P9, lines 1 – 4: the same sentence is repeated twice

C2

P9, lines 9 – 10: which stations?

P10: caption of fig 5 in not clear. Are biases downscalled ERA – measured T ?

P10, line 7: provide

P10, line 10: usually has

P11, table 2: Tair bias is in °C whereas it is in K everywhere else

P11, line 3: 0.1, since . . .

P11, line 3: can only occur

P11, line 4: should anyway preclude

P11, line 4: as they are opaque

P11, line 4: thermal regions of the spectrum

P12, line 19: what does behaviour mean here? The special parametrization for thin layers? Or the fact that there is only a thin snow cover. Please modify the sentence

P12, line 23: following Gardner and Sharp (2010).

P12, line 25: SOMARS model

P12, line 27: are connected

P15, line 6: "accumulation area almost reaches sea level". Accumulation almost reach the coast or ELA reaches sea level would be a better formulation

P 15, line 10: -14 cm

P15, lines 9 – 14: you make it sound like you consider that the ERA-40 trend is unlikely to be real. Forcing your model with ERA-40 and ERA-Interim over their overlapping period as suggested by reviewer#1 and comparing the trends should also give an indication on wether the 1957 – 2014 trend is actually significant or if it is an artifact.

C3

P15, line 16: melt season energy fluxes

P15, line 17: relatively instead of relative. And relatively to what?

P15 – 17: the use of a negative value for QM when there is melt is confusing in the whole section (also in the energy balance equation). Since QM is the result of the sum of all the other fluxes, it would make more sense to write the equation as  $QM = QN + \dots$ . On p15, line 3 you talk about days with negative radiation balance and very little melt at the beginning of the melt season, which contradicts the sign of QM (negative when melt). On p16, line 3 + p17, line 1 you also write positive values for QM (13 and 30 W/m<sup>2</sup>). Finally, you should move the sentence about QM after QG since QM is the result and its value should be the conclusion of the paragraph. Also add that the resulting trend is significant.

P17, fig 7: y axis units: cm w.e.

P17, line 14: comprises

P18, line 1: amounts

P19, line 1: and, accordingly, the potential for heat release through refreezing is also reduced

P19, line 1 – 2: please rewrite the sentence starting with "These areas experience", it is not really clear what you mean.

P19, line 4: depend

P19, line 5: remove )

P21, lines 4-5: the model slightly underestimates

P21, line 8: remove also

P21, line 9: also shows

P21: the period you use for the validation is not clear. The right panels of fig. 11 and

C4

the fact that you mention that there is no overlapping period with the Pinglot studies make it sound like you only use the period 2003 – 2014 like you do in your sensitivity experiments. Could you clarify that (also in the caption of fig. 11)?

P21, lines 18 – 20: you should carefully re-read and re-write these lines. E.g. To test the possible presence of a trend in the model performance, we compared the mass balance measured by stake at 380 m on Midtre Lovenbreen, a small glacier southeast of Ny-Alesund, to the modeled Bclim of a nearby pixel with the corresponding altitude. There is a good correlation . . .

P22, line 1: after 2000

P23, line 1: Due to large computational cost

P23, line 4: here we perturb

P23, line 8: relatively short

P23, line 10: The modeled Bclim

P25, line 2: without seasonality, by . . .

P25, line 3: results in

P25, lines 6 – 7: please re-write the sentence, it is not very clear at the first reading. E.g. However, the impact of this low sensitivity on Bclim is higher than for other glacierized regions given the low mass flux turnover in Svalbard.

P25, line 14: for (no capital F)

P25, line 26: the largest

P26, line 4: Tables 6 and 9

P26, line 5: shortwave

P26, line 6: indicative of

C5

P26, lines 6 – 7: Last part of the sentence, what about temperature? Do you mean that albedo is also closely related to temperature since it controls the precipitation phase and the rate of albedo decay?

P26, line 13: As in Greenland . . .

P26, line 13: has been proposed

P26, line 15: the 1957-2014 period

P26, line 23: substantial amounts

P26, line 24: the remaining of winter

P26, line 28: in the near future

P26, line 34: mechanisms

P27, line 17: by Blaszczyk

P30, line 22: is not necessarily

P30, line 22: too low

P30, line 23: accumulates

P30, line 24: erodes

P30, line 25: indicate

P30, line 27: accumulation pattern

P30, line 31: by the elevation difference or by elevation differences

P30, line 34: considerably

P31, line 7: that have the highest

P31, line 23: reveals

C6

P31, line 24: We assess

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