Dear Shawn Marshall,

Thank you very much for your review and suggestions that will certainly improve the quality of our manuscript. As you suggested, the question of decoupling Polar amplification vs synoptic circulation is indeed very interesting, though it may be worth another paper.

We have written answers to your comments in blue.

Best,

Damien Maure and all authors.

l.18, "could modify the SMB" - I guess this is very clearly happening, beyond just conditional. Many prior studies show how changing T and P are modifying the SMB across Arctic ice caps, e.g. Huggonet et al. (2021), IPCC (2021) and references therein

Absolutely, thank you for the notice there's too much caution there. We will correct this in the revised version of our manuscript.

l.23, "quick" is hard to define - seconds, minutes, months, years. Suggest being specific here, e.g., if you are referring to synoptic, seasonal, or interannual variability

It might be more appropriate to write "seasonal climate variations" indeed.

l.28, see also Rajewicz and Marshall (2014) on this point. Not that this needs to be cited, but it directly assesses the anticyclonic circulation/ridging anomalies that are being discussed here, and notes how these strongly and simultaneously impact Arctic Canada and southern/western Greenland, of relevance to this manuscript. I would also note that this can be expected to be highly correlated with cool anonalies in the eastern subArctic, as ridging over the western Arctic and Greenland would typically be accompanied by a trough (cooler conditions) in the eastern North Atlantic and Eurasian sector of the Arctic

Thank you for your suggestion, the paper is interesting and we will add it to the list of reference supporting the evidence of this strong effect of anticyclonic blocking over Greenland. It is also interesting to integrate it in the discussion, as we find a strong (anti)correlation between GBI and NAO, suggesting your point (in Rajewicz and Marshall 2014) about ridging patterns and NAO being covariant.

l.53, the 6 km resolution is high in some ways, for the size of the domain, but does not resolve many of the smaller ice masses, particularly in mountainous regions such as coastal Greenland and Baffin Island. On this particular point on l.53, omitting grid cells that are less than 50% ice covered, I worry if

this might exclude a large amount of the ablation area of many of the glaciers and ice caps. This could cause a systematic underestimation of ablation, by excluding a lot of marginal ice area. It will be good to discuss this and even compare the captured ice area/hypsometry to what one would see at 1 km, for example.

This was a comment made by the editor, absolutely relevant. We have done exactly what you suggested, comparing the hypsometries of the ice area (Fig. S1, see below). We find no significant discrepancies, except a small lower elevation for Franz Joseph Land and Baffin Island. This figure will be added in the supplementary of our revised manuscript.

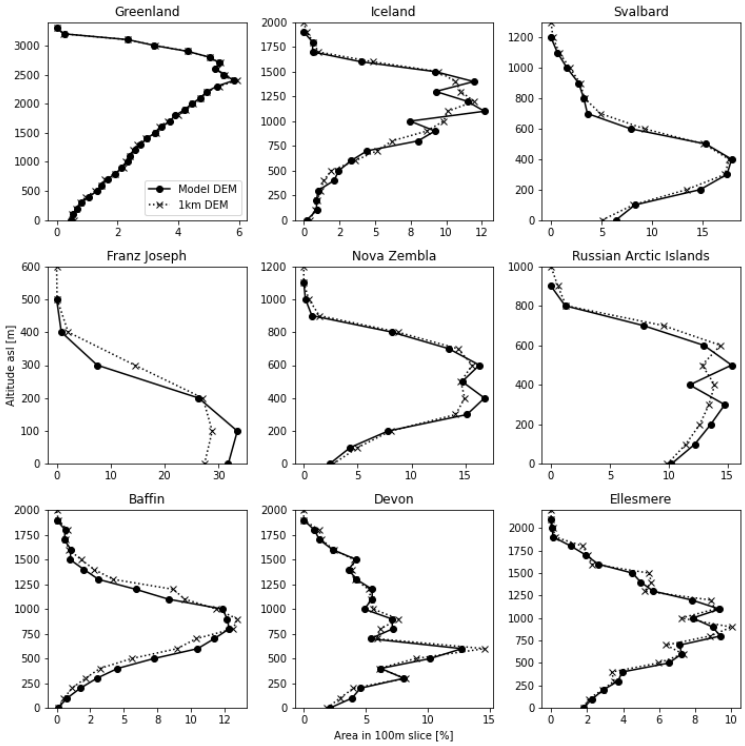
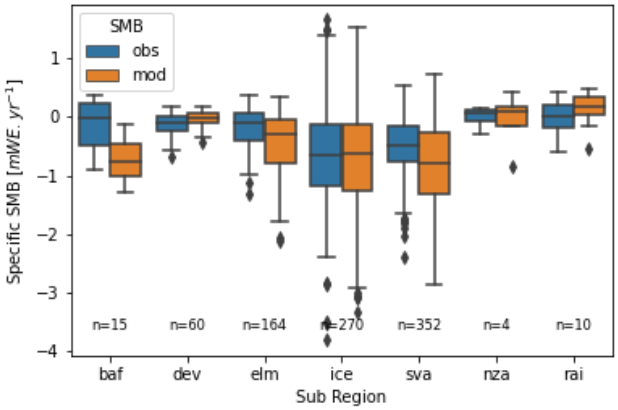


Figure 2, "annual time scale" - are these averaged for the decade? Please clarify in the caption

Thank you for the notice, this was unclear. We will improve this sentence by “Distribution of AWSs 10-years correlation coefficient between observed and modeled values.” in the revised manuscript.

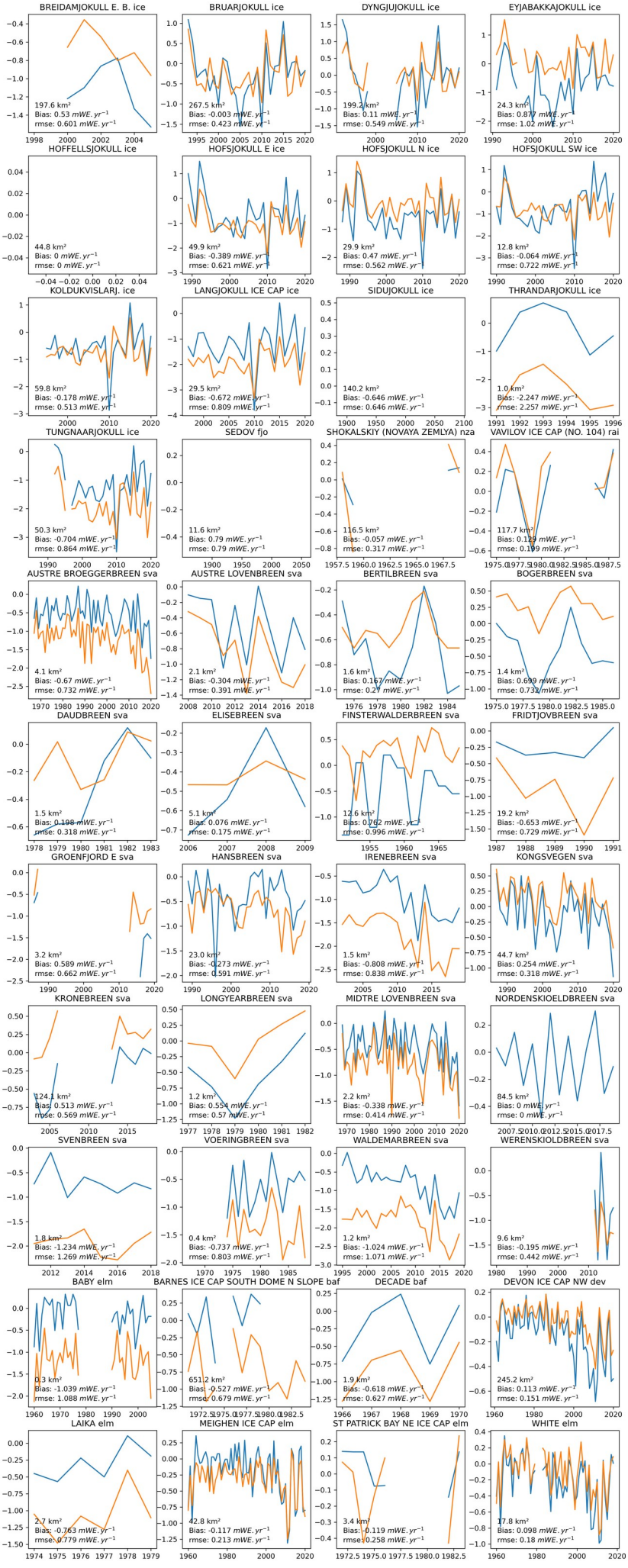
l.137-138, discussion of the lower interannual variability of the altimetry data. This would be helpful and interesting to compare with WGMS SMB data which is available for some of these regions (e.g., Artctic Canada, Iceland) - what does the interannual variability look like there? It would be very instructive to include a third box-whisker for the WGMS data where it is available, recognizing that it is not covering the full domain in any of these regions. Particularly around whether the modelled interannual variabiliy is realistic, and to compare SMB with SMB directly for all regions where this is possible.

This is a good idea, and we have done an evaluation using WGMS prior to switching to altimetry because of a low coverage over certain regions. Nevertheless, we have formatted the results as you suggested:



The figure shows the annual mean specific mass balance over different glaciers of a given region, with ***n*** the number of observations (Greenland periphery and Franz Joseph land are not included because there is no observation).The mean annual values and interannual variabilities are relatively close. The variability of the observations are closer to modelled values than in the case of Figure 3 of the manuscript with the altimetry dataset, in line with our comment on the lowered variability of such satellite products.

Overall, we need to keep in mind that only a small fraction of the iced area is evaluated here (except Iceland where a significant portion of the iced area in included). This could explain the strong underestimation of the SMB vs observations available over Arctic Canada (noticeably over Baffin islands), though in line with your comment on l.157.
You will find below the detail of all observations available of the WGMS, compared to our MAR outputs, with the orange line being the modelled SMB and the blue line being the observed WGMS SMB, in mWE.yr^{-1}. This figure will be added in the supplementary of our revised manuscript.


BREIDAMJOKULL E. B. ice
197.6 km²
Bias: 0.53 mWE.yr⁻¹
rmse: 0.601 mWE.yr⁻¹
BRUARJOKULL ice
267.5 km²
Bias: -0.003 mWE.yr⁻¹
rmse: 0.423 mWE.yr⁻¹
DYNGJUJOKULL ice
199.2 km²
Bias: 0.11 mWE.yr⁻¹
rmse: 0.549 mWE.yr⁻¹
EYJABAKKAJOKULL ice
24.3 km²
Bias: 0.877 mWE.yr⁻¹
rmse: 1.02 mWE.yr⁻¹
HOFFELLSJOKULL ice
44.8 km²
Bias: 0 mWE.yr⁻¹
rmse: 0 mWE.yr⁻¹
HOFSJOKULL E ice
49.9 km²
Bias: -0.389 mWE.yr⁻¹
rmse: 0.621 mWE.yr⁻¹
HOFSJOKULL N ice
29.9 km²
Bias: 0.47 mWE.yr⁻¹
rmse: 0.562 mWE.yr⁻¹
HOFSJOKULL SW ice
12.8 km²
Bias: -0.064 mWE.yr⁻¹
rmse: 0.722 mWE.yr⁻¹
KOLDUKVISLARJ. ice
59.8 km²
Bias: -0.178 mWE.yr⁻¹
rmse: 0.513 mWE.yr⁻¹
LANGJOKULL ICE CAP ice
29.5 km²
Bias: -0.672 mWE.yr⁻¹
rmse: 0.809 mWE.yr⁻¹
SIDUJOKULL ice
140.2 km²
Bias: -0.646 mWE.yr⁻¹
rmse: 0.646 mWE.yr⁻¹
THRANDARJOKULL ice
1.0 km²
Bias: -2.247 mWE.yr⁻¹
rmse: 2.257 mWE.yr⁻¹
TUNGNAARJOKULL ice
50.3 km²
Bias: -0.704 mWE.yr⁻¹
rmse: 0.864 mWE.yr⁻¹
SEDOV fjo
11.6 km²
Bias: 0.79 mWE.yr⁻¹
rmse: 0.79 mWE.yr⁻¹
SHOKALSKIY (NOVAYA ZEMLYA) nza
116.5 km²
Bias: -0.057 mWE.yr⁻¹
rmse: 0.317 mWE.yr⁻¹
VAVILOV ICE CAP (NO. 104) rai
117.7 km²
Bias: 0.129 mWE.yr⁻¹
rmse: 0.199 mWE.yr⁻¹
AUSTRE BROEGGERBREEN sva
4.1 km²
Bias: -0.67 mWE.yr⁻¹
rmse: 0.732 mWE.yr⁻¹
AUSTRE LOVENBREEN sva
2.1 km²
Bias: -0.304 mWE.yr⁻¹
rmse: 0.391 mWE.yr⁻¹
BERTILBREEN sva
1.6 km²
Bias: 0.167 mWE.yr⁻¹
rmse: 0.27 mWE.yr⁻¹
BOGERBREEN sva
1.4 km²
Bias: 0.699 mWE.yr⁻¹
rmse: 0.732 mWE.yr⁻¹
DAUDBREEN sva
1.5 km²
Bias: 0.198 mWE.yr⁻¹
rmse: 0.318 mWE.yr⁻¹
ELISEBREEN sva
5.1 km²
Bias: 0.076 mWE.yr⁻¹
rmse: 0.175 mWE.yr⁻¹
FINSTERWALDERBREEN sva
12.6 km²
Bias: 0.762 mWE.yr⁻¹
rmse: 0.996 mWE.yr⁻¹
FRIDTJOVBREEN sva
19.2 km²
Bias: -0.653 mWE.yr⁻¹
rmse: 0.729 mWE.yr⁻¹
GROENFJORD E sva
3.2 km²
Bias: 0.589 mWE.yr⁻¹
rmse: 0.662 mWE.yr⁻¹
HANSBREEN sva
23.0 km²
Bias: -0.273 mWE.yr⁻¹
rmse: 0.591 mWE.yr⁻¹
IRENEBREEN sva
1.5 km²
Bias: -0.808 mWE.yr⁻¹
rmse: 0.838 mWE.yr⁻¹
KONGSVEGEN sva
44.7 km²
Bias: 0.254 mWE.yr⁻¹
rmse: 0.318 mWE.yr⁻¹
KRONEBREEN sva
124.1 km²
Bias: 0.513 mWE.yr⁻¹
rmse: 0.569 mWE.yr⁻¹
LONGYEARBREEN sva
1.2 km²
Bias: 0.554 mWE.yr⁻¹
rmse: 0.57 mWE.yr⁻¹
MIDTRE LOVENBREEN sva
2.2 km²
Bias: -0.338 mWE.yr⁻¹
rmse: 0.414 mWE.yr⁻¹
NORDENSKIOELDBREEN sva
84.5 km²
Bias: 0 mWE.yr⁻¹
rmse: 0 mWE.yr⁻¹
SVENBREEN sva
1.8 km²
Bias: -1.234 mWE.yr⁻¹
rmse: 1.269 mWE.yr⁻¹
VOERINGBREEN sva
0.4 km²
Bias: -0.737 mWE.yr⁻¹
rmse: 0.803 mWE.yr⁻¹
WALDEMARBREEN sva
1.2 km²
Bias: -1.024 mWE.yr⁻¹
rmse: 1.071 mWE.yr⁻¹
WERENSKIOLDBREEN sva
9.6 km²
Bias: -0.195 mWE.yr⁻¹
rmse: 0.442 mWE.yr⁻¹
BABY elm
0.3 km²
Bias: -1.039 mWE.yr⁻¹
rmse: 1.088 mWE.yr⁻¹
BARNES ICE CAP SOUTH DOME N SLOPE baf
651.2 km²
Bias: -0.527 mWE.yr⁻¹
rmse: 0.679 mWE.yr⁻¹
DECADE baf
1.9 km²
Bias: -0.618 mWE.yr⁻¹
rmse: 0.627 mWE.yr⁻¹
DEVON ICE CAP NW dev
245.2 km²
Bias: 0.113 mWE.yr⁻¹
rmse: 0.151 mWE.yr⁻¹
LAIKA elm
2.7 km²
Bias: -0.763 mWE.yr⁻¹
rmse: 0.779 mWE.yr⁻¹
MEIGHEN ICE CAP elm
42.8 km²
Bias: -0.117 mWE.yr⁻¹
rmse: 0.213 mWE.yr⁻¹
ST PATRICK BAY NE ICE CAP elm
3.4 km²
Bias: -0.119 mWE.yr⁻¹
rmse: 0.258 mWE.yr⁻¹
WHITE elm
17.8 km²
Bias: 0.098 mWE.yr⁻¹
rmse: 0.18 mWE.yr⁻¹

l.151-152, "while this decrease is mainly driven by Greenland..." True, but this is mostly because Greenland dominates the total mass loss? vs. the % change being the driver, as argued here.

We are not sure of what you mean here, but we also realize our sentence might not be clear. IWesuggest rephrasing by “This total SMB decrease is mainly driven by Greenland (as being by far the largest ice body). However, Greenland runoff has increased by 35% between (1975–1995) and (2000–2020), but has on average increased by 45% over the other regions.”

Figure 4, Please define RU and SF in the caption

Thank you for the notice it should indeed be defined.

l.157, Are these numbers right, for Baffin Island? Something is sending up red flags for me here. The glacierized area of Baffin Island is much less than Ellesmere, so the modelled runoff and mass loss from here seems out of proportion compared with Devon and Ellesmere. There are a lot of smaller ice masses that may not be well-captured at 6 km. This might make sense in the context of more negative specific mass balance rates here (average m/yr of thinning), but it would be helpful to discuss and present this for the different regions, based on the RGI glacier areas.

Good point. It is true that, compared to the size of the glacierized area, the numbers are big. However, as seen in Fig.6, we model a decrease in SMB over time stronger above Baffin Island than over Devon or Ellesmere (with close to zero accumulation area). Moreover, it is comparable to what Noël et al. (2018) found (close to -30Gt.yr-1 if you look at the 2000-2020 period in their Fig.5(b), but also strong melting since the 60’s.), and we suggest adding a reference to that paper in the sentence l.157. Recent recurring blocking events over Greenland tend to increase the melt even more with strong positive temperature anomalies over Baffin Island.

It is still might be worth adding a recent value of m/yr per region as you suggest, though it is already written in Fig.3 (land terminating only) for the recent (2000-2020) period.

l.248, "that those regions" - Do you mean the eastern Arctic? Be specific here.

Again thank you for the notice, this is a bad phrasing. This will be “that all the regions studied here are still loosing mass” in the revised version of our manuscript.

l.264, I think that here and throughout, this should be Novaya Zemlya. Nova Zembla is an island in the Canadian Arctic, near Baffin Island, but is not what the authors are referring to, I think

We did not know the existence of this other island. We guess Novaya Zemlya is sometimes also called Nova Zembla, but indeed it is clearly worth changing for clarity in the revised version of our manuscript.

l.34, suggest rewording, "a unified estimate is still lacking"

l.39, "aims", plural

l.66, “over the ocean”

l.67, suggested rewording to "surface pressure, sea ice concentration, and sea surface temperature"

l.156, "over Baffin Island" (no the, here and throughout)

l.216, I don't think "desertic" is a word. Recommend just "dry" ?

l.268, Fig. 9a

l.269, "has been -62 Gt/yr"

Thank you for all the rewordings and corrections above. We will include them in the manuscript.