We first would first like to thank reviewer #1 for making constructive comments which will help to improve our manuscript. Please find our answers to your comments in blue in the text.

This paper fills an important gap left in the current research literature on future changes to the Antarctic Ice Sheet. My understanding of the current state of affairs is as follows. At present, centurial-scale predictions of future Antarctic ice volume use the outputs of global-scale earth system models to provide fields such as surface mass balance and runoff to ice flow models. These ESMs are necessarily run at a spatial resolution too coarse to resolve features like the Transantarctic Mountains. These topographic features would affect the local mass balance through feedbacks between elevation and precipitation and thus may be important for the purposes of ice flow modeling. Downscaling using a regional climate model such as MAR can provide the necessary resolution. Nowicki et al. 2020, due to time constraints and the computational cost of running RCMs, had little choice but to use ESM output directly to force ice sheet models in their work. The present paper fills the gap by downscaling the outputs from several ESMs using MAR for Antarctica over this forcing period.

I'm an ice flow modeler, so I found the methodology convincing but would not be in a great position to critique it in the first place. The big takeaway that I got from this paper was the necessity of doing the right thing and using downscaled RCM output to force future ice flow projections rather than the less expensive approach of using ESM output directly. Figure 10 was particularly striking in illustrating the difference, especially for CNRM-CM6-1 in the vicinity of the Amundsen Sea Embayment and over the Siple Coast Ice Streams.

Thank you for these remarks and for pointing out the importance of choosing the right method.

A few numbers are stated without additional context that might be helpful. For example, the authors state that the amount of precipitation falling as rain over the ice shelves will increase, but give only anomalies. Here it might be nice to say roughly what the total amount of rainfall is so that readers can get a feel for what the relative change is, or state that quantity directly.

We have preferred to give values relative to present rather than raw values for two main reasons:
-although our simulation has been successfully evaluated with respect to the available observations, the integrated values of our reference simulation may not be correct
-even if our downscalings of each ESM are very close to our reference simulation (see table S2), they remain not unbiased.

We therefore wanted to put more emphasis on the changes rather than on the raw values, by not highlighting the potential biases over present climate (and probably stationary in future following Krinner et al. (2019)).

However, we understand the reviewer's remark and propose to add the following tables with the raw values over grounded and ice-shelf SMB and components over the period 2071-2100 in additional material:

Mean (Gt yr^{-1}) over 2071–2100	SMB	Snowfall	Rainfall	Net Sublimation	Runoff	Melt
Grounded ice (11.94 10^6 km^2)						
MAR(ACCESS1.3)	2596	2829	50	117	166	330
MAR(NorESM1-M)	2573	2688	27	103	39	108
MAR(CNRM-CM6-1)	2829	3084	98	87	266	527
MAR(CESM2)	2909	3148	83	97	225	419
Ice shelves (1.77 10^6 km^2)						
MAR(ACCESS1.3)	372	637	57	55	267	536
MAR(NorESM1-M)	584	694	29	55	84	253
MAR(CNRM-CM6-1)	180	679	124	49	574	869
MAR(CESM2)	263	706	97	48	492	781

We also propose to add (L176):

Projected SMB and components values are given compared to their respective mean values over current climate to remove the dependence of the potential linear biases over current climate but raw values over the grounded ice sheet and ice shelves are available in Supplement (Tab.~S3).

Although it isn't strictly necessary, it would help to say something about what the oceans will do. It would be enough to add a single sentence stating that, while higher atmospheric temperatures and thus SMB over Antarctica may offset some sea level rise, increases in ocean heat content delivered to the ice shelves are likely to be a strong influence as well. You could cite Holland et al. 2019, West Antarctic ice loss influenced by internal climate variability and anthropogenic forcing. The authors do mention the possibility of other internal feedback mechanisms leading to ice shelf retreat, but I found the omission of any mention of ocean forcing to be quite glaring

We thank the reviewer for this suggestion which will certainly help to put our results into a wider context.

We will modify L31-33 :
Since the 2000s, the Antarctic ice sheet has been losing mass at an accelerating rate mainly due to an increased ice discharge in the West AIS (Shepherd et al., 2018), itself caused by the acceleration of outlet glaciers in response to basal (ocean) melt thinning the ice shelves and reducing their buttressing effect (Paolo et al., 2015; Gardner et al., 2018; Rignot et al., 2019).

by

Since the 2000s, the Antarctic ice sheet has been losing mass at an accelerating rate mainly due to an increased ice discharge in the West AIS (Shepherd et al., 2018), itself caused by *the acceleration of outlet glaciers in response to basal (ocean) melt thinning the ice shelves and reducing their buttressing effect (Paolo et al., 2015; Gardner et al., 2018; Rignot et al., 2019). Stronger basal melting of ice shelves is further projected to drive future Antarctic mass loss (Holland et al., 2019; Serroussi et al., 2020).*

We will also change the conclusion L422-424:

Under the Paris Agreement (limiting global warming to +1.5°C compared to pre-industrial temperature, which is a colder target than the projected mean CMIP6-ssp126 warming), increased surface melt over the ice shelves should remain weak, limiting potential ice-shelf collapses due to hydrofracturing.

by

Although other processes such as basal melting of ice shelves could lead to their disappearance (Holland et al., 2019; Seroussi et al., 2020), increasing surface melt should remain weak, limiting potential ice-shelf collapses due to hydrofracturing under the Paris Agreement (limiting global warming to +1.5°C compared to pre-industrial temperature, which is a colder target than the projected mean CMIP6-ssp126 warming).

28: retaining -> restraining 59: the abbreviation ESM is used before the term "Earth System Model" 79: abundantly -> frequently or predominantly 114: Why not REMA or BedMachine? Was this for consistency with work from before those products were available? 195: contrasted -> contrasting 332: cumulated -> summed or aggregated 343: "Although RCMs have been believed..." -> Some studies have argued that RCMs..." 355: "that simulates..." -> "which simulates" 360: cumulated -> aggregated 396: carrefuly -> carefully

Thanks for all the technical corrections that we included in our manuscript.

Bedmap was used instead of a more recent topography dataset (REMA or BedMachine) to enable comparison of the results from MARv3.11 (this study) to MARv3.6 Agosta et al (2019) in the aim of facilitating the model development. At the time of Agosta et al (2019), these datasets were not yet available. However, updating the topography dataset in MAR is one of the next planned developments.

References in this answer:

Agosta, C., Amory, C., Kittel, C., Orsi, A., Favier, V., Gallée, H., van den Broeke, M. R., Lenaerts, J., van Wessem, J. M., van de Berg, W. J., et al.: Estimation of the Antarctic surface mass balance using the regional climate model MAR (1979-2015) and identification of dominant processes, Cryosphere, 13, 281–296, 2019.

Krinner, G. and Flanner, M. G.: Striking stationarity of large-scale climate model bias patterns under strong climate change, Proceedings of the National Academy of Sciences, 115, 9462–9466, 2018.