Major Changes

There are 8 major revisions below. in addition to a change to the title to make it more specific to the region.
Revisions #1-5 are in direct response to reviewers' comments.
Revision #6 (regarding wind direction) is in response to a bug that we discovered in the process of revisions.
Revisions #7, #8 are additional changes which followed partially as a consequence of comments from Reviewer #2, although they were not explicitly requested).
In addition, changes in the language for clarity throughout (especially the abstract) and several additional references have been included in light of developments in the subject area in the last few months (King et al., 2017; Weisenekker et al. 2018; Van Wessem et al., 2018; Bozkurt et al., 2018).

MAJOR REVISIONS

1) Discussion of the choice of horizontal and vertical resolution

We now include a comparison between higher-resolution runs of a newer version MAR over the 2004-2005 melt season. The comparison includes 3 versions of MAR: (a) at 10km (b) where the horizontal resolution is increased from 10km to 5km and (c) where the vertical discretization is increased from 23 to 32 sigma layers. The variables examined are meltwater production, melt occurrence (over the domain) and wind speed/direction at the Larsen Ice Shelf AWS location. We find that an increase in resolution limits melt over the Larsen C ice shelf and increases southeasterly flow, suggesting that while the hydrostatic assumption is kept, the effect of increased resolution will lead to reduced melt overall, but potentially enhance the accuracy of melt just east of the AP due to better-resolved topography. This is specifically presented in the Abstract, discussed in detail in the Introduction and presented in the Discussion and Conclusions.

Abstract: P1, L29-31
Introduction: P3, L 4-12, 26-36
Data and Methods: P5, L 30-37
Discussion and Conclusion: P17, L30 – P18, L9
Supplement Fig. S12, S13

2) The hydrostatic assumption

We have altered the text to emphasize the relative advantages/disadvantages of hydrostatic vs. non-hydrostatic versions of the model, i.e. the accuracy of winds (in non-hydrostatic models such as WRF) vs. the long run periods and sophistication of the snowpack (in hydrostatic models such as MAR or RACMO2.3p2). Discussion of the latter is provided in #5 (below)

<u>Re: non-hydrostatic models</u>

We now include a more thorough review of recent non-hydrostatic modeling studies (King et al., 2017; Turton et al., 2018; Bozkurt et al., 2018) noting that factors other than föhn melt are important over the Larsen C ice shelf as well as recent work showing that even a high-resolution non-hydrostatic model was not fully able to resolve föhn characteristics.

Introduction: P3, L 2-12
Discussion and Conclusion: P18, L10-29

3) Overemphasis on föhn winds

The original discussion about föhn winds has been substantially limited to where the main emphasis is placed on previous studies with a non-hydrostatic model. More emphasis is placed here on the distinction between the initial intrusion of föhn flow (which high-resolution hydrostatic models may capture) vs. the eastward propagation towards the edge of the Larsen C ice shelf (where the comparison with AWS stations are conducted).
However, a section on northwesterly flow biases is specifically included to address the effects of probably föhn flow

Introduction: P3, L 1-12
Results: P16, L7-20
Discussion and Conclusions: P18, L 18-20

4) Driving Reanalysis

To understand the impact of forcing on the representation of wind dynamics in MAR, we have included a comparison of ERA-Interim wind fields and discussed possible reasons for the differences.

Fig. 8 d,k
Data and Methods: P5, L 26-28
Results: P14, L35 – P15 7

5) Comparisons with the hydrostatic model RACMO2.3p2

We have corrected a typo mis-stating that RACMO2.3p2 is a non-hydrostatic model, added greater detail about recent publications with RACMO2.3p2 over the AP, and included a direct comparison of melt occurrence/meltwater production between RACMO and MAR. References to recent work on RACMO3.2p2 over the AP are included (Van Wessem et al., 2018; Weisenekker et al., 2018)
Introduction: P3, 26-36, P4, 7-9
Data and Methods: P 6, 19-23
Results: P10, L 3-19; P11, L18-21
Fig. 3, Fig. 5c

6) Computation of Wind Direction

In the process of addressing the major revisions, we discovered a bug with the computation of wind direction in MAR. The now-corrected computation of wind direction substantially reduced the wind direction biases, although we address the biases that are present in light of how the absence of westerly flow affects melt on the eastern Larsen C ice shelf (where the AWSs are located).

Fig. 9: now focuses on the generalized absence of northerly and westerly flow rather than the two cases presented previously.
Fig. S10: now shows corrected wind directions, with Section 5 altered to account for these changes (wind directions are now in better agreement)
Table 2: Previously, wind directions were divided into N/S/E/W categories. This now examines flow divided into mutually-exclusive categories NE/SE/SW/NW with updated values
Section 4: Explicit discussion of the bias in MAR for southerly and easterly winds and an extended discussion of northwesterly flow

7) Explicit comparison of satellite-based, model-based and AWS temperature-based melt occurrence

We add a comparison of melt occurrence from all satellite measures with AWS temperature based criteria (and associated temperature biases) in order to assess the sensitivity of melt occurrence criteria independently, before addressing the additional impact of wind direction.

Fig. 4: This is a new figure. Fig. 4a uses a meltwater production threshold of 0.4 mm w.e. to detect melt in MAR. A similar figure in Supplemental Fig. S2 (described in #3)
Section 3.2 (P10, L21-33) discussed Fig. 4

8) Justification for the use of the MAR meltwater production threshold of 0.4 mm w.e. for melt occurrence

The decision to use a threshold of meltwater production exceeding 0.4 mm w.e as a criteria for meltwater occurrence is more thoroughly justified in the context of previous literature as well as via a comparison of melt occurrence estimates both domain-wide and at one AWS station (using satellite-based, model-based and AWS temperature-based estimates for melt occurrence) where multiple MAR thresholds are employed (0.1 mm w.e. – 4 mm w.e.).

Data and Methods: P6, L 8-18
Supplemental Fig. S2
Fig. 4