Review of “Future ice-sheet surface mass balance and melting in the Amundsen region, West Antarctica” by Marion Donat-Magnin et al.
Jan Lenaerts and Michelle Maclennan (University of Colorado Boulder)

This paper discusses the future SMB and components in the Amundsen Embayment area and surroundings using a regional climate model forced by bias-corrected CMIP5 forcing. The paper contains interesting and relevant results for the polar climate, firn, and ice sheet modeling communities and the topic fits very well for The Cryosphere. We have identified three major issues with the paper, as well as several minor topics for the authors to consider in a revision.

Major issues

1. Rainfall is not included in the analysis (Page 1, Line 13; Section 4.2), while this will be a significant component of the SMB and water budget in the ASE region in the future. Rain is highly non-linearly dependent on temperature (above the melting point), and warmer summers (and shoulder seasons) will imply more rainfall. This meltwater will need to be added to the surface meltwater to identify the liquid and solid water input to the surface.

2. (Page 2, Line 18, and many other references) In contrast to what the authors suggest, hydrofracture is not explained by/associated with runoff, but rather by a **lack** of runoff and by in-situ surface ponding of meltwater instead. Runoff is the mechanism by which water can be efficiently removed from the ice shelf, reducing hydrofracture potential. On flat ice shelves, runoff potential is limited, although local depressions on ice shelves can collect water from its surroundings, and some ice shelves have a pretty efficient wider surface drainage system (e.g. Bell et al., 2017 (Nature)). Similarly, if MAR suggests runoff to occur because a part of the surface meltwater does not refreeze, this will likely not occur in reality since the ice shelf slopes are too weak to support (widespread) lateral flow of water. This is an important misconception and needs to be addressed in the manuscript in several instances.

3. (Table 1) SMB over PIG and Thwaites are remarkably higher than obtained from extrapolating airborne radar results (Medley et al., 2014 (TC)). In their table 3, they obtain an SMB of ~67 Gt/yr over PIG and ~76 Gt/yr over Thwaites (numbers that are confirmed/validated by comparing to glacier discharge – see Figure 10 in Medley et al., 2014), suggesting that the MAR SMB is overestimated by 25-30%. This is an important bias that needs to be addressed, since it somewhat erodes the credibility of the future changes (at least in their absolute sense).

Minor issues

Page 1, Line 13:How well settled is this threshold, since you only use one firn model and one RCM?

Page 2, Line 20: Surface melt and/or rain

Page 2, Line 23: runoff and surface melt are used interchangeably, which is confusing. It is worth noting that surface runoff is the fraction of surface melt that does not refreeze or retain in the firn or at the surface.

Page 4, Line 25: described

Figure 3 (and others): Consider removing the southern Antarctic peninsula (and the interior ice sheet) from the figure since high SMB and melt patterns are not discussed or irrelevant in the paper, shifting the colorbar to view spatial differences in negative SMB and melt anomalies, and expressing the differences as relative instead of absolute numbers.

Table 2: consider not using 'runoff' as the generalized name for this, but rather use 'surface water budget' or something similar. As noted earlier, runoff is a fraction of and result of melt, not vice versa.

Figures: It would be very useful to add significance marking in all the maps, to highlight areas where future changes are (not) significant.

Figure 5 – remove arrows where changes are not significant.

Section 4.1: this section is very long and distracts the reader from the main message. Would it be an option to add this to an appendix or supplementary material?