This manuscript by Tigchelaar et al. explores the relative and combined impacts of sea level, atmosphere, and ocean forcing on Antarctic ice sheet evolution through the Quaternary. The results of their model simulations show that no individual external forcing can alone explain the entire ice sheet response, and that the forcings together exhibit a strong nonlinear response. Combined sea level and atmospheric forcing can account for most of the glacial-interglacial amplitude. Ocean melt changes are shown to be a function of ice sheet geometry rather than changes in climate. This sensitivity analysis is timely and insightful, and the manuscript is well-written. It should be of interest to readers of The Cryosphere. However, I hope the authors can address the following comments and questions. This review is divided into general and specific comments.

General comments:

1. Although this is a modelling study, the authors could reach a wider audience and better justify these experiments with more discussion of the experiments in the context of the geologic record. Much of the current debate on the relative roles of external forcings in driving Antarctic Ice Sheet changes is from surface-exposure chronologies that appear to show ice thinning of glaciers that occurs synchronously with changes in some external forcings, but not others (see Goehring et al., 2019 for a recent example). The sensitivity experiments are suited for testing these proposed mechanisms and assumptions, and this justification can be included in the introduction. It is not necessary to compare the model to every record, but a general indication of how the experiments compare to LGM reconstructions (e.g. Bentley et al., 2014) would also be of interest to many. Are the model experiments more consistent with reconstructions in some areas than others? This LGM comparison could be briefly mentioned in Section 3.2.

2. Another aspect that the authors could improve on is the clarification of caveats and model limitations, which may impact the relative and synergistic effects of the external forcings. There are two key limitations that require more detailed explanations: the sub-ice shelf melt parameterization and the sea level forcing.

2a. The relationship between ocean temperature and ice shelf depth to basal melting/freezing of ice shelves is complex and sub-ice shelf melt parameterization is an active area of research within the ice sheet model community. This is well-outlined in the review paper of Pattyn et al. (2017). The previous paper of Tigchelaar et al. (2018) offers a more detailed discussion of some of these uncertainties with respect to interglacial ocean temperatures, which is worth reiterating in this paper as well since this analysis specifically investigates the individual and combined effect of the ocean forcing. The current discussion seems too brief and there is little information offered in either paper of the parameterization used for sub-ice shelf melting/freezing (see specific comments below).

2b. Some discussion of eustatic versus relative sea level change is also warranted as relative sea level changes depend on deformational, gravitational, and rotational effects. The experiments are likely sensitive to model parameters used in the bedrock deformation relation, such as the term for the flexural rigidity of the lithosphere. It should be noted that this term has spatial variability in reality, and is quite different between East and West Antarctica. Does the ice sheet model account for this? If a single value is used, different ice sheet sectors in the model may have higher or lower relative sea level change than is realistic. This may increase or decrease the synergistic effects of the combined forcings as well. The solid Earth response has been explored in other ice sheet models with more complex bed deformation schemes (e.g. Kingslake et al., 2018), with quite distinct ice sheet responses to external forcings with different mantle viscosity values. It is not clear if the model accounts for the gravitational or rotational components of sea level change, as in Gomez et al. (2010) and (2013). These latter components should also be discussed because gravitationally-consistent sea level change can stabilize grounding lines during periods of ice sheet retreat. This relates to the authors' conclusion that sea level forcing must be accounted for in ice sheet projections.

Specific comments:

1. Page 5, Lines 12-17: Please show the equation for the sub-ice shelf melt parameterization. Based on the reference provided, I assume that it is Eq. 17 in Pollard and DeConto (2012). If not, please clarify. If so, what is the value used for the transfer factor (K_T) and what is it based on? Are different K values used in different basins? How sensitive are ice shelf melt/freeze rates to the value of this parameter in relation to the ocean temperature anomalies? Are modelled melt/freeze rates reasonable with present-day climate forcing?

2. Page 5, Lines 25-29: It should be noted that the MICI parameterization is still a topic of debate, and it may not be necessary to reproduce Antarctic sea level contributions of past warm periods (see Edwards et al., 2019).

3. Page 6, Line 24-25: With the caveat that 34.5 psu may not be appropriate for the ocean salinity at the ice-ocean interface.

4. Page 7, Line 25: Can the authors clarify the purpose of including the EOF1 plots in Figure 3?

5. Page 8, Line 12: The benthic Southern Ocean temperature reconstruction of Elderfield et al. (2012) could also be included as an alternative to the SST reconstruction.

6. Page 9, Line 31: Remove the comma before "because"

7. Page 10, Line 1: Remove the comma before "because"

8. Page 12, Lines 15-26: Meltwater fluxes may partly explain the low ocean temperature anomalies in the climate model, but I would also add that some of this may be specific to LOVECLIM. The authors previously mention the model overestimates present-day minimum sea ice extent and that this may contribute to the underestimation of ocean temperatures (Page 7, Lines 3-4). Glacial ocean temperature anomalies are much more negative in CCSM3 along the Antarctic coasts than in LOVECLIM (see Lowry et al., 2018). Other climate models may also show more positive ocean temperature anomalies during interglacial periods than LOVECLIM.

9. Figure 1: A darker colour for CO_2 and obliquity would make the axes easier to read.

10. Figure 3: Why do the temperature/accumulation composites include only East Antarctic ice cores? Please clarify the spatial domain for the PC1 lines in panels j-l.

11. Figure 7: See above comment for Figure 1.

12. Figure 8: Move the legend outside the plot so that it is not overlying the mass balance curves.

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