

Interactive comment on “Deglacial evolution of regional Antarctic climate and Southern Ocean conditions in transient climate simulations” by Daniel P. Lowry et al.

Anonymous Referee #1

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This manuscript analyzed published transient simulations of the last deglaciation with a focus on regional conditions in Antarctic and Southern Ocean. The authors compared modeled temperature, accumulation rate and sea ice with available proxy estimates. Using model simulations, the authors also explored changes in variables and relationships that could impact ice-sheet mass balance.

The manuscript is well-written. The topic may interest readers of Climate of the Past. But, I hope the following questions and comments will be addressed.

Major comments:

1. In general, I feel the authors largely overlooked potential biases and uncertainty
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in proxy records, including the ice-core temperature and Alkenone- and Mg/Ca-based SSTs. Stable isotopes in ice cores reflect complicated signals in climate system, such as changes in seasonality (Jouzel et al., 2003; Erb et al., 2018), sea-ice content and changes in moisture source regions (Noone and Simmonds, 2004; Holloway et al., 2016), etc. Similarly, marine SST records are also subject to substantial uncertainties (for example, see Tierney and Tingley, (2018) for a discussion of alkenone-based SSTs). The authors should better consider and incorporate these biases and uncertainties in their model-data comparison and related discussion. I suggest the authors further explore possible seasonality biases in ice-core and marine sediment records by comparing modeled seasonal temperatures, in addition to annual mean, with proxy records. They can also test whether water isotopes in ice cores more reflect temperature at condensation level or surface air temperature.

2. Related to the first comment, I suggest the authors provide more details on how ice-core δD is converted to temperature. What temporal temperature- δD slope is used for each proxy records? This could be done in Table 2.

3. The climate models used in the transient simulations were released more than 10 years ago (e.g., CCSM3 was released in 2004) and were considered outdated. I understand that there are no transient simulations using newer models, but some well-known biases in the models certainly deserves some caveats. For example, CCSM3 simulates much more sea-ice cover in both hemispheres than present-day observation (Yeager et al., 2006). Figure 7 of the authors' manuscript also shows a much more extensive sea-ice cover in the TraCE-21 LGM simulation than proxy estimates. Additionally, CCSM3 has problems simulating jet stream in the Southern Ocean and its response to external forcing (see Rojas et al., 2009). How are these model biases influence model-data comparison and findings in this manuscript?

4. For Figure 1a and b, I would like to see temperate changes at individual sites compared with model simulations. One way to do so is to use face color of markers to indicate proxy temperature changes and edge color (e.g., black or no edge) to repre-

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sent whether model agrees with proxy estimates within uncertainty.

5. The authors are comparing averaged proxy SST in the Southern Ocean with model simulations in Figure 5a. I would suggest them also show model-data comparison at individual core sites, which enables us to see any potential regional difference in proxy estimates and possible divergent behavior from different proxy types (e.g., Leduc et al., 2010).

Minor comments:

1. Line 92: version T31x3 → version 3
2. Line 99 and Table 1: What exact is the resolution of T21? 5.6° by 5.6°?
3. Line 162–163: Can you briefly justify the way you divide the Antarctic?
4. Figure1: it would be helpful if the authors can plot boxes/sectors for region EAIS interior, EAIS coastal, WAIS and AP.
5. Line 197: What is the assumed lapse rate of 1.0degC/100m based upon? I think this is too high. I suggest the authors to calculate the lapse rate in the model or reanalysis (e.g., Mokhov and Akperov, 2006).
6. Figure 5: Are these time series SST anomalies or absolute SST? If they are SSTA, how are they calculated?
7. Line 910–911: “within the range of proxy temperature reconstruction uncertainty of -10% to +30%” Where is the uncertainty range from? Jouzel et al. (2003)? Jouzel et al. (2003) estimated the uncertainty range for eastern Antarctic. How are the uncertainties for WAIS and AP obtained?

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