

Interactive comment on “A comparison of the present and last interglacial periods in six Antarctic ice cores” by V. Masson-Delmotte et al.

V. Masson-Delmotte et al.

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We thank the three reviewers for their comments and suggestions.

The manuscript has been revised according to these points and all minor suggestions have been taken into account. References have been updated for papers that have been published since our manuscript was submitted and requested references have been inserted. A few typos have also been corrected in the tables.

Several few major changes have been made:

- Following suggestions by reviewers 2 and 3, the methodology used to calculate the moisture sources has been described in further details (section 3.2, second

C1516

paragraph).

- Following a suggestion by reviewer 1, the seasons used to represent the moisture origins have been modified to August September October and January February March (in order to better capture the sea ice minima). The results have been modified in Figures 2 a and b.
- Following comments by reviewers 1 and 3, the analysis of the differences between the modern deuterium excess levels and the calculated moisture sources has been re-written to clarify the factors which can explain the inconclusive comparison (section 3.2, third paragraph).
- Following a question raised by reviewer 1, the problems of the original Taylor Dome age scale have been described in more details in section 4.1.
- And also following the major comment of reviewer 1, the importance of glaciological effects to explain the differences between sites has been described in the conclusion (Section 6, third paragraph).

We have submitted two documents, one with the “track changes” which allow to follow all the changes that have been made, and a second one with these changes accepted.

Detailed answers

Reviewer 1

We have taken all the detailed comments into account and thank reviewer 1 for his careful reading.

We have modified the conclusion to stress the importance of glaciological factors.

We have changed the seasons for moisture source calculations to JFM and ASO according to the suggestion and modified the text and figures.

C1517

Reviewer 2

We have modified the references.

Reviewer 3

- *The calculation of moisture origin is difficult to understand because the technique using the model is explained not enough as Sodemann and Stohl (2009). I read Stohl and James (2004) but have not understood well yet and this paper does not refer it*

The original description of the method is detailed in (Sodemann et al., 2008). The above-mentioned paper describes in detail how moisture sources are quantitatively determined from changes of specific humidity (E-P) along air parcel trajectories. The paper by Stohl and James (2004) is related to the method applied here, but not the direct reference, so we do not refer to it here. The main difference to previous trajectory calculations is that air parcels with this method are followed over 20 days backward in time to diagnose moisture sources along its trajectory. This allows for tracing water transport back to considerably more distant moisture sources than previous studies, in which typically 5-day backward trajectories were applied. For the calculation setup, the global atmosphere was three-dimensionally subdivided into 1.4 million particles of equal mass that were traced forward over a 5-year calculation period. The subset of air parcels for which moisture origin was considered here were selected when specific humidity anywhere over Antarctica (land mass south of 60°S) decreased by more than 0.1 g/kg when relative humidity was greater than 80% over Antarctica. Note that parcels can be located at any altitude within the atmosphere. Under these conditions it was assumed that a precipitating cloud is present in the model atmosphere. For the particles selected by these criteria moisture source regions were detected as the regions where specific humidity increased by more than 0.1 g/kg within the marine boundary layer, weighted under consideration of the temporal sequence of precipitation and evapora-

C1518

tion events along the trajectory. See Sodemann et al. (2008) and Sodemann and Stohl (2009) for further details. The manuscript has been revised to incorporate this answer.

- *Why can't you explain the reason for the difference between the modeled origin and the isotope records? It is very clear that modeled precipitation is not explained well in Antarctica. Some problems for modeling are still remained in precipitation system in Antarctica, such as diamond dust, blocking, and redistribution of katabatic winds and so on. You have compared the calculated moisture origin with the results from GCMs, but have you compared the water isotopes of snowfall events from the observations expect for the ice core data? I think a comparison of modeled moisture origin with the snow isotope data is better than the ice core data*

The reviewer suggests that part of the discrepancy between moisture source diagnostic and ice core isotope data could originate from post-deposition effects and the low quality of meteorological observations in Antarctica that were used for applying the moisture source diagnostic. In particular, he suggests (as we also state in our manuscript) that snow isotope data could be more successfully compared to modeled moisture sources than ice core data. While in principle we think that this is the case, we also emphasize that within one standard deviation the moisture sources for the drilling sites overlap, thus the results are not actually inconsistent, but rather inconclusive on the issue of the deuterium excess in the ice cores. This is in particular so since the moisture source diagnostic is at the limit of its applicability in regions of Antarctica where processes such as diamond dust make up a relevant part of the precipitation. In this study climatological differences between several ice core drilling locations are studied based on a five-year period. As for example the study by Cullather et al. (1998) has shown, ECMWF analysis data can reliably represent the weather over Antarctica. We believe that in terms of the results from the moisture source diagnostic, consideration of seasonal averages from a five-year period reliability is increased over considering

C1519

individual weather events, even when studying ice core data. Applying our moisture source diagnostic to snow fall samples might in the future provide interesting results, given reliable representations of the meteorology in Antarctica. We have also modified the text to explain that factors other than just source temperature do affect deuterium excess such as relative humidity at the ocean surface, and also site temperature and the amount of distillation.

Interactive comment on *Clim. Past Discuss.*, 6, 2267, 2010.

C1520