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Interactive comment on "Evaluating model outputs using integrated global speleothem records of climate change since the last glacial" *by* Laia Comas-Bru et al.

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Reply to Anonymous Referee 2

Though focusing most of my research interests on paleoceanography and spending most of my time on producing proxy records in paleoceanography, I also have great interests for comparison of paleoenvironmental proxy records with modelling results. Speleothem records have great significance in improving our understanding on hydrological cycles on timescales from orbital to millennial to centennial. Because speleothem records have much higher time resolution than the lake and marine records and could be precisely absolutely dated, they could serve as excellent target records for testing the simulation results of the Earth System Model. Therefore, they are very useful in refining our ESM model and thus promote our level of predicting future climate change. However, changes of speleothem records have temporal and spatial difference. Therefore, a good speleothem dataset which integrates different regional records and has global significance is the key to the final success. The updated SISAL database (SISALv1b) (SISAL, Speleothem Isotopes Synthesis and Analysis, an international working group under the auspices of the PAGES project) is such a dataset based on my evaluation. Additionally, to achieve such a success on model-data comparison, a reliable Earth System Model is another key because different Earth System Models also produce unexpected biases. The ECHAM5-wiso used for their simulation is such a reliable model. It is an isotope-enabled atmosphere GCM, of which the consideration of the water cycle is very good, which contains formulations for evapotranspiration of terrestrial water, evaporation of ocean water, and the formation of large-scale and convective clouds. The achievements using this model for climate and paleoclimate research are productive and of high reputation. The most advantage of this model is the high resolution. As the authors explains, all the ECHAM5-wiso simulations were run at T106 horizontal grid resolution (approx. 1.1âŮȩx1.1âŮȩ) with 31 vertical levels. My overall evaluation on their data-model comparison is the same as the authors stated in this manuscript that the simulations succeeded in catching the 1st order trend of records, which could be seen in Figures 5, 7 and 8.This manuscript is well written in language though the structure could be much simpler so as to make the reading easier for most readers. For example, they could move the contents related to methods to the supplementary and focus mainly on the results and discussion. This can make the reading more consistent.

We thank the reviewer for their comments. We try to clarify what we are doing in response to these comments: the reviewer comments are in black bold and our explanations in blue italics.

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Discussion paper

Minor issues.

Are the control runs for MH and LGM different? Probably I don't catch the points. In my understanding, they should be the same which is the base for probing the climatic significance of the difference between the MH and LGM simulation experiments.

Yes, the control simulations differ slightly in the prescribed monthly mean sea surface temperatures and sea ice cover data. Details of the different simulation setups are given in Wackerbarth et al. (2012) and Werner et al. (2018). However, both control simulations are more similar than the differences between MH-PI and LGM-PI. These different PIs have been taken into account in Figure 6 (anomaly maps) and we will add a line in the text clarifying how this has been done (as suggested by Referee 1).

The simulation results of the MH seem to be better than that of the LGM. Could they explain more on this? For example, they use the protocol of PIMP3 for the LGM modelling, and their SST forcing is based on the results of a full transient experiment. More clarification on why they take such steps will make this manuscript more convinced.

We cannot say that the MH simulation results fit better to the speleothem data compared to the LGM simulation due to the limited number of speleothem records available. However, we will add in the manuscript that for the MH simulation, we have chosen a simulation which fitted best to European stalagmite data. For the details on this, we will refer the reader to Wackerbarth et al., 2012, where three different ECHAM5-wiso MH simulations are compared.

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