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Climate of the Past
Discussions

Interactive comment on "A data-model approach to interpreting speleothem oxygen isotope records from monsoon regions on orbital timescales" *by* Sarah E. Parker et al.

Anonymous Referee #1

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The article investigates the water isotopic variations recorded in speleothems in monsoon regions worldwide and on orbital time scales. It uses the SISAL database (Atsawawaranunt et al. (2018)) and global simulations from two general circulation models (ECHAM and GISS).

I think this paper is an interesting contribution to this active area of research. However, my feeling at the end of the paper is that it is an addition of statistical diagnostics, and I'm often lacking an overall view and physical interpretations. In addition, when the model simulation are used, I wish I had some evaluation and discussion on to what extent the models can be trusted.

1 Major comments

1.1 Give some overall view and more physical intepretation

The paper directly dives into complicated statistical diagnostics. But before this, I think some overview would be useful. For example, a few basic figures showing the maps of simulated $\delta^{18}O_{precip}$ anomalies for a few key periods would be useful before showing the regional averages.

When describing the results of the statistical methods, it would be useful to better guide the reader in the physical interpretation of the figures: what does it mean when values are more negative, positive, larger, smaller... (more details in minor comments.)

At the end of each sub-section, a few sentences would be useful to summarize the results in terms of physical understanding of the processes driving the isotopic variability. A statistical analysis is not enough to identify causality and thus isotopic "drivers", so the discussion should rely more on the huge body of litterature devoted to the interpretation of water isotopic records in monsoon regions.

1.2 Evaluate and discuss the model realism and robustness

The models are used in the regression analysis but what is the realism of the simulations? To what extent can they be trusted?

Some comparison between SISAL and the models are shown in the figures, but the variables and diagnostics are different, so it's hard to compare (more details in minor comments). The observations and simulations should be compared in a more rigourous way. Also, figure 1 could be redone with the models, as an additional check of the realism of the simulations. An entire sub-section should be devoted to model evaluation.

Every time it is possible, both models should be used for the same diagnostics to assess te robustness. It's a great opportunity to have two models, and it should be used more systematically.

After the evaluation section, the reader should have a clear opinion on what feature in the simulations can or cannot be trusted. Then when the regression analysis is performed, there should be some discussion on what specific results can be trusted or not.

2 Minor comments

- l 48: "The temperature effects stem from the temperature dependance of oxygen isotope fractionation during condensation and ..." -> "The temperature effects stem from the oxygen isotope fractionation during condensation and ...". The contribution of the temperature dependance of the fractionation coefficient in the temperature effect is small (e.g. realistic results can be obtained even with constant isotopic fractionation: Galewsky and Hurley (2010)).
- l 59: "depleted" -> "enriched"? Actually, it depends depleted or enriched compared to what, but the specificity of evapo-transpiration is to be enriched relatively to the overlying water vapor, and thus to have an enriching effect of the water vapor (Gat and Matsui (1991)).
- l 64: you can also add Caley et al. (2014) in the citations.
- l 189: define "OIPC": is it the dataset described above?
- Figure 3: I have trouble reading this figure. For $\delta^{18}O$, is it possible to have the same y-scale for $\Delta\delta^{18}O_{precip}$ and $\Delta\delta^{18}O_{spel}$? This would allow a direct visual comparison of these 2 quantities. I also have trouble seeing whether anomalies

are negative or positive: could you draw an horizontal line to indicate the 0? The 0 line could be shared for all potted variables.
In addition, why do you compare observed $\Delta\delta^{18}O_{spel}$ to simulated $\Delta\delta^{18}O_{precip}$? Why not converting simulated $\Delta\delta^{18}O_{precip}$ into $\delta^{18}O_{calcite}$ for a more rigorous comparison?

- l 270: "consistently low PCoA1 scores": what does it physically mean?
- l 300: "The regional composites are z-scores, i.e. anomalies with respect to the base period (3000-7000 yr BP)." Are these just anomalies or true z-scores? Please clarify how you calculate those z-scores and what they physically mean. And why using z-scores in the first place? Why not just simple anomalies?
- Fig 4: what are the units of the plotted variables? Please add the units on the y-labels. I have trouble to compare the simulated and observed $\delta^{18}O$: please use similar diagnostics and units for both. For example, convert precip $\delta^{18}O$ into calcite $\delta^{18}O$ for the model, and use simple $\delta^{18}O$ anomalies for the speleothem observations.
- Fig 6: can you explain better how these diagrams should be interpreted? What do they physically mean?
- Fig 6, section 3.4: on which model was this regression analysis done? GISS or ECHAM? More generally, why doing each diagnostic with only one model? Why not doing each diagnostic with each model (when the period of interest is available), to assess the robusntess of the results?
- l 380: "drivers" -> "meteorological variables". This is just a statistical analysis, so no causality can be identified, so the meteorological variables cannot be assumed to be drivers.

- l 389: “changes in precipitation amount” -> “changes in local precipitation amount”: changes in upstream precipitation amount has been shown to be very important in previous studies (e.g. Battisti et al. (2014)) but were not analyzed here.
- Table 1: too many digits in the numbers.

References

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