

Interactive comment on “Modeling precipitation $\delta^{18}\text{O}$ variability in East Asia since the Last Glacial Maximum: temperature and amount effects across different time scales” by X. Wen et al.

Anonymous Referee #1

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General comments: This study looks at how $\delta^{18}\text{O}$ precip relates to temperature and precipitation over the East Asian monsoon regions on time scales of variability from seasonal to millennial using an isotope-enabled atmosphere-only climate model. The authors find interesting results that they say mean that $\delta^{18}\text{O}$ speleothem records should be interpreted with caution. I am very supportive of such modelling work to help the palaeoclimate community to better understand how isotopic data might be interpreted. I did though find the paper was quite descriptive and short in its explanations, and would benefit from the addition of further investigation into all the main points they made in order to improve the mechanistic understanding (see comments below). I recommend this be done before the manuscript can be published.

C1

Specific corrections: Abstract Line 1: change “Water isotope in precipitation has played a key role” to “Water isotopes in precipitation have played a key role”

Abstract line 1: add references to support the first statement

Abstract line 5: Although I realise ‘thru’ is sometimes used for ranges esp. in American English, I would recommend changing “22ka thru 00ka using an isotope-enable AGCM” to “22 ka to 0 ka using an isotope-enabled atmospheric global circulation model (AGCM)”.

Abstract line 7: “Our study confirms the robustness of the temperature and amount effects on the seasonal cycle over China” – does this statement refer just to the present day? Please add to the text.

Abstract line 8: “our analysis does not show significant temperature and amount effects over China on millennial and interannual timescales” – do you mean no significant change, or neither is significantly dominant?

Introduction page 1 line 13: “Sturm et al., 2010; Noone, 2008” – add an ‘e.g.’ and perhaps reference to some of the older earlier pioneering papers on this

Introduction page 1 line 15: “local temperature effect”, whereas the $\delta^{18}\text{O}$ -precipitation relationship in the tropics and low latitudes tends to be associated with the “amount” effect” – I would be keen to see a small amount of explanation of these terms for any readers who might be relatively new to the subject.

Page 2 line 9 Change “East Asia locates at the transition zone” to “ East Asia is located at . . .”

Page 2 line 10 “still remains as a great controversy” – delete “as”

Page 2 line 11 and all other instances of “isotope-enable GCM” change to “isotope-enabled GCM”

Page 2 line 20: delete “proxies”.

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Page 2 line 26: "These experiments are forced by the realistic green house gases (GHGs) concentrations, orbital parameters, land ice sheet and land-ocean mask" – are these all the same boundary conditions as used in the Liu et al. papers, as well as the SSTs/sea-ice?

Page 2 line 30: "1.6‰ (22ka) to 0.5‰ (0ka)" - please say/reference where you have derived the values from, which have then been linearly interpolated, if I understand right.

Page 3 line 1: add reference for the GNIP data

Page 3 line 3: change "This dataset has sufficient spatial coverage. But majority of..." to "This dataset has sufficient spatial coverage but the majority of..."

Page 3 line 4: change "there is only12 stations" to "there are only12 stations"

Page 3 line 4: change 'showing' to 'shown'

Page 3 line 18: "For each region, the modeled seasonal cycle are derived from" change to "For each region, the modeled seasonal cycle is derived from"

Figure 2: I know the names of the GNIP stations used are included in the plot, but is it also possible to add in the number that corresponds to the number of the site in figure 1.

Figure 2: The comparison of the left and right hand graphs is slightly improved as the y-axes have different limits. While I see that this is to maximize the details, it would be easier to make comparisons if the scales were the same. – Actually I realize this is mentioned on page 4 in the penultimate paragraph.

Page 3 line 20: why only use the 'GNIP station that has the longest records in that region' in the comparison in figure 2. Have you checked whether there is good correspondence between the one record chosen for each region and the other shorter records in the region? I.e. is each particular record indicative of the overall pattern in

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the region? Otherwise it seems insufficient reason to choose a particular record based on its length, or say why a longer record is better – e.g. to reduce the impact of interannual variability? Related to this – page 4 paragraph around line 25 – states that the $\delta^{18}\text{O}$ values have somewhat different magnitudes although the phase is a good match with the data, however, there are similar differences in precip and temperature between model and data (as I'd imagine with most models), which might be worth also pointing out in this paragraph.

Page 4 line 8: discusses that the $\delta^{18}\text{O}$ signal from the model in southern China doesn't replicate the seasonal pattern in the data and suggests a resemblance to the 'third mode' as discussed in the following paragraph. However, no mention is made of the fact that the seasonality of precipitation isn't quite right over S China either and how this could influence the mismatch between the model and data $\delta^{18}\text{O}$.

Page 4 line 18: change 'implications to the interpretation' to 'implications for the interpretation'.

Page 4 line 20: 'Thus, we would suggest that one should NOT interpret the $\delta^{18}\text{O}$ records around this region simply as the monsoon rainfall amount.' One could also suggest that the boundaries between these different regions could change significantly over time (through glacial-interglacial cycles for example). It would be useful if the authors could say something regarding this uncertainty and the implications for interpretation of palaeo-isotopic records.

Page 4 line 31: 'This distinctively different three regions' change to 'These three distinctively different regions'

Page 5, line 10-15 These lines contain a suggestion of why south Asia and East Asia show different correlations between $\delta^{18}\text{O}$ and temp/precip on interannual timescales, but not enough detail to understand the mechanisms for this beyond them having different moisture sources. I suggest a clearer and more detailed explanation is necessary here.

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Page 5 line 20: 'using the last 40 years of model output' do you mean where each of the 23 year time slices provides one time point that is the average of the last 40 model years of that simulation. Text could be a bit clearer.

Page 5 line 25 onwards: it is an interesting result that millennial-scale variability in d18O doesn't reflect high significance in correlation with local temperature or precip. In line with other studies, the authors suggest that d18O over East Asia could be influenced by upstream moisture transport from the Indian monsoon region (similar to Pausata et al). However, they do not investigate this any further in their model so we do not learn as much as we could about what mechanisms are important factors here. The authors have all the data at their disposal and so could look at e.g. correlation at the millennial time-scale of Indian monsoon temp/precip/d18O with d18O over China, and variability in the southerly monsoon winds etc. I would like to see the authors examine what is driving their millennial scale variation further.

Page 5: line 25: Related to the above point, does the seasonality of precipitation/temperature/d18O change much in the different locations in these 23 time slices? Do the seasonal correlations, interpreted as d18O being affected by the temperature effect in the north and the precipitation effect in the south still hold for the same locations or do the boundaries change from glacial to interglacial time slices?

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