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Climate of the Past
Discussions

Interactive comment on "Modeling precipitation δ^{18}O pariability in East Asia since the Last Glacial Maximum: temperature and amount effects across different time scales" *by* X. Wen et al.

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We would like to appreciate the anonymous reviewer for his/her helpful comments. The original comment (Q) and our response (A) are as follows:

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Q: The authors used a list of time slice experiments by an isotope-enabled GCM to evaluate the changes in precipitation d18O on various timescales. It is an interesting work and might give some insights for the interpretation of stalagmite d18O, especially for the paleoclimate reconstructions in Asia. I do not know whether these experiments are the same as those in Liu et al. 2014 QSR or not. The authors should clarify

this in the section of model description. These experiments are no doubt useful for exploring the interpretation of the precipitation d18O over the East Asian on different time scale. However, I am afraid that the present experiment design is not reasonable enough for examining the changes in d18O, especially on the seasonal and interannual timescales. The present 0Ka experiment may neglect some major changes in boundary conditions and can not directly compare to the modern GNIP observations. Are the greenhouse gases and sea surface temperature kept constant? Why do the authors not employ the observed GHG and SST to force the atmosphere model? This experiment is necessary and do not need much time. I strongly recommend to add this experiment and to reanalyze the results.

A: Yes, the numerical experiments are the same as those in Liu et al. (QSR, 2014). We added a sentence in section 2 to clarify this point. In Liu's paper (2014), we discussed the dynamic linkage between Chinese d18O and East Asian summer monsoon, whereas in this paper we would like to discuss the robustness of interpreting d18O records in terms of two effects on three different timescales: seasonal, interannual, and millennial. At the early stage of this work, we planned to focus on 4 timescales: millennial, interdecadal, interannual, and seasonal. But the big problem is lack of observed d18O record on interannual-to-interdecadal timescales. Most of the records from GNIP network have no more than 8-year (1985-1993) consecutive history (See Fig 1b). Thus, we removed the "interdecadal" and focus on the remaining three, among them the "interannual timescale", relatively, could be lacking data most. In general, the interannual variability of d18O or other variables include two sources: climate system internal variance and responses to external forcing. The observed d18O records are too short to reliably account for both. Our 00ka slice was driven by 1950 boundary conditions and was integrated for 50 years, which is able to provide more samples on interannual timescale than GNIP for internal variability problem, but for forcing-response problem. This is the shortage of current experiments. Thank the reviewer's kind suggestion, we would like to develop a number of AMIP-type ensemble experiments in the next phase to investigate the response and sensitivity of water isotopes to external forcing, like ENSO or global warming.

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Q: The authors use a series of time-slice experiments for the last 22 ka to evaluate the "temperature effect" and "amount effect" on millennial time scale in different regions in East Asia. I think that the author should present the long-term changes of precipitation d18O in these model simulations and compare them with the proxy records. If the outputs of these experiments capture the variations in the proxy time series, then it's robust to test the interpretation of the precipitation d18O on millennial time scale by using the model simulation. Otherwise, the bias in the model itself will mask the real processes which affect the precipitation d18O changes. This is fundamental to the model simulation. The authors must cross check the model outputs with the real observations and then come to the conclusion.

A: Thanks for this great comment! We compared the model results (d18O, precipitation, and meridional winds) with proxy data in Liu et al. (QSR, 2014). It is shown that the model successfully reproduces the observed orbital and millennial variability as compared to multiply proxies and generates reliable monsoon-associated anomalous circulation (in Liu et al., QSR, 2014, Fig 2e shows model results by comparing with d18O proxy and V winds; Fig 2f and 2g shows the comparison of modeled precipitation and other lake sediment proxies). This forms the solid base for present investigation. We attached this paper as a supplementary file.

Reference: Liu, Z and X Wen et al., 2014: Chinese cave d18O records representing East Asia summer monsoon, Quan. Sci. Rev., 83, 115-128.

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Q: As shown in figure 3, the authors correlate the annual mean d18O weighted with precipitation to the DJF temperature and JJA precipitation on the interannual and millennial time scales (panel c-f) and then use this statistic result to argue the "amount

effect" and "temperature effect". This is totally wrong! Because the annual mean temperature may not change the same way as the DJF temperature, and also the varied precipitation seasonality (as shown in figure 2) in different regions may deny the dominant contribution of summer precipitation to the annual precipitation.

A: Many thanks! The observed d18O records in speleothem, fundamentally, reflects precipitation-weighted annual mean value. For Asian monsoon region, it could be considered that these cave d18O records mostly take summertime rather than wintertime information. However, the water stable isotope's temperature effect mainly occur over high latitudes in winter, whereas the amount effect mainly occur over tropics in summer. Thus, in the discussion version of the manuscript, we compared prec.-weighted d18O with DJF temperature and JJA precipitation. Here, we re-examine this problem for millennial (supplementary Figure 1) and interannual (supplementary Figure 2) timescales. It is shown that the prec.-weighted annual mean of temperature and precipitation could be the appropriate variables accounting for temperature effect and amount effect. They are even more reasonable than equal-weighted annual mean by emphasizing rain-season footprint. Also, the varied seasonality of precipitation is implicitly considered. We will replace the corresponding plots in Figure 3 and modify the text in the revised manuscript.

We further investigate the robustness of interannual patter (as above) of temperature/amount effects across the past 22,000 years (say, 20ka, 15ka, 10ka, 5ka, and 0ka), as shown in the supplementary Figure 3. It is shown that the weak correlation (the blank) region does not change much, suggesting the conclusion that one should be very cautious in interpreting d18O records for this area on interannual timescale still remain.

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Q: Page 1 line 19, the citation of Yuan et al., 2004 is wrong. It presents the speleothem d18O record from southern China.

A: Thanks, we moved this item to speleothem part.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/cp-2016-2/cp-2016-2-AC2-supplement.pdf

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-2, 2016.

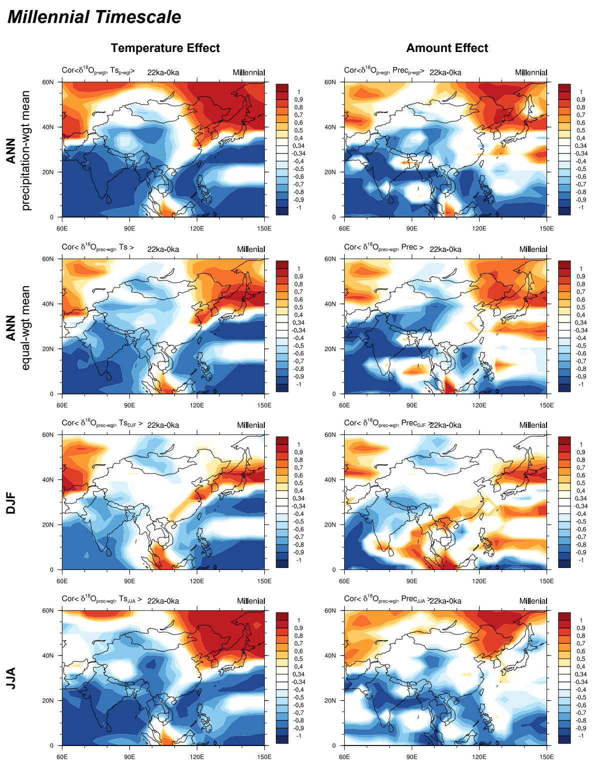

Fig. 1. Selection of temperature/precipitation associated with precipitation-weighted annual mean d18O through temperature/amount effect on millennial timescale.

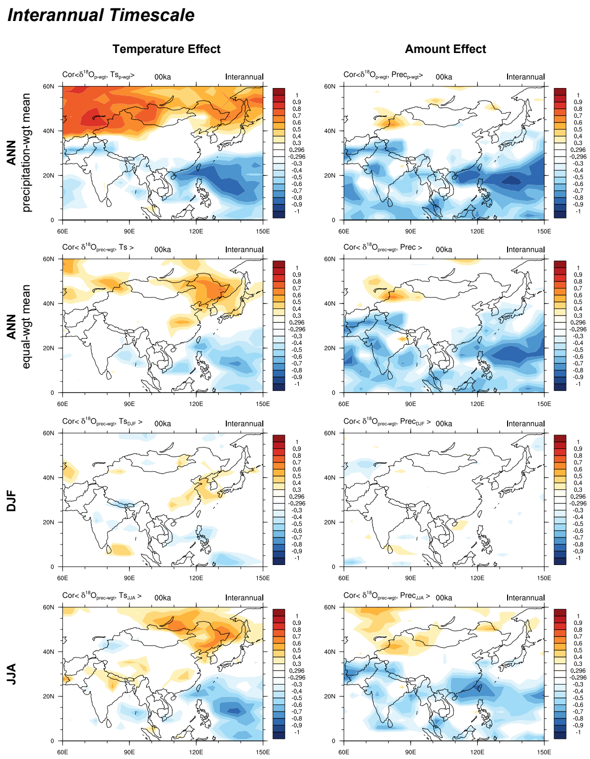

Fig. 2. Selection of temperature/precipitation associated with precipitation-weighted annual mean d18O through temperature/amount effect on interannual timescale.

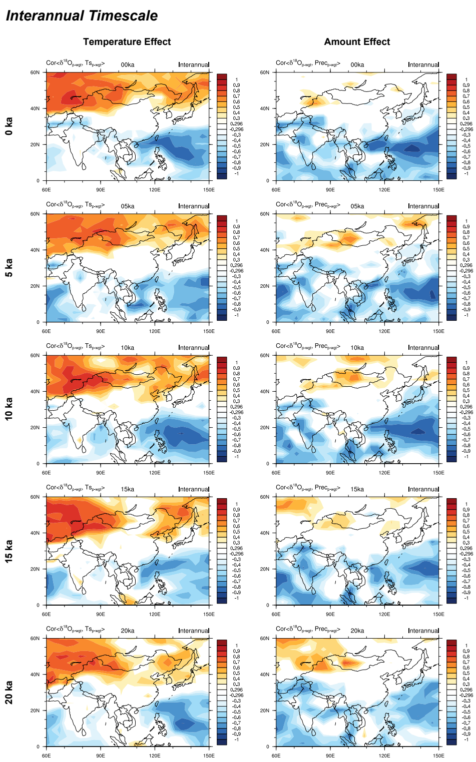

Fig. 3. The variation of spatial pattern of temperature/amount effect on interannual timescale across the past 20,000 years.