Clim. Past Discuss., 8, C1146–C1154, 2012
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Climate of the Past Discussions

Interactive comment on "Modeling the climatic implications of the Guliya δ^{18}O record during the past 130 ka" *by* D. Xiao et al.

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Response to Interactive comment 1 on "Modeling the climatic implications of the Guliya δ18O record during the past 130 ka"

Anonymous Referee #1

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The authors used an intermediate-complexity UVic Earch system climate model to simulate the Guliya surface air temperature (SAT) and analysis the relationship with simulated SST. The authors made a comparison between observed Guliya d18O and simulated Guliya SAT superficially. They concluded that Guliya d18O is an indicator of the August–September SAT in the NH and the Guliya precipitation may act as a "bridge" linking the SAT and the North Atlantic SST. This is a good attempt to link the atmospheric circulation processes in the northern polar region with that in the third pole region based on ice core record. The results are worthy publishing after major revisions.

Response: Thank you very much for your important comments. The manuscript has been greatly modified according to your comments.

In my opinion, there are five major problems in the manuscript:

1.The manuscript body is not fairly organized, no systematical discussion, and the interpretations are superficial given the available data. Authors need to present their work with better clarity.

Response: In this reversion, we have reorganized the entire manuscript and added more descriptions and explanations, particular in a comparison between the simulated Guliya SAT and the Guliya δ18O. For example, first, we modified the first paragraph of Section 3 to tell why we show the annual cycles of the incoming solar radiation and simulated SAT in Guliya. Second, we increased the annual cycle of incoming solar radiation anomalies as Figure 1a to explain the variation of the annual cycles of simulated Guliya SAT anomalies in Figure 1b. Third, we increased the discussion on the correlation coefficient between the simulated monthly Guliya SAT and Guliya δ18O in Figure 2. At last, the spatial representation of Guliya δ18O is discussed in Section 5.

Please see them in Page 9–12 in the modified manuscript.

2. The analysis on Guliya d18O and simulated SAT is too superficial to confirm the conclusion that d18O indicates the later summer temperature.

Response: We rewrote Section 3 and added some discussion about the relationship between Guliya δ18O and simulated August–September Guliya SAT. We analyzed the relationship between the Guliya δ18O and the simulated Guliya SAT in detail, compared the whole and sub-stage conditions between the Guliya δ18O and simu-

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lated August–September Guliya SAT, and examined whether the simulated August–September Guliya SAT could capture the main periods of Guliya δ18O. These results show that the simulated August–September Guliya SAT could reproduce the main varying features of the Guliya δ18O. Therefore, we proposed that the Guliya δ18O may indicate the local August–September SAT.

Please see the corresponding modifications in Page 9–12.

3. The title is not consistent with the context. The function of d18O is almost missing and there is no comparison between d18O record and simulations.

Response: We have changed the title to "Modeling the climatic implications and indicative senses of the Guliya δ18O temperature record to the ocean-atmosphere system during the past 130 ka".

4. Figures are not elaborated very much to pull meaningful and more specific conclusions. Many of them are just described by one sentence in the text. There is no logical relationship arrangement of so many figures.

Response: According to your suggestions, we have added more descriptions about many figures and organized the entire text so as to make it more logically be presented. For example, we added some discussions on the seasonal asymmetries of the incoming solar radiation anomalies and Guliya SAT anomalies and on a relationship between the simulated Guliya SAT and Guliya δ18O.

Please see the changes in Page 9–15.

5. The authors said that "demonstrating that the Guliya late-summer precipitation leads the Guliya temperature". They need more evidences and discussions to confirm it. Furthermore, there are many obvious arbitrarily conclusions in the text.

Response: According to your comments, we have greatly modified the sentences in which there are "obvious arbitrarily conclusions". For example, we have changed the description "demonstrating that the Guliya August–September precipitation leads the

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Guliya temperature” to “and suggests that the simulated Guliya precipitation may lead the simulated Guliya SAT in August–September” in Line 14–15 in Page 19.

In fact, the mechanism between the simulated Guliya August–September precipitation and Guliya August–September temperature is very complicated, beyond this manuscript, which will be highlighted in the future work.

Moreover, we have also changed the several words of the conclusion in the manuscript to make them more precise.

Some specific comments as follows:

1.Fig 1. The relationship is not robust from present to 60ka, and weaker than that before 60ka. There is no discussion in this part.

Response: The variation of incoming solar radiation is controlled by the astronomical parameters (precession, obliquity, and eccentricity). It can be seen from Figure A(d) that the eccentricity was smaller from 60 ka BP to the present than before. Meanwhile, the precession is weaker than before. Because the variation of precession is modulated by the eccentricity (Ruddiman, 2006), the 21-ka precession cycles were weaker from the present to 60 ka BP compared to that before 60 ka. Therefore, the anomalies of incoming solar radiation and Guliya SAT anomalies, which were weaker from the 60 ka BP to the present, were due to the variation of eccentricity.

In this revision, we have added the descriptions of incoming solar radiation and the discussion on why the simulated Guliya SAT anomalies were weaker during 60ka to the present in the first and second paragraph of Section 3. Please see it in the manuscript.

2. How do authors calculate correlation between Guliya d18O and simulated monthly SAT? Are linear interpolated data used?

Response: Yes, the correlation coefficients between simulated monthly Guliya SAT and linear interpolated Guliya δ18O were calculated in this study. Moreover, the authors descripted it in Line 22 in Page 8. The sentence is as follows “Because there are 1308 model years in this simulation, the Guliya δ18O data obtained from Yao et al. (1997) with 1875 samples during the past 130 ka are linearly interpolated over the 1308 model years."

3. Based on Fig 8, it seems that there is no relationship between late summer Guliya SAT and Arctic SATs.

Response: The correlation coefficient between the simulated Guliya SAT and simulated Arctic SAT is 0.58, suggesting a close link between them. Meanwhile, according to another reviewer's suggestion, in order to examine the contribution of precession and obliquity cycles to the two anomalous patterns, we replaced the simulated Arctic SAT with the obliquity parameter in Figure 7. The associated descriptions were also changed in the manuscript.

Please see the changes in Line 5–20, Page15.

4. Why choose the 21 ka SAT as the test period in section 4? How about other periods?

Response: In this manuscript, both the 21-ka precession cycle and the 43-ka obliquity cycle are discussed. Because the 21-ka precession cycle of the Guliya δ18O and the simulated August–September Guliya SAT is stronger, while its 43-ka obliquity cycle is weaker, we focus on the indicative senses of Guliya SAT to SAT and SST between the warm and cold phases of the precession of the Guliya SAT in August–September. However, these two anomalous SAT patterns between the warm and cold phases of the simulated August–September Guliya SAT alternate with a period of approximately 43-ka obliquity cycle. Therefore, the influences of obliquity cycles on SAT and SST are also contained and discussed in this manuscript.

Please find the descriptions in the last paragraph in Section 4.1 in Page 14.

5. Annual cycles are analyzed several times in the text. Could you demonstrate if they are valid with Guliya d18O?

Response: The gauge monthly Guliya δ18O started from the early 1990s and the time resolution of the reconstructed Guliya δ18O temperature record is approximately 0.07 ka. It is difficult to demonstrate the validity of the annual cycle of the simulated SAT according to that of gauge Guliya δ18O during the past 130 ka. Thus we give some indirect discussion as follows.

As noted in the introduction, the annual cycles of the Guliya nearby gauge SAT is well correlated to that of the Guliya δ18O using the early 1990s data (Yao et al, 1996). Expediently, we compared the annual cycle in the simulated Guliya SAT and the Guliya SAT in the Climatic Research Unit (CRU) analysis data in the last century (Mitchell and Jones, 2004). Figure B shows the annual cycle (red) Guliya SAT from 1901 to 2000 in CRU data and that of simulated SAT (green) from 1 ka BP to present (10 model years) under the astronomical forcing. It can be seen that their annual cycles show a consistent variation. Although the simulated Guliya SAT are higher than the Guliya SAT in CRU data in the latter half year, the UVic Model does well simulation on the annual cycle of the Guliya SAT. We have added the associated description in Page 16 in Section 4.2.

References

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Yao, T. D., Lonnie, G., Thompson, E. M., Yang, Z., Zhang, X., and Lin, P. N.: Climatological significance of δ18O in the north Tibetan ice cores, J Geophys Res, 101(D23), 29531-29537, 1996.

Thank you very much for your efforts and time on this manuscript again!

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/8/C1146/2012/cpd-8-C1146-2012-supplement.pdf

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Interactive comment on Clim. Past Discuss., 8, 1885, 2012.

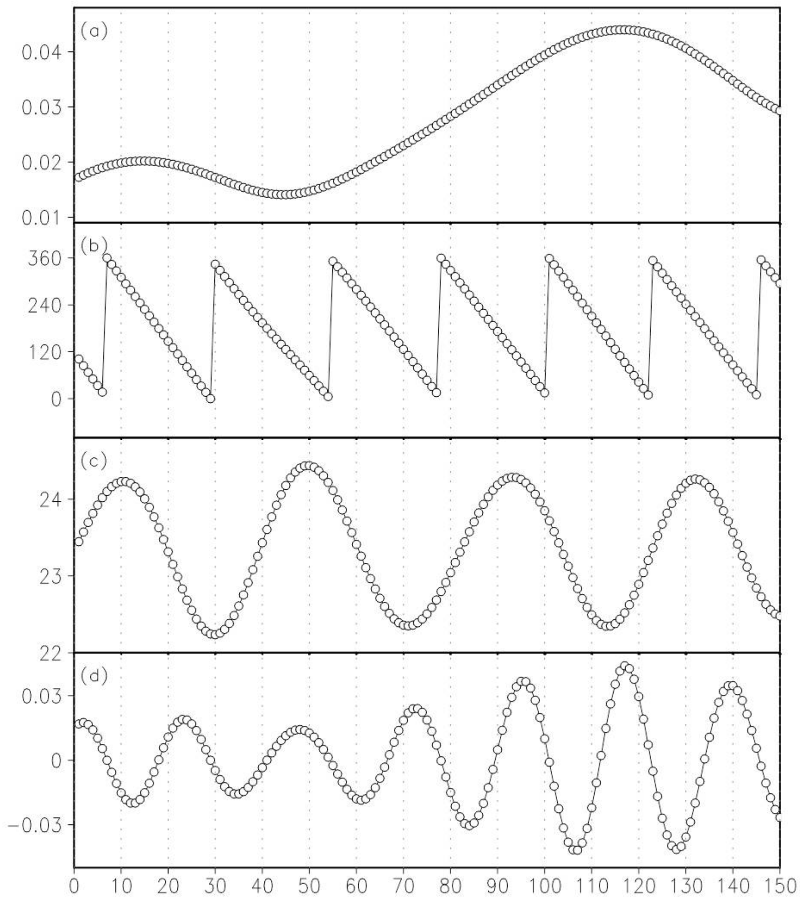

Fig. 1. Fig.A Astronomic parameters (a) eccentricity, (b) celestial longitude, (c) obliquity, and (d) precession in past 150 ka. The unit of abscissa and ordinate are ka BP and radian, respectively.

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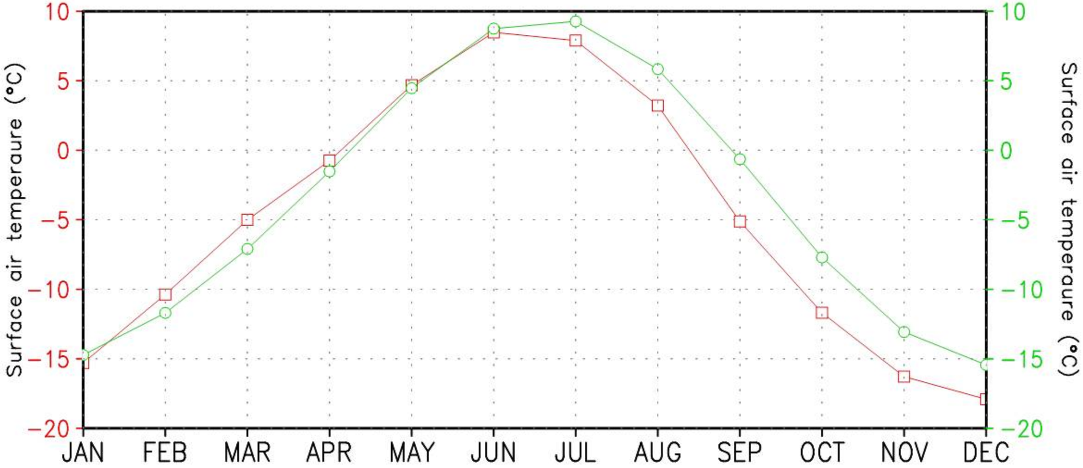

Fig. 2. Fig.B Annual cycles of Guliya SAT (red) in Climatic Research Unit (CRU) data averaged from 1901-2000 and simulated SAT (green) from 1 ka BP to present (10 model years) under only orbital forcing.