

Review of the manuscript entitled "Comparison of Cenozoic surface uplift and glacial-interglacial cycles on Himalaya-Tibet paleo-climate: Insights from a regional climate model" by Paeth et al.

This paper used a high-resolution regional climate model nested within an atmospheric model to investigate and compare various episodes of distinct climate states over the Tibetan Plateau region during the uplift of the plateau and Quaternary glacial/interglacial cycles, aiming to address the former hypothesis from Prell and Kutzbach (1992). The comments are as follows.

Major comments:

1, The climate effect due to the Tibetan Plateau uplift occurs on the tectonic timescale, and LGM and mid-Holocene are two representative intervals for the latest glacial and interglacial ages on the orbital timescale. The related climate changes at large and regional scales have been paid more attention to in recent decades. However, both questions are far from clear from the perspectives of both reconstructions and simulations at this stage. In this situation, it is difficult to address both questions on different timescales through sensitivity and time-slice experiments and hence test the hypothesis proposed by Prell and Kutzbach (1992). By the way, glacial-interglacial cycles indicate multiple cycles from glacial via interglacial to glacial periods, and LGM and mid-Holocene are only two typical intervals approximately 21,000 and 6,000 calendar years ago. Using the two intervals to represent glacial-interglacial cycles is not appropriate, particularly considering that mid-Holocene is moderate compared to earlier interglacial ages such as the last interglacial period.

2, At the moment, there are lots of debates about the history of the Tibetan Plateau growth throughout the Cenozoic. In the introduction section, the authors should give an overview of the main options about the issue in the literature. For example, the authors mentioned "Miocene-Pliocene uplift period"

for several times and “Altai region in the northern part of our model domain was built prior to the TP uplift”. Actually, many studies have indicated that the central-southern TP has already uplifted before the Miocene, and if the authors consider the Miocene-Pliocene uplift, they should emphasize the uplift of northern mountains, including northern TP, Tianshan and possibly the Mongolian Plateau, but not to the uplift of the whole plateau. Because the authors use idealized uplift scenarios, I suggest the authors consider the uncertainties in the uplifted history and add more discussions on uncertainties in the uplift history.

3, The authors discuss the climate consequences of the Tibetan Plateau mainly based on the regional climate model REMO in the current version. On one side, the authors should present the results of atmospheric general circulation model ECHAM5 that drives REMO. Of importance is also the difference between ECHAM5 and REMO in response to a stepwise uplift of the model topography. This is because readers cannot know the present results of REMO come from ECHAM5 or REMO itself, and hence the added value of REMO. On the other side, the authors must compare the present results to the previous numerical experiments from both global and regional climate models, and then readers can understand new insights.

4, LGM and mid-Holocene climates on and around the Tibetan Plateau and in Asia have been extensively investigated using many global climate models and a few regional climate models. The authors should compare your ECHAM5 and REMO results to earlier those experiments, and then indicate the similarity and difference between each other.

5, The current comparison between simulations and reconstructions is not enough. First, the simulations on the Tibetan Plateau should be compared to available geological records and then clarify the implications of the simulations. Second, only pollen data are applied for comparison with the LGM and mid-Holocene simulations. Actually, there are lots of qualitative and

quantitative temperature and moisture reconstructions available for the two periods, and have also been used to compare with PMIP-type experiments in the literature. A more detailed model–data comparison is necessary.

6, The present results of temperature and precipitation changes due to the growth of the Tibetan Plateau and the LGM and mid-Holocene external forcings are too descriptive. The related atmospheric dynamical analyses are necessary, for instance atmospheric circulation and atmospheric water vapor flux changes associated with precipitation and in turn moisture changes.

Minor comments:

1. L68-69, “Quaternary Quaternary” need to be edited.
2. L120-121, The third objective is similar to second objective, please rewrite this objective or combine these two objectives together.
3. L172-189, Shorten or moved to the “modeling design” section.
4. L246-248, Are you sure that Diethrich et al. (2013) described the boundary conditions for the LGM experiments? By the way, it is late Holocene, instead of late Holocene, in the title of the reference.
5. L295 and L922, which one is the validation period, 1978-1989 or 1971-2000?
6. L331-333, “it is a nonlinear function of reduced topography since the warming exhibits larger magnitudes in the 75% and 50% experiments than in the 25% and 0% experiments.” Please give more explanations about this statement.
7. L337, L356, and L597, the authors mentioned the “circulation changes” several times. But this is no circulation changes on all figures. Please show circulation changes.
8. L338-340, for “enhanced cold air advection”, please show circulation

changes to support this.

9. L357, for 25% of present-day elevation, the statement seems differ from that important climate change occurs when TP reaches 50%, why?
10. L360-361, the winter monsoon flow is cold and dry, how does this cold and dry flow increase the relief rainfall?
11. L58-59 and L378-397, does the downward movement induced by the uplift of the plateau affect the arid regions of western China? How does the uplifted plateau affect the stationary wave train?
12. L406, word "Tharr" needs to be edited.
13. L432, I think removing "0%" is better.
14. L513-515, please show other atmospheric variables you mentioned to support your idea, or I will think the cluster analysis do not work in this situation.
15. L540-541, see line 357.
16. Figures 8 and 13, Indicating the meaning of the number in the color bar.
17. Figure 14 and L536, in cluster 6, no uplifting symbols.