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Climate of the Past Discussions

Interactive comment on "Comparison of Cenozoic surface uplift and glacial-interglacial cycles on Himalaya-Tibet paleo-climate: Insights from a regional climate model" *by* Heiko Paeth et al.

Anonymous Referee #1

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The authors use a regional climate model (RCM) in order to investigate Asian climate changes in the Miocene-Pliocene uplift period, last glacial maximum (LGM) and the mid-Holocene optimum (MH). Their study is within the scope of Climate of the Past. Resolution of their simulation is higher than ever before, and their main results are reasonable. However, the research lacks novelty, listed below are some comments.

1. Stepwise uplift experiments: The experiment design is old-fashioned and imperfect. They followed previous study of Liu and Yin (2002) who had first investigated effects of the Tibetan Plateau (TP) uplift using stepwise uplift approach (0%, 10%, 20%, 30% . . . and 100%) experiments. Nowadays, actually, various improved uplift schemes have

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been proposed (see the review by Liu and Dong, 2013), especially considering of regional differences of surface uplift (Liu et al., 2017). However, even if a high resolution RCM was chosen, this study used an idealized uplift scenario without consideration of regionally differentiated uplift rates. Besides, the more important is that they limit the TP uplift to the Miocene-Pliocene period. Actually, more and more evidences show that main body of the TP has uplifted to 3000 meters or higher altitude before the Miocene (Rowley and Currie, 2006). In their 0% experiment (Fig. 2e), the TP was removed but Mongolian Plateau maintained. According to geological evidence (Windley and Allen, 1993), the uplift of Mongolian plateau is believed as a late Cenozoic event, and the Mongolian plateau should be younger than the TP. Therefore, their experiment design is inconsistent with the geological records.

2. LGM and mid-Holocene simulations: There are many published paleo-climate simulations including Asian monsoon and the TP regions for the LGM and mid-Holocene, and the authors listed part of them in their manuscript. Unfortunately, I cannot find any new contribution and progress from this study compared with previous researches in understanding the pattern or mechanism of regional climate change for the two typical geological periods.

3. High resolution climate simulation: The authors have repeatedly mentioned that their simulations have the advantage of high resolution, but the advantage seems not obvious from current manuscript. Many features of climate change along with the surface uplift or glacial/interglacial cycle are well known to the scientific community, such as drying in Asian inland with the TP uplift, warming and wetting during the MH, and cooling and drying during the LGM. Therefore, it did not help to deepen our understanding effect of the TP uplift or lower-boundary condition change on Asian climate. For example, we read “the disappearance of the arid climate types north of the TP in the 25% and 0% experiments is a feature that only occurs at higher resolution in REMO” in line 619-620. In fact, a low-resolution simulation without topography also shows the disappearance of Asian mid-latitude arid zone and occurrence of sub-tropical arid zone in

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South and East Asia (Liu et al., 2015).

4. The Cenozoic plateau uplift and Quaternary glacial/interglacial cycle comparison: The authors stated “The first objective of our study addresses the former hypothesis from Prell and Kutzbach (1992), suggesting that glacial versus interglacial boundary conditions during the Quaternary can produce climate anomalies across the TP that are in the same order of magnitude as during Cenozoic (last ∼55 Ma) surface uplift.” in the introduction. Actually, Prell and Kutzbach (1992) have not clearly proposed that hypothesis in their article. They used GCMs to estimate the sensitivity of the Indian monsoon to changes in orbital parameters, the orography of Tibet-Himalaya, atmospheric CO2 concentration and the extent of glacial-age surface boundary conditions and showed that increased elevations and summer solar radiation are most effective in strengthening the monsoon. Note that their focus was the sensitivity of the Indian monsoon rather than “climate anomalies across the TP”. As for the surface air temperature on the TP, it is not surprising that there are great surface temperature changes with the surface uplift of thousands of meters. Therefore, as far as the uplift region itself is concerned, it is not much significance to compare the uplift induced changes and those determined by the glacial-interglacial cycle.

5. Expression and clarification: Some places need more explicit statements in this manuscript. For example: a. How to set up the SST in the regional model experiments? b. How to set up the land vegetation and type in the stepwise uplift experiments? c. It is not clear “temperature changes” in Fig. 4 or “precipitation changes” in Fig. 5. Control minus Sensitivity experiment or Sensitivity experiment minus Control? d. Fig. 7 indicates annual mean or seasonal mean? e. There is no valuable conclusion in the conclusion section. It seems to be somewhat redundant. f. line 897, "oft he" -> "of the".

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