Clim. Past Discuss., 11, C15–C19, 2015
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Climate of the Past Discussions

Interactive comment on "Strong winter monsoon wind causes surface cooling over India and China in the Late Miocene" *by* H. Tang et al.

Anonymous Referee #1

Received and published: 12 February 2015

In this manuscript, Tang et al suggested that the Asian winter monsoon was stronger-than-present in the late Miocene, leading to cooler-than-present winter surface temperatures in southern China and India. Their study was started by a tentative reconstruction of surface temperature using plant and mammal fossil data. Part of the obtained MAT (mean annual temperature) and CMT (coldest month temperature) from southern China and India showed lower-than-present values. This led the authors to believe that late Miocene winter temperature was cooler-than-present in southern China and Indian, due to stronger-than-present winter monsoon.

The topic of the ms is of interests as the late Miocene has been tied with a series of regional climate and tectonic changes in Asia. It also corresponds to a critical period of the Cenozoic global cooling. Reconstructions of the late Miocene climate and relevant

circulation pattern are helpful towards a better understanding of this regional/global climate-tectonic complex.

However, I don't think the efforts of Tang et al are successful because of the following uncertainties.

DATA AND PROXY RECONSTRUCTIONS

The authors used pollen, macroflora, and mostly mammal fossils to reconstruct the late Miocene temperature. Considerable uncertainties could be raised due to the insufficient accuracy of their chronology, the wide and insufficiently understood habitat tolerance, the unknown elevation, the representativeness of the found flora/mammals in the ecosystems, the unknown effect of CO_2 for plants, and the methods used, etc.

Such kind of temperature reconstruction is only qualitatively and statistically significant. It would be an over-exploration, to my view, to make quantitatively/accurately comparison with the present-day temperature at individual site level. For example, we are unable to exclude the possibility that the authors correlated a late Miocene fossil from a 'cold period' with another late Miocene fossil from a 'warm period', at both long-term or/and orbital scales, given that accurate chronology or lithology/timeseries controls were not well established. This is just like to compare a glacial fossil site to an inter-glacial fossil site for the late Quaternary. The great variability of the estimated results (Table S1 & S2), and the rather large discrepancies between the nearby sites, support these uncertainties about the data quality.

The reconstruction method using mammal fossils is from Liu et al (2012). This method remains preliminary and tentative. It is not yet a commonly accepted method, of which the yielded results should not be used as a basis for comparing the late Miocene and present winter temperatures in a quantitative perspective.

The main scientific proposition of the study that late Miocene winter temperature was cooler than for the present-day is also not justified by the used dataset. Tang et al used plant data from 48 sites and mammal fossil from 174 sites to reconstruct the late Miocene temperature. Among these, only 21 plant sites (∼43%) and 59 mammal sites (∼33%) showed lower-than-present MAT or CMT values (Table S1 & S2), but all the other sites (∼64%), including a great number from southern China and Indian, showed higher-than-present MAT and CMT values (also Fig. 3). I am not clear why the authors optionally took the results from a small proportion of data as the target of the study.

The proposition that late Miocene winter temperature was cooler than for the present-day also contradicts most of the previously published geo-biological evidence while the authors failed to provide any valid explanation or discussion.

It is indeed very unlikely that the higher CO2 concentrations, the ice-free northern high-latitudes (currently with very large ice-sheets), and the globally warmer conditions during the late Miocene could generate cooler-than-present winters. At least, this needs some more robust demonstrations.

MODEL OUTPUTS AND DATA-MODEL COMPARISIONS

Several aspects with regards to the model outputs and data-model comparisons are confusing in the manuscript. The following are some examples.

The authors stated that

- 'both global and regional Late Miocene model runs (GLMio and RLMio) fail to reproduce the decrease of annual or winter temperature compared to present day as showed in the selected fossil' (P72, lines 27-30).

- 'Compared to the effect of the Late Miocene Asian orography, the other Late Miocene boundary conditions seem to have slightly opposite effect. . ., and thus favour a slightly weakened winter monsoon wind in East Asia (Fig. 4c) (P76, lines 1-6).

- 'considering only the effect of the Late Miocene orography changes (RLMio-RLMioPD), the regional model is able to produce the decrease of annual or winter temperature in all these fossil localities, even though the magnitude is still smaller than

that indicated by the proxies (P73, lines 1-4).

These are the main model outputs, but are mostly not supportive to the proposition that late Miocene winter was cooler than for the present. Only an assumptive orography scenario (lower Tibetan Plateau and mountains to the north) could produceïijŇ in the regional model, 'a small-magnitude decrease' of winter temperature. Since the authors explained 'low-than-present winter temperature' by 'stronger-than-present winter monsoon', this last statement about the effect of Tibetan Plateau indeed challenges many of the previously published modeling results, which showed that the uplift of Tibetan Plateau reinforces both summer and winter monsoons. The authors should at least discuss the model dependency in their simulations to challenge these previously published views.

It is hard to believe that the other boundary conditions, such as the ice and CO2 conditions had not obvious impacts on the Asian winter temperatures, as stated in the ms. A lower Tibetan Plateau and lower northern mountains in the late Miocene are also not commonly admitted. Many scientists suggested that Tibetan Plateau would have reached to its maximum elevation by ∼8 Ma.

CLIMATE INTERPRETATIONS

Although both proxy data and model outputs do not really support the view of cooler-than-present winter temperature in southern China and Indian, the authors continue to consider this a true scenario for the late Miocene, and attributed it to 'stronger-than-present' winter monsoon winds.

In terms of geological evidence, no data support 'stronger-than-present' winter monsoon. Tang et al cited Li FJ et al (2008, 2014) to support their view but Li et al has never stated stronger-than-present winter monsoon in their studies. They just recognized that winter monsoon was relatively strong during some late Miocene intervals (compared to the other late Miocene/Pliocene intervals). Stronger-than-present winter monsoon are also in contradiction with most of the geological data acquired up-to-date (references cited on P74, lines 8-10).

Note that the authors also miss-understood these studies (cited on P74, lines 8-10). These colleagues used grain-size to document the winter monsoon history, rather than dust accumulation rate as the Tang et al noted in the ms (P74, lines 10-15). Dust grain-size in China and in North Pacific is a widely accepted proxy for determining past wind strength. These data clearly defined much weaker winter monsoon winds for the late Miocene despite of the sub-order fluctuations. The conclusion for the stronger-than-present winter monsoon is indeed a speculation according to the 'cooler-than-present' winter temperatures. It is also very unlikely that winter monsoon could 'jump over' northern China, leaving it much warmer (as shown in Fig. 3), but only cool southern China and India.

Another main conclusion of the manuscript is that the late Miocene climate/circulation patterns would be different from today and that 'the modern-like interannual variation of winter monsoon with a strong association with the Siberian High and the surface temperature changes in the monsoon region may not have been fully established in the Late Miocene' (P77-78). This is also speculative, lacking necessary demonstrations. Similar-to-present environmental patterns have been well documented by paleobotanic and geological data (e.g. Sun and Wang, 2005, Palaeo-3, 222:181-222; Guo et al, 2008, Climate of the Past, 4:153–174; Wang et al., 2014, Climate of the Past, 10, 2007-2052). The authors should consider these available results.

Based on the above observations, I don't think the present manuscript is a significant contribution to the topic. Consequently, I'd suggest rejecting it.

Interactive comment on Clim. Past Discuss., 11, 63, 2015.