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

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Re: Issue 1 raised by me, problems with reliability of CA/Palaeoflora estimates

The assertion of Tang et al. that climate tolerances have been identified with "sufficient accuracy" has been proven to be wrong for the openly accessible Palaeoflora mean annual temperature (MAT) data using over 200 modern-day validation floras and has never been tested for the mean temperature of the coldest month. The validation floras used by Grimm and Denk (2012) are freely accessible, and include many Chinese, hence, it can be easily shown that CA/Palaeflora would reconstruct mean temperature of the coldest month (CMT) estimates with a precision and accuracy needed for the current study.

Utescher et al. (2014) do not provide any such documentation or validation of the accuracy of Palaeoflora tolerance data or CA/Palaeoflora estimates; the authors clearly state their opinion on p. 61:"There is no definite way to identify the accuracy of the method" (but see e.g. Mosbrugger & Utescher, 1997; Klotz, 1999; Grimm & Denk, 2012; Thompson et al. 2012; all using the reconstruction methods under consideration on modern-day floras to test effective accuracy). I may have overlooked it, but I did not see any data or example provided that would be critical to the estimates used in Tang et al. The only actual comparison relevant to the raised issue in that paper is a comparison of tolerance data provided by Thompson et al. (1999) with Palaeoflora data (Utescher et al., 2014, table 4) showing a 'climate range overlap' (regarding MAT) of "65.05%" to "103.39%" for 25 North American tree species representing 11 genera, including not a single one that informed any of the CA estimates of the studies used by Tang et al. as nearest-living relative (NLR).

Tang et al further state in their response that based on their experience there are only minor differences between previous CA-based palaeoclimate data and recalculated results using the updated Palaeoflora database. This may indicate that the tolerance data for critical NLR is still unrepresentative, and further updating of Palaeflora database is needed.

In this context, I need, however, to point out that many palaeo-MAT estimates in CA/Palaeoflora literature, including the Miocene of China, are based on "Engelhardia", an important taxon for palaeoclimate reconstruction (see Utescher et al., 2014, p. 63 vs. their table 2), used with a minimum MAT of 17.5 °C in the original publication and validation (Mosbrugger and Utescher, 1997), changed to 15.6 °C apparently soon after and informing many CA palaeo-MAT estimates (see Grimm and Denk, 2012, ES2 for a compilation), and most recently to 13.8 °C (Utescher et al, 2014); which would mean that a great number of CA estimated MAT intervals of a min. temperature of 15.6 °C are (at least) 2 °C too high (in fact the NLR for "Engelhardia" fossils would be Engelhardioideae, and the most temperature tolerant species still thrives in areas with

MAT = c. 10-11°C). This is critical to Tang et al.'s conclusion, noting the sharp margin between cooler or warmer than today and not so (see their response on Issue 3)

The dramatic differences can be found in the TOLERANCE DATA used by various authors for the same NLR; and this is fully documented in ES2 to Grimm and Denk (2012), which is supplied for anonymous download at www.palaeogrimm.org/data. As pointed out by Utescher et al. (2014, see my original comment) it is inevitable to use the SAME tolerance data, if any conclusions are to be drawn by comparison of different floral assemblages.

In their response, Tang et al. state that they will provide the full documentation as recommended by Utescher et al. (2014). With that data available is should be easy to provide CA estimates using the updated Palaeoflora database to actually support the main conclusions of Tang et al. and per se avoid the problem of different estimates because of different tolerance data .

Re: Issue 2 raised by me: bias towards subtropical climates

If a random flora results in a CA estimate similar to that found for many fossil plant assemblages, and this with increasing probability as the number of determined NLRs increase, how can we know that any fossil plant assemblage represents a genuine set? Utescher et al. (2014) state, as others before, that a misidentified taxon may result in a wrong (or biased) estimate. Furthermore, many CA estimates used by Tang et al. are based on palynofloras, which naturally have a high risk of being mixed floras with elements from different altitudinal belts or entirely allochtonous (hence, representing different climate zones), whereas macrofossil assemblages have a higher risk of misidentified fossils according Utescher et al. (2014). As Tang et al. agree in their response, mixing elements from different backgrounds (such as allochtonous and autochtonous pollen) will converge to an artificial climate, where most plants can thrive or survive (such as the subtropical, East Asian monsoon influenced climate of S.W. China, that is slightly colder than today in southermost China but warmer than the climate in the northern part of China). How has it been judged that this was not the case for the critical floras used to conclude on surface cooling?

Moreover, the same figures than shown in the response fig. 1 are obtained for the Eocene of China (see File S5 in the supplement to Grimm et al., 2015). The fact that the CA CMT estimates show more variation in their ranges than MAT is not surprising regarding the fact that MAT reflects CMT to a certain degree (see Thompson et al., 2012, for North America). The critical question is whether these reconstructions are reliable and reproducible, or just random and biased. Are differences representing a genuine signal from the entire palaeoflora, or are they just due to a presence/absence of a single or few exotic or even misidentified elements? The figure provided in Tang et al. response lacks some important information: the number of NLRs, and the number of NLRs that were eliminated as 'climatic outliers'. Showing error bars is misleading, as it is understood that CA explicitly refrains from applying any statistical framework (Mosbrugger and Utescher, 1997, Utescher et al. 2014, p. 60) in constrast to other NLR-mutual climate range approaches and has no protocol to estimate potential error, and identifies misleading NLRs solely by the fact that NLRs have no mutual climate range with the majority of NLRs (so-called "climatic outliers").

Based on what the provided response-figure shows (it may be a good idea to include such a figure in the text, and including the actual modern day value, so the reader can directly judge how colder/warmer it is today than supposedly it was in the past rather than have to refer to the supplement table S1), it can be noted that except for four assemblages all values fall within the range of the modern Cfa/Cwa climate of southern China, climate conditions in which most northern hemispheric plants could thrive, strengthening the point that CA is biased to subtropical conditions and the estimates need to be viewed with general scepticism.

The comparison to the Eocene is valid since it were often the same taxa that acted as CA-interval defining NLRs in the Eocene and in the Miocene (including the infamous "Engelhardia"). A critical assessment for Miocene CA reconstructions is not feasible for a 3rd party, as most of the shown intervals come from studies not documenting the used NLR tolerance data at all.

The chosen modern-day example (comparison of Vienna, continental Cfb climate, warm-temperate with warm summers) to Helsinki (somewhat buffered, coastal Dfb climate, snow climate with warm summers) hardly applies to what Tang et al. want to show. The authors should keep in mind the situation in the southern part of China, where evergreen to mixed deciduous forests grow up to 1500 m within a Cwa or Cfa climate(warm-temperate with hot summers; e.g. Shennongjia Forest District) without dramatic changes in their taxon composition despite a decrease of temperature of 1°C per 200 m (moist-adiabatic lapse rate, climate-station data confirmed) in the entire area (cf. Grimm and Denk, 2012, main text and ES). A CMT of 8°C vs 13°C has little effect regarding the vegetation within these climate zones (see data provided by Fang et al.). Regarding the 'dramatic' difference of 5°C in winter temperatures in the middle Eocene of southern vs. central China, please note that at the same time CA reconstructs a similar warm winter for the East Chinese Sea (as one of two equally "significant" reconstructions), and for northwestern China anything would be possible according CA, which applies also to two of the three critical Miocene assemblages. Please also note that it is a single out of the over 50 NLRs, Ocotea, that defines the much higher CMT estimate (CMT min tolerance recorded as 12.6 °C) for the middle Eocene of southern China, a statistical-definable outlier in this rich flora. Moreover, it is the only assemblage with this taxon. Ocotea is a Lauraceae, and the fossil it was associated with, is a macrofossil. Foliage of Lauraceae, a family also occurring outside the subtropical zone in China in areas with CMT substantially lower than 12.6°C (cf. Fang et al. 2009) are notoriously difficult, if not impossible in many cases, to distinguish (see e.g. Flora of China). Without the NLR Ocotea the lower boundary of the CMT interval would be defined by Cyatheaceae (recorded with an at least 1.5°C too warm CMT min-tolerance of 6.6 °C; cf. Grimm et al. 2015), i.e. 6 °C (!) lower than the shown interval, easily matching the difference between Helsinki and Vienna.

Re: Issue 3 raised by me: lacking documentation

I much appreciate the disclosure of the data following the guidelines of Utescher et al. (2014), remain to wonder, why this was not done at first-hand as it would have allowed discussing the conclusions by Tang et al. based on the actually used 'proxy' data. I fail to follow the logic why the palaeoclimate estimate for a plant fossil site (accumulating floristic components from a fairly undetermined period of time in the listed literature) should be compared only to an average value obtained from an observation period of 100 years, rather than the actual range (climate variation) realised within these 100 years. But whether two or five localities matters little, in the light of an equal or higher number of plant assemblages simply not showing this phenomenon. Also with respect to the reports of the two anonymous reviewers and the response of Tang et al. to them (which partly refer to equally biased CA studies as justification), the authors may want to add a statistical test, showing that the differences observed between modern-day and the Miocene (as estimated from CLAMP vs. CA) are significant for the hypothesis put forward and not just anecdotal.

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