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Climate of the Past Discussions

Interactive comment on "Postglacial fire history and interactions with vegetation and climate in southwestern Yunnan Province of China based on charcoal and pollen records" *by* Xiayun Xiao et al.

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Response to Referee #2:

General comments:

This paper reports a high resolution of macroscopic charcoal record from Qinghai in the monsoon region of China for the last 18500 yrs cal BP. A lower resolution charcoal record is already published in Xiao et al. 2015 JQS as well as the pollen analyses. In addition to the high resolution charcoal record, the novelty concerns fire and vegetation interaction using fire episodes and frequency indexes compared to vegetation diversity indexes obtained from pollen assemblages from the same core. The authors

reach the conclusion that fire occurs during cold and dry climate periods characterized by evergreen oaks and Alnus, and that fire lead to decrease in abundance of Lithocarpus/Castanopsis and tropical arbors. The material and methods section (and related figures) should be reduced as this is already published in details in Xiao et al. 2015 JQS. The discussion section needs to be restructured with a clear description of fire adapted and fire-sensitive taxa found in the region today in order to discuss fire impact on vegetation through time, and a discussion about how climate/monsoon drives the vegetation in the region should be presented before discussing the possible role of fire on the vegetation. Specific comments below should help to improve the manuscript in this way.

Response: We appreciate very much the referee's positive comments on the manuscript. According to these suggestions, we reduced the material and methods section and readjusted the discussion section. We address each comment with explanation as follows.

Specific comments:

1- Title: it seems from the reading of the title that the charcoal and pollen records are new – remove "based on charcoal and pollen records"

Response: Done. Thanks.

2- Line 12 page 1: compared with the pollen record – already published in Xiao et al 2015 JQS. Please modify to read "compared with major taxa and diversity indexes" or something similar.

Response: We change "compared with the pollen record" into "compared with major pollen taxa and pollen diversity indexes".

3- Line 10 page 2: the reference of Power et al. 2008 is wrong here

Response: Thanks. We change this reference into Zhao et al., 2005.

4- Line 21 page 2: “resulting in forest fire occurring frequently” please add some words here or in regional setting about the kind of vegetation that is burning today and the different fire adapted taxa and fire-sensitive taxa found in the region. This would help to follow the discussion.

Response: Relevant studies about the kind of vegetation that is burning today and the different fire adapted taxa and fire-sensitive taxa found in the region are very few. In here, we add some words “The study about forest fire during 1982-2008 in Yunnan Province shows that forest loss rates due to forest fire in different vegetation zones are different. The highest forest loss rate occurs in zone of semi-humid evergreen broadleaved forest dominated by Cyclobalanopsis glaucoides and evergreen oaks and Pinus yunnanensis forest. Secondly, forest loss rate in zone of monsoon evergreen broadleaved forest dominated by Castanopsis and Lithocarpus is relatively low. Forest loss rate in zone of tropical rainforest and monsoon forest is lower than that in the former two vegetation zones.” At the same time, we add some words about vegetation regions around the study area in “Regional setting” section. “Qinghai Lake is located within zone of semi-humid evergreen broadleaved forest in Hengduan Mountains of western Yunnan Province, whose south is adjacent to zone of monsoon evergreen broadleaved forest of southwestern Yunnan Province (Wu et al., 1987).”

5- Line 25 page 2: would be good also to discuss macrocharcoal results and Black Carbon of the same core published in Palaeogeography, Palaeoclimatology, Palaeoecology, Volume 435, 1 October 2015, Pages 86-94 by Zhang et al.

Response: Ok, we add the discussion about macrocharcoal results and black carbon in the revised manuscript. Please see lines 24-30 page 7 and lines 1-3 page 8 in the revised manuscript for detail.

6- Material and Methods - section 3.1: the Table 1 and age model (Figure 3) are already published in details in Xiao et al. 2015 and in Zhang et al. 2015. Table 1 and Figures (3a and 3b) should be removed and references should be clearly indicated in the Mate-

rial section 3.1. If the authors want to republish the age model, they should update their record from IntCal09 to IntCal13. For macroscopic charcoal analysis: please indicate that a low resolution record is already published in Xiao et al. 2015. Please explain in what the high resolution charcoal record will help to understand fire, vegetation and climate in this region.

Response: According to the suggestion, we remove Table1 and Figure 3 and cite the corresponding reference (Xiao et al., 2015). In the revised manuscript, we add an illustration about a low resolution charcoal record published in Xiao et al. 2015 and explain in what this high resolution charcoal record will help to understand fire, vegetation and climate in this region. Please see lines 26-30 page 2 in the revised manuscript.

7- Line 20 page 4: why standardizing pollen percentages? Please justify your approach.

Response: The reason is to see more clearly the interrelation among the variations of the selected pollen type percentages, we use min-max normalization to standardize pollen percentages and eliminate the influence of their values. We add an explanation in lines 2-4 page 5 in the revised manuscript.

8- Line 7 page 5: fire episode magnitude –discrepancy between units (particles/cm2) and the total charcoal influx?

Response: Thank the referee’s careful observation. The unit of fire episode magnitude is particles/ cm2/episode. We revise it in the revised manuscript.

9- Results – Chronology: remove this paragraph because this is already published in details in Xiao et al. 2015 – or shortened it and put this in the Material and Methods section – but clearly it is not new results. Keep the description of the temporal sampling of charcoal however.

Response: The paragraph about “Chronology” in the Results section is removed. The relative results are shortened and put in the Material and Methods section. Please see

lines 9-15 page 4 in the revised manuscript.

10- Section 4.2 Charcoal record, fire events and palynological diversity indices: this section is difficult to follow because the numbers reported in the text is not readable on Figure 4. Change the scale of the units reported in Figure 4. In addition, the authors describe the charcoal variations following pollen subzones determined in Xiao et al. 2015 but for pollen subzone TCQH-2 they changed this approach and determined subzone based on fire activity? As this paper is a focus on fire activity would be better to describe what is happening using fire activity zones and not following pollen subzones. Zone TCQH-4: only one fire event was detected – did the authors try several smoothing window and check whether this event remains in case of changing the smoothing background?

Response: The scale of the units reported in Figure 4 is changed. At the same time, Figure 4 is changed into Figure 2 according to other suggestions. Yes, pollen subzone TCQH-2 is determined based on fire activity in Xiao et al. 2015. According to this suggestion, we describe the results of charcoal record, fire events and palynological diversity indices using charcoal zones (fire activity zones). Please see lines 20-28 page 5, page 6 and lines 1-13 page7 in the revised manuscript. We try eight smoothing windows (300-1000 yr) and draw the conclusion that the fire event in Zone TCQH-4 (at 10.2 ka) remains in case of changing the smoothing background.

11- Line 22 page 7: "In the last 50 years, the charcoal concentration was still very low, and the relatively high CHAR may be at least partly due to the high sedimentation rate." Using the charcoal accumulation rate (CHAR) or in other word the charcoal influx instead of concentration is supposed to avoid "wrong" signal of fire in terms of concentration due to dilution. This sentence is unclear. Discussion section: - Line 23 page 7: same comment as above about the sedimentation rate.

Response: Yes, CHAR reveals more real signal of fire than charcoal concentration. We rewrite this sentence, and make it clearer to detect signal of fire using CHAR. Please

see lines 21-24 page 7 and lines 18-23 page 9 in the revised manuscript.

12- Line 16 page 8: While frequent fires appear to occur during the YD, it is unclear during the H1 giving the dates used by the authors (see sanchez Goni and Harrison 2010, QSR – HS1 is between 18 to 15.6 kyr cal BP) and the choice of using pollen zone to describe charcoal trend. In this case, low fire frequency is recorded during HS1.

Response: From our charcoal and fire activity records (Fig.2 in the revised manuscript), it can be seen that charcoal concentration, CHAR and fire frequency between 17.2 and 16.8 ka were relatively low, compared to their high values during the periods 18.5-17.2 ka and 16.8-15.0 ka. However, they were higher than most values in low value periods (15.0-13.0 ka, 11.5-4.3 ka, and after 0.8 ka). The major objective of this paper is to discuss stage changes of fire activity (such as during H1, BA, YD, HCO), and does not involve in more detailed changes in these stages. Thus, the period 17.2-16.8 ka with relatively low charcoal concentration, CHAR and fire frequency is included in the period 18.5-15.0 ka, and considered as one period with relatively high charcoal concentration, CHAR and fire frequency as a whole. In the previously published study, the pollen record reveals that the climate during the period 17.9-15.0 ka corresponds to H1, and the climate during the period 18.5-17.9 ka was also cold. There are some deviations between the time of H1 in this study area and the result of sanchez Goni and Harrison 2010, QSR, which may be caused by regional difference or age uncertainties.

13- From line 29 page 8: Artemisia pollen percentages are also high in TCQH-1b. Why Poaceae and Artemisia would be indicative of human activities from 4.3 ka? "Superimposed influence of human activities and climatic cooling and drying" what are the proxies that indicate a cooling and drying then?

Response: Artemisia is a dry-tolerant herb, and sometimes a pioneer in cleared lands in the wooded mountains. Poaceae pollen, especially cereal type, is a common indicator of human disturbance or agricultural activity. Although Artemisia pollen per-

centages are also high in TCQH-1b, there is no other signal of human activity in this period. Single signal of high Artemisia pollen percenages can not indicate human activity. Whereas the increase in Artemisia pollen percentages from 4.3 ka accompanied with the rapid increase in Poaceae pollen percentages and the rapid degradation of the primary evergreen broadleaved forest, thus human activity may have influenced vegetation changes from 4.3 ka. Of course, the rapid degradation of the primary evergreen broadleaved forest revealed by the pollen record may be also influenced by climatic cooling and drying. The reasons are as follows. On the one hand, intensity of human activity at this period is not enough to make this abrupt change in vegetation; on the one hand, the other independent climatic proxies and the evidence of the cultural responses also show a clear climate drying between 4-5 ka (Zhao et al., 2009). Thus, we consider superimposed influence of human activities and climatic cooling and drying may result in abrupt changes of vegetation and fire activity at 4.3 ka in this study. Zhao, Y., Yu, Z.C., Chen, F.H., Zhang, J.W., Yang, B. Vegetation response to Holocene climate change in monsoon-influenced region of China. Earth-Science Reviews 97 (2009) 242–256.

14- Line 9 page 9: again unclear about dilution and charcoal influx. Add the sedimentation rate curve to one of the figures.

Response: The sedimentation rate curve is added in Figure 2 (Figure 4 in the origin manuscript). At the same time, we rewrite this sentence, and demonstrate that dilution results in low concentration, not charcoal influx (CHAR). Signal of fire revealed by CHAR is more real than charcoal concentration. Please see lines 18-23 page 9 in the revised manuscript.

15- Line 13 page 9: “Paleofire studies at global scales reveal that high fire activity occurred during warm interstadials or interglacials, and low fire activity occurred during cold stadials or glacials (Power et al., 2008; Mooney et al., 2011; Marlon et al., 2013)”. The reference of Mooney et al. 2011 is for the Australasia, regional scale. Add for interstadials and stadials Daniau et al. 2010 QSR. Marlon et al 2013 is for the Holocene

only.

Response: According to the suggestion, we add a reference (Daniau et al., 2010 QSR), and delete the reference (Marlon et al 2013) because it is for the Holocene only.

16- Line 7-8 page 10: same comment about references

Response: Done.

17- section fire activity and vegetation: this section would benefit of a clear description of what are the fire adapted and fire-sensitive taxa found in the region today. In addition, it would be good to discuss how climate/monsoon drives the vegetation in the region before discussing the possible role of fire on the vegetation composition.

Response: This is a good idea to describe what are the fire-adapted and fire-sensitive taxa in the region. However, fire sensitivity studies of plant types in this region are very lacking, and there is still no special research in this region so far. At present, we can only analyze flammability of plant types according to forest loss rates due to forest fire in recent years in different vegetation zones. In “Introduction” section, we add these contents and consider that semi-humid evergreen broadleaved forest dominated by Cyclobalanopsis and evergreen oaks and Pinus yunnanensis forest are flammable, and monsoon evergreen broadleaved forest dominated by Castanopsis and Lithocarpus and tropical rainforest and monsoon forest are relatively nonflammable compared to semi-humid evergreen broadleaved forest and Pinus yunnanensis forest. Please see lines 21-26 page 2 in the revised manuscript. We add relevant contents about how climate drives the vegetation in the region before discussing the possible role of fire on the vegetation composition. Please see lines 23-29 page 10 in the revised manuscript.

18- Figure 2 is already published in Xiao et al. 2015.

Response: This figure is deleted in the revised manuscript.

Technical details:

- Line 3 page 9 and others: “Edirotial Board” modify to read “Editorial”

Response: Done. Thank the referee’s careful observation.

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