Anonymous Referee #2

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General comments: Charcoal records are rare and are of general interest as they in contrast to pollen provide a more detailed view on the local vegetation history and its species-specific composition. However, I have major concerns with the presentation and discussion of the results. In summary my concerns are: (1) the scientific scope of the study is somewhat unclear; (2) the depositional environment has not been critical assessed; (3) the method for climate inference from charcoal data has not been properly presented; (4) the construction of the age-depth-relationship is problematic; (5) the results were not sufficiently compared to other quantitative climate information for the mid-Holocene

Thank you for your constructive suggestions. I have revised the paper according to your advices point by point.

(1) We re-write the introduction and have added more details on the study goal. The IPCC's fourth assessment report (2007) concluded that Global warming from anthropogenic induced green-house gas emissions will produce the disastrous consequences, which has made a profound impact on governments and the public. In the next 100 years, the average global temperature is expected to increase 1.8-4℃ (Mann et al., 1998; IPCC, 2007; Solomon et al., 2009), but the extent of warming based on the different climatic models remain uncertain. Therefore, the quantitative reconstruction of the palaeoclimate record and the finding of palaeo-analogues have become the key requirements for future prediction.

(2) The sedimentary environment has been added in the paper: Tianshui Basin developed the loess-palaeosol deposit broadly. During the mid-Holocene, a layer of dark loessial soil developed when a strong summer-monsoon-dominated climate existed (Porter and Zhou, 2006). The vegetation was dominated by the sparse-wooded grasslands and grassland (Shang and Li, 2010), but the mixed conifer and deciduous forest developed in the valley area (Shang and Li, 2010; Li et al., 2011).

(3) The detail method of how we get the climate from charcoal data has been added in the paper. That is (a) confirming the distribution range of the plant species (http://frps.plantphoto.cn/; http://www.cvh.org.cn/cms/); (b) using the meteorological data from meteorological stations in the distribution range. Generally one of the meteorological stations is selected from the north, south, east, west border of the distribution range, respectively, and also the one from the highest and lowest elevation, respectively. So, the meteorological data used for each taxa are almost from about six meteorological stations; and (c) defining the maximum and minimum value of the meteorological data as the plant tolerance range of the climate.

(4) The age data appeared a little inverted. Li et al., (2007) built a chronology sequence on the Xishanping section using 5 AMS dating (selected from the 8 age data) according to the linearity of the ages. This paper used this age model and the depth of 40-450 cm is covered by 4300-4800 cal yr BP. We have added the information in the paper. We have discussed significant changes in the vegetation composition in other manuscript on the human activity and their impact on the landscape (Journal of Archaeological Science).

(5) We add more discussions according your suggestion.The results of our study are corresponded

with many records in the same period, for example the low lake level in northeast and middle-eastern China (Xu et al., 1988; Cui et al., 1992), decrease of arboreal and shrub pollen in Daihai Basin (Xu et al., 2004) and the western Loess Plateau (An et al., 2003), which is consistent with the weakening of the East Asian monsoon that led to the precipitation decrease after 5000 yr BP (Wang et al., 2005; Fleitmann，2007).

Specific remarks are: 1. Introduction: This part needs to be improved – much more details are necessary to indicate the relevance and challenge of this study and finally specific research questions need to be formulated. Also why particularly the time frame from 5200 to 4300 is of interest is unclear from that introduction.

Good suggestions. We re-write the introduction and have added more details on the study goal.

Global warming is concerned by the governments and the public, people worry that the future warming will lead to disastrous consequences. Actually, the palaeo-analogue reconstructed by palaeo-records can be obtained to predict in the global warming background. The Holocene Megathermal that is the nearest warm period which is similar to the pattern that temperature will increas1-2 °C in the future. Our study materials of fossil charcoal only covered the ages between 5200 and 4300, which was a period belonging to the Holocene Megathermal, which is suitable for intending to reconstruct palaeo-analogue in NW China. Of course, we try to find more sites of fossil charcoals for building the temperature and precipitation during Holocene in the future.

p.2, 25: What are the specific open palaeoclimatic questions that need to be answered with quantitative climate data from the loess plateau? Please provide a short review with references that are up-to-date.

Good suggestion.

The critical questions in the Loess Plateau are as follows: (1) the quantitative climate data in the Holocene Megathemal; (2) the potential nature of original vegetation and its pattern; （3）the climate change or the global warming will lead to what kind landscape. Scientists want to know. We have provided a review in the paper.

p.3, line 13: summarize all results that were published on quantitative climate reconstructions from the loess plateau – also those from pollen data

Thank you. More information about the climate reconstructions from the loess plateau has been added in the paper.

There are a few works on the climate data in the Loess Plateau. We have discussed the related references and added a review in the paper. Because of the shortage and little precision of pollen in the Loess plateau, there is no quantitative climate reconstruction from pollen data.

To date, a few quantitative reconstructions of climate have been carried using transfer function from the geological and biological records in the Loess Plateau (Wu et al., 1994; Porter, 2001; Lu

et al., 2006), which is the popular method to reconstruct the palaeoclimate quantitatively (Webb et al., 1972; Bartlein, 1986; Farquar, 1989; Maher, 1995).

Recently, climate transfer functions have been carried out in the Loess Plateau based on biological and isotope records. The phytolith records during the last glacial maximum showed that the mean annual temperature was 7-9℃ lower than today, and the mean annual precipitation was 240 mm lower in Weinan of the southern Loess Plateau (Wu et al., 1994). During the Holocene Magethermal, the mean annual temperature was 14-16℃ (1-3℃ higher than today), and the mean annual precipitation was 700-800 mm (100-200 mm higher than today) at Baoji in the southern Loess Plateau (Lu et al., 1996). The 10Be record show that the peak value of the precipitation during the Holocene Magethemal maximum in Luochuan is almost 800 mm (Zhou et al., 2007). The records of organic carbon isotopes indicate that the precipitation reached a peak value of 850 mm in interglacial and decreased to a minimum value of 350 mm in the last glacial for the past 130 kyr in Weinan (Ning et al., 2008).

p3., 20: provide more details on the limiting climatic factors for vegetation in your study area – how about human impact

Very good suggestion.

The extensive early anthropogenic disturbance such as agriculture, wood-cutting, and fire really impacted the landscape. In view of the paper length, we have written the other manuscript to discuss the issues.

Meanwhile the quantitative climate reconstruction of “CA Method” only consider the whole taxa of fossil charcoal not including the abundance of each plant taxon. Therefore the early anthropogenic disturbances have a little influence on the CA method.

p. 4, line 27: provide some more details on the potentials and limitations of charcoals– and indicate what studies have already been published from China/Central Asia

Good suggestion and thank you, the information has been added in the paper.

Fossil charcoal identification can give us more information about woody plants, for example bamboo can be picked out and identified from Gramineae which is hard to be identified from other proxies. While the limitation of fossil charcoal are as follows: (1) hard to identify the herbaceous plant (no big fossil charcoal preserved); (2) only come from the local not regional wood vegetation; (3) can’t give a certain change of charcoal quantity.

Some studies on fossil charcoal have been published in China, most of them focused on the wood types used by the prehistory people (Wang et al., 2007; Jiang et al., 2009), few of them discussed about the vegetation history (Cui et al., 2002), and now no studies have been reported on quantitative reconstructions of climate from fossil charcoal records in China.

2. Study area

Provide more information on how the sedimentary environment looked like during the mid-Holocene

Good suggestions.

Tianshui Basin developed the loess-palaeosol deposit broadly. During the mid-Holocene, a layer of dark loessial soil developed when a strong summer-monsoon-dominated climate existed (Porter and Zhou, 2006). The vegetation was dominated by the sparse-wooded grasslands and grassland (Shang and Li, 2010), but the mixed conifer and deciduous forest developed in the valley area (Shang and Li, 2010; Li et al., 2011).

We have added the information.

p. 4 line 15: Why do the authors consider the study area to be sensitive to climate change? Provide explanation!

Scientists have done many research on the climate sensitive region, it is argued that the area located on the following transition zone of north China is considered to be the climate sensitive region: (1) the climate transition belt of semi-arid and semi-humid; (2) the transition zone of forest and grassland or desert; (3) the farming-pastoral ecotone.(Fu, 1994)

We have added the information.

p. 4 line 16: What is the origin of these very detailed climate data? How is it possible that such detailed climate area provided (e.g. 491.6mm/a) for such a large area. How about further climatic parameter – evaporation, growing day etc.

Good suggestions.

All detailed modern climate data for this area come from the Surface Meteorological Data of China (1971–2000). We have provided more information in the paper.

3. Methods I do not understand how the age-depth-models for the single sample in the Xishanping section was constructed. As no AMS results were available for the investigated horizons and the sections is characterized by distinct sediment changes and also by age-inversions an interpolation is not appropriated with that record. It is just possible to give a rough estimate of the age as late-Mid-Holocene. Why the data were not investigated with ordination technique to see whether there occurred significant changes in the vegetation composition? It seems that this aspect of the charcoal results could be illuminated in more detail. Much more details are necessary on how the tolerance ranges of the single taxa have been calculate – as I suppose distribution ranges are not easily accessible.

Many thanks.

The cultural sediment was disturbed at times. The age data appeared a little inverted. Li et al., (2007) built a chronology sequence on the Xishanping section using 5 AMS dating (selected from the 8 age data) according to the linearity of the ages. This paper used this age model and the depth

of 40-450 cm is covered by 4300-4800 cal yr BP. We have added the information in the paper. We have discussed significant changes in the vegetation composition in other manuscript on the human activity and their impact on the landscape (Journal of Archaeological Science).

We provide more details on the ranges of tolerances of taxa, the detail steps are as follows: (1) confirming the distribution range of the plant species (http://frps.plantphoto.cn/; http://www.cvh.org.cn/cms/); (2) using the meteorological data from meteorological stations in the distribution range. Generally one of the meteorological stations is selected from the north, south, east, west border of the distribution range, respectively, and also the one from the highest and lowest elevation, respectively. So, the meteorological data used for each taxa are almost from about six meteorological stations; and (3) defining the maximum and minimum value of the meteorological data as the plant tolerance range of the climate.

4. Results Why the charcoal composition was not described in more detail for the single sites?

Good suggestion. We have added more detail information on the charcoal composition in the two sites respectively:

For Dadiwan: Figure 4 shows that the abundance of Ostrya, Alnus, Gymnocladus chinensis，Toxicodendron，Tilia and Bambusoideae were high (over 11.3%) between 5200 and 5100 cal yr BP, and after 5100 cal yr BP the abundance of these taxa reduced generally. While the abundance of Picea and Abies were relatively low before 5100 cal yr BP, and increased after 5100 cal yr BP.

For Xishanping: Figure 5 shows that the abundance of Picea, Quercus and Ulmus are high (over 20%), while the values of Bambusoideae are low with a range from 1% to 7% during 4800~4600 cal yr BP. After 4600 cal yr BP, Picea values decreased from a peak value of 28% to below 5%, Ulmus decreased to about 7%, while Bambusoideae increased significantly to a peak value of 23%. The abundance of Carpinus, Betula, Toxicodendron and Acer were relatively stable the whole time.

5. Discussion How did the transportation processes affect the material composition and how might this influence the climate reconstruction – this needs to be discussed.

Yes, we provide more information to discuss them. The Xishanping and Dadiwan sites are located on a highland of terrace and haven't been disturbed by rivers. In the meantime the selected fossil charcoals are the big size pieces that hard to be disturbed by wind. Therefore the assemblages of fossil charcoal from the two sections are efficient to reconstruct the local vegetation and climatic factors.

What caused the deposition of such a rich charcoal flora? Would it be possible that these fragments originate from a single event?

Good suggestion.

The section comes from the archaeological site that the early farmers have worked for several hundred years. The cultural sediment preserved the materials of fossil charcoal discarded by early farmer. In deed there are several thousand archaeological site and much cultural sediments that

preserved much fossil charcoal in the Loess Plateau, which provide the potential material for the regional vegetation and climate reconstruction during Holocene in the future.

A critical assessment of the CA method specifically for your example is indispensable here – describe what potential error occurred.

It is little insufficient that the CA method doesn't consider about the abundance of each plant taxon, which only used all the taxa occurred. As long as one taxon appeared it means the climate during that time is suitable for it; besides, the plant taxa in each site is almost even along the section, the changes over time is just the abundance of each taxon. And now we hard to find better method to reconstruct the precipitation and temperature quantitatively using the charcoal assemblages, but the CA method show the whole characteristic of climate in a period.

The results should be compared to other quantitative reconstruction and modeling results. What are the implications from your findings for the development of the Asian monsoon system during the mid-Holocene – the results should be discussed with a broader view.

Ok, we add more discussions according your suggestion.

The results of our study are corresponded with many records in the same period, for example the low lake level in northeast and middle-eastern China (Xu et al., 1988; Cui et al., 1992), decrease of arboreal and shrub pollen in Daihai Basin (Xu et al., 2004) and the western Loess Plateau (An et al., 2003), which is consistent with the weakening of the East Asian monsoon that led to the precipitation decrease after 5000 yr BP (Wang et al., 2005; Fleitmann， 2007).

p.9 line 17: I could not follow, why the authors assume that the subtropical vegetation expanded northward between 5200 and 4300.

And now the subtropical vegetation only distributes in the south Qinling Mountains. There are no subtropical taxa in the north Qinling Mountains (including natural forest). Therefore, the appearance of a lot of subtropical taxa in Tianshui basin of north Qinling Mountain could be regarded as the vegetation expand during the Holocene Megathemal.