

Dear reviewer:

We would like to express our feelings of appreciations to you for your kindly help and professional comments to our manuscript entitled “Summer precipitation reconstructed quantitatively using a Mid Holocene $\delta^{13}\text{C}$ common millet record from Guanzhong Basin, China”. We have tried our best to modify the weakness and flaws pointing out by you. Now, we believe that we made a better work which would probably satisfy the reviewer and suitable to be published. The answer to the comments is listing in the following paragraph.

Thanks again for your help.
Best wishes!

Sincerely,

Yang Qing and Xiaoqiang Li

Reviewer 1:

General comments

The paper intends to demonstrate the suitability, accuracy and usefulness of d^{13}C of millet seed as proxy of paleoprecipitation. Application is performed for late Holocene in northern China. This study is innovative and definitely deserves to be published in *Climate of the Past*. I do not have any irremediable concerns: raw data should be provided and I have some propositions 1- to tone down a little bit the writing to make it closer to the reality, 2- to be more precise in the text when talking about general concepts, 3- to be more accurate when reporting data by e.g. including uncertainty ranges and by propagating them and 4- to re-organize a little bit the manuscript. See details for these specific comments.

Details

* line 16: please replace "are highly suited" by "are suited", this is enough

Thanks for the reviewer's suggestion. We have removed “highly” from the sentence.

*Line 40: "modern records", do you mean "instrumental records"? Please correct.

Thanks for the reviewer's suggestion. We have corrected “modern records” into “instrumental records” following the suggestion.

* Lines 52-54: this better suits to late Holocene, even the newly acknowledged Anthropocene. Please be specific

Thanks for the reviewer's suggestion. According to the two reviewers' suggestions, we have shorten the first three paragraphs and this sentence have been removed.

* Lines 55-58: this is clearly overstatement. Megathermal was under quite different external forcings (insolation, CO_2 , ..) and can not be considered analog of future climate. This even for impacts as the warming recorded at mid Holocene was not global and the present global warming. This sentence does not furthermore have any added-value. Please remove

Thanks for the reviewer's suggestion. According to the two reviewers' suggestions, we

have shorten the first three paragraphs and this sentence have been removed.

*Line 73: please correct Hett é into Hatt é

Thanks for the reviewer's kind remind. We have corrected Hett é into Hatt é.

* Line 74: please decline EASM

Thanks for the reviewer's suggestion. Considering the integrity and coherence of the manuscript, we have revised the paragraph, adding the research significance of precipitation in the CLP rather than declined EASM, hoping EASM appears in the appropriate place.

*Lines 101-102: This has led [: :] results. Aggressive and useless. Please remove.

Thanks for the reviewer's suggestion. We have removed the sentence following the suggestion.

* Line 103: " : : a continuous distribution.." I don't know here if you're talking "in general" or if you already focus on millet. Pollen records are continuous, that's not the case for millet records. They might be numerous in a sedimentary record, they remain discrete and their absence can be interpreted as both i- too dry to allow millet to growth and to produce seed" or ii- bad luck

Thanks for the reviewer's suggestion. According to the suggestion, we have removed "a continuous distribution" from the sentence to avoid confusion.

* Lines 109-110: " : : : agricultural rain-fed crop: : ": how can you deal with irrigation? I guess this bias your signal towards more humid condition. How do you statistically deal with that issue?

Thanks for the reviewer's question. First, common millet is a typical agricultural rain-fed crop. Irrigation in favor of plant growth but the yield of seed will decrease. Secondly, the exploring model to distinguish carbon isotope composition of crops derived from natural precipitation or irrigation has been put forward by *Ferrio et al. (2005)*. According to the references *Yang and Li (2015)* and *Ferrio et al(2005)*, we inferred the abnormal high value probably indicate more water supply. So we excluded the abnormal high value according to the Boxplot using SPSS statistical software.

References:

Ferrio J P, Araus J L, Bux òR, et al. Water management practices and climate in ancient agriculture: inference from the stable isotope composition of archaeobotanical remains, 2005, 14: 510-517.

Yang, Q., and Li, X. Q. Investigation of the controlled factors influencing carbon isotope composition of foxtail and common millet on the Chinese Loess Plateau, *Sci. China Ser D*, 58(12), 2296-2308, 2015.

* Lines 132 and everywhere else: acronyms are OK on figure but please avoid them in the manuscript or restric them to DNA and USA. Nobody will remain what HDP is putting for. Keep the extended name in the manuscript. You don't have words limit!

Thanks for the reviewer's suggestion. According to the suggestion, we have extended all

the acronyms for the full names in the manuscript.

* Line 145: please precise "continuous" sampling if you did slice sampling (I understand you did).

Thanks for the reviewer's suggestion. We really did slice sampling, so following the suggestion, the sentence was changed into "The slice sampling were applied to continuously sampling and the interval was".

* Line 155: the total in table 1 is 66 not 67 seeds

Thanks for the reviewer's attention. The total samples for $\delta^{13}\text{C}$ analysis is really 67 seeds here, but there is one abnormal value which was excluded in the subsequent table.

* Line 159: what do you mean with "distilled water". I don't know any lab that still distills water. is it ultra-pure water? reverse osmosis purified water? deionized water?

Thanks for the reviewer's question. It was deionized water. To be more specific, we have corrected "distilled water" into "deionized water" in the manuscript.

* §2.2.: please complete the table 1 with the following information: how many measurements per site, did you run standard (even home reference) to evaluate the fractionation that can occur all along the different steps? please provide us with the values and variability on reference (is it the 0.2‰ you mention at the end of the §?).

Thanks for the reviewer's suggestion. The column of n means the number of measurements per site. We have revised the table and note the meaning of n . The fractionation that can occur all along the steps is the 0.2‰ as we mentioned at the end of the paragraph.

* Line 172: only to let me know, why did not you split the millet derived gas into 2 aliquots: one for $\delta^{13}\text{C}$ and one for $\delta^{14}\text{C}$ measurements? you would have had both data on a very homogeneous samples.

Thanks for the reviewer's question. Because the millet individuals are very tiny and a single millet is even not enough for the $\delta^{13}\text{C}$ measurement, three to five grains were composed for $\delta^{13}\text{C}$ analysis. That's why we cannot split the millet derived gas into 2 aliquots: one for $\delta^{13}\text{C}$ and one for $\delta^{14}\text{C}$ measurement.

* §2.3: please provide us with more information on chemical treatment and reduction prior the $\delta^{14}\text{C}$ physical measurement as you did for $\delta^{13}\text{C}$.

Thanks for the reviewer's suggestion. We have added the brief introduction on chemical treatment and reduction prior the $\delta^{14}\text{C}$ physical measurement in the manuscript.

* lines 181-186: - please separate these lines from the preceding, they should be in a §entitled "processing data" or something like that. - please provide us with raw data -> add a figure with all $\delta^{13}\text{C}$ and $\delta^{14}\text{C}$ versus depth and the group you built. - please show us in a figure where are the raw data and what the group you created we really need to understand what you did and what is the rationale behind this ANOVA that allowed you to do so.

Thanks for the reviewer's suggestion. We have separated the lines as another section

entitled “processing data of age model” and added a figure (Figure 3a) with all $\delta^{13}\text{C}$ and calibrated age range versus depth as well as the groups we built following your suggestion, hoping the readers can understand what we have done and why we did so.

* lines 193-204: these lines seem to be the result of hard time for authors. It seems they had to fight a lot to impose this SMA. Your choice was acknowledged by the publication of the Yang and Li, 2015 's paper. No need to demonstrate, here again, the appropriateness of the methodological approach. Please remove.

Thanks for the reviewer's suggestion. We have removed the related content according to the suggestion.

* line 207 " : : Neolithic .." do you mean "all seeds" or do you restrict to some of them. Please specify. That's the first time , you're talking about neolithic

Thanks for the reviewer's suggestion. To be more specific, we have modified the sentence into “Common millet remains sampled from cultural layers of Guanzhong Basin in our study.....”.

* lines 208 and everywhere else: " : : from -11.11‰ to -9.26‰ : : ". If analytical error is 0.2‰ one digit is enough. The second does not have any signification.

Thanks for the reviewer's suggestion. We have modified the related content and kept all per mil numerical value one digit left.

* line 209: you eliminated the -8.8‰ value based on statistics. Did you cross with the lab book to check if there is a physical (lab) reason for that?

Thanks for the reviewer's question. We did cross with the lab book to check this abnormal value, but no runtime exception occurred and the sample was not contaminated. According to the references *Yang and Li (2015)* and *Ferrio et al(2005)*, we inferred the plant of sample probably grew in a good ground upon many waters. In this situation, it cannot be included for precipitation reconstruction.

References:

Ferrio J P, Araus J L, Bux òR, et al. Water management practices and climate in ancient agriculture: inference from the stable isotope composition of archaeobotanical remains, 2005, 14: 510-517.

Yang, Q., and Li, X. Q. Investigation of the controlled factors influencing carbon isotope composition of foxtail and common millet on the Chinese Loess Plateau, *Sci. China Ser D*, 58(12), 2296-2308, 2015.

* line 218: "(Araus and Buxo, 1993)", please also refer to original work of Farquhar or O'Leary. They are the real pioneers.

Thanks for the reviewer's suggestion. We have added the references of Farquhar (1989) and O'Leary (1988).

* line 222: the 2015 values in Mauna Loa is -8.5‰ (<http://www.esrl.noaa.gov/gmd/obop/mlo/summary.html>) please adapt your calculation.

Mauna loa is an island, bare and far from any human activities. It was chosen to reflect the global CO₂ free from any local impact (human, vegetation). You are not in this configuration and should include the local effect within your estimation. Your database was designed and completed in 2015 in agricultural regions fully impacted by vegetation and human CO₂ emission. You were not in a free zone as Mauna Lo and likely your modern millet did growth in a much more negative atmospheric CO₂ that you think. Please discuss this point and (if possible) add d¹³C measured on modern atmospheric CO₂ sampled in locations you collected modern seeds to evaluate the modern shift between Mauna Loa and the CO₂ modern millet used for photosynthesis.

Thanks for the reviewer's suggestion. Here, authors would like to say: the modern millet was sampled in 2008 rather than in 2015. Although we don't have data of δ¹³C measured on modern atmospheric CO₂ sampled in locations where we collected modern seeds, considering our atmosphere is a perfect blender, we adopted the global mean value of three years after sampling, just as we used the mean value for the past period, from 11 ka BP to the pre-industrial age. So, we consider that the value -8.2‰ which published by Cuntz in 2011 should be more appropriate, even though the samples grew in agricultural regions but not in a free zone. If we adopt the value -8.5‰ to calculate, the reconstructed results would be amplified and bias the environment towards more humid. Based on the above consideration, we didn't adopt the reviewer's suggestion on this issue and hope the reviewer understanding.

* line 228 " : : : growing season : : : " should be defined.. but will be defined if you follow my proposition to move up a part you presently have in discussion (see lines 302-310)

Thanks for the reviewer's suggestion. We have moved up the lines 302-310 to just after the introduction and "growing season" has been defined in this section as follow: The growing season of modern common millet in the Guanzhong Basin lasts from June to September.

* line 229 : - what is the subscript "gp" for?

Thanks for the reviewer's carefulness. "gp" is short for "growing period", but to keep the internally consistent within the manuscript, we have changed "gp" into "gs".

- can you provide us with error margin on a (0.0077) and b (-14.56)?

Thanks for the reviewer's question. But we are sorry to say we cannot provide error margin on a (0.0077) and b (-14.56) since the SMATR software doesn't provide the margin. However, the regression coefficient of data samples are optimized which were solved by optimizing statistical responses in accordance with logical optimization criteria.

* line 238 "-10.55_0.16‰", the very low value of uncertainty clear seems to show that you didn't propagate analytical uncertainties to the mean d¹³C of each group

Thanks for the reviewer's enquiry. The values are close to each other in each individual group, so the uncertainty is assuredly the very low value in the group.

* line 246: what is the subscript "re" for?

Thanks for the reviewer's question. It means corrected value for precipitation

reconstruction. To avoid confusion, we change “ $\delta^{13}\text{C}_{\text{re}}$ ” into “corrected $\delta^{13}\text{C}$ ”.

* §4.1 should be better just after the introduction, it is not part of the discussion but part of rationale behind the approach. This can be part of a "rationale" §with lines 302-310.

Thanks for the reviewer’s suggestion. According to your suggestion, we have moved up the lines 302-310 to just after the introduction and entitled “2 The rationale behind using common millet $\delta^{13}\text{C}$ for precipitation reconstruction”.

* line 259: what is the biblio reference that attests that archeo combustion was performed at temperature of about 250_C? please add.

Thanks for the reviewer’s question. The reference is *Yang et al. 2011a*, which were there in the manuscript.

* line 263-265: only accusations that do not bring any added value to the paper. Please remove and only keep "The $\delta^{13}\text{C}$ signatures conserved in carbonized common millet are thus reflective of the true environment".

Thanks for the reviewer’s suggestion. We have removed the value and changed the sentence following the suggestion.

* line 266: carbon without capital letter

Thanks for the reviewer’s kind remind. We have changed carbon without capital letter.

* line 273: do you mean concentration of CO_2 and HCO_3^- ? please correct

Thanks for the reviewer’s question. Here “how much CO_2 and HCO_3^- ” expresses more accurate than concentration, and we consider it is more appropriate. So we didn’t change it, hoping the reviewer understanding.

* line 282: instead of IPCC reference, consider the vegetal physiology original bibliography

Thanks for the suggestion. We have instead the reference by “Hadley and Szarek, 1981; Ehleringer and Mooney, 1983; Murphy and Bowman, 2009”.

* line 289: corect stamatal into stomatal

Thanks for the reviewer’s kind remind. We have corrected it.

* line 296-301: already stated in results, no need to repeat. remove

Thanks for the reviewer’s suggestion. We have removed them.

* line 302-310: move up in a "rationale" §between intro and methodology

Thanks for the reviewer’s suggestion. We have moved up them after the introduction and entitled “2 The rationale behind using common millet $\delta^{13}\text{C}$ for precipitation reconstruction”.

* line 311-314: should better belong to methodology, in site description

Thanks for the reviewer’s suggestion. We have added site description in the section of sampling and moved line 311-314 to this section.

* line 323 and following: as the absolute value is highly dependent of the $\delta^{13}\text{C}$ value of the atmospheric CO_2 you had for the reference equation, please consider to discuss relative values: this period of Holocene was wetter or drier than the other part of Holocene

Thanks for the reviewer's suggestion. We have removed the absolute value and added discussion about the increasing variability of summer precipitation from early Holocene to late Holocene and provided the markedly humid periods in the manuscript.

* line 338: please provide references for ".. other global records".

Thanks for the reviewer's suggestion. We have added references Cullen and DeMenocal, (2000), Mayewski et al. (2004) and Wu and Liu (2004) for ".. other global records".

* lines 357-358: no interest, remove

Thanks for the reviewer's suggestion. We have moved the sentence following the suggestion.

* line 361: please be more specific, you don't have here the wettest climate but the wettest millet growth season.

Thanks for the reviewer's suggestion. We have changed the wettest climate into the wettest millet growth seasons.

* line 377: please add a reference for PMIP2 and this specific result

Thanks for the reviewer's suggestion. The reference for PMIP2 is Zhang and Liu (2009) and the specific result is demonstrated in the following sentence. To avoid confusion, we have adjust the sentence as follow:throughout most of China ~6 ka BP and the greatest increases in precipitation seen in the region,..... (Zhang and Liu, 2009). According to the result, it can be inferred.....".

* tables: legends are much too short. please extend them. Table and associated legend should have a stand-alone value.

Thanks for the reviewer's suggestion. We have extended legends and given them stand-alone value in each table.

* table 1: what do you mean with "sources"? please replace "N_" by "number of grains", replace accronyms by extended names (or define in legend)

Thanks for the reviewer's question and suggestion. The "sources" means "sample source" and we have added "sample" before "sources". We replaced "No." by "n" and gave a footnote "n means number of remnant common millet samples derived from the section." We also replaced accronyms by extended names.

* table 2: - replace accronyms by extended names (or define in legend), - I guess what you call "AMS ^{14}C age (cal yr BP)" is conventional ^{14}C age, thus replace the column title by "conv. ^{14}C age (yr BP) – 1sigma", - calibrated age range can not be presented as mean value of range extrema _ the half-distance between range extrema. This only because the mid point

of the interval is not associated to the maximum of probability. Please follow the 14C convention and provide us with the range(s) and the associated probability density (yes, for this period of time you might have several intervals that share the 100% of the 2-sigma probability density. You might consider to add the age with the maximum of probability (last column of the IntCal output table) if it better suits to you.

Thanks for the reviewer's suggestion. We have defined the accronyms in the title, changed "AMS 14C age (cal yr BP)" to "Radiocarbon age (^{14}C yr BP)" and changed calibrated age range (cal yr BP, 2σ) into the age interval.

* table 3: - replace accronyms by extended names (or define in legend), - in legend, please specify what N and $\delta^{13}\text{C}_{\text{re}}$ are for. - instead of mean $\delta^{13}\text{C}$ provide us with $\delta^{13}\text{C}$ range or add another column - please respect the significance of digits and provide $\delta^{13}\text{C}$ with only one digit

Thanks for the reviewer's suggestion. We have replaced accronyms by extended names, replaced "N" and " $\delta^{13}\text{C}_{\text{re}}$ " by " n " and "corrected $\delta^{13}\text{C}$ " respectively, which were defined in footnote. We also provided $\delta^{13}\text{C}$ range in the column of corrected $\delta^{13}\text{C}$.

* Figure 1: - make sure sites are visible and add their names (or acronyms) on the figure. - if possible add also the sites you mention in Figure 6 (if not possible, add a map with sites in Figure 6 itself) - please add a sign (star, point, arrow, ..) to show depths the seeds were extracted from (entlarge the figure if required) - this question is maybe more for publisher: is it require to provide references for CorelDraw or others Word or Excel?

Thanks for the reviewer's suggestion. We have added all sites names as well as the sites we mentioned in Figure 6 to Figure 1. We also added signs for sampling depths with triangle in the description of all sampling sections of Figure 1.

* Figure 6: the sites mentioned here should be geographically visible in a map, here or on the Figure 1 map. It would be great to locate them within a meteorological context, can you consider to add a limit of monsoon influenced zone?

Thanks for the reviewer's suggestion. We have added a China map with a limit of monsoon influenced zone. The modern Asian summer monsoon limit is shown by a dashed line in the map, where Qinghai Lake, Gonghai Lake and Guanzhong Basin are signed with red dot.