Dear Editor in chief,

We appreciate you for your handling and processing the MS. We also show our thanks to the two anonymous referees for their positive and constructive comments and suggestions. **We have made correction point-by-point responds to referee's comments and which we hope meet with approval**.

Once again, thank you and the two referees for your comments and suggestion.

Sincerely yours,
Jinxia Chen

Reply to Referee #2:

General comments:

This is an interesting paper that provides a better understanding about the vegetation changes during Holocene in the Bohai Sea region in response to climate change and hydrological processes. Especially it reveals that two rapid and abrupt changes in salt marsh vegetation are linked with the river-system changes.

Major Points and reply

Question 1.

In particular, the Introduction, Geographical settings, Climate and vegetation, materials and methods and discussion are generally well written and easy to follow, but the results need to be more clear and concise and express the key findings of this study including the pollen and spore concentrations.

Answer:

Thanks for this comment. We agree with this and in the revised manuscript we rewrote some of the sections. We hope the new manuscript will be more clear and readable.

Question 2.

Use ages in lieu of depths to express different pollen zones and key features as this paper is mostly focused on timescale not depth and the readers are not supposed to remember depth wise ages.

Answer:

Thanks for this good advice. In the revised manuscript ages information have been added into the pollen zone.

Question 3.

Besides, considering grammar, there are several problems with subject-verb

agreement,singular and plural expressions, and less use of cohesive devices. However, these problems could be improved with an English language expert.

Answer:

We are sorry for the grammar and language errors. We have invited a professional to modify the language and we have made lots of correction in the revised manuscript.

Some specific comments are below:

Question 4.

Page 3, line 60: As I know, the Yellow River is the largest sediment transport river in the world, please check this point.

Answer:

We are sorry for this ambiguous expression.

According to Milliman and Meade (1983) the average sediment discharge of the Ganges Brahmaputra River, Yellow River and Amazon River are 1.67×10^9 t/a, 1.08×10^9 t/a and 0.9×10^9 t/a, respectly. While result from Meade (1996) reported that the average sediment discharge of these rivers are $(0.9\text{-}1.2)\times10^9$ t/a (Ganges/Brahmaputra river), 1.1×10^9 t/a (Yellow River) and $(1.0\text{-}1.3)\times10^9$ t/a (Amazon River), respectively. In the primary manuscript, we proposed that "The YR, as the second largest river in the world in terms of sediment discharge (Milliman and Meade, 1983) ".

In order to avoid this inaccurate introduce, we changed the sentence "*The YR, as the second largest river in the world in terms of sediment discharge*" to "*The Yellow River (YR), as one of the largest river in the world in terms of sediment discharge*" in the revised manuscript.

Question 5.

Page 3, line 72: Before using Acronym for the first time is not correct. Although AMS is a very common acronym, I'll suggest to use Accelerator Mass Spectrometry (AMS) and then use AMS.

Answer:

We are sorry for the spelling error. We made correction to this mistake.

Question 6.

Page 5, line 118: “core collection” could be substituted by “Coring”.

Answer:

Thanks for the Referee’s careful review. We changed "core collection" to "Coring".

Question 7.

Page 5, line 123: check the acronym “NIGLAS”. Is it correct?

Answer:

We are sorry for the spelling error. The correct term is "Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences (NIGLAS) ".

Question 8.

Page 5, line 125: Did you identify the foraminifera? If so, provide their names for a better understanding. and why only 10 samples were selected? Provide an explanation.

Answer:

Actually we did no work on foraminifera identification. One importance reason is that foraminifera is quite scarce in this kind of shallow water coastal continental shelf. Indeed, neither of the single species of foraminifera is enough for AMS ^{14}C dating in our core. We had to mixed all kinds benthic foraminifera for dating (Detailed introduce was added in the revised Table 1). Even though, some of the layers are not fit for dating because there were almost no foraminifera. Therefore, we selected only 10 samples, and we have tried our best.

Question 9.

Page 6, line 132: Did you use wet or dried samples? Mention it.

Answer:

Thanks for this good advice. All samples for pollen and spore analysis were dried at 60° C and quantified precisely. We added this message in the revised manuscript.

Question 10.

Page 6, line 133: Lycopodium needs to italicize. How many Lycopodium spores were in the standard tablet?

Answer:

We are sorry for this mistake. The standard *Lycopodium* tablet (Batch 483216) is made by Lund University with a high standard. As mentioned in the **Certification**, each tablet contains 18,583 ± 764 *Lycopodium* spore.

Question 11.

Page 6, line 136: How many pollen and spore gains have you counted for each samples?

Answer:

Thank you. A minimum of 200 pollen grains were counted for each sample.

Question 12.

Page 6, line 134: KOH is highly corrosive and can degrade the pollen and spores if exposed for a long time. So, you need to clarify here, how long time you used the KOH.

Answer:

This is a good advice. We agree the point that KOH is highly corrosive and can degrade the pollen. In order to remove humic acids in the sediment, the samples were boiled in 10% KOH solution for 5 min .We added this necessary message in the revised manuscript.

Question 13.

Page 6, line 137: How many pollen and spore were counted for each sample? You

need to mention it.

Answer:

Thank you. A minimum of 200 pollen grains were counted for each sample.

Question 14.

Page 6, line 138: In figure, there is CONISS. But, in this section there is no explanation of using CONISS and which software have you used for the graphs and CONISS. Make a clarification here with appropriate references. In addition, please, provide the formula used for palynomorph concentration calculation.

Answer:

Thanks for this constructive comment.

The pollen diagram was plotted using ***Tilia program***. The pollen assemblage zones were divided based on the results of a constrained cluster analysis (***CONISS***) within Tilia. The palynomorph concentrations of per gram sediment (***PCP***) were calculated as the follow equation:

$$\boldsymbol{PCP} = \frac{18583}{\textit{Lycopodium}\ \text{number per slide}} * \frac{\text{Pollen or Spore Counts per slide}}{\text{Net weight of dry sample}}$$

Question 15.

Page 6, line 142: the expression is wrong. It should be mol/L or simply M. That is 1.0 mol/L HCl or 1.0 M HCl.

Answer:

We are sorry for the spelling error. We made correction to this mistake.

Question 16.

Page 7, line 152: be consistent using Pb isotopic expressions throughout the manuscript.

Answer:

Thanks for this good advice. We have changed $^{210}Pb_{ex}$ to excess ^{210}Pb throughout the revised manuscript.

Question 17.

Page 7, line 170: In figures 3, 4, there are sub-zones also. Make the sentence clear by mentioning how many major and sub-zones there are.

Answer:

Thanks for this good advice. We agree with this point. In the revised manuscript, we added the information "With the aid of CONISS, the whole sequence was vertically divided into three zones, with zone 2 further divided into subzones 2a, 2b, 2c and 2d. "

Question18.

Page 7, line 172: In text it is "Palynological zone", but in Figures it is only "Zone". Be consistent using it. I’ ll suggest to use "Palynological zones" in the figure too. You have mentioned only the depth range. Include the ages also, like Palynological zones 1 (271 – 156 cm; 10000-6000 a BP).

Answer:

Thanks the Referee’s careful review and good advice. We used "Palynological zones" in the revised figure. Accordingly, we made some revision in the related text.

Question 19.

Page 8, line 176: Which type of abundance? Absolute or relative? make it clear.

Answer:

We are sorry for this ambiguous expression. Here "abundance" refers to the "relative abundance". We made correction in the revised manuscript.

Question 20.

Page 8, line 185: This sentence need to make clear. Instead of "From 156 to 128 cm..." use "From depth of 156 to 128 cm...." elsewhere.

Answer:

Thanks for this kindly advice. We changed "From ** into *** cm... " to "From

depth of ** to *** cm... " in this sentence and throughout the revised manuscript.

Question 21.

Page 9, line 224: This word "our" is less formal and overused here in this manuscript. Try to limit its use in the manuscript. There are several other expressions used instead of "our core, our study, our data, and so on".

Answer:

We appreciate the Referee for the language advice. We polished the writing of this manuscript and we hope it is more readable.

Question 22.

Page 11, line 269: “Figure 3 and 6e” should be replaced by “Figures 3 and 6e” as you are referencing two figures. Correct it elsewhere in the manuscript.

Answer:

We are sorry for the spelling error. We made correction to this mistake.

Question 23.

Section 5.5 Holocene temperature variations in North China and possible driving mechanisms: Why have you chosen Quercus as a temperate index? Provide and discuss the reasons of using it as a proxy for temperate index.

Answer:

We are grateful for this constructive comment. As this comment was also suggested by the ***Referee #1 (Question 5, Answer (2))***.

Quercus has many species in the world. Different response of *Quercus* growth to climate in different region. *Quercus* mainly composed of Q. *acutissima*, Q. *mongolica*, and Q. *liaotungensis* in the land areas surrounding the Bohai Sea. Among these, Q. *acutissima* and *Pinus densiflora* forests develop in the low mountains and hilly area of Shandong Peninsula. Q. *mongolica*, Q. *acutissima* and P. *densiflora* develop in the Liaodong Peninsula (Li et al., 2007; Xu et al., 2010).

It’s worth noting that the pollen assemblages in marine surface sediments from

the Laizhou Bay revealed that higher concentrations of *Quercus* and *Pinus* pollen distributed in the east of Laizhou Bay, and lower concentrations in the nearshore area outside the estuary of the Yellow River (Figure 1a and b). The distribution of *Quercus* and *Pinus* pollen concentration in surface sediment shows a clearly increasing shoreward the Shandong Peninsula and it is a good indicator for source tracing. In the low mountains and hilly area of Shandong Peninsula, the vegetation is characterized chiefly by Q. *acutissima* and P. *densiflora* forests. Modern research found that incremental temperature had positive impacts on radial growth of Q. *acutissima* and negative impacts on that of *P. densiflora* (Byun et al., 2013). For example, with the rise of annual mean temperature, Q. *acutissima* forests have naturally increased by approximately 1.13% in South Korea from 1996 to 2010, while *P. densiflora* decreased by 4% (Korea Forest Service, 2011; Kim et al., 2011). Therefore, the variations of *Quercus* and *Pinus* pollen from Shandong Peninsula may be related to temperature change.

Except Shandong Peninsula, pollen from other regions around Laizhou Bay (such as Liaodong Peninsula) may also be transported to the Laizhou Bay, and deposited in core CJ06-435.

Previous studies revealed that *Quercus* and *Pinus* were the dominant components of the forests in northeast China (including the land areas surrounding the Bohai Sea) during the Holocene. The variation of *Quercus* and *Pinus* contents were closely related to the change of temperature (Ren and Zhang, 1998; Li et al., 2004; Xu et al., 2014; Zhang et al., 2019). Ren and Zhang (1998) investigated pollen data from Northeast China and found that *Quercu*s and *Ulmus* were the dominant components of the forests in northeast China between 10 and 5 ka, while *Pinus* were much more sparse, indicating a warmer and drier summers in northeast China for the early to mid-Holocene. A high-resolution 1000-year pollen record from the Sanjiaowan Marr Lake (42° 22′ 16″ N, 126° 25′ 39″ E) in northeastern China revealed that *Quercus* is a effective indicator for temperature reconstructing. Several notable cold periods, with lower *Quercus* frequencies, occurred at approximately 1200 AD, 1410 AD, 1580 AD, 1770 AD and 1870 AD (Zhang et al., 2019). Another 5350-year pollen

record from an annually laminated maar lake (42°18.0′ N, 126°21.5′ E) revealed a decrease of *Quercus* and an increases of *Pinus* component, indicated a cooling trend during the past 5350 years (Xu et al., 2014).

So, we suggested that *Quercus* is a suitable pollen type for indicating temperature variations in our study region.

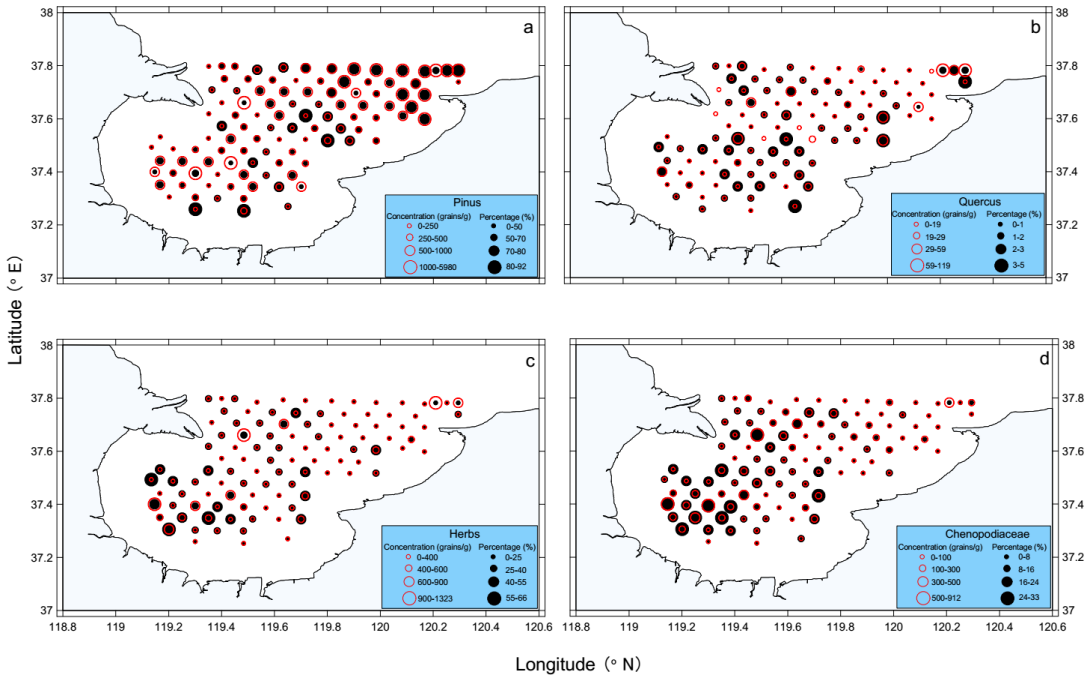

Figure 1: Spatial distribution of modern pollen percentage (black solid circle, %) and concentration (red open circle, grains/g) in Laizhou Bay, Bohai Sea (modified from Yang et al., 2016).

Question 24.

Section 5.4 Palaeovegetation reconstruction and its climate significance: This section need more careful considerations interpreting paleovegetation and paleoclimate. Make comparisons and combination with the findings of other nearby cores in Bohai Sea area. Although there are several cited references, they are not sufficient to establish your findings. What I mean that you need to elaborately discuss your findings and other's findings.

Answer:

Thanks for this constructive comment. We agree with this point that more detailed discussion and key references should be take consideration for better

interpreting paleovegetation and paleoclimate.

We rewrote this part in the revised manuscript. we gave a more detailed discussion of pollen percentage and concentration, the ecology and spread characteristics of main pollen species in core CJ06-435, paleovegetation and paleoclimate evolution of the study region and correlation and teleconnection with other findings in north China (such as Ren and Zhang, 1998; Yi et al., 2003; Chen et al., 2012; Stebich et al., 2015; Sun and Feng, 2015; Hao et al., 2016; Li et al., 2019; Li et al., 2020; etc.). We hope the revised part will be more logical and readable.

Question 25.

Page 21, line 515, 517: YR in this paper has two meanings: hydrological and Yellow River. Please differentiate them.

Answer:

Thanks for this good advice. We have changed "hydrological (YR) " in line 515 to "hydrological (the shift of YR channel) ".

Question 26.

In Table 1, the ages at depth of 119 and 129 cm are not consistent. Check and revise it. Instead of “mixed foraminifera” mention specific names and if possible the species names of them. In terms of the figures they are generally good, although you need to revise them and make more clear to understand even to a person outside of this research arena.

Answer:

Firstly we are sorry for the mistake ("*the ages at depth of 119 and 129 cm are not consistent* ").We corrected this mistake in the revised manuscript.

For the second question, actually we did no work on foraminifera identification. Moreover, neither of the single species of foraminifera is enough for AMS ^{14}C dating in our core. We had to mixed all kinds benthic foraminifera for dating. So, the materials for dating are mixed benthic foraminifera (Detailed introduce was added in the revised Table 1, we hope this revision is clear.).

Question 27.

Figure 1: Figure 1 (a) can be represented in terms of vegetation map, core locations and

Figure 1 (b) can be represented along with sea bed topography to make it more interactive. Please, think about it.

Answer:

Thanks for this good and constructive advice. We added an additional map illustrating the vegetation of the relevant area around the Bohai Sea in the revised MS. We redraw the figure 1(b) and added the information of water depth and topography in the revised figure 1(b).

Question 28.

Figures 3 and 4: The species names are not italicized. Provide a classification of the taxa showed in the figure into trees, ferns, and herbs (upside of the graph). In addition, give a classification of arboreal, non-arboreal pollen types in the figures (may be at the bottom part). It will make the figure easier to interpret.

Answer:

Special thank for this kindly comment. We redraw the figures and all species names have been changed to italicized. Also, we gave classifications of arboreal, non-arboreal pollen types in the figures.

Question 29.

Figure 5: There is no information about the position of land and Rivers. Point out the names in the maps for a clear understanding.

Answer:

Yes, we agree with the Referee. We added the information about the position of land and rivers in figure 5.

Question 30.

Figure 8: The unit of Age is not consistent here. Sometimes you have used cal kyr BP, ka BP, or cal. (a BP). Be consistent and use the instructions of the journal to express ages.

Answer:

Special thanks for this kindly and careful review. Indeed, there were many inconsistent use of age expression throughout the primary manuscript. We are very sorry for this kind of mistakes and ignorance. In the revised manuscript, we have checked the expressions thoroughly. We hope we have eliminated all this kind of errors.

The co-authors show special thanks to Referee #2 for his/her good comments and constructive advice. These comments are very valuable for improving this study.