Response to the referees

We thank the two reviewers for their valuable comments. According to their suggestions, we revised our article, and the revision details are as follows.

<u>Referee 3</u>

1) L. 45-48: Note that these are not mechanisms. There are variables. If you want to mention the mechanisms (which I was hoping for), you need to mention the eco-evolutionary processes which these variables are influencing. In other words, the mechanisms are the underlying processes. I suppose you cannot state the mechanisms, as you mentioned in the sentence that follows: 'a deep understanding of the factors that underlie … is missing'.

   We had changed the word "mechanisms" into "ecological factors". " ⋯ and several ecological factors are proposed to explain such seed mass variation gradients or patterns, for example, temperature (Moles et al., 2014),⋯⋯"

2) L. 71-74: note that correlation is not causality. All the results are correlations, from those the authors discuss their way to propose this set of relationship as a mechanistic framework. I am ok with that, but please add in the respective discussion part that for addressing causality, you need to develop mechanistic models or lab experiments. Also, at this point, you do not need to refer to the figure, which I find more appropriate to be referred only in the end of the discussion, so it become a conclusion figure and thus receive the last number.

   We had adjusted the position of the mechanistic framework from the beginning (Introduction) to the discussion of the article so it can become a conclusion figure. We had changed FIGURE 1 into FIGURE 6 and put it in the end of the whole figures (This suggestion is very interesting. In our first edition, the mechanistic framework is at the end of the article. In order to fit the referees 2's suggestions, we revised the sentence "we construct a general hypothesis for seed mass evolution based on our conclusions and previous results" and emphasized past work basis).

3) Study questions and Analyses: the authors list 4 study questions (L. 76-82), so it would be nice if the authors use this structure to present their analyses. This means, what analysis did you do to tackle each question. With this said, I find most analyses quite redundant.

   We had used the structure of the 4 study questions to present our description and analysis in the results and the discussion, and then delete some redundant sentences. For example, in the results, we added a paragraph "3.2 Variation of species richness, growth form spectra and abundance along the longitudinal gradient⋯".

4) Why haven't the authors done a phylogenetic spatial GLMM or similar (e,g, ape package)? Plot or biome could be given as random effect to account for community assembly effects, whereas spatial models would account for spatial autocorrelation and the phylogeny for phylogenetic autocorrelation. Not sure how well the authors can fit such more complex correlative models, but there are also spatial or phylogenetic models. It just seems odd to tackle each of these correlations in separate. I generally find ok to address phylogenetic signals and I am ok of separate tests, I am just intrigued by the choice of models, because at least some of the analyses might be combined. Please clarify why not combining the analyses if you choose not to.

Thank you very much for your comments. The approach you suggested is very powerful and promising. We may use it in our future work.
For our current work, our approach produced the expected results, although the analyses are not elegant. Combined analysis had also been conducted, but the results are not better than separate analysis we think, therefore we just provided present results. For instances, the effect of 4 variables (longitude, plant growth form, vegetation types, seed dispersal syndrome) on seed mass variation was analyzed and contribution rate of seed dispersal syndrome is the biggest in the four variables. We also analyzed the effect of 3 variables (plant growth form, vegetation types, seed dispersal syndrome) on seed mass variation and found that contribution rate of seed dispersal syndrome was the largest.

Minor points (some are almost major though):
1) Abstract, L. 20: at this point the reader does not know these five communities. So, you have to first mention the five communities. Moreover, I suppose a better term here would be biome.

   We had changed communities into biomes in the abstract. For example, in the abstract, "This study aims to explore seed mass variation patterns of different biome types along a longitudinal gradient and their underlying variation mechanisms by involving an in-depth analysis on the variation of seed mass"……

2) L. 26: note that this generalization rising longitude does not make sense (see major point above), as this pretty depends at what continent, part of the continent, latitude and direction you are addressing the longitude gradient.

   We had changed "along rising longitude" into "from west to east". For example, present L26 is: "Due to greater water availability and increasing leaf area, much more photosynthate (photosynthesis production) and allometric growth then ultimately increase the biome average seed mass from west to east."

3) L. 93-94: So you have rather a sunshine and rainfall gradient that happens to be in that particular longitudinal direction. I would ditch the longitudinal rationale and focus on the sunshine/rainfall gradient, which would make the gradient generalizable. With that said, what is the range of sunshine duration and intensity?

   We had added the range values of sunshine duration and intensity in the site description.

Past "···due to a gradual increase in sunshine duration and intensity and decrease in rainfall (from 780.6 to 29 mm) (Table 1)" was changed in present "···due to a gradual increase in sunshine duration (3000-3200h/y) and intensity ($586×10^4$ - $796×10^4$ KJ/m^2) and decrease in rainfall (from 780.6 to 29 mm) (Table 1)."

4) L. 99: what you mean about recent?

We had changed "recent" into "recent several". Present sentence is "Different sampling designs were used in different habitat types, owing to differences in vegetation structure and density. Within each forest plot, 6 quadrats of 10×10 m^2 were selected uniformly at random in undisturbed or slightly disturbed (at least in recent several years) areas."

5) L. 107-109: why using just these two? Why don't you have quantification of sunshine hours or light intensity or cloud cover as well? I am asking that because the authors mention the sunshine gradient before.

Precipitation and temperature have been considered to be the main ecological factors that affect plant growth in previous literature. So it is not surprise to use the two in this study. In our opinion, sunshine hours or light intensity (or cloud cover) can also affect distribution patterns of seed mass. Effect of sunshine hours or light intensity on seed mass are more complex process and they may play a certain role through rainfall and temperature. For example, sunshine hours or light intensity may play a positive role when rainfall amount is enough and on the contrary they may have a negative role when water remains shortage. In this study, from east to west, sunshine hours or light intensity is rising, however, their variation range is narrow (3000-3200h/y, $586×10^4$ - $796×10^4$ KJ/m^2). In Inner Mongolia, it is water and not sunshine that being a limit factor. So we did not analyze the two factors in detail. We had added several sentences about sunshine in the discussion.

The revised sentences are "Solar radiation variation is not very large along longitude (see site description) especially among typical grasslands, desert grasslands and deserts with similar elevation, therefore, its effect on seed mass variation is very small, moreover, since light is not a limited factor for growth in northern China according to our observation. Variation trend of sunshine hours or light intensity are contrary to that of rainfall amount along longitude. Only when water remain sufficient, strong light may favor plant growth and increase seed mass. For example, combination of much more belowground water with more sunshine hours or higher light intensity in Erjina may increase the average seed mass, and this may be responsible for larger seed mass in desert than in some sites of desert grasslands."

6) L. 120-122: I know that you cannot re-do the sampling, which I find already very impressive. However, it is a pity that you removed wind-dispersal structures, which is part of the propagule. I suppose these would have relative low impact in the overall seed mass. Although for some small seeds, that could play a role. Can you say something about this loss of seed mass by the removal of this structures?

We think that loss of seed mass overall did not affect the patterns owing to the removal of

wind-dispersal structures, which just is small part of the propagule as you mentioned. In previous documents, wind-dispersal structures of seeds are often removed when measuring seed mass. Since majority of the species are from Asteraceae, their propogules practically are fruits and not seeds. The removal of wind-dispersal structures may be favor selection to the results of this article.

7) L. 123-125: So what was it: based on ornamentation and appendages or based on Kew Gardens/literature? This is confusing as you provide two ways to determine dispersal mode. Please, clarify.

   We had revised the sentence into "The dispersal modes of each species were confirmed by referring the Kew Gardens (Howe and Smallwood, 1982) and literature collection from northwest China (Liu et al., 2014)".

8) L. 175-176: You can calculate MANOVA for non-independent response variables. Or the authors could be a PCA and perform regressions with the axes loadings, hypervolumes or centroids to the explanatory variables. In this way the authors would address the entire functional syndromes (i.e. trait correlations).

   Yes, MANOVA is more powerful. But our approach produced expected results although the analyses are little awkward.

9) - L. 186-187: you can delete the half-sentence after the comma. The same in the follow-up sentence. Anyway, this entire paragraph is confusing, as you talk about average seed mass in different ways, but it reads the same.

   We had deleted the half-sentence after the comma in L.186-187. The present sentences are "There were considerable differences in average seed mass and seed spectra among the five community types (Figure 1). Forests have the largest average seed mass (23.45±18.34 mg) and both typical grasslands (4.75±3.93 mg) and sparse forests (4.45 ± 1.18 mg) have the lowest average seed mass."

10) Tables 2-3: use the same format. Check journal formatting.

    We had revised format of tables and figures by journal formatting. For example, present TABLE 3 is as following

**TABLE 3** Seed mass, species number and proportions of 5 dispersal types in the whole study area

Dispersal agent types	Seed mass (mg)	Species number	Proportion in the whole (%)
Wind	2.46±6.23	279	44.86
Vertebrate	232.09 ± 823.98	66	10.61
Unassisted	7.42±12.08	70	11.25

Ants	3.56±10.03	195	31.35
Adhesive	5.07±8.12	12	1.93
Total	50.12±172.09	622	100

11) Fig.1: It might nicer if the authors further identify (i.e. graphically distinguish) the ecological/physiological processes (e.g. the mechanisms), related traits and the external drivers (i.e. abiotic conditions). Also, it is strange to refer to this figure before presenting the results. I see this figure more like a conclusion figure than a result figure, in which the rationale would be explained over the course of the discussion.

We had revised the frame figure and adjusted its position according to this suggestions. Present Fig.6 (past Fig.1) is as following:

FIGURE 6 Mechanistic frameworks of large seed formation and then community average seed mass increment process
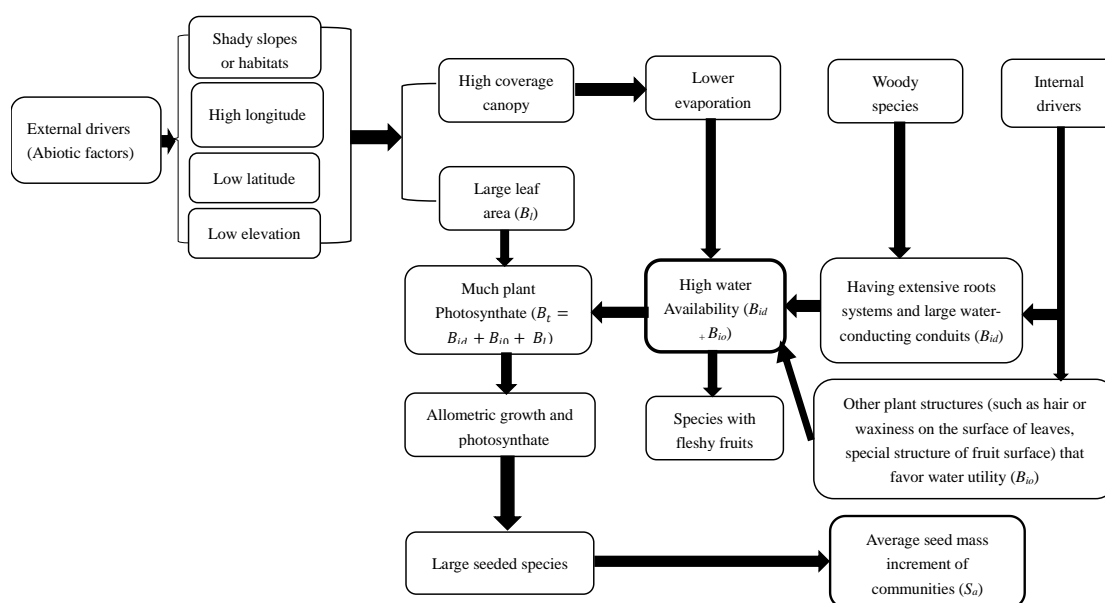
12) Fig. 2: please, add lettering to the panels. In the top panel, add title to the legend and the units to the numbers (or the legend title). Explain the lettering in the boxplots in the figure caption. Add the statistics as well (I suppose the tests provided in the main text).

We had added letters to the panels and explained the lettering in the boxplots in the figure caption. For upper figure of Fig.2 (present Fig.1), there is not bar, they are percentages of species in total species of each biomes. Present Fig.1 is as following.

FIGURE 1 Seed mass spectra varied among five community types in Inner Mongolia and proportions of larger seeds and average seed mass decline from forests to desert grasslands along decreasing longitude but increase in deserts (Average seed mass bearing the same letter are not significantly different at $p < 0.05$)
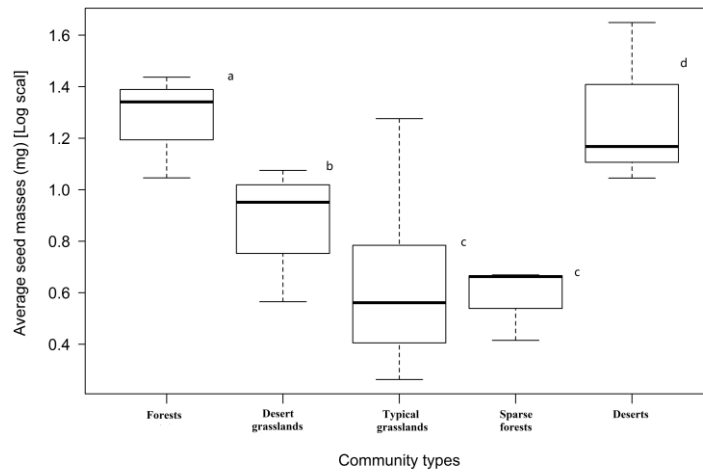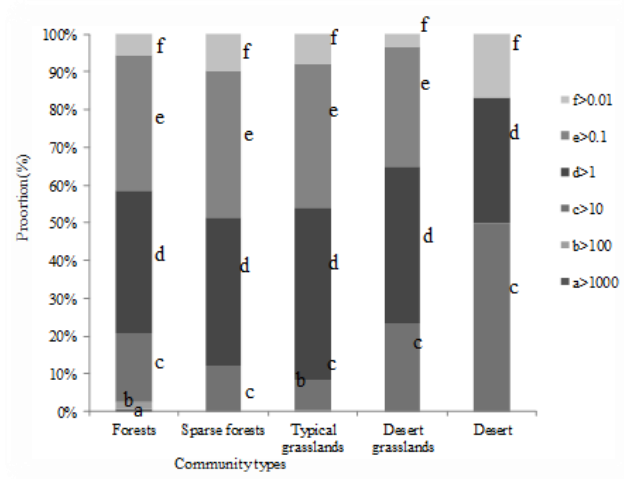
13) - Fig. 3: add letters to the panels and explain statistics in the caption.

We had added letters to the panels and explained the lettering in the boxplots in the figure caption (present Fig.2). Present Fig.3 is as following.

FIGURE 2 Trees (12 species) have largest average seed mass, followed by shrubs (65 species), lianas (15 species), subshrubs (20 species), perennial herbs (396 species) and annuals (110 species) (2A) (Average seed mass bearing the different letter are significantly different at $p < 0.05$). Average seed mass of fleshy fruits is larger than that of dry fruits in each community type (2B) (f: fleshy fruits, d: dry fruits)
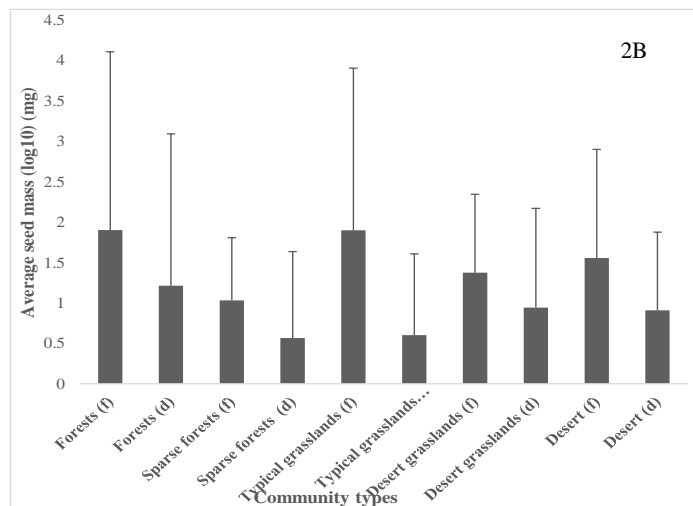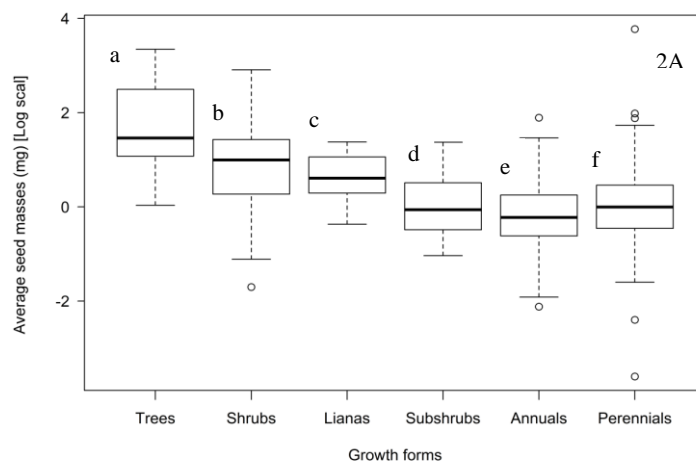

14) - Fig. 4: the same

We had revised it (present Fig.3 is as following).

FIGURE 3 Relationships between average seed mass of communities and longitude and phylogenetic diversity. Average seed mass declines as longitude rises and it reaches its bottom at around 114 degrees, and after that it increases. But average seed mass do not have significant relationships with phylogenetic diversity ($p>0.05$)
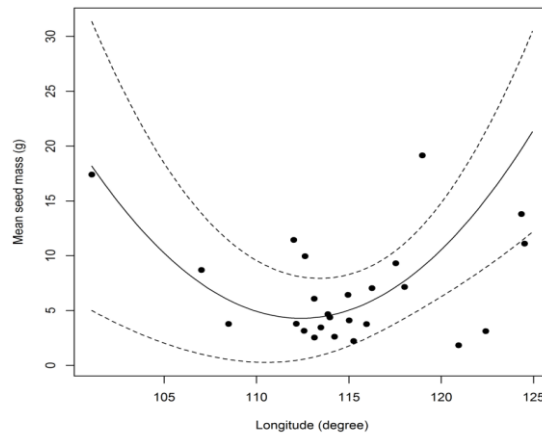
(a)
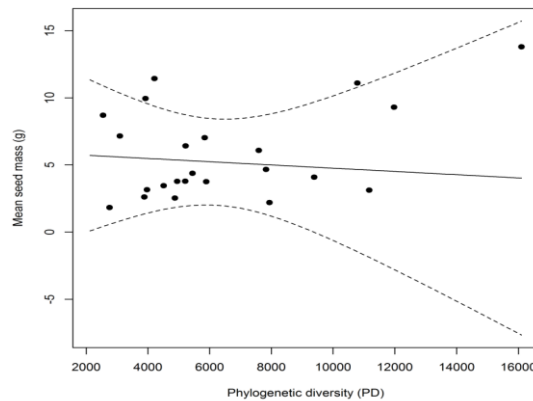
(b)

15) - Fig. 5: why were those sites excluded? And please check journal style for lettering the panels.

We had added results about those sites included. Some sites such as Erjina may be a special regions because of a river flowing through it. We just want to check how the results changed when exclude it.

We had revised Fig.4 (past Fig.5). We had corrected those mistakes about site number Present Fig.4 is as following:

FIGURE 4 Relationships between number of species with fleshy fruits and longitude (A, B) and phylogenetic diversity (C, D). Number of species with fleshy fruits increases as longitude increases. But it does not have significant relationship with phylogenetic diversity ($p>0.05$)
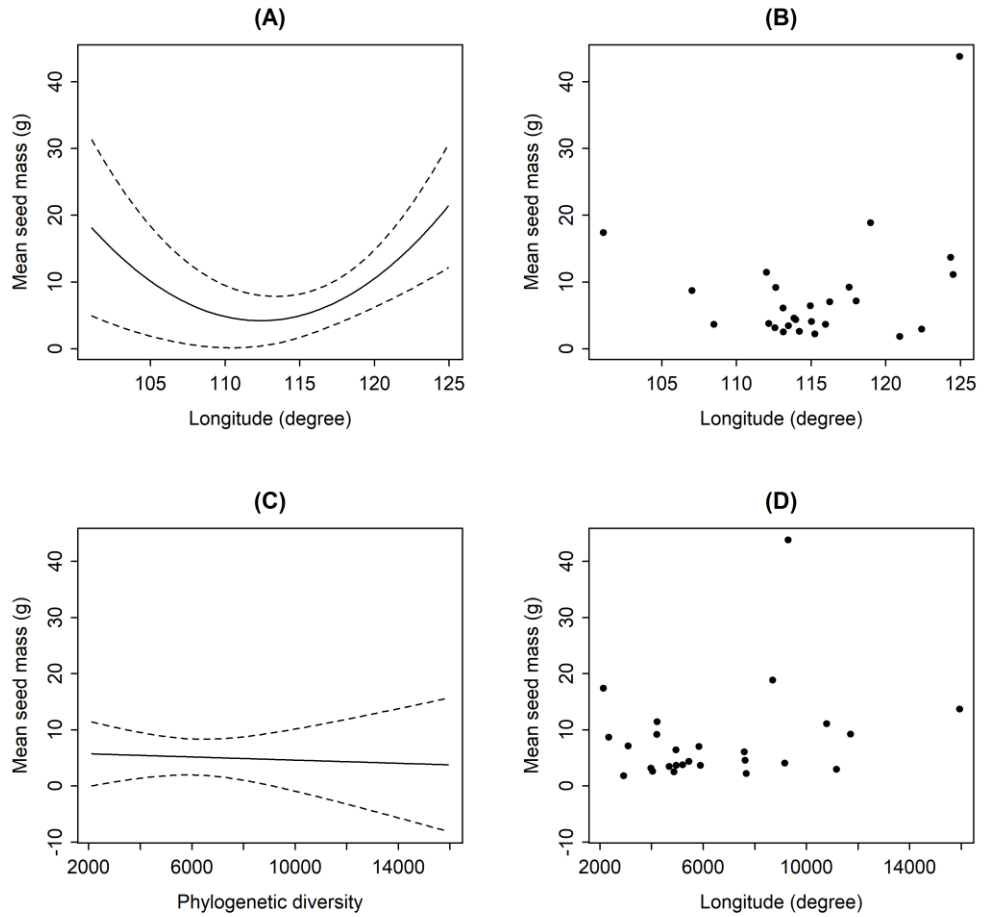
16) - Fig. 6: Use the same names and ordering to the communities as previous figures.

We had revised them (adding A and B in the caption and the figure) and present Fig.5 is as following.

FIGURE 5 Proportions (A) and species richness (B) of plants with fleshy fruits decline gradually from forests through sparse forests to (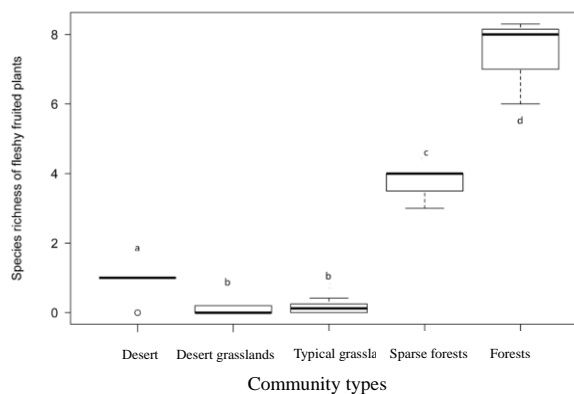typical and desert) grasslands, but increase in deserts (The same letter indicates difference is insignificant at $p < 0.05$)
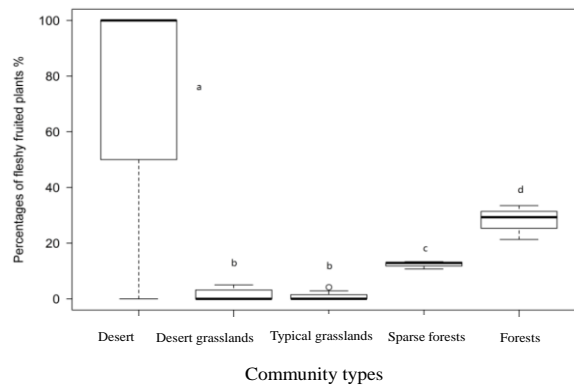
(A)

(B)

17) - L. 204: use italic font for 'p' (check throughout, there are other occasions in which the p is not in italic font)

We had changed into italic font for 'p'. For example, present L.204-207 is as following:
Seeds that are dispersed by vertebrates (232.09 ± 823.98mg) were significantly larger than those dispersed by wind (2.46±6.23 mg) (F = 238.2, *p* < 0.0001), ants (3.56 ± 10.03 mg) (F = 17.73, *p* < 0.0001), and those with unassisted dispersal (7.42 ± 12.08 mg, F=17.73, *p*=0.000) and adhesive dispersal (5.07 ± 8.12 mg, F = 17.73, *p* < 0.0001) (Table 3).

18) - L. 226-227: do not use parentheses side by side, just open and close parentheses once then. This happens elsewhere as well, so check throughout.

We had revised them. Present L. **226-227 is as following.**

···average seed mass had significantly positive relationship with longitude ($R^2 = 0.232$, $p = 0.012$) and MAP ($R^2 = 0.48$, $p = 0.00015$). Average seed mass was found to just be···

19) - L. 228: check paragraph indentation

We had revised it.

20) - L. 263: respectively should go inside the parentheses with the p values.

We had finished it. Present sentence is "However, relationships between number of genera or genetic diversity and longitude are not significant (respectively, $p = 0.056$ and $p = 0.058$) (Figure 4)".

21) - L. 269-270: "however, mean seed masses increased from typical grasslands to desert grasslands and desert ecosystems and then to forests (Figure 2)" => This is just repeating the first half-sentence. Actually, this entire sentence is confusing, because you start the sentence mentioning the longitudinal gradient of Fig. 4, but using the community types whereas the reader does not have a clue the ordination of community types along the gradient and in Fig. 4 whatsoever. Please use in the rationales only thoughts the reader can follow.

We had deleted the repeating sentence. Present sentence is "The average seed mass displays a significantly declining trend along decreasing longitude from forests to typical grasslands and then to some sites in desert grasslands in this region (Figure 3), showing congruent distribution patterns to plant growth form spectra variation (Table 2)".

22) - L. 271-272: you cannot draw mechanistic explanations from correlations simply like this. You have to explain how you think MAP and MAT might be affecting these trends, based on the indication that they might play a role due to significant relationships. I think this is a general comment that apply to other reasoning in the text (using correlations as causation). Please check throughout.

We had deleted the sentence about "mechanistic explanations" and try to explain how MAP and MAT affected these trends. In other parts of this article, we had also revised those unfit reasoning.

23) - L. 275: Note that vegetation syndromes involve trait values, you just listed trait names, not the values (e.g. the combination of low seed mass and of low fruit water content would be a syndrome).

We had revised them. Present L.275 is "The combined effects of precipitation and temperature may be, to some extent, most important to certain vegetation syndromes such as high seed mass and high fruit water content (Moles et al., 2014)."

24) - L. 290: larger leaves

We had revised it. Present L.290 is "Surely, woody species, on average, having larger leaves, can produce more photosynthate to invest in seeds (Díaz et al., 2016)."

25) - L. 294-295: so can you argue that the plants invest can invest more in (seedling) survival than in competitive strength?

We had rewrote the sentences (that make the plants invest more in propagules than in their survival and competitive strength).

26) - L. 302: can you back this up with references or with more details on this wide range?

We had added more details. **Present sentences is "Biotic dispersal agents exert a strong selective pressure on angiosperm species with various seed size in Inner Mongolian plateau, as evidenced by the evolution of a wide range of adaptations for animal (such as ants, birds, squirrels) dispersal".**

27) - L. 382-383: please sort out the font sites and style. It seems it make more sense to start with the equation for St, then for Sa.

We had revised this paragraph. Present sentences are "S_t is the total seed mass of all species in a community, S_a is the average seed mass per species taken from the total community (St/n), n is number of species in a community, C_{il} is the allometric growth coefficient (or allocation portion to seeds)…".

28) - L. 384: Sa is the average seed mass per species taken from the community total (St/n).

We had corrected this sentence and please see above 27).

29) - L. 388: the authors should better connect this text with Fig. 1. For example, place the same symbols as parameters of the respective processes in Fig. 1(present Fig.6).

We had added some symbols in Fig.6. Please see above 11).

30) L. 399-401: So these are the key gradients, not longitude.

We agree with you. We had added other two environmental factors: sunshine hours or light intensity.

31) L. 402-404: this can become its own sentence.

We had rewrote the conclusions. The conclusions are as following.
"Mean seed mass, seed dispersal spectra, fruit type spectra and plant growth form spectra of

five biome types vary significantly along a longitudinal gradient, with the lowest average seed mass and the smallest proportion of species dispersed by vertebrates occurring at the middle longitude (typical grasslands). The selection for these propagule attributes is most likely to be driven by external and internal drivers (Figure 6), however, water availability potentials and growth-allometry may be key drivers of seed-mass variation along climatic gradients or resource gradients. Larger seeded species or species with fleshy fruits may have evolved due to much photosynthate or high water availability in plants. Our findings can provide help in understanding origin and evolution of species with large seeds or fleshy fruits."

32) L. 406-407: it is odd to say we need further studies when you just did this. Exclude this sentence, or make it more detailed about what else can be tested.

We had deleted the sentence "Further studies are needed to better understand the⋯".

<u>Referee 4</u>
The critical aspects concern

1) the use that is done of the data and the gap between the mechanisms involved and the methodology used

We had deleted some unreasonable sentences and rewrote some sentences in order to repair the gap. For example, we had deleted "we suggested that transition between dry fruits and fleshy fruits in response to environmental variations …"(see following details).

1) the fact that several times the text makes mention of a variable X strongly associated to Y, but refers to a figure that does not directly explicit this link

In this results, we surely makes mention of a variable X strongly associated to Y, but this is not a figure that does not directly explicit this link. Because those are the results from part of the research sites and not the analysis on the data of the whole research sites. Our purpose is to explore more distribution patterns of seed mass and their mechanisms. The journal do not allow to publish more figures. In fact, the 6 figures had presented main results.

2) 3. text mentioning the wrong figure

We had checked twice and some similar mistakes were corrected.

3) a discussion that ends being a bit lost in gener` alities and does not properly highlight the value of this work

We had revised them, rewrote some sentences and deleted some sentences. Then it may be properly highlight the value of this work now.

4) generally speaking, it is difficult to define the limits of this work: what was done before the study, why this work was necessary, what has be done and what can be said with the data at hand, and what remains to be done.

We had tried to revise them. For average seed mass variation, there may have different patterns in different regions with longitudinal gradient. Therefore, we startup this study. Although many works had been conducted in seed mass variation, their mechanism remains controversial and unclear. In this study, we try to find seed mass variation patterns in the regions and try to explain their reasons. Combined previous results, we provided a mechanistic frame that may be useful for future related works.

Specific comments

1) The main point of this article seems to be to describe and summarize a number of seeds parameters (mass, phylum etc) and their relationship with geographic (longitude, latitude) and environmental (temperature, precipitation) variables. The nature of the work seems to be in nature more descriptive than functional, what is perfectly normal and expected, as the community needs data sets that are well presented and summarized to fit appropriate models. However, the authors tend to draw hypothesis and conclusions that can be quite remote from the data and methods used here, and sometimes subject to interpretation. With no particularly elaborate inferential framework and no genetic data to aliment these models, it is expected that one may not always be able to link some variable to a distant mechanism. However, the connection between involved mechanism suggested by the authors (eg., selection) and the data (no genetic data) is extremely lose, making it difficult for the reader to trust the statement or to understand the limits and merits of the work (eg., l.371: "we suggested that transition between dry fruits and fleshy fruits in response to environmental variations may also be genetically simple, involving suppression and re-expression of only a few genes" or, l.376 "This proves that the environment affects seed mass in the community context independent of phylogenetic constraint"). In the absence of formal modeling or inferential framework, making such statement is indefensible.

We had deleted some those unfit sentences (for example, "we suggested that transition between dry fruits and fleshy fruits in response to environmental variations may also be genetically simple, involving suppression and re-expression of only a few genes") and revised those sentences (for instance, This proves that the environment affects seed mass in the community context independent of phylogenetic constraint").

2) A map of the area representing the main habitats and the sampling sites would complement the Table 1 fairly well, as it would allow the part of the readership that is not familiar with the biogeography of China to have a better sense of the geographic scales and ecological transitions underlying this work.

In the early edition of the article, there are 10 figures. Because of limiting space of the

journal, we just present 6 figures.

3) Reading the introduction, l.72 "this article presents a novel mechanistic framework that integrates previous theory and hypotheses (related to climate, phylogeny, water conduction systems and other traits related to water balance) to evaluate seed mass variation among species or communities (Figure 1)": it is unclear what is novel in this mechanistic framework, please precise. Also, this is the only time that this figure is referred (or at least correctly, see following remark) in the whole text. If this framework is worth mentioning in the abstract, we would expect further mention in the manuscript.

We had adjusted the position of figure 1 to the last one of the whole figures and its name became figure 6, being mentioned 3 times in the discussion.

4) The article makes numerous general statements about the effects of "decreasing", "declining", "increasing" latitudes or longitudes on the flora. For example l.25: "Due to greater water availability and increasing leaf area, much more photosynthate and allometric growth then ultimately increase the community average seed mass along rising longitude (or declining latitude or elevation)". Such statements are announced in a very general context, but are actually limited to the area of study as many areas of the world have ecological transitions happening in the reverse longitudinal trend. Please make sure that the context of the area of study is made clear. I personally found expressions such as "from east to west" (l.94) more intuitive.

They are very nice suggestions. We had corrected our unfit statement.

5) Some terminology may be unclear for people foreign to the field interested by this work (eg, a mathematician, statistician or computer scientist interested by your model/data). Helping them understanding the interest of this work could be done simply by having a box briefly explaining terms like Â´n growth form Â˙z , "allometry growth theory", "photosynthate" (for this last term, a brief theory is given way too late, by the end of the discussion, l.365).

We had added their short explanations on the terminology. For instances, present sentence is "Due to greater water availability and increasing leaf area, much more photosynthate (photosynthesis production) and···".

6) Too many figures were not correctly referred in the text (eg. l.183). Please check that each reference to a Figure number is actually linked to the correct figure.

We had checked each reference to a figure number and corrected the wrong number.

7) l.113-114. Mixing seeds together is a loss of data, and I would actually be curious to know how the seeds traits change according to the mother individuals too. Ideally, we want the sampled seeds traits to be independently and identically distributed variables for a same location. That is, we hope that the variation between mother plants at a same location does not overwhelm the variation between sites. Having access to the distribution of seed traits for each mother plant at

each location may have enabled interesting insight on this level of variation, and does not seem too complicated to implement (if seeds are harvested directly on the mother plant) and to test statistically.

We agree with your opinions, in a smaller scale there also are heterogeneity for seed mass distribution. This is also an interesting question. However in this article it is not our study emphasis. If having another opportunity, we will expand these works.

8) Table 1: Please add in the legend the complete names and/or a brief descriptive of the variables MAP, MAT, K-value, evaporation and vegetation types, so the table can be self-explanatory

We had added their brief descriptive of the variables such as MAP, MAT, K-value, evaporation and vegetation types. The brief descriptive is following.

TABLE 1 Information geographic positions and environmental factors in 26 sampling sites in Inner Mongolia plateau and Northeastern China (MAP: mean annual precipitation, MAT: mean annual temperature, K-value: phylogenetic signal values, the small the values, the weak the signals. Evaporation: the change process of evaporating from a liquid to a vapor. Vegetation types: Deserts-DS, Desert grasslands-DG, Typical grasslands-TG, Sparse forest-SF, Forests-FR)

9) Table 2 :Reading this table is rather difficult. Maybe the readability could be enhanced by splitting the woody and the herbaceous columns into two sub-column, rather than separating the variables richness and percentage by a slash bar.

We had split the woody and the herbaceous columns into two sub-column.

10) Figure 3 : Please split this figure into two sub-figures (eg, 3A and 3B) for future references. The bottom figure could be made less ambiguous by slightly spacing the fleshy fruits and dry fruits bars so they don't overlap. More generally, the clarity of the manuscript could be enhanced by providing adequate labeling of Figure AND sub-figures.

We had added labeling (2A and 2B) in this figure.

11) l.380 Linking data to theory through a formal model is always useful and welcome and appreciable in biology. Here the authors provide an explicit model linking average seed mass variation to biological parameters in the discussion, but this model does not take any part in the general scientific method. Details and comments about the model are rather sparse. It is unclear how much related to the results this theory is, or how useful it is in explaining the data at hand, or what data is missing for this model to be useful. I would suggest to rewrite this paragraph. The easy way would be to remove this part, as it does not help the user understanding the interest of the work. That could be detrimental if this model has a real interest for this kind of work, or could be an easy extension of the work. In that case I would advise to provide a more ample description of the theory: how the model relates to the work presented here, how the data

presented in this work could be used to inform the model, and why this has not be done, what remains to be done for this model to be useful, and references to adequate literature around this theory. l.391 "strange patterns" is a rather . . . strange expression for a scientific paper ;) Please replace this expression and provide a clearer explanation about what part of your results are surprising and why, and how they could have been affected by the heterogeneous distribution of groundwater in desertic sampling areas and what could be done to solve this problem. More generally, this whole paragraph sounds a bit blurry and does not promote the quality of the discussion or the interest of the work. We advise the authors to rewrite this paragraph, with a clear statement of what could have affected the quality/results of the work, in what aspects and to what extend, what could be done to remove these limitations, and what would be too difficult/expensive to implement. l.402. I would end the sentence just before "however,"

We had rewrote this paragraph, with a clear statement of what could have affected the quality/results of the work,

12) The conclusion needs rewriting. In the first sentence ("Mean seed mass, seed dispersal spectra, fruit type spectra and plant growth forms of five community types vary significantly along a longitudinal gradient, with the lowest average seed mass and the smallest proportion of species dispersed by vertebrates occurring at the middle longitude (typical grasslands)",l.397), it is difficult to understand if the authors are making a general statement, or are describing the patterns observed in their dataset. Please clarify. The second sentence is a long list of general factors at the end of which one may wonder what factor was left out and why. It does not make a good job at summarizing the thoughts the authors have about their work, or at conveying larger implications of the study, or placing the study within the context of past research. The last sentences are very arid, and deserve more explanations (eg., what are the "important implications in understanding origin and evolution of species with large seeds or fleshy fruits" ?, l.405).

We had rewrote the conclusions. Present conclusion is "Mean seed mass, seed dispersal spectra, fruit type spectra and plant growth form spectra of five biome types vary significantly along a longitudinal gradient, with the lowest average seed mass and the smallest proportion of species dispersed by vertebrates occurring at the middle longitude (typical grasslands). The selection for these propagule attributes is most likely to be driven by external and internal drivers (Figure 6), however, water availability potentials and growth-allometry may be key drivers of seed-mass variation along climatic gradients or resource gradients. Larger seeded species or species with fleshy fruits may have evolved due to much photosynthate or high water availability in plants. Our findings can provide help in understanding origin and evolution of species with large seeds or fleshy fruits".

Technical corrections
1) l.20 The variations of average seed mass display high congruent with transition of growth forms : this sentence seems incorrect.

We had added "spectra" after growth form.

2) l.39 relating to plant habits do you mean habitats ?

We had deleted "habits" and revised this sentences. Present sentence is "Furthermore, as an important aspect in the reproductive biology of plants, seed mass is evolutionarily associated with and corresponds to other plant traits, relating to growth forms (for instances, trees, shrubs and herbs), life history (for example, annual plants or perennial plants) (Moles et al., 2005a), stature and canopy sizes⋯".

3) l.61 "Average seed mass is expected to decrease with declining longitude . . . to desert ecosystems" : this sentence does not make sense at a global scale, and seems to hold only for some regions, please precise.

In this sentence, we had added "in this region" to limit our research scale.

4) l.98 "were selected at random" : at random is not statistically rigorous, even if widely used in biological fields. You maybe mean "sampled uniformly at random" ?

We had revised the sentence and it became "Different sampling designs were used in different habitat types, owing to differences in vegetation structure and density. Within each forest plot, 6 quadrats of 10×10 m² were selected at random in undisturbed or slightly disturbed (at least in recent several years) areas".

5) l.106 please provide adequate citation for the worldclim database and the raster package.

We had added citation for the worldclim database and the raster package. Present sentence is "Data of temperature and precipitation as well as other climatic factors were retrieved from the Wordclim database (http://www.worldclim.org/ version1.4) using R raster package (R Core Team, 2017)".

6) l.126 "the dispersal mode represents seeds from ..." a word seems to be missing?

We had added two words in this sentence and now it became "and the dispersal modes represent how seeds move from the parent plant to the soil surface".

7) l.278 "display" you mean "displays" ?

We had corrected it. I think that "displays" is right.

8) l.269 Please chose to address the variable "mean seed mass" as singular (mass) or plural (masses) and make it consistent along the text.

We had turned "seed masses" into "seed mass".

9) l.272 : "see results" : please name the specific tables or figures to consult, and explicit better the sentence "MAT and MAP may be responsible ..."

We had deleted the sentence and rewrote it. Present description is "In these sites, average seed mass was found to have significantly positive relationship with MAP and weakly positive relationship with MAT".

10) l.274 : I had to read the cited article abstract (Moles et al 2014) to understand why you cited it. Please provide a more explicit explanation on how your findings contrast the results found by Moles 2014.

We had revised the sentence. Now it became "The combined effects of precipitation and temperature may be, to some extent, most important to certain vegetation syndromes such as high seed mass and high fruit water content (Moles et al., 2014)".

11) l.306. The authors mention Â´n typical grasslands and desert grasslands Â˙z and refer to Figure 4, but it seems a mistake, as Figure 6 seems a better fit. Please go through each Figure refered in the article and make sure that you refer to the right figures and tables.

We had corrected those mistakes as mentioned above.

12) l.309. Are the authors citing Figure 6 in the article of Yu et al, 2017 ? The typing does not seem correct, I would rather say "see Figure 6 in Yu et al. 2017" or "Zu et al, 2017, Fig. 6 ". If the authors use latex, you can use brackets to include words before and/after a citation : something like citep[see eg,][, Fig. 6](Yu2017)

We had corrected those inadequate citation. Present sentence is "Previous findings showed that fleshy fruited species were often associated with shaded habitats, mature forests, tropical forests, regions with lower elevations and woody life form (summarized in Yu et al., 2017), indicating high canopy coverage and low evaporation (Figure 6)".

13) l.310 "The increasing prevalence of fleshy-fruited species with increasing canopy coverage (Table 2)". Table 2 does not refer explicitly to fleshy fruited species, making the relationship with canopy coverage implicit. Please refer to the adequate result, or provide a better explanation, so the reader does not have to interpret what is meant. The same remark holds for l.318 and mention to Figure 3.

We had revised this sentence. It had become "The increasing prevalence of canopy coverage (Table 2, Figure 4) with increasing fleshy-fruited species is probably related to the prominence of species with larger seeds in such habitats".

14) l.359 Please provide citation for CO2 concentration homogeneity and small fluctuations. Same for solar radiation.

We had added citation for CO2 concentration homogeneity and small fluctuations and for solar radiation. The citation is as following.

Wang, G. C., Wen, Y. P., Kong, Q. X., Ren, L. X., Wang, M., L. Background concentration and its variation of CO2 over China Mainland. Chi. Sci. Bul., 47, 780-783, 2002.

15) l.360. I never heard of the term "partition out", but I'm no native speaker either. Maybe a synonym would make things clearer?

We had changed "partitioned out" into "excluded".

16) l. 377 independent of : independently of ?

We had checked "independent of" and we think it is right.

17) l. 378 : "the five communities ..." The interest of this statement is unclear. Please elaborate.

We had revised it. Present statement is "the five communities and found to be little involved in the relationships between seed mass and longitude, MAP and MAT".