July 10, 2014

Dear the Editor of Biogeosciences,

Subject: Regarding revision of the BG manuscript (**bg-2014-131**)

Thank you very much for reviewing carefully our manuscript, entitled "**Net primary production of Chinese fir plantation ecosystems and its relationship to climate"** by Ling WANG, Baoli DUAN, Yuanbin ZHANG and Frank BERNINGER published in BGD. We are submitting the replies to the queries of the honorable reviewers.

We are very grateful to the reviewer's constructive, valuable, and preferable comments, and appreciate deeply the reviewer's hard works on critical reading of our manuscript. We checked carefully all the comments and revised the manuscript almost following the comments. The comments are very helpful to improve clarity and quality of the paper. Detailed responses to the reviewer's comments including changes that have been made to the original manuscript are written in the attached sheets.

We wish to sincerely thank you and the reviewers again for editing and reviewing our manuscript. If there are still inappropriate points before acceptance, we are pleased to revise them as soon as possible.

Sincerely yours,

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Replies to Reviewer's comments (1)

There are four main comments raised by the reviewer 1. We wish to reply to these valuable and constructive comments as follows. The portions revised following the comments and suggestions by the reviewer are shown on the revised manuscript by red letters. The comments are copied by blue italic letters below.

General comments:

1. First, the Abstract is really not clear, and need to read the manuscript to understand the main points of this study. It need be more polished for better understanding.

We appreciate this valuable comment. Considering this comment and the minor comments related to the abstract, we revised the abstract as follows.

[Original] This article focuses on the relationship between the net primary production (NPP) of Chinese fir and the climate. Spatial-temporal NPP pattern in the potential distribution area of Chinese fir from 2000 to 2010 was characterized utilizing the Moderate Resolution Imaging Spectroradiometer (MODIS) data in a Geographic Information Systems (GIS) environment. The results showed that the production of Chinese fir was higher in southern and eastern regions than in northern and western areas, which was consistent with the spatial pattern of temperature and precipitation. The relationship between NPP of Chinese fir and climate variables was analyzed comprehensively on three scales: regional scale, zonal gradients and pixel scale. On the regional scale, precipitation showed higher correlation coefficients with NPP than did temperature. When scaling to pixels, the spatial variability pattern indicated that temperature was more important in central and eastern regions, while precipitation was crucial in the northern part. Negative correlations between NPP and precipitation and temperature were found in the southern region. The zonal analysis revealed that the impact of precipitation on the production was more complicated than that of temperature. When compared to natural forests, plantations appear to be more sensitive to the mode of precipitation, which indicates their higher vulnerability under climate change which could potentially lead to increasing variability in rainfall. Temporally, NPP values decreased despite of increasing temperatures, and more in plantations than

among other vegetation types, which draws attention to carbon sequestration potential by plantations under climate change.

[Revision] This article focuses on the relationship between the net primary production (NPP) of Chinese fir and temperature and precipitation. Spatial-temporal NPP pattern in the potential distribution area of Chinese fir from 2000 to 2010 was characterized utilizing MODIS MOD17 product in a Geographic Information Systems (GIS) environment. The results showed that the highest NPP value of Chinese fir presents in the Fujian province in the eastern part of the study region. The relationship between NPP of Chinese fir and climate variables was analyzed spatially and temporally. On the regional scale, precipitation showed higher correlation coefficients with NPP than did temperature. The spatial variability pattern indicated that temperature was more important in central and eastern regions (*e.g.* Hunan and Fujian province), while precipitation was crucial in the northern part (*e.g.* Anhui province). The zonal analysis revealed that the impact of precipitation on the production was more complicated than that of temperature. When compared to natural forests, plantations appear to be more sensitive to the mode of precipitation, which indicates their higher vulnerability under climate change. Temporally, NPP values decreased despite of increasing temperatures, and more in plantations than among other vegetation types, which draws attention to carbon sequestration potential by plantations under climate change.

2. Secondly, much more information is needed about how to identify the Chinese fir from the global land cover data set. I think there is no Chinese fir vegetation type in the original Glabal Landcover 2000 dataset. This is very important for their whole analysis.

Yes, there is no Chinese fir vegetation type in the original Glabal Landcover 2000 dataset. We agreed with the comment that identification of Chinese fir is very important for our analysis. In our paper, The distribution of Chinese fir was specially modified from the artificial Chinese forest map, which we applied from “Data Sharing Infrastructure of Earth System Science ” (http://www.geodata.cn/), a Chinese web that provide data related to nature science. The distribution area of Chinese fir is corresponding to that of coniferous forest partly in Global Landcover 2000. So we replaced those coniferous forest areas with Chinese fir utilizing ArcGIS software to make a new landcover map that contains Chinese fir.

Considering this comment, we revised the sentences in Page 5 Line 25 to Page 6 Line 2 in BGD paper as follows.

[Original] the Chinese fir distribution as modified from an artificial Chinese forest map (Data Sharing Network of Earth System Science) was combined with Landcover 2000.

[Revision] the distribution of Chinese fir was specially modified from the artificial Chinese forest map, which we applied from "Data Sharing Network Infrastructure of Earth System Science" (http://www.geodata.cn/), a Chinese web that provides data related to nature science. The distribution area of Chinese fir is corresponding to that of coniferous forest partly in Global Landcover 2000. So we replaced those coniferous forest areas with Chinese fir utilizing ArcGIS software to make a new land cover map that contains Chinese fir.

3. Third, it's not good idea to use the station climatic data for the regional analysis. It's better to use gridded reanalysis data to do such work.

We would like firstly to clarify that we utilized 75 stations data to model the temperature and precipitation. However we gave a misleading number of stations, which is 41 in our manuscript. This number only referred to the stations that are included in the study area which is irregular and not continuous. So we changed the original 41 stations in Page 6 Line 4 to 75 stations.

We chose Kriging as an estimator to interpolate the climatic data to be gridded surface with resolution of 1 km. Kriging is a linear optimum interpolation method for regionalized single variable with the minimum variance of the estimation variance. It evaluates uncertainty of the estimation at non-sampled points by kriging variance, which offers a measure of the estimation precision and reliability of the spatial variable distribution. The cross validation result for the kriging model is good as in the Fig.1 below.

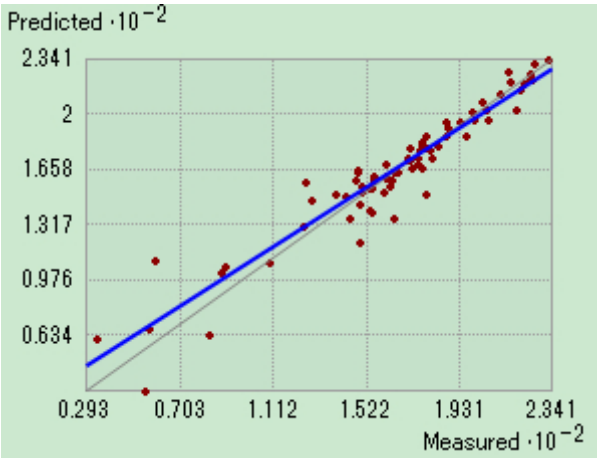

Fig.1 Cross validation result for kriging model for making temperature surface. Measured represents the station temperature which is ˚C× 10.

We compare our climatic data with WorldClim data which is a set of global climate layers (climate grids) with a spatial resolution of about 1 square kilometer (Fig.2). Our surface is smoother than worldclim data, but they have similar characteristics. In addition, difference between each other is also due to the time difference Since the available Worldclim data is for the 1950-2000 period.

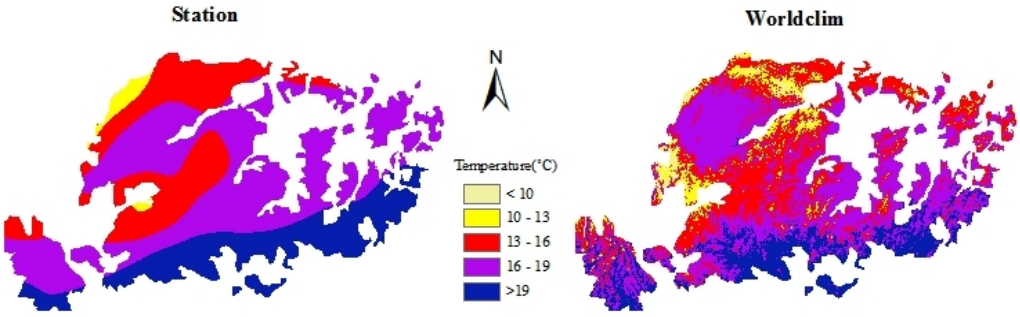

Fig.2 comparision between interplated station data and Worldclim data.

4. Last, since there were several drought and other extreme events in their study area during last decade, they need analysis the impacts of these events on decreasing trends of NPP of Chinese fir.

We appreciate the reviewer's valuable comments on this part. Considering this comment, we added analysis on impacts of these events on decreasing trends of NPP of Chinese fir to the revised manuscript by red letters as follows.

[Revision] Droughts in autumn 2004, floods and hurricanes in 2007 and snowstorms in 2008 were reported in current study area. Our results (Fig.6) shown that NPP of Chinese fir decreased in 2005, which was to some extend influenced by autumn droughts in 2004. Floods and hurricanes in 2007 also corresponded with a declined NPP value in 2007 compared to that in 2006. While snowstorms in 2008 made the NPP value even lower than that in 2007. These events could potentially increase the variability in precipitation, which may further explain why the production of plantations had the greatest decreases, if they were more sensitive than natural forests to precipitation variability.

For the other minor comments:

*We revised the manuscript in accordance with the other minor comments

**Abstract As I said above, the abstract need to rewrite.*
The abstract has been rewritten as in the first major comment.

**P1 L2: the climate: need specific of temperature and precipitation.*
"The climate" has been specified to "temperature and precipitation".

** P1 L5: Need specify the MODIS GPP/NPP product.*
"the Moderate Resolution Imaging Spectroradiometer (MODIS) data" has been replaced with "MODIS MOD17 product".

** P1 L6-8: This is really hard to understand if you don't know the study area.*
"The results showed that the production of Chinese fir was higher in southern and eastern regions than in northern and western areas, which was consistent with the spatial pattern of temperature and precipitation." has been changed to "The results showed that the highest NPP value of Chinese fir presents in the Fujian province in the eastern part of the study region.".

**P1 L18-19: delete which could ... in rainfall.*
"which could potentially lead to increasing variability in rainfall" has been deleted.

**Methods P4 L1-11: You don't need such detail about the algorithm of MODIS GPP*

product.

This paragraph has been replaced by one sentence of "MODIS product MOD 17 was chosen for evaluation of GPP and NPP in our study."

**P4,2.2.2 Land cover data: Need more information how you identify the Chinese fir vegetation type.*

This comment and the second general comment are related and connected. Please see our reply to the second general comment.

**P5 2.2.3 Need check the reanalysis data. It is really risky to interpolate to 1km grid with 41 stations. At least, you need compare it with some reanalysis grid data.*

We appreciate this valuable comment. This comment is connected to the third general comment. Please see our reply to the third general comment.

**P6 2.4 Need give more information about zonal analysis. It's not clear here.*

Zonal analysis is one of the most important spatial analysis tools in ArcGIS. It is the creation of an output raster (or statistics table) in which the desired function is computed on the cell values from the input value raster that intersect or fall within each zone of a specified input zone dataset.

**P6 L12: 'while a low R value represents the oposite'. Are you sure? Shouldn't negative R value?*

A high R-value signifies a better relationship while a low R-value represents the opposite. A positive R implies that the NPP has the same trend with temperature or precipitation, while a negative R implies the opposite.

Results P7 L3-4: 'It is evident... north and west'. How?

This result is based on the temperature and precipitation surface (Fig.3).

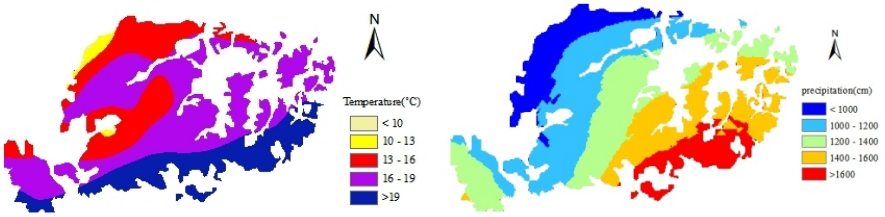

Fig.3 Temperature (left) and precipitation surface (right)

**P6 L19: invaluable -> valuable*

"invaluable" has been revised to "valuable" .

P7 L18-20: two 'second highest'?

The second "second highest" has been revised to "third highest".

**P8 L 11-12: don't need this sentence.*

"Red and orange colors indicate areas where most pixels increase their NPP, while green tones indicate areas where most pixels decline." has been deleted.

**P9 L1: what's hydrothermal zonal gradients? Need explain this in the methods.*

We changed "hydrothermal zonal gradient" to "zonal analysis" in revised manuscript, which is the original meaning.

**Discussion P12 4.2: See general comments. Some analysis of drought effects need to be done. In addition, for the decreasing trends of NPP, how about deforestation or harvest impacts?*

This comment is connected to the fourth general comment. Please see our reply to the fourth general comment.

Deforestation, Harvest or other disturbances that change the land-use could alter terrestrial net fluxes at regional and global scales. However, it is extremely challenging to estimate the carbon balance change associated with land-use change because of current lack of information on the amount and spatial pattern of deforestation (Piao *et al.*, 2012; Houghton, 2007). However, most of the plantation in south China is collective owned stand. Farmers has always been repeatedly planted Chinese fir on the same sites without intercropping or periods of fallow (Bi *et al.*, 2007), which reduce the land-use change impact.

Houghton, R. A., 2007. Balancing the global carbon budget. *Annual Review of Earth and Planetary Sciences* 35, 313-347.

Piao, S. L., Ito, A., Li, S. G., et al., 2012. The carbon budget of terrestrial ecosystems in East Asia over the last two decades. *Biogeosciences* 9(9), 3571-3586.

Bi, J., Blanco, J. A., Seely, B., et al., 2007. Yield decline in Chinese-fir plantations: a simulation investigation with implications for model complexity. *Canadian Journal of Forest Research* 37(9), 1615-1630.

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