July 30, 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 following the comments. The comments are very helpful for improving our manuscript and future research work. 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,

Ling Wang (PhD)
Chengdu Institute of Biology
Chinese Academy of Sciences
PO Box 416, Chengdu 610041, China
E-mail: lynn084@gmail.com

[You can contact also] Baoli Duan (Professor)
Institute of Mountain Hazards and Environment
Chinese Academy of Sciences
PO Box 416, Chengdu 610041, China
E-mail: duanbl@imde.ac.cn

POINT-BY-POINT RESPONSES TO REVIEWS

The comments are copied by blue italic letters below.

COMMENTS FROM REVIEWER #1:

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.

RESPONSE: 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 investigates the relationship between net primary production (NPP) of Chinese fir, temperature and precipitation. The spatial-temporal NPP pattern in the potential distribution area of Chinese fir from 2000 to 2010 was estimated utilizing MODIS MOD17 product in a Geographic Information System (GIS) environment.

The results showed that the highest NPP value of Chinese fir is 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). Zonal analysis revealed that the impact of precipitation on the production was more complicate than that of temperature; larger amount of precipitation is not always corresponding with greater NPP value. When compared to natural forests, plantations appear to be more sensitive to the variability of precipitation, which indicates their higher vulnerability under climate change. Temporally, NPP values decreased despite of increasing temperatures, and the decrease was larger in plantations than among other vegetation types.

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.

RESPONSE: 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 5644 Line 25 to Page 5645 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.

RESPONSE: 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 5645 Line 4 to 75 stations.

We chose ordinary kriging as an estimator to interpolate the climatic data to be gridded surface with resolution of 1 km. ordinary 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 ordinary kriging model is good as in the Fig.1 below.

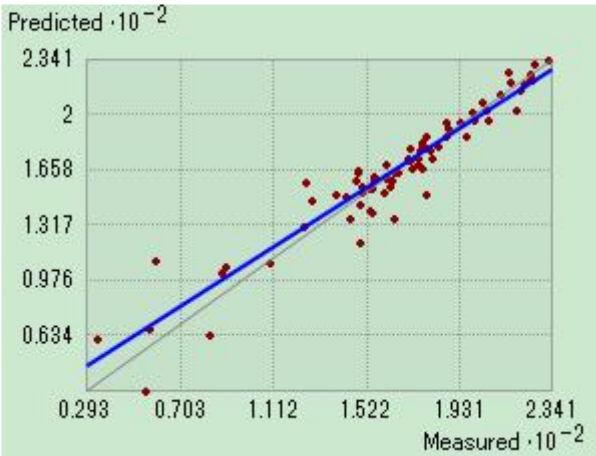

Fig.1 Cross validation result for kriging model for making temperature surface. Measured represents the station temperature which is ˚C× 10.

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.

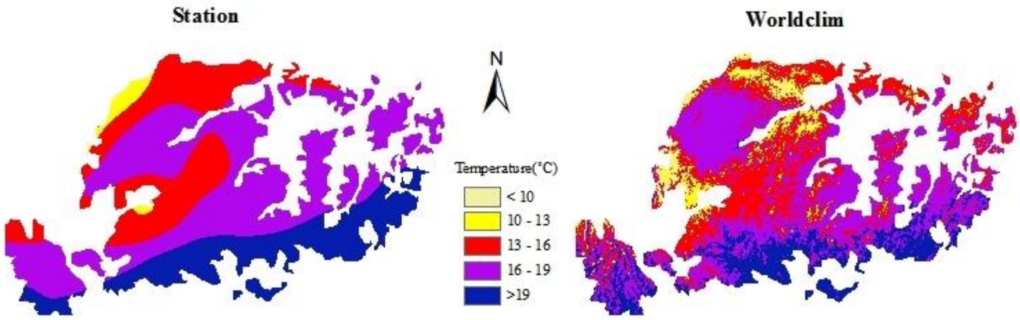

Fig.2 comparision between interplated station data and Worldclim data.

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.

RESPONSE: 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.*
RESPONSE: The abstract has been rewritten as in the first major comment.

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

** P1 L5: Need specify the MODIS GPP/NPP product.*

RESPONSE: "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.*

RESPONSE: "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.*

RESPONSE: "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.*

RESPONSE: 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.*

RESPONSE: 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.*

RESPONSE: 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.*

RESPONSE: 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?*

RESPONSE: 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.

**P6 L19: invaluable -> valuable*

RESPONSE: “invaluable” has been revised to “valuable”.

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

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

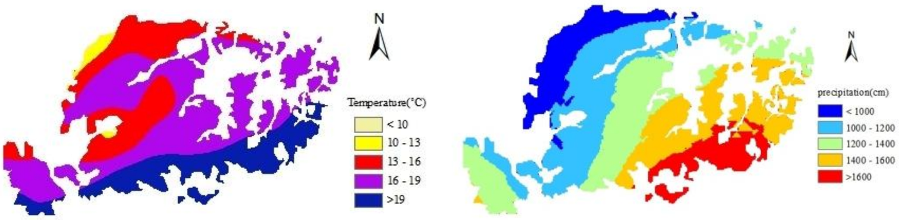

Fig.3 Temperature (left) and precipitation surface (right)

P7 L18-20: two ’second highest’?

RESPONSE: The second “second highest” has been revised to “third highest”.

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

RESPONSE: “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.*

RESPONSE: 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?*

RESPONSE: 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.

COMMENTS FROM REVIEWER #:2

1. The Abstract is a bit confusing. It would be nice to re-write it trying to highlight only the key messages.

RESPONSE: We appreciate this valuable comment. In accordance with this comment, we revised abstract to describe more clearly and highlight only the key messages 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 investigates the relationship between net primary production (NPP) of Chinese fir, temperature and precipitation. The spatial-temporal NPP pattern in the potential distribution area of Chinese fir from 2000 to 2010 was estimated utilizing MODIS MOD17 product in a Geographic Information System (GIS) environment. The results showed that the highest NPP value of Chinese fir is 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). Zonal analysis revealed that the impact of precipitation on the production was more complicate than that of temperature; larger amount of precipitation is not always corresponding with greater NPP value. When compared to natural forests, plantations appear to be more sensitive to the variability of precipitation, which indicates their higher vulnerability under climate change. Temporally, NPP values decreased despite of increasing temperatures, and the decrease was larger in plantations than among other vegetation types.

2. The material and methods section should be completed in different parts: MODIS data - the way the MODIS data are presented is confusing, the authors refer to MODIS GPP without giving details about the product they are using. Are they referring to the MOD17 product? What they mean with "The FPAR and epsilon max were determined using remote sensing MODIS"? To my knowledge the epsilon max is derived using Biome Parameter Lookup Table (BPLUT).

RESPONSE: For the comment "*The material and methods section should be completed in different parts: MODIS data - the way the MODIS data are presented is confusing, the authors refer to MODIS GPP without giving details about the product they are using. Are they referring to the MOD17 product?*" Yes, we used MOD17 product. Since this paragraph was briefly description of the MODIS GPP algorithm. We deleted it and replaced it with one sentence "MODIS product MOD 17 was chosen for evaluation of GPP and NPP in our study."

We appreciate the correct comment *"What they mean with "The FPAR and epsilon max were* *determined using remote sensing MODIS"? To my knowledge the epsilon max is derived using Biome Parameter Lookup Table (BPLUT)."* Yes, the ε max is derived using Biome Parameter Lookup Table (BPLUT). It is the calculation of ε that needs the MODIS land cover data. This paragraph was deleted as we said above.

3. Climate data - the authors describe the study area as "a region of low mountains and hills with a very broken topography and complicated geology", in such conditions the propagation of the meteorological data from few stations to the whole region can be not trivial. How the interpolation of the meteo data has been performed? How the obtained maps compare with already available gridded meteorological products?

For the comment *"Climate data - the authors describe the study area as "a region of low mountains and hills with a very broken topography and complicated geology", in such conditions the propagation of the meteorological data from few stations to the whole region can be not trivial."*, we would like 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 (see Fig.1 in our manuscript). So we changed the original 41 stations in Page 5645 Line 4 to 75 stations.

For the comment *"How the interpolation of the meteo data has been performed?*, We chose ordinary 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 ordinary kriging variance, which offers a measure of the estimation precision and reliability of the spatial variable distribution. The cross validation result for the ordinary kriging model is good as in the Fig.1 below.

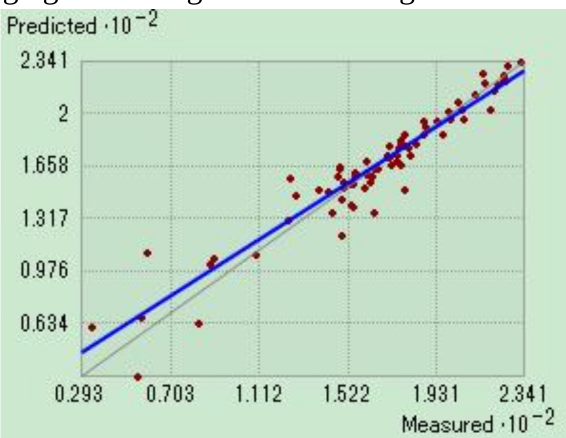

Fig.1 Cross validation result for kriging model for making temperature surface. Measured represents the station temperature which is ˚C× 10.

For the comment *"How the obtained maps compare with already available gridded meteorological products?"*, 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 characteristic. In addition, difference between each other is also due to the time difference Since the available Worldclim data is for the 1950-2000 period.

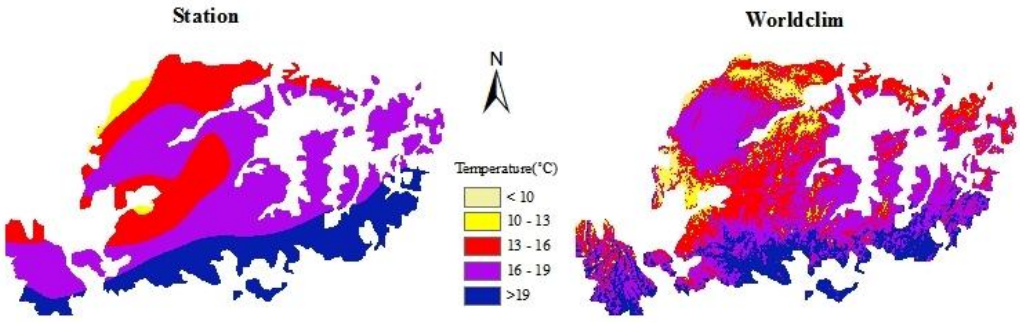

Fig.2 comparision between interplated station data and Worldclim data.

4. Analysis between NPP pattern and climate variables – it is not clear if and how the presence of different land cover classes has been taken into account in the analysis of the spatial patterns of NPP Validation of MODIS data using flux tower data – how the temporal GPP corresponding to flux tower has been derived from MODIS data? how big is the tower footprint? How big is the MODIS area used to extract the GPP trend? The data analysis has some weakness and clarifications are needed.

RESPONSE: For the comment *"Analysis between NPP pattern and climate variables – it is not clear if and how the presence of different land cover classes has been taken into account in the analysis of the spatial patterns of NPP Validation of MODIS data using flux tower data"*, the classification of land cover was not taken into account in the analysis of the spatial patterns of NPP Validation of MODIS data using flux tower data.

Reply to the comment *"how big is the tower footprint?"* is as follows. The sensors measuring flux were installed at about 39m above the ground. Footprint changes according to the wind speed and wind direction. According to the study on source area in Qianyanzhou station by Shen *et al.* (2005), the footprint of the tower is within 1.7 km.

Shen Y., Liu Y., 2005. Examination of source area in- flux measurements at the mid-subtropical forest region. *Acta Phytoecologica Sinica* 29 (2), 202-207.

For the comment *"How big is the MODIS area used to extract the GPP trend?"*, 4×4 pixels around the tower were extracted to correspond with the eddy flux data.

Our reply to the comment *"how the temporal GPP corresponding to flux tower has been derived from MODIS data?"* is as follows.
Eddy flux GPP on daily basis in 2006 were provided by Qianyanzhou Experimental Station. Correspondingly, MODIS GPP data in 2006 were downloaded. Subsets of 4×4 pixels around the tower were extracted. In accordance with MODIS GPP, which is an 8-day composite, 8-day summations of eddy flux GPP were created to make a correlation with average of MODIS GPP subsets.

5. Fig. 4 eddy and MODIS GPP are correlated but the relation is not as good as we can expect; possible reasons of the scatter in the relationship have to be discussed.

RESPONSE: MODIS GPP is based on the light use efficiency model. Any parameters that contribute to the calculation of GPP would influence the value of it. Land cover is a potential source of bias because of the spatial heterogeneity of the landscape. MODIS did not capture finer scale light use efficiency. We checked the land cover in our study area, and found that two pixels surrounding the eddy tower were classified into open shrublands. However, in maximum source location of the tower, the dominate vegetation is forest, which contribute the most of the tower flux. Such bias made the correlation not so perfect. In addition, MODIS GPP can be used to determine the GPP within a pixel (an area of 1 km^2 in this study); however, EC measures GPP over a footprint that changes according to the wind speed and wind direction in one year. Differences in the spatial scales of the two methods may lead to differences in the predicted GPP of the MODIS-GPP algorithm and EC. However, we compared our result with Wang *et.al* (2014), which Validates MODIS-GPP product at 10 flux sites in northern China. Our correlation coefficient is very similar with the one after them calibrating the GPP model.

Wang, X., Ma, M., Li, X., *et.al*, 2013. Validation of MODIS-GPP product at 10 flux sites in northern China. *International Journal of Remote Sensing* 34(2), 587-599.

6. Attention should be given to other factors (besides temperature and precipitation) that can have an effect on the spatial and temporal variability of fir productivity (fires, harvest, deforestation, stress events . . .)

We appreciate the reviewer's valuable comments on this part. We agreed with the comment that other factors (fires, harvest, deforestation, stress events . . .) can have an effect on the spatial and temporal variability of Chinese fir productivity.

Considering this comment, we added some discussion to the revised manuscript by red letters as follows.

[Revision] Page 5652 Line 24: Fires, harvest, deforestation 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.

Page 5653 Line 13: 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.

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.

RELEVANT CHANGES MADE IN THE MANUSCRIPT

In accordance with the comments raised by both reviewer 1 and reviewer 2, relevant changes made in manuscript are listed in the form of P (page) and L (line) numbers as follows **in red letters**. Here pages and lines refer to the ones that in the **bg-2014-131-manuscript-version1**. We have improved our manuscript further in the language by a native expert. In addition, our manuscript was revised again by Professor Frank Berninger. Relevant changes were listed here **in blue letters**.

P2.L2 "focuses" was changed to "investigates"

P2.L2 "climate" was changed to "temperature and precipitation"

P2.L3 "the Moderate Resolution Imaging Spectroradiometer (MODIS) data" was changed to "MODIS MOD17 product"

P2.L5 "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" was changed to "the highest NPP value of Chinese fir presents in the Fujian province in the eastern part of the study region"

P2.L8 "comprehensively on three levels: regional scale, zonal gradients and pixel scale" was changed to "spatially and temporally"

P2.L10 "When scaling to pixels," was deleted.

P2.L11 "(e.g. Hunan and Fujian province)" was added

P2.L12 "(*e.g.* Anhui province)" was added

P2.L12 "Negative correlations between NPP and precipitation and temperature were found in the southern region" was deleted

P2.L15 "larger amount of precipitation is not always corresponding with greater NPP value" was added

P2.L16 "mode" was changed to "variability"

P2.L16 “which could potentially lead to increasing variability in rainfall” was deleted
P3.L9 “Subsequently,” was added

P3.L18 “carbon dioxide fertilization and changes in the climate itself changes” was changed to “changes in the meteorological drivers of growth and through carbon dioxide fertilization”

P4.L7 “It was quoted by Zhao (2010)” was changed to “Zhao (2010) showed”

P4.L16 “the associated effects of a changing climate on the carbon cycle”was changed to “changing climate”

P7.L2 “a suite of R packages” was changed to “R programing language (R Core Team, 2014), and a suite of R packages (sp (Bivand et al., 2013), rgdal (Bivand et al., 2014), ggplot2 (Wickham, 2009))”

P7.L7 “The algorithm of MODIS GPP is based on the light use efficiency model, with the equation of GPP = ε × FPAR × PAR, where ε is the radiation use conversion efficiency of the vegetation; PAR (Photosynthetically Active Radiation) is absorbed solar radiation between 400-700 nm wavelength, and FPAR is the fraction of incidental PAR that is absorbed by the canopy. PAR was determined from meteorological data from the NASA Data Assimilation Office. The FPAR and ε max were determined using remote sensing MODIS. NPP was calculated as the product after subtracting maintenance respiration. The growth and maintenance respirations were determined based on remotely sensed leaf and root mass, and the maintenance respiration rate was based on the biological properties of each biome (Zhang et al., 2009)” was changed to “MODIS product MOD 17 was chosen for evaluation of GPP and NPP in our study”

P7.L21 “(http://r-gis.net/?q=ModisDownload)” was added

P8.L10 “the Chinese fir distribution as modified from an artificial Chinese forest map (Data Sharing Network of Earth System Science) was combined with Landcover 2000.” was changed to “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.”

P8.L17 “41” was changed to “75”

P8.L20 “climate data were then interpolated to a 1 km-resolution image using a module of the geostatistical analyst in ArcGIS” was changed to “ordinary kriging was chosen as an estimator to interpolate the climatic data to be gridded surface with resolution of 1 km using a module of the geostatistical analyst in ArcGIS”

P10.L5 “A positive R implies that the NPP has the same trend with temperature or precipitation, while a negative R implies the opposite.” was added

P10.L6 “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 (ESRI).” was added.

P10.L13 “invaluable” was changed to “valuable”

P10.L18 “Based on the location of the tower, the corresponding temporal GPP calculated from the MODIS data was first retrieved and then compared with temporal GPP from eddy flux measurements.” was changed to “Eddy flux GPP on daily basis in 2006 were provided by Qianyanzhou Experimental Station. Correspondingly, MODIS GPP data in 2006 were downloaded. To match the footprint, subsets of 4×4 pixels around the tower were extracted. In accordance with MODIS GPP, which is an 8-day composite, 8-day summations of eddy flux GPP were created to make a correlation with average of MODIS GPP subsets.”

P11.L6 “(Fig.3a&b)” was added
P11.L9 “Fig.3a” was changed to “Fig.3c”

P11.L10 “Fig.3b” was changed to “Fig.3d”

P11.L22 “the second highest” was changed to “the third highest”

P12.L10 “forests in the region” was added

P12.L18 “Red and orange colors indicate areas where most pixels increase their NPP, while green tones indicate areas where most pixels decline.” was deleted

P13.L14 “hydrothermal zonal gradients” was changed to “zonal analysis”

P16.L4 “We got a good correlation between MODIS GPP and GPP from eddy flux measurements ($r = 0.79$, $P < 0.0001$) that was similar to the correlation in another study using satellite data from China (Wang et.al, 2014). MODIS GPP can be used to estimate the GPP within a pixel (an area of 1 km2 in current study), while eddy tower measures GPP over a footprint that changes according to the wind speed and wind direction in one year. Differences in the spatial scales of the two methods may lead to differences in the predicted GPP of the MODIS-GPP algorithm and eddy tower (Wang et.al, 2014).

To characterize the spatial pattern of temperature and precipitation, we chose ordinary kriging as an estimator to interpolate the station data. Ordinary kriging is a linear optimum interpolation method for regionalized single variable with the minimum variance of the estimation variance. A cross-validation was conducted to estimate the interpolation accuracy, which showed a high correlation coefficient of 0.92 between the original temperature data and predicted kriging value, and 0.85 for that of precipitation data. Moreover, we compared our climatic data with WorldClim data (http://www.worldclim.org/), which is a set of global climate layers (climate grids) with a spatial resolution of about 1 square kilometer, and found a very similar characteristic between the those two dataset.” was added

P16.L14 “On the other hand, such consistency validated that NPP from MODIS can represent the real ecosystem production in the current study site, thus providing an effective way to monitor dynamic ecosystem changes on a regional scale in southern China.” was deleted

P16.L22 “Lauenroth (1992) indicated that NPP was significantly related to precipitation but not to temperature.” was changed to “Del Grosso (2008) pointed that precipitation was better correlated with NPP than temperature.”

P18.L7 “Sequential decadal research on the climate change (2000-2010) was now implemented in the current study. Same trend of an increasing temperature was recorded.” was changed to “For our data, a similar trend of increasing temperatures was recorded for the period (2000-2010)”

P19.L1. “Fires, harvest, deforestation 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." was added

P19.L16 "Our results (Fig.6) show 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." was added

P21.L11 "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.

Bivand, R. Tim Keitt and Barry Rowlingson. "rgdal: Bindings for the Geospatial Data Abstraction Library". R package version 0.8-16, 2014.

Bivand, R. Pebesma, E.Gomez-Rubio Z., Applied spatial data analysis with R, Second edition. Springer, NY. ,2013" was added

P22.L6 "Del Grosso, S., Parton, W., Stohlgren, T., et al., 2008. Global potential net primary production predicted from vegetation class, precipitation, and temperature. Ecology 89(8), 2117-2126." was added

P22.L9
"ESRI.http://support.esri.com/en/knowledgebase/GISDictionary/term/zonal%20analysis" was added

P23.L3 "Houghton, R. A., 2007. Balancing the global carbon budget. Annual Review of Earth and Planetary Sciences 35, 313-347." was added

P23.L11 "Lauenroth, W., Sala, O., 1992. Long-term forage production of North American shortgrass steppe. Ecol. Appl. 2, 397-403." was deleted

P24.L14 "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." was added

P25.L1 "R Core Team. "R: A language and environment for statistical computing". R

Foundation for Statistical Computing, Vienna, Austria, 2014." was added

P26.L14 "Wang, X., Ma, M., Li, X., et.al, 2013. Validation of MODIS-GPP product at 10 flux sites in northern China. International Journal of Remote Sensing 34(2), 587-599.

Wickham, H. ggplot2: elegant graphics for data analysis. Springer New York, 2009." was added

P28.L10 "Temporal changes of climate variables in the study region from 2000 to 2010. (a) mean annual temperature (MAT); (b) mean annual precipitation (MAP)" was changed to "Spatial patterns and temporal changes of climate variables in the study region. (a) temperature surface; (b) precipitation surface; (c) mean annual temperature (MAT); (d) mean annual precipitation (MAP)"

P33. Two graphs were added in Fig.3

Acknowledgments: The authors wish to express their grateful thanks to the anonymous reviewers for the valuable comments and suggestions that helped improve the clarity of the manuscript.