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Biogeosciences Discussions

Interactive comment on "Multiyear precipitation reduction strongly decrease carbon uptake over North China" *by* W. P. Yuan et al.

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Response to Referee 2 Comments

General Comments

This study used three simulation models and satellite imagery to detect variations in plant production in northern China from 1999 to 2011. The paper is not acceptable for publication in any scientific journal, due to incorrect assumptions about the application methods for these plant production models and unsubstantiated conclusions about the model results. I recommend that the paper be withdrawn from BGD as soon as possible.

Authors' response: We hope the referee and editor can reconsider and evaluate our

mansucript based on our responses. Briefly, the referee mentioned three major issues existed in this study. First, CASA model need be recalibrated. It is very good point, and we did model paramteter calibration as suggested. The results on the impact of drought did not change. Second, CASA model can not be used to simulate GPP. Theoretically, CASA should be used to simulate GPP because it follows light use efficiency principle, which highlights the conversion from solar energy to chemical energy. So GPP is the first and direct variables to indicate the solar energy conversion. However, the original CASA is designed for simulating NPP because there were only NPP observations to calibrate the conversion efficiency of solar energy to NPP when it was developed at the early 1990. Currently, GPP can be estimated based Eddy Covariance measurements, so we can calibrate GPP efficiency parameter. Third, MODIS GPP is unreliable due to limitations described by Medlyn (2011) and Samanta et al. (2011). Zhao et al (2011) has addressed those issues of Medlyn and Samanta, and highlighted the applicability of MODIS GPP. Based on the site validation, we also showed MODIS GPP product can be used to investigate the impacts of drought on carbon cycle. Please refer the detailed responses as followings.

Specific Comments

1. The modeling methods reviewed in section 2.2 do not provide nearly enough detail to evaluate whether the models used in this study were calibrated correctly and applied in the proper manner, particularly using satellite data inputs. For instance, the CASA model requires recalibration to MODIS or AVHRR greenness data by optimization of the maximum light use efficiency parameter. There is no description of which satellite greenness index was used in this model application, nor how the NPP algorithm was calibrated with a valid maximum light use efficiency parameter.

Authors' response: Thanks for great comments. CASA model was developed and calibrated using AVHRR NDVI data originally. In this study, AVHRR NDVI was adjusted based on MODIS NDVI in order to generate long-term NDVI dataset, and it is needed to calibrate CASA model parameters. We selected randomly 50

2. Furthermore, CASA is not and never has been used as a GPP simulation model. It is completely unjustified (i.e., with no empirical evidence) to simply double NPP to estimate GPP from a simple model like CASA. All the results from the CASA model reported in this paper are therefore invalid for this reason alone and should never have been included in the comparison results.

Authors' response: Although, CASA was designed to simulate NPP, however, it follows light use efficiency principle. Basically, light use efficiency models simulated the conversion of solar energy to chemical energy, and should directly simulate Gross Primary Production (GPP). That is reason that most LUE-based models simulated GPP directly not NPP. CASA model is unique for simulating NPP because it was developed in the early 1990s and there were no available GPP observations at that time for calibrating model parameters (i.e. conversion efficiency from solar energy to GPP). Actually, CASA model made an assumption that there are constant conversion ratios from GPP to NPP. In the revised manuscript, we calibrated potential LUE for simulating GPP, therefore, the issue on conversion ratio from GPP to NPP is not a problem anymore. Moreover, numerous studies have indicated the uncertainties of individual model, and therefore we used three LUE models to reduce the model uncertainties. We highlighted the analyses of water indexes within three models and investigated the impacts of drought on carbon uptake. Therefore, we also still want to keep CASA model after calibrating parameters at the manuscript.

3. MODIS GPP and NPP algorithms have been judged to be inherently unreliable due to limitations described by Medlyn (2011) and Samanta et al. (2011), which include generally weak correlations with field observations and extreme sensitivity to air temperatures that can unrealistically increase autotrophic respiration costs and artificially drive down these NPP predictions during drought periods. Therefore, the odds of presenting misleading results from the MODIS GPP and NPP results for northern China are high.

Authors' response: Samanta et al (2011) compared isolated pixels from MODIS NPP

data set with 14 small plots of field-measured NPP from Amazon, and questioned the credibility of MODIS NPP. However, Samanta's study just focuses on the tropical forest areas, and our study only covers temperature areas. Moreover, Zhao et al (2011) argued Samanta et al (2011) ignore a number of methodological differences between NPP measured on the ground and NPP measured by satellite. We will closely follow a discussion by Zhao et al (2011) in the following text. As Zhao et al (2011) pointed out, the satellite is integrating each entire square kilometer of landscape, whereas Samanta's field data directly measures only a few fully forested ha at each study site. The field measures quantified only growth of trees, whereas the satellite measurement quantifies growth of all vegetation leaf areas. The field measurements were taken sporadically for various single years, as shown in Table 1 of Samanta et al. (2011), not annually for the whole period, so they document no interannual variability. Even the field methodologies offered by Samanta et al. are very different from plot to plot. On the contrary, Zhao et al (2011) provided the results on comparison of average MODIS NPP from 2000 through 2009 at half-degree scale with 2335 NPP cells from the Global Primary Production Data Initiative, and showed good performance of MODIS NPP. Moreover, time series of NPP are best estimated from eddy covariance flux tower data, of which >400 towers exist worldwide, some with 10 to 15 years of continuous data (Zhao et al., 2011). Medlyn et al (2011) pointed out the extreme sensitivity to air temperatures that can unrealistically increase autotrophic respiration costs and artificially drive down NPP predictions during drought periods. Because we only used MODIS GPP data, so this issue should not impact our results in this study. For MODIS GPP, besides the validation reported by Zhao et al (2011), other studies have been conducted for model validation globally (Turner et al., 2006; Wang et al., 2013), and showed the reliable model performance. It has been widely used to evaluate spatial and temporal variability of GPP. In this study, we also conducted the model validation for MODIS GPP, and the results showed the good performance. Therefore, MODIS GPP algorithm can be used in this study to investigate the impacts of drought on vegetation production.

4. Other weaknesses of the paper: Section 1. The second paragraph of the introduc-

tion is not relevant to this study. The topic of this paper is carbon uptake over northern China, nowhere else.

Authors' response: The second paragraph aims to review the impacts of drought on terrestrial ecosystem carbon uptake, which are relevant to the major objective of this study.

5. Section 2.1 No peer-reviewed publication references are provided for either the land cover fractions nor the climate input data sets used in the carbon modeling.

Authors' response: We used MODIS land cover product to indicate land cover and we will add necessary information. Climate input data for driving model is generated using thin plate smoothing splines method, and related reference has been cited in the manuscript (page 6, line 1-5).

References 1. Medlyn BE. 2011. Comment on "Drought-Induced reduction in Global Terrestrial Net Primary Production from 2000 Through 2009". Science, 333, 1093. 2. Samanta A, Costa MH, Nunes EL, Vieira SA, Xu L, Myneni RB. 2011. Comment on "Drought-Induced reduction in Global Terrestrial Net Primary Production from 2000 Through 2009". Science, 333, 1093. 3. Turner DP, Ritts WD, Cohen WB, et al. 2006. Evaluation of MODIS NPP and GPP products across multiple biomes. Remote Sensing of Environment, 102, 282-292. 4. Wang XF, Ma MG, 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. 5. Zhao MS, Running SW. 2011. Response to Comments on "Drought-Induced Reduction in Global Terrestrial Net Primary Production from 2000 Through 2009". Science, 333, 1093.

Interactive comment on Biogeosciences Discuss., 10, 1605, 2013.

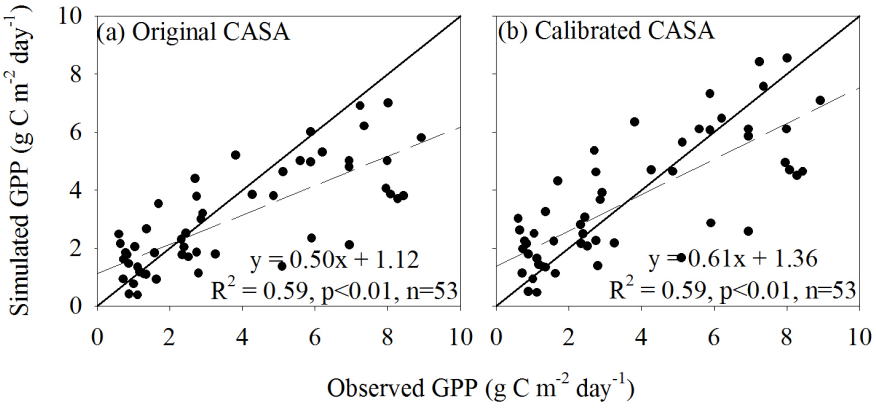

Fig. 1. Comparison of GPP simulations from the original and calibrated CASA models. The solid lines represent the 1:1 line, and the long dash lines showed the regression lines.