**Biogeosciences
Discussions**

Interactive comment on "Effects of cloudiness on carbon dioxide exchange over an irrigated maize cropland in northwestern China" *by* B. C. Zhang et al.

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General comments

The study is about the impacts of clouds via diffuse radiation on Net ecosystem exchange (NEE) on a maize cropland. Additionally, the authors look at effects of temperature and VPD, under various Clearness index (CI), on carbon uptake.

Most of the recent literature on measured effects of diffuse radiation on photosynthesis has been concentrated on forest ecosystems, with few studies looking at grasslands and even fewer studies looking at croplands. The relevance of this study lies on the fact that it provides an analysis of effects of diffuse radiation on a C4 cropland.

The authors use NEE derived from eddy correlation measurements and parallel measurements of meteorology to produce various response curves under cloudy and clear sky conditions. Some of the plots lack the regression line that was fitted to the data set (figures 2, 5, and 6), so it is difficult to know if there is any statistical difference between these lines (i.e. for instance the VPD effect). Key plots such as GPP or NEE against CI need to be added. Additionally, it would be good to have separate plots for different

CI groups. i.e. response of GPP to radiation for high, low and intermediate values of CI (see Dengel and Grace, 2010).

Response of photosynthesis to VPD and T: Simple plots of GPP against VPD and T (for different CI) could be very useful to see at which point photosynthesis stars decreasing with increasing VPD and T. It seems that photosynthesis does not reach its optimum value under the measured conditions.

This study looks at an irrigated cropland, however the authors do not mention what the effect of irrigation on their results is. Additionally, the obtained results could be put into context with results from other studies on croplands (i.e Niyogi et al. (2004) had croplands on their study), also, is there any difference with a C3 cropland?

Overall, additional exploration of the data would be necessary to confirm the stated conclusions of this work. Also, the study would benefit from additional analysis that included stomatal conductance, Light use efficiency (LUE) and water use efficiency (WUE) under various CI conditions. Finally, this paper would benefit greatly from an overall improved level of English.

Answer: We sincerely thank you for your valuable and constructive comments on our manuscript submitted to Biogeosciences 'bg-2010-293'. We have tried our best to improve our manuscript according to yours comments. The major revisions according to your above general comments included the following aspects:

1) We have revised the methods part, and shorted the study period to the plant steady

growth period to eliminate the effects of changing leaf area index.

2) We have rewritten the Section '2 Materials and methods', added the definition of sunny, cloudy and overcast days, equation of canopy stomatal conductance estimation and diffuse PAR estimation in more detail.

3) According to your suggestion, Rectangular hyperbola equation was use to describe the relationship between NEE, GPP and PAR. And analysed the parameters retrieved from this equation.

4) We have added the relationship between NEE and clearness index under diverse sky condition, the relationship between canopy stomatal conductance, GPP, PAR and clearness index.

5) We give up analyses the relationship between GPP and PAR divided by air temperature and vapour pressure deficit according to your suggestion, and we reanalysed their relationship in total data.

Specific comments

Page 1672, Site description, what are the mean temperature and precipitation during the growing season? , this could be relevant to add here.

Answer: We have added the information of the mean temperature and precipitation during the growing season according to your suggestion. **(page4, line6-9)**

Page 1672, line 16, the fetch is mentioned, but what is the footprint of the system?

Answer: The footprint of the system was estimated in the same place by other research, The fetch was more than 250 m. **(page4, line18-20)**

Page 1672, line 21, measurements of soil parameters are mentioned here, is this used on this paper?

Answer: We have deleted the soil parameters according to your suggestion. **(page5,**

line1-6)

Page 1674, lines 4-6, again a lot of information given on data that is not used on this paper, such as soil temperatures and soil moisture.

Answer: We have deleted the not used data according to your suggestion.

Page 1674, Equation 6, how did you estimate Sf i.e. the total diffuse radiation received by horizontal plane on the Earth surface?

Answer: We have revised this part more detail. **(Page7, line9-16)**

Page 1675, lines 1-3, and in other places too: -How do you define clear and cloudy sky? , is it based on CI, or diffuse fraction? Which ranges?

Answer: We have added the definition of clear, cloudy and overcast skies, it was based on CI and the solar elevation angle. **(Page6, line16-20)**

-How many days are included in Figure 1.

Answer: We have deleted the previous Figure 1, and shorted the study period in order to eliminate the effect of LAI.

Page 1675, lines 11-13, Does it make much of a difference to use a polynomial equation rather than the usual asymptotic response NEE=Amax*Radiation/ (b+ Radiation)?. Parameters from this type of curve have some physiological meaning, such as Amax and Amax/b (light use efficiency). If it was possible, it would be interesting to use this type of equation to be able to compare Amax, and Amax/B for cloudy and clear sky conditions. For instance, is Light use efficiency higher under cloudy & overcast conditions than under clear sky conditions? -It would be useful to see a plot of NEE or GEP against CI, to show where GEP is maximum. Page 1675, line 15, on Figure 2. What are the statistics of those curves, i.e R2, are those regressions significant, number of points used? What are equations?

Answer: Thanks very much for your suggestion. We have changed use Rectangu-

lar hyperbola equation to describe the relationship between NEE and PAR. **(page5, line20-23).** We also plot NEE against CI under different sky conditions. **(Figure 3)** And we added the related information according to your suggestion.

Page 1676, lines 1-2, If the authors are talking about NEE here, then you need to mention the whole plant respiration and heterotrophic respiration (i.e . ecosystem respiration). Response to temperature and VPD, Page 1676, lines 1-9 (figs 5 and 6). Again, are these regressions significant?, what are the p-values and R2 or simply under the measured conditions (irrigated) has not reached the threshold temperature and VPD values at which photosynthesis starts decreasing with increasing VPD and T. It would be useful to see just GPP against VPD (for high, low and intermediate CI) and GPP against air Temperature (also for various CI values).

Answer: Thanks for your suggestion. We have added the information of GPP against canopy stomatal conductance under different sky conditions according to your suggestion. We analyses the relationship between total GPP and VPD, and the ecosystem respiration at night and air temperature. We didn't analysed the irrigated condition as no irrigation in the study period in this revised manuscript. **(page11, line20-23 to page12, line1-19), (page12, line22-23 to page13, line1-7)**

Page 1676, lines 12-13, to make this point clear, a plot of GPP against CI would be more useful. And stay clear to the reader what you mean by cloudy or clear sky conditions in terms of CI values.

Answer: Thanks for your suggestion. We have added the definition of clear, cloudy and overcast sky conditions. And we added the relationship between NEE and CI under diverse sky condition. **(Page9,line22-23 to Page10,line1-16)**

Page 1676, lines 9-20. This is not very clear at all.

Answer: We have rewritten this part.

Page 1677, lines 6-7. What is optical temperature? Or do you mean optimal tempera-

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ture?

Answer: Canopy photosynthesis reached it maximum values when reached its optical temperature. All below or above the optical temperature will depress plant growth. We have written this part.

Page 1677, line 15. The authors mentioned the important role of stomata regulating CO2 exchange. However they have made no attempt to show what Gs is doing. It would be really valuable for this paper to show how Gs is varying with CI, T and VPD, to help understand what GPP is doing.

Answer: Thanks very much for your suggestion. We have added the information of Gc, and analysed the relationship between Gc and CI, GPP. **(Page11, line20-23 to Page12, line1-19)**

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