Biogeosciences Discuss., 8, C1164–C1175, 2011
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Biogeosciences Discussions

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Interactive Comment

Interactive comment on "Modeling impacts of farming management practices on greenhouse gas emissions in the oasis region of China" *by* Y. Wang et al.

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Received and published: 19 May 2011

Author(s): Y. Wang et al. MS No.: bg-2011-57 MS Type: Research Article

Dear REVIEWER #2,

We thank you for your very careful reading of the manuscript and the resulting constructive comments! We believe that the new version of the manuscript satisfies all concerns raised by you and it meets the journal's standard. Below you will find our point-by-point responses to your comments/questions. Please see the supplement in the submission system. Thank you!

Yours sincerely,

Ying Wang

To REVIEWER #2: General comments: This paper tests the DNDC model only by comparing the one year measured and simulated values of CO_2 and N_2O fluxes. However, for the validation of the biogeochemical model as DNDC, more comparisons should be provided. Comparisons between the measured data and model output parameters such as carbon/nitrogen content in soil and plants, soil temperature and soil water content should also be provided to verify the applicability of the model. The limitation of the DNDC model should be addressed. The text contains numerous minor problems, with respect to syntax, word usage, and other grammatical issues. There are several other points that need to be addressed. ResponseïijŽThanks for your kind words. We agreed. There was a significant correlation between modeled and observed daily N_2O and CO_2 emission fluxes under conditions of four different fertilizing, the coefficients of determination (R^2) ranging from 0.62 to 0.82 for N_2O and from 0.70 to 0.78 for CO_2, and the relative deviations were about 45% for N_2O and 25% for CO_2ïijŇrespectively. The results suggest that the N_2O and CO_2 emissions can be well modeled by DNDC. The relationship between observed and modeled the nitrate (NO_3^-) for the top 10 cm of the soil profile in summer maize fields are shown in Figure 1 in the following or in Figure 4 (please see page 27 in the revised manuscript) in the revised manuscript, and the relative deviations are about 40%. The results further support the acceptability of the DNDC model. The DNDC model captures the main peak emissions of N_2O, which are well matched with field observations in discharge time.

Fig. 1. Comparison of observed and modeled the nitrate (NO_3^-) for the top 10 cm of the soil profile in summer maize fields There is only one year of measured data, the change of the carbon content in soil is not obvious, and so we did not use this data to validate the DNDC model. Please see the following figure (Fig. 2). The coefficient of determination (R^2) between modeled and observed soil temperature is 0.77, and the relative deviation is about 8.45%.

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Fig. 2. Comparison of observed and simulated soil temperature The limitation of the DNDC model which use vertical mass movement to describe water drainage and nitrate leaching (Tonitto et al., 2010). DNDC regional modeling is constrained by model capacity or data base resolution (Bouwman et al., 1993; Li et al., 1996). In this paper, only one year measured and simulated values of CO2 and N2O fluxes were compared in our study area, so it is still difficult to analyze the limitation of this model. In year 2011, we continue to conduct the field work, and more observation data will be obtained. We hope to study further about the limitation of this model in our future research. Except for this, we have invited a native English speaker and helped us revise the problems with respect to syntax, word usage, and other grammatical issues.

Comment 1: P3122, Line 10: Change "indicate" to "indicated". Past tense should be used since this sentence is reporting observations that were made in the past. Line 11: Change "are" to "were". Insert "included" after "to". ResponseïijŽWe agreed and therefore changed these. Please see page 1 line 20 in the revised manuscript.

Comment 2: P3123, Line 3: Recent references should be cited. Line 4: Change "managing" to "management". ResponseïijŽWe agreed and therefore changed these. IPCC: Climate change 2001: summary for Policymakers, Contributions of working groups to the Third Assessment Report of the intergovernmental panel on climate change, based on a draft prepared by: Watson, R. T., Albritton, D. L., and Barker, T., IPCC, Wembley, United Kingdom, 2001. IPCC: Climate change 2007: Synthesis report, in: Contribution of working groups i, ii and iii to the fourth assessment report of the intergovernmental panel on climate change, edited by: Core Writing Team, Pachauri, R. K. and Reisinger, A., IPCC, Geneva, Switzerland, 2007a. Oenema, O., Velthof, G., and Kuikman, P.: Technical and policy aspects of strategies to decrease greenhouse gas emissions from agriculture, Nutrient Cyvling in Agroecosystems, 60, 301-315, 2001. Please see page 2 line 11 and line 12, page 16 lines 6-12, page 18 lines 10-12 in the revised manuscript.

Comment 3: P3123, Lines 20-21: from 1980 to 2000, which increased not only the productivity but the GHG emissions (FAOSTAT, 2002). ResponseïijŽWe agreed. However, the sentence has been deleted due to the revision of the related passage.

Comment 4: P3124, Line 7: few studies. Line 13: Change "of" to "on". Line 14: Change "can" to "could". Line 15: Change "exceed" to "exceeded". Line 17: What are the four factors? From P3123 Line 6 to P 3124 Line 18: This paragraph is too long. ResponseïijŽ"P3124, Line 7: few studies. Line 13: Change "of" to "on". Line 14: Change "can" to "could". Line 15: Change "exceed" to "exceeded"." We agreedïijŇhowever, the sentence has been deleted due to the revision of the related passage. We're sorry that the "Four factors" in the original manuscript is not a proper expression. We changed it into "The above studies were about the individual effects of nitrogen fertilizer or organic fertilizer on the N2O or CO2 emissions; however, few studies have considered the associated impact of two factors (i.e. nitrogen fertilizer and organic fertilizer) on the N2O and/or CO2 emissions". Please see page 3 lines 4-7 in the revised manuscript. "From P3123 Line 6 to P 3124 Line 18: This paragraph is too long.", we accepted and modified this paragraph: "China is an agricultural country with centuries of history of agricultural development. To support the increasingly growing population since the middle of the 20th century, Chinese agricultural area has expanded dramatically, reaching approximately 140 M ha (China statistical yearbook, 2006). The areal expansion has been accompanied with increasingly intensive managements including fertilizer applications. However, these achievements have come with a great cost in exhausting natural resources and in degrading the ecosystems (Huang, 2008a). Although the areal extent of the agricultural lands has been recently decreasing due to acceleration of industrialization and urbanization (Huang, 2008b), fertilizer application has been recently intensified to increase agricultural productivity. An undesired consequence of the intensified application of fertilizer is of course the increase of the agricultural emission of the Greenhouse Gas (FAOSTAT, 2003). Globally speaking, since the industrial revolution the contents of the atmospheric CO2, CH4 and N2O increased 100 ppm, 1000 ppb, 50 ppb, respectively (IPCC, 2007b; Lal, 2004; Mosier et al., 1998). Since the study area of this research is situated in an arid region where soil CH4 oxidation rate was negligible (Li et al., 2010a), our following discussion thus only focuses on

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soil N_2O and CO_2 emissions. Soil N_2O comes from two processes in soil: nitrification and denitrification, and these two processes can be affected by climate changes and agricultural activities. For example, the optimal temperature for both nitrification and denitrification is 25-35 oC (Bouwman, 1990b) and nitrogen fertilizer application increases soil N_2O emission (Chen, 1989; Li, 1993; Wang, 1994; Hou et al., 1998; Chen, 1995). Soil CO_2 emission is also controlled by climate changes and agricultural activities. For example, temperature rising can effectively enhance the soil CO_2 emission (Han, 2007) and nitrogen fertilizer application can stimulate soil CO_2 emission (Liu et al., 2008; Xing, 2006). The above studies were about the individual effects of nitrogen fertilizer or organic fertilizer on the N_2O or CO_2 emissions; however, few studies have considered the associated impact of the two factors (i.e., nitrogen fertilizer and organic fertilizer) on the N_2O and/or CO_2 emissions." Please see page 2 lines 14-32 and page 3 lines 1-7 in the revised manuscript.

Comment 5: P3126, Lines 7-15: The material size and number of the chambers, the sampling frequency and sampling time for N_2O flux should be described in detail. The measurements of CO_2 flux were not clear since the frequency of observation, the number of repetitions; the measurement times were all unknown. The reader can not determine how the fluxes of N_2O and CO_2 were measured. ResponseïijŽWe added these details in the revised manuscript (please see page 5 lines 1-31 and page 6 lines 1-2 in the revised manuscript). For N_2O, Gas samples were collected using the closed-chamber method. Each of the chambers consisted of two parts, one is the chamber cylinder (30 cm $\times$ 50 cm $\times$ 70 cm) made of organic glass, and the other one is the base collar with 5 cm internal diameter. The base collars for gas collection chambers were installed in each plot 24 h before the sampling. One base collar was installed in each one of the 12 plots. Permanent boardwalks were set before the cropping season to minimize soil disturbance during gas sampling. The gas sampling started at 9:00 AM and ended at 11:00 AM (local time). Each sampling lasted for 20 minutes and 5 samples were taken at an interval of 5 minutes during each sampling. The field measurement was conducted once per week from April to May, twice or more per

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week from June to August, and again once per week from September to October. The N2O concentration of gas samples was measured using a GC Agilent 7890 equipped with a 63Ni electron capture detector (ECD) in the laboratory within 2-3 days after sampling. The column for measuring N2O was packed with Porapak Q (80-100 mesh), and the length of the column was 3 m. The temperature of ECD was 350 âĎČ and the temperature of column was 55 âĎČ. The flow rate of carrier gas was 30 ml min-1. The N2O concentration of each sample was quantified against the concentration of the calibration gas. Soil CO2 flux in the field was determined with open-type soil carbon flux monitoring instrumentation of LI-8100 (LI-COR, Lincoln, NE, USA). Three steel collars were installed for each treatment as duplicates. That is, one steel collar was installed in each one of the 12 plots. To avoid short-term fluctuation in the respiratory rate of soil caused by human disturbance, we inserted all of the steel collars into the soil, with a 5 cm wall exposed above the soil surface for installing the monitoring chamber, and cleared the litter and the newly-germinated weeds in the steel collars 24 h before measurement (Zhang, 2008). Each measurement was commenced at 9:00 AM and ended at 11:00 AM (local time). The field measurement was conducted twice or three times per month during May, August and September, and twice or more per week from June to July.

Lines 13-15: I can not find the close relationship between the avoidance of human disturbance and the remove of all live vegetations in the bases. Usually, weeding in the filed will be removed by hands. Here, we expressed it unclearly. The “live vegetation” in the sentence implied “the newly-germinated weeds”. Therefore, we revised the original sentence into “To avoid short-term fluctuation in the respiratory rate of soil caused by human disturbance, we inserted all of the steel collars into the soil, with a 5 cm wall exposed above the soil surface for installing the monitoring chamber, and cleared the litter and the newly-germinated weeds in the steel collars 24 h before measurement”. Please see page 5 lines 27-30 in the revised manuscript.

Comment 6: P3130: Fig. 2 could not demonstrate adequately the good relationship be-

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tween modeled and observed daily N2O fluxes since the distributions of scatter points in Fig.2 were not homogeneous. More detailed analyses should be provided about the differences between modeled and observed N2O fluxes. Additionally, how the daily N2O and CO2 fluxes were obtained from the measurement data are confusing and need further explanation. ResponseïijŽWe agree with you. In order to analyze the deviations of N2O flux between simulated and observed, we added the relative deviations. Statistical results showed that the mean relative deviation is about 45%, which is an acceptable result (Li et al., 2010). This suggests that the N2O flux simulated was well matched with field observations in the peak emissions, and demonstrates that the model captured the main peak emissions of N2O. The peak emissions of N2O mainly occurred after fertilization and irrigation or during soil freezing and thawing (Li et al., 2010a). Please see page 8 lines 9-21 in the revised manuscript. Soil N2O fluxes were measured using the closed-chamber method. Permanent boardwalks were set before the cropping season to minimize soil disturbance during gas sampling. Steel base frames for gas collection chambers were installed in each plot 24 h before the sampling. One chamber was installed for each one of the 12 plots. The gas sampling started at 9:00 AM and end at 11:00 AM (local time). Each sampling lasted for 20 minutes and 5 samples were taken at an interval of 5 minutes during each sampling. The field measurement was conducted once per week from April to May, twice or more per week from June to August, and again once per week from September to October. The daily N2O flux was obtained from the equation as follows (Li et al., 2010a): F = 60*10ˆ5*[273/(273+T)]*(P/760)* H*(dc/dt) where F is the N2O emissions flux (mg N2O m-2 h-1), (g/l) represents N2O density at 0 âĎČ and 760 mmHg, T (âĎČ) is the mean value of air temperature inside the chamber measured during the closure, H (cm) is the height of chamber headspace, t (min) is time for sampling, dc/dt (10-9 min-1) is the increase of the N2O concentration per minute in the closed chamber, P (mmHg) is the air pressure of experimental site. Please see page 5 lines 1-23 in the revised manuscript. Daily CO2 flux was determined with open-type soil carbon flux monitoring instrumentation of LI-8100 (LI-COR, Lincoln, NE, USA). The unit of monitoring result is μmol m-2 s-1, which has been converted into kg C ha-1 d-1, to have it comparable with the simulated results. Please see page 5 lines 24-31 and page 6 lines 1-2 in the revised manuscript. Comment 7: P 3130, Lines 14-15: Figure should be provided to demonstrate the relationship between CO2 flux and air temperature. ResponseïijŽYes, we agree with you. There was a significant positive correlation between CO2 flux and air temperature. When the daily average temperature was greater than 0°C, the coefficients of determination (R2) between modeled CO2 fluxes and temperature were 0.47, 0.47, 0.47 and 0.51, respectively (please see Fig. 3 in the following or Fig. 5 in page 28 in the revised manuscript).

Fig. 3. The relationship between CO2 emissions and the daily mean temperature greater than 0 âĎČ

Lines17-19: Data or Figure should be provided to support the results. The conclusion came from the modeled results in our study area. Please see the following Table 1 or Table 1 in the revised manuscript in page 21. And some papers (Li et al, 2010b; Moyes et al., 2010) also support this view. Table 1. Modeled soil CO2 flux with autotrophic respiration by plant roots and heterotrophic respiration by soil microorganisms

Comment 8: P3133, Lines 14-16: Rephrase the sentence. ResponseïijŽYes, we accepted. "In this study, CO2 flux is 215, 607 and 506 kg C ha-1 yr-1, as soil texture is sand, loam and clay, respectively, as SOC decomposition inhibited by SOC absorption of clay mineral." Please see page 11 lines 10-12 in the revised manuscript.

Comment 9: P3136, Line 9: Change "under" to "in". ResponseïijŽYes, we accepted. Please see page 13 line 19 in the revised manuscript.

References Bouwman, A. F., Fung, I., Matthews, E., John, J.: Global analysis of the potential for N2O production in natural soils. Global Biogeochemical Cycles., 7, 557–597, 1993. Li, C. S., Narayanan, V., Harris, R. C.: Model estimates of nitrous oxide emissions from agricultural lands in the United States. Global Biogeochemical Cycles., 10, 297–306, 1996. Li, H., Qiu, J. J., Wang, L. G., Tang, H. J., Li, C., and

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Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C1164/2011/bgd-8-C1164-2011-supplement.zip

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Interactive comment on Biogeosciences Discuss., 8, 3121, 2011.

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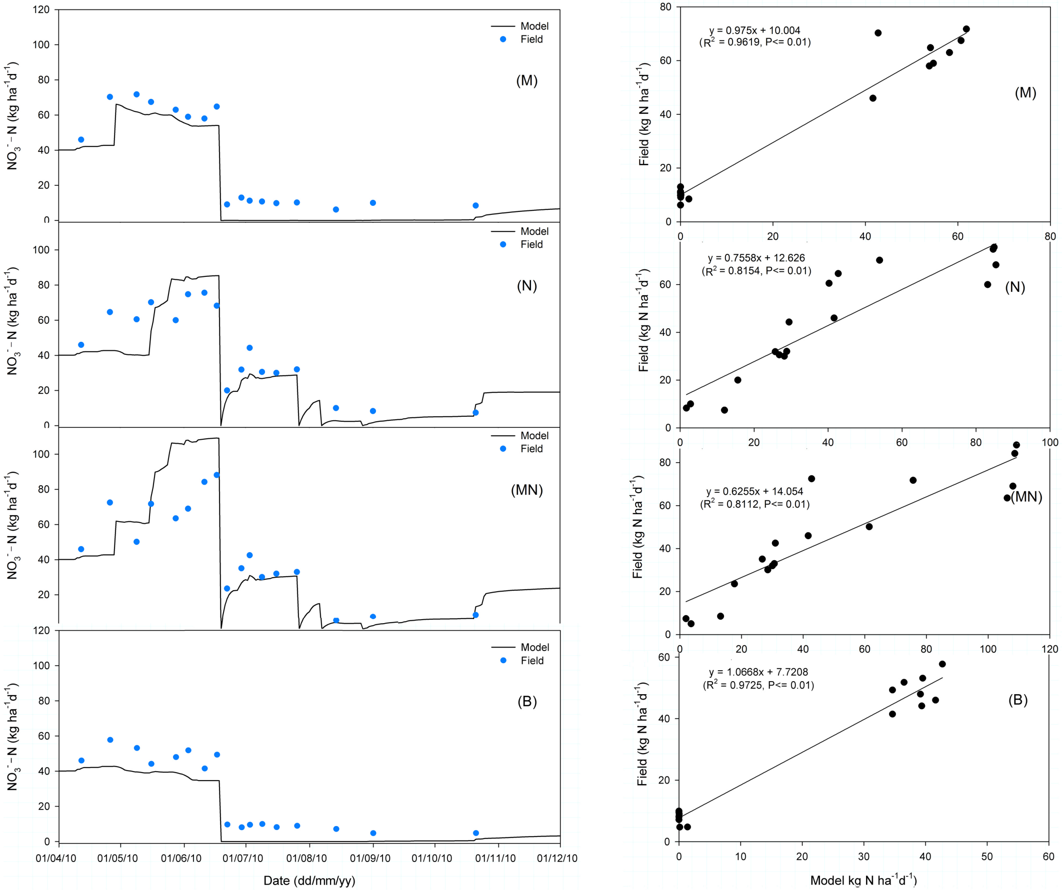

Fig. 1. Comparison of observed and modeled the nitrate (NO3-) for the top 10 cm of the soil profile in summer maize fields

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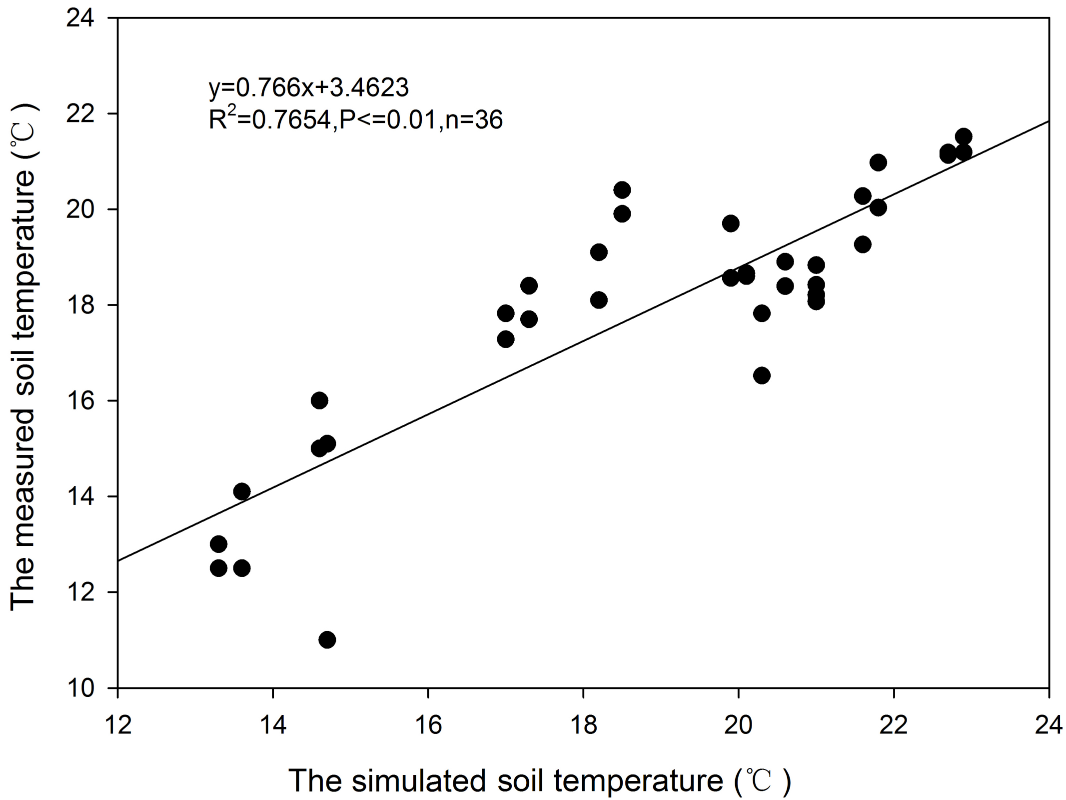

Fig. 2. Comparison of observed and simulated soil temperature

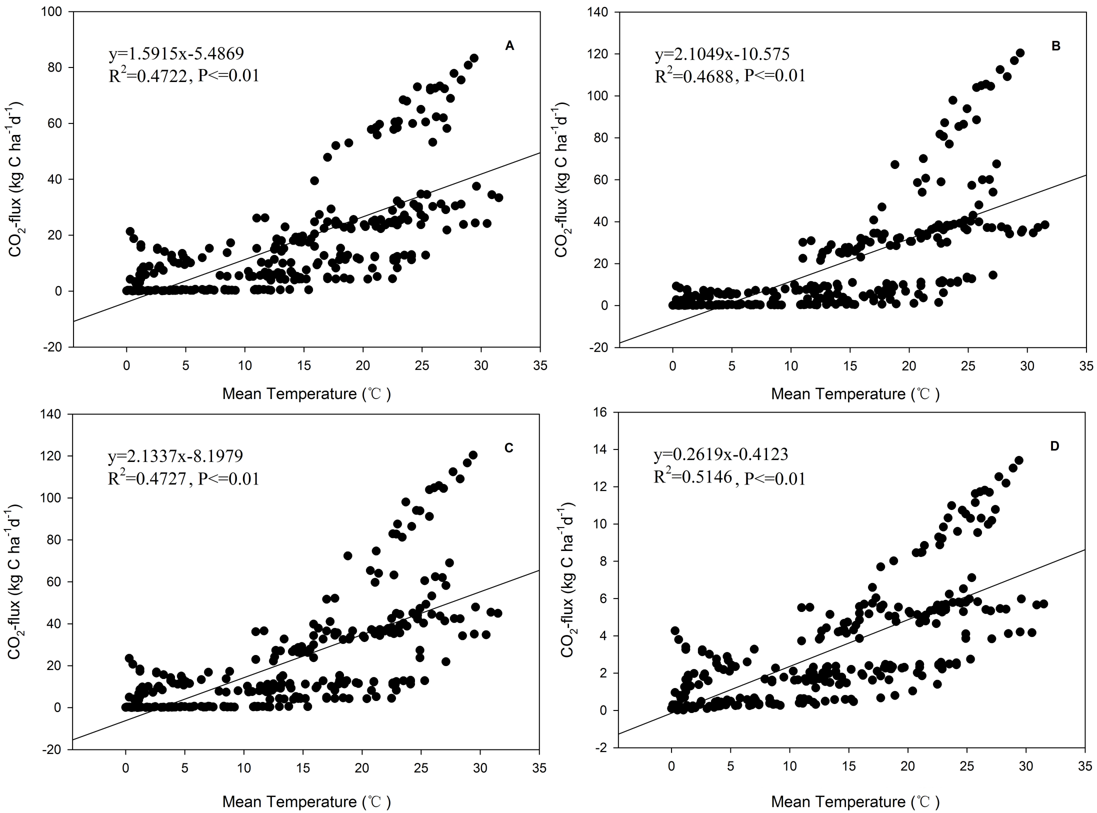

Fig. 3. The relationship between CO2 emissions and the daily mean temperature greater than 0 âĎČ

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