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Biogeosciences Discussions

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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Dear Prof. X. J. Lin,

We highly appreciate for your time in reviewing this Discuss paper. We have seriously considered and addressed your valuable comments by point-to-point responses in the following context. Revisions have been made in the revised manuscript. Please see the supplement in the submission system. Thank you!

Yours sincerely,

Ying Wang

To Prof. X. J. Lin: Comment 1_ The greenhouse gases in title means CO2, N2O and CH4, but why were only the N2O and CO2 analyzed? ResponseïijŽYes, the greenhouse gases mainly include CO2, N2O and CH4. CH4 is produced by methanogens through anaerobic decomposition of organic matter when Eh dynamics is from -300 to -150 mV. On the contrary, part of the CH4 is oxidized by methanotrophic bacteria and absorbed as a major sink in aerobic regions of the soil. We choose an oasis as our study area in arid and semi-arid areas of northwestern China. Limited irrigations make the soil in an aerobic environment in most cases, and it is not conducive to microbial activity of methane while increased CH4 reoxidation (Xie, 2009). And the simulation results showed that CH4 emission in our experimental site was negative or zero. That is, the agricultural soil in our experimental site is CH4 sink, and it is only a small portion of the whole GWP. Above all, we ignored CH4 emission in the calculation of GWP. We also mentioned this point in the article "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 soil N2O and CO2 emissions." (Please see page 2 lines 26-28 in the revised manuscript)

Comment 2_ Section2.1 should give necessary information: how large are the test area and 4 subareas for the 4 treatments, how many measurement points were selected in the each subarea, and how many days were tested? How do you conduct the QAQC? The photos for both test instruments may be perfect. ResponseïijŽWe added the related information in Section 2.1 in the revised manuscript (Please see page 4 lines 24-31, page 5 lines 1-31 and page 6 lines 1-2 in the revised manuscript). The experiment was a randomized block design with three replications. That is, 12 plots were used and each plot was 4 m $\times$ 8 m. For N2O, 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. 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 N2O concentration of gas samples was measured using GC Agilent 7890 in the lab within 2-3 days after 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. For CO2, 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. In order to conduct the QAQC: (1) the experiment was a randomized block design with three replications, and each of the treatments was applied at a plot of 4 m $\times$ 8 m; (2) gas sampling and soil CO2 respiration measurement were conducted in each plot, in other words, gas sampling and soil CO2 flux measurements for each treatment have three duplicates; (3) the N2O concentration of gas samples was measured using GC Agilent 7890 in the lab within 2-3 days after sampling, and it has shown that within 2-3 days after sampling, the N2O concentration of gas samples was almost unchanged (Xu, 1999); (4) The N2O concentration of each sample was quantified against the concentration of the calibration gas; (5) Soil CO2 flux in the field was determined with open-type soil carbon flux monitoring instrumentation of LI-8100 (LI-COR, Lincoln, NE, USA); (6) to avoid short-term fluctuation in the gas sampling and respiratory rate of soil caused by human disturbance, steel base frames for gas collection chambers and PVC collar were installed in each plot 24 h before the sampling and measurement, and permanent boardwalks were set

before the cropping season to minimize soil disturbance caused by gas sampling.

Comment 3_ Section 2.2.1 is review of literatures, and should be moved to introduction. ResponseïijŽYes, we accepted it. We moved it to introduction: “In order to assess the potentials of reducing agricultural N2O and CO2 emissions through changing management practices and evaluate the possible responses of agricultural N2O and CO2 emissions to different management practices, we utilized the DeNitrification-DeComposition (DNDC) model to simulate soil carbon sequestration potentials and greenhouse gas emissions brought about by different farmland management practices in agroecosystems (Li, 2004a). In the past 20 yr, the DNDC model has proven to be effective in many places around the world, such as North America, Europe, Asia and Oceania (Li et al., 1996; Plant, 1999; Stange et al., 2000; Li, 2000; Zhang et al., 2002; Xu et al., 2003; Cai et al., 2003; Frolking et al., 2004; Grant et al., 2004; Smith et al., 2004; Butterbach-Bahl et al., 2004; Pathak et al., 2005; Jagadeesh Babu et al., 2005; Beheydt et al., 2007; Smith et al., 2010). Application of this model in China began in the late 1990s. The study of Xu et al. (2000, 2001) in Guizhou Province suggested that soil N2O fluxes can be well simulated by the DNDC model for corn-rape rotation, soybean-winter wheat rotation and fallow fields. A study of soil N2O emission in soybean fields also lends a strong support to the acceptability of the DNDC model in simulating N2O emission flux during the soybean growing period (Xie and Li, 2004). The strongest support to the acceptability of DNDC model came from the Quzhou experiment station of China Agricultural University where long-term observational data of soil organic carbon variations with different treatments of fertilization and tillage were consistent with the DNDC modeling results (Wang et al., 2004).” Please see page 3 lines 8-26 in the revised manuscript.

Comment 4_ In section 3.1, the results show the relationship between the modeled and measured concentrations. But the model accuracy to predict the N2O and CO2 should be analyzed, and give the errors of model prediction. ResponseïijŽThere was a significant correlation between modeled and observed daily N2O and CO2 emission fluxes under conditions of four different fertilizing, the coefficients of determination (R2) ranging from 0.62 to 0.82 for N2O and from 0.70 to 0.78 for CO2, and the relative deviations were about 45% for N2O and 25% for CO2. This relative high correlation suggests that the N2O and CO2 emissions can be well modeled by DNDC. The relationship between observed and modeled the nitrate (NO3-) for the top 10 cm of the soil profile in summer maize fields are shown in Figure 1 in the following, and the relative deviations were about 40%. The results further supported the acceptability of the DNDC model. The DNDC model captured the main peak emissions of N2O, which were well matched with field observations in discharge time. Please see page 8 lines 9-16 and pages 25-27 in the revised manuscript. Fig. 1. Comparison of observed and modeled the nitrate (NO3-) for the top 10 cm of the soil profile in summer maize fields

Comment 5_ Line 14-15 on page 3130, a figure is needed to demonstrate the relationship between temperature and CO2. ResponseïijŽYes, we added a new figure (Fig. 2) to demonstrate the relationship between temperature and CO2. Please see page 28 in the revised manuscript. Fig. 2. The relationship between CO2 emissions and the daily mean temperature greater than 0 âĎČ

Comment 6_ Line 17-19 on page 3130: How do you let readers to believe the root respiration is the main source of CO2? ResponseïijŽWe added a new table (Table 1) into the manuscript (please see page 21 in the revised manuscript). From this table, it can be seen that root respiration is the dominated source of the total CO2 flux. Some studies have also found the similar results in other study areas. (Li et al, 2010; Moyes et al., 2010). Table 1. Modeled soil CO2 flux with autotrophic respiration by plant roots and heterotrophic respiration by soil microorganisms

Reference Li, J. M., Ding, W. X., and Cai, Z. C.: Effects of nitrogen fertilization on soil respiration during maize growth season, Chinese Journal of Applied Ecology, 21 (8), 2025-2030, 2010. Moyes, A. B., Gaines, S. J., Siegwolf, R. T. W., and Bowling, D. R.: Diffusive fractionation complicates isotopic partitioning of autotrophic and heterotrophic sources of soil respiration, Plant,Cell and Environment, 33, 1804-1819,

2010. Xie, P.: Research on spatial and temporal evolution of soil carbon sequestration of oasis farmland ecosystem in Hexi [PHD Dissertation], Lanzhou: Gansu Agricultural University. Xu, W. B.: Theoretical and practical problems associated with chamber measurement âĂŤ taking N2O for example, Geology-Geochemistry, 27 (3), 111-117, 1999.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/8/C1155/2011/bgd-8-C1155-2011-supplement.pdf

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

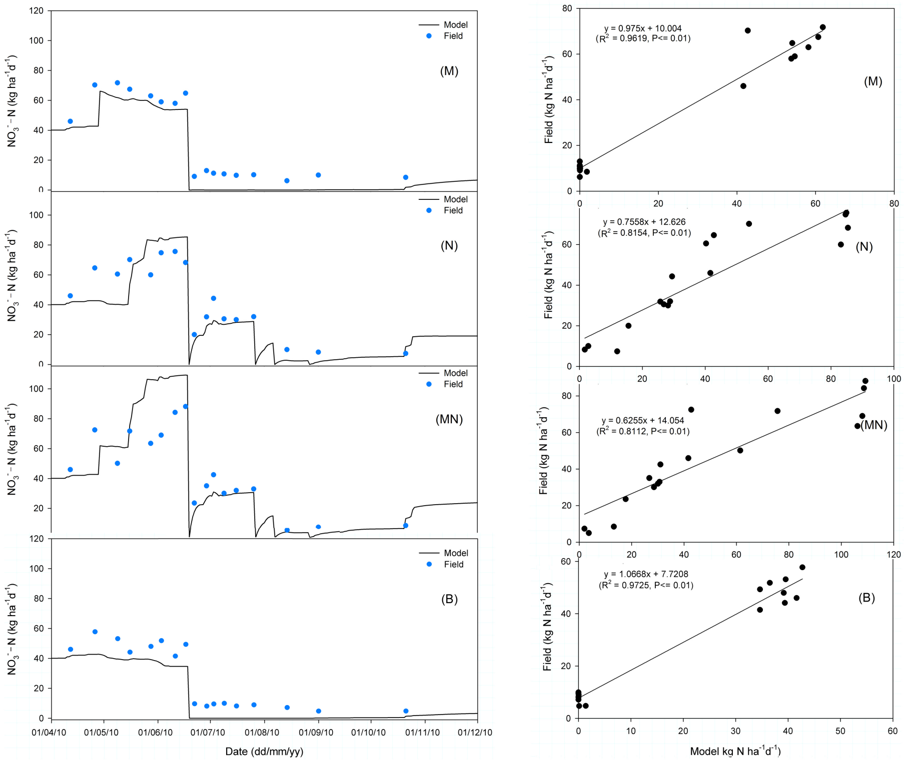

Fig. 1. Fig.1. Comparison of observed and modeled the nitrate (NO3-) for the top 10 cm of the soil profile in summer maize fields

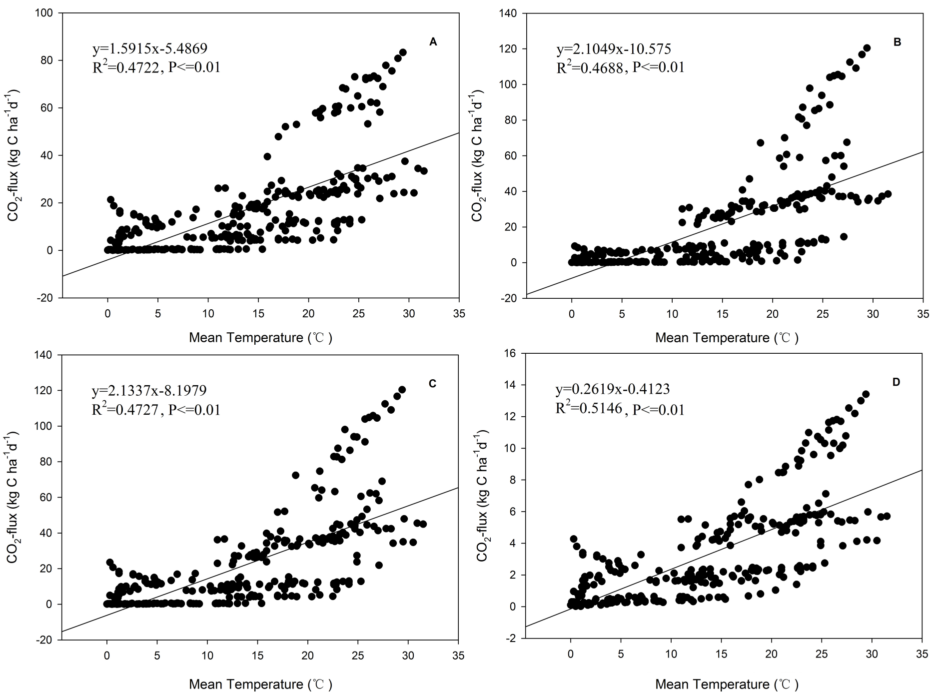

Fig. 2. Fig. 2. The relationship between CO2 emissions and the daily mean temperature greater than 0 âĎČ

Table 1. Modeled soil CO_2 flux with autotrophic respiration by plant roots and heterotrophic respiration by soil microorganisms

Treatment	Root-respiration kg C $ha^{-1}y^{-1}$	Soil-heterotrophic-respiration kg C $ha^{-1}y^{-1}$
M	3416	1524
N	4654	939
MN	4635	1751
B	595	359

M was a traditional agricultural fertilization mode when there was no chemical fertilizer provided; N was a fertilization mode with high input and intensive agriculture; MN was a fertilization mode recommended by local experts; B was a controlled trial.

Fig. 3. Table 1. Modeled soil CO2 flux with autotrophic respiration by plant roots and heterotrophic respiration by soil microorganisms