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Biogeosciences Discussions

Interactive comment on "Responses of soil respiration to elevated carbon dioxide and nitrogen addition in subtropical forest ecosystems in China" *by* Q. Deng et al.

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Anonymous Referee 2

This study provides very important information of soil respiration in tropical region in China with an OTC experiment. Most data are very interesting and seems to be essential for predicting future soil respiration. In Fig3, it is wonderful data of respiration and soil moisture condition. It is very nice. However, the Introduction is irrelevant in the arrangement of each paragraph. Also there are some mistakes in text. Please consider them.

Response: We thank the reviewer for the positive comments. We considered all the

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suggestions carefully and incorporated them into this revision.

1 This study focused on soil respiration so that you should start the description of soil respiration. In 8361, Introduction: Please start the second paragraph (from line 18-26), and insert line 7-17 to the end of line 15 in 8362 with some of your modification.

Response: We re-arranged the paragraphs as suggested by deleting the first paragraph and moving sentences between lines 7-17 into this paragraph.

2 In 8363, line 13: there is no hypothesis of this study. You should state it.

Response: As also suggested by another reviewer, we added hypotheses in the introduction. This part now reads as "We hypothesized that 1) elevated [CO2] would stimulate soil respiration due to greater soil C input (root biomass and SOM); 2) the stimulatory effect would be sustained over time due to the high ambient N deposition in subtropical China; and 3) the combined effect of elevated [CO2] and N addition would be greater than the impact of either one alone due to positive interaction."

In details

1 In 8365, line 16. Unfortunately, number of chambers was not enough, so that you should explain how to "overcome statistical difficulties "with limited number of chamber.

Response: In this study, 10 large chambers were constructed and used. Since a design with two treatment factors with 2 levels each and 3 replications needed 12 chambers, we used two replications for ambient CO2 treatments [included one control (ambient CO2 and low N deposition, CK) and one ambient CO2 and high N deposition (NN)]. General linear model was used in data analysis. We also installed four PVC soil collars in each chamber and measured soil respiration once a week for 30 months. We believed this high-frequency and long-term measurements will overcome statistical difficulties with limited number of chamber.

2 Line 23, why did you use NH4NO3 as a nitrogen source.

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Response: We use NH4NO3 as a nitrogen source due to the following reasons. 1. In the past decades, atmospheric nitrogen (N) deposition in southern China mainly composed of NH4+-N and NO3—N, resulted from elevated NH3 emissions from agriculture and increased NOx emissions from fossil fuel combustion (Galloway et al., 2004; Chen and Mulder, 2007). 2. Use of NH4NO3 as fertilizer is a common practice locally. The seedlings of native species are suitable for this fertilizer rather than others. 3. We use NH4NO3 as a nitrogen source by referring to some of other N addition experiments (e.g., Mo et al., 2007 and 2008; Allen et al., 2008; Keeler et al., 2009).

Allen, S.D, Czimczik, C.I., and Treseder, k.k.: Microbial activity and soil respiration under nitrogen addition in Alaskan boreal forest, Global Change Biology, 14, 1156–1168, 2008.

Chen, X.Y., Mulder, J.: Indicators for nitrogen status and leaching in subtropical foreste cosystems, South China, Biogeochemistry, 82, 165–180, 2007.

Galloway, J.N., Dentener, F.J., and Capone, D.G..: Nitrogen cycles: past, present and future, Biogeochemistry, 70, 153–226, 2004.

Keeler, B.L., Hobbie, S.E., and Kellogg, L.E.: Activity in eight forested and grassland sites: implications for litter and soil organic matter decomposition, Ecosystems, 12, 1–15, 2009.

Mo, J.M., Zhang, W., Zhu, W.X., Fang, Y.T., Li, D.J., and Zhao, P.: Response of soil respiration to simulated N deposition in a disturbed and a rehabilitated tropical forest in southern China, Plant and Soil, 296, 125–135, 2007.

Mo, J.M., Zhang, W., Zhu, W.X., Gundersen, P., Fang, Y.T., Li, D.J., and Wang, H.: Nitrogen addition reduces soil respiration in a mature tropical forest in southern China, Global Change Biology, 14, 403-412, 2008.

3 In 8370, related to Fig. 2, Please explain or give plausible understanding of the big variation around high soil temperature.

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Response: This phenomenon has been observed in several studies (e.g. Knapp et al., 1998; Zhang et al., 2005). We think that the slightly high variation of soil respiration at high temperature may be caused by other factors such as resource supply rates and great rainfall event. When soil temperature was low, roots and microbial activities were strongly influenced by soil temperature. However, this constraint will be gradually weakened as soil temperature increased. Root respiration and microbial respiration would simultaneous be influenced by plant growth in wet season. In addition, our study site is characterized by a typical south subtropical monsoon climate. There is higher air temperature in wet season, always accompanied more rainfall events. Rapidly Transitions between low and high water status in great rainfall event can disturb temperature as a control on soil respiration (Melillo et al., 2002). Thus, more scatter points were often observed at higher temperature.

Knapp, A.K., Conard, S.L., Blair, J.M.: Determinants of soil C02 flux from a sub-humid glassland efect offireandfire history, Ecological Applications, 8, 760-770, 1998.

Melillo, J.M., Steudler, P.A., Aber, J.D., Newkirk, K., Lux, H., Bowles, F.P., Catricala, C., Magill, A., Ahrens, T., and Morrisseau, S.: Soil warming and carbon-cycle feedbacks to the climate system. Science, 298, 2173-2176, 2002.

Zhang, J., Song, C., and Yang, W.: Temperature sensitivity of soil respiration and its affecting factors in the different land use, Acta Soientiae Circumstantiae, 25(11), 1537-1542, 2005.

4 In 8373, line 2, sol should be soil?!

Response: Corrected.

5 In 8374: Is there any relationship between symbiotic micro-organisms in rhizosphere and respiration with high nitrogen loading. Activity of ectomycorrhiza is usually suppressed at high N. Do you have any data related to this point?

Response: We did not measure the symbiotic micro-organisms in rhizosphere and the

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activity of ectomycorrhiza, thus we have no data to test if the activity of ectomycorrhiza was suppressed at high N. But we found that soil respiration would gradually be suppressed with soil drier under N addition (Table. 2) which suggests that the positive effect of N addition treatment may be weakened over time. In addition, Aber et al. (1989) reported that N additions would initially stimulate soil microbial activity, but would lead to a carbon limitation state after microbial demand for N was satisfied over time.

Aber, J.D., Nadelhoffer, K.J., Steudler, P., Melillo, J.M.: Nitrogen saturation in northern forest ecosystems, BioScience, 39, 378–386, 1989.

6 In 8375, Do you have any discussion related to planted seedlings and soil respiration?

Response: In this revision, we added a few references related to soil respiration and planted seedlings. For example, in the section 4.3, we added: "Our results also demonstrated that elevated CO2 increased considerable amount of carbon release (about 28 percent on average) from the forest floor. The increase was comparable to an open-top chamber study in eastern Finland which reported an about 30 percent increase (Sini et al., 2004). However, it was higher than the Duke Forest Free Air CO2 Enrichment (FACE) Experiment (about 16 percent on average) (Bernhardt et al., 2006). "

In the section 4.4, we added: "Lu et al (1998) also reported that the root respiration rate of seedlings grown at 50 mg L–1 N concentration due to higher root biomass were significantly higher that those grown at 10 mg L–1 N. We believed that young seedlings used in this study grew quickly under N addition and required more soil N, which would lead to a transitory and slight N limitation at our study sites. Increased aboveground biomass was observed by Duan et al., (2009) and increased root biomass (Fig. 4) was obtained in the N treatment. "

In the section 4.5, we added: "In OTC studies with CO2 and N manipulations, poplar seedlings and saplings (≈1–5 years old) had greater plant growth stimulation under elevated [CO2] at high rather than at low N supply after two years in Michigan (Zak et

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al. 2000) and Italy (Liberloo et al. 2005), and three years in Iceland (Sigurdson et al. 2001)."

Please also note the Supplement to this comment.

Interactive comment on Biogeosciences Discuss., 6, 8359, 2009.