Dear reviewer,

Thank you very much for your comments with regard to our manuscript (**bg-2014-523)**. The comments from the reviewer were very helpful and we agree that the previous version needed revision. We take all of these comments into account in preparing the revised manuscript. We believe that manuscript has been improved satisfactorily and hope it will be accepted for publication in **Biogeosciences**.

We thank again the reviewer for the helpful comments. Should you require any further information, please do not hesitate to ask.

To the Comments of Reviewer #2

QII-1: I think the root effects can be potentially included in the difference of your and previous studies (P1455 L1-5), which also play important roles in Q10 of soil CO2 effluxes (ex. Booe et al 1998 Nature, Janssens et al. 2004 GCB). Thus, please be careful about this aspect.

R: Firstly, the bare fallow soil used in the present study is selected from the long-term experiments, which was established in 1984. The bare plot is always in a state of fallow since June 1984 after the harvesting of winter wheat (*Triticum aestivum* L. 'Chang Wu 131 series'). **Therefore, there were no any vegetation and also no any inputs of aboveground and belowground litter.** Secondly, different components of soil respiration (root and microbial respiration) has different response to the increasing of temperature, with root respiration Q_{10} can be higher than that of microbial respiration (ex. Boone et al 1998 Nature, Janssens et al.

2004 GCB). Finally, in this part (P1455 L1-5) we total cited ten previous studies, and in which five previous studies include root respiration, for instance, "(Janssens and Pilegaard, 2003; Davidson et al., 2006; Zheng et al., 2009; Bond-Lamberty and Thomson,2010; Vanhala et al., 2011; Luan and Liu, 2012) ". Therefore, the five previous works reported Q_{10} of soil respiration was deleted from our manuscripts.

QII-2: P1454 L11: Please define WFPS in this part.

R: Yes, WFPS was defined in this part, for instance "annual soil moisture content ranged from 38.6 to 50.7% soil water-filled pore space (WFPS), with mean value of 43.8% WFPS and CV of 11%, which were mainly affected by the frequency and distribution of precipitation".

QII-3：P1455 L1-5: In the sentences, some previous works reported Q10 of soil respiration including root respiration, which have different processes from SOC mineralization treated in your study.

R：See the replies for QII-1.

QII-4：P1456 L7: "agricultural ecosystems" –> "vegetation ecosystems"? , as the references included works in forests.

R: Yes, agricultural ecosystems were replaced by vegetation ecosystems due to the previous references included works in forests ecosystems.

QII-5：P1458 L10: Please recheck the equation of WFPS, and the 2.65 is the particle density?

R: Yes, 2.65 is the particle density of the soil (g cm^{-3}). After carefully checked the equation of WFPS, a mistake for spelling the equation was corrected. Additionally, the following equation was cited in the text: Soil water-filled pore space (WFPS) was calculated as follows: WFPS (%) = 100 × [volumetric water content / (2.65 − soil bulk density) / 2.65], with 2.65 being the particle density of the soil (g cm^{-3}). Detail information in the 2.3 Measurements of SOC mineralization rate and soil microclimate sections.

QII-6：P1459 L7-9: How about estimating annual cumulative SOC using Eq4? Also, the annual cumulative SOC mineralization rate estimated by the liner interpolation should be compared with average of the measurements in each year, to discuss the potential errors due to the estimation methods.

R: Soil temperature and moisture is the major abiotic factors to influence SOC mineralization rate, whereas the interactions of soil temperature with moisture content can more accurately simulate soil respiration than either soil temperature or moisture alone (Tang et al., 2005). After comparing different functions and resulting residual plots, a bivariate model was used to simulate the effect of soil moisture content and temperature on SOC mineralization rate:

$$F = \beta_0 e^{\beta_1 T\theta + \beta_2 T\theta^2} \quad (4)$$

Annual cumulative SOC mineralization rate was estimated using Eq4 during the experimental period from 2008 to 2013 (Fig. 1). In most cases, we found that the Eq4 can well predict the SOC mineralization rate (Fig. 1), which was in line with the previous studies (Tang et al, 2005; Tree Physiology). Additionally, we compared the annual cumulative SOC mineralization rate estimated by different methods (linear interpolation, modeled using Eq4, and unit conversion from the mean SOC mineralization rate in each year) for discussing the potential errors due to the different estimation methods (Table 1).

The results presented herein clearly showed that there was no significantly different for estimating annual cumulative SOC mineralization rate between linear interpolation and modeled method (Table 1), whereas compared with linear interpolation and modeled method for estimating annual cumulative SOC mineralization rate, unit conversion method seriously overestimated annual cumulative SOC mineralization rate (Table 1).

The large errors for estimating annual cumulative SOC mineralization rate using unit conversion method can be ascribed the following reasons: 1) the study site had a continental monsoon climate with 60% of rainfall occurred from July to September (rainy season), thus the significantly season characteristic for climate in our sites is hot and rainy in the rainy season, cool and dry in the non-rainy season; 2) SOC mineralization rate measured in the rainy and non-rainy season is basically equal, whereas the rainy season is only a quarter of the time in a given year; 3) due to the hot and rainy climatic characteristics in the rainy season, the SOC mineralization rate was much greater in rainy season than in non-rainy season, thus seriously overestimated cumulative SOC mineralization rate in a given year.

In conclusions, linear interpolation method is a simple and actionable method for estimating annual cumulative SOC mineralization rate, which had been well used in other studies (King et al., 2004, GCB. Riveros-Iregui et al., 2012, GCB; Storlien et al., Soil Science Society of America Journal); the modeled method with soil temperature and moisture can well estimating annual cumulative SOC mineralization rate but the method needing soil temperature and moisture data every day, thus the method is limited in practice; unit conversion method may seriously overestimate annual cumulative SOC mineralization rate unless the measuring of SOC mineralization rate is very uniform in a given yea

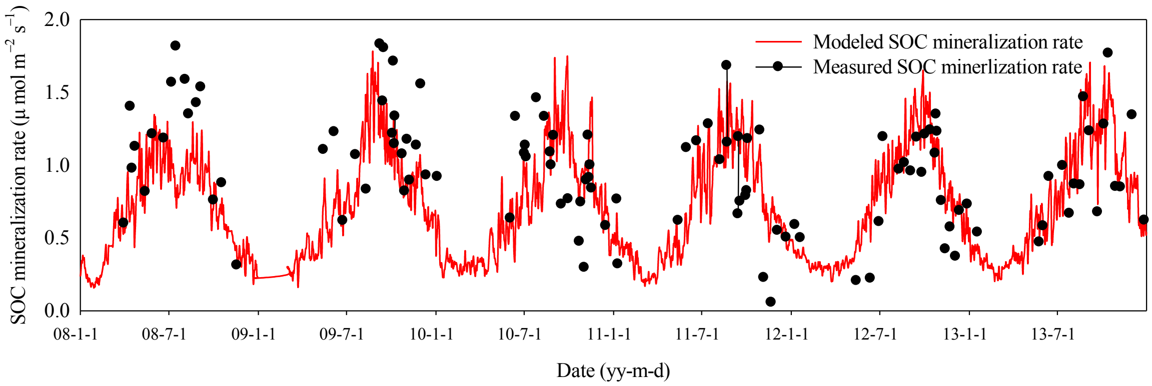

Fig. 1 Modeled (using Eq4) and measured SOC mineralization rate from 2008 to 2013.

Table. 1 Annual cumulative SOC mineralization rate was estimated by linear interpolation method, modeled by Eq4, and unit conversed by the mean SOC mineralization rate in each year.

Years	Cumulative SOC mineralization rate		
	Linear interpolation	Eq4 modeled	Unit conversion
2008	293	258	462
2009	298	272	460
2010	238	268	344
2011	234	260	325
2012	226	271	314

2013	240	284	348
Mean	255±32	269±6	374±65

QII-7：P1459 L19: Table 1 should be referred before Table 2?

R：Yes, we had revised the order for Table 1 and Table 2 in the **3.1 Interannual variation in *Q₁₀* sections .** For instance, “the annual cumulative SOC mineralization ranged from 226 g C m^{-2} y^{-1} (2012) to 298 g C m^{-2} y^{-1} (2009), with a mean of 253 g C m^{-2} y^{-1} and a CV of 13% (Table 1), and the annual Q_{10} in our sites was 1.65 in 2008, 1.94 in 2009, 1.72 in 2010, 1.48 in 2011, 1.86 in 2012, and 1.55 in 2013, respectively, with a mean Q_{10} of 1.72 and a CV of 10% (Table 2) ”.

QII-8：P1459 L20: Again, please add the mean annual SOC mineralization rate using the unit of cCm-2yr-1 for readers’ reference.

R: Yes, see the replies for QII-6. Additionally, in order to for readers’ reference, the mean annual SOC mineralization rate was added in the Table 1.

Table 1. Cumulative SOC mineralization rate (g C m^{-2} $year^{-1}$), annual precipitation amount (mm), annual precipitation days, and air temperature (ºC) from 2009 to 2013. Data are represented as mean ± S.D.

Years	Cumulative SOC mineralization rate	Precipitation amount	Precipitation days	Air temperature
2008	293±10	520	105	9.76
2009	298±9	481	99	10.26

2010	238±50	588	101	10.39
2011	234±48	644	100	9.43
2012	226±19	481	98	9.43
2013	240±30	523	71	11.08
Mean	253±32	540±64	96±12	10.1±0.6

QII-9：L1460 L4: Please clearly define when the dry and wet season occurs? Every year same? Otherwise, there are some inter-annual variations

R：Yes, the dry and wet season had been clearly defined in the **3.2 Interannual variation in soil microclimate sections.** For example, "The seasonal mean soil moisture content was 49.2% WFPS in the wet season (July to September in each year) and 38.6% WFPS in the dry season (other seasons except for wet season for every year)".

QII-10：P1460 L20: I think Raich and Schlesinger (1992) is the review paper for Q10 demined form soil respiration rates, which different from that of SOC mineralization. Note that root respiration Q10 can be higher than that of microbial respiration in response to the seasonal variations in root increments (ex. Boone et al 1998 Nature, Janssens et al. 2004 GCB)

R: Firstly, the bare fallow soil used in the present studies is one of the long-term experiments, which was established in 1984. The bare plot is always in a state of fallow since June 1984 after the harvesting of winter wheat (*Triticum aestivum* L. 'Chang Wu 131 series'). **Therefore, there were no any vegetation and also no any inputs of aboveground and belowground**

litter. Secondly, different components of soil respiration (root and microbial respiration) has different response to the increasing of temperature, with root respiration Q_{10} can be higher than that of microbial respiration (ex. Boone et al 1998 Nature, Janssens et al. 2004 GCB). Thirdly, the Q_{10} for soil respiration was deleted from our manuscripts such as Raich and Schlesinger, 1992 and Peng et al., 2009. Finally, this part was revised for "The range of annual Q_{10} (1.48–1.94, with a CV of 10%) in our sites for the period 2008- 2013 was within the range of limits reported for annual Q_{10} (1.20–4.89) at global scale (Boone *et al.*, 1998; Zhou *et al.*, 2007; Gaumont-Guay *et al.*, 2008; ZHU and CHENG, 2011; Zimmermann *et al.*, 2012). However, the mean annual Q_{10} in our sites (1.70) was lower than the global mean (2.47) (Boone *et al.*, 1998; Zhou *et al.*, 2007; Gaumont-Guay *et al.*, 2008; ZHU and CHENG, 2011; Zimmermann *et al.*, 2012), probably due to the low SOC contents, small microbial communities, dry soil conditions in semi-arid regions (Conant et al., 2004; Gershenson et al., 2009; Cable et al., 2011), additionally the different methods for separating soil SOC mineralization may also contribute to this difference (Boone *et al.*, 1998; ZHU and CHENG, 2011; Zimmermann *et al.*, 2012)".

QII-11：P1461 L12: It seems the rainfall "distribution" was not examined in the current MS

R: In the **3.2 Interannual variations in soil microclimate sections**, interannual variation in rainfall distribution was examined. For instance, "Annual precipitation showed a significantly annual variation (Fig.1 and Table 1; $p<0.05$), with rainfall ranged from 481 mm (2009 and 2012) to 644 mm (2011), with a 6-year mean value of 540±64 mm and a CV of 12%. Annual rainfall days ranged from 71 days (2013) to 105 days (2008), with a 6-year mean value of

96±12 days and a CV of 13%."

QII-12：P1461 L13: I cannot understand the definition of the "annual precipitation events" in the Figure 5b. Does this mean "rainfall days"? For the rainfall characteristics, you can use rainfall intensity, rainfall days, and rainfall frequency in addition to the rainfall amount (ex, D'Odorice et al 2000 Water Resource Res, Kao et al. 2013 Hydrological Processes).

R: In the present studies，annual precipitation events means rainfall days, thus annual precipitation events had been replaced by annual precipitation days in the Figure 5b in the latest manuscripts.

QII-13： P1461 L21: Please remove "However".

R: Yes, "However" was deleted from our old manuscripts.

QII-14：P1463 L5: I am not sure if the inter-annul variations in Q10 in your site were large or not. Please compare your results with previous studies if possible. Some previous studies reported inter-annul variations in soil respiration (ex. Savege and Davidson 2001 Global Biochem Cycle, Epron et al 2004 Ann For Sci, Irvine et al. 2008 GCB, Kume et al. Ecohydrol).

R: In the present studies, our bare fallow soil treatment is always in a state of fallow (31 years) from 1984 to now, thus respiration rate in our studies only means SOC mineralization. Soil respiration is a complex process that includes two major sources of soil respiration: root-derived respiration, SOC mineralization and decomposition (Kuzyakov, 2006, SBB).

Different components of soil respiration (root and microbial respiration) has different response to the increasing of temperature, with root respiration Q_{10} can be higher than that of microbial respiration (ex. Boone et al 1998 Nature, Janssens et al. 2004 GCB). To our knowledge, in the previous studies, inter-annul variations in soil respiration has been well studied (ex. Savege and Davidson 2001 Global Biochem Cycle, Epron et al 2004 Ann For Sci, Irvine et al. 2008 GCB, Kume et al. Ecohydrol), whereas there was no report for inter-annul variations in Q_{10} of SOC mineralization. Therefore, this is impossible to compare our results with previous studies.

The description of inter-annul variations in Q_{10} in your site were large was replaced by "The results of this study showed that the annual cumulative SOC mineralization ranged from 226 to 298 g C m^{-2} y^{-1}, with CV of 13%, annual Q_{10} ranged from 1.48 to 1.94, with CV of 10%, and annual soil moisture content ranged from 38.6 to 50.7% WFPS, with CV of 11%".