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Interactive comment on "The abiotic contribution to total CO_2 flux for soils in arid zone" *by* J. Ma et al.

Anonymous Referee #1

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This paper addresses abiotic CO2 fluxes, which might be important sources for soil respiration in certain ecosystems. The study included a number of different ecosystem types in a desert region in China, and concluded from field incubations that abiotic fluxes contribute considerably to respiration in some soils with low respiration rates. However, the experimental setup and sample treatment does not necessarily justify those conclusions. While the general attack on common procedures of extrapolating soil respiration rates to long-term annual fluxes (page 11231) could have some justification, this cannot be done based on field incubations over two days under non-native conditions for most samples. Rather, it would have been more useful to specify the conditions under which such an extrapolation might be inappropriate and what could be done to improve the procedure.

1. While the design of the study can be followed to a certain extent, even though it was not properly described, it is unclear what the measured properties mean in the end. Soil sterilization breaks up all microbial and root biomass, and some of the protected fractions of organic matter, and turns them available for microbial decay. It is unclear, if indeed all microbial activity was stopped and if no re-inoculation by microorganisms occurred in the field. Therefore, because of the presumably large pool of new substrates after sterilization those samples are a potential source for microbial respiration. On the other hand, it is unclear what the status of the living roots was in the unsterilized samples. Aboveground biomass was apparently cut off prior to measurements, with unknown consequences and timelines for respiration rates and survival of roots.

2. Potential release of CO2 from soil water was the only abiotic 'source' of CO2 considered in this work. But since CO2 first had to dissolve into water from the atmosphere, this process cannot be considered a true CO2 source over a longer period of time, as acknowledged by the authors. It needs to be added that no explanation was provided for the apparent pH dependency of the instantaneous abiotic flux. Moreover, the authors state that CO2 was dissolved in soil solution when temperature increased and released from solution when temperature decreased. However, chemical laws state the exact opposite relationship which might actually fit the observations of CO2 release during daytime and absorption during nighttime. Another major issue to discuss would be biologically generated CO2 dissolving into soil water and later being released, i.e. a biotic source of the apparent abiotic CO2 efflux. If the dissolution-release mechanism would indeed be causing the abiotic fluxes, why did the authors no attempt of a mass balance calculation for CO2 dissolution and release as a function of Henry's law and soil properties, such as temperature and pH? This could show, whether such fluxes are actually reasonable when soil moisture was very low.

True abiotic and possibly large sources of CO2, such as produced by photodegradation of organic matter on the soil surface could not be assessed in this study because of complete blocking of solar radiation by the measurement chambers.

BGD
12, C4398–C4401, 2015

3. The entire study is based on a one-time measurement of 2 days during the month of July, the year of which was not stated. What were the climatic conditions during that month and were the measurement days comparable among each other? We are told that every 2 days a set of samples was measured, but we don't know what those sets were. Since all samples were buried at one site, samples should have been measured randomly in terms of their site of origin.

Objectives: The objectives of the study were not clearly stated, but need to be extracted from the motivation and the description of the experiment towards the end of the introduction.

Methods: More information is needed to describe the field sites, including the coordinates; a description of the dominant vegetation type outside the agricultural fields and a measure of the size of vegetation, such as biomass; basic climatic variables relevant to the measurements; some history of the sites, e.g. irrigation of agricultural fields. The soil water content of the incubated soil does also not seem to be accurately measured, since only a one-time measurement of SWC is available for the top 10 cm of each incubated sample, whereas the sample seemed to be at least 20 cm deep.

The standard procedure for reporting characteristics of mineral soil states oven-dry (105 deg. C) soil mass as the basis, not air-dry soil. Is reported root biomass fresh or dry mass? Information about soil texture and bulk density would also be useful.

The experimental design should be properly explained at the beginning of the methods section, instead of letting the reader know 'by the way' about some treatments when describing how the samples were handled.

The equations need to be numbered. Equation 2 is unclear, and the measurement units should be mentioned. Apparent respiration rates need to be explained. This flux was never explained in the paper. It is unclear what data entered the multiple regression analysis across the field sites, whether single soil samples or means were used.

BGD

12, C4398–C4401, 2015

Results: Root respiration cannot universally regarded as the main contributor to soil respiration (page 11225). In addition, there is no place for citations in the results section.

Discussion: The discussion is too repetitive of the results in general. It is not necessary to discuss temperature insensitivity at very soil water contents when soil moisture was low across all ecosystems in this study (page 11229). It is unclear what fixation of temperature fluctuations mean for the abiotic model in Table 3 (line 29 on page 11229).

Table 1: Only one unit should be presented for soil moisture, either % (grav.) or g water / g soil.

Tables 2 and 3: Units of the variables are needed. Especially in Table 3 there are large intercepts and fitted parameters.

Figure 3: The y axis was erroneously set as flux instead of a ratio.

Interactive comment on Biogeosciences Discuss., 12, 11217, 2015.