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Interactive comment on "Response of respiration and nutrient availability to drying and rewetting in soil from a semi-arid woodland depends on vegetation patch and a recent wild fire" *by* Q. Sun et al.

Q. Sun et al.

sunqiaoqi@hotmail.com

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Dear Editor,

We thank the reviewers for their constructive comments. Below are our responses to each comment. [AR – Author Response]

Referee #1

1. The main problem is the experimental design – soil sampling strategy and insufficient data set related to it. Three soil samples were taken from under the each patch

at the burnt and unburnt area, however, composite samples from three samples were prepared and thus there is no true replication for each patch. Each of these samples was divided into two parts maintained by different water content, all in four replications. I find more reasonable to have replication of patches at each plot because of the soil variability than replications of laboratory analyses. Making conclusions only on, in fact, one sample per patch and treatment is disputable. As mentioned in the Introduction, the size of rewetting flush is determined by concentration, availability and distribution of organic C, this is a known fact. Mixing of the three samples into a composite sample removes natural spatial variation existing in the soil, the subsequent subdivision into four pseudoreplicates masks true variation in soil properties.

[AR] We agree that by making a composite sample out of three field samples, we can no longer assess the variability in the field. But the aim of this study was not assessment of field variability. We aimed to determine the response to drying and rewetting in soils from different patches in burnt and unburnt sites. For this, it was important to have a representative soil sample from the chosen patches which was achieved by mixing three samples from a given patch, located along separate transects.

This approach has been used in the past. The following papers, among many others, have bulked or pooled soil samples according to corresponding categories which were then subsampled for analysis (e.g. Schaeffer et al., 2007 ; Sanderman et al., 2011).

We will revise the methodology to 'Within burnt and unburnt Mallee, three transects > 50 metres apart from each other were randomly selected. Three samples underneath trees, shrubs and in open areas were taken along each transect. The three samples from a given patch were then combined, mixed and subsampled to give the four replicates in the experiment.'

2. I also do not understand statistical treatment – according to the M&M section two-way and three-way ANOVA were conducted, but the pairwise tests presented in Table 2 indicate that dfferences between all possible combinations of factors were tested by

one-way ANOVA (with subsequent Tukey tests).

[AR] This comment shows that the section of statistical analysis was not sufficiently clear. We used three-way ANOVA followed by a post-hoc Tukey test to determine effects of 'burning (burnt and unburnt)' 'patch (under shrubs, in open areas and under trees)' and 'treatment (constantly moist and dry rewet)' and their interactions as explanatory variables (see Table A1).

In the revised manuscript, we will write 'Data was analysed by three-way ANOVA to determine effects of patch (under shrubs, in open areas and under trees), burning (unburnt and burnt) and moisture treatment (constantly moist or dry-rewet) and their interactions on respiration rate on day 1 after rewetting and for the following data from day 19 (end of the experiment): cumulative respiration per soil/g TOC, soil MBC and available nutrients.'

3. L14/8726 – "The soil is sandy loam.." it cannot be sandy loam if there is 94% sand, 4% silt and 2% clay

[AR] We will revise the texture description to sandy soil instead of sandy loam.

4. L17/8726 – the date is not right "from 15th to 1 th January 2014."

[AR] The dates we provided in the text were 'from 15th to 19th January 2014'.

5. L2/8728 – "espiration"

[AR] The spelling mistake will be corrected to 'respiration'.

6. L5/8732 – "..soils.(Hazelton.."

[AR] The dot will be removed.

7. Table 1 – standard errors are missing

[AR] The Table 1 caption will be revised and we will only present mean values for soil pH1:5 and total organic C content to keep consistent format with soil water holding

capacity.

References:

1. Sanderman J, Baldock J, Hawke B, Macdonald L, Massis-Puccini A, Szarvas S (2011) National soil carbon research progreamme: field and laboratory methologies. Page 1-26, Adelaide, Australia, CSIRO.

2. Schaeffer SM, Billings SA, Evans RD (2007) Laboratory incubations reveal potential responses of soil nitrogen cycling to changes in soil C and N availability in Mojave Desert soils exposed to elevated atmospheric CO2. Glob Chang Biol, 13, 854-865.

Referee #2

1. The authors only used two treatments to simulate the effects of heavy rainfall event (drying-rewetting) on soil respiration and nutrient availability of forest ecosystems during 20-day incubation. I am wondering why the authors set the control treatment at 80% water holding capacity. I have found that this experimental site is subjected to semi-arid climate with 251 mm of mean annual rainfall (Line 12 page 8726). I think that they should set a control treatment at 40% or lower of water holding capacity. Thus there are a total of three treatments rather than two treatments in this paper, which will make this experimental design more reasonable. Although they give a reason (Lines 15-18 page 8727) to explain why they used 80% of water holding capacity, I think the reason is weak and not convincing. This is forest soils, not wetland soils. So I have to reject this current version of paper. I suggest to supply these data which will make this work more interesting.

[AR] It is correct that at the site where the soils were collected, the soil is at 40% of WHC throughout most of the year. In these very sandy soils where the maximal WHC is only 0.06 g water g-1 soil (see Table 1), microbial activity is severely limited at 40% of WHC.

However, in this study, we did not attempt to simulate field conditions. The principle of

most drying-rewetting (DRW) studies is to compare the DRW treatment (representing stress) with a control which is maintained at a water content where microbial activity is not limited by water (see for example, Borken and Matzner, 2009; Denef et al., 2001; Saetre and Stark, 2005). In a preliminary experiment (in which the sandy soils were incubated at 40 to 80% of maximum water holding capacity, at 10% intervals) we determined that in our soils, respiration was maximal at 80% WHC. Since the soils are very sandy, this is equivalent to only 0.05 g water g-1 soil. Given the nature of most DRW studies, we believe that our control (soil water content at which water is not limiting microbial activity) is appropriate.

References:

1. Borken, W., and Matzner, E.: Reappraisal of drying and wetting effects on C and N mineralization and fluxes in soils, Global change biology, 15, 808-824, 10.1111/j.1365-2486.2008.01681.x, 2009.

2. Denef, K., Six, J., Bossuyt, H., Frey, S. D., Elliott, E. T., Merckx, R., and Paustian, K.: Influence of dry–wet cycles on the interrelationship between aggregate, particulate organic matter, and microbial community dynamics, Soil Biology and Biochemistry, 33, 1599-1611, http://dx.doi.org/10.1016/S0038-0717(01)00076-1, 2001.

3. Saetre, P., and Stark, J. M.: Microbial dynamics and carbon and nitrogen cycling following re-wetting of soils beneath two semi-arid plant species, Oecologia, 142, 247-260, 10.1007/s00442-004-1718-9, 2005.

Interactive comment on Biogeosciences Discuss., 12, 8723, 2015.