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Interactive comment on "Micro-topographic variation in soil respiration and its controlling factors vary with plant phenophases in a desert-shrub ecosystem" *by* B. Wang et al.

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Response to referee's comments

We thank referee and greatly appreciate the thoughtful and constructive comments and helpful suggestions. We have fully considered the referee's comments in the revision and improved the manuscript accordingly.

General comments: It is a very written and concise paper, addressing micro-topographic variations in soil respiration and its controlling factors. This paper uses a well-designed and collected dataset to illustrate the variations caused by the plant biomass variation across sand dune. The information will be useful to the stabilization

of the sand dune in the desert region. My minor suggestion to improve this paper is to ask the authors to further exemplify the potential application of this research in practical aspects. For example, how this study can be helpful in relating to the big issue - desertification.

In term of the microsite around a sand dune, the depression area around the sand dune is completely different from the sand dune slope. For example, there is a higher water level and different pH compared with sand slope. Soil texture is completely different. Therefore, the natural vegetation shows great variations across sand dune, which results from multiple processes (wind blowing, seed transportation, soil water movement during a year, and soil nutrient dynamics, soil crust formation, biological processes within the soil). In particular, the soil crust in the desert could change the gas release pattern of soil. The plant coverage can also have critical feedback impacts on the crust depth and structure. Therefore, the soil respiration difference could be a combined result of multiple processes. Do you have any finding which could illustrate the relationships between the crust depth and plant coverage or partitioning the component soil respiration. A few other suggestions are attached in the supplement file.

Answer: The main purpose of our study is to investigate the controls of micro-spatial variation in soil respiration across a sand dune, thus we exemplify the potential application of our results in C cycle models but not for desertification. However, our results showed much higher plant cover on leeward slope than other slopes, which potentially indicated a better condition for plant growth on this slope, and suggests revegetation in desert ecosystem may consider this specific slope of sand dunes. We agree with you that soil crust in the desert could change the gas release pattern of soil. However, the microsites we measured were with no crust, thus the influences of crust on soil respiration were not considered in this paper.

Specific comments (bgd-12-C4554-2015-supplement):

P9470 L9-12: This does not make any sense because only individual average size

without density does not tell the coverage. In the desert, the vegetation coverage has a critical impacts on the soil crust which has critical effects on the soil CO2 efflux. I would convert a coverage percentage.

Answer: We agree. We added the sentence 'The coverage percentage of plant in this area ranged from 30 - 60%.' next to this sentence. (see P 9470, L 12 in the revised manuscript)

P9471, L3: There is normally a depression area between sand dunes. There is a significant differences between the depression areas and sand dune slope. Do you have any measurement point(s) to address this?

Answer: No, we did not have the measurements on depression area between sand dunes. This point will be considered in our future measurements at larger special scale, e.g. inter-dune variation in soil respiration.

P 9473, L 10: Is the soil nitrogen plant related factor?

Answer: In our study, we found good relationship between soil nitrogen and litter fall (Figure 7b), which suggested the decomposition processes of litterfall were the important sources of soil nitrogen. Therefore, we attributed the soil nitrogen to plant related factor in our site.

P 9473, L 15: I would say locations instead of slopes.

Answer: The slopes here represent for different orientations of the sand dune. Therefore, we prefer using word 'slopes'.

P 9473, L 16: significant?

Answer: Yes, it is statistically significant. We added the p value ($p < 0.001$) there. (see P 9473, L 16 in the revised manuscript)

P 9475, L 17: space?

Answer: We agree. We corrected 'earlierthat' into 'earlier that'. (see P 9475, L 17 in the revised manuscript)

P 9476, L 16-20: provide some justifications about why you have this comparison.

Answer: Our results show the contributors to the spatial variation in soil variation in desert was different from that in forests and grassland. We suggested future studies on spatially scaling up soil respiration in desert ecosystems should consider the spatial variation in substrate supply more than temperature. This statement was added in the revised manuscript.(see P 9476, L 20 in the revised manuscript)

P 9476, L 25: What are they?

Answer: Here, the photosynthesis-related parameters refer to root biomass and litterfall. We clarified the sentence (P 9476, L 25) in the revised manuscript.

P9477, L 10: Any concerns about the reason to cause the variations in plant distribution? To my knowledge, it is the soil water, nutrient and the microsite that has led to the distribution of plants along a sand dune.

Answer: We agree that soil water, nutrient and the microsite have led to the distribution of plants at earlier stage of plant formation on a sand dune, thus plants subsequently affecting spatial variation of soil respiration.

P 9478, L 3: ?

Answer: We deleted 'to'. (see P 9478, L 3 in the revised manuscript)

P9485: what are the time scale for the means?

Answer: The time scale for the means was showing in Figure 2 in our study. We added this statement (see P 9485) in the revised manuscript.

P9486: Time scale?

Answer: We added time scale 'over the measurement period' at the end of this sen-

tence. (see P 9486 in the revised manuscript)

P9486: Leeward has higher biomass and root mass, of course, higher soil respiration, even more soil biota activity as well because of the higher soil moisture, relatively lower soil temperature which are the critical factor in the desert ecosystem. It is the combination of relative.

Answer: We agree with you.

P9486: north-facing has a higher temperature than south-facing, any reason? What is the time scale for the mean?

Answer: In our study, plant distribute sparsely in both north- and south-facing. However, litterfall in south-facing was about three times higher than that in north-facing, which may exert stronger shading effects in south-facing, thus resulting in lower soil temperature in south-facing. The time scale for the mean is the whole measurement period in our study.

P9487: the "x" in the equation is not needed in my opinion.

Answer: We agree. The "$\times$" in the equation was excluded. (see P 9487 in the revised manuscript)

P9488: Is there any site located in the depression area between sand dune?

Answer: No, we don't have site in our study located in the depression area between sand dunes. The between-dune sites will be considered in our future measurements at larger special scale, e.g. inter-dune variation in soil respiration.

P9490: Time scale?

Answer: Time scales of each phenophases were showed in figure 2. We added this statement (see P 9490) in the revised manuscript.

P9490: represents?

Answer: We agree. We changed 'represent' to 'represents'. (see P 9490 in the revised manuscript)

P9491: Table 3 can be combined into this figure, making the figure easy to understand.

Answer: The relationships between soil respiration and other variables are also showing in Table 3, but no in Figure 4. Thus we would like to keep them both.

P9495:' thresholds'

Answer: We changed 'thresholds' into 'critical values'. (see P 9495 in the revised manuscript).

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/12/C4845/2015/bgd-12-C4845-2015-supplement.pdf

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