Comments on Stegen *et al*. 'Soil CO2 flux across a permafrost transition zone: spatial structure and environmental correlates'

General perspectives

--- In general the manuscript is clear and well-written
--- In general it is a good experimental design except lack of soil moisture recording
--- In general authors give proper data analysis

Authors addressed spatial heterogeneity of soil C efflux in Alaska permafrost with six 72 m-long transacts. In general, it is a meaningful study given the unsolved problem on spatial structure of soil C efflux and the research priority of permafrost. My major concern is lack of water condition monitoring both at temporal and spatial scale for this study. As shown in the method section, measurements covers nearly a half month both during summer (7.31~8.13) and fall (9.10~9.24). During this period, the soil water condition might be changed which caused either by rainfall or evaporation, or both. This is especially important when authors suggest '*one potential explanation is that SR associated with thinner ALDs is constrained by relatively high soil moisture – likely due to facilitation of anaerobic conditions*.'

On the other, the most significant finding in the study as suggested by authors is the thresholding behavior of the soil C efflux (see figure 4). Nevertheless, authors did not provide strong direct supports to explain this finding instead of providing some possible discussions.

I suggest author to reduce hypothesis in the introduction section. Some of the hypotheses do not have strong significance and some of the hypothesis authors did not give explicitly testing conclusion. Focus on the threshold finding and give solid evidence to support it.

Overall, I would like to recommend it be accepted by BG finally even though some of the points might need some revision.

Specific points

P1L13-15: I suspect the permafrost depth and tree basal area is highly correlated. Authors could try to find which one is the major driver and the other is just a correlation.

P1L16-18: be specifying here. Spatial variation and scaling contains a lot of information, please point out in detail in which aspect or aspects Boreal forests is similar to other biomes.

P1L18-19: This has been stressed in L13-15.

P1L19-20: If remote sensing implication presented in the abstract, it is better to show it in discussion.

P2L23-24: the range here might be related to sampling scale and is not comparable here.

P2L30: weak spatial structure or weak heterogeneity?

P2L33: I am wondering why not including soil moisture during field work even if authors want to test the idea that soil moisture play slight role in driving spatial pattern of soil C efflux.

P3L16: How long will it last before measurements but after collar installed. You know, there will be certain kind of disturbance to soil when a soil collar insert to a depth of 5 cm. It might cut some of the surface root and may change soil structure.

P3L32: How air and soil temperature was measured? Which sensor was used? How it collected?

P4L19: in examine soil C efflux spatial pattern vary across season, authors might be better provide some basic information on forest phenology, i.e. leaf area index or normalized vegetation index from satellite. This is important when authors suggest carbon input by forest have strong impact on soil C efflux. Soil C efflux is the sum of soil heterotrophic respiration and respiration that contributed by plant root. During the summer period, root respiration might be a large proportion in total Soil C efflux.

P9L17-30: I am not so convinced by the explanation on the threshold finding. Not only because there lack the soil moisture data, but also other variables, such as soil temperature, aboveground vegetation change dramatically in space at the same time. Soil temperature and total basal area have some major influence on causing the pattern (Table 3 and table 4).

P10L5-10: The absolute value of soil C efflux is higher in the summer than that in the autumn. It is might be one of the reasons to find higher heterogeneity in summer.

P17Figure 3: This figure might could be moved to support material.