Wang et al. investigated the influence of freeze-thaw processes on seasonal CO_2 respiratory fluxes from a permafrost-affected ecosystems on the Qinghai-Tibet Plateau (QTP). Winter CO_2 fluxes, the effect of freeze-thaw processes as well as the QTP are understudied. The authors found that different freezing stages affect soil respiration dynamics differently but that soil temperature is the most important driver independent of soil water status. The manuscript therefore addresses relevant scientific questions within the scope of the journal. Impressive are the regular flux measurements during the frozen winter period. The manuscript, however, needs revision with regards to the presentation of figures and discussion of the results.

Tables 1 and 2 were missing from the manuscript. But from the text I understand that some of my comments below may have already been addressed in the tables.

Major comments

P1L21-23: The abstract contains quite a few abbreviations which make it somewhat difficult to quickly grasp the major points of the manuscript. None of the different freeze-thaw stages are defined nor the abbreviations explained.

P4L143-150: Some more information about chamber volume, chamber closing time, and flux calculations might be beneficial. What was the minimum flux the chamber system was able to detect? Did you have to increase the chamber closing time in winter in order to achieve the needed minimum change in CO_2 concentration for flux calculations? Do you have any concerns about the disturbance caused by collar installation and above-ground plant removal for the determination of soil respiration? What about the roots left in the soil after plant removal? It has been shown that roots respiration as well as the decomposition of dying/dead roots can affect soil respiration for some time after plant removal (e.g. Subke et al., 2006).

P9: During the ZC sub-stage, several possible scenarios are offered for the sudden increase in Rs. How many in situ measurement points actually fall within this very short period? From Figure 2 it looks like only one, maybe two points. How does this affect uncertainty for the developed Rs model? Did you also measure a diurnal freeze-thaw pattern during this period? How long after thaw during the day did you do the Rs measurement? Could substrate availability and soil aggregation be affected by freeze-thaw cycles and thus affect microbial activity during this stage?

Figure 4: Are these results based on the Rs model? Can you give an uncertainty range? On how may measurement points is the AF stage based? On the y-axis; should it read Rs and μmol? Is SWC the same as volumetric water content, i.e. ratio of water volume to soil volume? What is the dotted line in the AF subplot?

Using the different freeze stages and the developed Rs model in combination with the observed changes in active layer dynamics described by Wu et al. (2015) for the site, can you estimate or comment on by how much Rs has changed (or will change) and what period/freeze stage the changes are largest?

Minor comments

The usage of units differs between the text and figures. The date format between Figure 1, 2, and 4 is inconsistent.

P1L39: I suggest to start the sentence with “Furthermore, […]”

P2L47: […] on the northern hemisphere […]

P2L47-50: The numbers for the circumpolar SOC stocks mentioned here seem to be the numbers from Tarnocai et al. (2009)? Then they should be referenced. You could also consider updating the numbers published by Hugelius et al. (2014).

P2L50: Do you mean “sensitivity”?

P2L57: What do you mean with “completed”?

P3L91-93: If this is the hypothesis of this manuscript, I suggest using “should” instead of “must”

P3L106: Is all that precipitation falling as rain? Is the study site covered in snow in the winter?

P3L116: How large is the chosen terrain? Does the active layer observation site contain one or multiple locations with soil temperature and moisture probes?

P4L147: Did you use an automated system or manual measurement?. Nevertheless, a measuring interval of 3-7 days is still quite impressive, especially during the frozen periods.

P4L156-157: Was SWC determined at every measurement day, including when the soil and/or the soil water was frozen? Does the soil moisture probe detect only liquid water? Is SWC based on soil or on pore volume?

P5L179: Do you present and/or discuss the ANOVA results in the manuscript?

Section 3.1. A summary table with an explicit definition of the different stages, a description of the characteristic temperature and soil moisture profiles as well as the timing and length of each freezing stage might be beneficial. You could also include the number of measuring points for each period.

P6L28: What do you mean with “regularly”?

Section 3.3: Table 2 was missing from the manuscript. However, a summary table of the Q10, mean (min/max) Rs rates, SR, and contribution to the annual balance would be helpful. Then the numbers do not necessarily have to be mentioned in the text, which could help with readability. Figure 3 could then possibly be presented in Table 2 as well? For Q10, it would also be important to indicate the range of soil temperatures during the different stages, since the effect of low temperature on temperature sensitivity and Q10 is later discussed in the text.

P7L274: “shown”

P7L286-287: Did you test the effect of soil moisture on Rs? In the manuscript you state that Ts is the most important factor.

P8L312: Is the exponential increase in abundance of microbes, which are adapted to freezing conditions, with increasing temperature true for all freezing stages? Would that mean that these microbes also dominate during the summer?

P8L320: I would assume that a higher Q10 would then specifically matter in winter if the winter was warming more than the summer?

P8L325: What was the limit for soil water content to be “sufficient”?

P14L11: “[…] late April 2017 […]”

Reference list need checking. Some reference are not edited correctly (e.g. Grogan, P., and Chapin III, 2000)

Figure 1: It could be more intuitive to reverse the y-axis to indicate soil depth. In addition, it would be helpful to also indicate the timing of the different stages along the x-axis (similar to Figure 2)

References

Hugelius, Gustaf, et al. "Estimated stocks of circumpolar permafrost carbon with quantified uncertainty ranges and identified data gaps." *Biogeosciences (Online)* 11.23 (2014).

Subke, Jens-Arne, Ilaria Inglima, and M. Francesca Cotrufo. "Trends and methodological impacts in soil CO2 efflux partitioning: a metaanalytical review." *Global Change Biology* 12.6 (2006): 921-943.

Tarnocai, Charles, et al. "Soil organic carbon pools in the northern circumpolar permafrost region." *Global biogeochemical cycles* 23.2 (2009).

Wu, Qingbai, et al. "Changes in active-layer thickness and near-surface permafrost between 2002 and 2012 in alpine ecosystems, Qinghai–Xizang (Tibet) Plateau, China." *Global and Planetary Change* 124 (2015): 149-155.