

Interactive comment on “Soil CO₂ efflux in an old-growth southern conifer forests (*Agathis australis*) — magnitude, components, and controls” by L. Schwendenmann and C. Macinnis-Ng

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Referee #2 We thank the referee for providing helpful comments. Please find below a detailed response to the each of the comments

General remarks: The interesting manuscript (ms) represents the investigations within a native forest in New Zealand with the aim to characterize dependencies between forest structure, soil properties, meteorological conditions and soil respiration processes. The ms has clear objectives and represents a good contribution to scientific progress in the interdisciplinary field of abiotic and biotic soil respiration influences. In order

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to describe temporal variability the data interpretation is based on times series over 18 month of CO₂ efflux measurements. Furthermore, the authors considered a huge number of relevant references, giving a comprehensive insight and the chance to compare the approach with the results from other researchers. The overall quality of the manuscript is high. It offers interesting insights into the soil CO₂ efflux within an old-growth kauri forest and the main controlling factors for such a forest site. The entire results are discussed based on sound statistical analysis. However, in my opinion there are some issues which need to be discussed more in detail to close some minor gaps improving the ms.

Specific comments:

Line 36: Janssens et al., 2001 – two times in reference list – which one is meant here?
→ 2001a, b

Response: Janssens et al, 2001a; in-text citations and reference list have been changed accordingly

Line 138 and Figure 1: The figure 1 is not easy to understand concerning the experimental set up. There are some items, which are not explained in the legend: filled grey circles, filled grey stars, grey lines (I supposed it is the topography in m a.s.l.?) Where are the trenched plots? There is only text at the upper edge.

Response: The figure and legend have been modified to provide a better illustration of the experimental set-up.

In the context topography: you mention a potential dependency between topography and organic layer thickness (line 448-450). I would strongly recommend analyzing a functional trend between soil moisture and topography and hence, maybe some influences on soil respiration. From your data compilation it is not clear to see, but maybe the soil moisture differences you mentioned in Table 2 for the trenched plots could be superimposed by topographic driven soil moisture differences. You can find some

discussions in recent papers, e.g., Masamichi Takahashi, Keizo Hirai, Pitayakon Limtong, Chaveevan Leungvutivirog, Samreong Panuthai, Songtam Suksawang, Somchai Anusontpornperm & Dokrak Marod (2011) Topographic variation in heterotrophic and autotrophic soil respiration in a tropical seasonal forest in Thailand, *Soil Science and Plant Nutrition*, 57:3, 452-465, DOI: 10.1080/00380768.2011.589363 Wang, B., Zha, T.S., Jia, X., Gong, J.N., Wu, B., Bourque, C.P.A., Zhang, Y., Qin, S.G., Chen, G.P., Peltola, H., 2015. Microtopographic variation in soil respiration and its controlling factors vary with plant phenophases in a desert–shrub ecosystem. *Biogeosciences* 12, 5705-5714.

Response: Following the referee's recommendation we investigated the relationship between elevation (m a.s.l.), soil moisture, organic layer thickness, root biomass and total soil CO₂ efflux. We found a significant negative correlation between elevation and organic layer thickness ($r=-0.539$, $p=0.021$). However, none of the other parameters showed a significant relationship with elevation. We modified the discussion (Section 4.1) as follows: "The topography of the study site (moderately to steep slope) likely explains the negative correlation between organic layer thickness and elevation ($r=-0.539$, $p=0.021$). Erosive removal of the organic layer and mineral soil on steep slopes and deposition downslope have been shown to affect soil characteristics and C cycling (Quideau, 2002; Vitousek et al., 2003; Yoo et al., 2005). For example, in a temperate forest in Japan (Nakane et al., 1994) and a tropical seasonal forest in Thailand (Takahashi et al., 2011) soil CO₂ efflux decreased with increasing slope. However, we did not find any correlation between elevation and total soil CO₂ efflux, root biomass, and soil moisture suggesting that forest structure (see 4.2) may have had a stronger effect on soil characteristics than topography at this site."

Line 221: . . . plant material (45% C, 25 2.3% N) . . . → 25 ??

Response: corrected (45% C, 2.3% N)

Line 312 and Figure 2: You mentioned a relation between high CO₂ efflux and heavy

rain events (as described and shown in paper Macinnis-Ng & Schwendenmann, 2015). Why do not show precipitation information in figure 2? I suppose, that graph would visually support very well your interpretation!

Response: Figure 2 was modified as suggested.

Line 333: . . .Outside_Trench_Insered . . . t is missing

Response: corrected

Line 537: reference Epron et al., 2001 is not in reference list

Response: added Epron et al., 2001

Line 564: . . .de Jong and Schappert. . .

Response: corrected - Schappert

Line 957: January

Response: spelling mistake corrected

Line 958: The different letters .. indicates a significant difference . . . between what? Mean and Median? What means a, b, x, y, z?

Response: The table caption has been changed as follows: "Samples were separated into plot and trench for the statistical analysis due to different sampling designs. Different letters (a, b for plot; c, d for trench) for a given variable indicate a significant difference between treatments."

Line 965a: The determined regression coefficients are in all cases very weak – hence, it is not really a convincing correlation! As an example, you could include a figure to show the different modelled approaches.

Response: We re-analysed the data set (combing the plot and trench sampling points) using the most commonly used temperature response functions (linear, exponential Q10 and modified Arrhenius function). This results of the linear regression (best fit)

are shown in Figure 4 (see below) which will be included in the manuscript.

Line 965b: Table 3 subscription . . . adjusted R2 = coefficient. . . RMSE = root mean square

Response: changed

Line 798: reference Metcalfe et al., 2011 is not mentioned in text

Response: Metcalfe et al., 2011 added in Section 1

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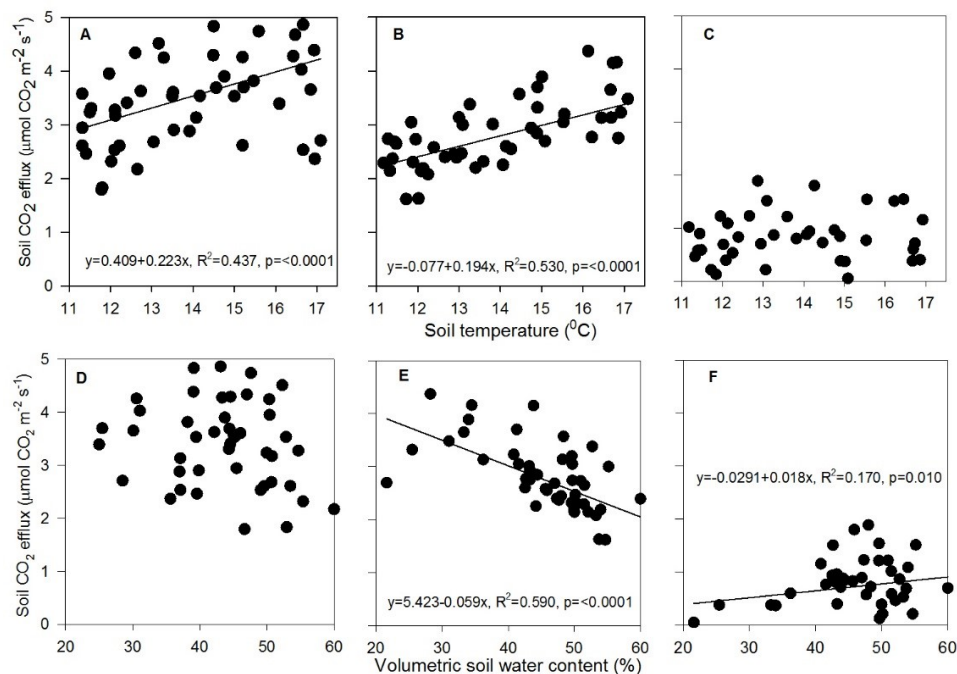


Fig. 1. Figure 4. Upper panel. Relationship between soil temperature and total soil CO₂ efflux (A), heterotrophic respiration (B) and autotrophic respiration (C). Lower panel: Relationship between volumetric

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