

Dear Editor Prof. Yakov Kuzyakov,

Thank you very much for your positive feedbacks and for giving us an opportunity to resubmit the revised manuscript. Based on the reviewers' constructive comments, we have strongly improved this manuscript. We hope the revised manuscript will meet the standards of your journal *Biogeosciences*. Please see our detailed point-by-point responses below.

Best regards,

Xiaoqi Zhou on behalf of all authors

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Editor's comments to the Author:

Dear Authors,  
the reviewers mentioned important shortcomings you need to improve before acceptance.

R: Done as suggested.

Additionally, please improve the following:

- Add some quantitative results/Conclusions to your Abstract.

R: Done as suggested.

The results showed that incubation temperature and tree species significantly influenced all soil EEA and *Eucalyptus* had 1.01-2.86 times higher soil EEA than coniferous tree species. Modeling showed that *Eucalyptus* had larger soil C losses but had 0.99-2.38 times longer soil C residence time than the coniferous tree species over time.

On the other hand, the modeling results help explain why exotic slash pine can grow faster, as it has 1.22-1.38 times longer residual soil N residence time for LAP, which mediate soil N cycling in the long term, than native coniferous tree species like hoop pine and kauri pine (*Agathis robusta* C. Moore).

Page 1 Lines 23-24 and Line 28

- Because the modelling is the most important part of your paper - please explain the models with more details

R: Done as suggested.

We assumed that the differences in soil properties and litter C/N contents under different tree species are the results of effects of tree species, and therefore we established a new soil–enzyme–C/N model to consider the effects of both tree species and incubation temperature without considering other soil properties and litter C inputs derived from tree species. In other words, we considered changes in soil properties and C inputs to be a 'black box' as part of the overall effects of tree species, all of which influenced soil EEA.

We first transformed the enzyme activity data using a natural logarithm. As the enzyme activity data for each plot were not independent along a gradient of temperatures, we needed to consider the interaction of tree species and incubation temperature on soil EEA.

We found that the interactions between incubation temperature and tree species were not significant on soil EEA (Table S1). Therefore based on the **Model 1**, we further established a simpler model (**Model 2**) without considering their interactions.

A conventional soil enzyme–C model (**Model 3**) (Schimel and Weintraub, 2003) has been widely used to predict how soil organic C contents change with soil EEA over time.

In this study, for quantitative analysis of the changes in total C (TC) contents over time under tree species, we combined **Model 2** with the addition of TC and **Model 3** together to establish a dynamic tree species–enzyme–C model (**Model 4**) as shown below:

To get a better understanding these 4 models, we made a simple table to compare the advantages and disadvantages of each model (Table 2).

Page 4 Lines 32-33, Page 5 Lines 1-6, 22-23, 32-33, Page 6 Lines 1-3, 7-8

- Add assumptions to the models

R: Done as suggested.

We assumed that the differences in soil properties and litter C/N contents under different tree species are the results of effects of tree species, and therefore we established a new soil–enzyme–C/N model to consider the effects of both tree species and incubation temperature without considering other soil properties and litter C inputs derived from tree species. In other words, we considered changes in soil properties and C inputs to be a 'black box' as part of the overall effects of tree species, all of which influenced soil EEA.

Page 4 Lines 32-33 and Page 5 Lines 1-3

- to get a better overview about the 4 models - make a simple Table describing the main differences, advantages/disadvantages of each model

R:Done as suggested.

**Table 2.** Description and comparison of the 4 models used in this study.

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>	<b>Model 4</b>
Advantage	Tree species–enzyme model with considering the effects of tree species, incubation temperature and their interactions on soil EEA	Tree species–enzyme model with only considering tree species and incubation temperature on soil EEA, as their interactions were not significant in this study (see Table S1)	Conventional enzyme–C model	Tree species–enzyme–C model by combining <b>Model 2</b> and <b>Model 3</b>
Disadvantage	Without considering the interactions of soil EEA	Without considering the interactions of soil EEA	Without considering the effects of tree species and without considering the interactions of soil EEA	Without considering the interactions of soil EEA

Page 14 Line 7

- Check for papers of Razavi BS, Blagodatskaya E - they made important steps for understanding of temperature effects on soil enzymes; Especially to the jumps you have between 15 and 20 °C (e.g. in Fig 1)

R: Done as suggested.

Interestingly, we noticed that for a certain tree species, the gaps between residual soil C contents with BG at 23°C, 25°C and 27°C increased with time, which may be explained by the canceling effects (absence or strong reduction of response of the enzyme to temperature) of soil EEA (Razavi et al., 2015). Previous findings showed that this phenomena was most pronounced at low substrate concentrations (Razavi et al., 2015), which was consistent with our results in Fig. 3.

Page 7 Lines 6-10

- Move Tables 2 and 3 to Supplementary

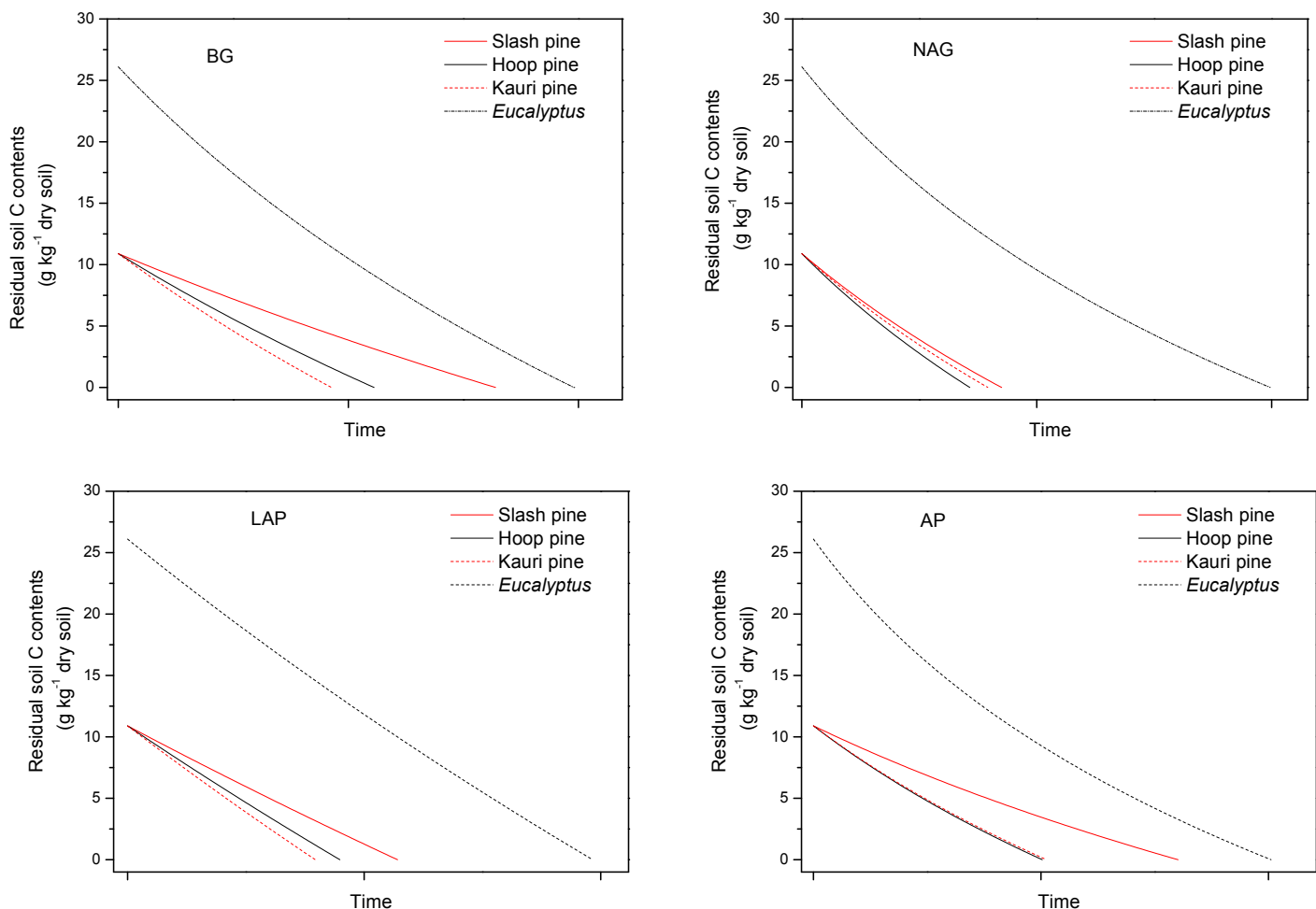
R:Done as suggested.

- What are the units on X axis on Fig 2-6? --> these figs are not clear at all.

R: We assume that the current differences in soil properties and litter C/N contents to be a 'black box' and are mainly derived from the effects of tree species. We therefore established a soil–enzyme–C/N model with both tree species and incubation temperature without considering the influence of litter C inputs and soil pH etc on soil

EEA. Our model in this study is an ideal model without a unit for decomposition time. However, we have provided the half-residence times of residual soil C and N contents under different tree species in Table S6 and Table S7.

Additionally, we have re-drawn these Figs to make them clearer. Please check them below.



**Figure 2.** Residual soil C contents under different tree species across time for  $\beta$ -glucosidase (BG), *N*-acetylglucosaminidase (NAG), leucine aminopeptidase (LAP) and acid phosphatase (AP) at 25°C. The total soil C decomposition over time was calculated via Equation 5 and the residual soil C contents over time was compared for different enzyme activities among the tree species.