

## Comment on bg-2021-126

Russell Anderson (Referee)

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Referee comment on "Net soil carbon balance in afforested peatlands and separating autotrophic and heterotrophic soil CO<sub>2</sub> effluxes" by Renée Hermans et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-126-RC1>, 2021

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### General comments

This study helps answer an important, highly policy-relevant question concerning use of peatlands in temperate regions for plantation forestry. Very limited research on the implications for climate change of this land use on this soil type has been published. This work provides empirical data to support modelling of the balance between CO<sub>2</sub> emission due to peat decomposition and atmospheric CO<sub>2</sub> removal into tree biomass. It clarifies the reliability of assumptions used about the relative rates of heterotrophic and autotrophic restoration to estimate the rate of peat decomposition from total soil CO<sub>2</sub> efflux and will inform similar assumptions in future. It highlights the important role of rhizosphere priming effects in decomposition of afforested peat. This study is excellent - well conceived, carefully undertaken and concisely reported. Its limitations are recognised and discussed.

### Specific comments

- Your finding that the soil of these 30-year-old forests is a net C sink is arguably as important as the findings about the relative magnitudes of the autotrophic and heterotrophic CO<sub>2</sub> effluxes. The title of the preprint indicates a focus on the latter. Consider expanding discussion of the net soil C balance and altering the title to reflect a dual focus.
- The likelihood that killing roots by trenching will also have stopped rhizosphere priming of peat decomposition is acknowledged as a limitation of the study. The priming of litter decomposition in the same way is demonstrated to make a substantial difference to litter-derived CO<sub>2</sub> efflux by the litter decomposition measurements in the trenched and control plots but no evidence is provided on the likely size of this effect on peat decomposition. Any further evidence that can be obtained from the literature would help in assessing the degree of underestimation of peat decomposition by the trenching treatment.
- Generally, you have been consistent about the boundaries of the system under study

(line 74: 'the C budget of a drained and afforested peat soil'). Mentions of root growth in line 324 and belowground productivity in line 327 are slightly confusing because assimilation of C in tree biomass was not included in your study. If by 'root growth and turnover' and 'belowground productivity' you are referring to root litter and/or exudate deposition, make this clearer. It is important that readers do not confuse soil C stocks with below-ground C stocks.

- The limitations of not measuring fluvial C fluxes or root litter and exudate deposition are briefly mentioned but could be discussed more fully in the context of their implications for afforested peatland soil C balance. These limitations and any conclusion about their likely implications for the main findings should be mentioned briefly in the abstract.
- The final discussion point about the importance of knowing the net C balance over the lifespan of a plantation is important and welcome but, for balance, should be expanded. The fact that this lifespan normally ends with timber harvesting and deposition of large quantities of felling residues above ground and whole root systems below ground means that we need to go beyond a single forestry rotation to assess the soil C balance of the land use. The separate litter and dead root decomposition fluxes reported here may help inform assessment of post-felling CO<sub>2</sub> fluxes but need to recognise the different water table level and soil moisture conditions created by the soil rewetting associated with clear-felling.

Technical corrections provided in supplement file 'Ref\_comments\_MS\_No\_bg-2021-126'

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2021-126/bg-2021-126-RC1-supplement.pdf>