

## ***Interactive comment on “Carbon budgets for an irrigated intensively-grazed dairy pasture and an unirrigated winter-grazed pasture” by J. E. Hunt et al.***

### **Anonymous Referee #3**

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Review of “Carbon budgets for an irrigated intensively-grazed dairy pasture and an unirrigated winter-grazed pasture” published in Biogeosciences Discussions.

This study reports important numbers about net carbon budgets at two differently managed pastures and concludes that 1) net ecosystem carbon budget results show agreements with other previous studies done over grazed grassland 2) this finding is inconsistent with long-term carbon stock studies of other New Zealand pastures.

The methodologies used in this study are well described and based on the latest procedures of eddy-covariance method. Inversely, this implies that this study puts more focus on methods and numbers rather than efforts to understand underlying biogeochemical processes. Please check comments below and hope that these comments

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help to improve this manuscript for better readability and contributions to communities.

Overall comments:

- More extensive comparison with previous studies is needed. This study tries to compare their results with values reported by previous studies but remains to be superficial, especially to NEP. Particularly, in 5. Discussion, the authors briefly mention that studies of impacts on soil moisture and temperature on GPP and ER are needed. But I believe that this analysis can be done directly because GPP and ER are already computed with meteorological and soil variables. Do not stay in simple speculation only from NEP and go forward further with separate analysis with GPP and ER.
- The authors wrote that annual GPP of the managed pasture was twice that of the latter but ER showed about 68
- The authors argue that respiration by cattle is originated from carbon in the grazing term in Eq. (3), cattle respiration should be excluded from the carbon budget equation to avoid double-counting. But I am not quite sure if this argument should go to the term of excreta, if considering that carbon uptake by cattle through grazing is conserved as the sum of respiration (metabolism) and excreta while they stay in pasture. Table 3 shows that difference between excreta and grazing is about 303 and 30 gC m<sup>-2</sup> year<sup>-1</sup> at the managed and unmanaged pastures, respectively and I wonder how to deal with this issue properly. In addition, if considering typical values of CO<sub>2</sub> respiration by cows per day and grazing period of about 10 days per year, these differences seems to be related to cattle respiration. This is also important in comparing this study with previous papers because previous studies did consider the cattle respiration in the carbon budget equations. More clear description is needed.
- Several sentences are redundant in method, results and discussion sections.

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Specific comments:

- Figure 4 (b): Volumetric soil moisture sometimes exceeded 0.6 and I wonder if this large number is related to calibration issues of TDR in soils having significant clay.
- page 6 line12: If considering 1 m tube length and 5.8 mm and 3.9 mm inner diameter, transit time of 0.36 s and 0.28 s seems to be pretty long. Please can you explain how it could be decided?
- page 11 line 5: It seems to me that ER increased after grazing events.
- page 12 line 26: How can we know that it is not reasonable?
- page 13 line3-4: How can we know that it is not reasonable?
- page 13 line 12: How can we know that it is not reasonable?
- 5. Discussion: It will be much better if there are figures to show GPP and ER separately and extensive analysis on GPP and ER with atmospheric drivers, soil temperature, and soil moisture.
- page 15 line 23: How can we know that it is not reasonable?
- page 17 line 12: How can this study consider cattle respiration in comparing with other studies.
- Figure 5. It seems to me that ecosystem respiration increased shortly after grazing events (Fig. 5). Can you explain why?

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