Review of bg-2016-46: “Carbon budgets for an irrigated intensively-grazed dairy pasture and an unirrigated winter-grazed pasture.”

In this manuscript, the Authors investigate the carbon (C) exchange dynamics and C balance of cattle-grazed pastures in New Zealand using the eddy covariance (EC) technique, and a technique to estimate C uptake and loss by cattle. As is the case with many grasslands and pastures globally, a mostly-ungrazed pasture was net C neutral during the one-year study period, whereas a pasture that experienced irrigation, fertilization and periodic grazing was a net C sink. Yet, the C sink dynamics of this intensively-managed pasture hinged on whether or not C uptake and loss by cattle was accounted for in the ecosystem C balance.

This manuscript is well-written, the C measurement methodology is technically-sound, and I have only nominal contextual comments. However, I am concerned that this study does not present an advancement in understanding of pasture C dynamics, nor is it up to par with other, similar studies. Specifically, I am concerned that the Authors attempt to draw conclusions on ecosystem C balance using a single year of measurements, especially because there is no true control ecosystem nor is there any pretreatment comparison. Yet, for this OZFlux special issue, I think this manuscript may ultimately be considered for publication because it focuses specifically on management issues in New Zealand. I will be happy to recommend this article for publication once my main concerns are addressed.

1) The Authors need to better frame their findings in the context of existing literature on pasture/rangeland C dynamics and C balance, and also the C balance of grasslands in general. I believe that this study is best presented as a supplement to the larger body of literature that exists on this subject. It may also be useful to focus more on the weekly and seasonal dynamics of C exchanges as a way to differentiate this manuscript from longer-term studies.

Potential sources include:

Felber et al. 2016. Agricultural and Forest Meteorology
McGinn et al. 2014. Journal of Environmental Quality
Oates and Jackson. 2014. Rangeland Ecology and Management

2) Because the UUW pasture is not a true control, the Authors may wish to truncate their study period to Aug 2012 – May 2013 (so grazing did not occur in the UUW pasture during the study period). Alternatively, it may be appropriate to cite literature on the neutral C balance of other ungrazed grasslands in NZ, which would support the Authors' determination that the grassland in their study is an acceptable control.

3) On page 16, line 15, the Authors state that the UUW pasture and IFR pasture had different grazing histories prior to the study period. Without a pretreatment comparison, I am greatly concerned that these pastures aren't comparable.

In-text comments:

I recommend that the Authors use active voice throughout the manuscript.

I recommend using negative NEE values to indicate a carbon sink or uptake by the ecosystem, and positive NEE values to indicate a carbon source or loss.

Page 1

Line 11: Remove sentence beginning, “Primary terms...”

Line 17: Differences in GPP and RE are both very large. I recommend simply stating these differences as a result.

Line 18: Efficiency measured as what metric or variable?

Line 19: Need a stronger conclusion than this. What new information was obtained in this study?

Line 24: Intensification of grasslands needs changed.

Line 26: Needs citation.

Line 29: Remove “for pasture”

Page 2

Line 1-4: Remove this sentence.

Line 7: This sentence is unclear.

Line 31: Because of the coarse temporal resolution of what?

Line 31: Remove this sentence.

Page 3

Line 1-7: Consider moving this to Methods or removing.

Move the entire “C budget of a pasture ecosystem” to Methods

Make a separate Site section in the manuscript.

Consider moving a good portion of the Methodology to an Appendix.

Page 10

Please add p-values or other values of statistical significance to the Results.

Line 11: Remove sentence beginning “This amount...”

Line 17: This occurred in both pastures?

Again, I suggest that differences in GPP and RE are actually both large, just that GPP differences > RE differences.

Page 11

Line 21: Consider changing mmol C and mol H2O to grams and mm. Also, need a unit of time.

Why are the “Uncertainty analysis” and “Non-CO2” sections in Results? Please separate results from methodology in these, and put them in the correct sections of the manuscript.

Page 15

Line 3: Remove “warranting the rigorous...”

Entire “C budget uncertainty” section is not appropriate for the Discussion.

Page 16

Line 17: Please rewrite and clarify this sentence.

Line 21: “Efficiently used” needs to be better explained.

Line 23: Remove sentence beginning “It is instructive”

Line 32: change “C balance” to “C neutral”

Page 17

Line 5: Why did this maximize GPP? Need a citation.

In Section 5.3, need to include additional sources.

Line 25: Need citations

Line 27: Explain the difference between this study and Rutledge 2015 more substantially.

Line 33: Information about management activities is important, but it is impossible to separate the influence of irrigation versus that of fertilizer in your study. It's probably best to pay this some attention, and suggest the value of better understanding the influence of these variables.

Table 3: I recommend briefly explaining why some data were not available, and why FCH4 is the same for both pastures.

Figure 1: Not a typical map, but it works.

Figure 3: Consider moving to Appendix.

Figure 8: Consider moving to Appendix.