

Interactive comment on “Drivers of interannual variability in Net Ecosystem Exchange in a semi-arid savanna ecosystem, South Africa” by S. Archibald et al.

S. Archibald et al.

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1 Response to specific comments by reviewer 2:

1.1 How to separate the effect of high temperature from the effects of short term water deficits due to surface drying?

We agree that this is an important next step in our understanding and modelling of ecosystem respiration. Partially stimulated by this paper we have initiated an experiment where we hope to manipulate both soil moisture and temperature so as to collect data under conditions of high soil moisture and high temperatures which are not of-

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ten recorded in the field. However, based on our current knowledge we still believe that the generalised Poisson function we used to fit our respiration curve is a better representation of the functional response than any other currently used.

ACTION TAKEN: none taken in this paper.

1.2 We interpret this comment as a request to clarify the connection between APAR and water availability. i.e. to connect the fact that we demonstrated that water availability was important in determining both respiration and photosynthesis at a daily time step, and then also showed that APAR was the best predictor of NEE at an annual time step.

Please see general comments on linking precipitation, fapar and APAR.

1.3 No term for moisture in the respiration model?

Perhaps we misunderstand the comment, but the respiration model did include terms for soil moisture, as well as moisture deficit and time since saturation. In fact all three moisture terms together contribute 46% to the importance as determined by the ANN model.

It is possible that the reviewer was referring to our respiration interpolation function with this comment. In implementing this interpolation we made the assumption that both soil moisture and leaf area do not vary substantially within a day, which (excluding days when there is a thunderstorm at 3 o'clock in the afternoon), an analysis of half hourly soil moisture data shows to be true. The coefficient of variation in daily soil moisture measures had a highly skewed distribution - with most of the data having very low CV's. Only 8 of the 944 days sampled had a CV greater than 0.1 (10 %). Similarly, the difference between the maximum and minimum soil moistures was seldom more

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than 0.2 % (Figure 4). This allowed us to assume that within one day our measured respiration values vary only with respect to temperature. For example, when Fapar and soil moisture are low, the observed night time respiration will be low, resulting in a scaling parameter which "pinches" interpolation function, resulting in a relatively low allowable maximum respiration level, and a interpolation curve which is flattened. See Appendix B for details of this method.

ACTION: none taken

1.4 The reviewer asked for more discussion on the long-term implications of the site being a sink.

We are wary of too much speculation without further corroboration of our results. However, prompted by these reviewer comments we have since sourced datasets on tree turn-over at the site. These record high rates of tree turnover: 8 % (+- 3%) per annum - with damage by elephants and senescence of old *Acacia nilotica* trees being the main cause (Archibald - unpublished data). These turnover rates are high, but not exceptional for southern African savannas (Shackleton, 1997), and it is perfectly feasible that tree growth could match these losses. Therefore, it would be precipitous to speculate further on the implications of the long-term predictions until there is better information on tree productivity, and more peak-growing season flux data to calibrate the models with.

ACTION TAKEN: We add some sentences to this effect in the discussion

1.5 Typo in Figure B1.

ACTION TAKEN: Thank you, we have corrected this.

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1.6 Figures referred to in text - appended to the revised manuscript

Figure 5: Probability distribution of the range in soil moisture values over one day (midnight to midnight) at the flux tower. The soil moisture difference was less than 0.2% in about 75% of the days.

Interactive comment on Biogeosciences Discuss., 5, 3221, 2008.

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5, S2501–S2504, 2008

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