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Biogeosciences Discussions

Interactive comment on "Response of carbon fluxes to water relations in a savanna ecosystem in South Africa" *by* W. L. Kutsch et al.

Anonymous Referee #1

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In your evaluation please take into account the following aspects:

1) Does the paper address relevant scientific questions within the scope of BG?

Yes it does.

2) Does the paper present novel concepts, ideas, tools, or data?

There continues to be a need to measure and interpret fluxes from savanna systems. I find them to be model systems for studying global change as they experience wide ranges in soil moisture and temperature.

Unfortunately I find much of the content rather pedestrian. The authors do not push the analysis beyond what is found in many, many flux papers. Furthermore the goals of the

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paper are too narrow and modest. The authors need to be more intellectually bold and ambitious. On pp 2200, ln 9 The authors ask explicitly “how water availability and seasonality drives ecosystem respiration?”. But carbon and water are intrinsically linked. The question should be rephrased to include how water availability and seasonality drives ecosystem photosynthesis, respiration and evaporation?

I’d like to know how this system functions in context of related and contrasting ecosystems. I’d like to know more about the role of extreme events and conditional statistics on the functioning of this system. Many workers are showing the role of rain pulses on respiration. Or in Mediterranean savanna that the rain during the spring drives year to year differences in net fluxes. What about lags and delays on the start and end of the rain season on evaporation, photosynthesis and respiration?

There is some interesting and useful information, such as the plots in figures 7 and 9. They show us how fluxes are affected by water deficits and how these limitations translate into alterations in key model parameters.

3) Are substantial conclusions reached?

To some degree.

4) Are the scientific methods and assumptions valid and clearly outlined?

The investigators use the eddy covariance method to study fluxes of mass and energy between vegetation and the atmosphere. This is a direct, widely used and well vetted technique. Since this study is in the bush, the site seems to be flat enough and provides extended fetch in a variety of predominant wind directions.

The site at Kruger “see"s two different footprints and vegetation types. This attribtute is a strength and a weakness of this study. For ecological questions it is best to produce annual budgets of fluxes from different vegetation types. This objective is impossible to meet at Kruger, as partial budgets from the acacia and broad-leaf *Combretum* savanna can only be produced. On the other hand, the investigators are able to construct

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canopy-scale response functions between surface fluxes and driving meteorological variables.

The interpretation of any flux study depends upon how well the investigators measure an array of ancillary variables like soil, plant and climatic characteristics. The Kruger site has been studied since 2000 and a variety of relevant variables have been collected over the years (eg canopy height, leaf area index, soil properties, rainfall, light, temperature etc).

I need to know more about how Q10 was computed. Many investigators convolve seasonal changes in metabolism and temperature and produce unrealistically and wrong Q10s much greater than 2.5. When smaller data windows are used many find Q10 to be well constrained between about 2 and 2.5, unless water deficits force it to be lower. I want to be assured that the investigators are computing Q10 correctly. I suspect they may be doing it correctly as later in the manuscript (pg 2209) they refer to using the method of Reichstein et al, which is standard and appropriate. But I look at the data in Fig 4 and see data from 2 to 3 month periods with clumps of data from different phenological stages. It is appropriate that the authors separate the data by moisture class and the plots are informative.

Soil moisture is very important in interpreting these data. Do the trees tap deep water sources? Is the integrated soil moisture weighted with respect to where the roots are? This operation is critical for producing information on the moisture sensed by the trees. Yet little information is presented on nuances associated with water budgets.

5) Are the results sufficient to support the interpretations and conclusions?

There are some basic problems with the interpretation of the derived quantities. In fig 6 the authors compare canopy conductance vs vapor pressure deficit. But canopy conductance is derived from measurements of vpd. This plot provides no new knowledge, insights or information due to autocorrelation. The findings that water use efficiency scales with vpd can be considered to be trivial too. We've known this since the 1960s

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and the important and pioneering papers of Slatyer and Bierhuizen. The authors need to move away from the obvious analyzes that are well treaded in many papers and try and plow new paths and give alternative and innovative insights on how this system functions and operates.

Other aspects of the paper are noteworthy.

6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

In many respects yes

7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

The authors cite key papers in the literature on the subject and the manuscript is written in a scholarly manner citing appropriate papers, where and when needed.

8) Does the title clearly reflect the contents of the paper?

NO. The title is appropriate RESPONSE OF CARBON FLUXES TO WATER RELATIONS IN A SAVANNA, but much of the text tends to focus only on surface conductance and respiration. I see nothing wrong with the title. The rest of the paper needs to step up several notches and treat the title better.

9) Does the abstract provide a concise and complete summary?

yes

10) Is the overall presentation well structured and clear?

Much of the text rambles and contains some material that may be viewed as irrelevant.

There are many paragraphs in the discussion on leaf data and stomatal conductance. Yet, little discussion is on stand level processes from related studies.

The presentation of the figures is odd and inappropriate. Fig 6 is discussed, then fig 9

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is introduced, then fig 7. I looked several times for discussion of fig 8. I finally found it going back several pages and it was in the section on nocturnal respiration. Then I found fig 8 presented after fig 9. These are major flaws in elementary writing that should have been corrected before the paper was submitted.

Nor does the content and presentation live up to the title. Much of the presentation focuses on a narrow set of components, respiration and canopy conductance.

Other aspects of the presentation are good. I like the sections in the discussion on how these data relate to those from other experiments in Africa, eg Albertson and Scanlon, Veenendaal

11) Is the language fluent and precise?

The text needs much editing and revision. I recognize that the lead author is not a native English speaker. I encourage him to have an editor revise the text. Many sentences are awkwardly phrased. They make reading the text distracting and the presentation of complex material unclear.

12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

The attribution of Equation 5 seems in error. The authors refer to it being derived from equation 4, which defines canopy photosynthesis. On the other hand Eq 5 is the canopy conductance which is a function of evaporation.

13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

I recommend revising and improving the discussion. Remove irrelevant material and discuss the data better with regards to relevant stand studies.

14) Are the number and quality of references appropriate?

The authors cite key papers in the literature on the subject and the manuscript is written

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in a scholarly manner citing appropriate papers, where and when needed.

15) Is the amount and quality of supplementary material appropriate?

n/a

Interactive comment on Biogeosciences Discuss., 5, 2197, 2008.