Hydrol. Earth Syst. Sci. Discuss., 9, C5617–C5622, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C5617/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "The importance of plant water use on evapotranspiration covers in semi-arid Australia" *by* A. Schneider et al.

Anonymous Referee #1

Received and published: 1 December 2012

Review of "The importance of plant water use on evapotranspiration covers in semi-arid Australia" by A. Schneider, S. Arnold, D. Doley, D. R. Mulligan, and T. Baumgartl
General comments.

The authors attempt to measure evapotranspiration from individual trees and bare soil using chamber based measurements and attempt to explain the drivers of evapotranspiration by relating it to VPD. The authors then propose some scenarios to vary the species composition and plant cover fraction. The paper it is well written and the overall presentation is well structured and clear.

Generally I have a concern about only having one of replicate of bare soil. Given that the plant evapotranspiration is calculated as a function of the bare soil evapotranspi-

ration, what are the consequences in terms of error and uncertainty for the individual plant evapotranspiration measurements? In only having one replicate you have no error estimate for bare soil evapotranspiration and therefore cannot have confidence in measurements of individual played evapotranspiration. In addition, the number of chamber replicates a very small for the study and only sampled on a handful of occasions. The study currently does not quantify any error or uncertainty estimates. Therefore I do not have confidence in the data are used to support the study.

Most of the discussion about drivers of ET are speculative and not robust. Moreover, it is based on the slopes of evapotranspiration versus VPD which are problematic. This is because evapotranspiration covaries during the day as a function of net radiation, wind speed and soil moisture. Therefore an independent relationship with VPD is not assured. At the very least evapotranspiration should be normalised by net radiation to produce an evaporative fraction. A multivariate analysis would be appropriate here to break this down, however the authors do not have enough data to perform this.

In addition, the aspect of 'theoretical' scenarios for plant cover are unrealistic as they are based on a small sample size and are extended beyond what could be reasonably expected from the measured dataset. The rationale for this unrealistic scenario is not apparent. The authors also state on mine sites the plant cover is rarely greater than 50 per cent so extrapolating plant cover to 100% is meaningless. Measurements of evapotranspiration over different plant covers across the range of natural compositions would have been a useful to actually elucidate the interaction between cover, evapotranspiration and soil moisture balance rather than just some arbitrary and simplistic scenario that also has no physical basis and we know a priori that the changes in cover will not scale linearly and that changes in cover will have non-linear interactions with radiation (via shading and albedo), soil moisture (through competition between plants), and nutrient cycling. These scenarios cannot be justified.

In addition, the assertions and conclusions regarding plant cover having critical thresholds at 50 and 80% are erroneous. There is not really any magic threshold at which

HESSD

9, C5617–C5622, 2012

the plant cover is 'critical'. In fact it is simply a linear function of plant and there is no rationale for any thresholds in cover as the authors claim. The authors then state that the potential ET can be used as a predictor at 100% cover. This is also not correct and the lines drawn in their scenarios just happen to intersect at about 100% but there is not quantitative or predictive power here. In some systems this intercept will be about or below. As a result this aspect of the manuscript many is untenable.

In general, the paper certainly addresses questions relevant to the scope of HESS however the manuscript is likely to be of limited value and does not provide any new concepts, ideas or tools for the community. Unfortunately due to the small sample size and the lack of robust treatment of errors and uncertainties the data can be indicative only and is not particularly useful in a quantitative sense. Many of the interpretations in the discussion are simply inferences that are not supported by the underlying data.

I cannot recommend publication it its current form. Other comments:

a. TITLE: The title could be made more meaningful especially given the of the word 'evapotranspiration covers' which I had not come across before. Regardless the title didn't make sense to me anyway.

b. PAGE 11914, LINE12: Given the scope of the paper in the semi arid landscape I would like to see more detail on the climate of the region. Distributions of temperature, precipitation, relative humidity and vapour pressure deficit would be useful to illustrate where the study fits into that climate regime.

c. PAGE 11914, LINE18: Report the soil bulk density and soil characteristics such as particle sizes if available.

d. PAGE 11914, LINE22: Please elaborate on the establishment of the evapotranspiration covers. How were they established, by natural seeding or planting? What was the species composition? What fraction of it was native vs. invasive species?

e. PAGE 11915, LINE18: The sentence is a little bit confusing, were the plants sampled

HESSD

9, C5617–C5622, 2012

for soil moisture or for biomass or leaf area?

f. PAGE 11915, LINE21: Please provide a justification for the 17mm event. Compare this to the longer term rainfall rate distribution. How was this applied? Over what area?

g. PAGE 11915, LINE24: What do you mean by this? How much is markedly? What measurements of soil water were undertaken? How was root zone soil moisture quantified?

h. PAGE 11918, LINE8: Reporting of simple R2 is inadequate here. A thorough assessment of the error and uncertainty is required for the measurement system. A plot of test data would be beneficial here. What is your statistical conference in the chamber observations?

i. PAGE 11917, LINE07: Description of the OTC method is inadequate.

j. PAGE 11917, LINE17: You need to report the sensor specifications including accuracy and response time. Is the use of the HMP155 appropriate for the task? Please justify the choice of sensor and suitability.

k. PAGE 11915, LINE10-30: There must be adequate quantification of errors and uncertainties. The statistical error must be reported and plotted in all figures and values in the text. An assessment of uncertainty must also be undertaken.

l. PAGE 11920, LINE5: Are these 'significant'?

m. PAGE 11920, LINE22: The aspect of 'theoretical' scenarios for plant cover are unrealistic as they are based on a small sample size and are extended beyond what could be reasonably expected from the measured dataset. The rationale for this unrealistic scenario is not apparent. The assertion regarding plant cover at 50 and 80% is misleading. There is not really any magic threshold at which the plant cover is 'critical'. In fact it is simply a linear function of plant and there is no rationale for any thresholds in cover. As a result this aspect of the manuscript many is tenuous.

HESSD

9, C5617–C5622, 2012

n. PAGE 11920, LINE8: Measurements of evapotranspiration and vapor pressure deficit are overly simplistic .

o. PAGE 11920, LINE29: No. It just happens to be the same value. It is not predictive.

p. PAGE 11921, LINE8: I would expect 'after watering' for this to maybe not be the case. Can you show this data in figure four.

q. PAGE 11921, LINE17: At what point do these plants reach their wilting point? Measurements over further days would have been useful here.

r. PAGE 11922, LINE4: Not just soil water but rather soil – route – plant – atmosphere continuum. Also there are other different drivers including net radiation and wind speed that are crucial. Differences in evapotranspiration, and hence the difference between the evapotranspiration versus vapor pressure deficit relationship in the morning and afternoon could be due to radiation and/or wind speed. Discuss.

s. PAGE 11922, LINE5: Additional sap flow measurements may have added value here.

t. PAGE 11922, LINE10: Importantly plant stomatal conductance is likely to be a major driver. Measures of plant physiology and stomatal conductance would have added significant value to the study. At the moment the discussion used mainly hand waving and inconclusive given the lack of measurements.

u. PAGE 11922, LINE17-20: This section is speculative and not robust. Moreover it is based on the slopes of evapotranspiration versus VPD which are problematic. This is because evapotranspiration covaries during the day as a function of net radiation, wind speed and soil moisture. Therefore an independent relationship is not assured. At the very least evapotranspiration should be normalised by net radiation to produce an evaporative fraction. A multivariate analysis would be appropriate here to break this down, however the authors do not have enough data to perform this.

v. PAGE 11922, LINE16: Isn't what you of observe just stomatal closure? Do you have

HESSD

9, C5617–C5622, 2012

Interactive Comment

any evidence for stomatal closure? Physiological measurements of leaf, soil and root water potentials would be invaluable.

w. PAGE 11922, LINE18-30: There is no evidence in the data set for hydraulic redistribution.

x. PAGE 11923, LINE10-15: Some of measurement of plant biomass, root biomass and leaf area index would be useful to interpret the results. Were the differences observed in this study really due to differences in transpiring leaf area?

y. PAGE 11923, LINE20 to PAGE 11922 , LINE 12: The scenario here is arbitrary and not viable. The author also states on mine sites the plant cover is rarely greater than 50 per cent so extrapolating plant cover to 100% is meaningless. Measurements of evapotranspiration over different plant covers across the range of natural compositions would have been a useful to actually elucidate the interaction between cover, evapotranspiration and soil moisture balance rather than just some arbitrary and simplistic scenario that also has no physical basis and we know a priori that the changes in cover will not scale linearly and that changes in cover will have non-linear interactions with radiation (via shading and albedo), soil moisture (through competition between plants), and nutrient cycling. These scenarios cannot be justified.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 11911, 2012.