Hydrol. Earth Syst. Sci. Discuss., 2, S61–S65, 2005
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European Geosciences Union

Hydrology and Earth System Sciences Discussions

Interactive comment on "Variability in riparian zone potential and actual evapotranspiration in a 1st order agricultural catchment in Southern Ontario, Canada" *by* R. M. Petrone et al.

Anonymous Referee #2

Received and published: 11 March 2005

Manuscript hessd-2004-0014

General Comment The manuscript adresses a subject that is certainly relevant. Riparian zones are widely studied as ecological corridors for many aspects. Hydrological processes are basic to their functioning because of the direct interaction between variable vegetation-soil-shallow groundwater- surface water. Because of the fact that the width of the riparian zone in the Strawberry Creek (see: http://info.wlu.ca/˜wwwgeog/special/strawberry/tour.htm) is so small (10-15 m) no regular micrometeorological methods for observing actual evapotranspiration are available. Authors seek a solution by using weighable micro-lysimeters. Following that approach investigators have to ensure that the hydrological processes of the direct surrounding of each lysimeter are fully represented/copied in the selected lysimeter approach.

In the manuscriptin the section ‘Methodology’ there is no detailed and clarifying description, and/or are pictures or drawings about the experimental setup and therefore it raises several questions about the appropriateness of the experimental design to achieve the objectives as posed in the title and in the Introduction.

What has been understood by this reviewer from the too scarce information in the manuscript about the lysimeter/container is that: - there has been 8 micro-lysimeters installed (2 vegetated and 2 bare soil lysimeters at both sites each). In statistical sense it means that there is only very limited information available about the magnitude of small scale AET-variability per site, information especially needed if the zone is narrow and strongly inclined toward the creek. - the mini-lysimeter has a small volume of approx. one liter. Unfortunately no information has been given about the depth of the lysimeter samples but related to the mentioned volume one may estimate it at approx. 10-15 cms. Because of the fact that the lysimeter is enclosed by a second, closed box for collecting the percolated water from the lysimeter this setup implies that the complex and dynamic vertical transport behaviour of moisture in the (probably much deeper) rooting zone and between the rooting zone and groundwater (see the given definition for the riparian zone) must be accurately copied in the small lysimeter. With respect to the above mentioned two aspects the described experimental setup is certainly not convincing.

Authors argue in extenso and conclude that the apparently found difference in AET between the upper and lower site of the riparian zone results from a difference in windspeed between the 2 investigated sites. Apart from the point whether registrated windvariation would have that influence anyhow on AET as suggested (and can never be demonstrated by radiation formulas!) simple inspection of fig.2 (not mm/day!) shows that the observed difference of AET between the two lysimeter sites can be entirely explained by 2 outliers. If this 2 points inthe figure will be omitted for a moment one gets a perfect 1:1 line between the upper and lower AET! This leads to the conclusion that if the wind is causing the disparity in AET it must have happened solely during that

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2 periods. An unlikely result it seems and so seems the conclusion on the windeffect. More precise evidence for maintaining the windeffect-story and/or a careful inspection of the 2 outliers is absolutely needed.

Additional specific comments will show that the manuscript has several shortcomings in presentation of data, in discussion of results and in drawing experimentally well based conclusions.

Specific Comments Page 265, lines 11-13 (Abstract): how can the hydrological components of the hydrological balance be similar at two places if the precipitation is similar but the actual evapotranspiration differ? The same question applies to the energy balance in the presence of a similar net radiation flux for both sites.

Introduction: General remark: this section contains several items which are irrelevant to the problem and objectives of the study. For instance some considerations on temperature, wind and humidity for PET/AET are superfluous. Furthermore the suggestion is made here that these components outweigh radiation.

Page 266: lines 9-14: how critical is it for this basin? A first estimate yields ca. 1% of the basin area belongs to this narrow corridor. Of course this would not imply that a study of ET is not useful for reasons other than the overall water balance of the basin.

Page 267: line 29 etc: From where the abrupt choice of Pr.& Ta. here? Especially remarkable because of the earlier emphasized importance of temp., hum. and wind in the PET/AET processes. Logically spoken one would expect a first choice for a more sophisticated expression like Penman-Monteith for instance.

Methodology: See my general comment. Additional comments are more specific.

Page 270, line 11 etc.: what was the (fixed?) time interval between 2 observations? Why are there no results presented of a (temporal) comparison of soil moisture inside and outside the lysimeters? Are there no groundwater depth observations next to the lysimeters? How does the depth of the lysimeter compare to the natural depth of the

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rooting zone in the riparian zone? These data are essential for a proper interpretation how far the lysimeter results represent correctly the hydrological field conditions.

Page 270, line 17 and equation 1: what is meant by “to ensure thatĚ. soil”? How can it be ensured? Does it mean that periodically after each hand-made TDR-observation of soil moisture inside and outside the lysimeter water is added to the lysimeter and is represented by the term Vr in the balance equation? If not, what represents Vr? How otherwise to compensate for changes in theta below the depth of the lysimeter column and for upward moisture flow to the rooting zone?

Page 271, line 13 etc.: rather confusing the term PETeq. Reserve the usual P for a realistic condition. One may wonder anyhow if ideal ET-conditions do exist for a saturated atmosphere (= at equilibrium). See the correct statement on stomatal behaviour at Page 267, line 4 in contrast. Equilibrium evaporation may have some meaning for a free water surface but not for vegetated areas with different controls on transpiration fluxes. A more concise explanation about equilibrium ET may be enough where finally the authors can agree on a potential value of 1.26 for humid climates.

Page 272, section 4.1 + section 4.2: The presented results show 1) a strong reduction of AET related to PET [α=1.26] , 2) a difference in AET between the 2 sites [fig. 2], 3) strong variation of alpha from interval to interval [fig.3]. All these results raise questions about the plausibility of the results in representing the real field conditions in the riparian zone. Ad 1): No separate results are given for the vegetated and bare soil lysimeters, neither the contribution to the combined result. Furthermore 178 mm of rainfall has been recorded in the total period of 80 days, favourably fallen, see fig 4f. If we do some simple waterbalance calculation for the lower site using the moisture information from fig. 4c (ΔӨ˜0 between beginning and end of the period), we end up with a total local discharge of 178-83 = 95 mm or on average 1.2 mm/day. A relatively very high number if compared to the discharge from the basin in fig. 4d and to what is said at page 274, line 11 about discharge-reaction during the middle wet period. Ad 2): discussed already earlier, see under General Comment. Ad 3):

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The entire observation period comprises 80 summer days. As can be concluded from fig.2 a number of 15 observations has been made with apparently an irregular pattern of intervals. The average intervallength between two observations is 5 to 6 days . Despite the expected effect of averaging within each interval the variation in alpha is surprising large for mid-summer conditions and needs to be further explained.

Section 4.3: As is pointed out in this section only 30%(Lower) respectively 37 % (Upper) of the available net energy is used for AET over the period of 80 days. Once more, this is a remarkable low percentage for a generally well vegetated zone with potential groundwater interaction and a substantial amount of rainfall (178 mms).

Discussion + Conclusions: - About the range of α-values found in this study comment has been given already under Ad 3). - Wind variation between the two locations as the explaining factor for the variation in AET has also been discussed earlier. - At page 278 authors recommend the application of the Pr.&Ta.-formula as a less intensive research method. In principle this is correct. However, in their case of the availability of all the standard meteorological data together with their emphasis on the importance of the wind on the magnitude of AET one would expect at least the application of a wind included expression like Penman-Monteith to evaluate the windeffect.

Technical corrections:not relevant.

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 265, 2005.