Hydrol. Earth Syst. Sci. Discuss., 11, C2939–C2942, 2014
www.hydrol-earth-syst-sci-discuss.net/11/C2939/2014/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Divergence of reference evapotranspiration observations with windy tropical conditions" *by* R. G. Anderson et al.

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Received and published: 5 August 2014

General

In this paper a comparison is made between eddy-covariance measured actual evapotranspiration rates and reference evapotranspiration rates from two mid-season growth stage sugar cane fields that experience differences in climate (windspeed, temperature) in the tropical environment of Hawaii. The eddy covariance evapotranspiration rates were somewhat lower than those estimated by the Priestley-Taylor equation, and much lower than those estimated by the ASCE short and tall reference equations. The study suggests that due to the specific climate at the sites the bulk surface resistance term amy need adjustment to reduce the advective term in the ASCE short and tall

reference equations. The study is well-designed, robust and uses eddy covariance, standard meteorological measurements, canopy cover measurements and soil moisture measurements to make the ET intercomparison and to support their interpretation and explanation of the results. The scientific methods are described well and are sound, and allow traceability of the results. The abstract is informative.

The paper addresses a relevant scientific question. The divergence between the actual evapotranspiration rates and those estimated by the reference equations is surprising. As these reference equations are commonly used worldwide, such a discrepancy suggests that there is a need for more research into the actual evapotranspiration of crops outside the temperate climate zone, where most research has been done. The outcome of this study serves as a caution to indiscriminately using reference ET and crop factors in tropical environments to determine irrigation water demand.

specific comments

Title: I would suggest to include "actual evapotranspiration" and "irrigated sugarcane" in the title, e.g. "Divergence of actual and reference evapotranspiration observations for irrigated sugarcane with windy tropical conditions".

Section 2.1. The eddy covariance technique needs a good fetch and preferably a rather flat surface within the fetch. What was the relief of the area surrounding the towers, is the general area sloping towards the west as suggested by the drainage pattern? Does this have implications for the rotation needed to create an average vertical wind speed of zero for the EC system?

Rainfall varies between 275 and 1275 mm/y. The towers are in the South, so was rainfall input at the sites much lower than ET_EC (1170-1390 mm/y)?

Sections 3.2 and 3.3. Different cumulative / daily actual and reference evapotranspiration rates are presented in the text for mid-period and for the whole period (the latter not for ET_EC unfortunately!). I would like to suggest that a summary of these ET rates

be presented in a table for easier comparison. I would like to suggest that this table also include information on cumulative rainfall in the different periods and additional irrigation inputs to provide a waterbalance summary. Inclusion of the latter values would perhaps better support the contention of the authors, expressed on page 6492, l. 18, that cumulative ET_EC was always lower than irrigation plus precipitation.

Section 4.1. The actual evapotranspiration rate ET_EC presented here is based on dry canopy conditions (transpiration + soil evaporation), as the eddy covariance system does not give reliable estimates under rainfall and wet canopy conditions. These missing wet canopy periods were filled using the Max Planck Institute tool based on results from (dry) periods with similar micrometeorological conditions. Rainfall interception loss is perceived quite low for sugarcane in Brazil (4-7% of precipitation - P.R. Leopoldo and A. de P\'adua Sousa and S. T. Filho, Intercepta\ccão da \'aqua de Chuva em Cultura de Cana-de-a\cc\'ucar, Brasil A\ccucareiro, 1981, 98, 6, pp. 9–16; Cabral, O.M.R. and da Rocha, H.R. and Gash, J.H.C. and Ligo, M.A.V. and Tatsch, J.D. and Freitas, H.C. and Brasilio, E., Water use in a sugarcane plantation, Global Change Biology - Bioenergy, 2012, 4, 5, pp. 555-565).

Arguably, actual evapotranspiration ET_EC may be somewhat underestimated because rainfall interception losses may have been higher than the corresponding transpiration values used for gap filling under the specific high wind / low aerodynamic resistance conditions of the Hawaii sites, and with possible advection effects due to the proximity of the ocean to the sites.Would it be possible to comment on this in the discussion?

Authors might also compare their actual evaporation rates and rc and ra values for sugarcane with those also observed by eddy covariance by Cabral et al. (Cabral, O.M.R. and da Rocha, H.R. and Gash, J.H.C. and Ligo, M.A.V. and Tatsch, J.D. and Freitas, H.C. and Brasilio, E., Water use in a sugarcane plantation, Global Change Biology - Bioenergy, 2012, 4, 5, pp. 555-565).

Technical corrections

6476 l. 18-19: Reference Hoogebloom should be Hoogenboom, correct in reference list 6477 l. 10: Reference again, Hoogenbloom should be Hoogenboom 6481 l. 21: place dot (.) after , respectively) to end sentence

Markers in Figure 11 are very closely plotted making these difficult to distinguish, use different colours here perhaps?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 6473, 2014.