Hydrol. Earth Syst. Sci. Discuss., 11, C6820–C6824, 2015
www.hydrol-earth-syst-sci-discuss.net/11/C6820/2015/


Hydrology and Earth System Sciences
Discussions



# *Interactive comment on* "Evaluation of an extreme-condition-inverse calibration remote sensing model for mapping energy balance fluxes in arid riparian areas" *by* S.-H. Hong et al.

**S.-H. Hong et al.**

shong4@murraystate.edu

Received and published: 17 April 2015

This paper presents a study of using the SEBAL to estimate daily energy balance components in arid riparian areas based on satellite (Landsat) imagery. Authors evaluated the model performance by comparing the model outputs to the ground-based measurements at three sites in the southwestern U.S. In general, the methodology (including problem setup, modeling, and data analyses) appears to be appropriate and the study could potentially be valuable addition to the hydrologic studies over arid/semi-arid riparian regions. Answer: Thank you.



Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

Although my overall opinion of the paper is positive, the paper in its present form is not publishable in the HESS and requires substantial revisions. Listed below are my major concerns as well as suggestions for the authors to consider.

1. My major concern is whether the application of the SEBAL approach could be extended to other or more general arid riparian regions. In the Introduction, authors state that the study areas are very "heterogeneous" and if the approach works "under these challenging conditions, it is likely to perform well in most arid and semi-arid regions." In the manuscript, however, I have read many explanations and discussion on why certain bias/errors occurred in this study associated with the three selected areas and what specific techniques were used. One of the examples is that, in Lines 19-23 (Page 13499), "these differences area about two to three times larger than those typically reported for SEBAL. The much larger than usual MRD is attributed to the heterogeneity of the riparian sites. . ." If the "heterogeneity" is the cause, how could readers believe that the approach would perform well in other heterogeneous riparian areas?

Answer: Thank you for this important feedback because it shows us that we need to reformulate this paragraph. We changed the statement on SEBAL performing well in other regions. The much larger than usual MRD should not be attributed to the heterogeneity of the riparian sites but to the fact that the ground measured net radiation did not capture the true net radiation averaged over a pixel consisting of patches of bare soil and vegetation. The reason is that only one net radiometer was used and it was directed towards the canopy. As a consequence the measured net radiation became biased towards the net radiation of vegetation instead of the true pixel-scale net radiation consisting of bare soil and vegetation. A remedy would have been to install several net radiometers on each site. In addition, it still would be difficult to place these meters in a way that a representative net radiation would be measured. Instead we argue that under such circumstances the SEBAL observed net radiation is likely a better alternative for energy balance assessment than the use of a biased net radiation measurement on the ground. Earlier tests between net radiation from remote sens-



HESSD

11, C6820–C6824, 2015

ing and in-situ measurements of homogeneous land use classes showed an excellent agreement. There are many papers (SEBAL as well as non-SEBAL models) showing that net radiation can be accurately estimated from remote sensing.

2. I am a modeler, but not a SEBAL user. I am curious about the acceptable level of accuracy for SEBAL estimates. According to the results (e.g., Figures 4 and 6), the deviations (from 1:1) are obvious and R2 values are not very impressive, ranging from 0.56 to 0.75 (Table 4) and from 0.32 to 0.78 (Table 8).

Answer: The R2 values do not give information about the accuracy of the SEBAL ET values but only about their correlations with the ground measurements. Therefore, it is better to inspect the values for MRD; for LE those are well within $\pm$10% that is considered a pretty good accuracy.

3. I understand that the selection of "hot" and "cold" pixels is very essential to the success of SEBAL application. But how sensitive is this procedure to the quality of ET estimation? In other words, if a less accurate or a bad selection of "hot" pixel is made, how would it impair the model performance in estimating the ET? It is not clear according to the manuscript and some quantitative analysis in this respect would be interesting.

Answer: You are right. The selection of the cold and hot pixel is the most critical aspect of the extreme-condition-inverse calibration. If done well, it yields seasonal ET values for watersheds with a bias of around $\pm$5%. For cropland seven papers have reported a mean absolute percentage error of 1%. All these papers used an extreme-condition-inverse calibration (see Karimi and Bastiaanssen, 2015). Morton et al (2013) demonstrates that these hot and cold pixel selection can be fully automated on the basis of years of manual experiences (that can be spelled out in terms of mathematical steps). They also demonstrated that the uncertainty was the highest for fields with low ET levels and lowest for fields with high ET levels, with a seasonal mean uncertainty of approximately 5% for all fields. In a blind comparison, automated daily and seasonal



HESSD

11, C6820–C6824, 2015

ET estimates compared well with flux tower measurement ET data at multiple sites.

Morton, C.G., J.L. Huntington, G.M. Poll, R.A. Allen, K.C. McGwire and S.D. Basset, 2013. Assessing calibration uncertainty and automation for estimating evapotranspiration from agricultural areas using METRIC, J. American Water Resources Association (JAWRA) 49(3): 549-562

4. The manuscript is too long, containing too many details that are not necessary. Pages 13485-13487: if the descriptions of the method are not new to the SEBAL users, many contents of these pages could be removed. Sections 3.2, 3.3, and 3.5: have too many details and could definitively be shortened.

Answer: Please, see our response to the second major comment of reviewer 1. At the request of the editor we removed all SEBAL method information that is easily found in the literature but we kept study specific information. Unfortunately, there are many critical details that we cannot remove without shortchanging readers who want to implement SEBAL themselves.

5. Locations of the study areas. Please, provide map(s) showing the locations of the three areas. It is very important to include information such as where/how large the study areas are and where the field-based measurements were made.

Answer: We have added a map.

6. The manuscript needs careful editing, e.g.: “has” (Line 9, Page 13482) “Peters Lidard et al., 2004” (Line 14, Page 13482) “exists” (Lines 11-12, Page 13482) “others suggest” (Line 13, Page 13487) “Since,” (Line 20, 13488)

Answer: We have checked our editing.

7. "Table 5” (Line 2, 13491): mentioned/used in the context before Tables 3 and 4. Please re-arrange tables in sequence.

Answer: We have removed the reference to Table 5 in order not to violate the table



HESSD
11, C6820–C6824, 2015

sequence.

8. Figures 4, 6, 8, 9, 11, 12 and 13: The fonts and symbols of these figures are too small. Answer: We have increased the size of these figures.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/11/C6820/2015/hessd-11-C6820-2015-supplement.pdf

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 13479, 2014.