

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.

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Received and published: 17 April 2015

Summary: The authors present an application of SEBAL to semi-arid riparian regions in the US West. The study design is appropriate to the problem and the presentation of methods and results is clear throughout. I am not a SEBAL user, but my impression is that this paper will present a useful case study and a number of useful application tips for users of that system. Since SEBAL is a widely used model and semi-arid riparian zones are of particular interest for ET analysis I believe that publication of this paper in HESS is justified. Answer: Thank you.

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That said, I admit that I find the paper disappointing in some respects, as indicated in my major comments below. My overall impression is that the paper as it is currently written provides a technical resource for SEBAL users, but that the authors have missed the opportunity to put their analysis into the broader context of semi-arid riparian hydrology, or at least the broader context of available ET methods and datasets in these regions.

Major comments:

1. I find it odd that so many ET methods and products are listed in the introduction, yet the paper only presents internal analyses. It would be very interesting to know how the calibrated SEBAL estimates from this study compare to available ET estimates from MODIS (MOD16 and/or the UW product for CONUS), ALEXI, NLDAS, or other available datasets. Indeed, I had really hoped that in reading the paper I would learn whether calibrated SEBAL performs substantially better than other methods or publicly available products in these regions.

Answer: We fully agree that it would be interesting to know how the calibrated SEBAL estimates compare to those by operational ET products such as MOD16, ALEXI, NLDAS or other ones. However, the goal of this paper is “to conduct a thorough evaluation of the performance of SEBAL in arid riparian areas.” Other international research groups have evaluated SEBAL for irrigated areas, forested catchments, cropped soil and desert surfaces. There are many scientists that believe SEBAL is designed for irrigation systems, hence it is an excellent idea to synthesize the multi-year research work in semi-arid riparian regions. The latter is an ecosystem requiring more global attention in water accounting frameworks of river basins. Comparison between SEBAL and METRIC at the one hand with other remote sensing based ET models at the other hand has been done before (TSEB, DISALEXI, IWMI Turkey experiment, Caren Jarman South Africa). References to that could be provided Co-author Hendrickx is involved with a statewide assessment of ET in New Mexico and evaluation of the MOD16, ALEXI and SSEBop operational ET products. The study started last fall and publication

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of its results will take a while to complete.

As it stands I find it difficult to interpret the reported error estimates, since I have no reference for what constitutes a good or bad estimate of turbulent heat fluxes for these locations.

Answer: Whether an ET estimate is “good or bad” depends on one’s needs, and in particular on the given space and time scales. A farming operation requiring ET data for Variable Rate Irrigation Application needs localized data and for every single day. The basin agency working on water transfers or groundwater exploration plans, requires the regional ET data to be available at monthly or seasonal time scale. One can probably define also different type of users of water balances in riparian corridors. The best solution is to present the SEBAL accuracy of semi-arid riparian regions at a range of temporal scales, and then the user can understand the range of plausible standards and decide to use or reject it. Co-author Bastiaanssen just published a paper that gives a reference frame for interpretation of ET error estimates. [Karimi, P., and W. G. M. Bastiaanssen (2015). Spatial evapotranspiration, rainfall and land use data in water accounting – Part 1: Review of the accuracy of the remote sensing data, *Hydrol. Earth Syst. Sci.*, 19, 507-532.] This reference has been added to the manuscript.

2. The title and introduction indicate that this paper is motivated by the problem of estimating ET in semi-arid riparian areas. The selection of study sites is consistent with this goal, and in some sections the presentation of results touches on matters relevant to riparian areas. But overall the very lengthy results section and the conclusions have very little to say about riparian zones. Instead various details of SEBAL calibration and bias correction are explored without any explanation as to how or why the results are specific to / informative of / generalizable across semi-arid riparian zones. Instead the paper becomes a list of specific lessons learned and recommendations for SEBAL, some of which are semi-arid specific but others of which seem not to be. I would urge the authors to present a more compelling synthesis of their results as they inform study of semi-arid riparian zones. Alternatively, if the results are more generalizable then the

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authors could consider removing the semi-arid focus and reframing the paper in terms of its technical contribution to SEBAL applications.

Answer: We share the ambivalent feeling of this comment: focus on all the little technical aspects of an extreme-condition-inverse calibration for mapping ET in riparian areas or skip those and show with a few figures how well the calibration works in riparian areas and what can be done with those reliable ET data. Further to satellite images and routine weather data, there is no additional information needed to apply models such as SEBAL and METRIC. This makes this method potentially attractive for heterogeneous landscapes and ungauged basins. Many other spatially distributed ET models require additional aerodynamic information and data on the atmospheric constituents during the moment of satellite overpass. It is in our view proper to explain some of these fundamental mechanisms, and provide a logical framework why SEBAL could work where other models fell short. We definitively have opted for a focus on all technical aspects because the “devil is in the details”. We want to take our readers by the hand and explain all the important details needed to arrive at accurate and reliable ET estimates with our method. There are too many articles that ignore those details. Often this may be justified but the disadvantage is that the interpretation of the error estimates becomes impossible. Almost every application of ET algorithms by individual investigators has its own quirks and often is different from other applications using the same method. In our opinion, there is also a need for papers that give all technical details as does our study. Because each application depends on its environment (semi-arid or sub-humid) we opt to keep the semi-arid focus. In addition, the assessments of performance are in the context of riparian systems. This context should provide insights and “comfort” to users of remote sensing of ET information in riparian areas.

Minor comments:

Introduction p. 13482: The inclusion of NLDAS and LIS in the discussion of satellite derived ET estimates is misleading. NLDAS ET estimates are the product of land

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surface models that simulate ET prognostically, while LIS is a software framework that supports LSM simulations with data assimilation. Neither is really a satellite-derived ET product in the way that the other listed analyses are. If the review of "ET products" is to include prognostic modeling systems alongside diagnostic energy balance methods then the authors should make a clear distinction between the two.

Answer: We fully agree with your comment. Reviewer 2 made a similar comment. We have removed any reference to NLDAS and LIS in the manuscript.

Introduction p. 13484: The statement that "If SEBAL performs well under these challenging conditions, it is likely to perform well in most arid and semi-arid regions" requires further justification. I understand that short fetch and sub-pixel thermal contrasts make riparian areas difficult, but riparian areas also present a strong ET signal that is absent in most semi-arid regions and that might make RS detection easier.

Answer: We agree with these insights. We have expanded on this statement to suggest that good performance should be expected from other types of moderate to high ET systems that are surrounded by relatively dry land uses. The above quotation has been replaced by "A good SEBAL performance under these challenging conditions would be a strong indication that satisfactory performance should be expected from other types of moderate to high ET systems that are surrounded by relatively dry land uses [Compaoré et al., 2008]".

Please also note the supplement to this comment:

<http://www.hydrol-earth-syst-sci-discuss.net/11/C6811/2015/hessd-11-C6811-2015-supplement.pdf>

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