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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Estimating evapotranspiration with thermal UAV data and two source energy balance models" *by* H. Hoffmann et al.

Anonymous Referee #1

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Summary

This MS assesses whether a lightweight thermal camera installed on board an Unmanned Aerial Vehicles (UAV) is able to provide data of sufficient quality to attain high spatial and temporal resolution surface energy heat fluxes as input for the estimation of actual evapotranspiration (ETa) using two source energy balance models.

The MS presents an interesting application of UAV technology to remote sensing of ETa. It fits well to the scope of this journal. However, the MS contains several syntax errors and structural problems. The method section is written in a poorly comprehen-

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sible way. In addition there are some issues with regard to the used methods and presentation of the results that need to be resolved. The MS focuses on the evaluation of the UAV data for ETa estimation a modified TSEB model that was already presented elsewhere (e.g. Guzinski et al., 2014). Nevertheless, the technical aspect of using UAV is instead of satellite data is very promising. Therefore, I recommend resubmission of this MS in the form of a technical note.

General comments

The major issue of this MS is the lack of scientific analysis of the data. Basically only the validation results are presented, but a thorough discussion of the spatiotemporal patterns of ETa is missing. For instance, the comparison of estimated ETa pattern with irrigation pattern is too superficial and also the effects of heterogeneity soil properties on ETa pattern could be discussed. Since the both the EC-footprint and UAV coverage are very different for the investigated dates, the effects of different overlapping data sets should be quantified and discussed.

The structure of the section describing the TSEB models is poorly structured and thus difficult to comprehend. Also it contains several errors and inaccuracies (see specific comments).

Specific comments

P1L18: delete “the”

P1L21: “are” instead of “is”

P2L1: remove “and sunny”

P2L3: “being” instead of “as”

P3L2-5: Check syntax

P3L5-6: This statement needs more explanation

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P3L9: Check syntax

P3L11: The term “TSEB-PT” is not used throughout the MS

P3L16-17: What kind of results?

P3L18-P45: Too extensive

P4L9: “rainfall”

P4L9: “enables” instead of “permits”

P4L12: the term “output maps” is not appropriate here

P4L13: “decimetre scale” would be more appropriate

P4L13-15: The presented method is suitable to providing spatial information on ETa, whereas the analysis of different stages of plant growth is very limited given the effort in data acquisition and processing. For temporal analysis the EC-techniques is more suitable.

P5L6: Delete “(UTC. . .)”

P5L6: What is the size of the test area?

P5L6: Please provide information on soil properties.

P5L8: 990 mm precipitation is quite a lot. Why is irrigation needed? Please describe the irrigation management in more detail.

P5L9: These statements should be more quantitatively described (e.g. in days per year)

P5L22-25: This statement needs more explanation.

P5L26-28: This sentence needs to be revised.

P6L1-2: f_theta also depends on canopy type and fraction of vegetation cover

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P6L2: Priestly-Tayler provides potential latent heat flux

P6L2-5: Unclear statement

P6L5-6: The related equation needs to be presented if new parameters are introduced.

P6L6: This value of alpha stems from Priestly and Tayler (1972).

P6L7-16: This part is confused and difficult to comprehend. Typically, first the relevant equations are presented and then the implementation of the algorithm.

P6L22: Eq. 5 seems to be wrong

P7L1-8: More explanation is needed. It is not appropriate to present an equation without fully describing the parameters and variables (referencing another paper is not sufficient). How are all these parameters estimated in this study?

P7L13: Explain “energy divergence”

P7L25-27: Check syntax.

P9L22: What is the resulting position accuracy after correction?

P9L8: This should be 4.2

P10L3-4: Figure 2 is not really needed because the ETa maps already show the resolution of the data.

P10L14-20: For potential users, it would be interesting to know, how much difference the different composition techniques would produce in terms of estimated ETa.

P10L21: The EC-footprint analysis should be presented after the EC-measurements have been introduced.

P10L29: Please show the respective EC-footprint weights in the ETa maps (e.g. using isolines). Since the ETa maps are covering very different areas, it should be analysed to which degree missing ETa information within the EC-footprints may have influenced

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the results.

P11L9-13: Given the limitations in the model description, it is unclear how most of these data sets find their way into the modelling.

P11-11-12: The values for these parameters used for each ETa estimation should be presented.

P11L16-17: This needs to be described in more detail. How can linear fits for two periods be produced from only three LAI values?

P12L22: Shouldn't the patterns be exactly the same, since no further spatial information is added?

P12L22-24: How will this affect the results?

P13L1-4: The effect of tramlines should be presented in more detail. I have difficulty to spot the tramlines in the ETa maps, so please add information in the maps. You could determine differences of ETa rates.

P13L7-8: Please provide possible reasons.

P13L9: "bodes"?

P13L15-17: This is statement is rather trivial.

P13L19-26: As you point out, the R_n estimates include the R_s,in from the EC-station. There you should compare the R_l values, which are purely determined from UAV measurements.

P13L27-28: This statement is difficult to comprehend. Please reformulate.

P14L3-8: Here you are comparing Rn not ETa. Rn is determined at the meteorological station with much higher resolution. Thus, you could compare the same measurement periods. The variations in irradiance should be recorded by both systems, so that the average should be similar.

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P14L10-11: reformulate “steadier trend prediction”

P14L15-16: This data should be presented.

P16L16: Change “will” into “should”

P16L22: Which kind of calibration, if any, was applied in this study?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 7469, 2015.