

## ***Interactive comment on “Area-averaged evapotranspiration over a heterogeneous land surface: Aggregation of multi-point EC flux measurements with high-resolution land-cover map and footprint analysis” by F. Xu et al.***

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Reading the manuscript, I found that the concept of the experimental design and the data analysis is very similar to the experiment LITFASS-2003, which was published in BAMS (Mengelkamp et al., 2006) and in a special issue of Boundary-Layer Meteorology (2006, vol. 121, issue 1). Some of these papers are quoted, but papers published later are missing (Foken et al., 2006; Foken et al., 2010; Charuchittipan et al., 2014).

Several parts in the paper are unclear, or information is missing that would enable the paper to be followed accurately:

C1

The area of investigation was very much dominated by maize fields. Only three stations had another dominant land cover (stations 1, 4, and 17). This is a significant limitation for the stated aim of the paper to determine area-averaged fluxes over a heterogeneous area. For the LITFASS-2003 experiment (and other experiments given as references), different land cover types were much better distributed. This deficit should be discussed.

The function of the LAS in the aggregation schema was not clear. I could not find a reason for the use of such data. In LITFASS-2003, LAS systems were also used with a specific function: It was assumed that LAS can also measure the fluxes of larger turbulence or circulation structures and that this is not affected by the non-closure of the energy balance (Foken, 2008). This information was used to discuss the unclosed energy balance of the flux measurements and to correct this. The problem of the unclosed energy balance is not mentioned in the whole paper, but it is a standard for the analysis of surface flux measurements (Foken et al., 2012).

Any information is missing as to why the footprint model by Kormann and Meixner (2001) was used in your study. Perhaps the textbook by Leclerc and Foken (2014) would give you the relevant information. Questionable is the exact location of the small non-maize-covered areas in the footprint of the EC and LAS measurements. A discussion of the accuracy of the footprint analysis combined with the accuracy of the EC and LAS measurements is urgently necessary.

The applied multiple-linear regression analysis needs more information. Did you aggregate the fluxes according to the land-cover type in different effect levels of the footprint? Compare your method with the methods presented by Leclerc and Foken (2014).

What is meant by “Remotely sensed ET products”? If I understood the paper correctly, only the land-cover type was determined by satellite measurements, but, as seems probable, did these also include the net radiation for use in the Penman-Monteith equation? But this would then be difficult for the heterogeneous land cover. It is impossible

C2

to discuss the underestimation of the fluxes by the Penman-Monteith equation without knowing the parameterizations used in this equation. E.g., the atmospheric resistance and the stomata resistance are extremely variable and should be included in any discussion.

Please also show in Fig. 2 the daily cycle of the evapotranspiration and not only the daily sum. This is necessary to indicate the energy exchange of the different sites, possible oasis effects, and the Bowen ratio. The latter may be a good indicator which to classify the sites.

Undoubtedly the authors have an interesting data set with a significant scientific potential. Such a data set should be published with a good scientific concept. Besides some deficits in the experimental design, the concept of area-averaged fluxes may be such a concept. But the paper needs significant improvements according to the points given above. Therefore I recommend major revisions.

Minor remarks:

The numbering of the figures is confusing. Figure 3 should be renamed as Fig. 1.

Table 1: The instrumentation (sonic anemometer, gas analyzer) is missing.

Table 2: Do not mix LAS type and LAS producer, please give both for all sites.

p. 6, line 21: What do the flags mean?

p. 6, line 23: Why did you use 2D-rotation and not planar fit? Was the terrain absolutely even?

p. 7, line 13: L can be easily misinterpreted as the Obukhov length in a micrometeorological paper.

Fig. 4 and 5: Why did you use different names or land cover types in both figures?

Fig. 6: Probably  $y$  has a lower accuracy than given in the figure!

C3

p. 16, line 11: The reference should probably be Fig. 3!

p. 17, line 12: This is trivial; when maize dominates the land cover it is normal that maize also dominates the ET.

Table 6: Give the units in the columns.

p. 19, line 16-25: Such a paper needs a well-written conclusion chapter and not only ten not very significant lines.

p. 22, line 13: Many authors are missing.

p. 22, line 18: Print CO<sub>2</sub>.

#### References

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London, New York, 85-131, 2012.

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