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Atmospheric Measurement Techniques Discussions

Interactive comment on "Uncertainty analysis of computational methods for deriving sensible heat flux values from scintillometer measurements" *by* P. A. Solignac et al.

Anonymous Referee #2

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The LAS is an upcoming measuring technique for the determination of area averaged sensible heat fluxes, which needs additional meteorological measurements for the exact flux determination. The paper has some interesting aspects which should be published, but it needs significant modification and a more precise presentation of the theory.

The presentation of the classical method is absolutely confusing. On the one hand you have an eddy-covariance system to determine the sensible and latent heat flux and with both you determine the Bowen ratio. On the other hand you determine with an indirect profile approach the friction velocity, while the eddy-covariance system mea-

sures this parameter more accurately. I guess that your classical method is a different one. For the determination of the Bowen ratio the classical Bowen-ratio system was used with temperature and moisture measurements in two levels. From the ratio of the temperature and humidity difference the Bowen ratio can be easily calculated. For this method no eddy covariance method is necessary and the "classical approach" is a possible way to calculate the sensible heat flux. This part must be reformulated: Either you use the "classical approach" or you use entirely eddy-covariance data – the mixture of both is not really comprehensible.

It is a good idea to include a correction term in the energy-balance equation with measured turbulence fluxes with the eddy-covariance method. The reviewer is not sure if the authors have understood the problem with all consequences (Foken 2008). But finally they distribute the energy of the coefficient gamma, according to the Bowen ratio, to the sensible and latent heat flux. It would be innovative to include the Bowen ratio into the iteration schema of Fig. 5. It would be interesting, if the Bowen ratio calculated from the sensible heat flux measured with the LAS differs from the flux with the Bowen ratio determined from the gradient "classical method" or from the eddy-covariance fluxes due to a non-existing scalar similarity. Because of the low measuring height, differences in the vertical flux distribution (Foken 2008; Meijninger et al. 2006) can be excluded for the presented measurements.

When you compare the equation for the Bowen ratio in both methods including the energy balance equation you can easily see that the results of both methods must be equal. It would be good to also explain this from the equations used.

In the paper a footprint analysis for the LAS (Meijninger et al. 2006) is necessary if wind directions from N to SE are excluded from the further analysis.

Nearly all processes in the surface layer are highly non-linear. Therefore you have to make all calculations on the basis of 10 to 30 minute values. The final results (fluxes, Bowen-ratio) you can average. It is not allowed to average the input parameter and then

determine the fluxes. It is not fully clear what the authors have done. But the question remains whether this is a useful way. The Bowen-ratio already changes during the day over vegetated surfaces. Each rain event or the drying of the upper soil layer changes the Bowen-ratio. Monthly Bowen ratios may be interesting from the climatological point of view, but not to correct highly accurate 30 minute measurements. This part should be cancelled from the paper.

Brief remarks:

- Use the eddy-covariance method instead of the eddy-correlation method (sometimes you do this) otherwise you should explain what you have measured.

- The Monin-Obukhov similarity theory describes the similarity between gradients and fluxes for non-neutral stratification (Foken 2006; Monin and Obukhov 1954). In the paper the relation between the sensible heat flux and the structure function is used - published by Obukhov (1960).

- 'Monin-Obukhov function' is not the usual name for a function. The functions of the Monin-Obukhov similarity theory are called the "universal function", but you do not use these.

- What are EC parameters – you probably mean fluxes determined with the eddy-covariance method.

- Twine et al. (2000) did not compare different eddy-covariance systems but data sets. For system comparison see e.g. Mauder et al. (2007).

- Please compare for moisture influence of the structure functions with Beyrich et al. (2005) as well.

- Why do you give the Obukhov length L (Obukhov 1946) the index MO?

- Why is the application of the classical method restricted to stable stratification? Only eq. (7) is used and not (6)!

- The use of the energy balance equation to determine the Bowen ratio is the classical Bowen-ratio method (Bowen 1926). This method has already been applied for various problems.

- Because the Bowen ratio is defined as the ratio of sensible to latent heat it must depend on the sensible heat flux!

- The former Webb-correction is currently called the WPL-correction.

- The paper by Halldin and Lindroth (1992) is an excellent one, but the devices discussed are not used any more. Due to the BSRN initiative (Ohmura et al. 1998) much work was put into this area. For your CRN1 see Kohsiek et al. (2007).

- Nowadays the latent heat flux is not systematically underestimated by sensor problems any more (Mauder et al. 2007).

- Eq. (9) gives the integrated form of the universal functions. Which functions (author!) did you use?

- The reference Beziat et al. given for the CARBOEUROPE measuring technology is a secondary one (Aubinet et al. 2000; Aubinet et al. 2003; Lee et al. 2004)..

- Billesbach et al. is probably not a general reference for the accuracy of eddy-covariance measurements. Is a reviewed paper of these authors available? Please use micrometeorological textbooks to apply the right terminology.

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