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An attempt to account for within-footprint heterogeneity in scintillometry

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Spatial variation in surface sensible heat fluxes is a critical factor in producing and modifying regional atmospheric circulations and has been a major subject of research during the past two decades. Nowadays remote sensing algorithms are widely used for estimating these spatially distributed surface fluxes. To validate these algorithms, ground truth data are required that are directly comparable to the flux estimates obtained from such algorithms. The increasing popularity of using a large aperture scintillometer (LAS) for doing so can be explained by both its ease of operation and relatively low cost as well as by its potential capability of obtaining spatially aggregated flux estimates. However, this validation exercise is not as straightforward as one may hope for, due to mainly two issues that are related to the spatial heterogeneity of the surface and thus the fluxes.

A first complication is due to the fact that although over homogeneous terrain this methodology has proven to provide accurate estimates of sensible heat it is also well-known that some problems of theoretical nature are faced when applying the scintillation technique over a heterogeneous surface.

Apart from these problems that are related to applying the scintillation technique over heterogeneous areas as such, a second problem relates to the direct comparison between the remote sensing-based and ground-based estimate of sensible heat flux. If the surface is heterogeneous, the signal measured by the sensor, the LAS in this case, depends on which part of the surface has the strongest influence on the sensor, and thus on the location and size of its so-called footprint. In most natural landscapes, the footprint will contain different landcover types and a successful interpretation of the measured fluxes will depend on an appropriate footprint model. Therefore the only useful comparison between remote sensing-based and ground-based estimates of sensible heat flux can be done by accounting for heterogeneity within the footprint.

In the current contribution a footprint-weighted approach is proposed to aggregate surface characteristics, taking into account within footprint heterogeneity by using information obtained through remote sensing. The approach will first be demonstrated versus existing methods using simulated data and will then be applied over a very heterogeneous test site. A discussion on the results will conclude the contribution.