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Effect of fetch length on latent heat flux data accuracy calculated by Bowen ratio energy balance method

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Bowen ratio energy balance (BREB) is one of the most widely used indirect methods for deriving latent heat (LE) and sensible heat fluxes. The BREB technique relies on net radiation, ground heat flux, and air temperature and humidity gradients measurements. Whilst the first two mentioned can be practically considered as point measurements, the source area of temperature and humidity gradients is at least one order of magnitudes larger. Therefore, the horizontal, homogeneous and extensive area is necessary prerequisite for correct flux determination by BREB method. An ideal fetch for BREB has been reported to be within 10 to 200 times the height of upper measuring level above zero plane displacement. This broad range is a result of different atmospheric stratifications and surface roughness, but the fetch to height ratio 100:1 has become generally acknowledged as a rule of thumb.
In this study, data from four different BREB systems above various covers (two poplar plantations, grassland and turf grass field) will be used to calculate and analyse LE for different fetches. Data were recorded in Domanínek near Bystřice nad Pernštejnem in Czech-Moravian highlands where two BREB systems have measured above poplar plantation and turf grass since summer 2008 until present and two more systems have been placed above grassland and another poplar plantation at the beginning of 2011 and have measured until present time.
During the measurements changing wind direction limited the fetch of particular BREB systems on the sites. That is why LE calculated for particular fetch lengths will be split into three categories - fetch classes (“good”, “medium”, and “bad”) according to prevailing wind direction and corresponding fetch. These categories will be delimited using the simple footprint model. Fetches with more than 75% of the measured entities coming from the area of interest will be considered as the “good” ones. The “medium” class will contain fetches with 50-75% of the flux data coming from the area of interest and the category “bad” embraces fetches with less than 50% of the LE from the area of interest.
Finally, the midday values of LE (measured between 10:00 and 14:00) for rainfree days will be normalized by reference LE based on Penman-Monteith equation and the analysis of variance will be used to find statistical relation between the normalized LE and fetch classes during particular 14 day long time periods. The aim of this study is to determine if there are statistically significant differences between LE calculated for different fetch classes during different time segments and under various environmental conditions, and to quantify the errors in LE resulting from the inadequate fetch.

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