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Gap filling strategy for Bowen ratio energy balance method

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The accurate determination of available energy partitioning between sensible (H) and latent heat (LE) fluxes is a crucial topic in micrometeorology with practical application and impacts in agriculture, forestry, landscape ecology and other related fields. Nowadays, these fluxes are usually measured with eddy covariance (EC) method, however other indirect methods can also provide satisfactory results for practical utilization. One of them is Bowen ratio energy balance (BREB) method, which is well known for its low demand in instrumentation and also because it has been well examined across various surfaces. As well as the EC method also BREB approach faces up specific limitations. These are linked mainly with the atmosphere stability, adequate fetch and of course with the accuracy of the individual probes. Due to these constraints some of the data have to be excluded which consequently causes difficulties in integrating the data into the longer period data series (e.g. daily sums of actual evapotranspiration). There are several procedures for quality control used around the world but not for filling the missing values which might considerably increase number of days with reliable estimates of water vapor fluxes. The main aim of this study is to compare several approaches used for gap filling. For their calibration, validation and comparison we used reliable and quality checked data of BREB measurements above different covers (reference lawn, short rotation coppice, winter wheat, spring barley and winter rape) situated at two experimental localities in the Czech Republic (Domanínek 49°32′ N, 16°15′ E, 530 m a.s.l. and Polkovice 49°23′ N, 17°17′ E, 205 m a.s.l.). Firstly, we used linear regression relationship between measured LE and potential LE estimated by common Penman equation to replace the missing values. Additionally, we operated with splitting the days into a few parts and analyzed them separately in order to obtain better results. Secondly, we tested Priestley-Taylor evaporation model with Priestley-Taylor coefficient α specifically calibrated for three types of situations with different directions of fluxes - namely I (LE>0, H>0), II (LE>0, H<0) and III (LE<0, H<0) - as another way how to create uninterrupted diurnal fluxes curves. Finally, we had taken advantage of modeling the stomatal conductance and establishing it in Penman-Monteith equation to receive LE which was used as a source for filling the missing data. To validate and compare these different strategies we randomly made artificially gaps in measured dataset and let them fill with mentioned different ways. The filled patterns were subsequently compared with the measured data and the most promising method for particular case was identified.

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