

EGU21-8919, updated on 06 Dec 2022

<https://doi.org/10.5194/egusphere-egu21-8919>

EGU General Assembly 2021

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A tool for evaluation of target area homogeneity at ecosystem stations employing eddy covariance method

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Our understanding of the carbon and water cycle was greatly improved through application of eddy covariance measurements in recent decades. Though powerful, this micrometeorological approach relies on a number of assumptions that can be affected by a selection of station location. Most importantly, terrain of the target area should be flat, target area should be homogeneous and adequate air mixing should be achieved. Although possible shortcomings can be reduced by careful site inspection before tower installation (flat terrain) or can be corrected for during data post-processing (filtering of periods with low mixing), preliminary assessment of target area homogeneity is difficult as well as correction of its impacts afterwards. The influence of such inhomogeneities can lead to a bias in the flux annual sums but also a bias in their relationships with environmental variables. Certain solutions were already proposed, but target area homogeneity was so far assessed only at a few selected sites. Here we aim to provide a suit of software tools that build on the existing software packages (REddyProc, Flux Footprint Prediction, openair, openeddy) and allow easy diagnosis of the situation at the given ecosystem station. We plan to provide directional analyses of variables of interest. This will allow to identify the wind sectors that show large deviations from the mean value of the whole target area. In a further step, we plan to combine footprint modeling with CO₂ and energy flux measurements and thus provide attribution of mean (weighted) fluxes to their source area. Based on the differences with the directional analyses we will assess whether the higher computational expenses of footprint modeling are justified and bring additional information. Finally, we plan to separate the target area to a limited amount of wind sectors and attempt separate gap-filling and flux partitioning for areas identified by preceding homogeneity evaluation. The limitations and feasibility of this approach will be assessed.

This work was supported by the Ministry of Education, Youth and Sports of CR within Mobility CzechGlobe2 (CZ.02.2.69/0.0/0.0/18_053/0016924).