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Chambers versus Relaxed Eddy Accumulation: an intercomparison study of two methods for short-term measurements of biogenic CO_2 fluxes

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The presented work is a part of comprehensive study aimed at thorough characterization of carbon cycle in the urban environment of Krakow, southern Poland. In the framework of this study two independent methods were employed to quantify biogenic CO_2 flux in the city: (i) closed chambers, and (ii) Relaxed Eddy Accumulation (REA). The results of a three-day intensive intercomparison campaign performed in July 2013 and utilizing both measurement methods are reported here.

The chamber method is a widely used approach for measurements of gas exchange between the soil and the atmosphere. The system implemented in this study consisted of a single chamber operating in a closed-dynamic mode, combined with Vaisala CarboCAP infrared CO_2 sensor in a mobile setup. An alternative flux measurement method, covering larger area is represented by REA, which is a modification of the eddy covariance method. It consists of a 3D anemometer (Gill Windmaster Pro) and the system collecting updraft and downdraft samples to 5-litre Tedlar bags. The CO_2 mixing ratios in the collected samples are measured by Picarro G2101i analyzer. The setup consists of two sets of bags so that the sampling can be performed continuously with 15-min temporal resolution.

A 48-hectares open meadow located close the city center was chosen as a test site for comparison of the two methods of CO_2 flux measurements outlined above. In the middle of the meadow a 3-metre high tripod was installed with the anemometer and REA inlet system. For a period of 46 hours the system was measuring net CO_2 flux from the surrounding area. A meteorological conditions and intensity of photosynthetically active radiation (PAR) were also recorded. In the same time, CO_2 flux from several points around the REA inlet was measured with the chamber system, resulting in 93 values for both respiration and net CO_2 flux.

Chamber results show rather homogenous distribution of the soil CO_2 flux (the mean value equal to 40.9 ± 2.2 mmol/m2h), with slight increase towards the city centre. Good agreement between the two measurement methods was obtained, with night-time flux ranging from around 10 to 80 mmol/m2h and day-time net flux reaching –88 mmol/m2h at peak PAR intensity. Positive correlation between the net CO_2 flux and intensity of PAR was also observed.

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