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# Advantages of measuring eddy covariance and soil respiration simultaneously in dry grassland ecosystems

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## Abstract

An automated open system for measurement of soil $CO_2$ efflux ($R_{sc}$) was developed and calibrated against known fluxes and tested in the field, while measuring soil respiration also by the gradient method ($R_{sg}$) at a dry sandy grassland (Bugac, Hungary). Ecosystem respiration ($R_{eco}$) was measured by the eddy covariance technique. While the correlationbetween ecosystem and soil $CO_2$ efflux rates as measured by the independent methods was significant, $R_{eco}$ rates were similar or even lower than $R_{sc}$ in the low flux (up to 2 $\mu$ mol$CO_2$ $m^{-2}$ $s^{-1}$) range, probably due to the larger than assumed storage flux. The gradient method showed both up and downward $CO_2$ fluxes originating from the main rooting zone after rains. Downward fluxes within the soil profile amounted to 15% of the simultaneous upward fluxes and to 7.6% of the total (upward) effluxes during a 3 months long measuring period. The continuously operated automatic open chamber system and the gradient system makes possible the detection of situations when the eddy system underestimates $R_{eco}$, gives the lower limit of underestimation (chamber system) and helps in quantifying the downward flux component of soil respiration (gradient method) between the soil layers. These latter (downward) fluxes are expected to seriously affect (1) the $R_{eco}$ vs. temperature response functions and (2) the net ecosystem exchange of $CO_2$ vs. photon flux density response functions, therefore potentially affecting also the gap filling procedures and to led to a situation (3) when the measured surface and the real time ecosystem fluxes will necessarily differ in the short term. Simultaneous measurements of $R_{eco}$ and soil $CO_2$ effluxes may reveal the time and degree of the above decoupling, thereby contributing to decrease uncertainty, associated with eddy flux measurements over flat terrains.

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