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Experimental evaluation of flux footprint by natural tracer experiment.

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Accuracy and representativeness of fluxes estimates by micrometeorological methods are strictly dependent on the spatial distribution and contribution of sources of the detected signal, whose study is generally referred to as the footprint analysis. Until now most part of the measurement has been carried out over surfaces homogenously extended for long distances, of the order of several hundreds of meters, following a general rule of thumb for which footprint of fluxes is extended up to 100 times the measurement height. This common practice prevented researchers from exploitation of micrometeorological techniques on smaller spatial scales.

We investigated the use of eddy covariance technique on very small plots and the effect of variable source areas on, mainly, CO2 fluxes above an oats crop canopy. One system has been installed on a reference plot with vegetation surface of 30m radius, two other identical systems have been placed at two heights above a crop surface identical to the reference one, whose extension has been progressively reduced by mowing. This experimental setup allowed estimation of the contribution to the measured flux signal coming from areas close to the measurement point and a statistical comparison with unperturbed signal.

Results indicate that a significant part of the flux signal come from a very small area surrounding the measurement system. According to the theory and model simulations the footprint is reduced with lower measurement heights, but source area extension as indicated by first results is surprisingly small compared to all models predictions, analytical or numerical, for both measurement height: most part of the turbulent fluxes seems to be generated from distances lower than 15 times the measurement height, or less if we consider measurements very close to the canopy top.

Turbulence statistics profiles have been measured above vegetated and mown surfaces to provide data input for Lagrangian stochastic simulation, while comparison with analytical models already confirmed the apparent overestimation of footprint simulations.

With this investigation we want to test the reliability of common micrometeorological techniques in extremely small spatial scale and to evaluate how close to the surface we can realize measurement of turbulent exchange: in particular we are interested in understand if this can effectively help us decreasing the sensors footprint, without significant loss in sampling accuracy.