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Uncertainties in surface mass and energy flux estimates due to different eddy covariance sensors and technical set-up

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Eddy covariance is a well established and widely used methodology for the measurement of turbulent fluxes of mass and energy in the atmospheric boundary layer, in particular to estimate CO2/H2O and heat exchange above ecologically relevant surfaces (Aubinet 2000, Baldocchi 2003). Despite its long term application and theoretical studies, many issues are still open about the effect of different experimental set-up on final flux estimates. Open issues are the evaluation of the performances of different kind of sensors (e.g. open path vs closed path infra-red gas analysers, vertical vs horizontal mounting ultrasonic anemometers), the quantification of the impact of corresponding physical corrections to be applied to get robust flux estimates taking in account all processes concurring to the measurement (e.g. the so-called WPL term, signal attenuation due to air sampling system for closed path analyser, relative position of analyser and anemometer) and the differences between several data transmission protocols used (analogue, digital RS-232, SDM). A field experiment was designed to study these issues using several instruments among those most used within the Fluxnet community and to compare their performances under conditions supposed to be critical: rainy and cold weather conditions for open-path analysers (Burba 2008), water transport and absorption at high air relative humidity conditions for closed-path systems (Ibrom, 2007), frequency sampling limits and recorded data robustness due to different transmission protocols (RS232, SDM, USB, Ethernet) and finally the effect of the displacement between anemometer and analyser using at least two identical analysers placed at different horizontal and vertical distances from the anemometer.

Aim of this experiment is to quantify the effect of several technical solutions on the final estimates of fluxes measured at a point in the space and if they represent a significant source of uncertainty for mass and energy cycle studies at different temporal and spatial scales.