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Use of the daily differencing approach to evaluate uncertainties affecting eddy covariance measurements

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The eddy covariance technique is recognised to be the most adapted micrometeorological method to study the exchange processes between terrestrial ecosystems and the atmosphere. Like all other methods, it is submitted to systematic and random measurement errors. A thorough analysis of these errors is necessary in order to set the limits of validity of the method and to quantify the uncertainty that affects net carbon exchange computed with this method.

In this presentation, we'll concentrate on the random errors using the daily-differencing approach (DDA) developed by Hollinger and Richardson (2005). The interest of this approach is that it requests only single tower measurements and is thus applicable to all flux tower sites. In this approach, uncertainties are estimated by comparing flux values taken at two successive days at the same hour and under similar meteorological conditions. The analysis may be applied to sensible heat, latent heat and CO_2 flux densities. It was applied here to the eddy-covariance data from the Vielsalm mixed forest site (10 years of data) and from the Lonzée agricultural site (4 years of data). Both sites are situated in Belgium and are part of the Carboeurope IP network. The study is developed in the frame of the European IMECC project.

The absolute and relative random error was quantified for both sites. Their daily evolution and their dependencies on different climate conditions (magnitude of the flux, PPFD, Rnet, wind velocity, wind direction, clarity index) were analysed. For both sites, the absolute random error increases linearly with the absolute value of flux. This

is the principal factor controlling the random error. More particularly the response of the random error to wind velocity was analysed. For the CO_2 flux, the absolute random error decreases with increasing wind speed. This effect is more important for the agricultural site than for the forest site. The behaviour of the relative random error with wind speed is more contrasted: it generally decreases with increasing wind speed at low velocities but, for some directions may increase with wind speed at high velocities. In addition, the random error was found very dependent on wind direction at the forest site probably as a result of site heterogeneity.