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Comparisons of turbulent fluxes measurements over crops estimated with 2 independent Eddy Covariance set-ups and uncertainties..

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This study aims to evaluate the quality of surface turbulent flux measurements, estimated with the Eddy Covariance method (EC) on two agricultural sites in southwestern France. These two sites, namely Lamasquère (FR-Lam) and Auradé (FR-Aur) belongs to the ICOS ERIC (www.icos-ri.eu) and are fully equipped according to the ICOS standards. During the last five years (2012-2017), two independent Eddy Covariance devices (closed-path and open-path) were run in parallel to measure the turbulent fluxes of sensible and latent heat, and net CO_2 fluxes. The differential design, deployment and data post-processing of open- (OP) and closed-path (CP) eddy covariance systems is a potential source of bias for ongoing global flux synthesis activities.
Therefore, this study analyzes the variability of the turbulent flux estimates with the 2 set-ups and their sensitivity to different instrumental and environmental factors. It also tackles the consequences of these differences on a long-term basis, e.g. on annual carbon and energy budgets. Measurements of the sensible heat flux (H) and net CO_2 flux (NEE) show good agreement between the two EC devices whereas substantial differences could be observed for the evapotranspiration term (LE). Potential causes of these systematic discrepancies are investigated related to sensor monitoring and data processing. We evaluated the sensitivity of the measured turbulent fluxes to 1) instrumental parameters such as sensor fouling, sensor calibrations and drift, 2) to environmental parameter like high relative air humidity or lower air temperature conditions and eventually 3) to data processing. Eventually, an estimate of the uncertainties associated with the two devices is also presented.