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Uncertainty in eddy covariance flux estimates of CO_2, water vapor and energy, related to post-field data processing

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The Eddy Covariance (EC) method is one of the most direct, defensible ways to measure turbulent fluxes within the atmospheric boundary layer. However, the knowledge of errors and uncertainties related to CO_2 and energy flux estimates by EC is still an outstanding issue to be solved (Richardson et al. (2006); Papale et al. (2006); Mauder et al. (2007)). Among the sources of these uncertainties, the one deriving from the post-field data processing has been rarely addressed, though suspected to be crucial (e.g. Massman and Lee, 2002). Estimating CO_2 and energy fluxes from raw wind, temperature and gas concentration data with the EC method implies a remarkably long sequence of operations, including calibrations, corrections, unit conversions and statistical screening for quality check and assurance. Various attempts have been made to standardise the processing methodology (e.g. Aubinet et al., 2000). However the correct application, order and sometimes meaning and consequences of several processing steps are still topics under discussion. As a result, EC processing software available to the community feature different implementations: some operations are not supported by some software, while other are implemented in different ways even when they reflect the same conceptual assumptions (Mauder et al. (2007) and evidences in the present work). In addition, many research groups use custom software that may include further corrections suggested by recent findings. Different data treatments may largely affect the consistency and inter-comparability of flux data produced by different groups and prevent a confident use of eddy fluxes on the regional, continental and global scale, e.g. in the Fluxnet synthesis activities or in the bio-geochemical models parameterization and validation. As a matter of fact, nowadays different groups contributing to carbon databases use different post-field processing schemes and this situation is likely to last in the forthcoming future. In this work we want to investigate the uncertainty that this practise introduces in the overall picture of carbon cycle assessment and suggest uncertainty estimates to consider when the exact processing scheme applied to the filed-data is unknown.

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