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Technical note: Flagging inconsistencies in flux tower data

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Abstract

Global collections of synthesized flux tower data such as FLUXNET have accelerated scientific progress beyond the eddy covariance community. However, remaining data issues in FLUXNET data pose challenges for users, particularly for multi-site synthesis and modelling activities.

Here, we present complementary consistency flags (C2Fs) for flux tower data, which rely on multiple indications of inconsistency among variables, along with a methodology to detect discontinuities in time series. The C2F relates to carbon and energy fluxes, as well as to core meteorological variables, and consists of the following: (1) flags for daily data values, (2) flags for entire-site variables, and (3) flags at time stamps that mark large discontinuities in the time series. The flagging is primarily based on combining outlier scores from a set of predefined relationships among variables. The methodology to detect break points in the time series is based on a non-parametric test for the difference in distributions of model residuals.

Applying C2F to the FLUXNET 2015 dataset reveals the following: (1) among the considered variables, gross primary productivity and ecosystem respiration data were flagged most frequently, in particular during rain pulses under dry and hot conditions. This information is useful for modelling and analysing ecohydrological responses. (2) There are elevated flagging frequencies for radiation variables (shortwave, photosynthetically active, and net). This information can improve the interpretation and modelling of ecosystem fluxes with respect to issues in the driver. (3) The majority of long-term sites show temporal discontinuities in the time series of latent energy, net ecosystem exchange, and radiation variables. This should be useful for carefully assessing the results in terms of interannual variations in and trends of ecosystem fluxes.

The C2F methodology is flexible for customizing and allows for varying the desired strictness of consistency. We discuss the limitations of the approach that can present starting points for future developments.

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