

Unlocking the potential of eddy covariance data with the R software package openeddy

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<https://github.com/lsigut/openeddy>

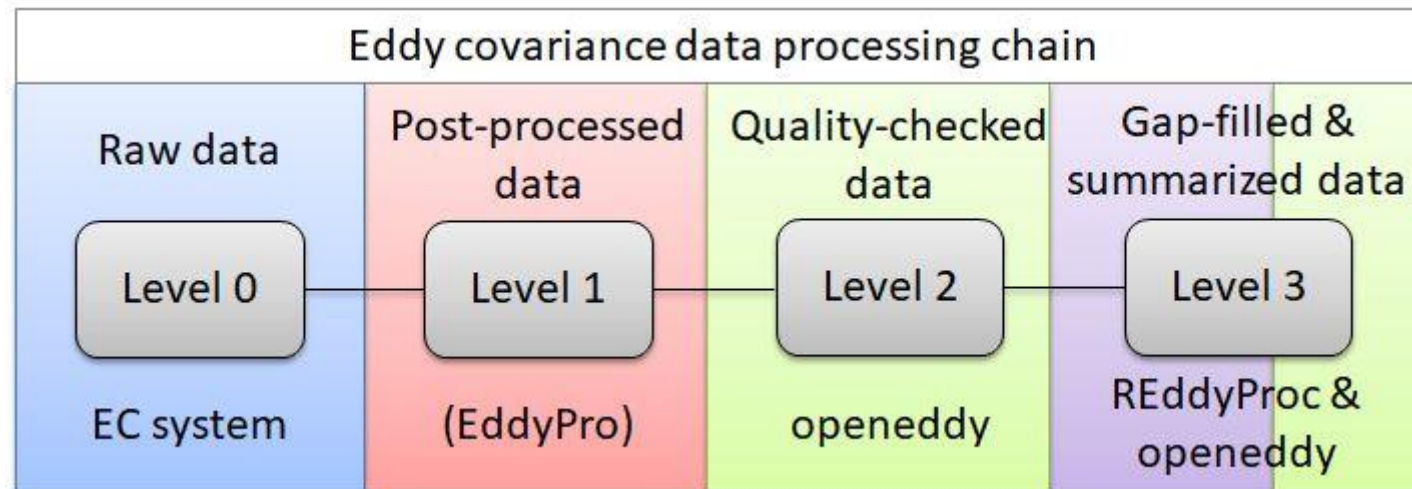


Why openeddy?

- Data post-processing can take substantial amount of time
 - hindering FLUXNET submissions, producing papers
- Need to assess and quality check all four fluxes (Tau, H, LE, FCO₂)
 - often subjective, not scalable
- Difficult to assess data effectively across different timescales
 - plotting resolution/aggregation

Principles

- [Complete processing chain](#) currently tuned to EddyPro and REddyProc
 - loading EddyPro output and then working solely in R environment
 - incorporation of additional routines for computing wind roses, footprints, storage, spectral analysis, ...
 - stop bothering about the practicalities of the processing implementation

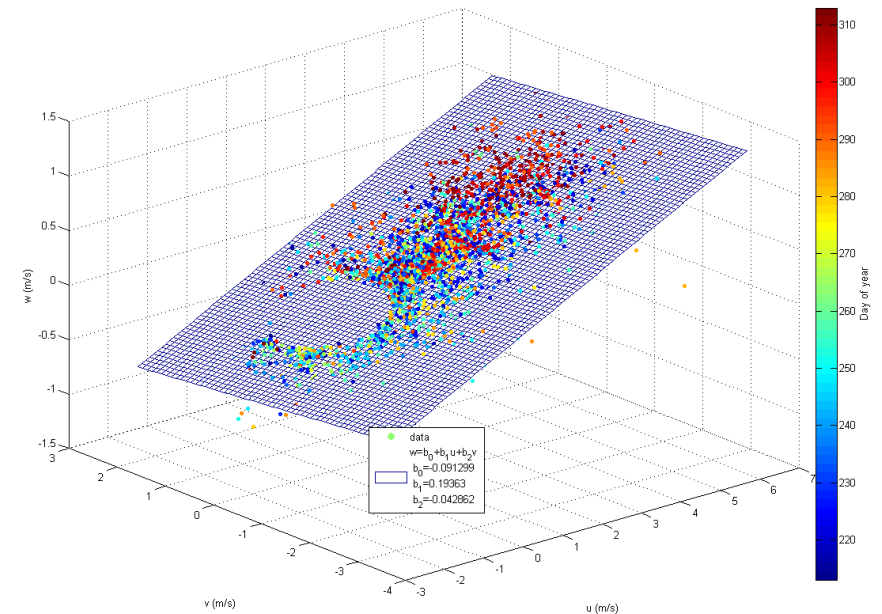


Quality control (QC)

- Separating to multiple substeps checking different aspects of data
 - typically order-dependent steps
 - predefined set of tests/filters free to adapt for given site
 - process documented by adaptable [workflow scripts](#) and QC summaries
- Visual check of flagging results - check the effect on the data
 - “flagging effectivity”: data exclusion % vs. uncertainty increase or degree of change in aggregated fluxes

Available tests/filters

- Steady state test & test of integral turbulence characteristics (SSITC)
- Plausibility limits (abslim)
- Threshold for spike percentage in 30 mins (spikesHF)
- Threshold for missing data in 30 mins (missfrac)
- Threshold for spectral correction factor (scf)
- Mean w residual after planar fit (wresid)
- Flux interdependency (interdep)
- Outlier removal (spikesLF)
- Fetch filter (fetch_70)
- User defined thresholds for a variable (thr)
- User defined data exclusion periods (man)
- Runs with repeating values (runs)



Naming strategy in openeddy

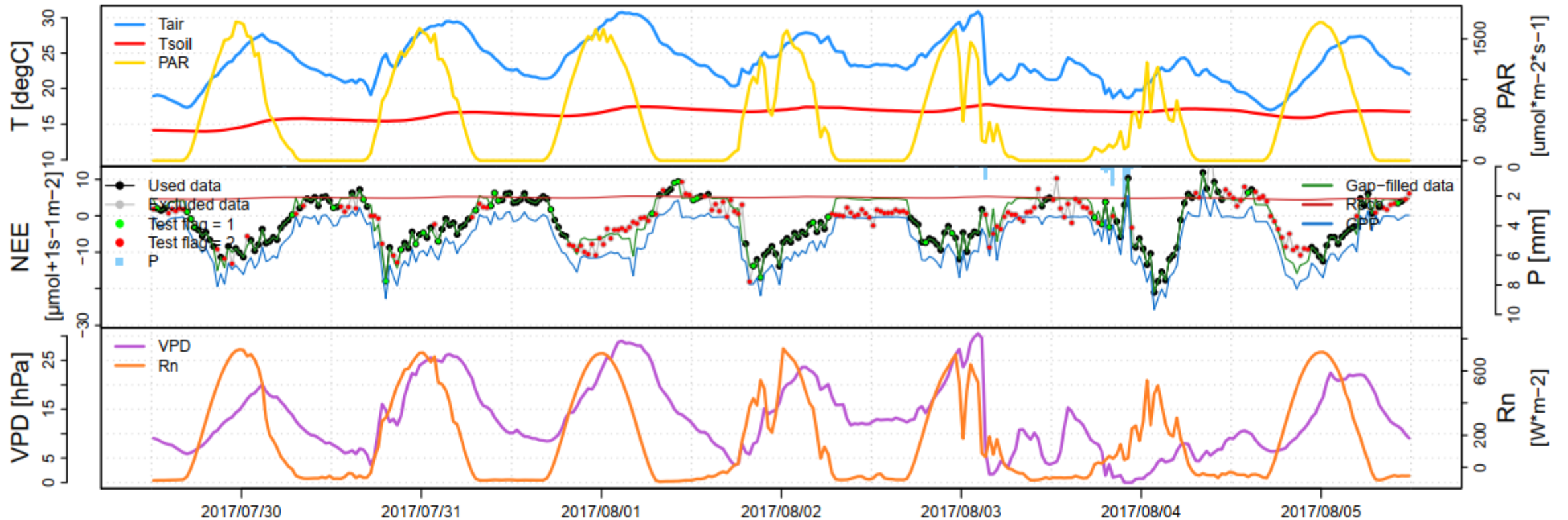
qc prefixes

- specify which flux is affected by that QC output
- qc_Tau, qc_H, qc_LE, qc_NEE: only applicable for the respective flux
- qc_SA: applicable to fluxes relying only on sonic (Tau, H)
- qc_SA_IRGA: applicable to fluxes relying both on sonic and IRGA (LE, NEE)
- qc_ALL: applicable to all fluxes

qc suffixes

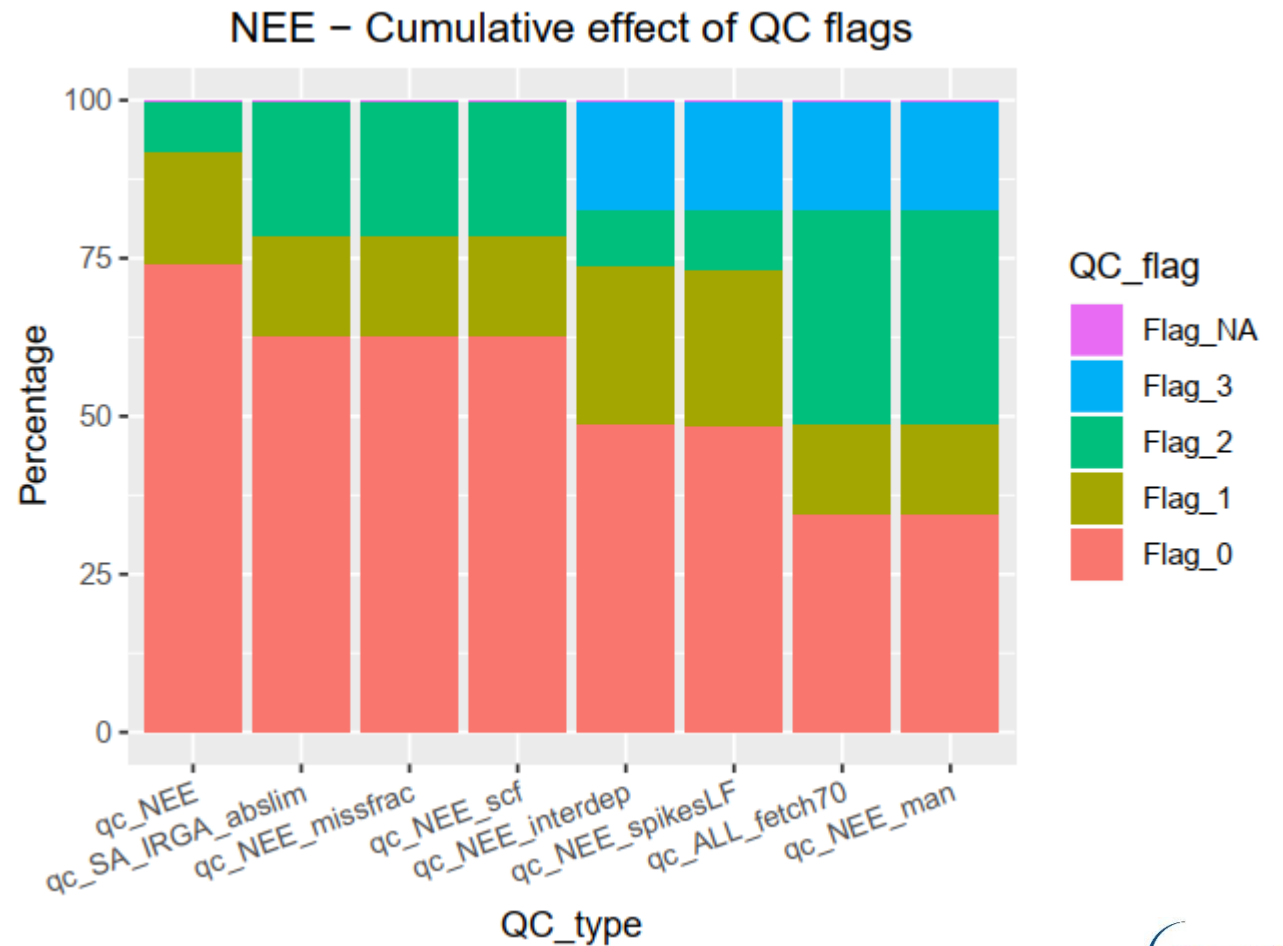
- specify which QC test/filter was applied to get the QC flags
- QC tests/filters relevant for given flux can be then combined
 - allows QC variants for different applications
(e.g. FLUXNET submission, fundamental reasearch, budgeting)

See data in perspective – plot_eddy()



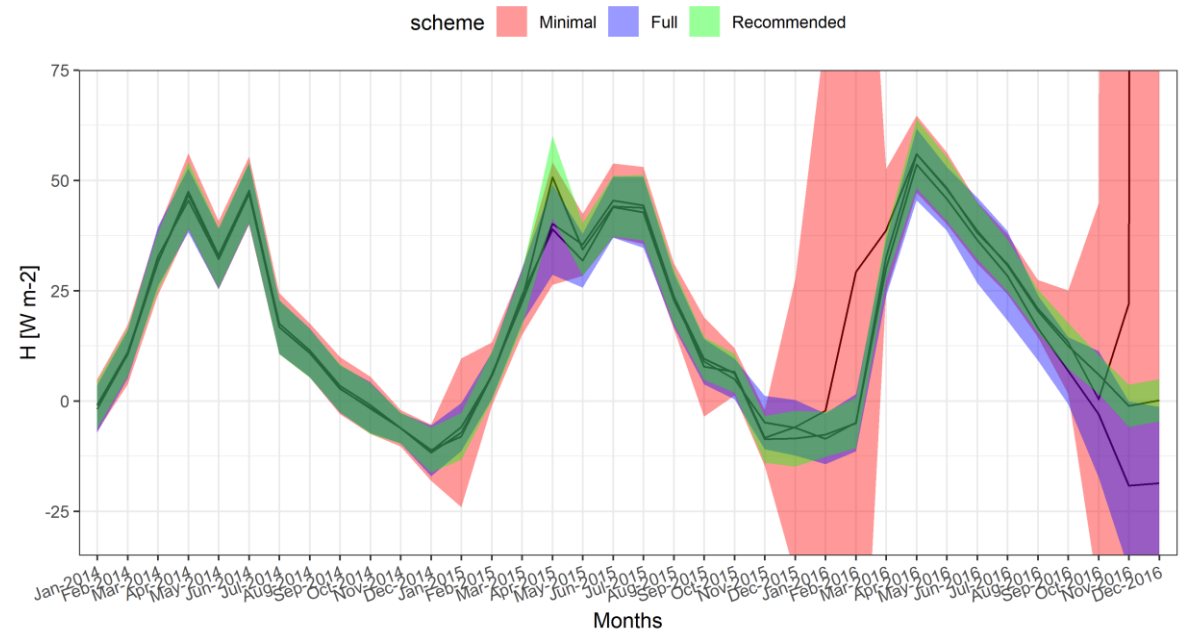
QC summary of all fluxes

- reads from left to right
- see how much each test refined the resulting QC
- only flags 0 and 1 are used



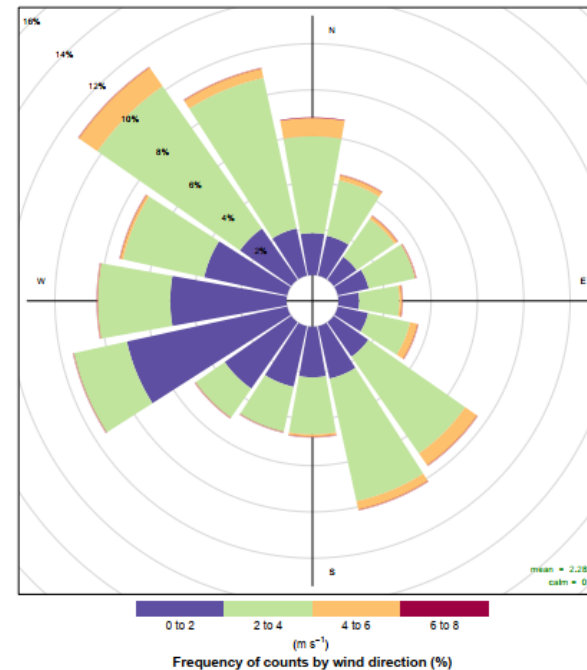
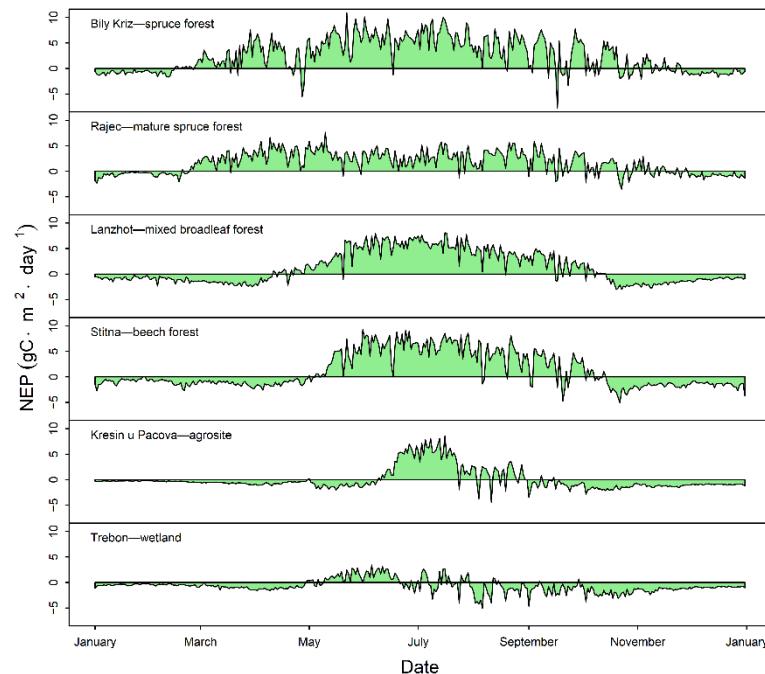
Flagging effectivity

- Monthly means of sensible heat flux and its uncertainty for a beech forest site in 2014-2016
- Applying only minimal QC scheme (SSITC test) does not appear sufficient
- Using all available tests can lead to high exclusion fraction and increased uncertainty



Dataset summary

- After gap-filling with REddyProc: aggregation of key variables and their uncertainties on different timescales (daily, monthly, yearly, ...)



Conclusions

- Predefined tests/filters simplify QC process and allow flexibility
- Proposed QC scheme can help to identify reasons for reduced quality of given eddy covariance setup
- Package openeddy offers a variety of general tools suitable for processing of regularly collected data (time series)
 - application not limited to eddy covariance data
- Automation saves time, provides richness of auxiliary data and helps to see data in different perspectives

Lookout

- Possibility to consider additional data quality issues over time
- Connecting other free software to the processing chain
- Looking forward to contributions from the community

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