fluxible: an R package to process ecosystem gas fluxes from closed-loop chambers in an automated and reproducible way

J Gaudard[1], J Chacon-Labella[2,3], H R Dawson[4,5], B J Enquist[6], R J Telford[1], J P Töpper[7], J Trepel[8], V Vandvik[1], M Baumane[9,10], K Birkeli[1], M J M Holle[11], J R Hupp[12], P E Santos-Andrade[13], T W Satriawan[14], A H Halbritter[1]

plant-functional-trait-course.github.io/fluxible
joseph.gaudard@pm.me
@jogaudard.bsky.social
0000-0002-6989-7624

A proxy for ecosystem balance

Ecosystem gas fluxes allow to measure the balance of an ecosystem in a non destructive way. In particular, carbon fluxes measurements are used to assess ecosystem carbon storage. They are widely used to study the effects of global changes on ecosystem functioning. These data are crucial to understand ecosystem responses to future climate, compare landscapes and biomes, and to train land surface models.
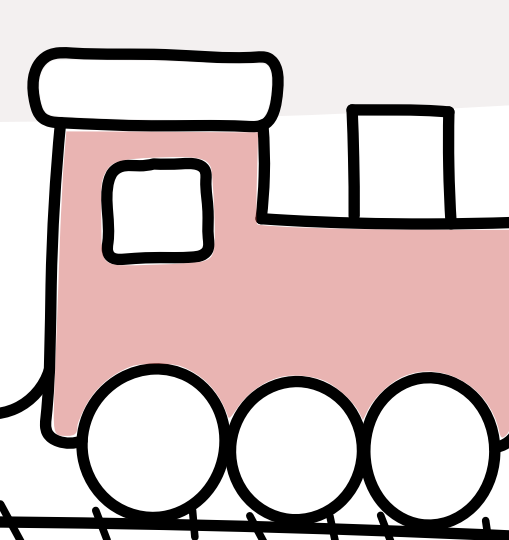
Mine of raw data from field measurements

flux_match()

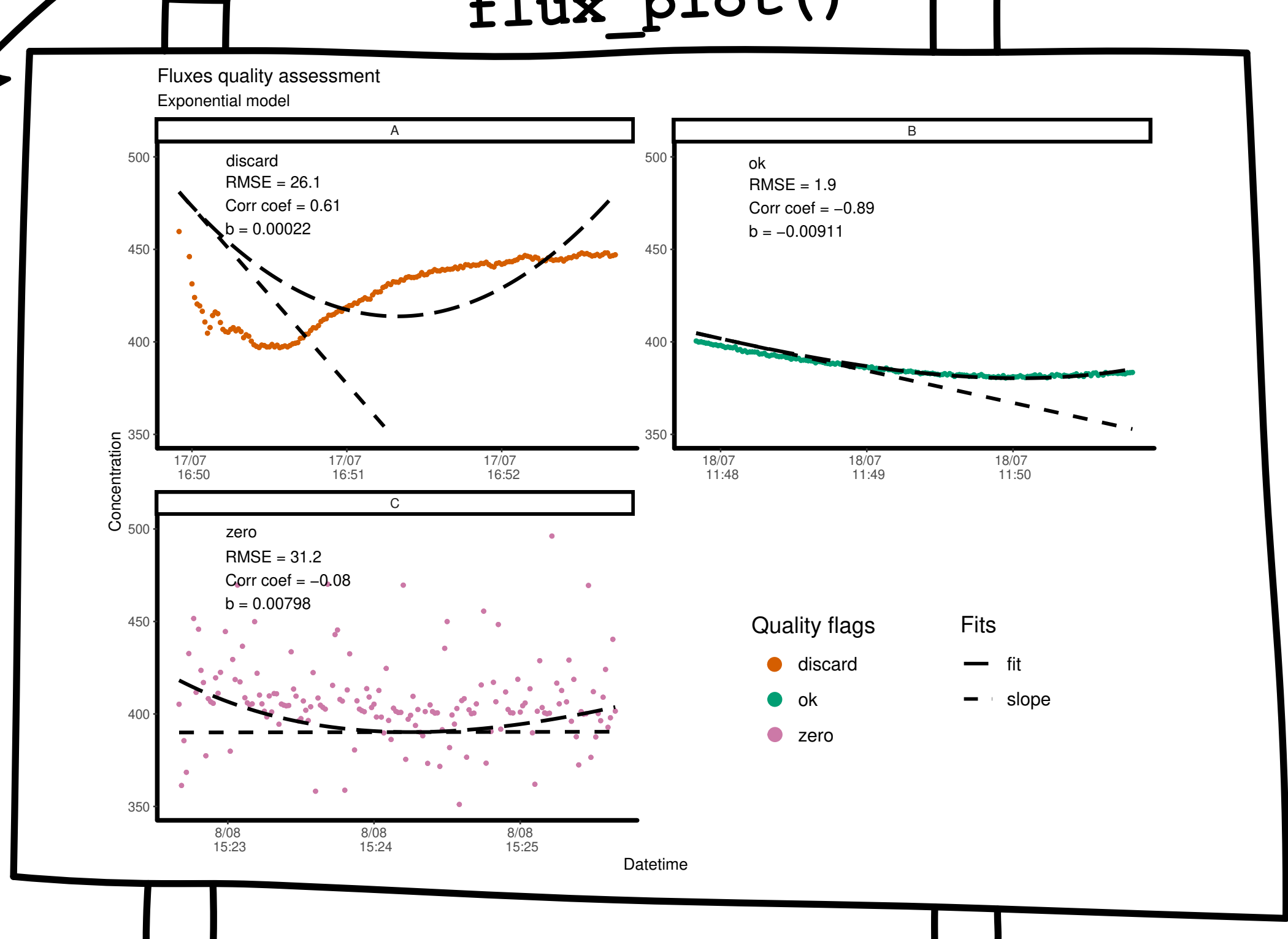data fluxID data fluxID data fluxID

flux_fitting()

The need for reproducibility

Gas fluxes are calculated data from measured changes in gas concentration over time. These calculations typically involve manual steps or user-prompted decisions, which is not reproducible and may be prone to bias. This lack of homogeneity and reproducibility is an issue when comparing datasets or collaborating at a large scale. There is therefore a need for a widely applicable and reproducible method for cleaning and calculating ecosystem gas fluxes. **The fluxible R package** provides such a method, and is more time efficient by automatizing most of the processes.

Troll of cherry picking

Avalanche of data overwhelm

Dangerous mountains of manual flux modelling
- Non reproducible
- Time consuming

Peaceful meadow of automatically fitted fluxes

flux_quality()

User's assessment

flux_plot()

Fluxes quality assessment
Exponential model

A
discard
RMSE = 26.1
Corr coef = 0.61
b = 0.00022

B
ok
RMSE = 1.9
Corr coef = -0.89
b = -0.00911

C
zero
RMSE = 31.2
Corr coef = -0.08
b = 0.00798

Concentration

Quality flags
● discard
● ok
● zero

Fits
— fit
-- slope

Datetime

Desired quality?

flux_fitting(cuts, other fit)

From raw gas concentrations to fluxes in five steps

flux_match	attribute meta data and unique ID to each measurement
flux_fitting	fit a model (linear, exponential or quadratic) to the data and obtain the slope for each flux
flux_quality	obtain diagnostics on the fits quality
flux_plot	visually assess and check the fits
flux_calc	calculate the fluxes

Clean fluxes

flux_calc()

Analysis

Bottom-less pit of manual calculations

Supporting infrastructure

flux_drygas	wet air correction
flux_flag_count	summarises quality flags
flux_diff	difference between paired fluxes
flux_lrc	light response curves for CO_2 fluxes
licoread R package	imports LI-COR gas analysers raw data in R as fluxible-friendly dataframe

The **fluxible R package** aims to:
- bridge the reproducibility gap in the cleaning method of raw field measured flux data
- increase compatibility between datasets
- provide an efficient, flexible and user-friendly workflow.

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