Eddy covariance and CRDS based techniques of GHGs measurements provide additional constraint in partitioning the net ecosystem exchange

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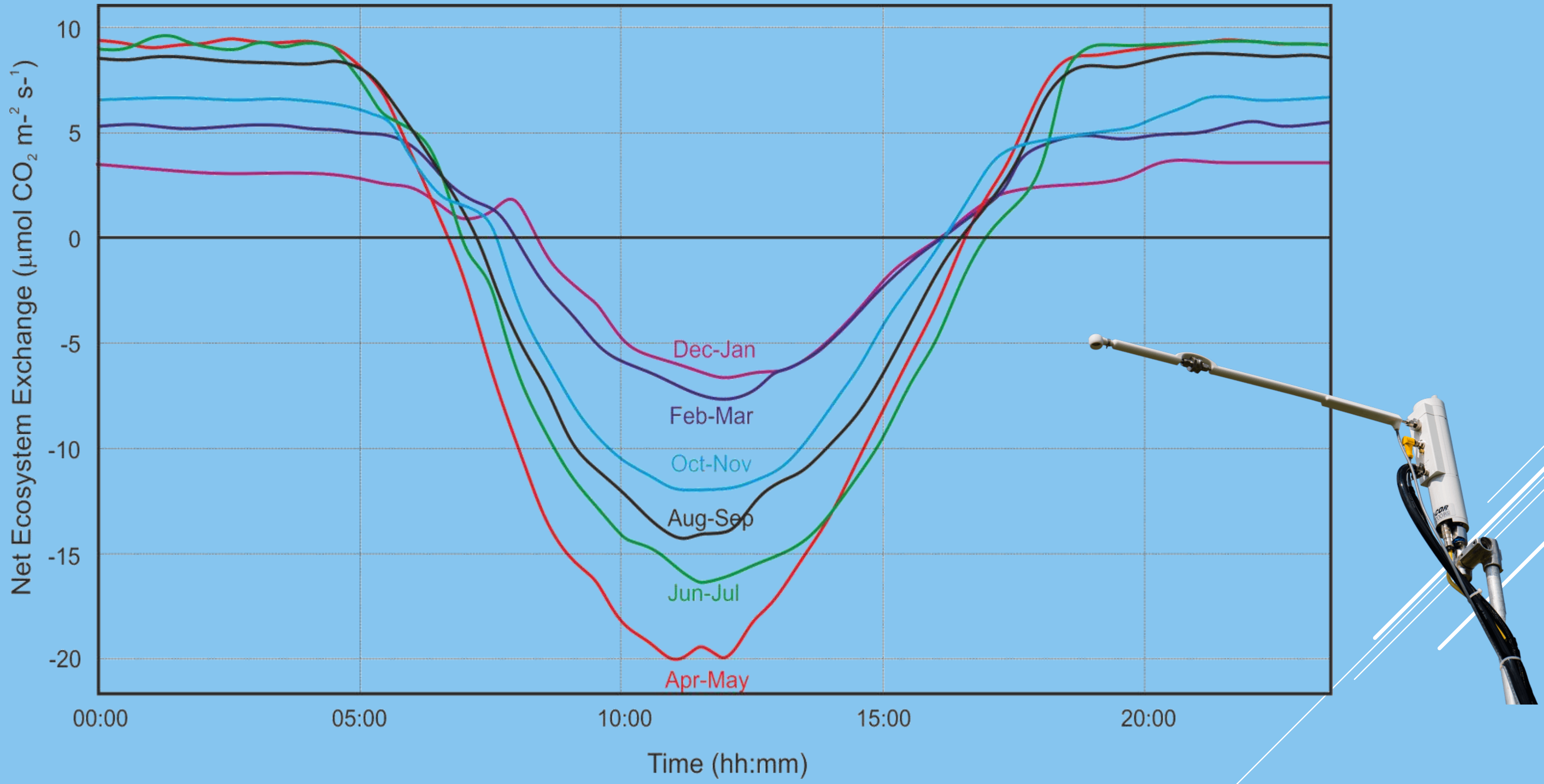
Eddy-covariance based CO_2 flux estimation in north-east India

Kaziranga National Park (KNP)



IRGA Sensor; Licor 7200 measures CO2 and water vapor fluxes

Diurnal variation of the Net Ecosystem Exchange on a seasonal timescale at the KNP, India

Sarma et al. 2018, Deb Burman et al. 2019

Partitioning of the CO_2 fluxes into photosynthetic and respiration components

$$NEE = R_{eco} + R_A$$

R_{eco} = eco-system respiration

R_A = photo-synthetic uptake of carbon

<u>Problems in flux partitioning</u>

NEE is small in comparison to its component fluxes.
Partitioning of two components from one equation -> ill-posed problem.

Objective

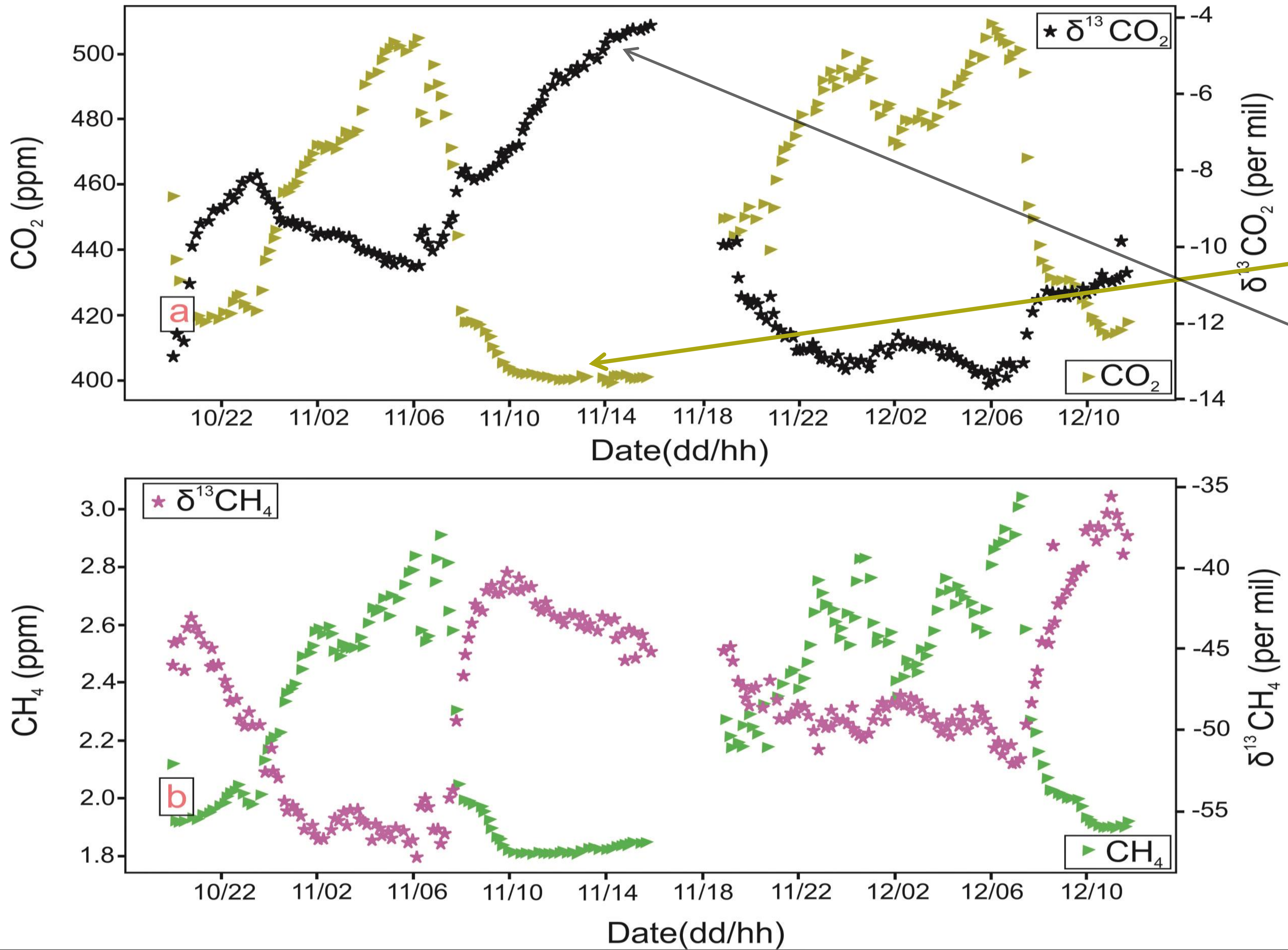
Hence, it is required to parameterize the one term and then estimate the other one.

Real-time GHG analyzer

Picarro 2201-*i* CO_2-CH_4 Analyzer was used to get the following parameters:

$[CO_2]$, [CH4], $\delta^{13}C_{CO2}$, $\delta^{13}C_{CH4}$
(1 Hz frequency)

In association with the IRGA CO_2 data (10 Hz)
$\delta^{13}C_{CO2}$ was calculated
(at 10 Hz frequency).



Photosynthetic uptakes reduces CO_2 and increase $\delta^{13}C_{CO2}$

CH_4 and $\delta^{13}C_{CH4}$ (10 min averaged)

Calculation of " isoflux"

$$\boldsymbol{isoflux = \rho\overline{w'(\delta^{13}C_aC)'} + \rho\frac{d(\delta^{13}C_aC)}{dt} = \delta^{13}C_RF_R + F_A(\delta^{13}C_a - \Delta)}$$

(I) (II) (III) (IV)

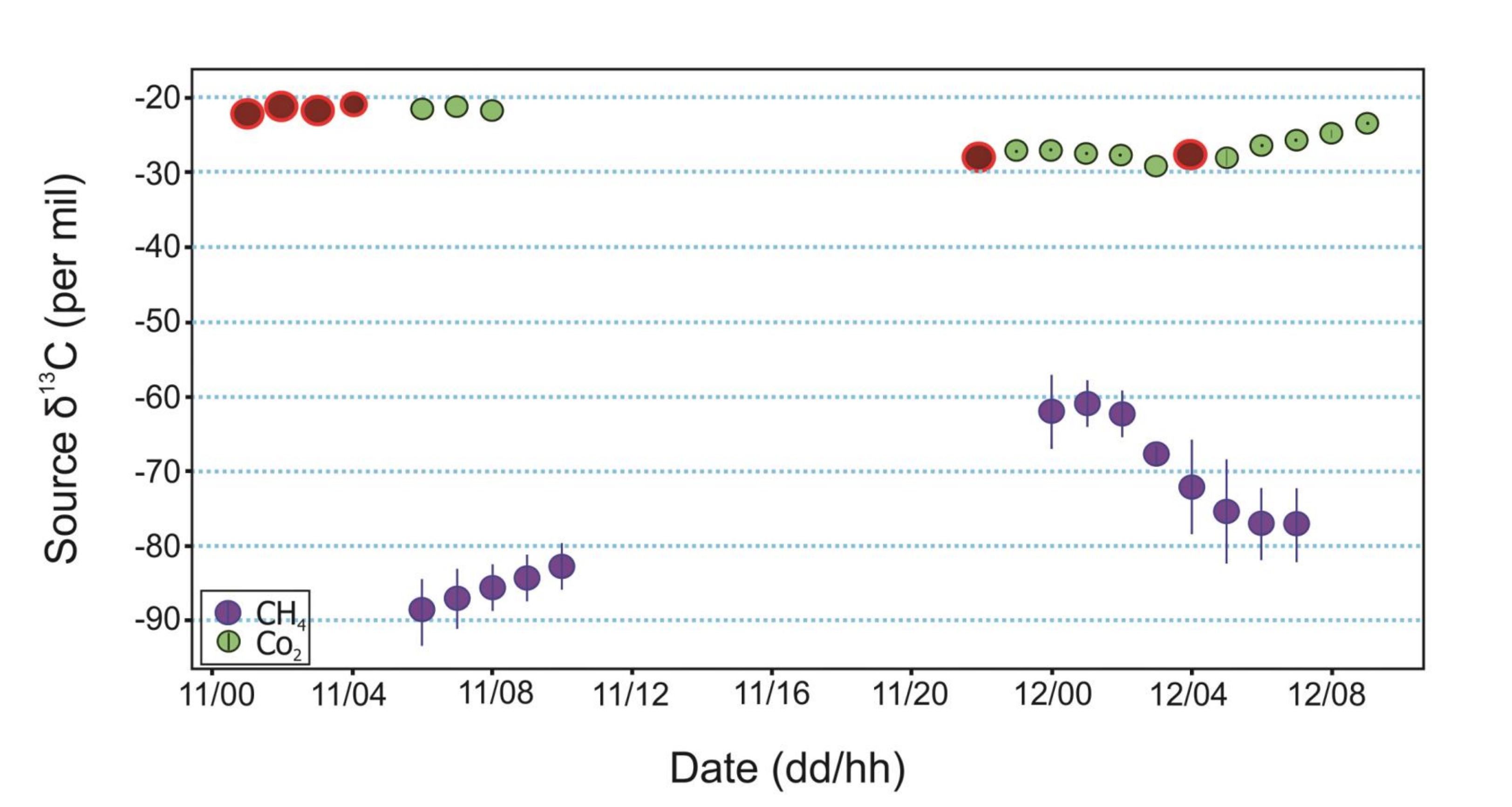
Isoflux = eddy isoflux (term I) + storage isoflux (term II).

(term III) denotes total ^{13}C added to the atmosphere by respiration and

(term IV) presents total ^{13}C removed from the atmosphere by photosynthesis.

Δ denotes the mean carbon isotope discrimination by the canopy.

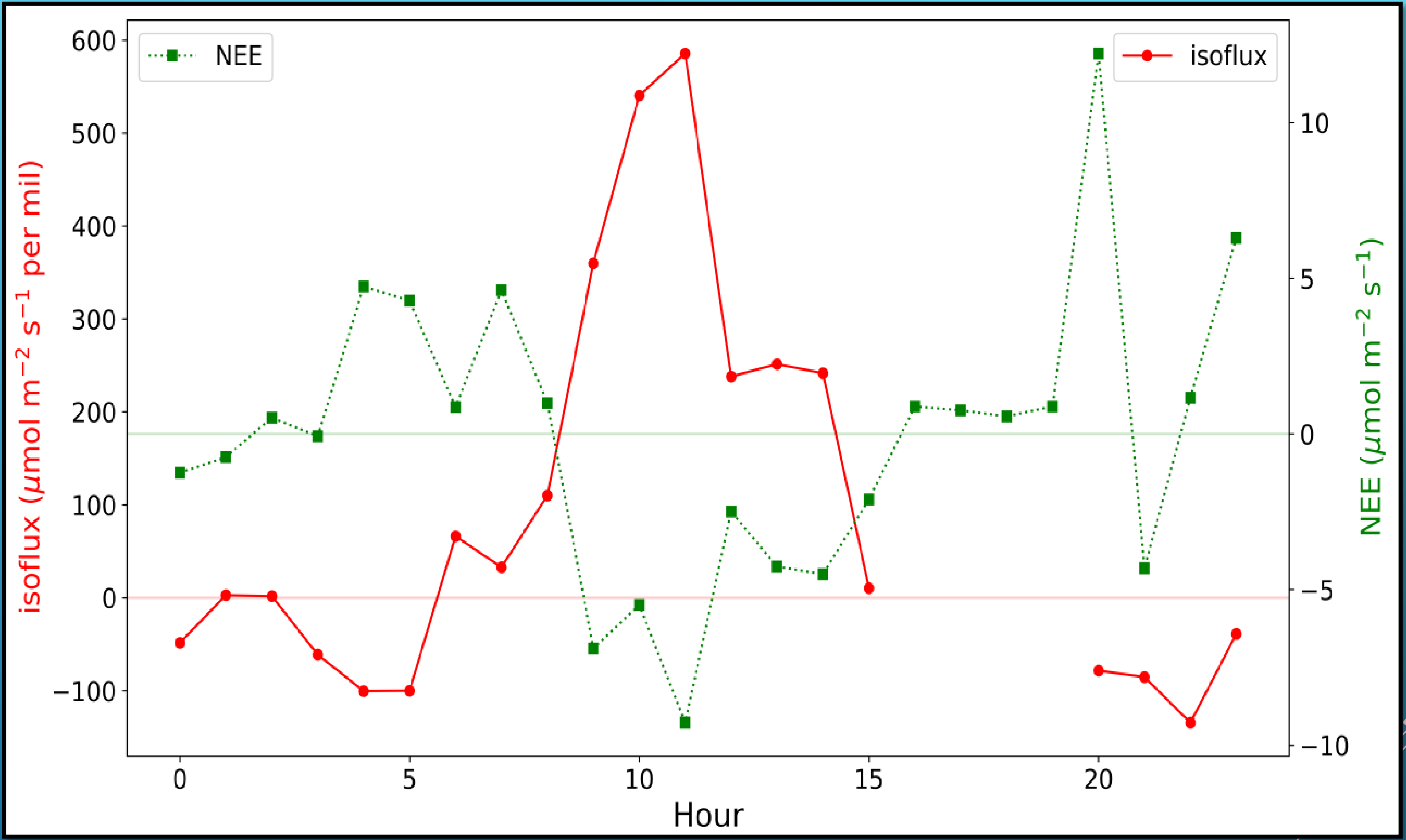
Identifying the source signature



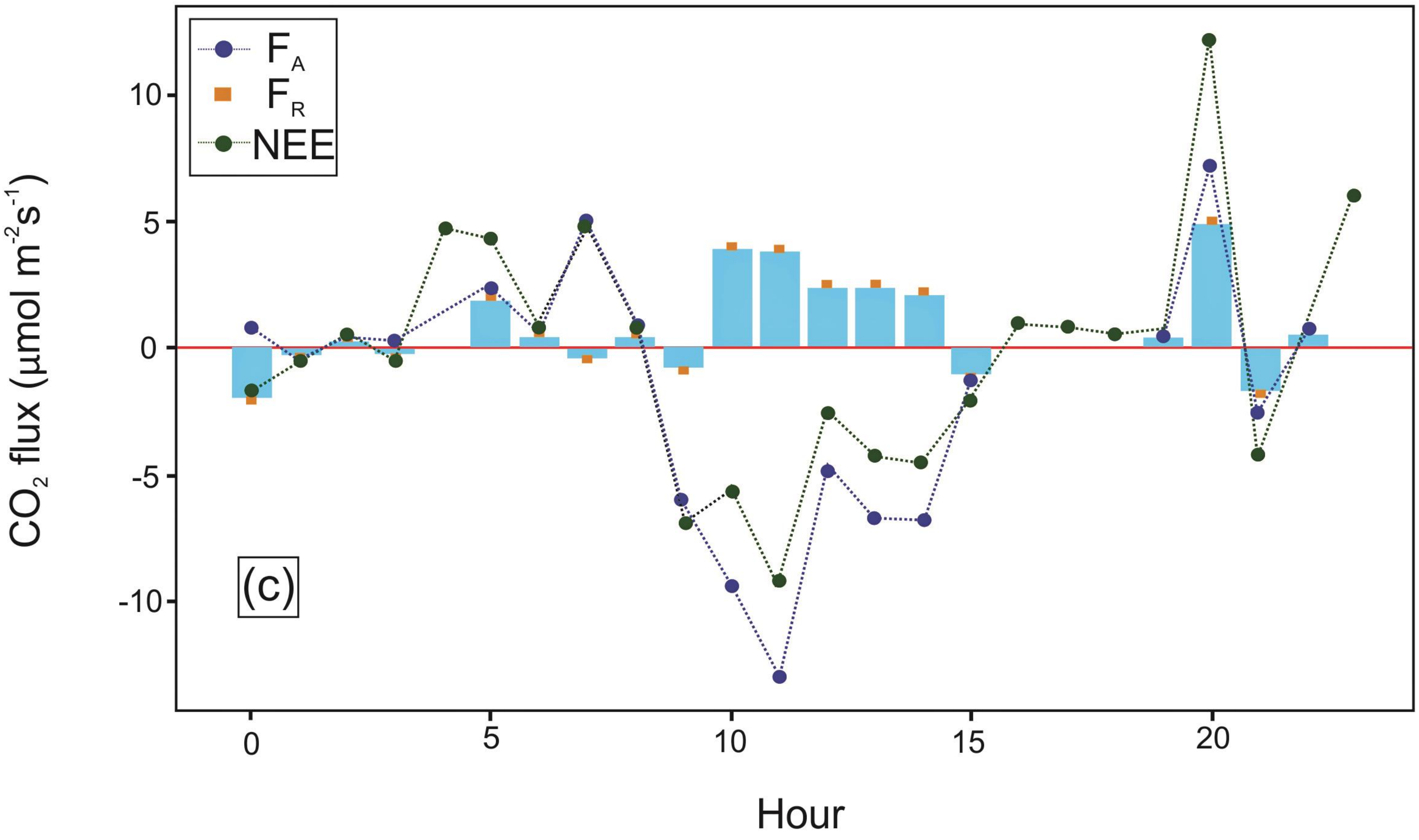
Moving Miller and Tans plot.

Green and red solid circles denote source signature for CO_2.

Blue circles present the source signature for CH_4.

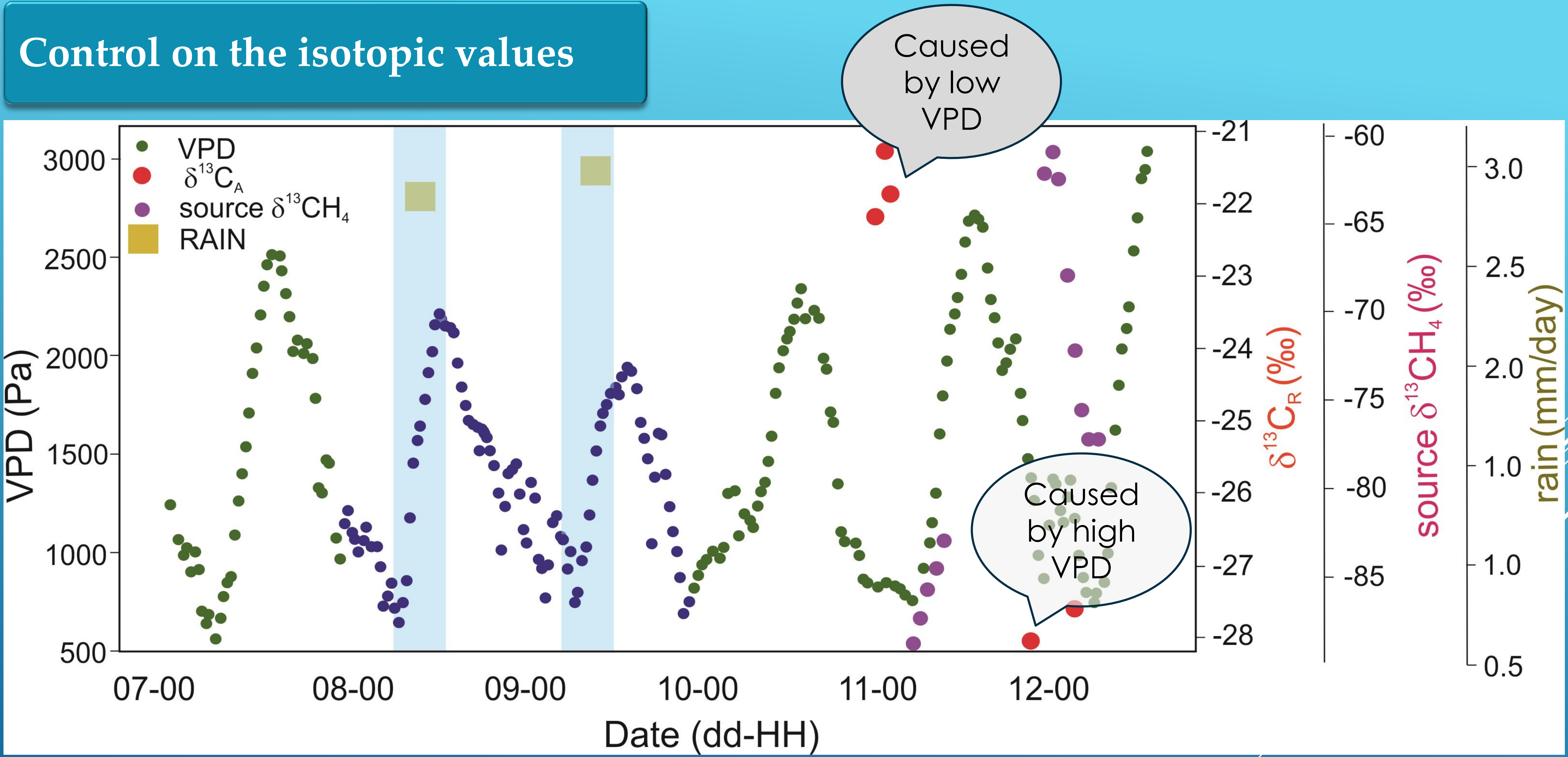


Hourly average NEE (green squares) and isoflux (red dots).



Photosynthesis and respiration flux calculated from NEE (blue dotted line), isoflux, $\delta^{13}C_A$ and $\delta^{13}C_R$.

Control on the isotopic values



solid dots = time series of VPD. Blue-dot represents = low VPD. Red-cross = $\boldsymbol{\delta^{13}C_R}$ and magenta-triangles = $\boldsymbol{\delta^{13}CH_4}$. Yellow squared box = daily rainfall.

Conclusions

A large change (~ 6 ‰) in mean $\delta_s^{CO_2}$ in subsequent nights was attributed to the change in VPD as a result of sudden rain during the dry season.

A large depletion (~ 16 ‰) in $\delta_s^{CH_4}$ on the first observation night was linked to aerobic methane production from the plant methoxyl groups.

The NEE components, F_A and F_R, were estimated using the Isotope-EC combination method proposed by Bowling et al. (2001).

Thank you