

LIAISE-NL isotope flux measurements

For better understanding land-atmosphere exchange

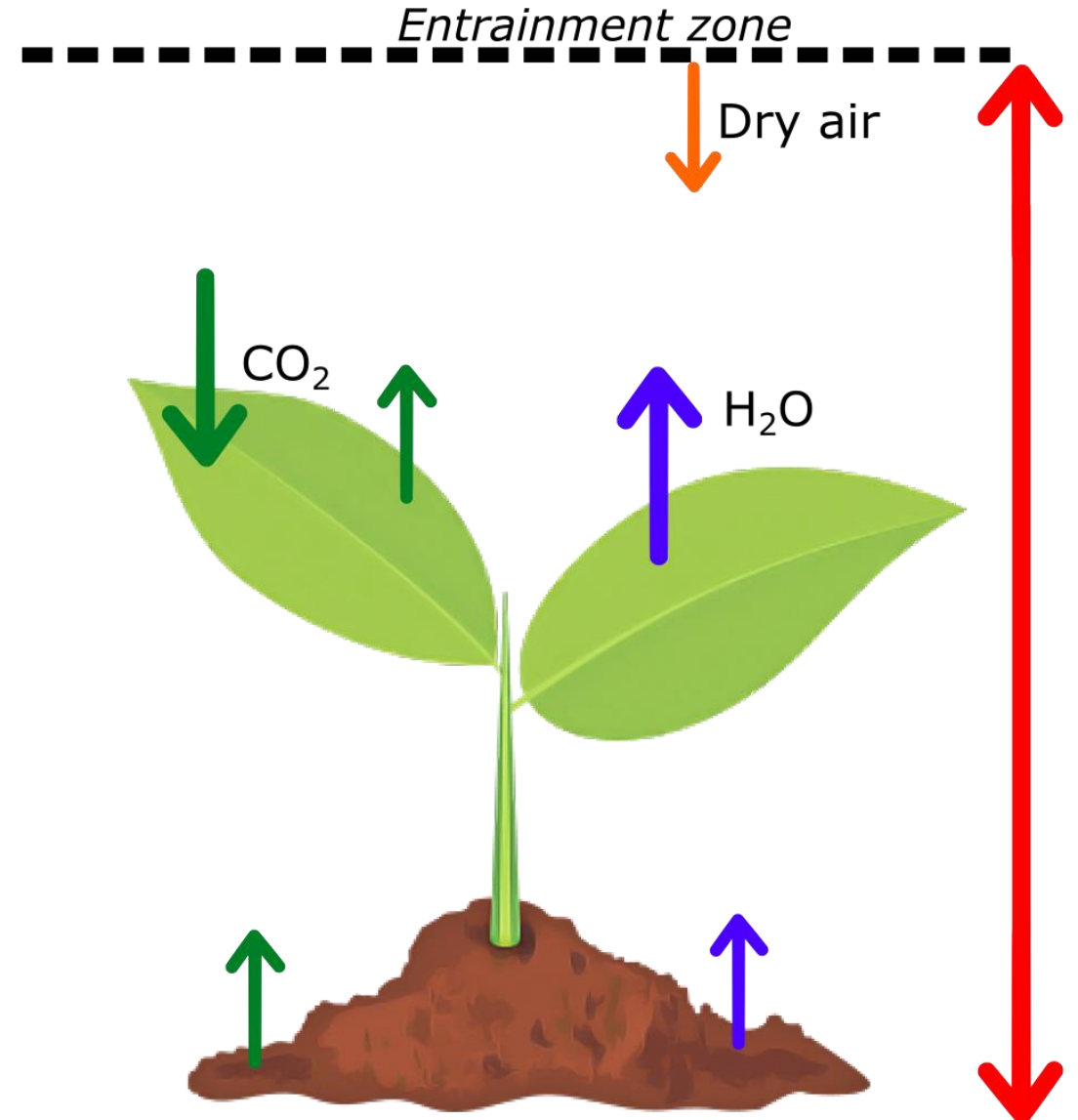
2023-03-27
LIAISE conference Lleida



Land-Atmosphere exchange

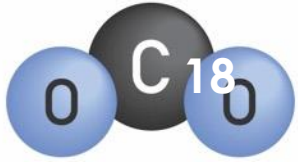
Sub - goal?

- Ecosystem scale gas exchange currently measured as NET flux
- For CO₂:
$$NEE = GPP + R_{eco}$$
$$(R_{eco} = R_{root} + R_{dark} + R_{soil})$$
- For H₂O:
$$ET = T_{trans} + E_{soil} + E_{surf}$$
- Models rely on gross fluxes.
--> Need specific validation.

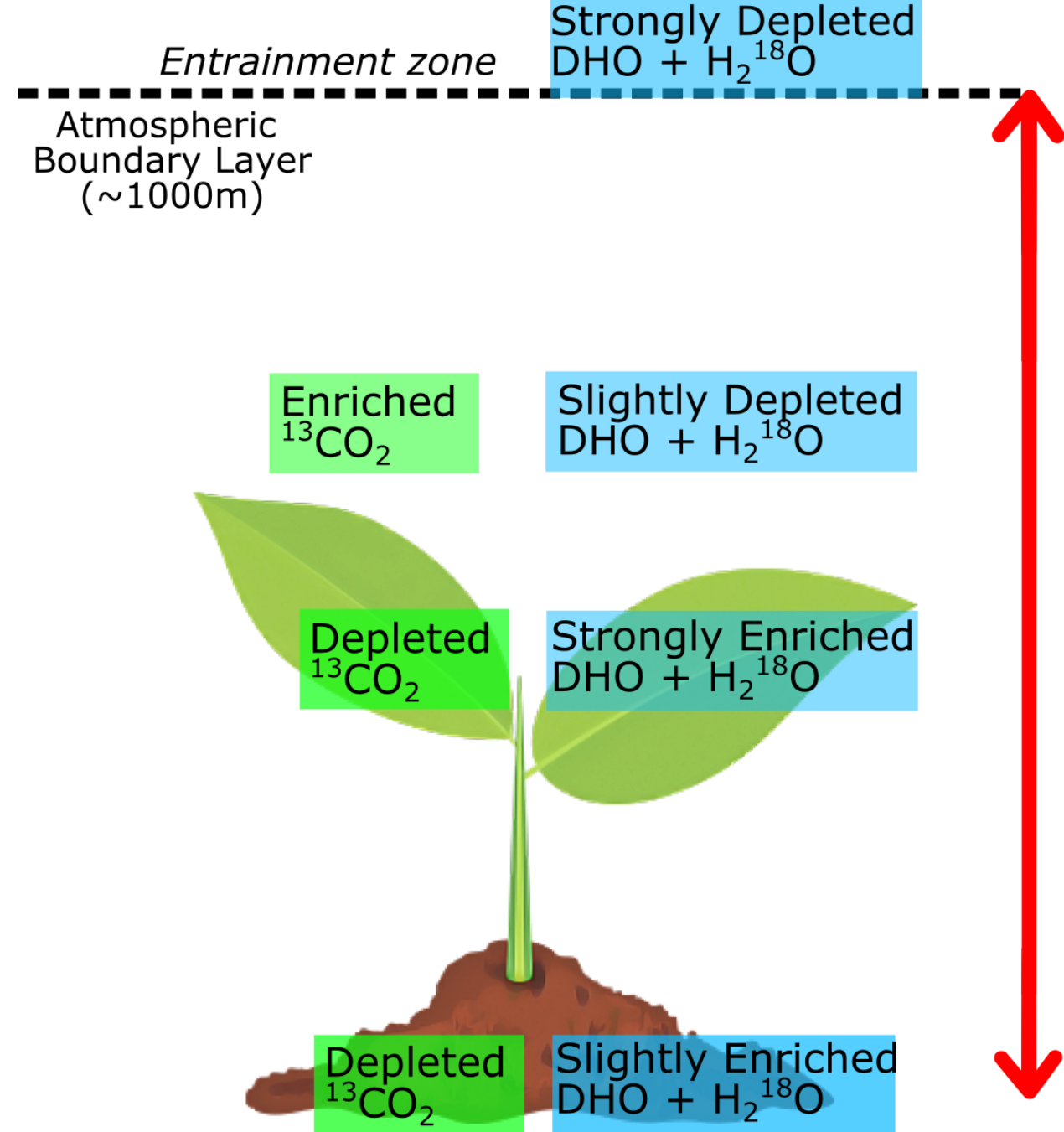


Stable isotopes (isotopologues)

What can we learn?

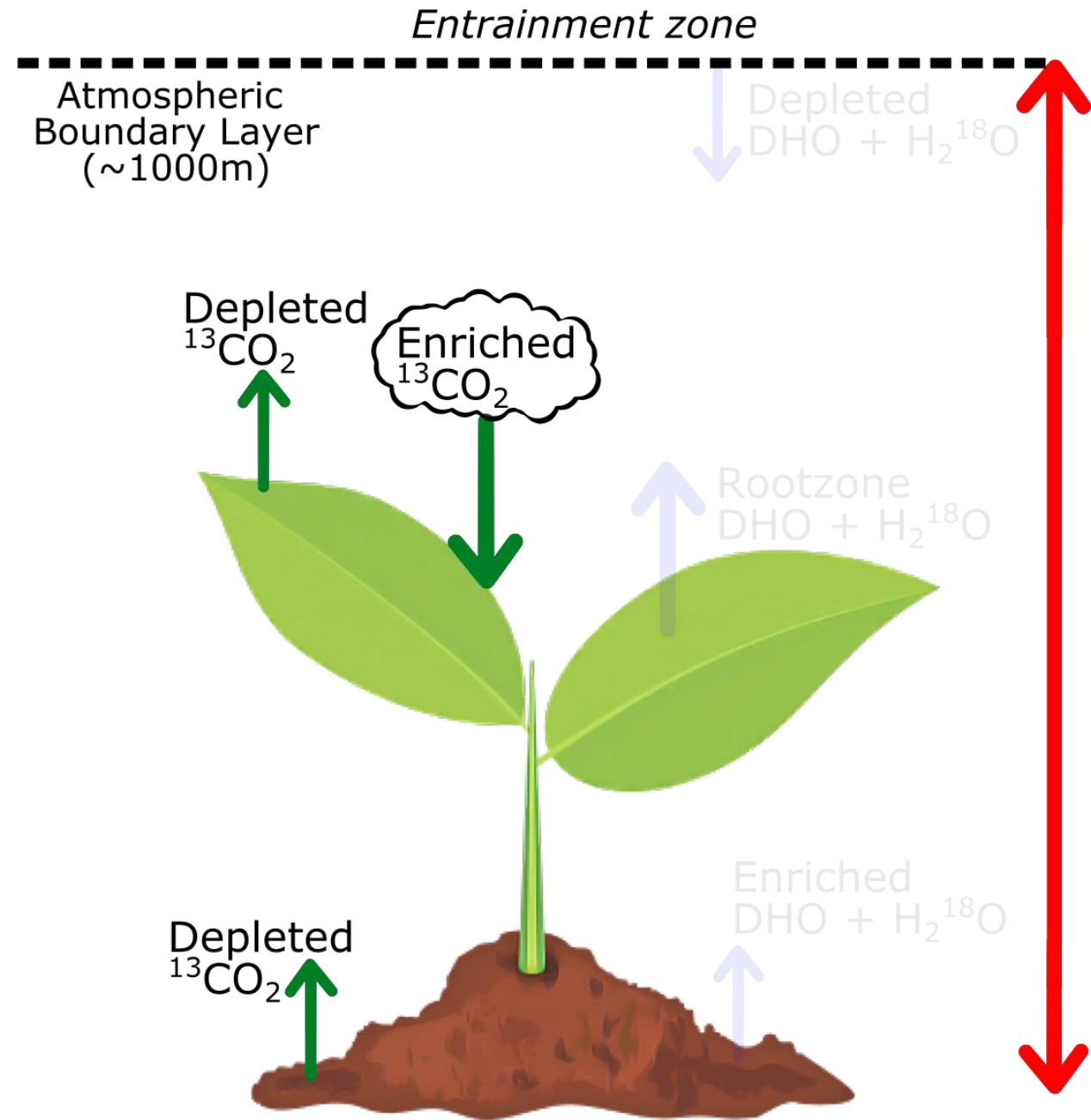
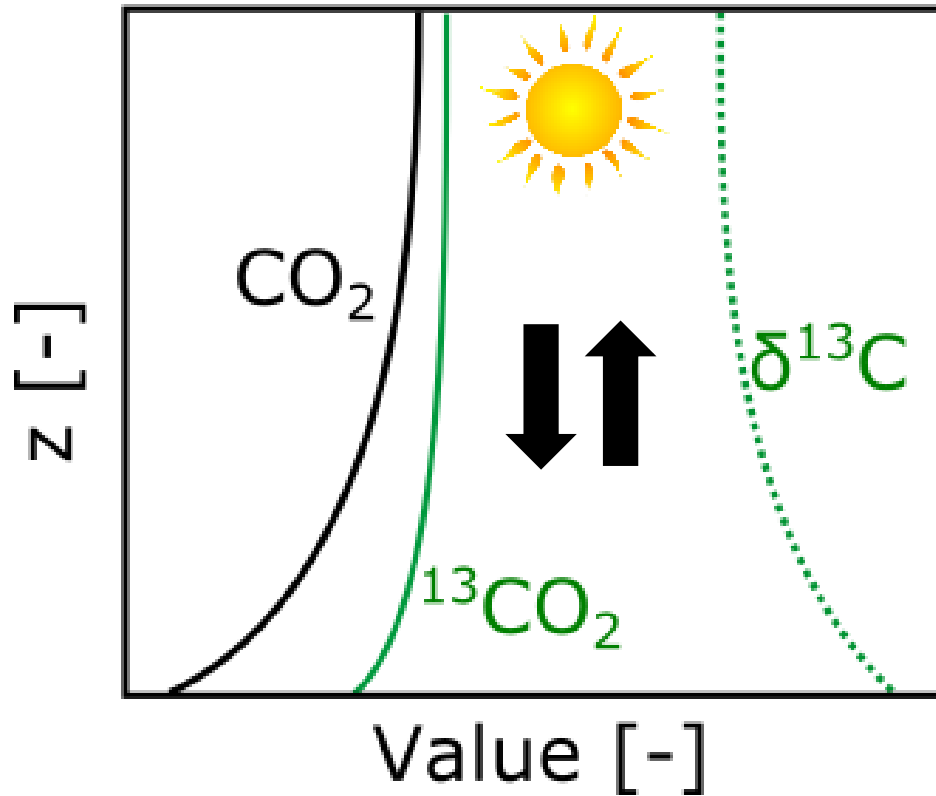
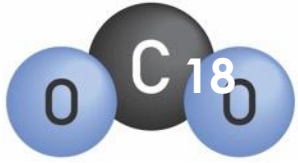


- Natural tracers in exchange processes
 - Fractionation (Change in Ratio)
- Reservoirs with specific isotopic fingerprints.



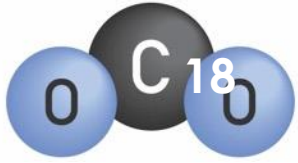
Stable isotopes (isotopologues)

What can we learn?



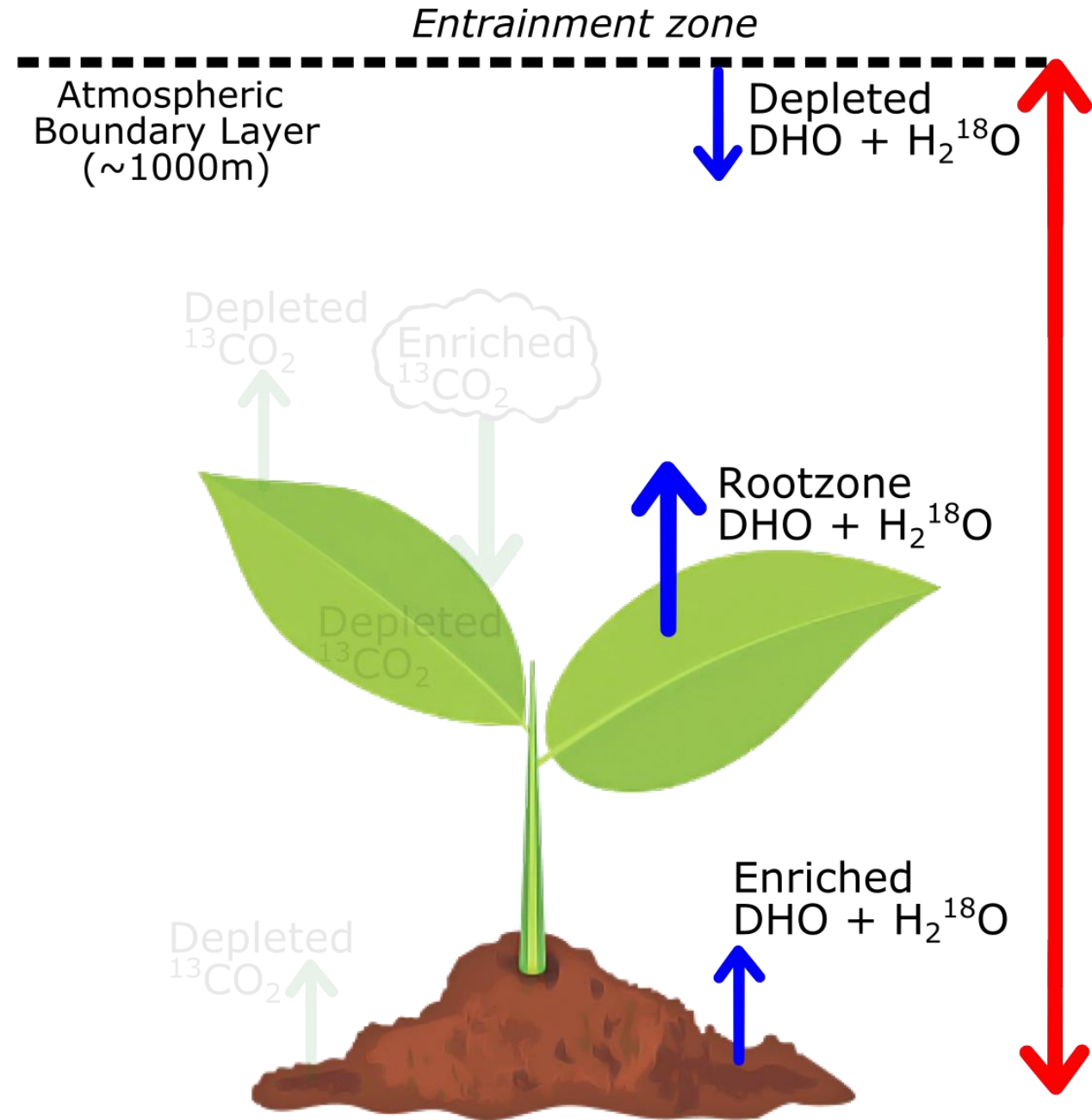
Stable isotopes (isotopologues)

What can we learn?



Vapour
Depleted

Liquid
Enriched



Flux partitioning

How?



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

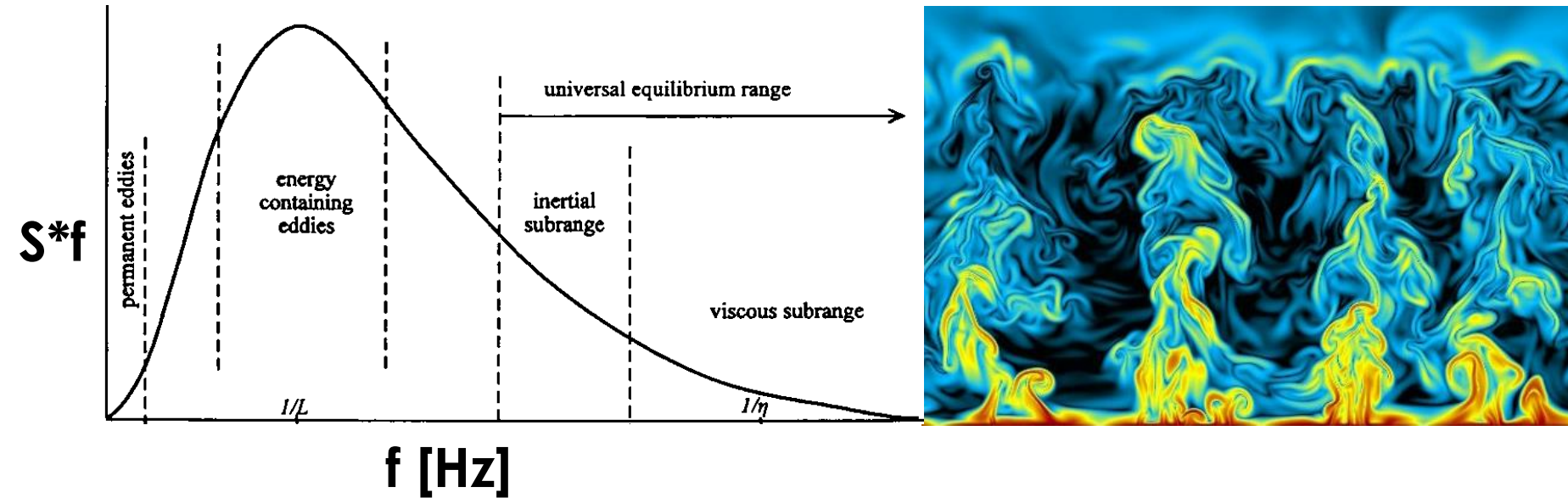
$$isoflux = \delta^{13}C_r \times R_{eco} + \left(\frac{\delta^{13}C_a - \Delta}{1 + \Delta} \right) \times GPP$$

Isofluxes

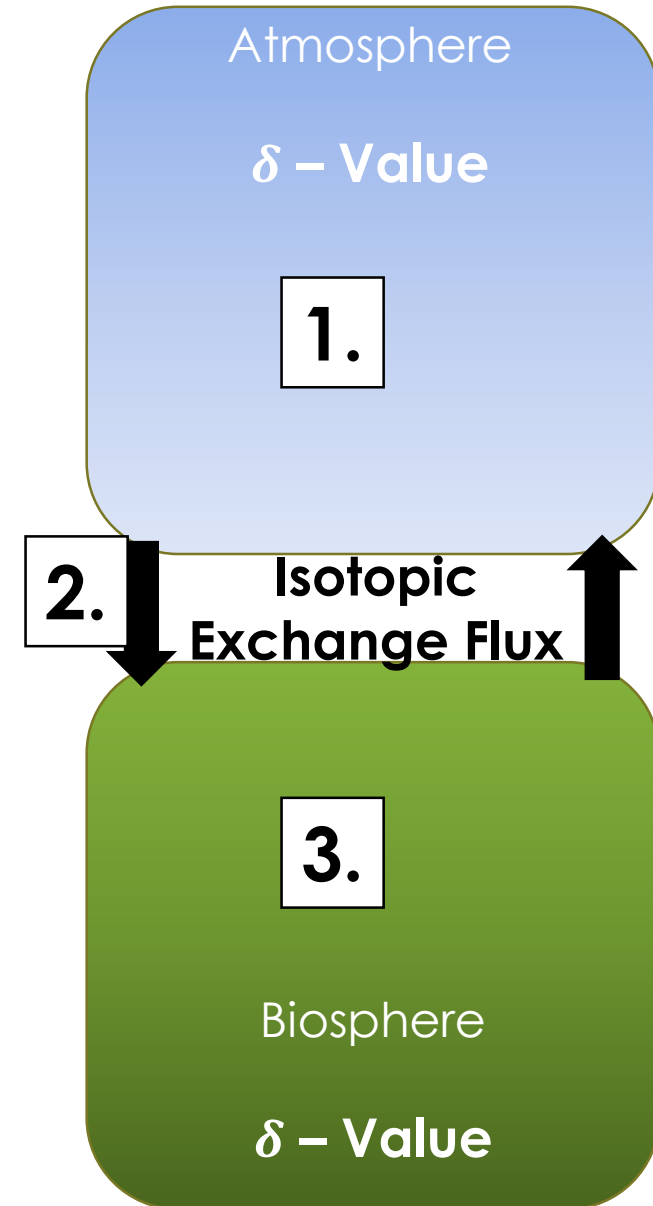
Measure Isofluxes

$$1. \quad \delta h_{atm}$$

$$2. \quad F_{\delta h} = \overline{w' \delta h'}$$



$$3. \quad \delta F R_{h/l} = \frac{F R_{h/l}}{R_{reference}} - 1 = \delta h_{atm} + F_{iso} \frac{C}{F}$$



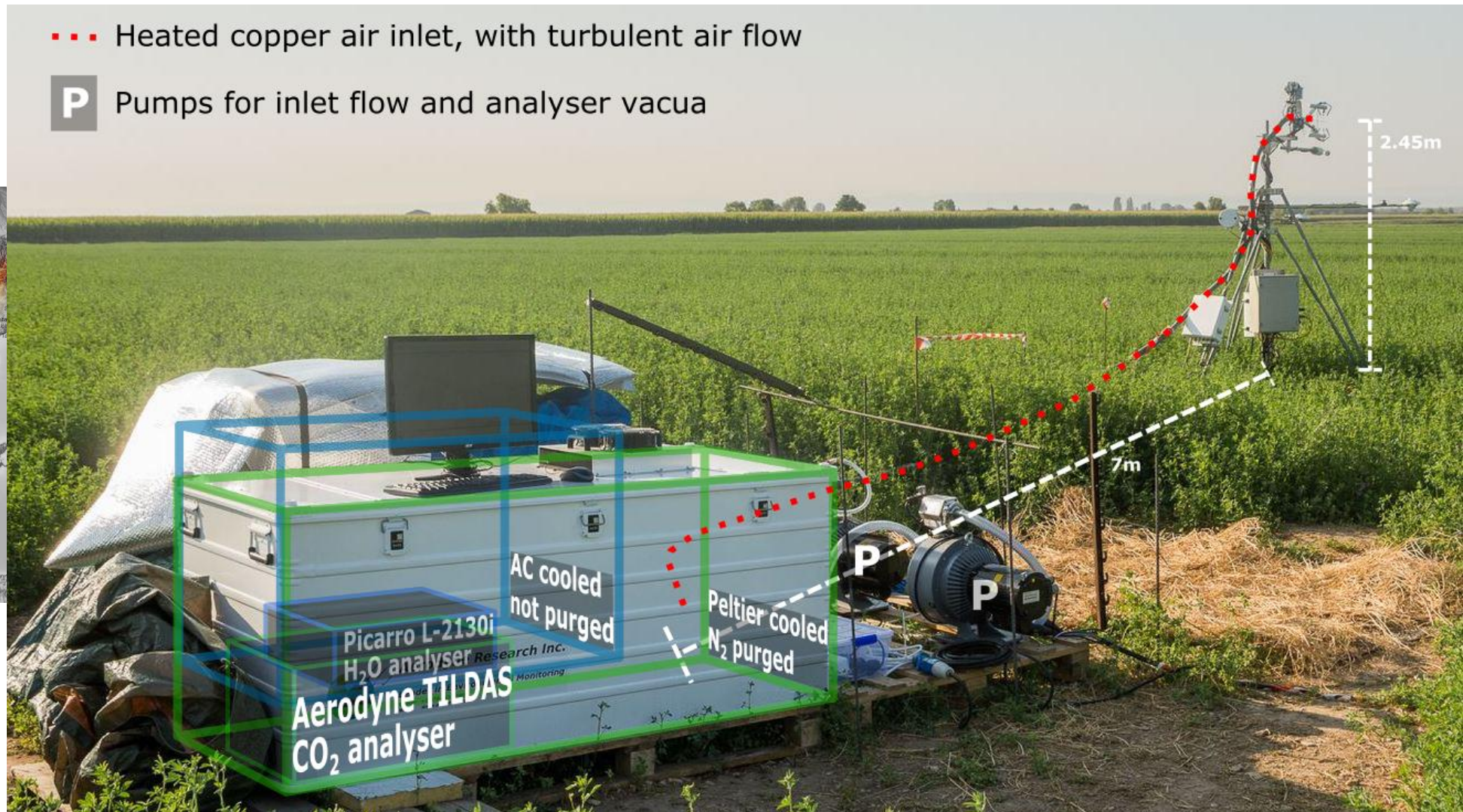
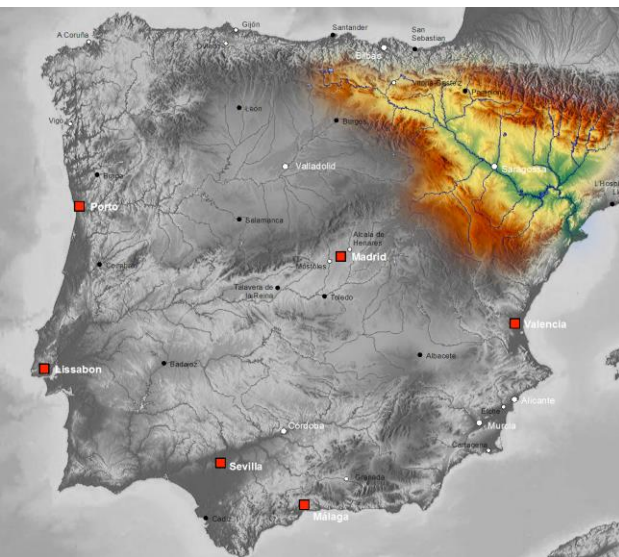
LIAISE Campaign

Measure Isofluxes

Measurement Setup:

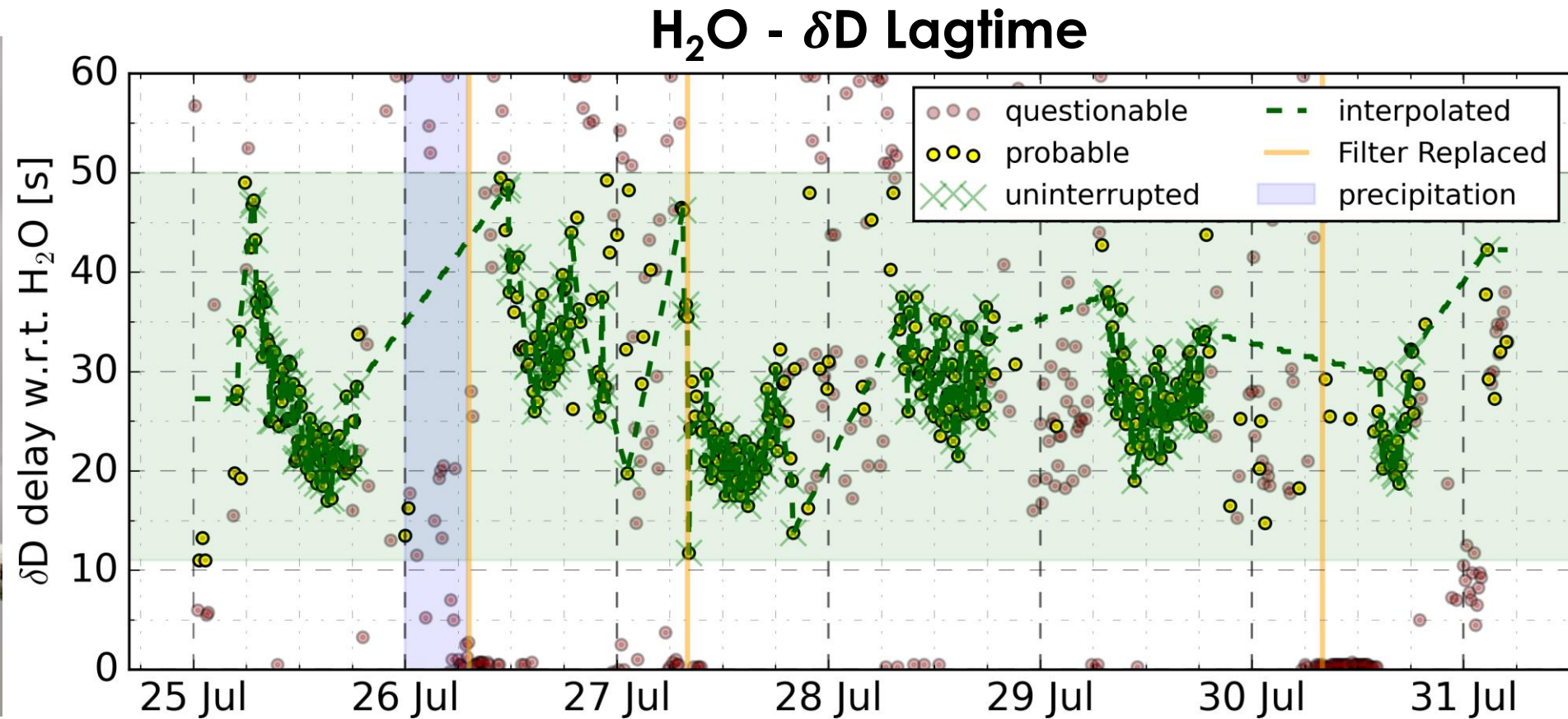
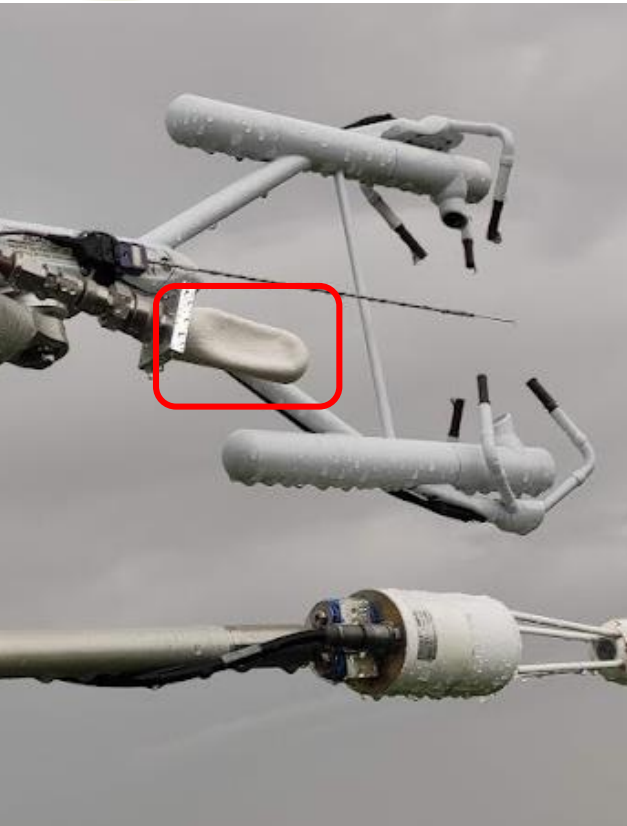
- ... Heated copper air inlet, with turbulent air flow
- P** Pumps for inlet flow and analyser vacua

Ebro river Basin:



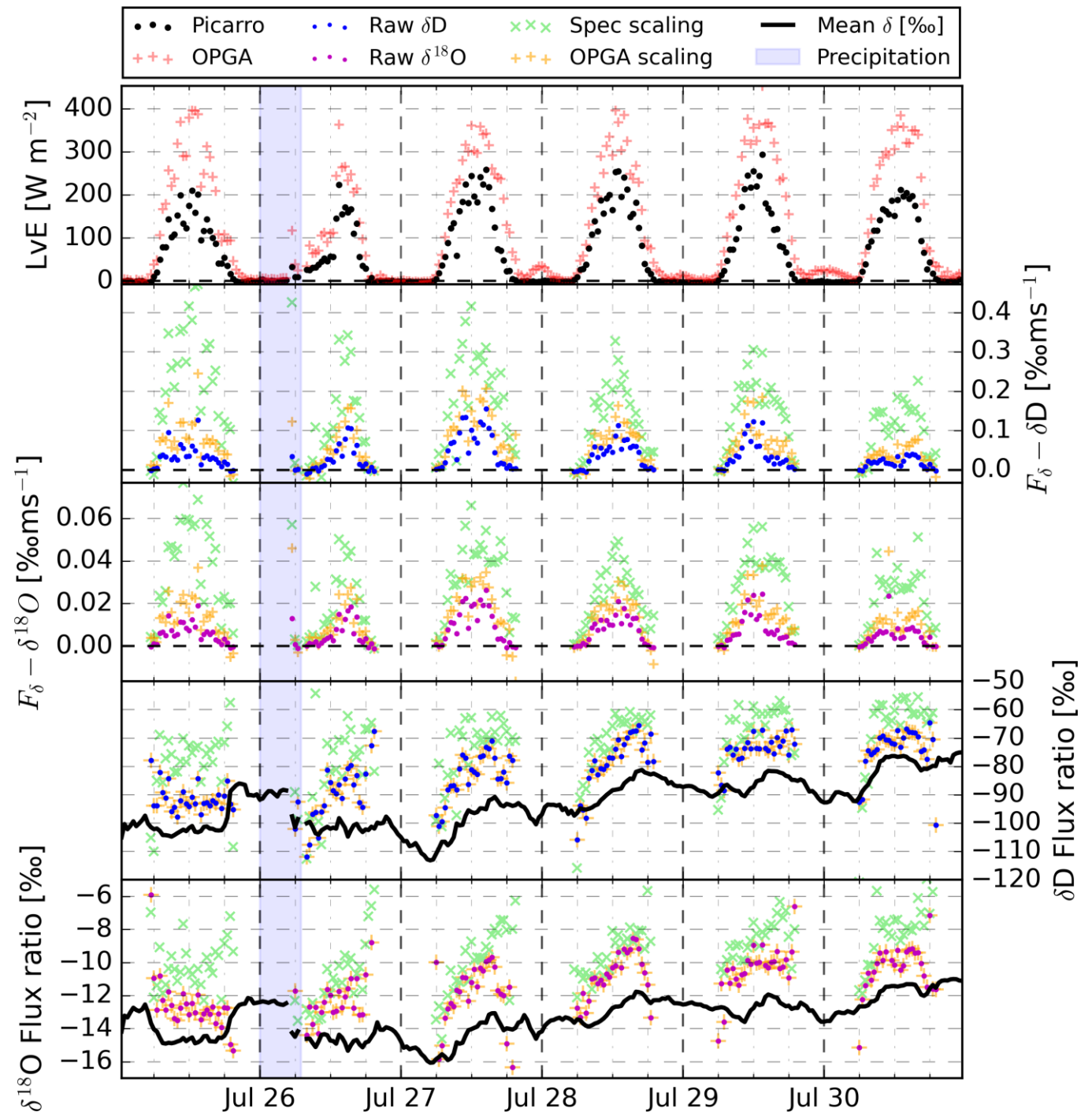
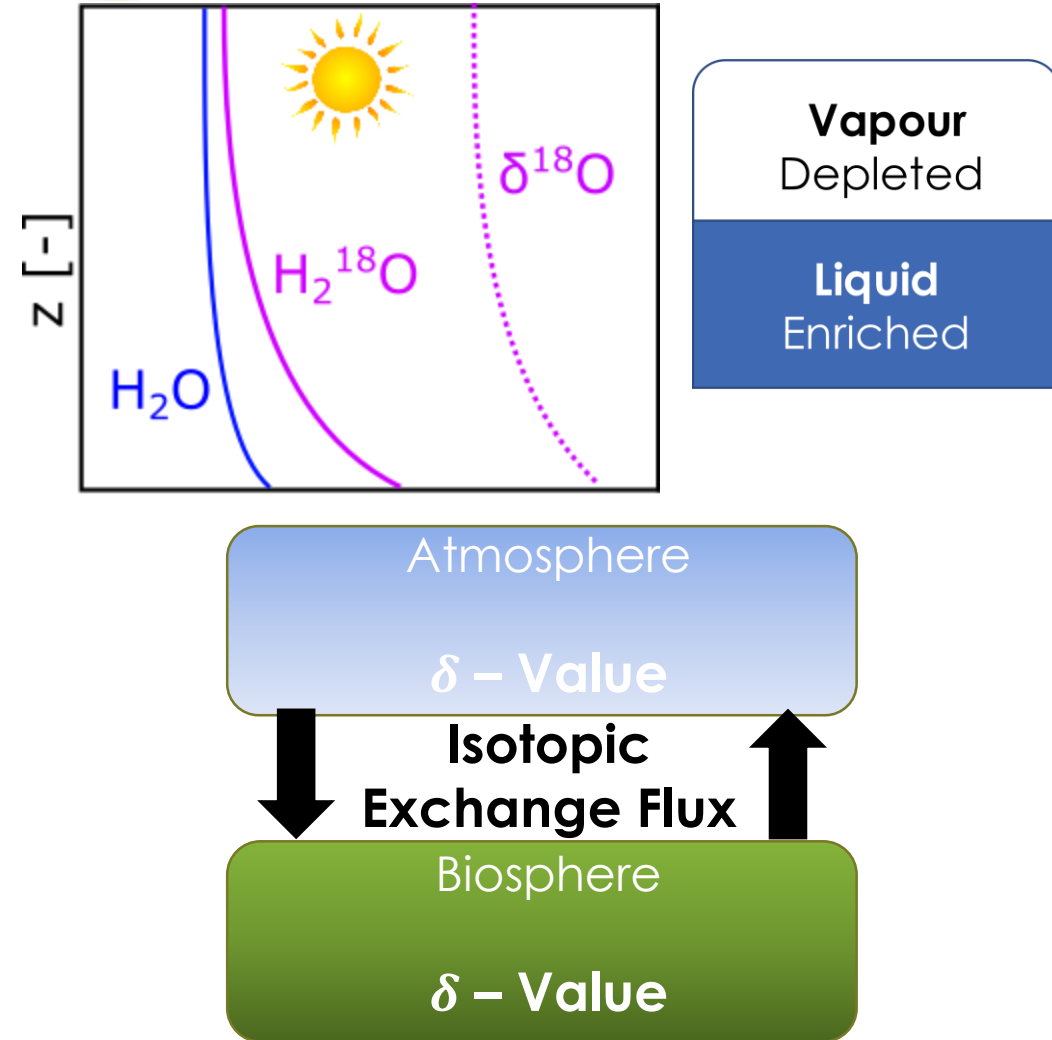
Isotopic signal delay

Inlet filter



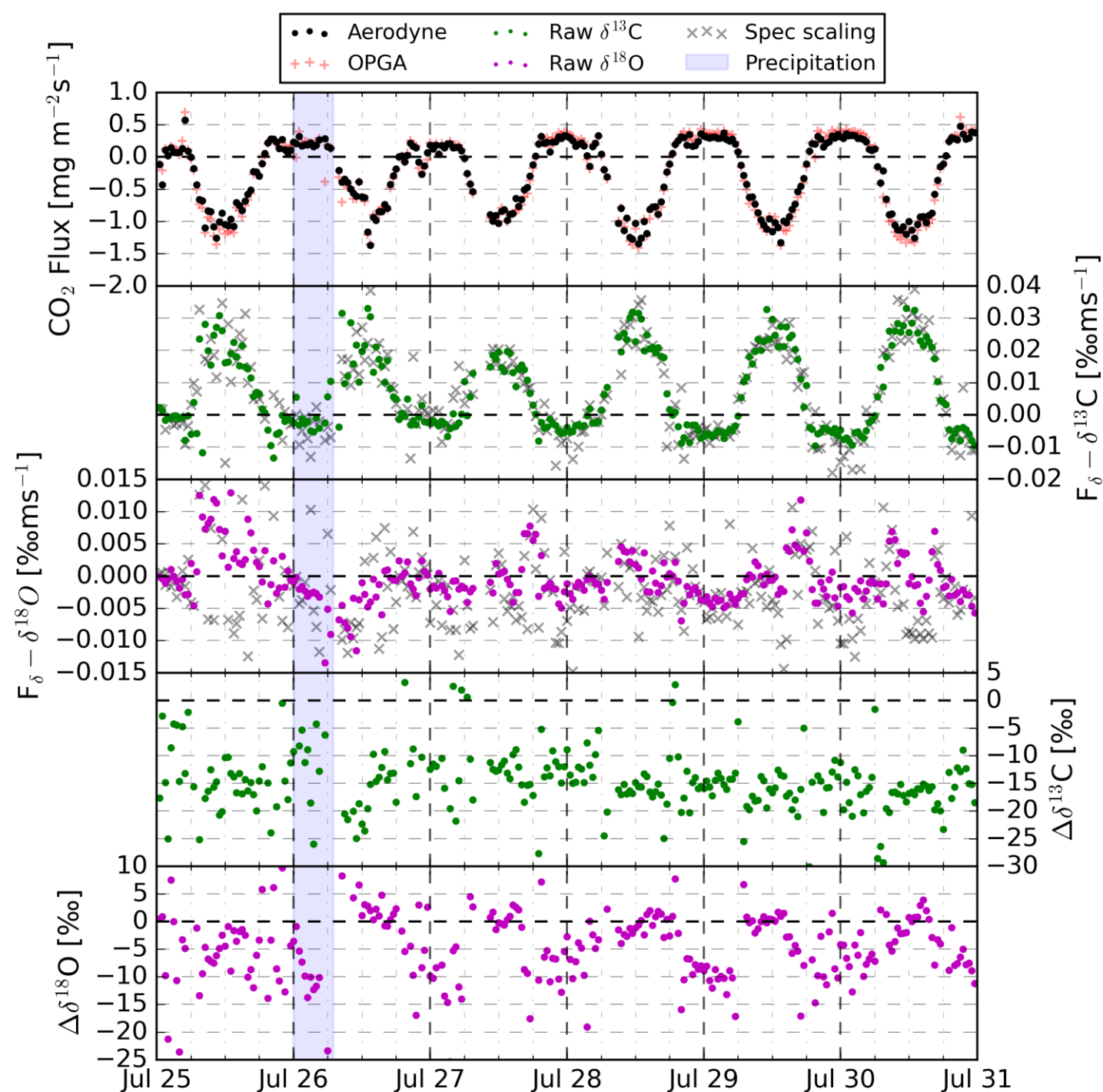
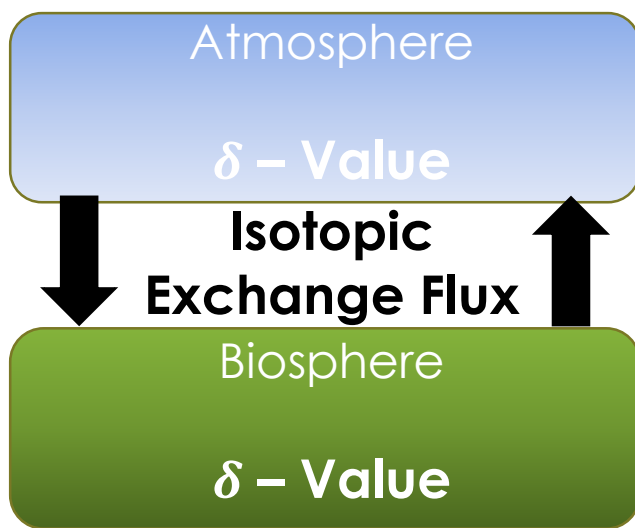
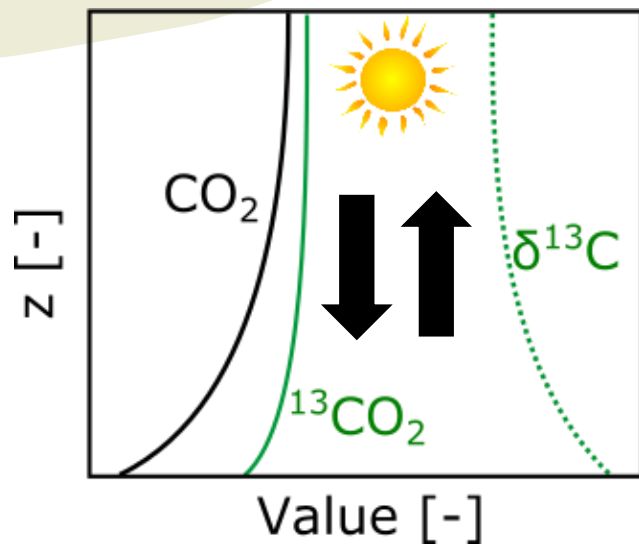
H₂O Isofluxes

LIAISE



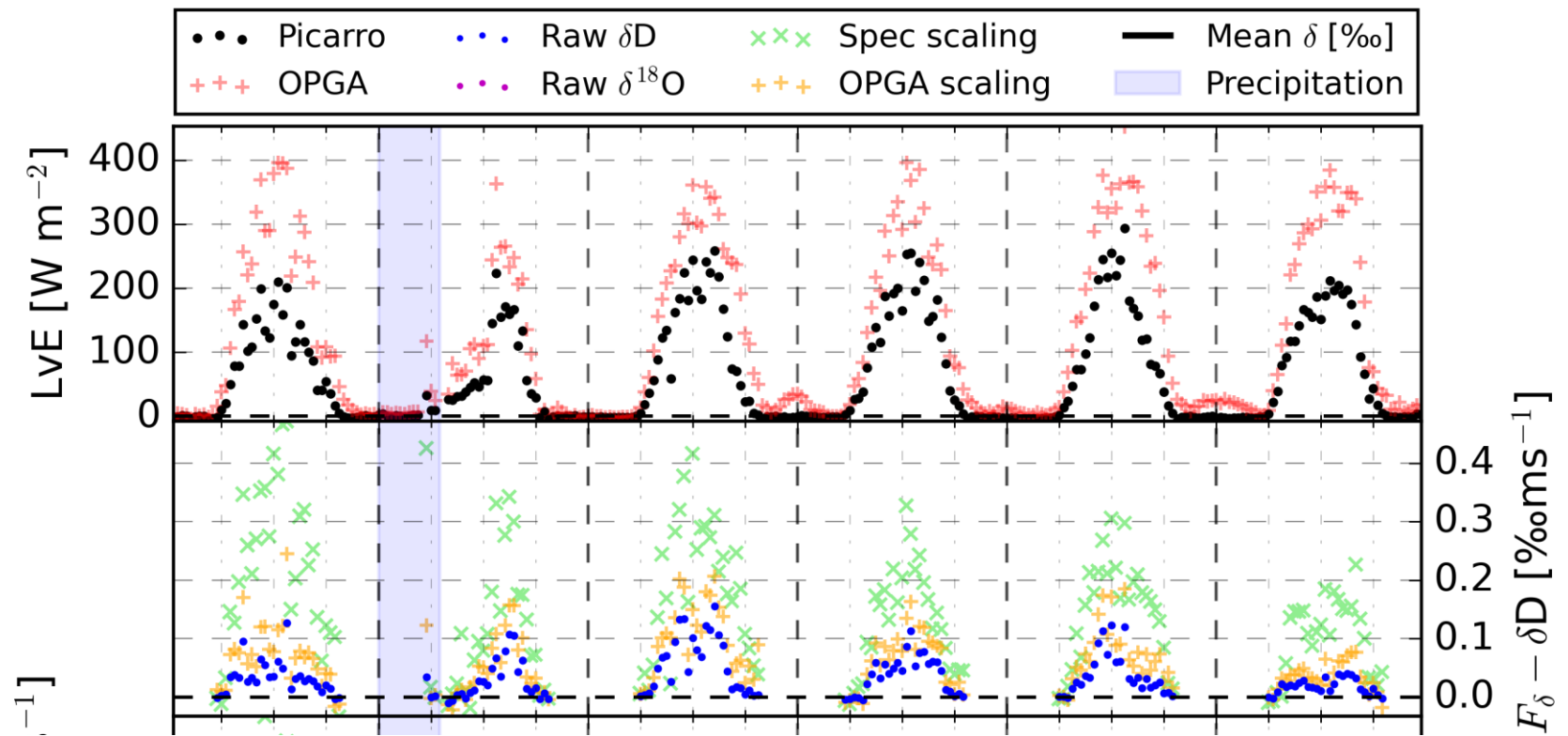
CO₂ isofluxes

LIAISE



Methodological consequences

1. Unequal correction for net fluxes and isotope fluxes
2. Leads to different partitioning results
3. Raises questions on previous work
4. Suggests isotope fluxes could be measured with slower sensors



1. Solving 2 equations for R_{eco} and GPP (30min intervals)

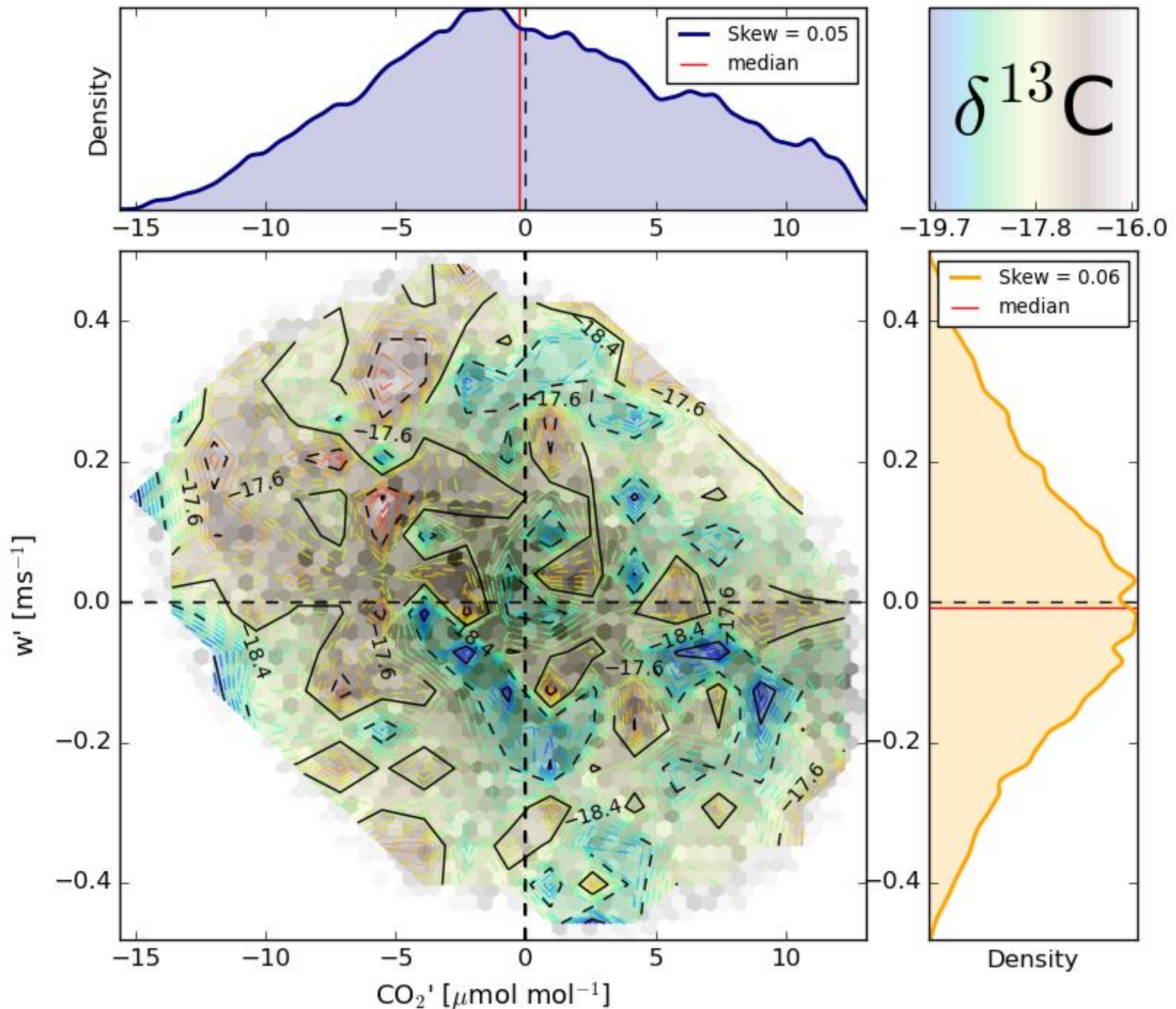
$$ET = T_{trans} + E_{soil}$$

$$isoflux = \delta D_{trans} T_{trans} + \delta D_{soil} E_{soil}$$

Outlook

Short timescales

- Prevent exchange and high frequency loss
→ Worked at following campaign
- Isofluxes and NET fluxes at minute scale using laser scintillometry
→ Cloud effects
- Quadrant analyses to investigate sub 30minute flux information.



Conclusions

1. We are able to measure isotope fluxes, the key to doing isotopic partitioning at ecosystem scale.
2. Observed large unexpected H₂O isotope lag time.
3. Proposed new spectral correction methods that has consequences for flux partitioning