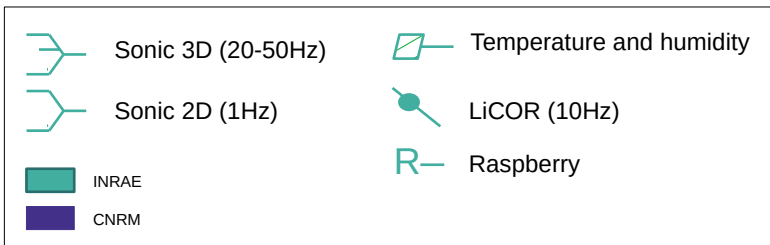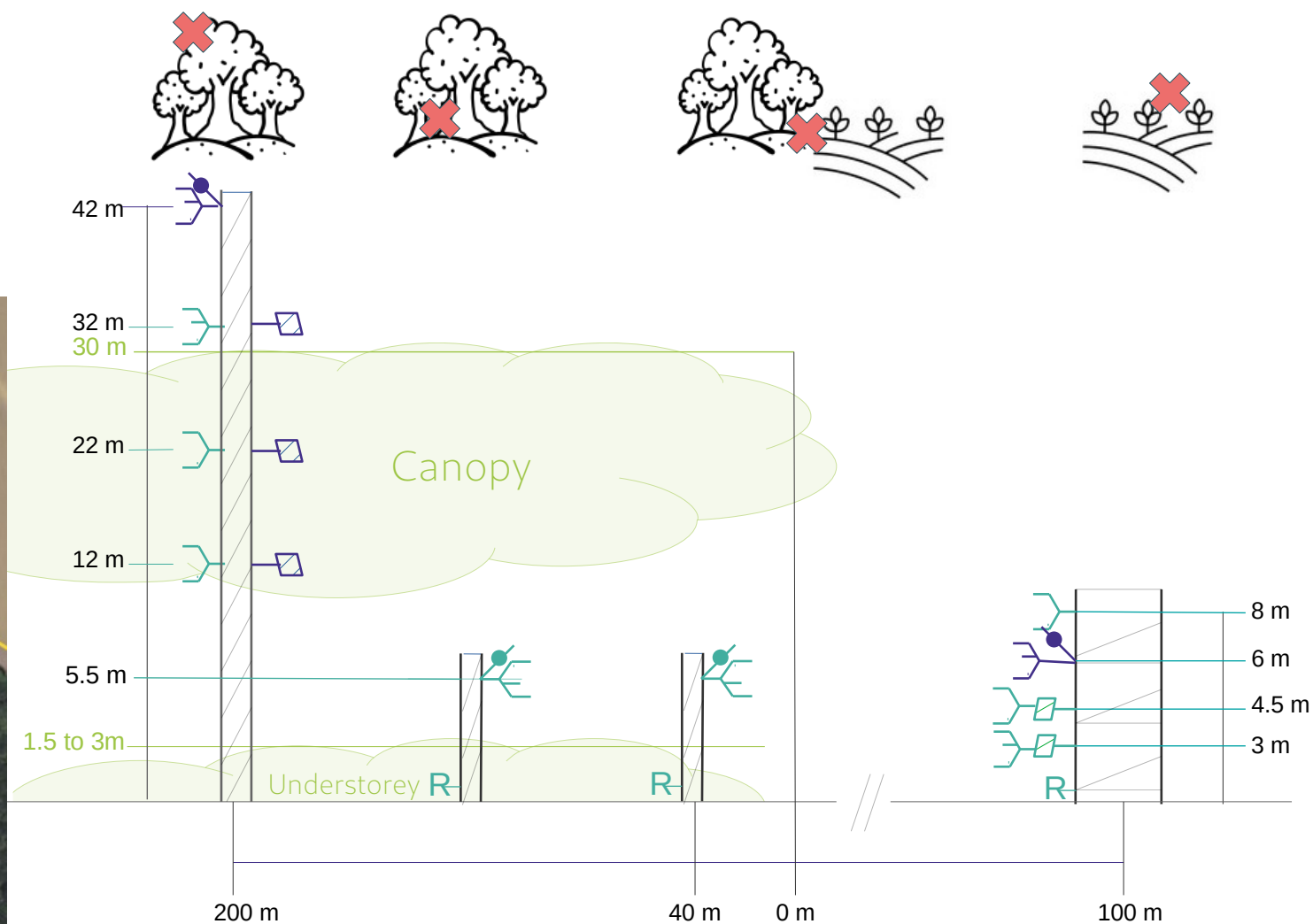# First analysis of edge flows during the august POI

Myrtille GRULOIS, S. Dupont, M. Irvine, J. Ogée −13/06/2024

RÉPUBLIQUE
FRANÇAISE
*Liberté*
*Égalité*
*Fraternité*

INRAe

anr

MaCCMiC

MOSAI

# Configuration



Legend:
- Sonic 3D (20-50Hz)
- Sonic 2D (1Hz)
- Temperature and humidity
- LiCOR (10Hz)
- R— Raspberry
- INRAE
- CNRM

Heights: 42 m, 32 m, 30 m, 22 m, 12 m, 5.5 m, 1.5 to 3m
Right mast: 8 m, 6 m, 4.5 m, 3 m
Distances: 200 m, 40 m, 0 m, 100 m

Map labels: Grassland, Triticale, Maize, Maize scaffolding, Edge mast, Small forest mast, CNRM mast, Tarbes, Échelle 1 : 3 000

# Summary of the important periods during the year



Leaves appearing from 15/04 to 15/05, maize sowed West

Beginning of June: maize sowed North

Mid-October: maize harvested

Around 15/11 start of leaf fall

Forest masts installation 18/03/2023

Maize installation 19/04/2023

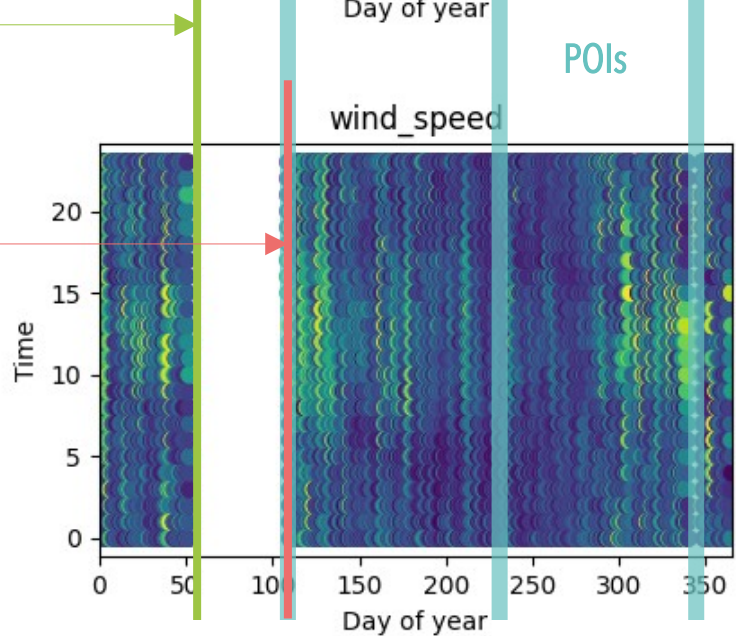Maize HOBO installation 17/07/2023

Maize HOBO removed 16/10/2023

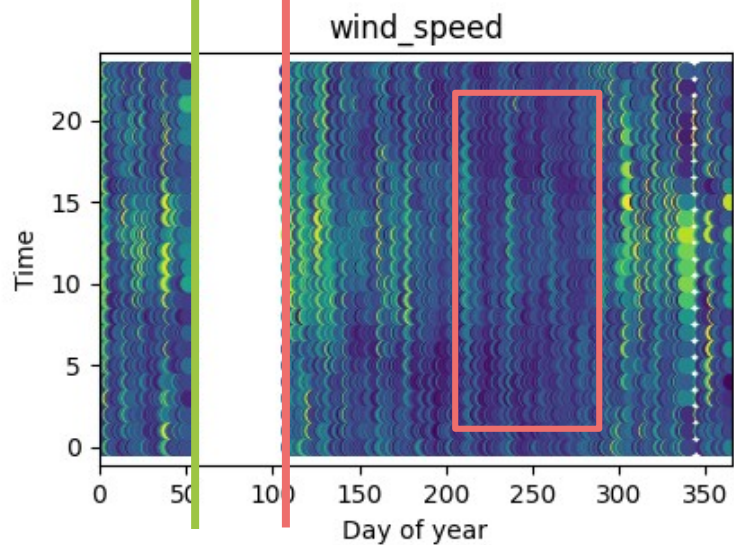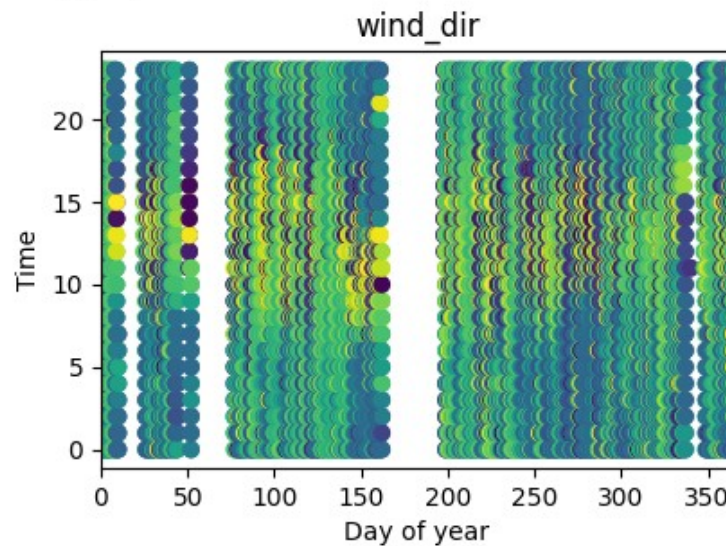Desinstallation 4/03/2024
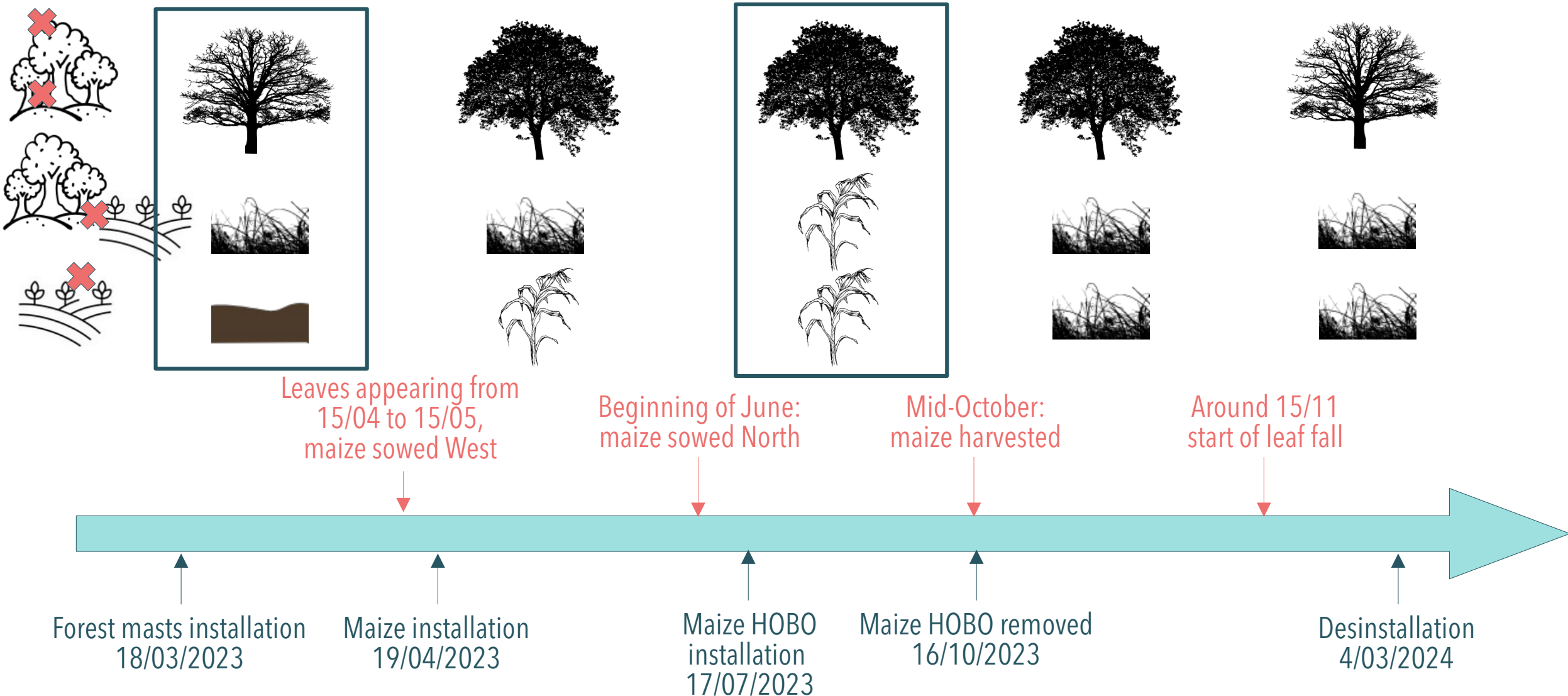
# Overview of measurement periods



Installed
day 78, 2023

Forest canopy top

2023

2024

wind_speed
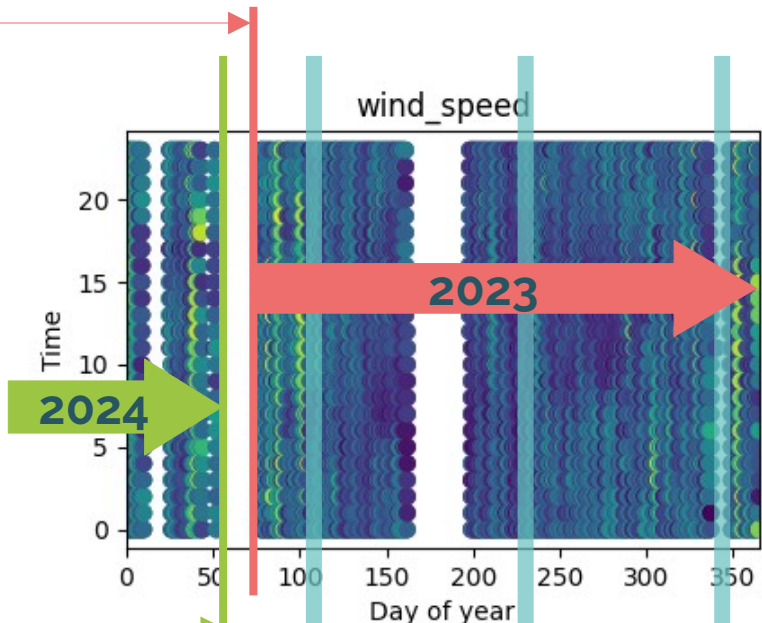
Desinstalled
day 63, 2024

POIs

Maize 3m

Installed
day 109, 2023

wind_speed

Forest canopy top

Maize 3m
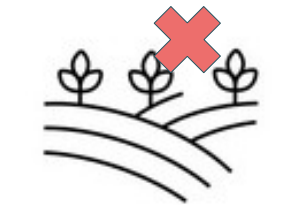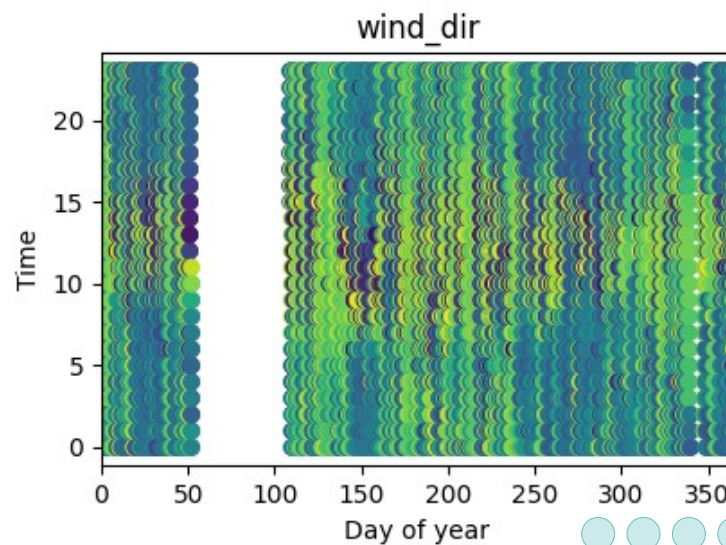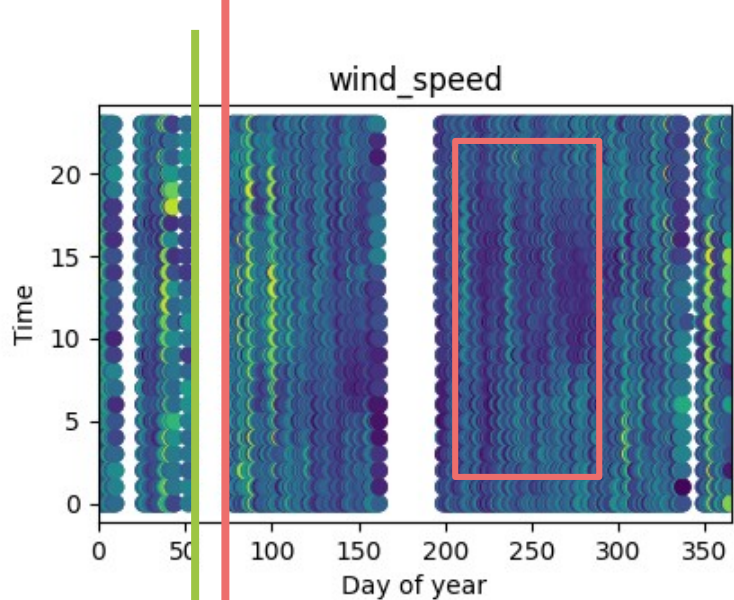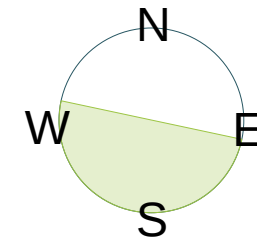
# Overview of measurement periods – fluxes



Forest understorey

**LE** (W.m⁻²)

**H** (W.m⁻²)

**co2_flux** (μmol.s⁻¹.m⁻²)

Edge understorey

**LE** (W.m⁻²)

**H** (W.m⁻²)

**co2_flux** (μmol.s⁻¹.m⁻²)

Leaves
Day 115, 2023

Corn sowed North
day 166, 2023

First analysis of edge flows during the august POI
Myrtille Grulois – 13/06/2024
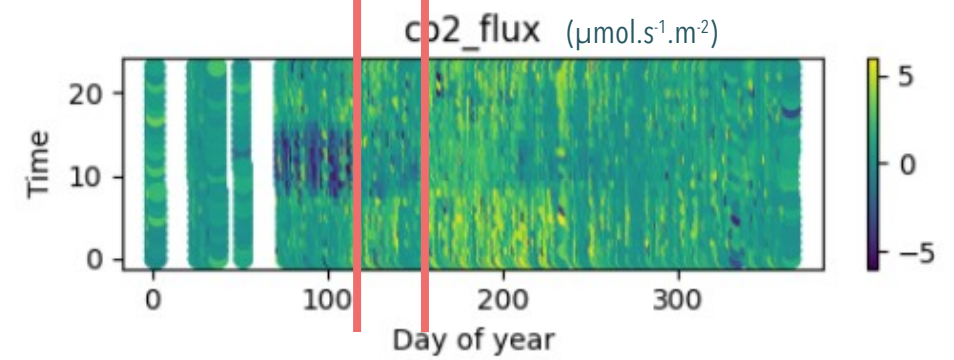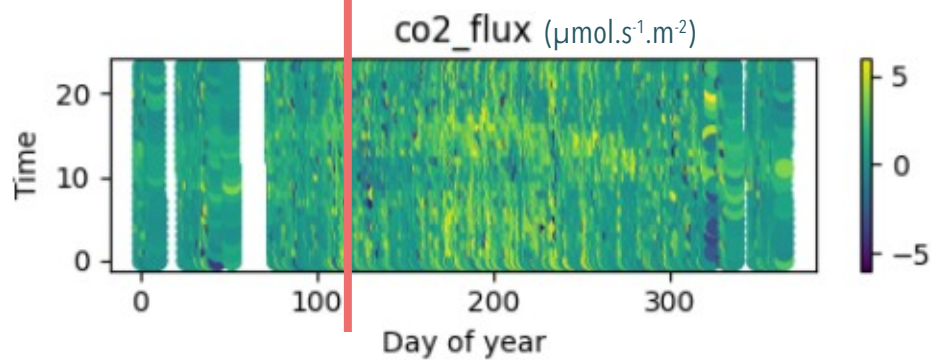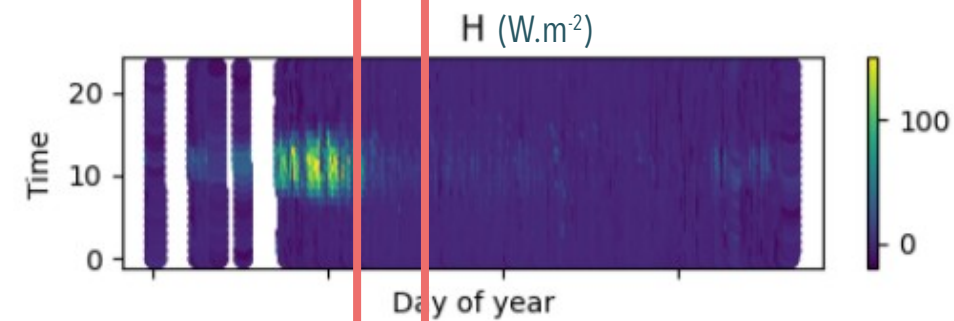
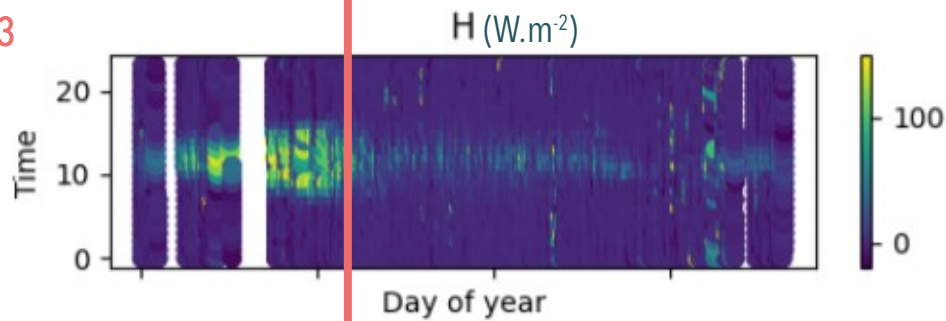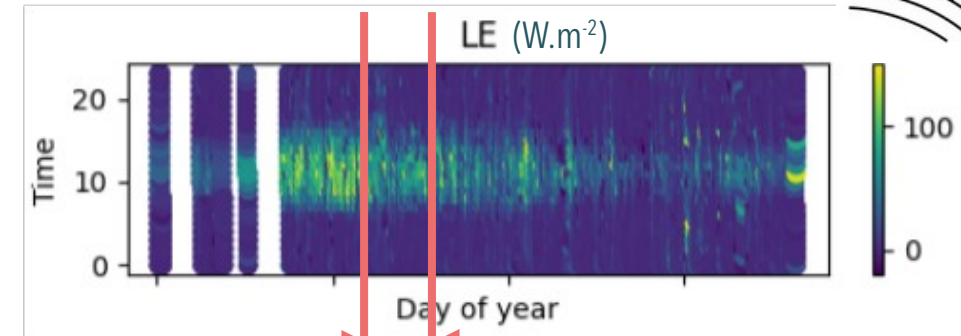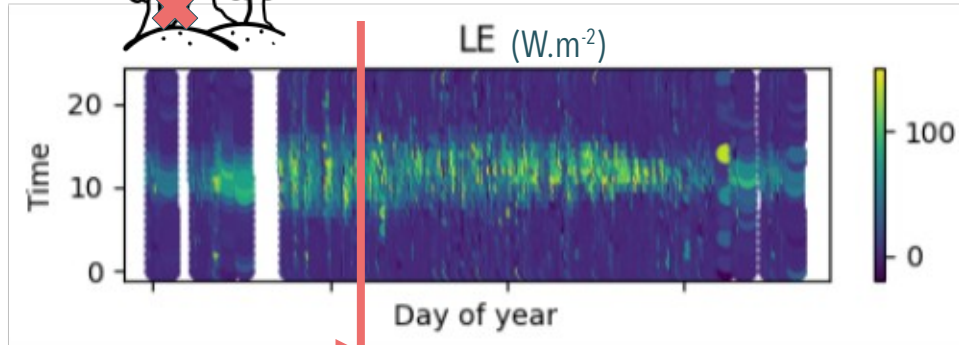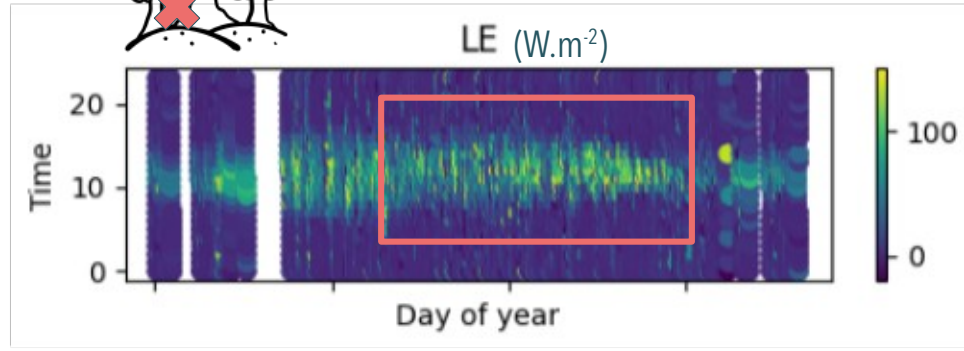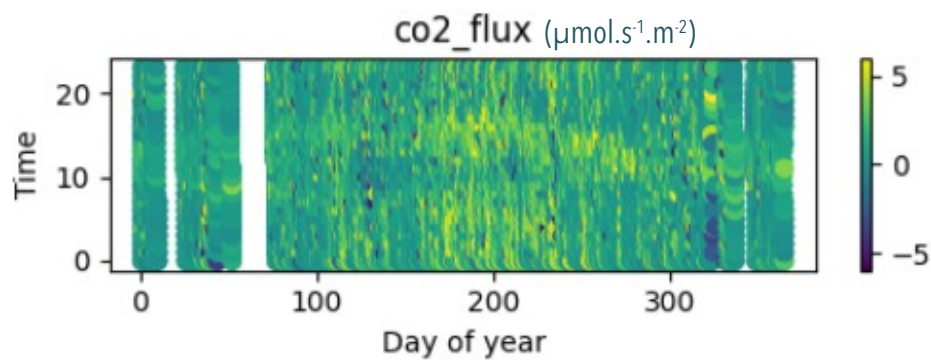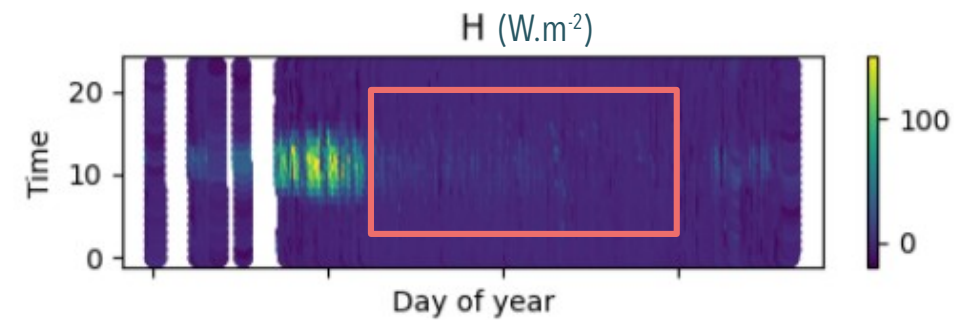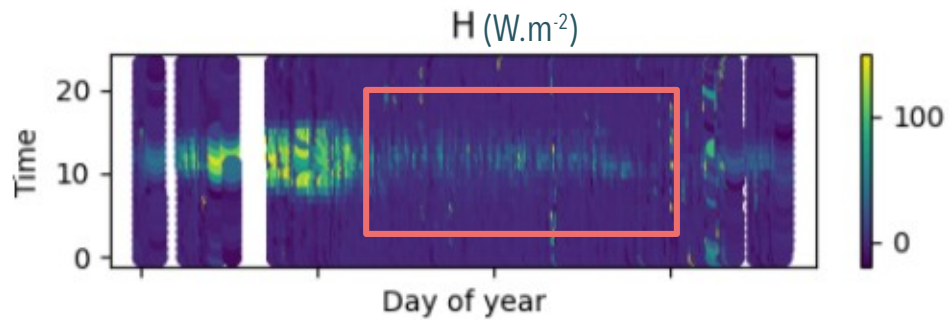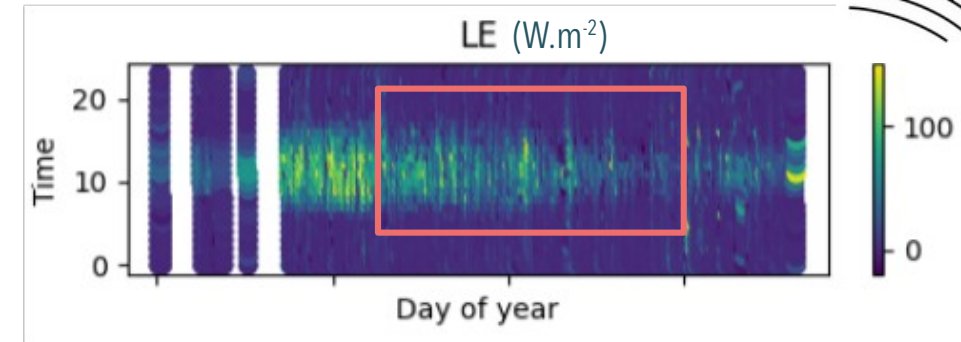# Overview of measurement periods – H & LE
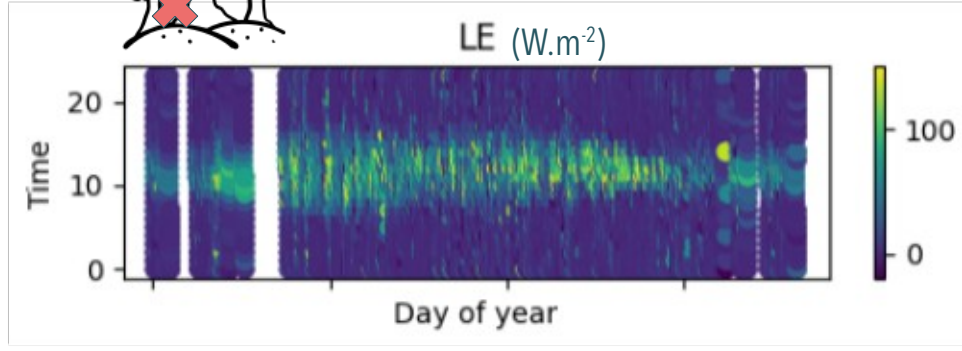
# Overview of measurement periods – CO₂ flux



Forest understorey

Edge understorey

LE (W.m⁻²)

H (W.m⁻²)

co2_flux (μmol.s⁻¹.m⁻²)

No leaves

Leaves

No leaves, grass

Leaves, maize
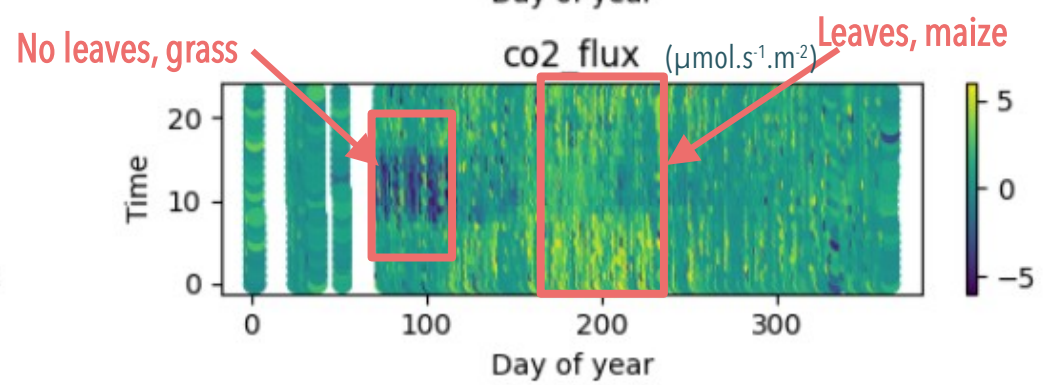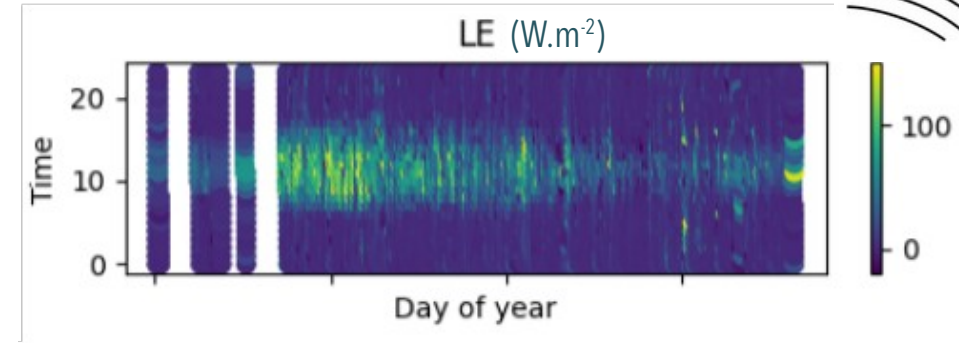
# Discussion on CO₂ flux

# Wind rose in unstable atmosphere

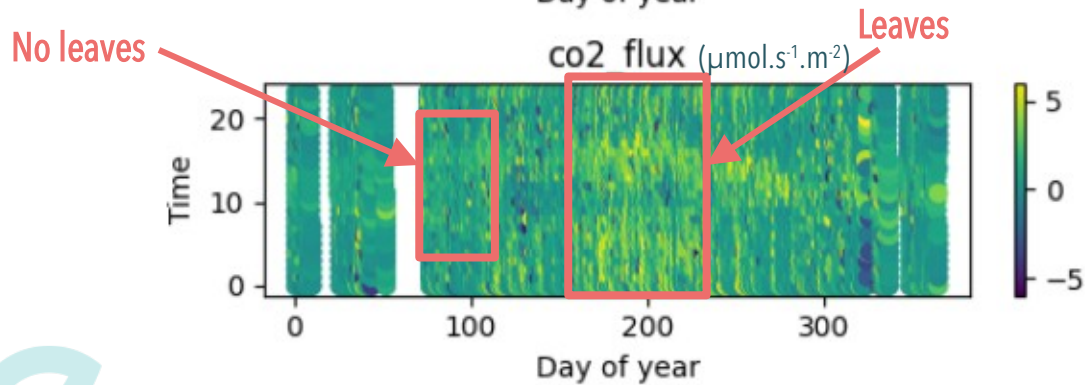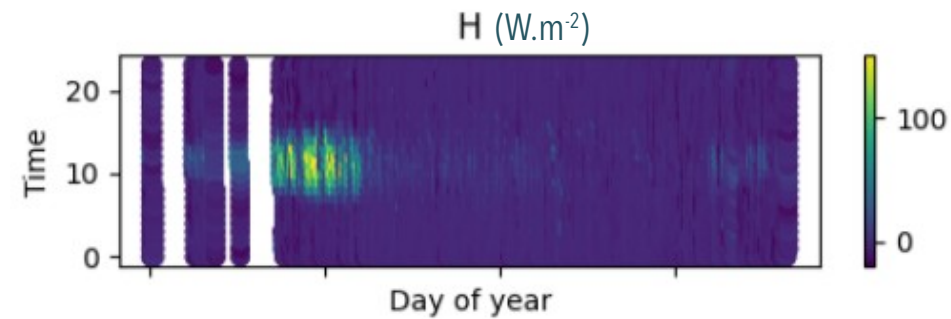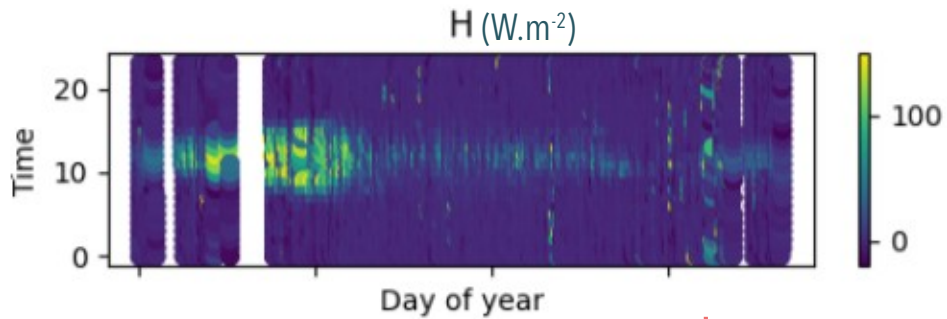› Count of half-hours with said wind direction and stability class for JJA

› Red curve
  › free convection
  › low winds
  › mainly thermics
› Orange curve
  › forced convection
  › high winds
  › thermics involved



Legend:
- (-0.02, 0.0]
- (-0.1, -0.02]
- (-0.6, -0.1]
- (-100.0, -0.6]

# Constant flux layer above maize and forest



Forest canopy top



Maize canopy top
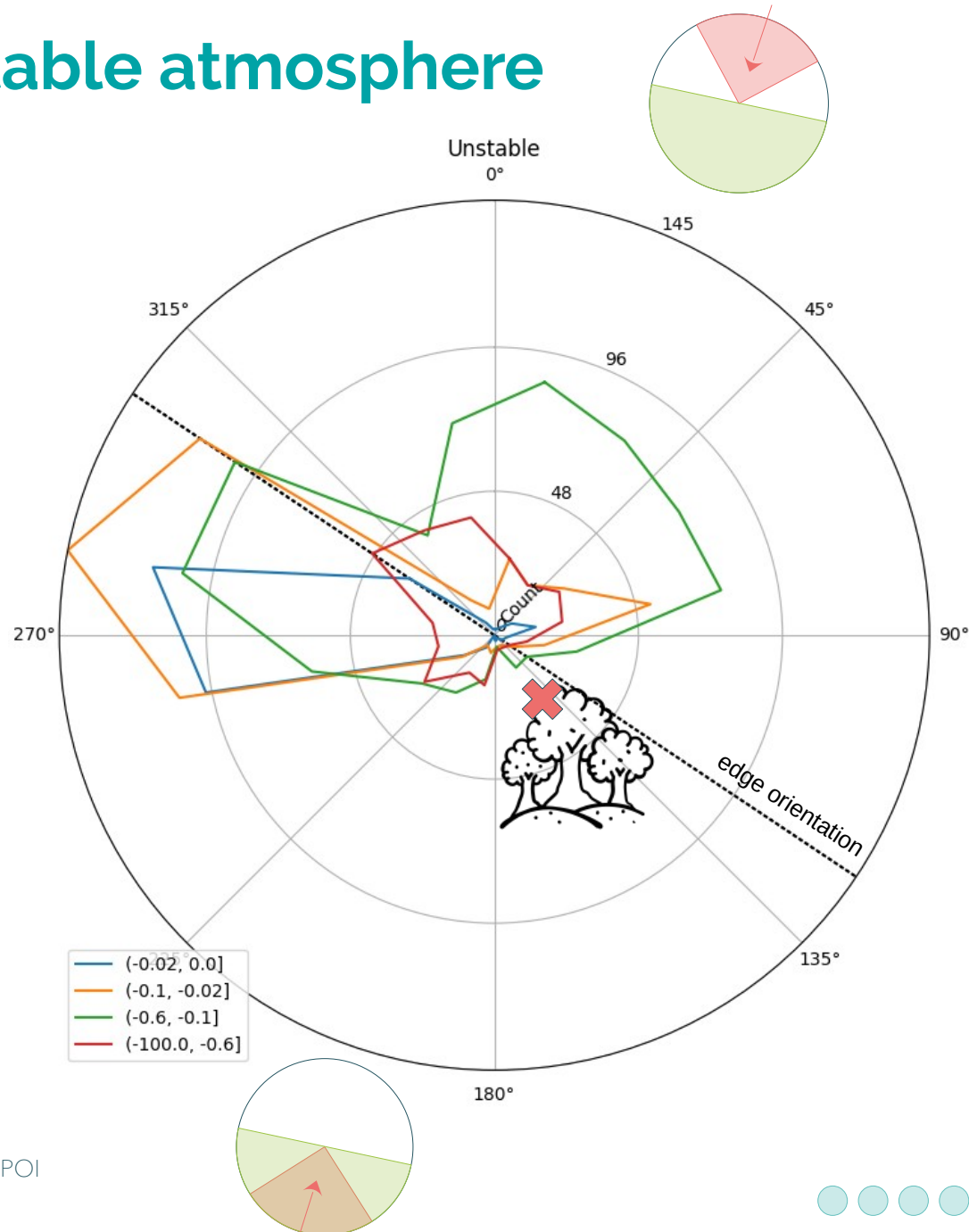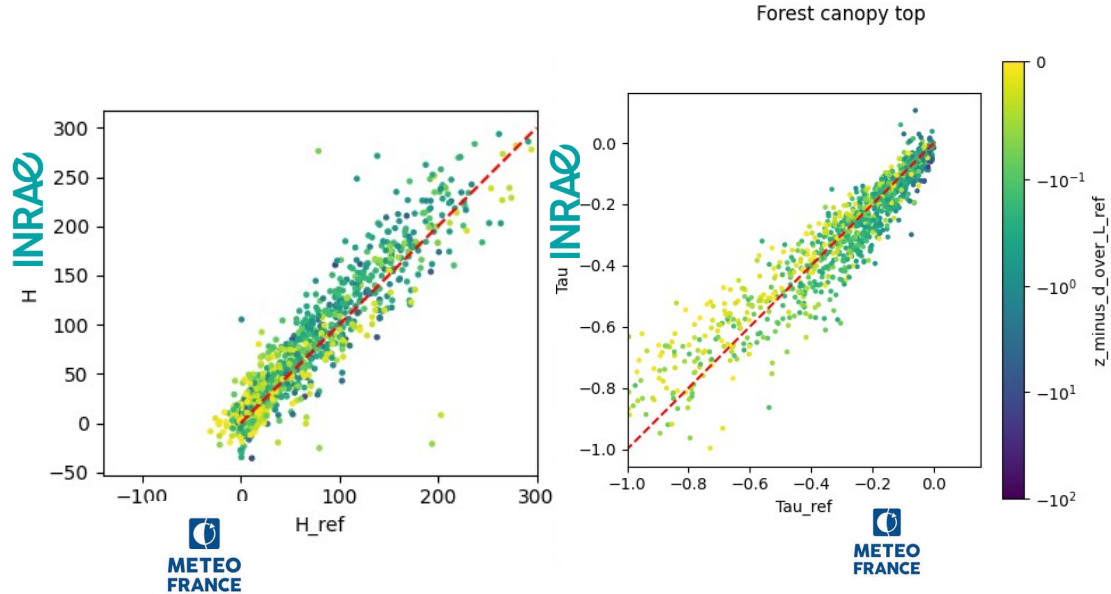
› No flux source between INRAE and CNRM instruments
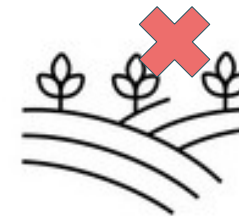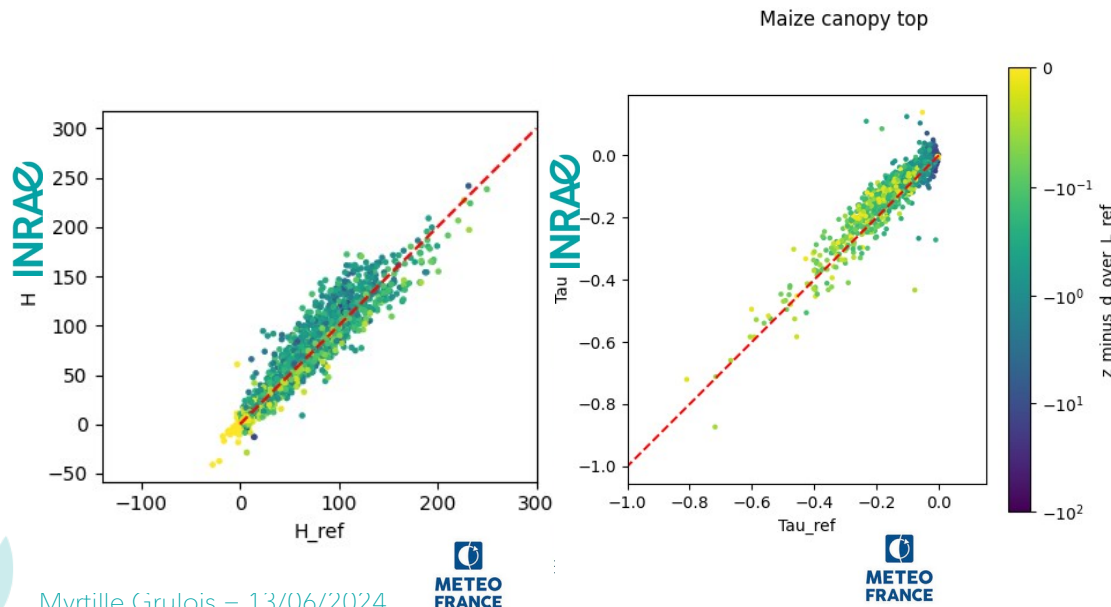
› Constant flux layer

# Spectra analysis: how it works

30 minutes of raw instantaneous data
(10 à 50Hz)

Discrete Fourier transform
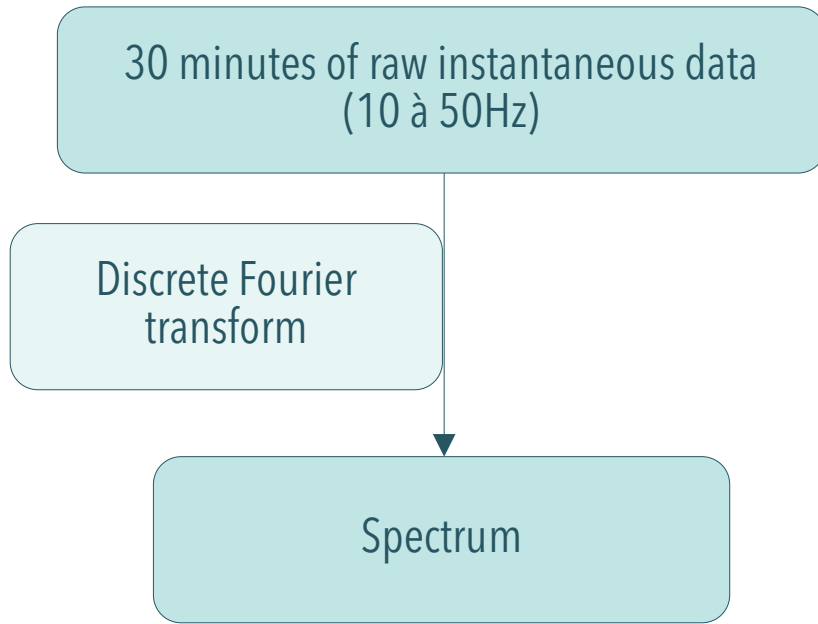
Spectrum

› Visualise the contribution of the different sizes of eddies to total wind



CSAT maize

- Free convection with leaves: u'
- Forced convection with leaves: u'
- Free convection with leaves: w'
- Forced convection with leaves: w'
- slope of -2/3
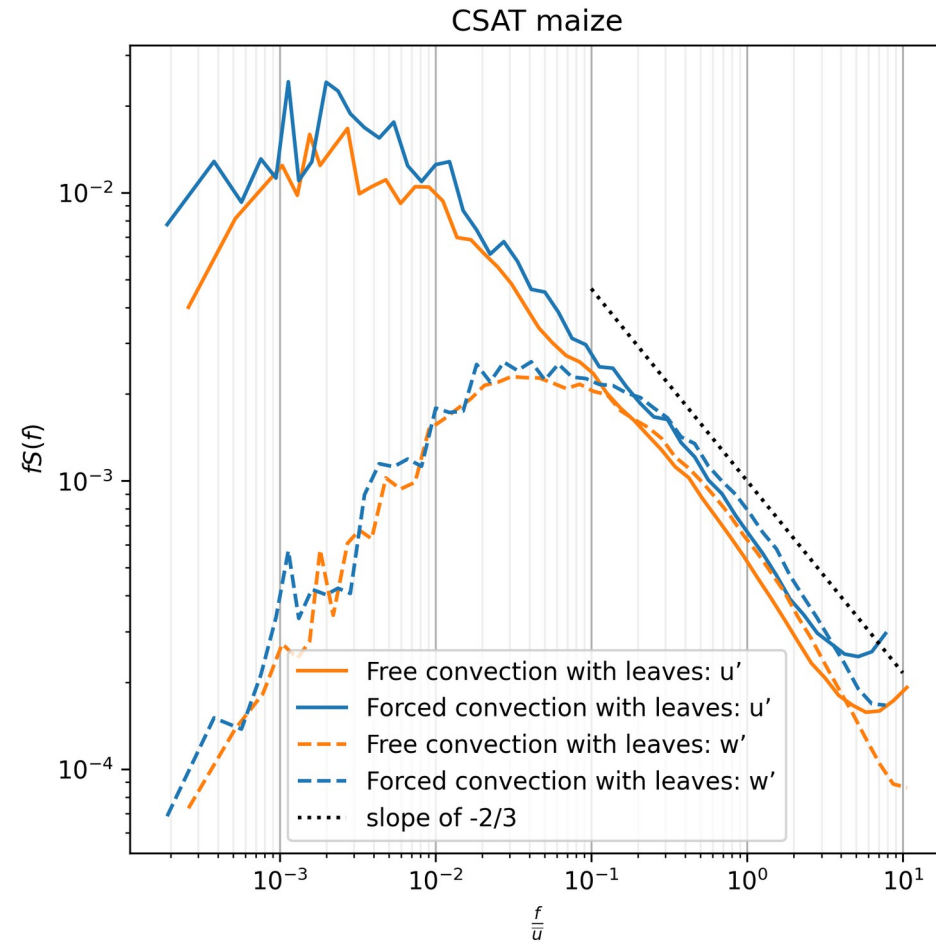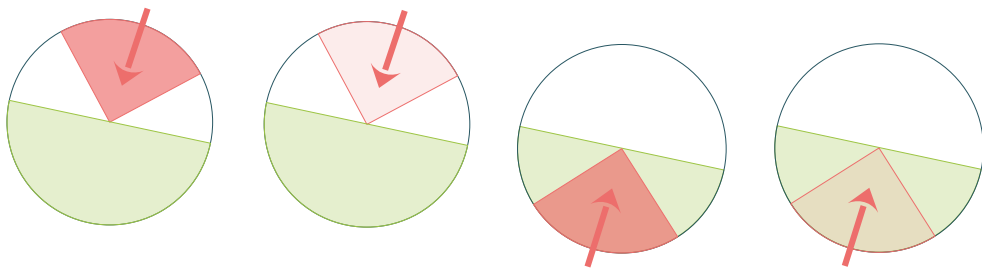
Higher frequencies = smaller eddies

# Spectra at canopy top under different conditions



› u

› 27 m

› w

› 9 m
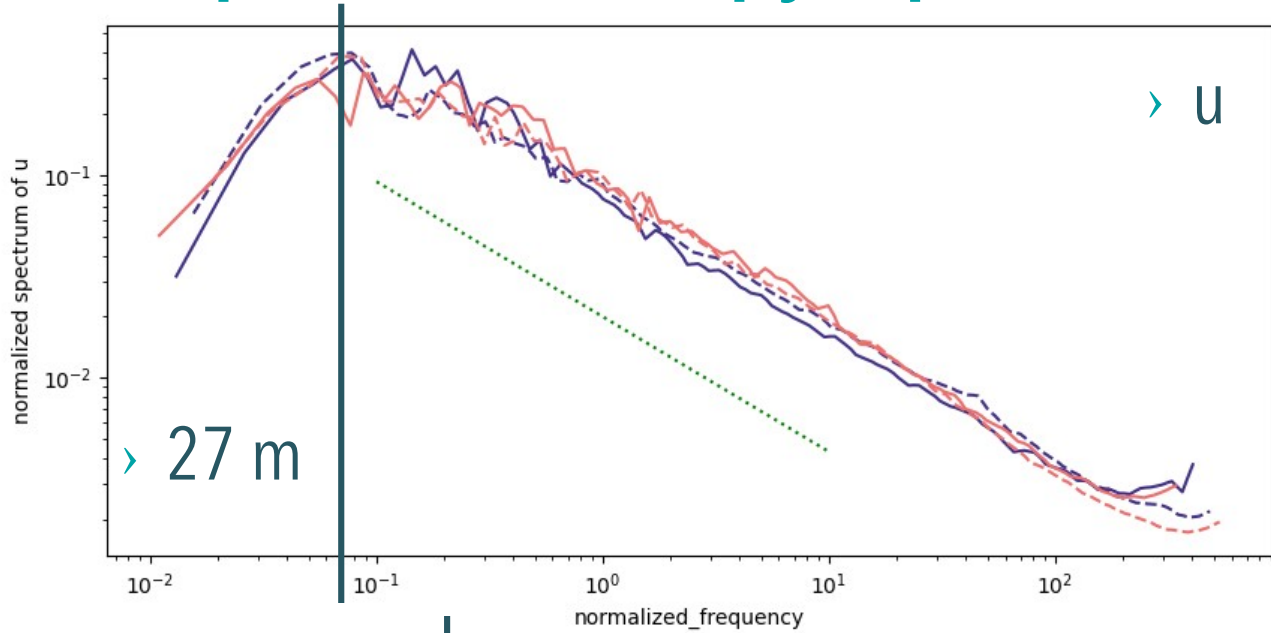
› Expected behaviour
› No impact of wind direction or atmospheric stability

› Normalised frequency : (h-d) / u  * fq

› Λ = (h-d) / (2 * π * normalized_fq)
  (Kaimal & Finnigan 1994)
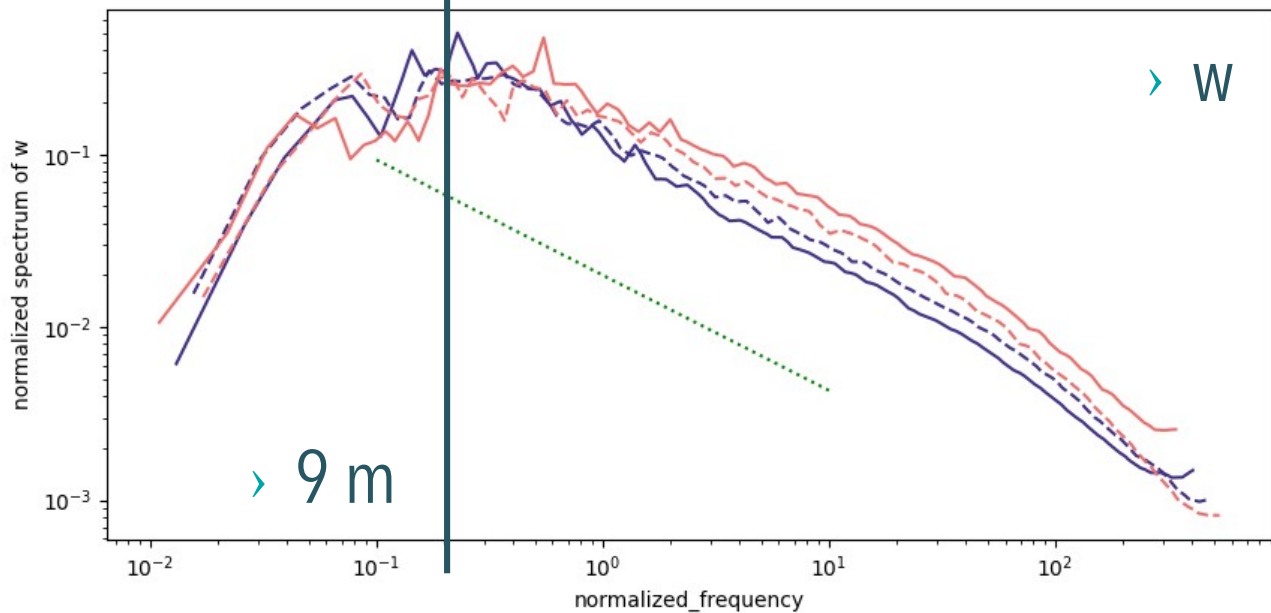
High wind from edge (79)
Low wind from edge (113)
High wind from forest (25)
Low wind from forest (64)
slope of -2/3

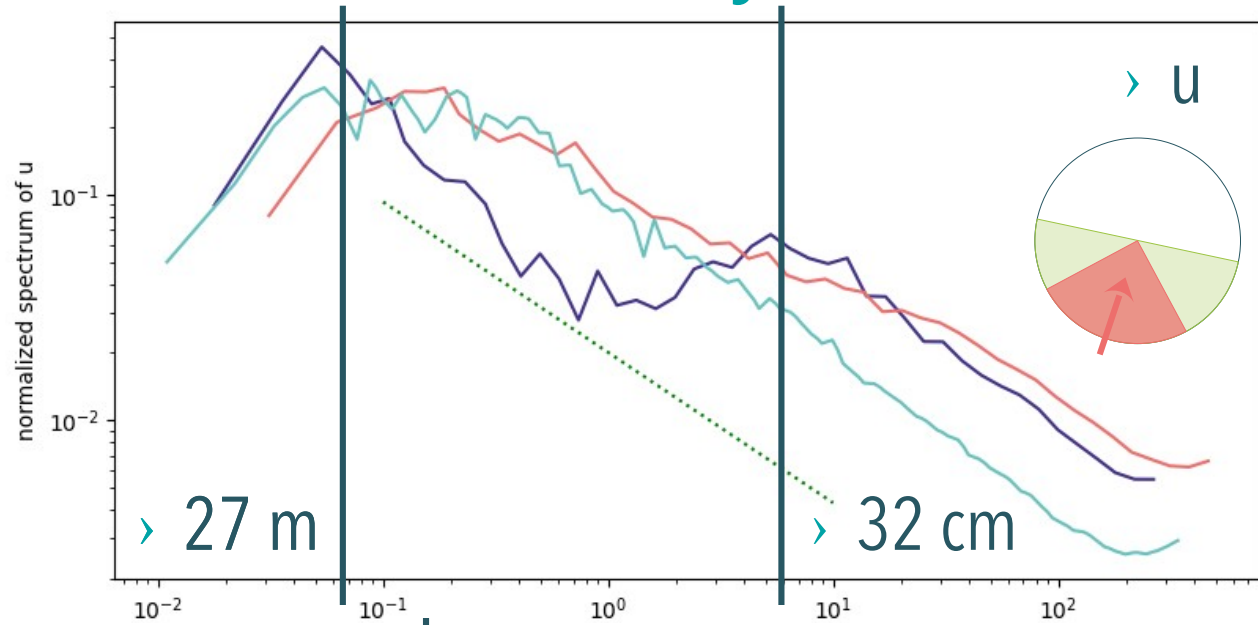# Constant flux layer above maize and forest



› 27 m

› 32 cm

› u

› 10 m

› u
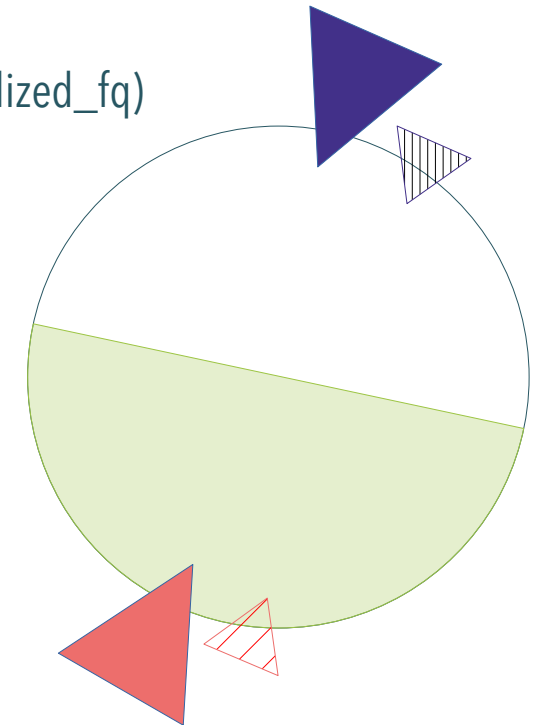
Edge understorey
Forest understorey
Canopy top
slope of -2/3

› Secondary bump in edge understorey

› Fast decrease of forest energy at high frequencies

› Peak shifted in forest understorey: think about the normalisation
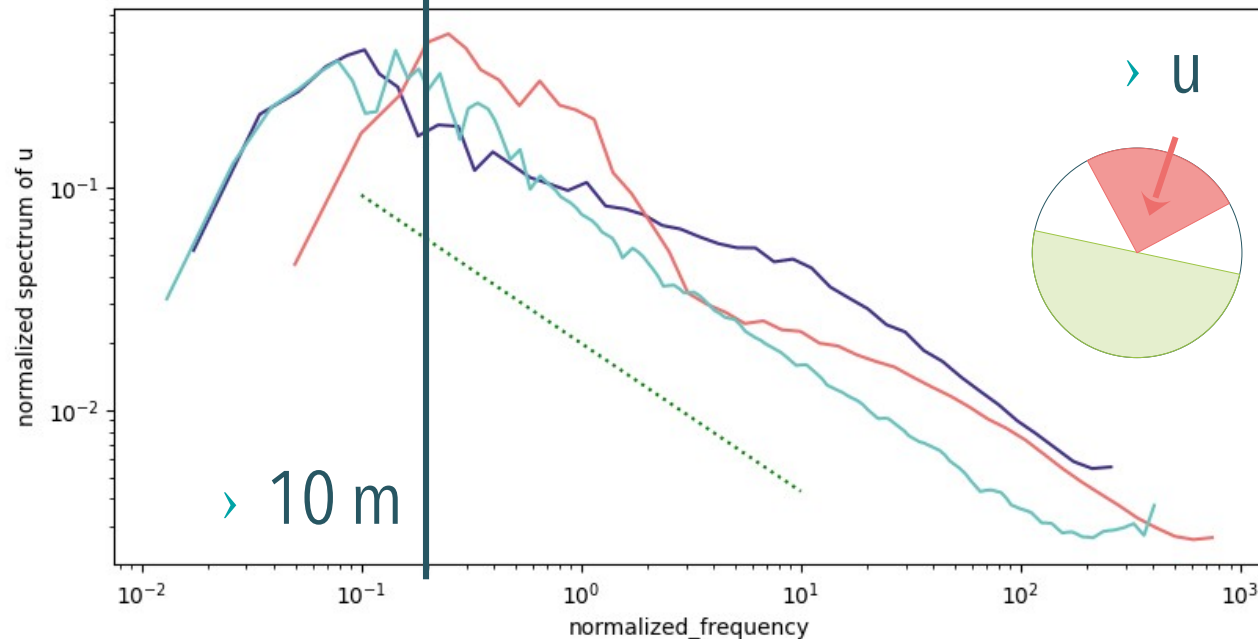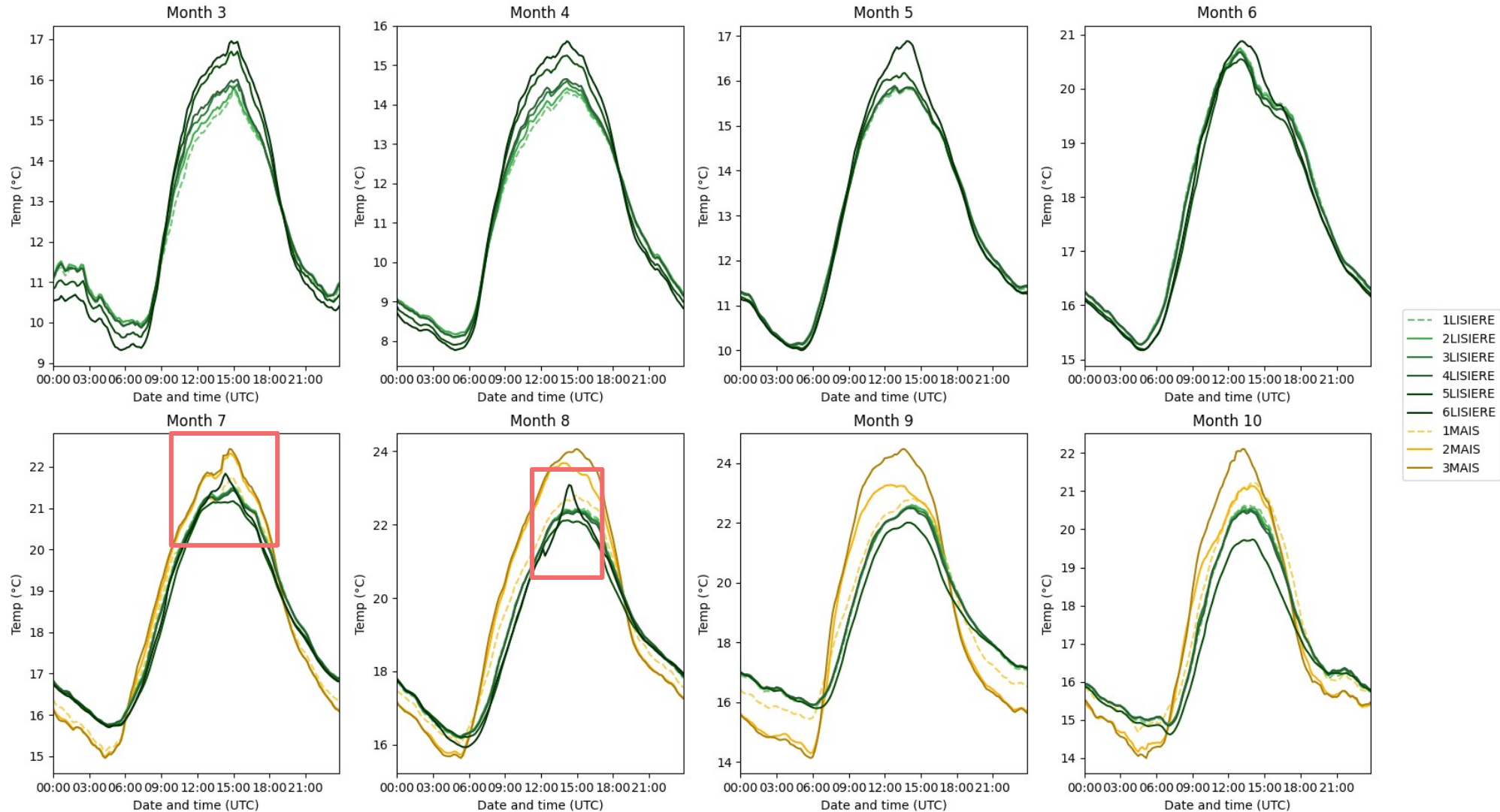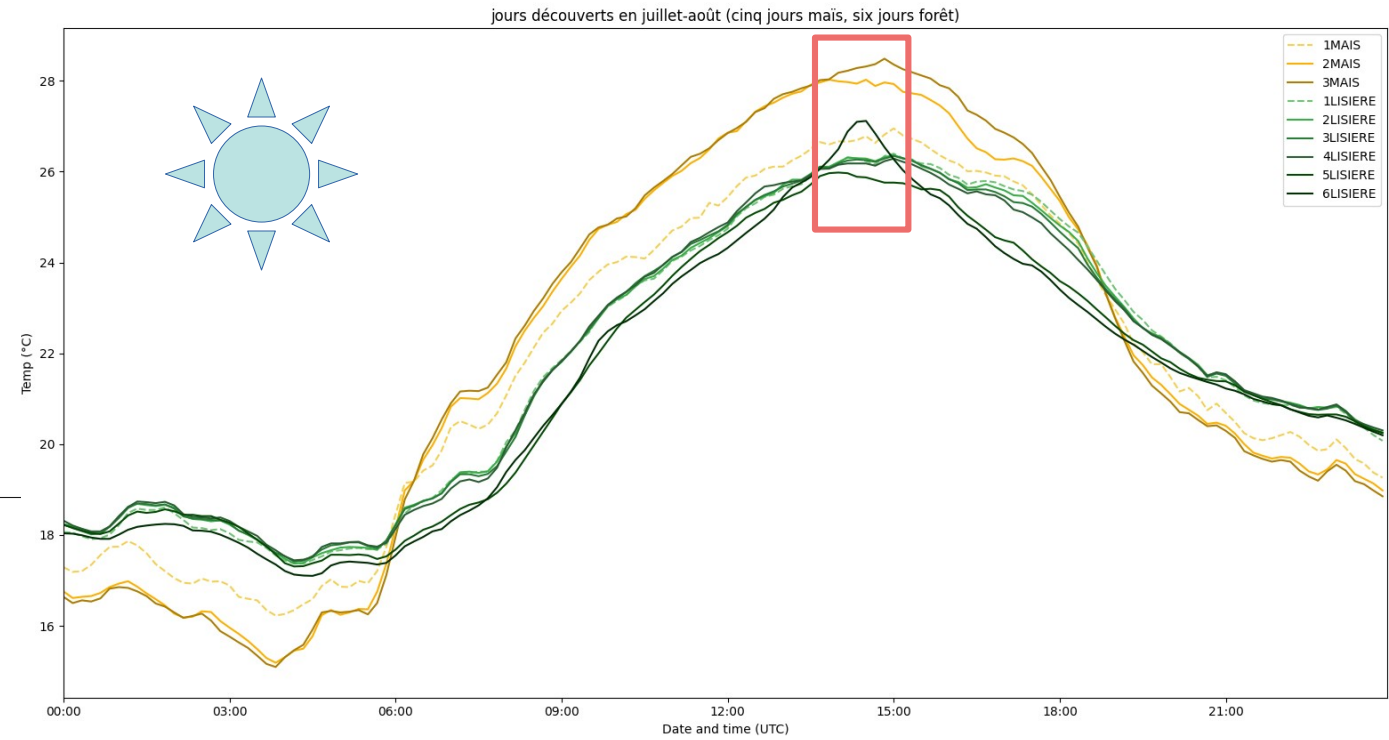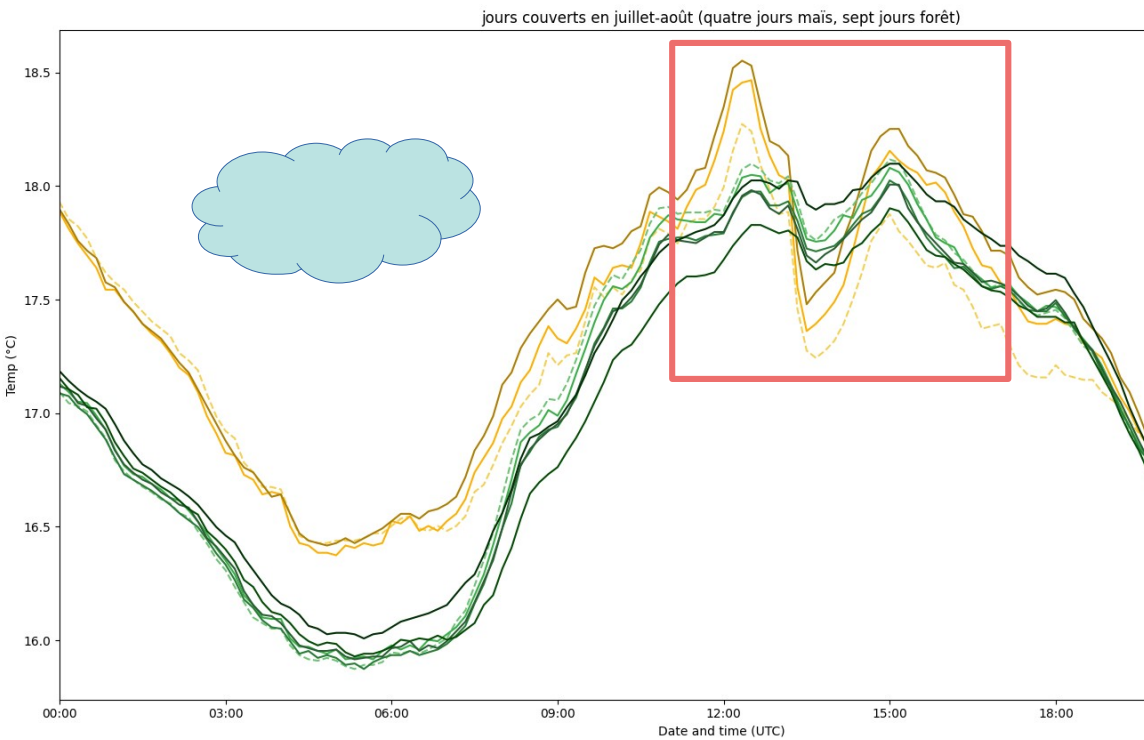
# Transect of temperature and humidity across the edge



Monthly averaged diurnal cycle

# Transect of temperature and humidity across the edge



Monthly averaged diurnal cycle

# Transect of temperature and humidity across the edge



jours découverts en juillet-août (cinq jours maïs, six jours forêt)

jours couverts en juillet-août (quatre jours maïs, sept jours forêt)
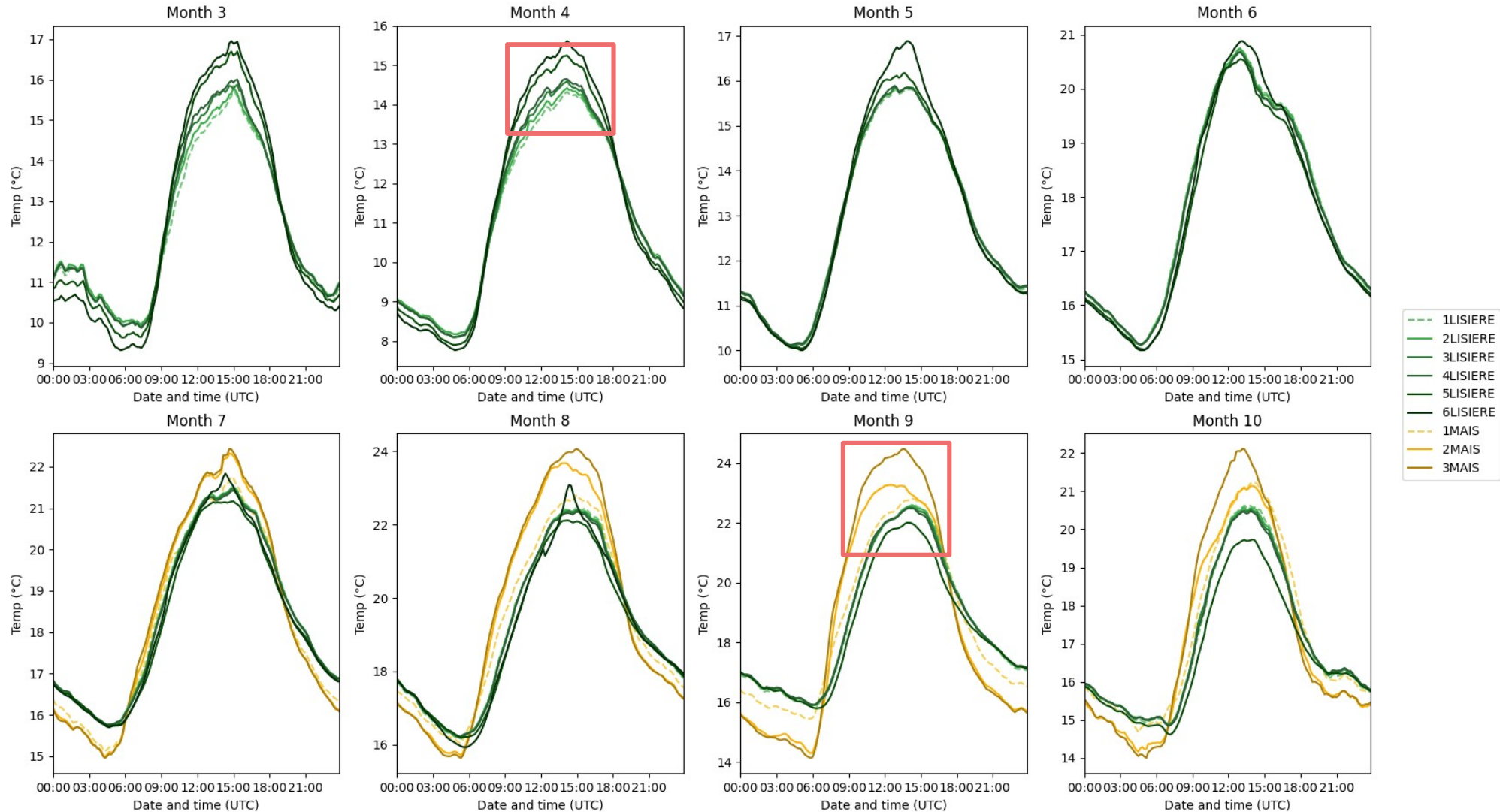
# Summary and conclusions

› Lots of things left to understand in the data
  › spectra, appropriate normalisation & size of structures
  › yearly evolution
  › decoupling, turbulence differences from under and above the canopy

› Determine edge flow main features from the measurements
  › check if simulations reproduce the behaviours

› Share the data