

Introduction

- Volatile organic compounds (VOCs) contribute to production of pollutants harmful to human health and the environment.
- Most VOCs (90 %) are biogenic (BVOCs).
- Forests account for 55 % of the total VOC emissions, crops 27 %, and grasslands, wetlands and shrubs 18 % (Karl, 2009).
- These estimates lack of data measured at the ecosystem scale.

Objectives

- In this work we measured VOC fluxes above the mixed Rambouillet forest south west of Paris during the ACROSS 2022 summer campaign
- The objective is to evaluate
 - 1) Emissions of constitutive VOC,
 - 2) Emissions in response to heat and drought stresses,
 - 3) VOC formation in the canopy.

Measurements

Site description:

The Rambouillet mixed forest dominated by oak and pines

Flux @ 40 m

Profile @ 1, 5, 10, 20 and 40 m

Measurements set up

- PTR-Qi-TOF-MS with E/N: 120Td
- 10 Hz on-line peak integration and data storage
- Eddy covariance and profiles of VOCs, NO_x and O₃
- CO₂ and H₂O fluxes and profiles

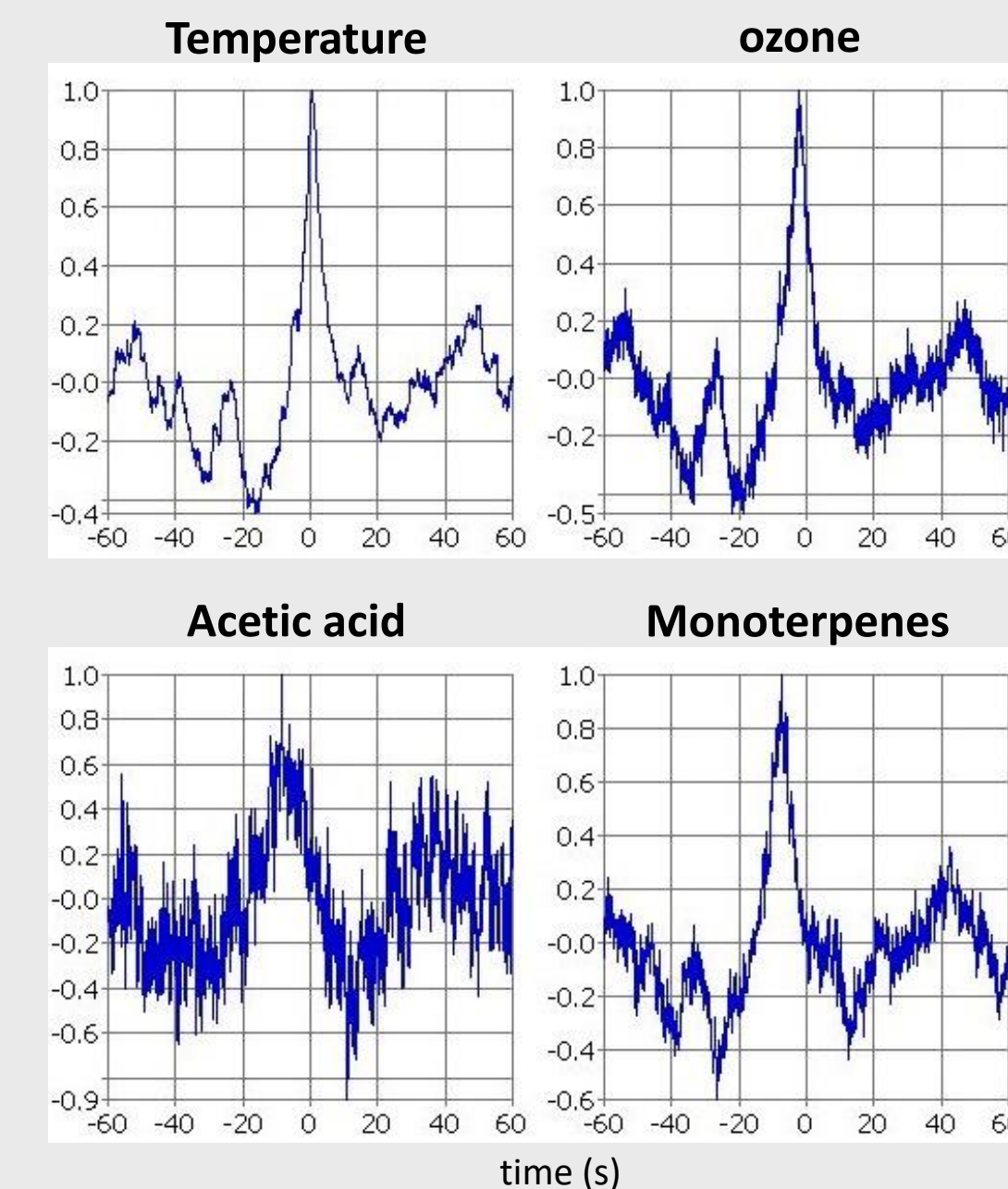


Essences	% area
Oak	68%
Pines	19%
Open spaces	6%
other deciduous	3%
Beech	2%
Chesnut	2%

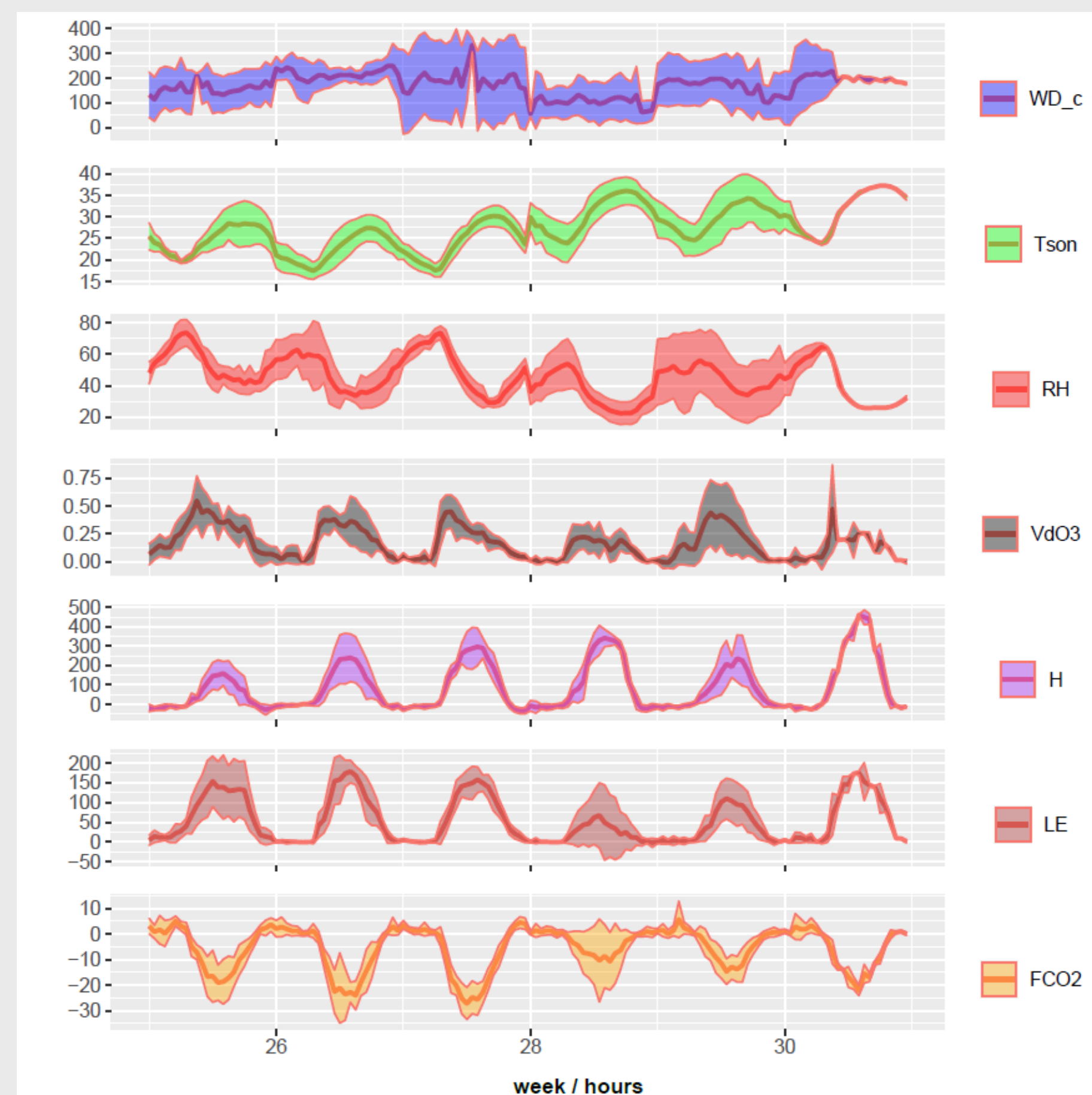


A view to the west of the tower (showing a mix between pines and oaks or beech)

Typical cross correlation functions between *w*, the vertical wind speed component and the concentration of a compound. A clear maximum or minimum can be seen indicating good conditions for Eddy covariance flux measurements. The maximum of the function determines the lag time which was around 5 seconds.



CO₂, heat and O₃ fluxes & micromet



The period was rather dry and hot with a few intense rainfall events.

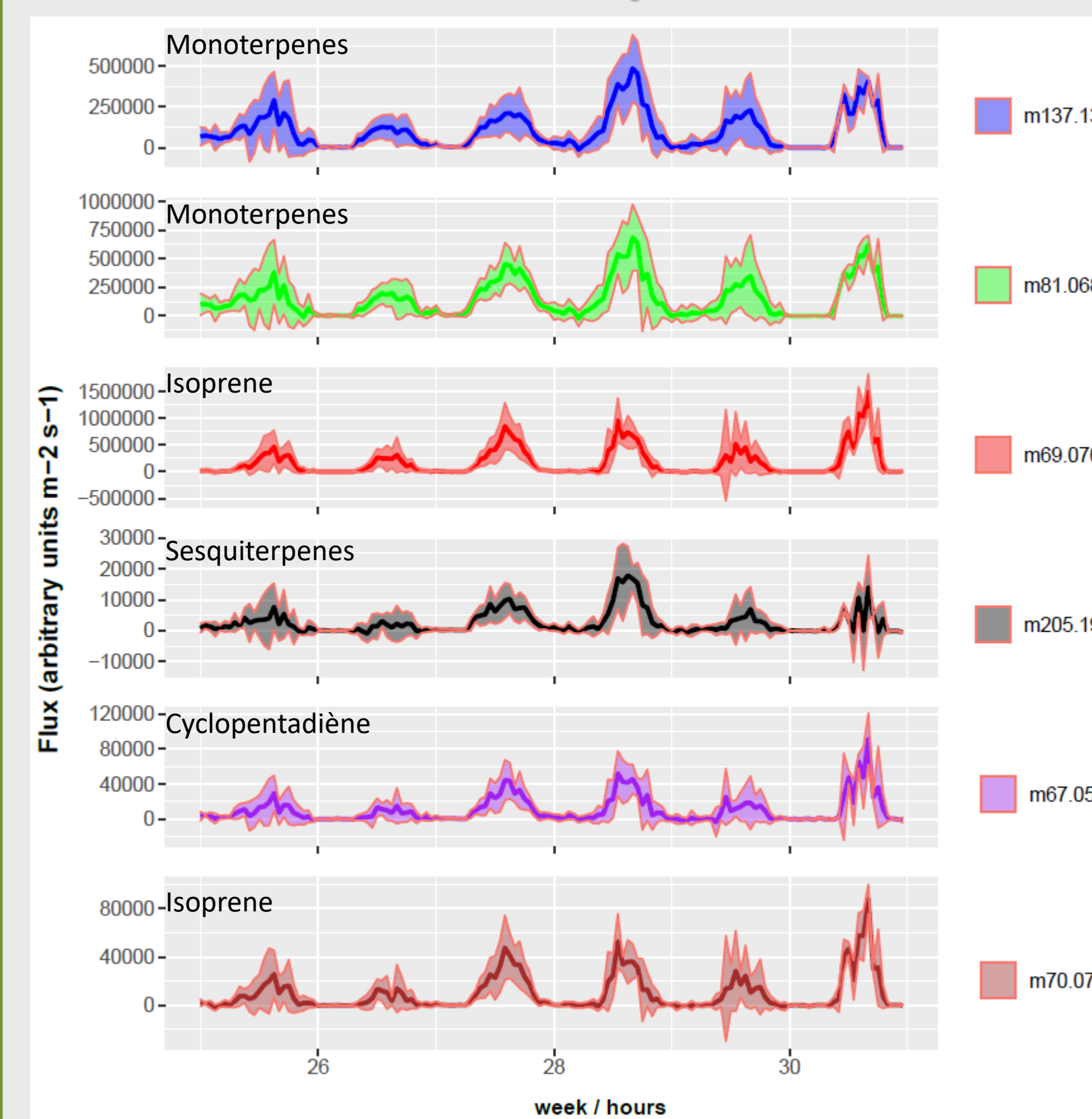
The week 28 (and also a bit 29) showed a marked decrease in CO₂ and latent heat (LE) fluxes, indicating a temperature or drought stress.

The ozone deposition velocity (VdO₃) was quite high showing a consistent deposition

Ozone deposition was higher in the morning in week 26 and 27 than in week 29 and 30

A marked wind direction change was observed between weeks 26 and week 28

Emitted compounds



The forest was a large emitter of monoterpenes but also of isoprene suggesting the flux footprint was dominated by pine.

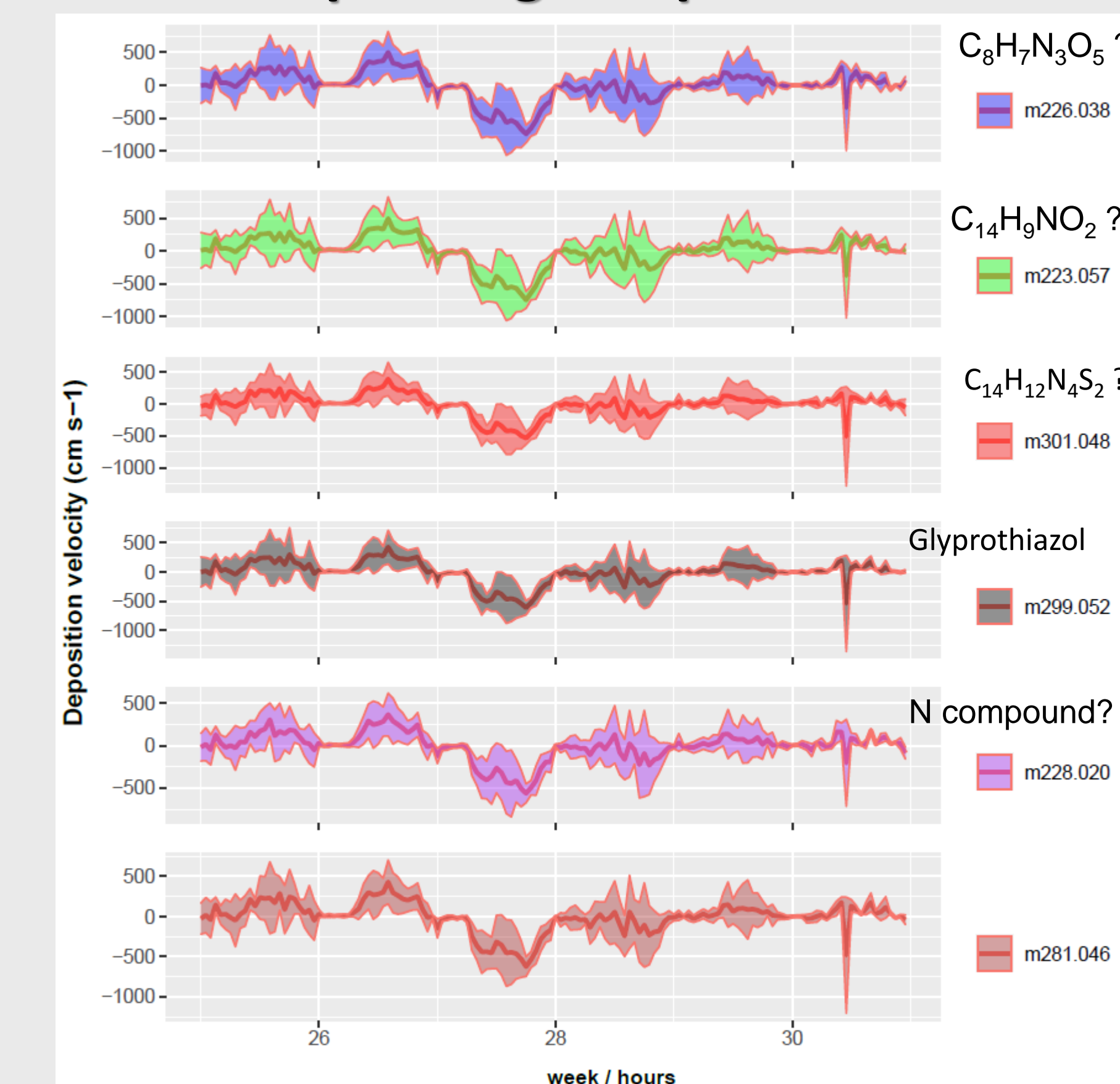
Sesquiterpenes were also emitted consistently

The week with a marked stress (29) was also showing the largest fluxes of terpenes.

80 compounds showed a flux significantly larger than noise

Results

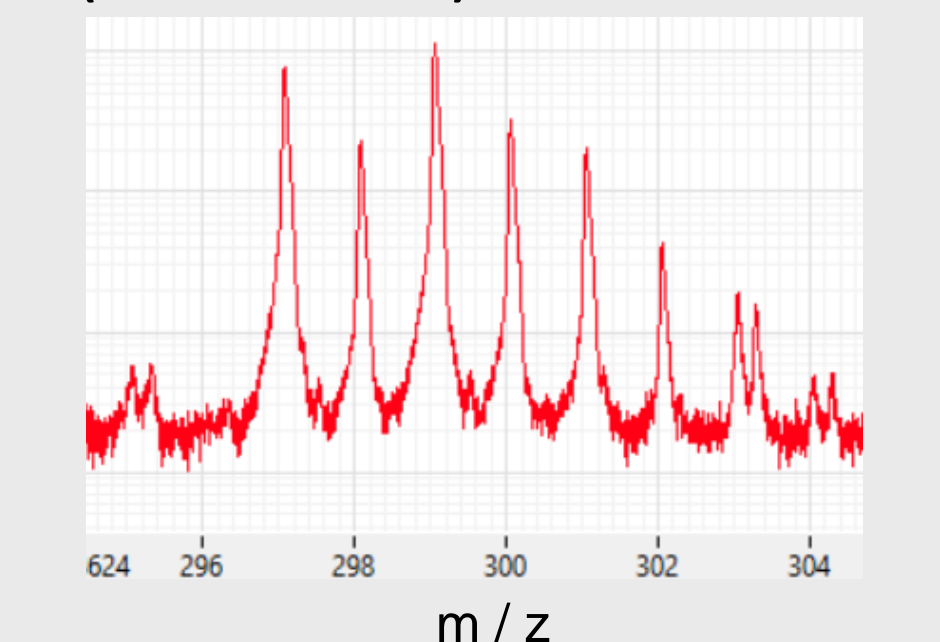
Depositing compounds



A lot of heavy compounds showing a high deposition flux in weeks 25 & 26 and an emission flux on week 27

Nitrogen and sulphur compounds are likely.

Large isotopic clusters will help identification (see below)



Preliminary conclusions

- The Across VOC flux campaign showed emissions and deposition of more than 80 VOC at 40m above the ground.
- An interesting heatwave event has led to clear decrease in photosynthesis and transpiration from the forest in week 28. This period also corresponds to the highest emissions
- Deposition of VOC with high masses was also observed, containing possibly nitrogen or sulphur.