

Volatile Organic Compounds: Concentrations and Fluxes at a Belgian Mixed Forest Site

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1. Introduction

i) Background

Above-canopy CO₂ turbulent flux measurements have been performed at Vielsalm, Belgium (BE-Vie) since the 90s. From 2009 to 2011, these fluxes were extended to include a selection of VOCs often exchanged between terrestrial ecosystems and the atmosphere, using a PTR-Quad-MS instrument. Recently, we returned to the site with new instruments to extend characterization by including a plethora of additional VOCs and ozone.

ii) Objectives

Obtain **multi-year** data at the mixed forest site in Belgium to identify VOCs and their above-canopy fluxes.

Quantify the role of **bio-physico-chemical processes** in the **soil-canopy-atmosphere** continuum affecting VOC concentrations and fluxes.

2. Campaign description

i) Site description

Mixed forest ecosystem in the Integrated Carbon Observation system (ICOS) network located in the Belgian Ardenne at about **450 m a.s.l.** and characterized by a **temperate maritime climate**.

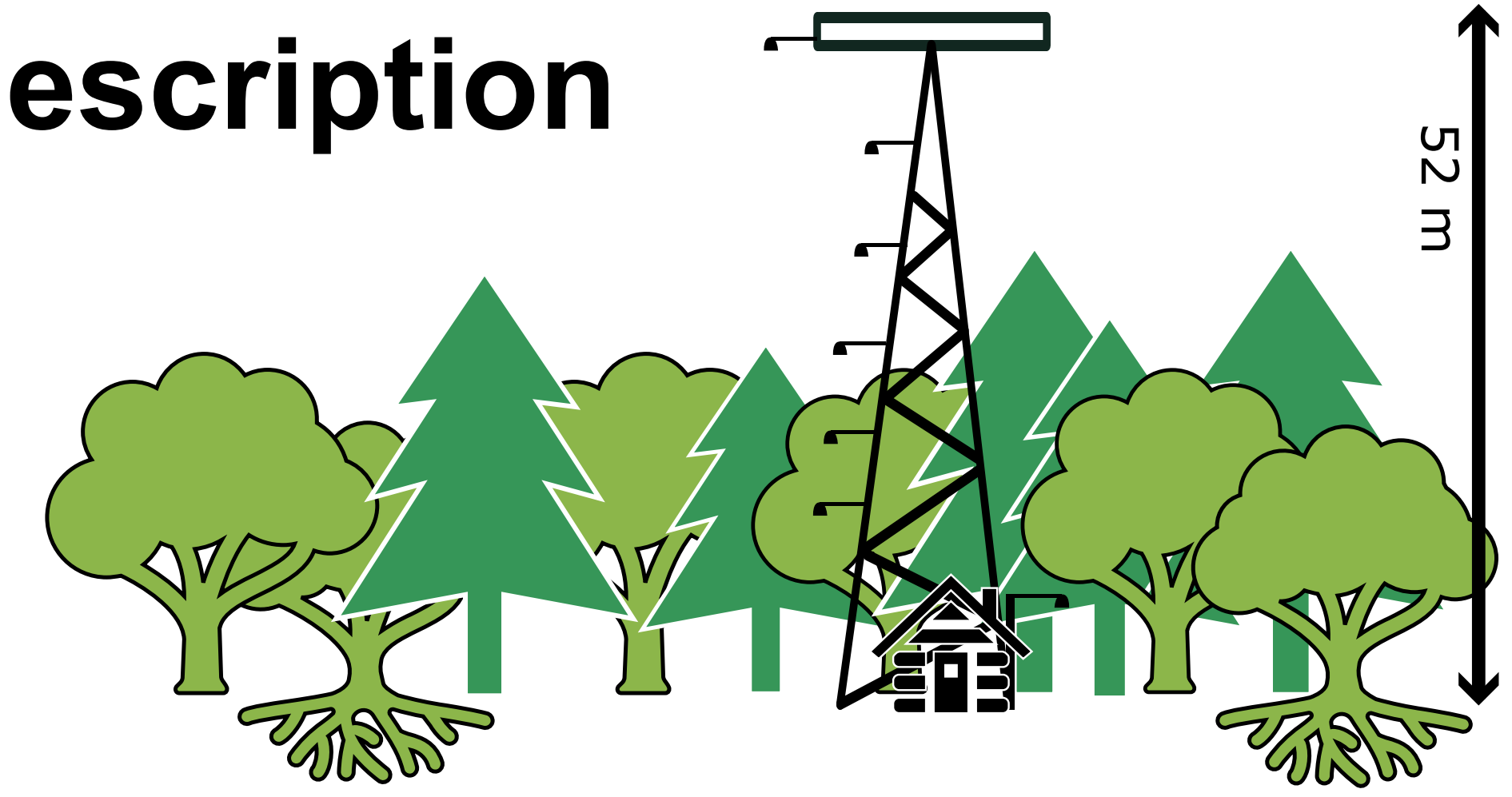
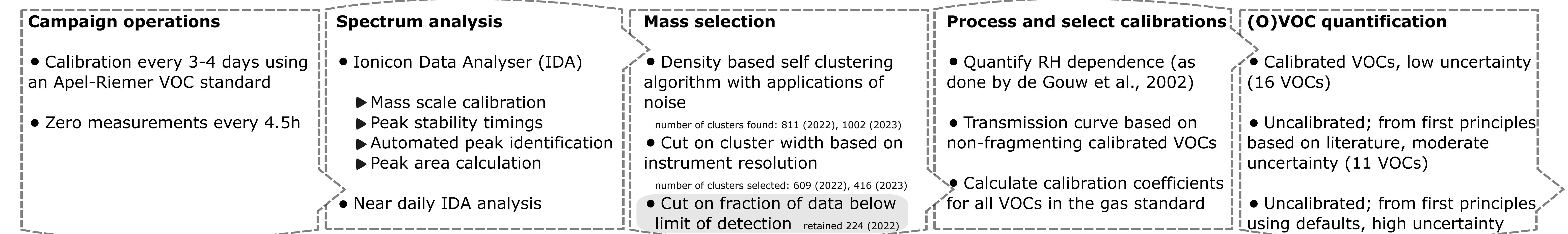


Fig 1: Schematic representation of measurement site.

ii) Instrumentation

- **PTR-TOF-MS** (PTR-TOF-4000, Ionicon Analytik GmbH): sample **above-canopy** (52 m a.g.l.), **trunk space** (3 m a.g.l.; 2023), **profile** (trunk space + 5 points along tower)
- **Sonic anemometers**: above canopy, trunk space (2023), profile (2 instruments)
- Above canopy **fluxes** calculated by eddy covariance (GEddySoft, based on InnFlux)

3. (O)VOC quantification



4. Results

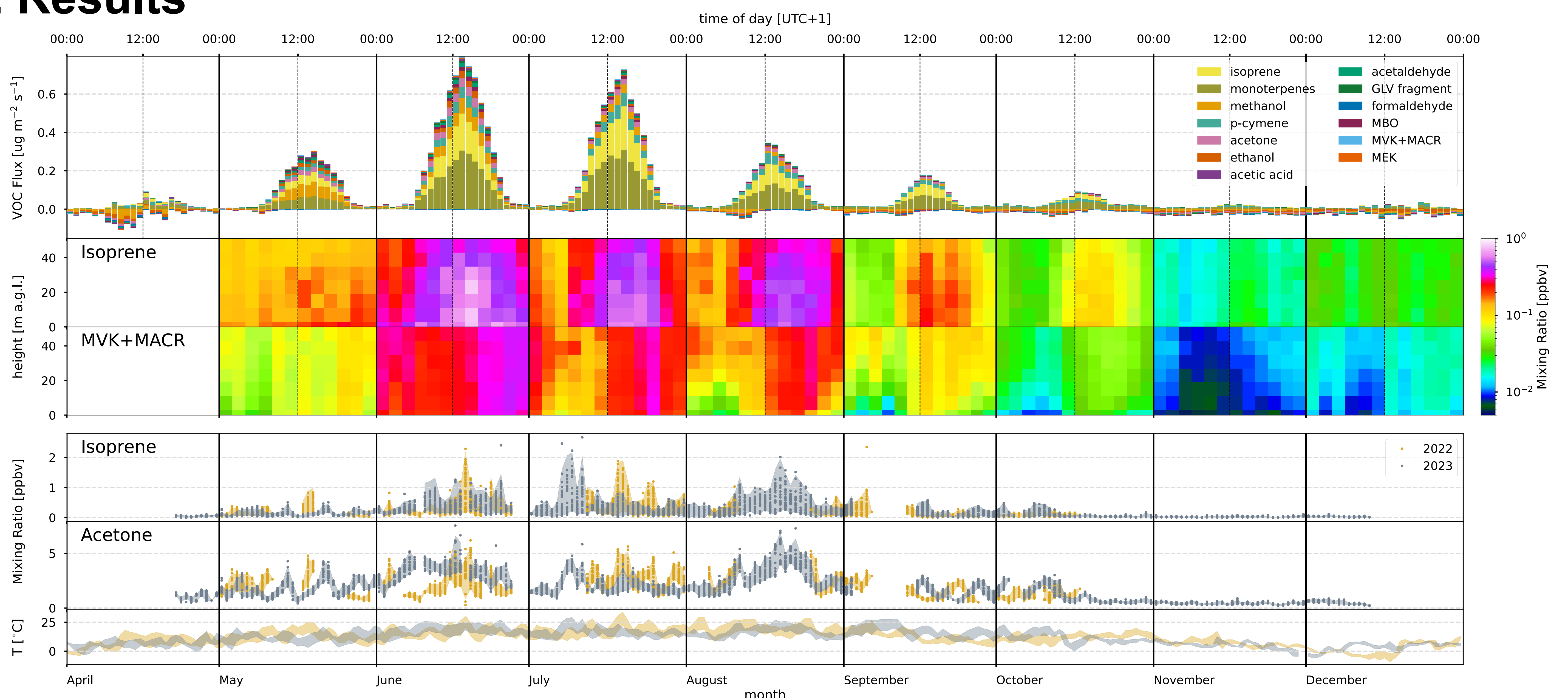


Fig 2: Top, monthly median diel profile of VOC fluxes (for the 13 most exchanged VOCs), calculated using the eddy covariance method. Second and third rows, monthly median diel vertical concentration profiles of isoprene and its oxidation products, respectively. Fourth and fifth rows, daily 10 minute average concentrations in 2022 (yellow) and 2023 (gray) for isoprene and acetone, respectively. Bottom row, daily temperature in 2022 (yellow) and 2023 (gray).

5. Conclusion & Preliminary Analyses

Two growth seasons of VOC concentrations in a mixed forest environment were obtained and are currently being analysed. Preliminary results:

- 60% of NMVOC-OH reactivity originates from tracers present in the calibration gas standard.
- Mixed forest site, nearby saw-mill and industrial sites complicate VOC concentration analysis.

- **Bi-directional exchange** of low molecular mass OVOCs, deposition enhanced with RH.
- **Emission bursts** for selection of compounds after bud break.
- **10 compounds** account for 90% of total exchanged mass.

6. Prospects

Measurements

- The **2024** campaign has started in early June and is currently ongoing.
- In **2025**, a campaign is scheduled at this site with added **NO_x** measurements.

Data analysis

- Perform a **flux driver analysis**, using data from ICOS ecological follow-up.
- Apply **matrix factorization** to identify mesoscale sources.

Modelling

- Compare fluxes with emissions from **MEGANv3**.
- Apply **1-D canopy model with chemistry** (FORCAST).
- Perform a **Lagrangian inversion** of vertical profiles.