

Source characterization of reactive carbon in a mixed forest ecosystem (Vielsalm, BE)

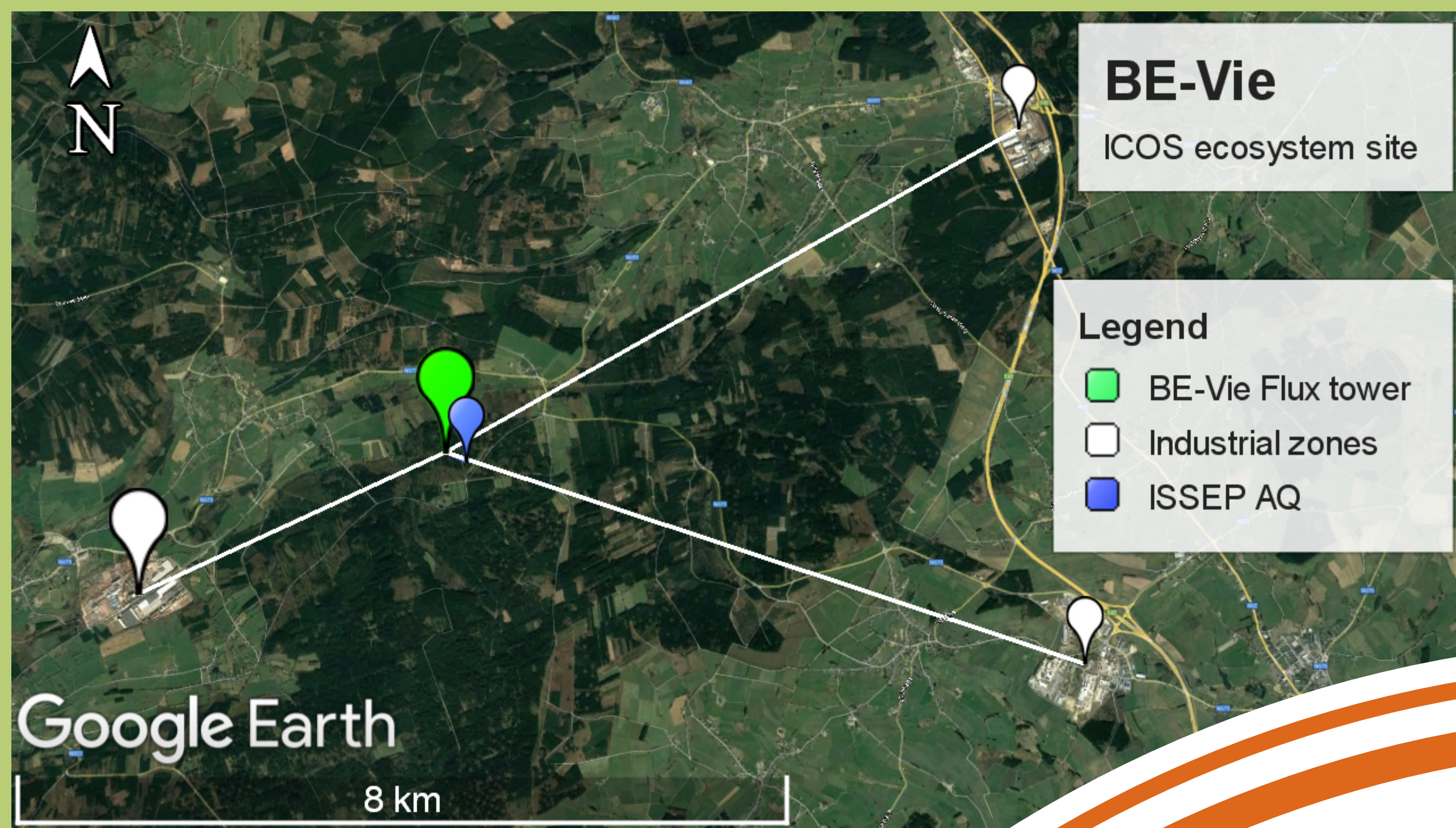
B. W. D. Verreyken^{1,2}, C. Dumont²,
N. Schoon¹, B. Heinesch², C. Amelynck^{1,3}

LIÈGE université
Gembloux
Agro-Bio Tech



1. Royal Belgian Institute for Space Aeronomy (BIRA-IASB), 1180, Belgium
2. Gembloux Agro-Bio Tech, Biosystems Dynamics and Exchanges (BIODYNE), 5030, Belgium
3. Department of Chemistry, Ghent University, 9000, Belgium

1. Measurement site



Mixed forest ecosystem in the Integrated Carbon Observation system (ICOS) network located in the Belgian Ardennes.

Data presented here from the **2022 growth season** (May-October).

2. Objectives

i) Source Identification

What are the chemical signatures present in our dataset?
Can we **attribute** these signatures to specific sources/processes?

ii) Source localization

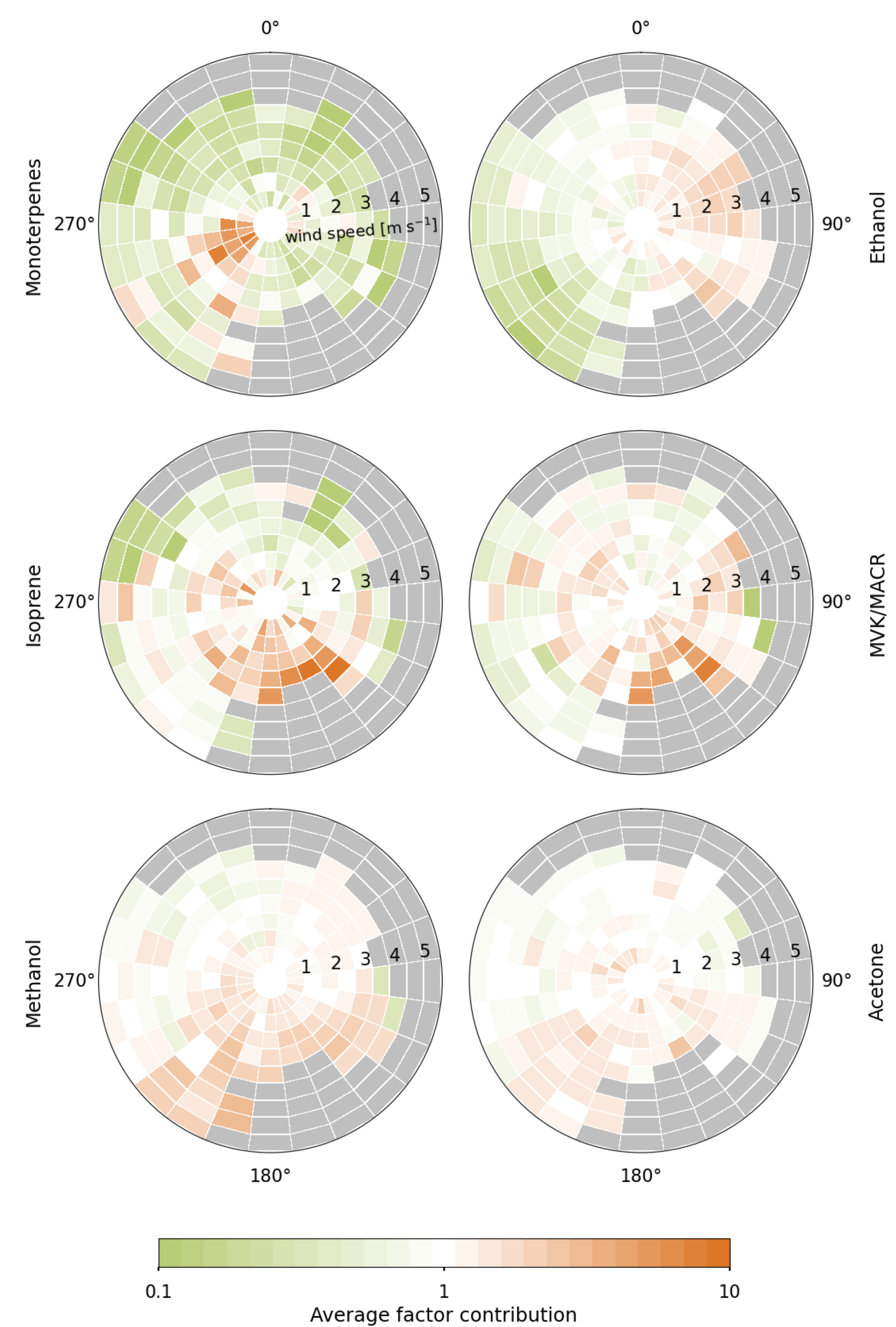
Can we identify **where** these chemical signatures originate from?

iii) Chemical reactivity

How do the different chemical signatures affect **OH-reactivity**?

4. Results

ii) Factor contribution pollution roses

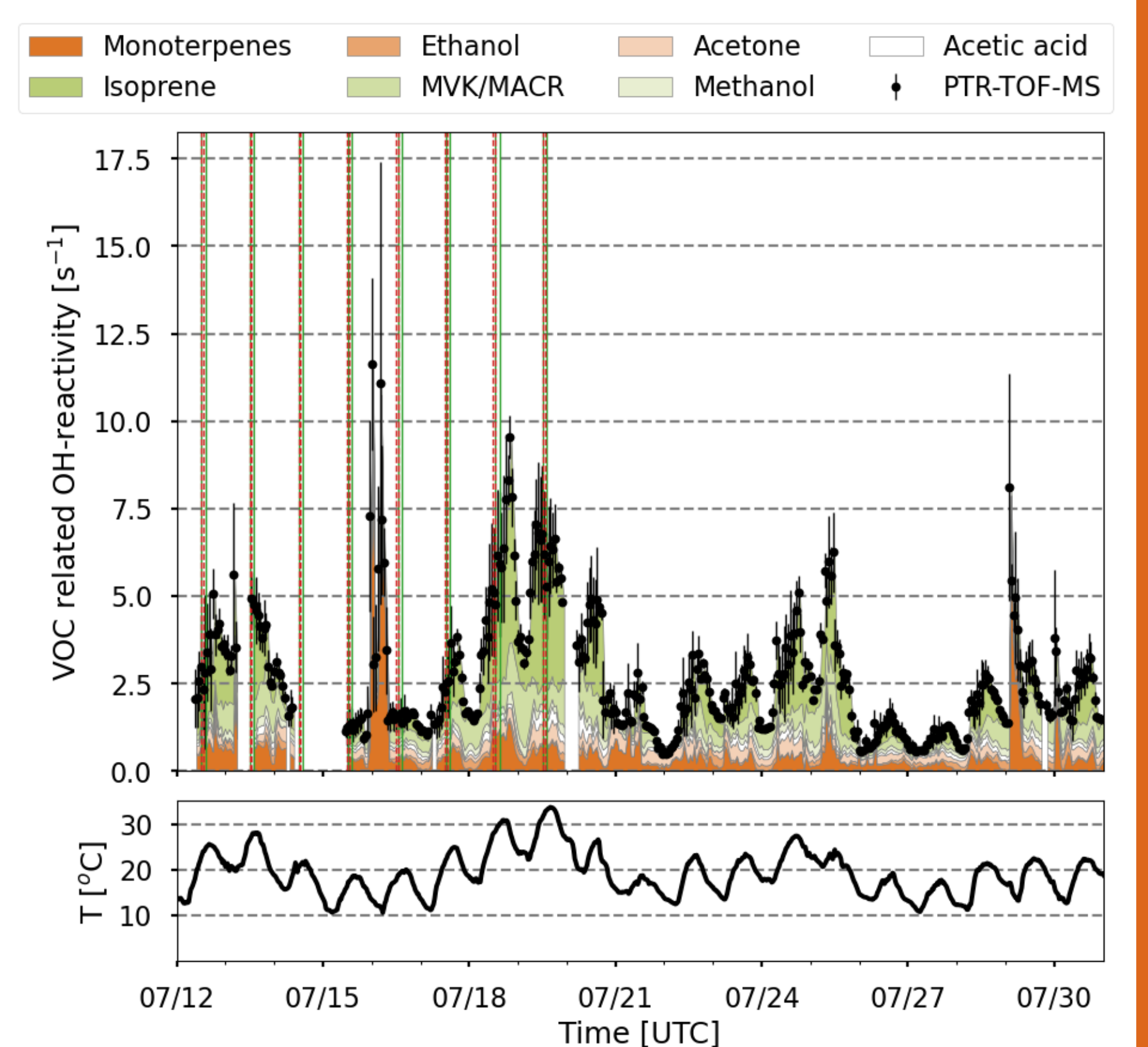


i) Factor profiles

| Observed VOC (H ⁺) | Monoterpenes | Trimethylbenzene | C8-Aromatics | Toluene* | MEK | C ₅ H ₁₀ .H ⁺ | MVK/MACR | Isoprene | C ₂ H ₄ O ₂ .H ⁺ | Acetone | Ethanol | Acetaldehyde | Methanol |
|--|--------------|------------------|--------------|----------|------|--|----------|----------|--|---------|---------|--------------|----------|
| Monoterpenes | 90.3 | | | | | | | | | | | | |
| Trimethylbenzene | 18.6 | 56.8 | 7.9 | 10.9 | 5.8 | | | | | | | | |
| C8-Aromatics | 2.2 | 17.0 | 63.9 | 5.3 | 11.5 | | | | | | | | |
| Toluene* | 8.7 | 22.2 | 47.0 | 5.2 | 16.9 | | | | | | | | |
| MEK | 25.8 | | 36.4 | 11.3 | 21.0 | | | | | | | | |
| C ₅ H ₁₀ .H ⁺ | 15.5 | 7.2 | 54.1 | 0.6 | 22.6 | | | | | | | | |
| MVK/MACR | 2.4 | | 68.4 | | 29.2 | | | | | | | | |
| Isoprene | 3.1 | | | 24.6 | 62.8 | 9.6 | | | | | | | |
| C ₂ H ₄ O ₂ .H ⁺ | 23.9 | 0.7 | 5.6 | 30.3 | | 39.5 | | | | | | | |
| Acetone | 18.6 | 0.2 | 17.9 | 17.8 | 45.5 | | | | | | | | |
| Ethanol | 22.2 | 0.1 | 72.9 | 0.6 | 3.6 | 0.6 | | | | | | | |
| Acetaldehyde | 22.1 | 4.8 | 32.2 | 17.2 | 16.4 | 1.5 | 5.7 | | | | | | |
| Methanol | 92.7 | 4.9 | | | 0.1 | 2.3 | | | | | | | |

PMF factor dominant compound

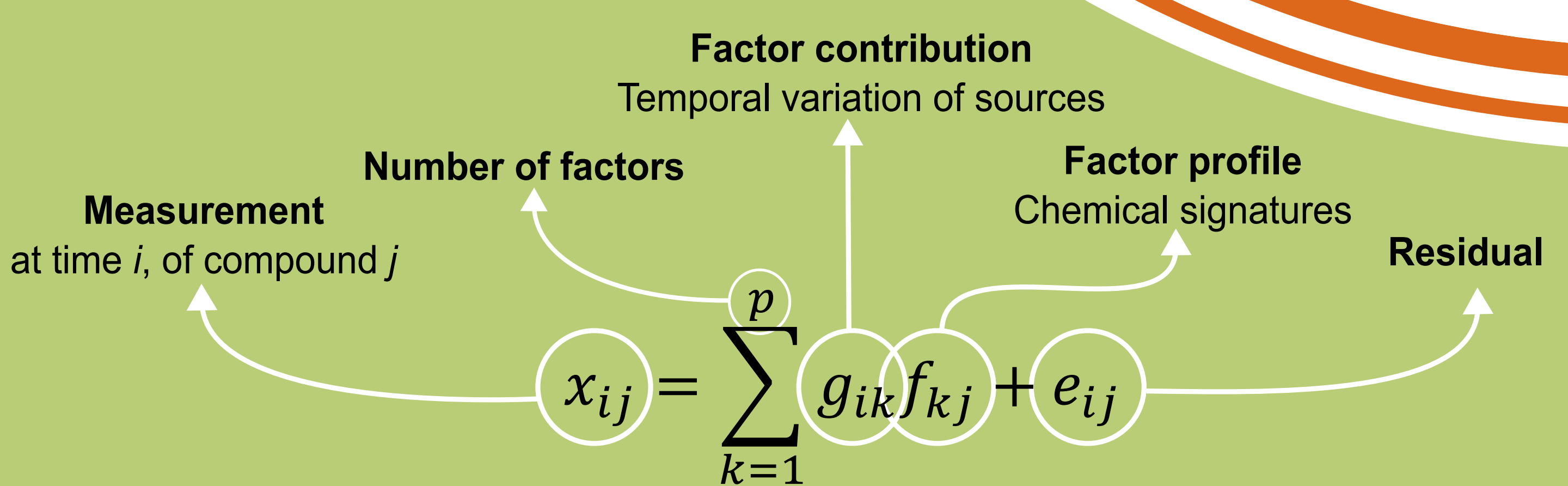
iii) Factor based OH-reactivity



Data shown for OH-reactivity are hourly averages (July 2022)

3. Methodology

i) Positive Matrix Factorization



ii) VOC related OH-Reactivity calculation

VOC related OH-Reactivity of source k , at time i

Reaction rate constant between compound j and OH

$$R_{i,k} = \sum_j k_{OH-VOC,j} g_{i,k} f_{k,j}$$

5. Conclusions

Monoterpenes factor

Origin: Mainly sawmill, southwest of site
Local contributions from biogenic sources
OH-reactivity: 0.6 ± 1.2 (22.8) s^{-1}

Isoprene factor

Origin: Biogenic, highest contributions from the South-East
OH-reactivity: 1.0 ± 1.2 (11.1) s^{-1}

Methanol factor

Origin: Unknown, broad southern source
OH-reactivity: 0.2 ± 0.1 (0.6) s^{-1}

Acetic acid factor

Origin: Unknown, uniform pollution rose (not shown)
OH-reactivity: 0.1 ± 0.1 (0.7) s^{-1}

Ethanol factor

Origin: Industry, sites to the East
OH-reactivity: 0.1 ± 0.1 (0.4) s^{-1}

MVK/MACR factor

Origin: Isoprene oxidation
OH-reactivity: 0.5 ± 0.4 (1.7) s^{-1}

Acetone factor

Origin: Unknown, broad southern source
OH-reactivity: 0.3 ± 0.1 (1.1) s^{-1}

OH-Reactivity:
mean \pm std (max) s^{-1}