Trends of Ozone Precursors in Europe
The Campaign in Zürich and Hohenpeissenberg

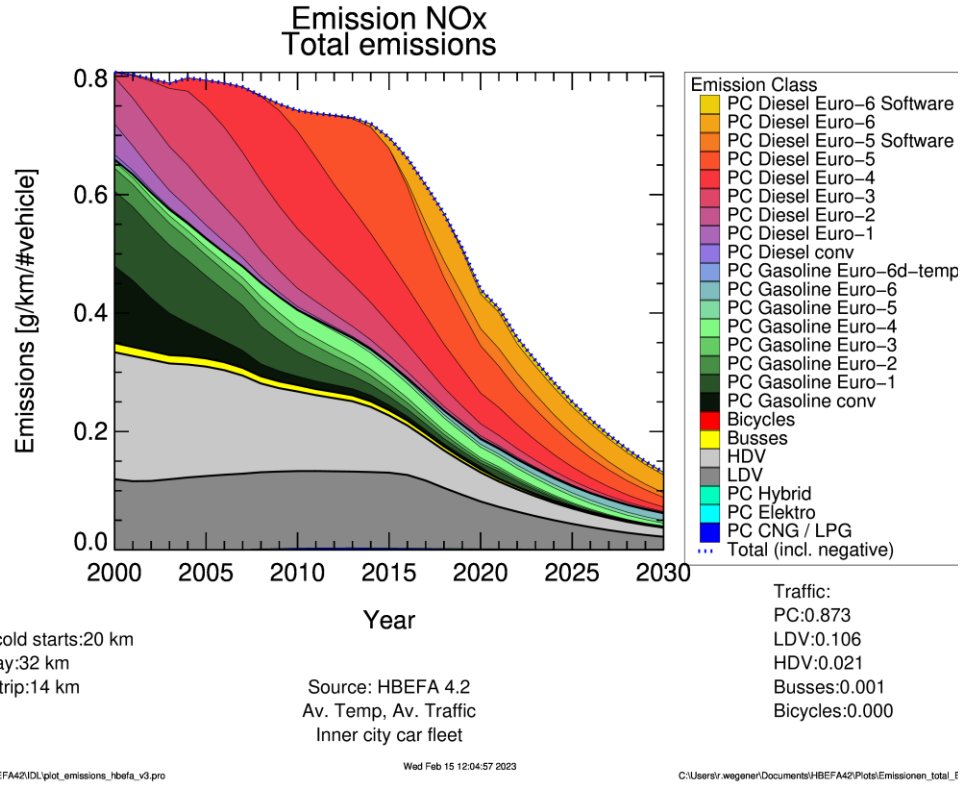
Robert Wegener[1], Thérèse Salameh[2], Anja Claude[3], Franz Rohrer[1], Dieter Klemp[1], Dagmar Kubistin[2], Sverre Solberg[5], Stefan Reimann[4], Max Gerrit Adam[1], Stéphane Sauvage[2], Robert Holla[3]

[1]FZ Jülich, Germany
[2]IMT, France
[2]DWD, Germany
[4]Empa, Switzerland
[5]NILU, Norway

Germany | France | Norway | Switzerland | Germany

ACTRIS and the of TOAR-2 Data

Motivation: VOC and NOx Emissions from Vehicles in Germany



Distance between cold starts:20 km
Mean milage per day:32 km
Mean distance per trip:14 km

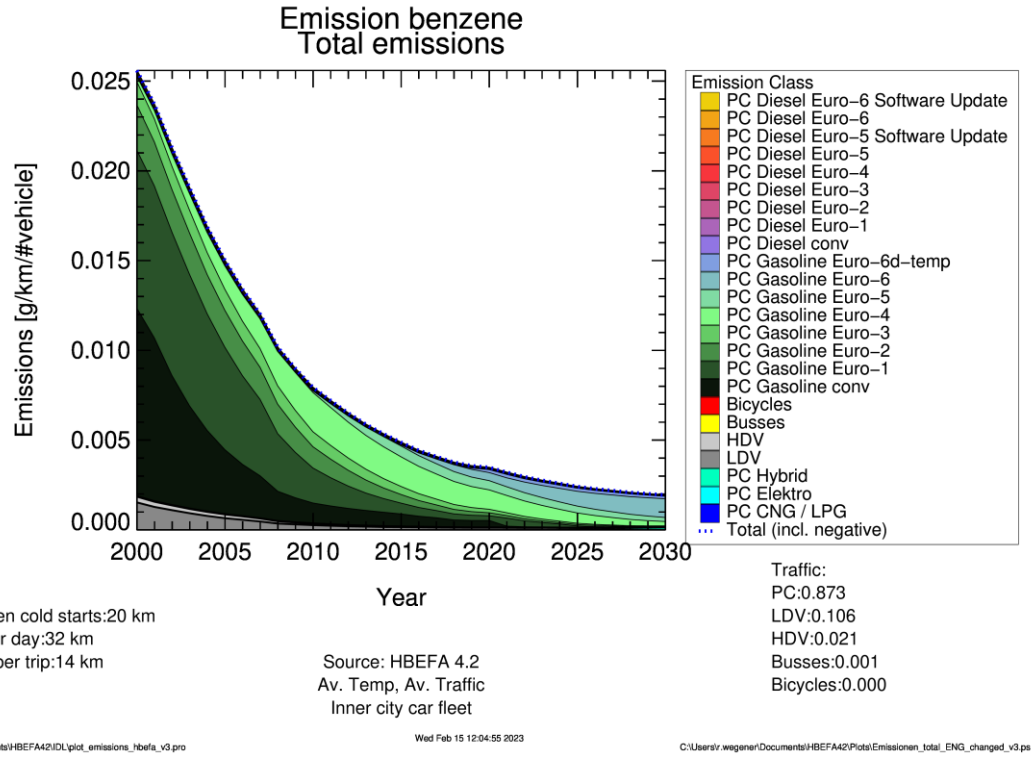
Source: HBEFA 4.2
Av. Temp, Av. Traffic
Inner city car fleet

Traffic:
PC:0.873
LDV:0.106
HDV:0.021
Busses:0.001
Bicycles:0.000

C:\Users\r.wegener\Documents\HBEFA42\IDL\plot_emissions_hbefa_v3.pro

Wed Feb 15 12:04:57 2023

C:\Users\r.wegener\Documents\HBEFA42\Plots\Emissionen_total_E



Distance between cold starts:20 km
Mean milage per day:32 km
Mean distance per trip:14 km

Source: HBEFA 4.2
Av. Temp, Av. Traffic
Inner city car fleet

Traffic:
PC:0.873
LDV:0.106
HDV:0.021
Busses:0.001
Bicycles:0.000

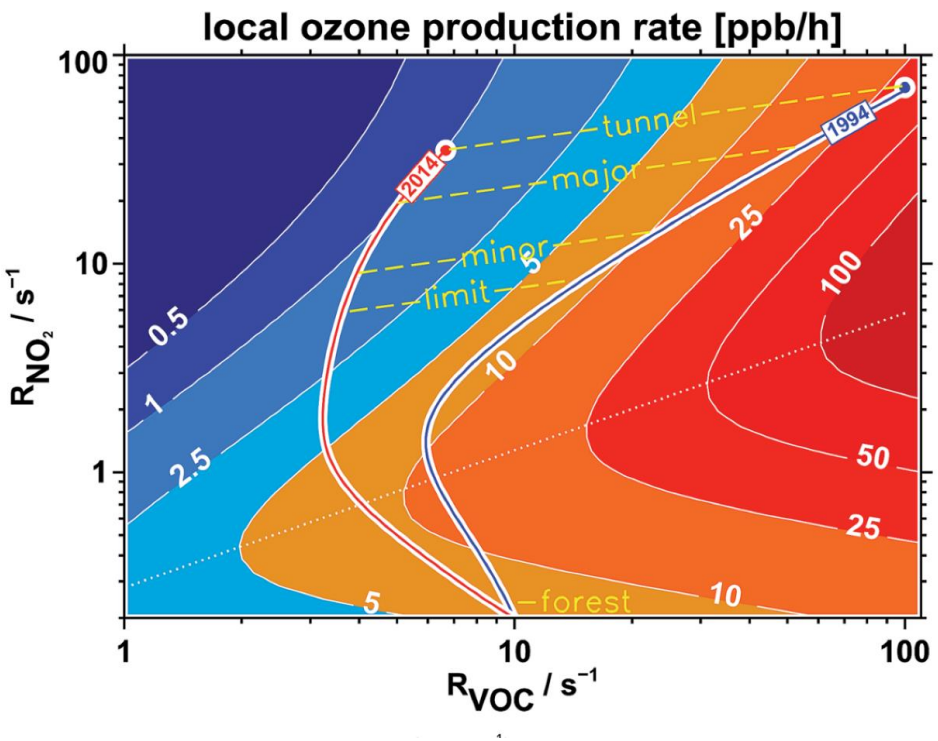
C:\Users\r.wegener\Documents\HBEFA42\IDL\plot_emissions_hbefa_v3.pro

Wed Feb 15 12:04:55 2023

C:\Users\r.wegener\Documents\HBEFA42\Plots\Emissionen_total_ENG_changed_v3.ps

Trends of Ozone Precursors in Europe

Motivation

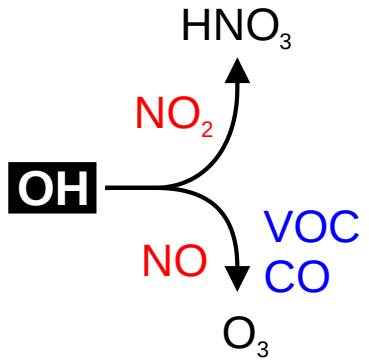


MCM3.2, 10min runtime, Summer conditions in Germany, J_{O1D}=2.9x10^{-5}s^{-1}, J_{NO2}=8.4x10^{-3}s^{-1}

- In recent years, NOx concentrations have decreased faster than VOCs.
- This could lead to an increase in ozone production.

$$R_{VOC} = \sum k_{OH+VOC_i} \times [VOC_i]$$

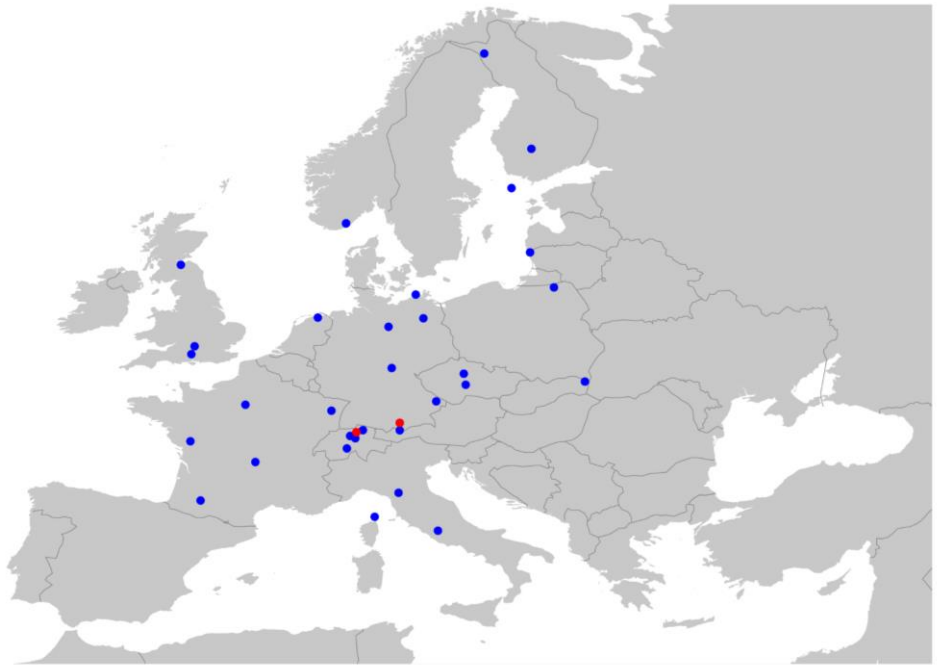
$$R_{NO_2} = k_{OH+NO_2} \times [NO_2]$$



From: Ehlers, C., et al. (2016). "Twenty years of ambient observations of nitrogen oxides and specified hydrocarbons in air masses dominated by traffic emissions in Germany." Faraday Discussions 189: 407-437.)

Trends of Ozone Precursors in Europe

VOC Datasets

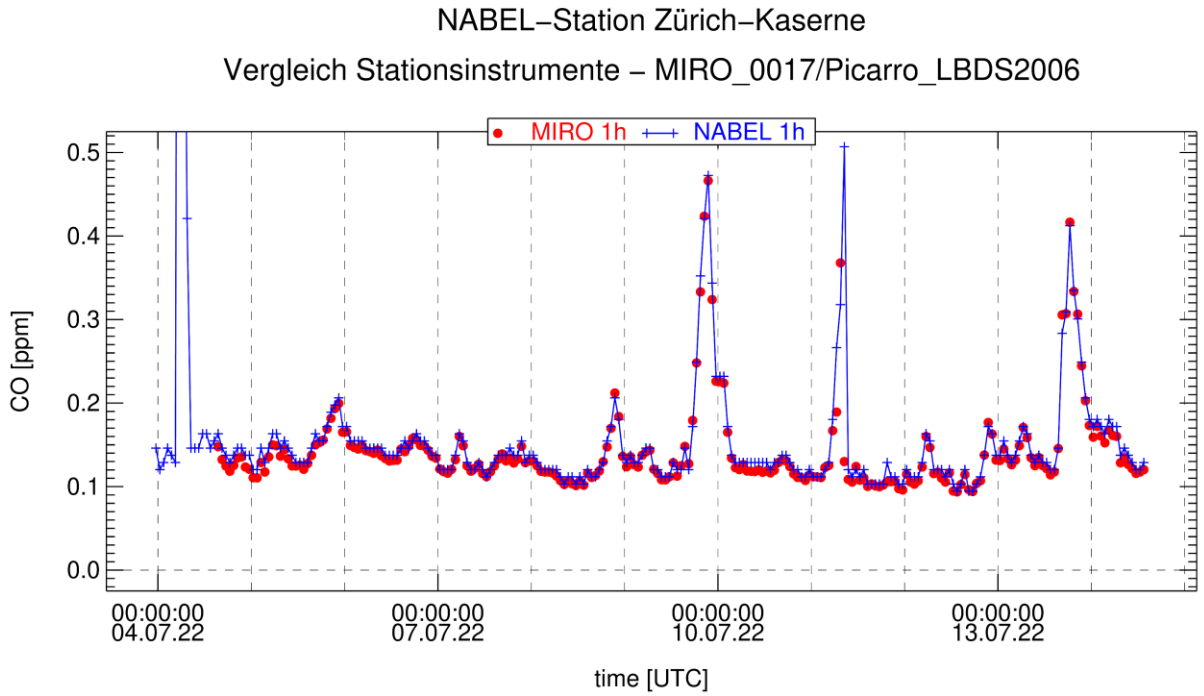


Several VOC datasets exist
ACTRIS and EMEP

The data sets in Zürich and Hohenpeissenberg are very comprehensive.
Intensive Campaign in 2022 at both locations

Campaign in Zürich

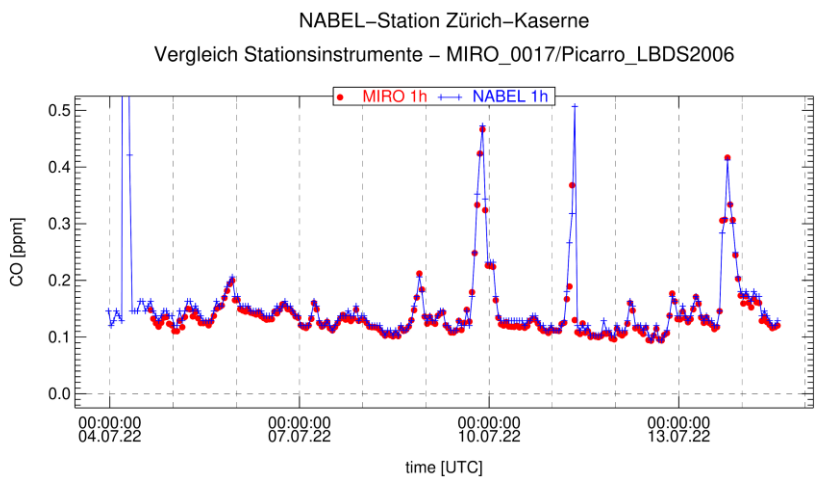
Comparison with NABEL

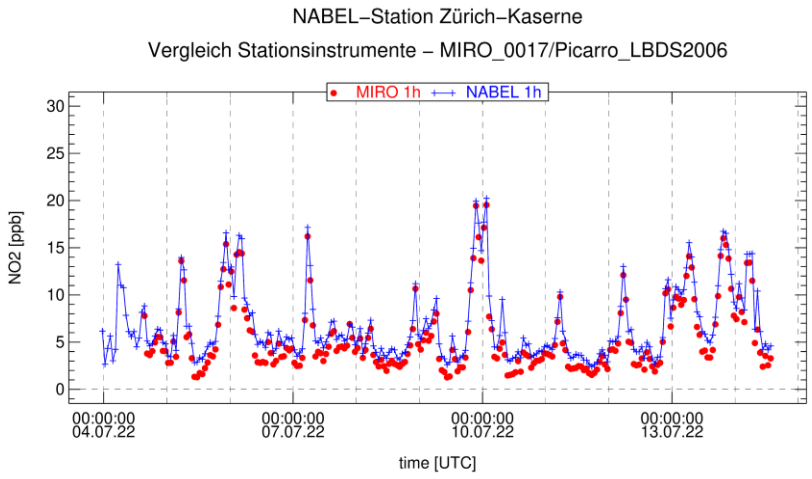


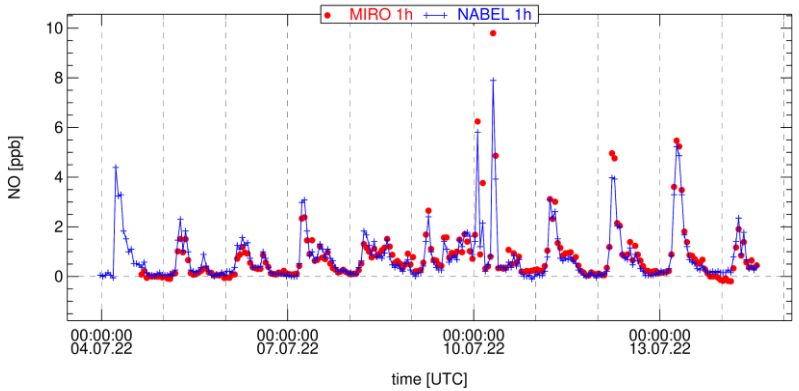
Zürich – Kaserne is
in the middle of Zürich

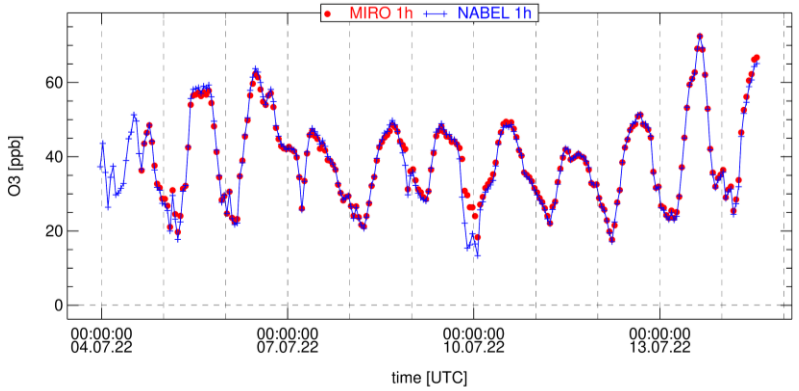
Campaign in Zürich

Comparison with NABEL





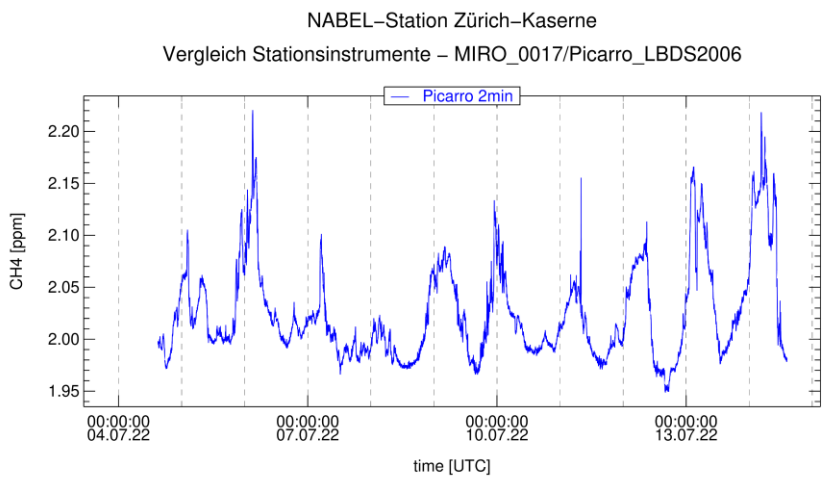


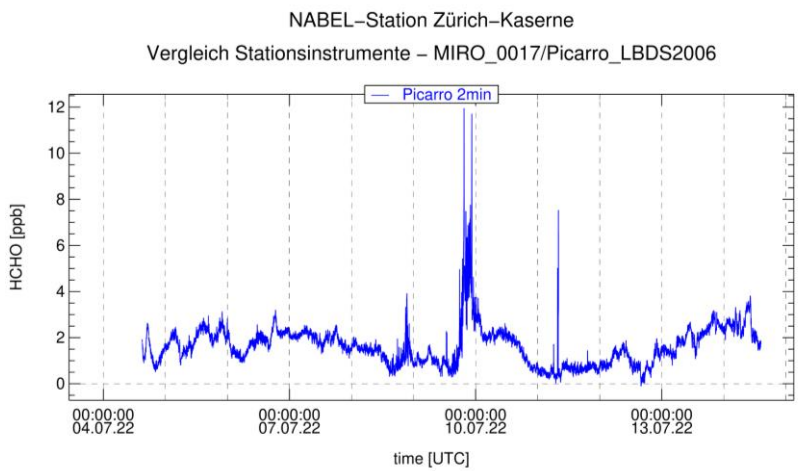


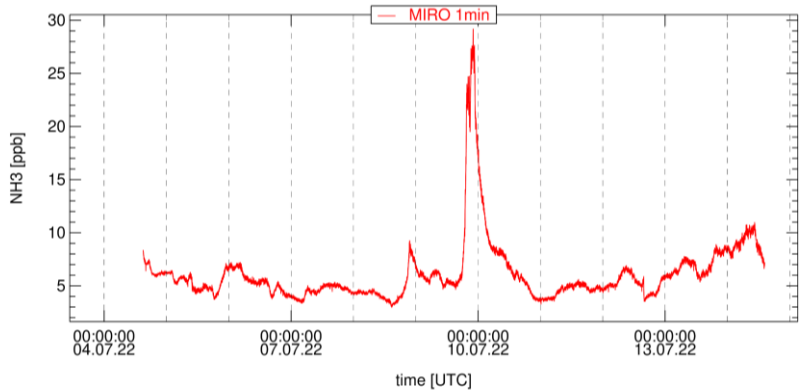
Good agreement (apart from low NO_2)

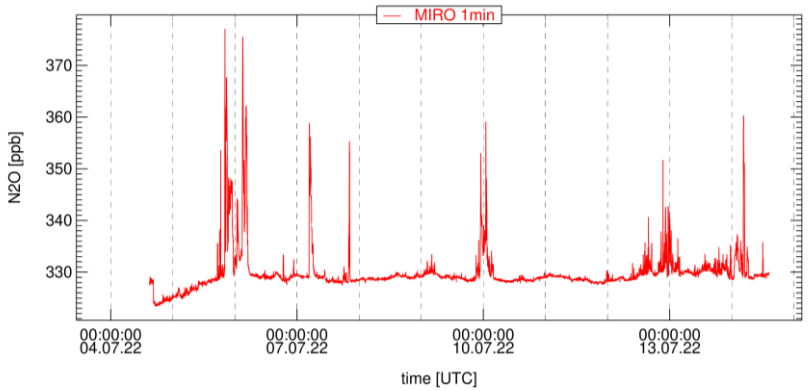
Campaign in Zürich

Additional Compounds





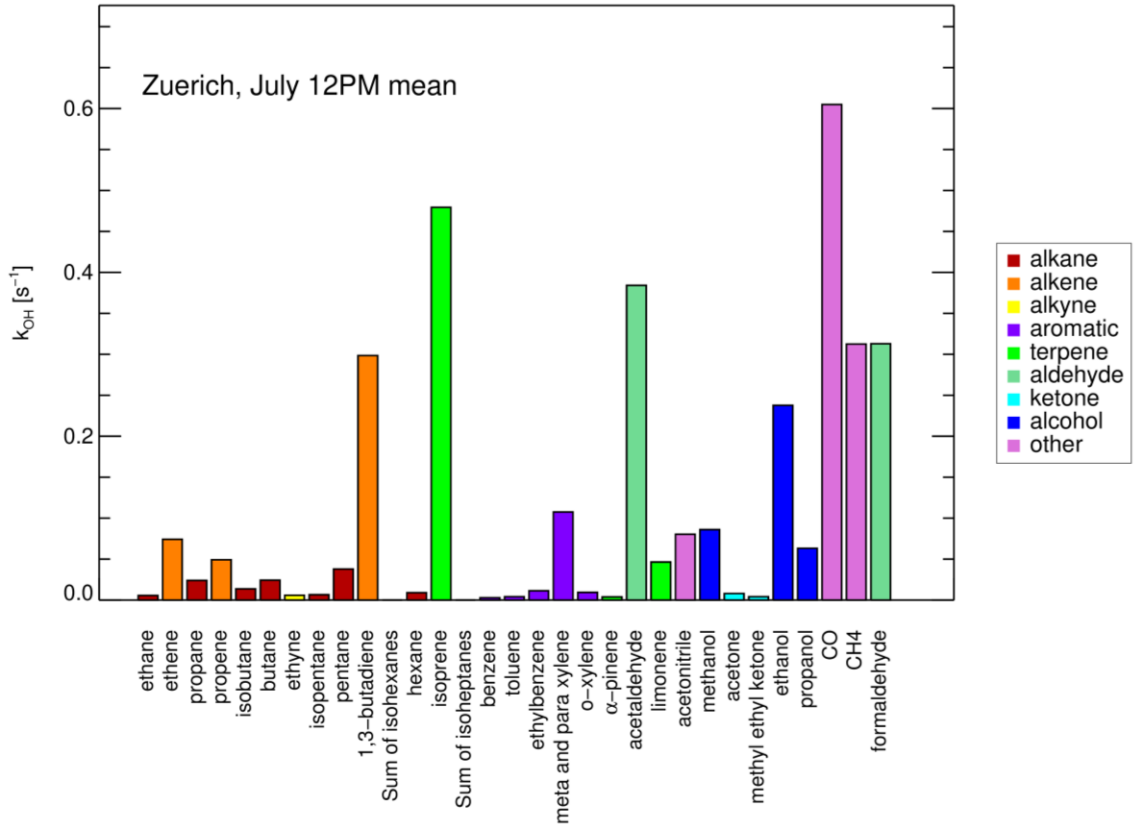




Additional compounds measured

Campaign in Zürich

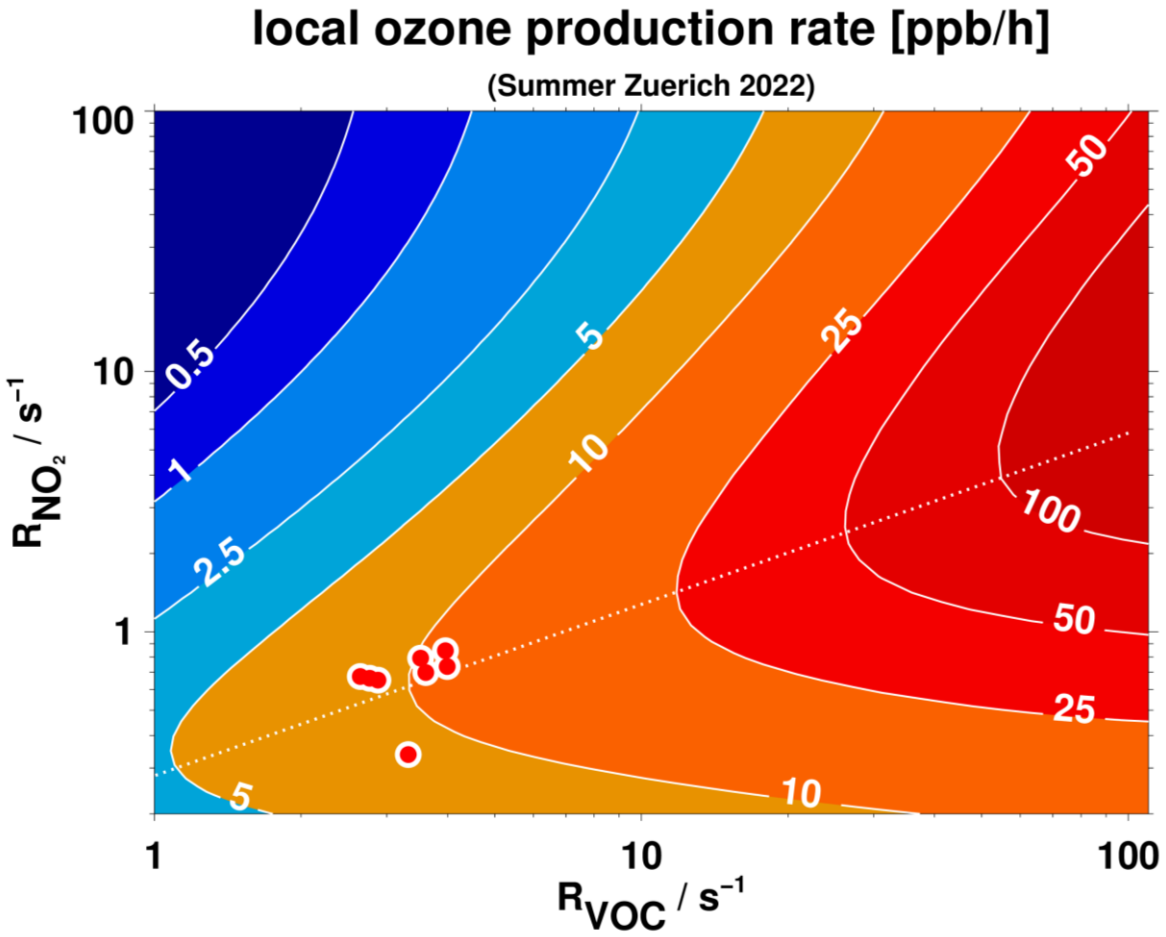
Precursor composition



As with many sites, NMHCs, OVOCs and biogenics contribute to the OH reactivity

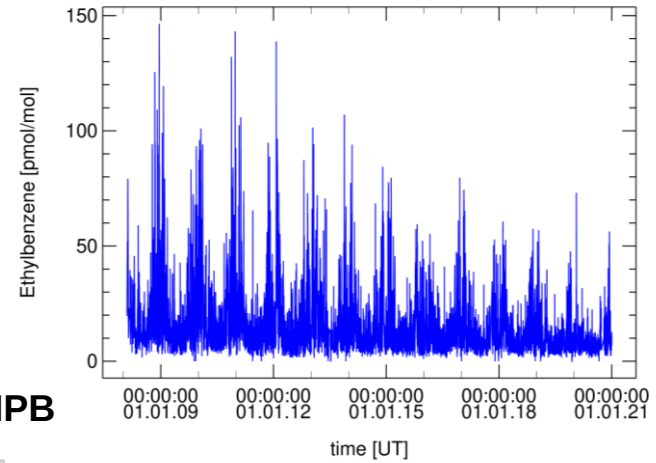
Campaign in Zürich

Ozone formation 2022



- VOC / NO_2 ratio ratio was optimal for ozone formation.

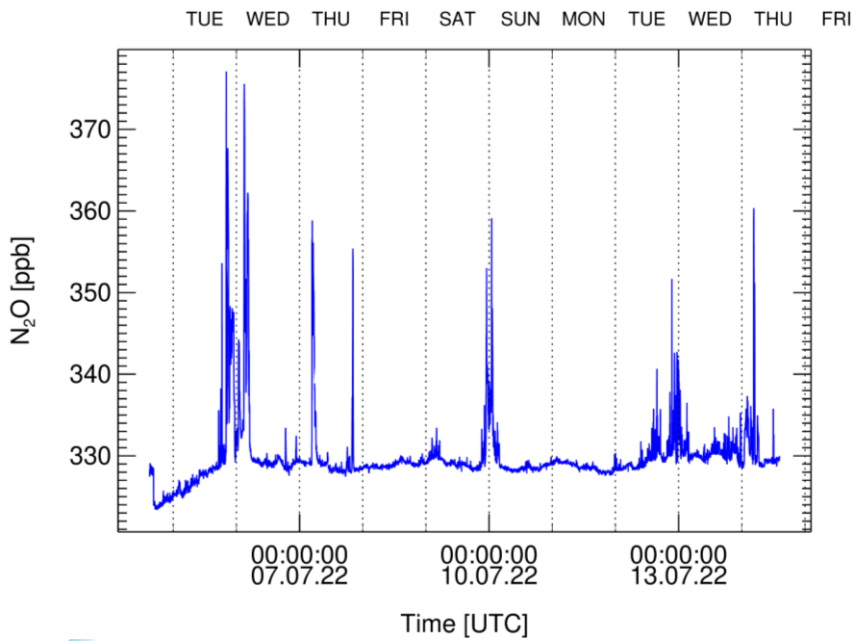
- Compare with data from the past
- Trends at other stations
- What VOC data we need to describe the trend in ozone production ?



Ethylbenzene at HPB

Campaign in Zürich

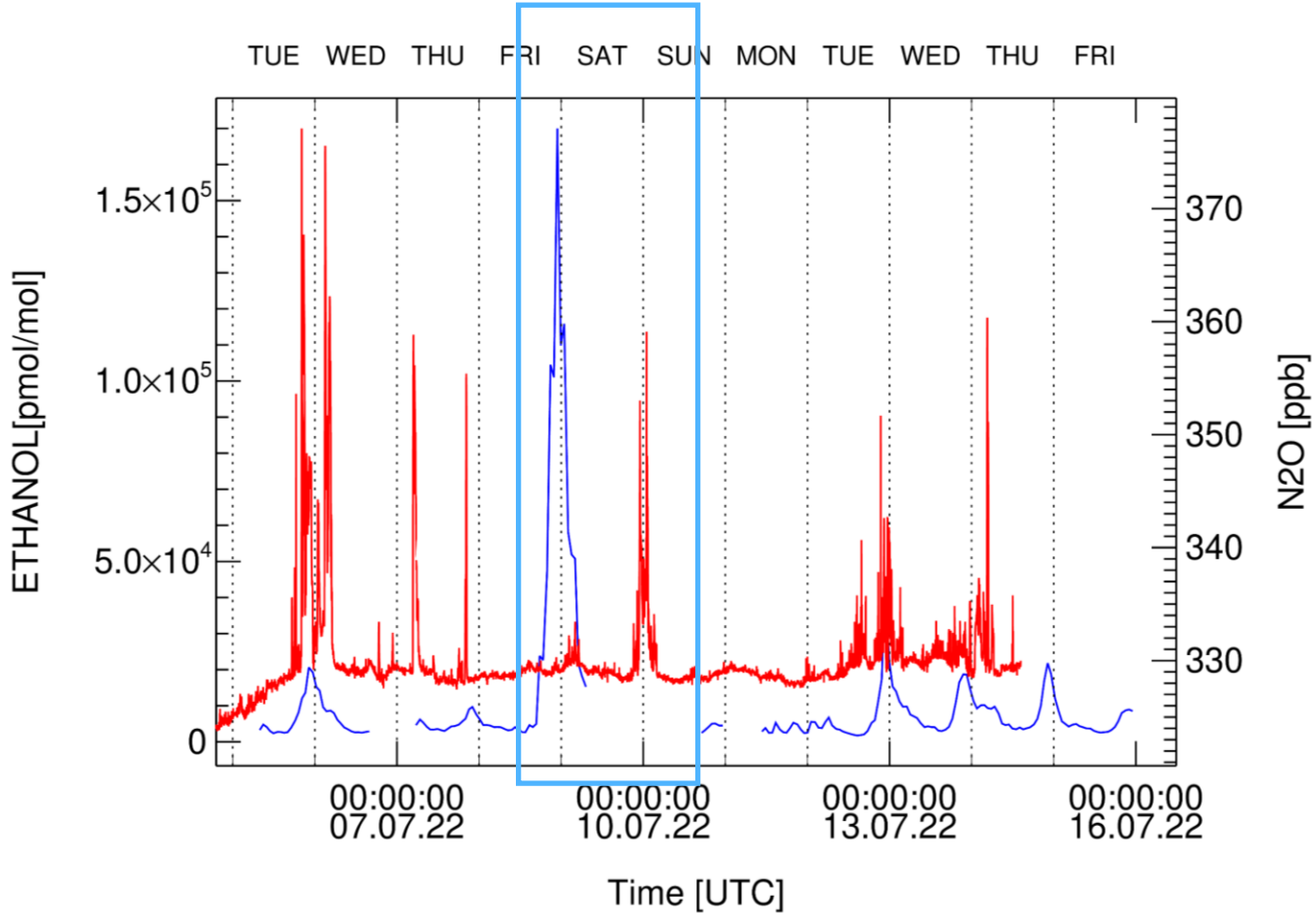
N_2O Peaks



640g for 40€

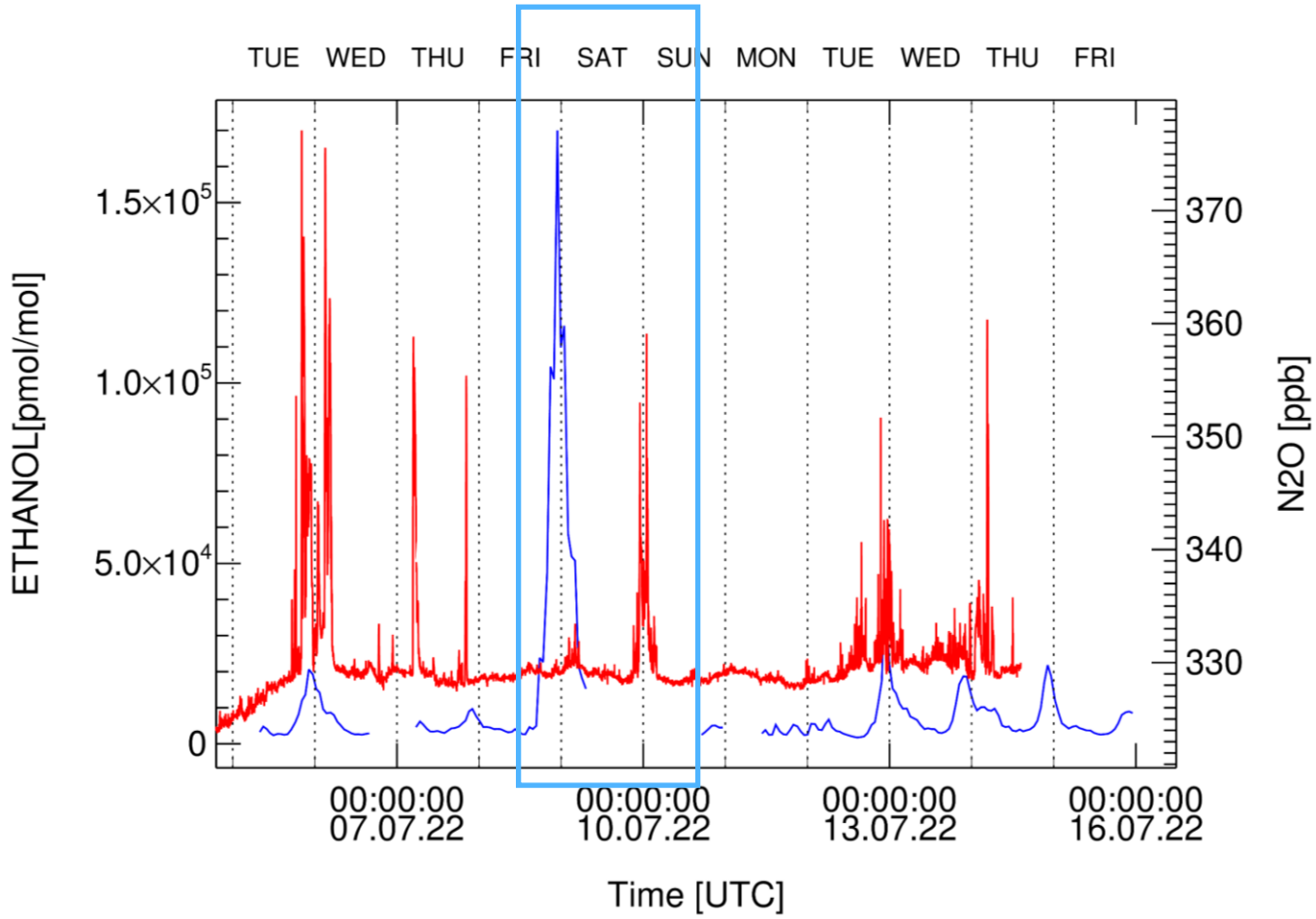
Campaign in Zürich

Nocturnal emissions



Campaign in Zürich

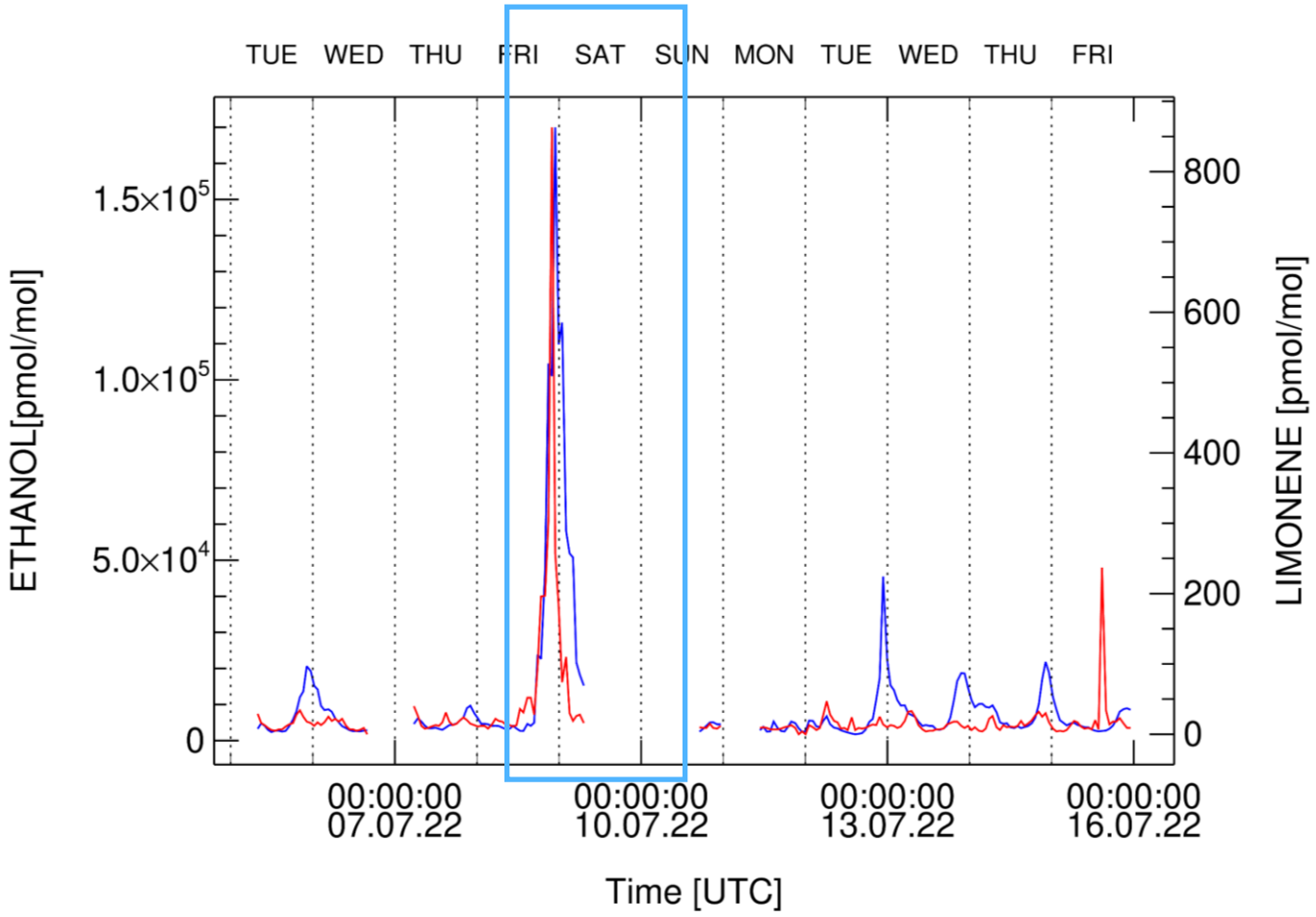
Nocturnal emissions



https://www.facebook.com/calientefestival/videos

Campaign in Zürich

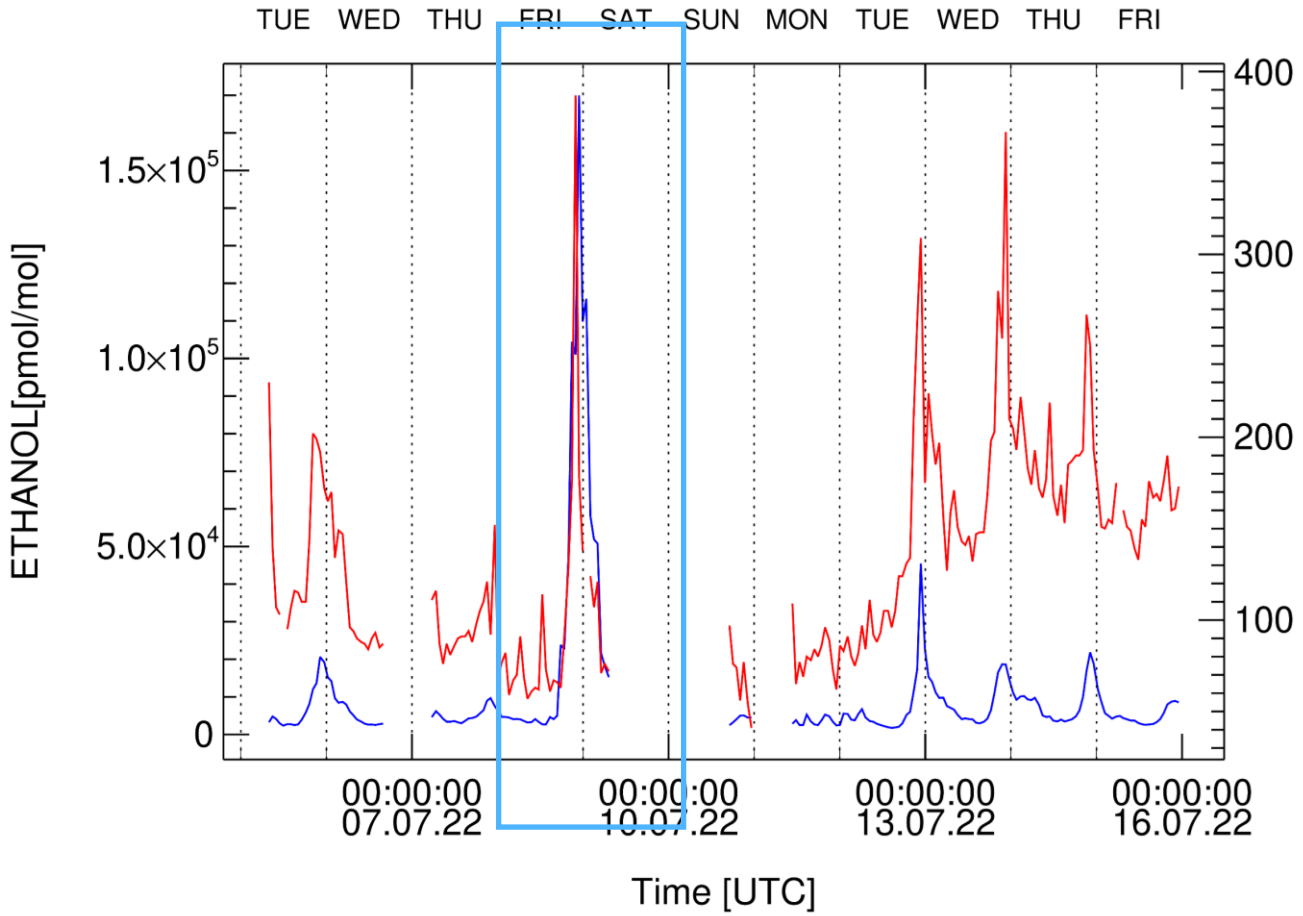
Nocturnal emissions



https://www.facebook.com/calientefestival/videos

Campaign in Zürich

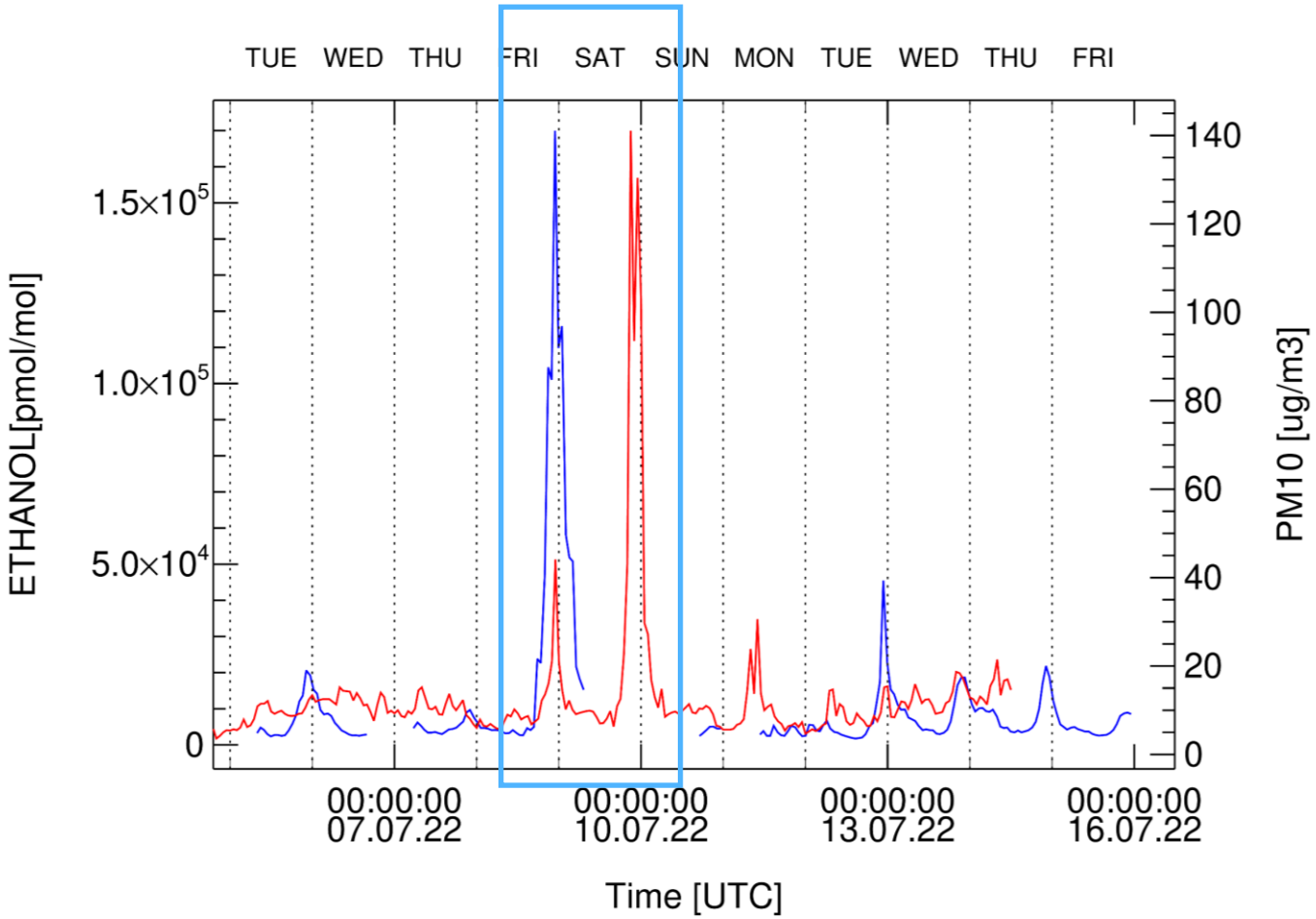
Nocturnal emissions



https://www.facebook.com/calientefestival/videos

Campaign in Zürich

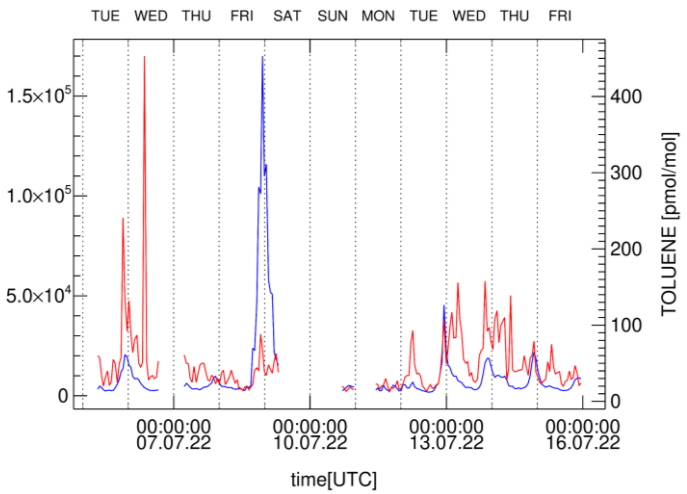
Nocturnal emissions



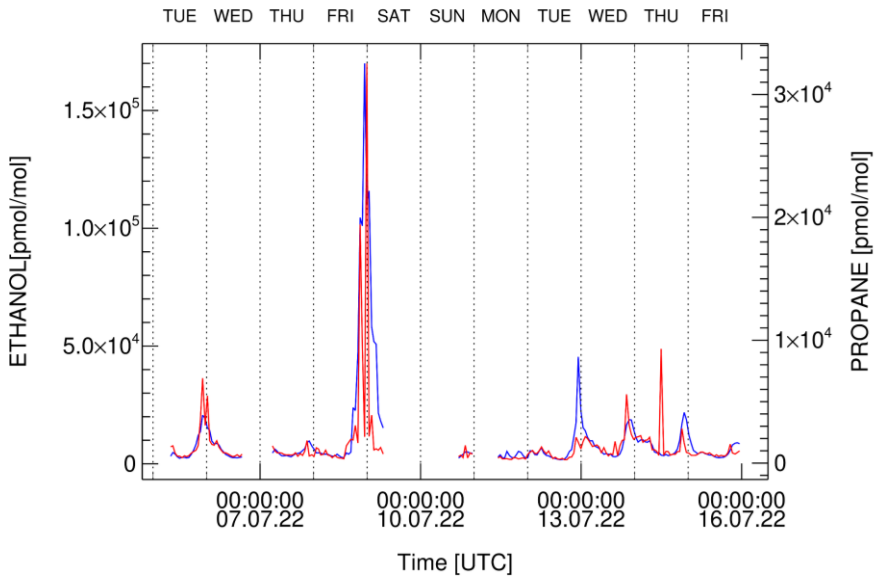
https://www.facebook.com/calientefestival/videos

Campaign in Zürich

Nocturnal emissions



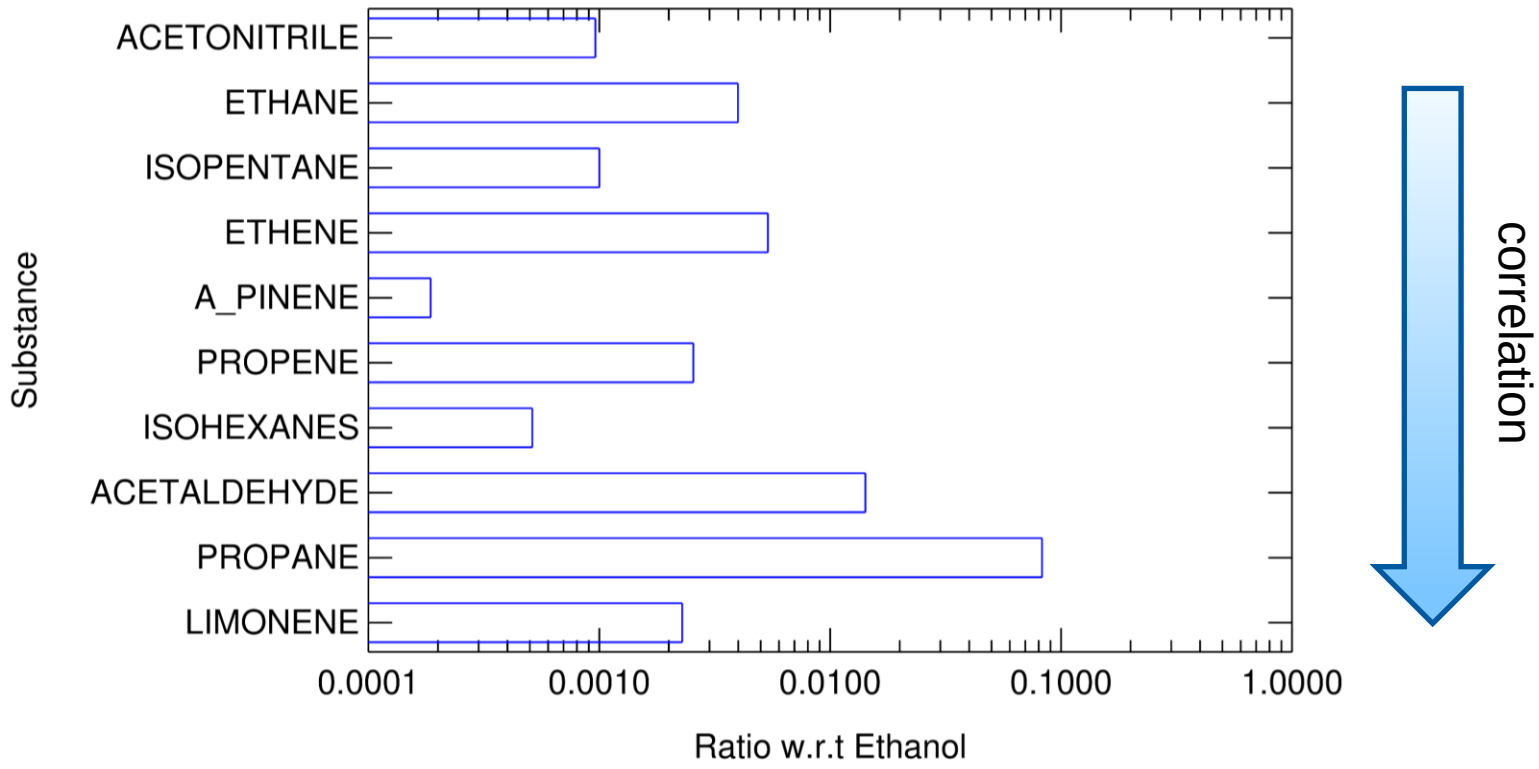
- No increase in traffic related substances



- Some correlations were unexpected

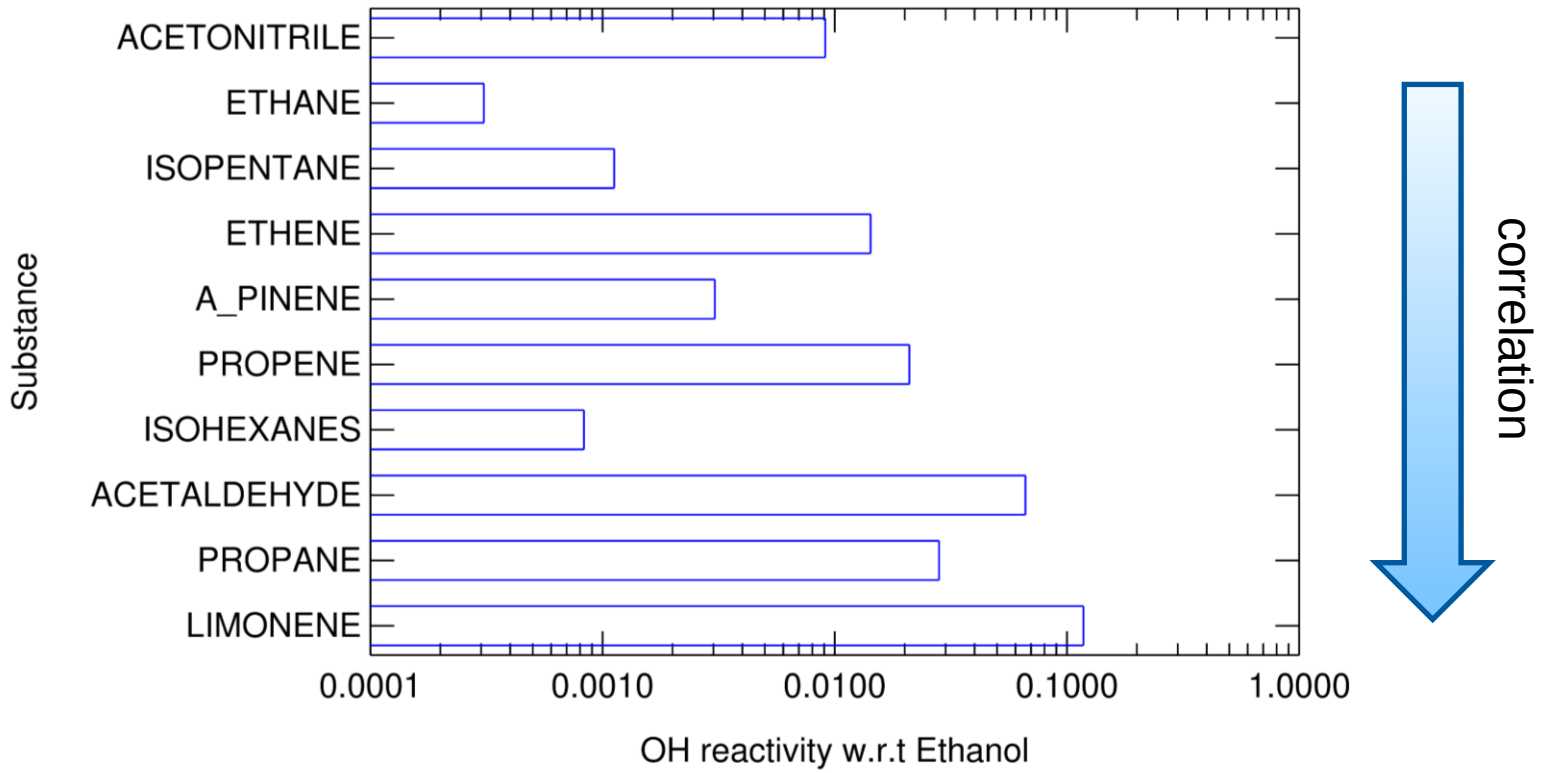
Campaign in Zürich

VOC party pattern



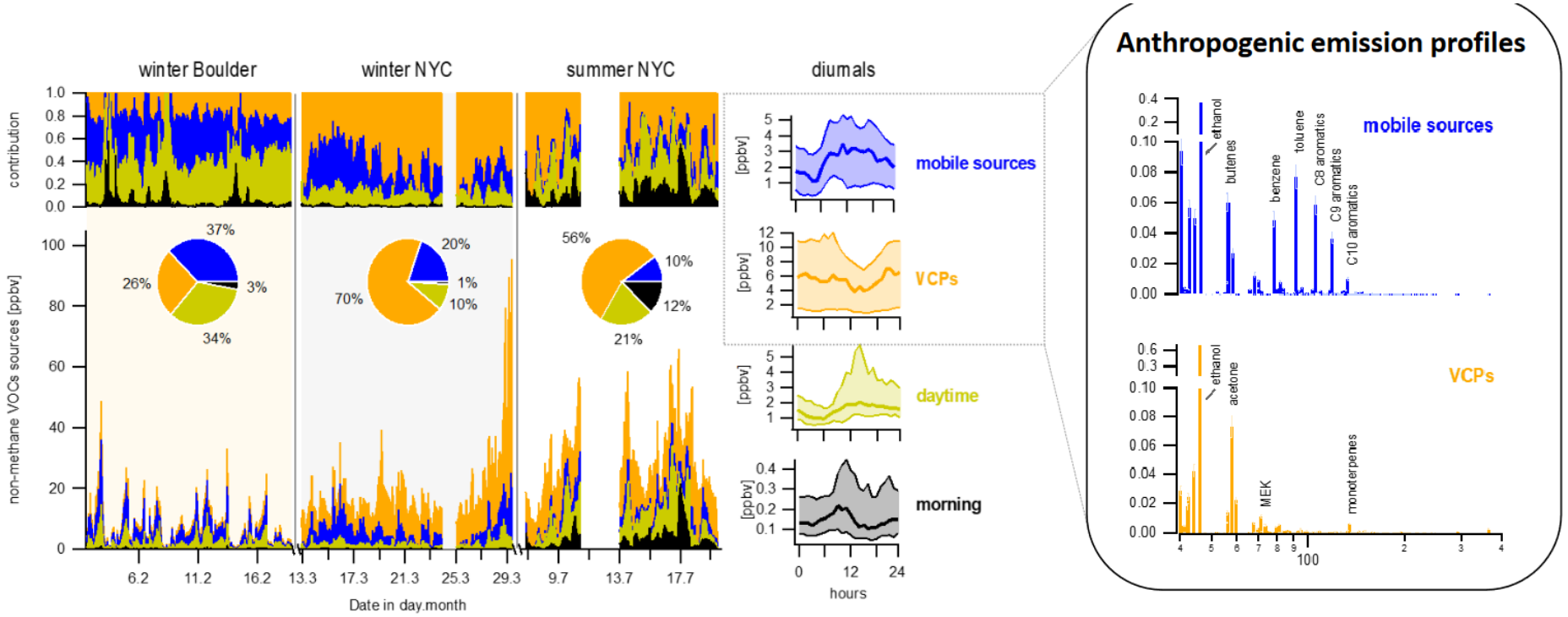
Campaign in Zürich

VOC party pattern



Campaign in Zürich

VCP (volatile chemical products) will be come more important and will dominate air chemistry



- *VCPs accounted for 25-70% of the VOCs mass (used in PMF)*
- *Mobile-source emissions were constrained using SoFi Me-2*

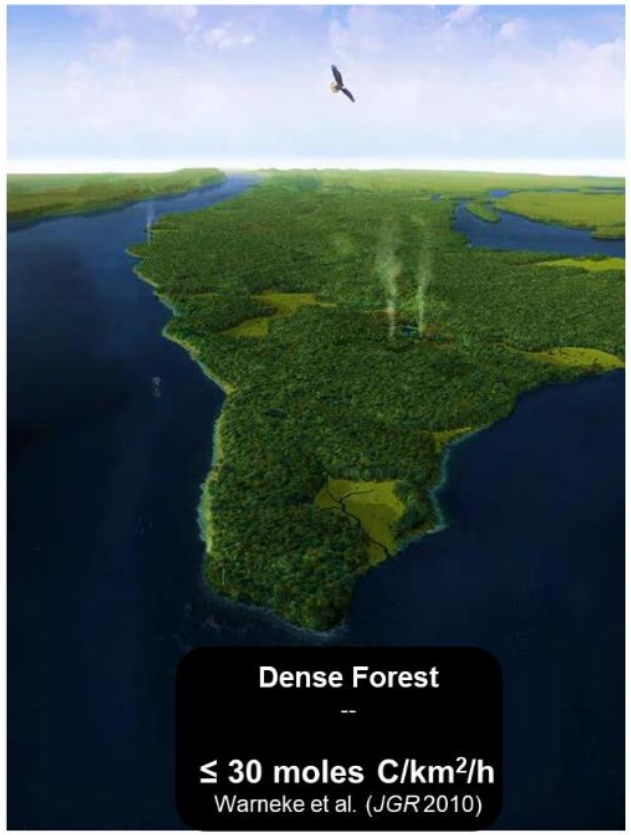
*Gkatzelis et al., ES&T (2020) **(a)**, in review*

Campaign in Zürich

VCP (volatile chemical products) will be come more important and will dominate air chemistry

Monoterpene emissions equivalent to those from a forest

=




ACTRiS
CiGas

ACTRIS and the of TOAR-2 Data

VOC reactivity at different European Sites