



**HAL**  
open science

# Development of a mobile photochemical reactor to investigate gas-phase chemistry and aerosol formation in the field

Marius Duncianu, Alexandre Tomas, Nadine Locoge, Sébastien Dusanter

## ► To cite this version:

Marius Duncianu, Alexandre Tomas, Nadine Locoge, Sébastien Dusanter. Development of a mobile photochemical reactor to investigate gas-phase chemistry and aerosol formation in the field. 25th International Symposium on Gas Kinetics and Related Phenomena, Jul 2018, Lille, France. hal-04250522

**HAL Id: hal-04250522**

**<https://hal.science/hal-04250522>**

Submitted on 20 Oct 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Development of a Mobile Photochemical Reactor to Investigate Gas-Phase Chemistry and Aerosol Formation in the Field

Marius Duncianu, Alexandre Tomas, Nadine Locoge, Sébastien Dusanter

IMT Lille Douai, Université Lille, Département Sciences de l'Atmosphère et Génie de l'Environnement (SAGE), F-59000 Lille, France

IMT Lille Douai  
École Mines-Télécom  
IMT-Université de Lille

## Context

The development of innovative tools is important to tackle atmospheric complexity, i.e. its composition and future changes. Investigating chemical transformations during intensive field campaigns is not straightforward due to the impact of emissions, vertical dilution, and other meteorological parameters on ambient concentrations of trace gases and aerosols. Investigations of these transformations in the laboratory using smog chambers provide a much more controlled environment but are limited to simple chemical systems, which are not representative of complex atmospheres.

## Objectives

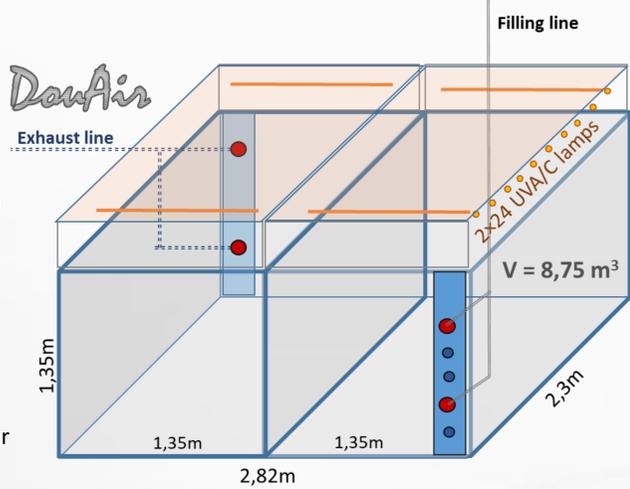
The objective of the current study is to combine both concepts through the construction of a mobile photochemical reactor and its deployment in the field during intensive measurement campaigns. This new tool will allow trapping real air masses, directly on site, to characterize the fate of primary emitted trace gases using all the benefits of an environmental chamber, i.e. decoupling the chemistry from other processes (emission, transport...).

## Strategy

A 9 m<sup>3</sup> photo-reactor was constructed to trap ambient air at atmospheric pressure into a FEP foil bag maintained by an aluminium frame.

The reactor allows both solar and artificial irradiations, whose irradiance is monitored by a spectroradiometer.

The chemical composition, including volatile organic compounds, oxidants and aerosols, is probed in real time during an oxidation experiment using state-of-the-art instrumentation (PTR-ToFMS and offline sampling on cartridges for VOCs, CRM for OH reactivity, PERCA for peroxy radicals, O<sub>3</sub> and NO<sub>x</sub> analysers, hygrometer, CPC for particles).

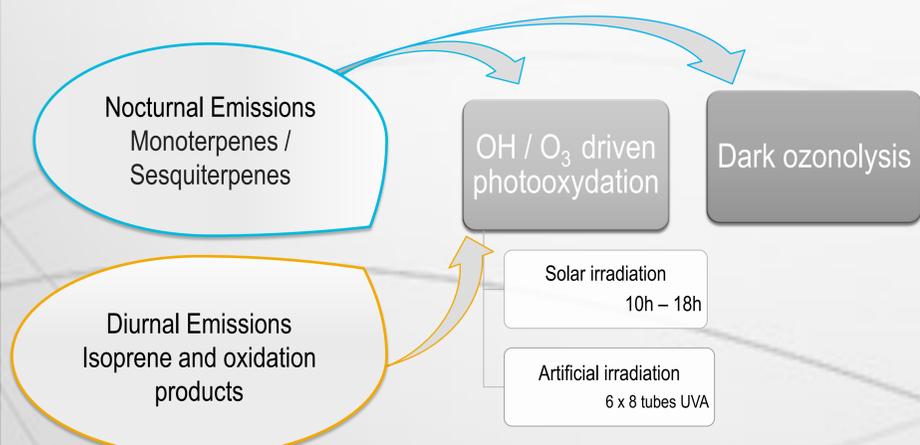


The DouAir, mobile photochemical reactor layout

Sampling flow rate from instruments:  
8 SLPM

Zero air compensation flow rate:  
10 SLMP

Overpressure: 0.05 mbar



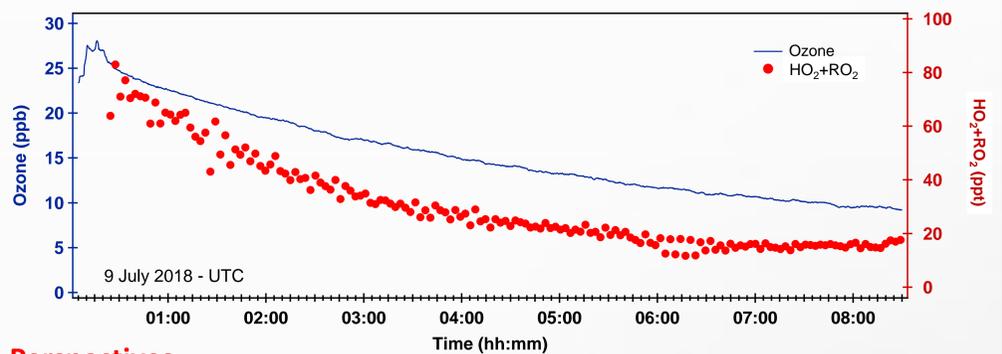
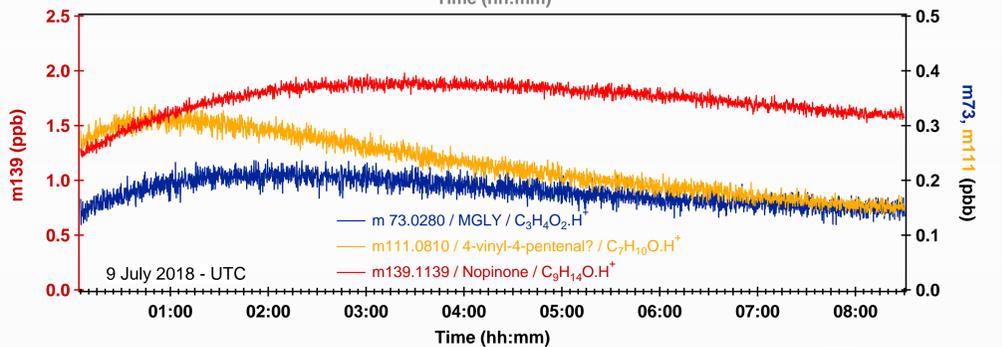
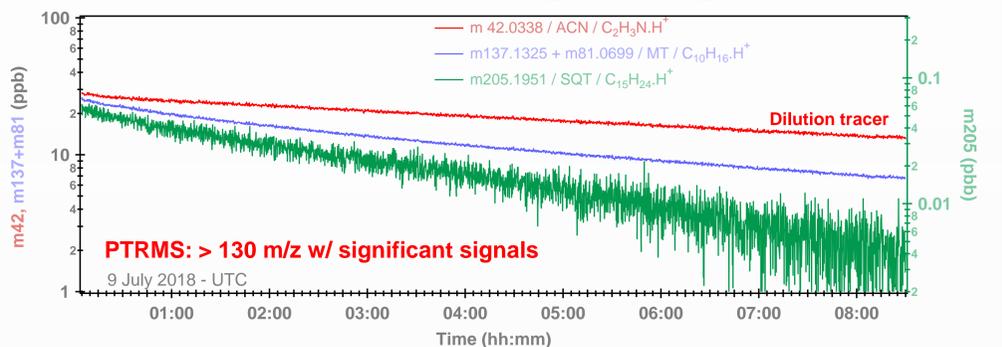
Sampling and oxidation strategies for the 2018 CERVOLAND field campaign

## Preliminary Results from the CERVOLAND Field Campaign (July 2018)

- Flushing time: 45 min / 90 min to reach equilibrium b/w the GP species and reactor surfaces
- Mixing time < 10 min
- Good stability of primary BVOCs and their oxidation products in the chamber

### Nocturnal emissions ozonolysis - initial concentrations:

$\Sigma$  MT 26ppb,  $\Sigma$  SQT 40 ppt, O<sub>3</sub> 25 ppb



## Perspectives

- ✓ Field experiments will be reproduced in the laboratory inside the same simulation chamber on the basis of a "simplified" air mass. Comparison between field observations and laboratory results will indicate whether any minor species not included in the mixture or unmeasured ambient species are important players for the oxidation chemistry occurring in the chamber.
- ✓ Simulations from OD box modeling will be compared with the field results to test our understanding of the BVOC chemistry.



## Acknowledgements

