



TNA User Report

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Project title	Investigation of the impact of nitryl chloride chemistry on the radical budget in ambient air
Name of the accessed chamber	SAPHIR
Number of users in the project	2
Project objectives (max 100 words)	Measurements of nitryl chloride (ClNO ₂) in air masses representative of continental Europe and quantification of ozone production from chlorine chemistry using the facilities provided by the SAPHIR chamber.
Description of work (max 100 words):	Deployment of a chemical ionization mass spectrometer (CIMS) at the SAPHIR chamber coupled with a 50m sampling tower to sample above the nocturnal boundary layer.

Principal Investigator's and group's information	
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Family name	Sommariva
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Activity domain ¹	Earth Sciences & Environment
Home institution	University of Birmingham/University of Leicester
Institution legal status ²	UNI
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Gender	MALE
User status ³	RES
New user	YES

User 1 Information ⁴	
First name	Thalassa
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User status	PDOC
New user	YES

¹ Physics; Chemistry; Earth Sciences & Environment; Engineering & Technology; Mathematics; Information & Communication Technologies; Material Sciences; Energy; Social sciences; Humanities.

² UNI= University and Other Higher Education Organisation;
RES= Public Research Organisation (including international research organisations and private research organisations controlled by public authority);
SME= Small and Medium Enterprise;
PRV= Other Industrial and/or Profit Private Organisation;
OTH= Other type of organization.

³ UND= Undergraduate; PGR= Post graduate; PDOC= Post-doctoral researcher; RES= Researcher ENG= Engineer; ACA= Academic; TEC= Technician.

⁴ Reproduce the table for each user who accessed the infrastructure

User 2 Information	
First name	
Family name	
Nationality	
Activity domain	
Home institution	
Institution legal status	
Email	
Gender	
User status	
New user	

Trans-National Access (TNA) Scientific Report

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Instructions

Please limit the report to max 5 pages, you can include tables and figures. Please make sure to address any comments made by the reviewers at the moment of the project evaluation (if applicable, in this case you were informed beforehand). Please do not alter the layout of the document and keep it in Word version. The report will be made available on the eurochamp.org website. Should any information be confidential or not be made public, please inform us accordingly (in this case it will only be accessible by the European Commission, the EUROCHAMP-2020 project partners, and the reviewers). Please include:

- Introduction and motivation
- Scientific objectives
- Reason for choosing the simulation chamber/ calibration facility
- Method and experimental set-up
- Data description
- Preliminary results and conclusions
- Outcome and future studies
- References

Name of the PI: Roberto Sommariva

Chamber name and location: SAPHIR, Juelich, Germany

Campaign name and period: JULIAC-1, 31/1/19-8/2/19

Text:

Nitryl chloride (ClNO_2) has been shown in recent years to be present at a much larger extent than previously thought, even in regions that are not close to the coast, where sea salt can serve as a source for chloride. Laboratory studies and field campaigns have shown that the photolysis of ClNO_2 , which is heterogeneously formed during nighttime, releases chlorine atoms which react with organic compounds to form organic peroxy radicals, which have a large impact on the formation of ozone (O_3). However, only few measurements of ClNO_2 in ambient air have been done in Europe and in none of these studies radical species were measured at the same time.

The main aims of this project are to measure ClNO_2 contained in ambient air masses representative of continental Europe and to quantify the additional ozone production caused by ClNO_2 chemistry using simultaneous measurements of photolysis rates, organic peroxy radicals (RO_2), O_3 , NO_x and ClNO_2 .

The SAPHIR chamber in Juelich has recently been coupled to an inlet for ambient air that allows sampling from a 50m height, higher than the nocturnal surface layer, so that the sampled air mass is not directly influenced by local sources. For this project, measurements of radicals (OH , HO_2 , RO_2) and ancillary measurements (photolysis rates, NO_x , O_3 , organic compounds) were provided by the SAPHIR core instruments. The ClNO_2 measurements were done using the Leicester Chemical Ionization Mass Spectrometer (CIMS), which was installed at SAPHIR between January 30th and February 8th 2019.

One day was dedicated to calibrations and a total of 8 days of CIMS measurements were taken. During this period two types of experiments were done:

1. Air masses were continuously flushed into the SAPHIR chamber at a high flow rate of $250 \text{ m}^3/\text{h}$ (resulting in a residence time of air in the chamber of about 1 hour) and the instruments sampled from within the chamber. These experiments provided measurements of ClNO_2 and other chemical parameters which can be considered representative of continental Europe and not affected by local sources.
2. The SAPHIR chamber was filled with nocturnal air and the roof opened to allow the photochemical processes to take place. These experiments allowed the direct observations of the impact of ClNO_2 chemistry on ozone formation.

The data collected during the project are still being analysed, but the preliminary results look encouraging. ClNO_2 was detected every night and its decay inside the closed chamber will allow a determination of its loss terms, as well as quantification of ozone production.

Due to the limited time available, this project was considered a proof-of-concept for these type of experiments. The preliminary results suggest that the project has been successful and a more comprehensive project should be considered.