TNA User Report

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Project title	Aerosol particle organic analytical training course
Name of the accessed chamber	OGTAC CC/ LEAK-LACIS
Number of users in the project	1
Project objectives (max 100 words)	The aim of the visit to the calibration centre for organic tracer and particulate aerosol constituents (OGTAC CC) of the Atmospheric Chemistry Department (ACD) at TROPOS was to gain insight and training in the highly specific analytical technique of HPAEC-PAD developed and routinely employed at the host institute by experts in the field (Iinuma *et al.*, 2009). Subsequent to such training, levoglucosan, mannosan and galactosan concentrations of approximately 50 samples, plus corresponding blanks, collected in Dublin, Ireland were to be determined using the aforementioned technique, followed by data analysis and interpretation.
Description of work (max 100 words):	As part of the training, sample preparation and the technique (Ion Chromatography coupled with Pulsed Amperometry Detection) were described and explained in great detail. Sample preparation (extraction) was completed under expert supervision. Levoglucosan, mannosan and galactosan quantification measurements on approximately 50 filter samples, and corresponding blanks, were completed. Training on the software and subsequent analysis of raw data obtained from IC was completed. This also involved interpretation of data, with the aim of accurately comparing it to data obtained by other instruments simultaneously during the monitoring period.

Principal Investigator's and group's information	
First name	Eimear
Family name	Heffernan
Nationality	Irish
Activity domain[1]	Chemistry, Earth Sciences & Environment
Home institution	University College Cork
Institution legal status[2]	University
Email	eimear.heffernan@umail.ucc.ie
Gender	Female
User status[3]	Post Graduate Researcher
New user	No

[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 EXP= Engineer; ACA= Academic; TEC= Technician.

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: Eimear Heffernan
Chamber name and location: OGTAC CC at TROPOS ACD
Campaign name and period: Aerosol Particle Organic Analytical Training 18/03/2019 – 29/03/2019
Text:

Introduction and Motivation

Carbonaceous aerosols can have both natural and anthropogenic sources, the major source being the combustion of fossil fuel and biomass. Economic, industrial and global population growth have caused increasing emissions in recent decades. Carbonaceous aerosols impact the atmospheric radiative balance, climate, regional air quality, as well as human health (Kourtchev *et al.*, 2011). Legislation on PM levels in the atmosphere has been developed by the European Union (EU) in order to protect human health and combat climate change and adverse environmental impacts up to the year 2030. Considering the impacts on health, and on climate, it is important to determine the contribution of different combustion sources; fossil fuels used for road transport, or solid fuels like wood, peat and coal used for domestic heating. By identifying emission sources and quantifying source contribution estimates, and raising public awareness of air-quality problems, more efficient abatement strategies can be developed.

In Ireland, domestic home heating relies heavily on coal and peat burning, as well as wood. In order for policy makers to develop effective and efficient abatement strategies for reducing air pollution, current levels of pollution and the contribution that each fuel source makes to particulate pollution are required. In an effort to investigate this, and as part of the EMEP/ACTRIS/COLOSSAL Winter Campaign (2017 – 2018), $PM_{2.5}$ filter samples were collected at four sites across Ireland; all either rural or urban background sites, covering the four corners of the country. An AE33 multi-wavelength aethalometer (Model AE33, Magee Scientific) was deployed at each site. Filter collections of PM for further offline analysis were made with a DIGITEL DHA-80 High Volume Sampler or a Partisol 2025i Sequential Air Sampler.

The aethalometer measured optical attenuation as a basis for apportioning solid fuel burning and traffic related equivalent black carbon (eBC) using the aethalometer model (Sandradewi *et al.*, 2008). Using source specific Ångström exponent (alpha) values of 0.9 and 1.68 for fossil fuel and biomass burning respectively (Zotter *et al.*, 2017), initial results from the AE33 aethalometer show a strong diurnal trend. Previous studies have noted the strong correlation between black carbon originating from wood burning (BC_{wb}) and levoglucosan concentrations, which is a wood burning marker compound (Fuller *et al.*, 2014, Martinsson *et al.*, 2017). Therefore the aim of this TNA activity was to use the established technique of High-Performance Anion Exchange Chromatography Coupled with Pulsed Amperometric Detection (HPAEC-PAD) to determine the amount of levoglucosan, mannosan and galactosan in a selection of filters, and the corresponding blanks, collected at the UCD campus in Dublin, Ireland using the procedures originally described by Iinuma *et al.*, 2009. The results will be compared with the aethalometer data, as well as the EC/OC values already obtained using a Sunset carbon analyser to provide more detailed source apportionment of $PM_{2.5}$ from solid fuel burning at the designated urban background site in Dublin.

Scientific objectives

The objects of this TNA visit were i) to gain insight and receive training in the analytical technique of HPAEC-PAD, which was developed and is routinely employed by researchers at the host facility, ii) to determine the concentration of levoglucosan and its isomers in approximately 50 filters samples collected in Dublin, and iii) to interpret the data obtained using specialized software. The results obtained during the visit to OGTAC CC at TROPOS ACD will be used to further investigate the correlation between on and offline techniques for determining black carbon and its origins.

Reason for choosing the simulation chamber/ calibration facility

The OGTAC CC was the ideal location to perform this offline chemical analysis as it has the required instrumentation and necessary protocols, as well as the expertise to train and guide visitors. Following training, sample preparation, analysis and quantification was completed under expert guidance and supervision, thus a very valuable data set was generated in an efficient and reliable manner. Aside from hands-on training on this specific technique, the visit involved an introduction to the statistical analysis of larger data sets and obtained instructions on interpretative approaches for those data sets obtained from ambient measurements.

Method and experimental set-up

The filter samples that underwent HPAEC-PAD analysis were collected in Dublin between December 2017 and March 2018 on pre-baked (850 °C, 6 hours) 47 mm diameter quartz fibre filters using a Partisol Sequential Air Sampler. The sample duration was 24 hours, from 08:00am to 08:00am. The flow rate of the sampler was 16.7 L/min. The samples were kept in storage at -20 °C before analysis.

A portion of each quartz fibre filter (1 cm^2) was extracted in 1 mL UP water on a shaker at 420 min^{-1} for 120 minutes. The extract was then filtered through a syringe filter (0.45 µm) to remove any impurities that may have been present. The extracts were subsequently analysed by Ion Chromatography coupled with Pulsed Amperometry Detection, as described in Iinuma *et al.*, 2009. The analysis of each sample took 65 minutes. Six stock solutions containing 11 standards were also analysed for validation purposes.

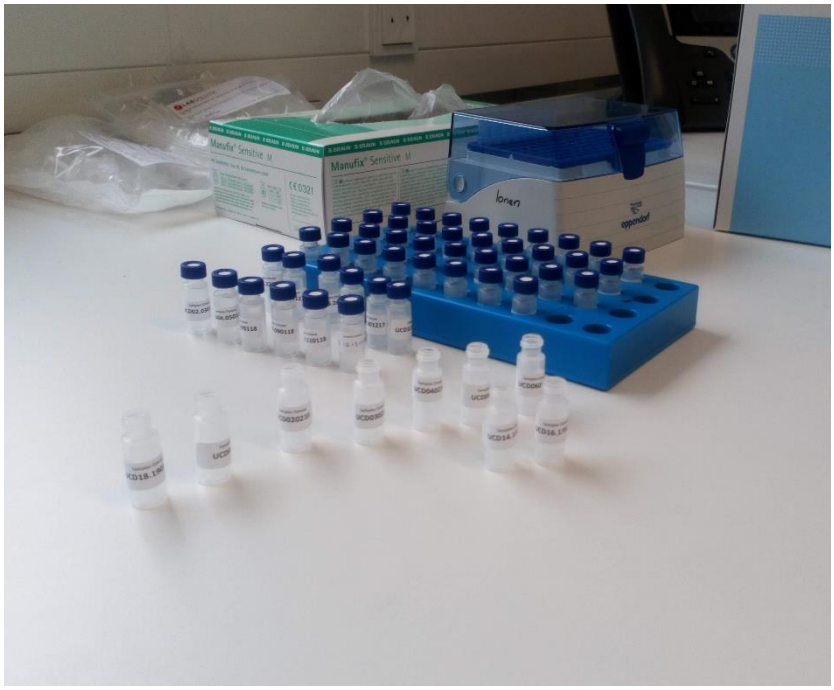

Figure 1. Sample preparation

The chromatograms generated were automatically integrated by the computer software associated with the instrument, but each one was assessed and confirmed manually before the final data file was created. This file included sugar concentrations in mg/L for each sample.

Preliminary results and conclusions

Levoglucosan, mannosan and galactosan concentrations were determined for 50 ambient samples and 2 blanks during the TNA activity. For the duration of the measurement period, levoglucosan concentrations showed significant daily variation, ranging between 14.94 ng/m^3 and 1089.98 ng/m^3. The average concentration of levoglucosan for this period was 119.69 ng/m^3.

Sample Name	Amount mg/L Levoglucosan	Amount mg/L Mannosan	Amount mg/L Galactosan
UCD010218	0.1094	0.0167	n.a.
UCD020218	0.2292	0.0444	n.a.
UCD030218	0.1659	0.0276	n.a.
UCD040218	2.4507	0.4401	0.0784
UCD050218	0.6473	0.1115	0.0175
UCD060218	0.2289	0.0358	n.a.
UCD070218	0.0743	0.011	n.a.
UCD BLANK 01-070218	n.a.	n.a.	n.a.
UCD140218	0.0788	0.0132	n.a.
UCD150218	0.0753	0.013	n.a.
UCD160218	0.0772	0.0174	n.a.
UCD170218	0.9651	0.1607	0.0381
UCD180218	0.22	0.0411	0.0114
UCD190218	0.1359	0.0209	n.a.
UCD200218	0.4929	0.0883	0.0227
UCD210218	0.248	0.044	n.a.
UCD220218	0.191	0.0319	n.a.
UCD230218	0.1834	0.0293	n.a.
UCD240218	0.4582	0.0741	0.0222
UCD250218	0.4041	0.0621	0.0164
UCD260218	0.0922	0.0172	n.a.

Table 1. Raw data obtained for samples from February 2018

Similar to the results published by Fuller *et al.*, 2014, initial analysis suggests that there is little correlation between the levoglucosan concentrations and daily average temperature data reported by Met Éireann, suggesting that wood burning is not the primary source of solid fuel burning for domestic heating in this area.

Further data analysis and interpretation is still in progress. Most importantly, the correlation between the levoglucosan concentrations and measurements from the aethalometer model is ongoing.

Outcome and future studies

The main objectives of the proposed TNA activity were successfully completed. A high level of training was received and each of the samples were analysed during the 10 day period, generating a reliable data set. The findings of this project will provide new quantitative insights into levoglucosan concentrations in ambient air in an Irish context. The results obtained for the urban background site in Dublin during this project, will be compared to those obtained at other, rural background sites around Ireland during the same monitoring period. Future research will involve the comparison of levoglucosan concentrations with aethalometer measurement and the determination of appropriate Ångström exponent (alpha) values for the Irish environment.

References

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