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Airborne DNA at a simulated crime scene

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Nordic Society for Aerosol Research (NOSA) Symposium



*20-22 January 2025, at the Department of Chemistry, Aarhus University,
Langelandsgade 140, 8000 Aarhus C, Denmark.*



Detailed Program

Monday, January 20, 2025

- 13:30 – 14:30 **Registration at the Department of Chemistry**
- 14:30 – 15:30 **Tutorial by Sigurd Christiansen (UFI)** – *“Marine Aerosols and Cloud Formation”*
Chairs: Eva R. Kjærgaard and Sneha Aggarwal.
- 15:30 – 16:00 **Coffee break and exhibition.**
- 16:00 – 17:00 **Tutorial by Sara Blichner (SU)** – *“Modelling aerosols in the Earth system”*
Chairs: Morten Engsvang and Dina Alfaouri.
- 17:00 – 18:00 **Icebreaker – Foyer + Auditorium VI**

Tuesday, January 21, 2025

- 08:00 – 09:00 **Registration at the Department of Chemistry**

Oral session 1: From vapors to particles – SOA formation & composition

Chairs: Matthias Hallquist and Eva Johanna Horchler.

- 09:00 – 09:15 **Welcome by the Vice-Dean of Research (Poul Nissen) & NOSA President (Jonas Elm)**
- 09:15 – 09:45 **Keynote by Mikael Ehn (UH)** – *“SOA Formation Chemistry”*
- 09:45 – 10:00 **Matthieu Riva (CNRS)** – *“Resolving particle phase composition of SOA formed from the nighttime oxidation of a simulated urban environment using a newly designed online particle-phase chemical ionization technique.”*
- 10:00 – 10:15 **Siddharth Iyer (TAU)** – *“Sequential formation of condensable vapors in aromatic photo-oxidation”*
- 10:15 – 11:00 **Coffee break and exhibition.**

Oral session 2: From vapors to particles – Theory, experiments and measurements

Chairs: Merete Bilde and Natasha Garner.

- 11:00 – 11:15 **Iida Pullinen (UEF)** – “*Changes in peatland ecosystems: first look into aerosol formation potential*”
- 11:15 – 11:30 **Ivo Neefjes (AU)** – “*Developing machine learning potentials with accurate long-range interactions for atmospheric molecular dynamics collision simulations*”
- 11:30 – 11:45 **Olga Garmash (UCPH)** – “*Formation of oxygenated organic vapors and particles over the Siberian boreal forest*”
- 11:45 – 13:00 **Lunch and exhibition.**

Oral session 3: Global and regional scale aerosol impacts

Chairs: Michael Boy and Haochi Che.

- 13:00 – 13:30 **Keynote by Colette L. Heald (ETHZ)** – “*Global Scale Aerosol Processes & Impacts*”
- 13:30 – 13:45 **Benjamin Foreback (UH)** – “*Severe haze episodes in Beijing may have origins as far as 2000 km west*”
- 13:45 – 14:00 **Gargi Sengupta (UO)** – “*The climate impact of organic aerosol acid and base dissociation*”
- 14:00 – 15:30 **Poster session, coffee break and exhibition.**

Oral session 4: Aerosol properties: pH & surfaces

Chairs: Johannes Schneider and Nicolas Fauré.

- 15:30 – 15:45 **Siegfried Schobesberger (UEF)** – “*Determining sub-micron aerosol pH from gas- and particle-phase composition measurements and thermodynamic modeling*”
- 15:45 – 16:00 **Linnéa Jönsson (LU)** – “*How can we control the structure and surface composition of metal oxide nanoparticles in-flight?*”
- 16:00 – 16:15 **Georg Trolle (AU)** – “*Modeling Local Aerosol Surface Environments: Clustering of Organic Acids, Water, and Ions*”
- 16:15 – 16:30 **Xiangrui Kong (GU)** – “*Water-Induced Catalysis on Atmospheric Aerosol Surfaces: Molecular Insights from APXPS Studies*”
- 17:30 – 21:00 Social conference dinner at:
Aarhus Street Food, Ny Banegårdsgade 46, 8000 Aarhus

Wednesday, January 22, 2025

Oral session 5: Aerosol processes and impacts on ecosystems

Chairs: Marianne Glasius and Christina Isaxon.

- 09:00 – 09:30 **Keynote by Annele Virtanen (UEF)** – *“The Role of Biogenic Aerosol in the Atmosphere-Ecosystem Interactions”*
- 09:30 – 09:45 **August Thomasson (LU)** – *“Towards Better Black Carbon Emission Estimates in Europe: assimilating surface observations with a Bayesian inversion framework”*
- 09:45 – 10:00 **Haochi Che (UIO)** – *“Changes in Aerosol Hygroscopicity over the South-East Atlantic Ocean During Biomass Burning Season and the Factors Behind Them”*
- 10:00 – 10:15 **Jonas Enarsson (LU)** – *“Real-time measurement of reactive oxygen species emitted from indoor sources”*
- 10:15 – 10:45 **Coffee break and exhibition.**

Oral session 6: Bio-aerosols & health impacts

Chairs: Tina Santl-Temkiv and Jakob Löndahl.

- 10:45 – 11:00 **Corina Wieber (AU)** – *“Aerosolization triggers the expression of the ice-nucleating gene in the plant pathogen Pseudomonas syringae”*
- 11:00 – 11:15 **Marcus Liljenberg (LU)** – *“Airborne DNA at a simulated crime scene”*
- 11:15 – 11:30 **Christian Castenschild (AU)** – *“Seasonal Dynamics of Arctic Marine and Atmospheric Ice-Nucleating Particles”*
- 11:30 – 11:45 **Hugo Öhrneman (LU)** – *“The Potential of Using Aerosol to Investigate Our Most Common Airway Diseases”*
- 11:45 – 13:00 **Lunch and exhibition.**

Oral session 7: Aerosols in polar regions

Chairs: Henrik Skov and Robert David.

- 13:00 – 13:30 **Keynote by Paul Zieger (SU)** – *“Aerosol-Cloud Interactions in the Arctic”*
- 13:30 – 13:45 **Tim Carlsen (UO)** – *“Over the edge: Semi-Lagrangian cloud phase changes in Antarctic mixed-phase clouds across the marginal sea ice zone”*
- 13:45 – 14:00 **Malte Schuchard (GE)** – *“Airborne measurements of the vertical and horizontal variability of ultrafine aerosol particles in Svalbard during melting season 2024”*
- 14:00 – 14:15 **Lu Zhang (AU)** – *“Long term trend of aerosol chemical compositions at Villum Research Station”*
- 14:15 – 14:30 **Awards, closing remarks by Department Head Thomas Vosegaard and farewell.**

Marcus Liljenberg (Lund University, Sweden)

Airborne DNA at a simulated crime scene

M. Liljenberg, S. Thuresson, S. Bergstrand, J. Bengtsson, J. Löndahl, M. Alsved, and J. Hedman.

Introduction

DNA found on a crime scene is often used as evidence. DNA traces are usually sampled from surfaces, leading to arguments about whether or not the DNA was there before the crime was committed. If particulate DNA from a suspect is found in the air of the crime scene, it would indicate recent presence (e.g. Fantinato et al., 2023). The purpose of this study is to examine DNA in aerosol particles after a simulated crime.

Method

A test person performed a 30-minute exercise and singing program inside a climate controlled room size (36 m³) chamber with HEPA-filtered particle-free air (one air exchange per hour) to simulate a crime being committed. All equipment and surfaces inside the chamber were cleaned and disinfected with 40% ethanol prior to all experiments. After the exercise and singing program, the test person went out and aerosols were collected using a 2 mm circular jet impactor (d₅₀=0.6 µm) at 30 L/s, for 2.5 hours in 30-minute intervals. Two 8-stage cascade impactors (Next Generation Impactor, Copley Scientific, UK) running at 60L/min were used to collect size resolved aerosol samples (0.1 µm up to > 8.1 µm). An optical particle counter with a fluorescence detector (BioTrak®, model 9510, TSI Inc., US) was used for online size-resolved measurement of total and biological particles (28.3 L/min sampling flow rate). Collection plates were swabbed, DNA was extracted, and human DNA was quantified by qPCR. DNA profiles were generated using multiplex PCR followed by capillary electrophoresis to investigate if the test person could be identified.

Results

Preliminary particle concentration data from the simulated crime indicate 70% increase of the >10 µm size bin, 30% decrease of 3-10 µm size bins, and 20-40% increase of 0.5-3 µm size bins. Preliminary biological particle concentration data indicate a decrease during the simulated crime. The concentration of biological particles, as detected by fluorescence, were on average 1519/m³ during the last 10 minutes of the simulated crime and thereafter decayed by ventilation. DNA from the test person could not be identified from collection plates (DNA concentration below 0.001 ng/µL),

Discussion and Conclusion

As no DNA was found on the collection plates further development and optimization of the experimental design needs to be performed. Information about the size distribution of human DNA in aerosols after a simulated crime is important to determine the residence time of DNA in air and for development of suitable samplers for forensic analysis. A possible application would be to estimate if and how long ago a suspect was at the crime scene, based on what particle size range their DNA could be sampled from.

References

Fantinato, C et. al., 2023, The invisible witness: air and dust as DNA evidence of human occupancy in indoor premises. Scientific Reports, 13(1), p.19059