EERL Lab

Section Sciences et Ingénierie de l'environnement
Design Project 2024 (semestre de printemps)

Proposition n°14

Volatility information of aerosols collected on nanomechanical membranes

Partenaire externe ou laboratoire IIE
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Descriptif du projet

Aerosols contribute to air pollution, a leading cause of premature deaths worldwide, and also affect Earth's climate. The climate effect of aerosols is subject to large uncertainties and is influenced by factors such as meteorological conditions, aerosol size and chemical composition. Determination of the chemical composition of aerosols is particularly challening in pristine environments such as Polar regions due to the low aerosol mass concentrations. An important property of aerosols related to their chemical composition is their volatility, which affects aerosol lifetime and fate in the atmosphere.
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In this project, we propose the students to contribute to the development of a novel method to measure aerosol mass and chemical composition based on infra-red spectra of aerosols suspended on nanomechanical resonators (EMILIE). In particular, while EMILIE has been previously shown to be able to separate substances based on their volatility, a systematic characterisation as well as appplication to atmospherically relevant mixtures and real ambient samples is a logical next step.

The students can be expected to understand the desorbtion of chemical compounds with known volatility in EMILIE. They can then develop procedures for estimating the volatility of unknown substances. Finally, these methods can then be tested on more complex mixtures as well as ambient samples of Valais aerosols measured in a campaign in February 2024, providing volatility-resolved chemical information of ambient aerosols which can improve our understanding of regional aerosol sources.

Objectif et buts
The main objective of this project is to retrieve volatility-resolved chemical information of complex mixtures as well as ambient aerosol samples. The first realistic goal of the project is for the students to systematically characterize the EMILIE instrument in our lab with chemical standards with a known volatility. Students will then gain first experience of communicating with a start-up company (Invisible Light Labs, Vienna) as they discuss their findings and seek to improve the method. Next, the goal of the students is to use statistical methods such as

singular value decomposition to do data analysis on their samples, possibly including the ambient aerosol samples from the field campaign in Valais.

Descriptif tâches

In the first week of the semester, the students will support with fieldwork in the lab's helikite campaign in Valais in February 2024. Afterwards, the project moves to the lab where students use polyethylene glycol (PEG) chemical standards to obtain a calibration of the compound desorbtion as a function of volatility. Here, students will communicate with the start-up manufacturing the EMILIE (Invisible Light Labs, Vienna) to get input on the optimal settings for separation of chemical compounds via desorbtion as well as statistical methods which can be used for compound separation. The students will analyse the data and develop the first standard operating procedures for this method, Finally, the students will apply the procedures that they have developed on more complex mixtures as well as the ambient samples they previously obtained.

Divers

This project will be carried out in close collaboration with the start-up Invisible Light Labs, Vienna, Austria. Regular teleconferences will be held on the design of the analysis set up.
The project entails intensive laboratory work, understanding theory and improving the design of a novel measurement technique.