Aix-Marseille Université - CNRS

UMR 7376 : Laboratoire Chimie Environnement

Equipe : IRA
Adresse postale : 3 Place Victor Hugo
13331 Marseille cedex 03
Case courrier 29
https://lce.univ-amu.fr/

Postdoctoral Position on aerosol-cloud interactions:
Gas-particle partitioning of organic compounds and cloud droplet activation

The Atmospheric Reactivity and Instrumentation research group in the Environmental Chemistry Unit of CNRS and Aix-Marseille University (France) seeks for a highly motivated postdoctoral researcher to study gas-particle-droplet partitioning of organic compounds during cloud droplets activation.

The Atmospheric Reactivity and Instrumentation research group has more than 20 years of experience in atmospheric chemistry, chemical composition, aerosol and VOC characterization, and physico-chemical processes. It handles state-of-the art analytical devices and is the University PI of the mobile MASSALYA[1] platform.

Work description

Cloud droplets in the Earth's atmosphere form on ubiquitous aerosol particles. At present, predictions of cloud droplet size and number concentration derived from aerosol properties are still poor, leading to large uncertainties in the radiation budget and climate projections. Cloud droplet formation on cloud condensation nuclei (CCN activation) is often investigated in closure studies, where the number of activated particles derived from their hygroscopic growth is compared with the one directly measured with a CCN counter. Many of these studies result in poor agreement, most probably due to effects related to the organic aerosol fraction which efficiently lowers surface tension of the growing droplets compared to pure water. This might be related to i) surface-active substances (or surfactants) ii) the non-ideality of the solutions, affecting hygroscopic growth due to sparingly soluble organic substances, and iii) co-condensation of semi-volatile organic substances from the gas phase.

The successful candidate will be involved in the ORACLE[2] project which aims to fundamentally improve the understanding of the role that organics play in CCN activation through combined experimental and modelling work. One of the main objectives is to elucidate the effect of co-condensation on particle growth and surface tension. The successful candidate will work in close collaboration with the Swiss partners of ORACLE[2], on simulation chamber experiments (Marcolli et al., 2004; Kanji et al., 2013; Friebel and Mensah, 2019), where a monodisperse particle population will be equilibrated with an organic vapour over long time periods at different relative humidity (RH) closely mimicking the atmosphere. The equilibration process will be monitored by measuring the concentration of the semi-volatile species in the gas and the condensed phase. The influence of co-condensation on hygroscopic growth will be assessed by sizing the equilibrated particles at different RH and measuring their CCN activity.

[1] https://lce.univ-amu.fr/fr/massalya

[2] ORACLE: AerOsol-Cloud Interactions: the Role of orgAnic compounds in CLoud droplEt activation. ANR-SNF project including LCE, IRCELYON (France), and ETH-Zurich (Switzerland)

In this project, the role of the successful candidate will be to conduct gas-to-particle partitioning of organic compounds using the CHemical analysis of Aerosol ONline (CHARON) inlet (Eichler et al. 2015). This inlet consists of a gas-phase denuder for stripping off gas-phase analytes, an aerodynamic lens for particle collimation combined with an inertial sampler for the particle-enriched flow, and a thermodesorption unit heated for particle volatilization of low-, semi- and intermediate-volatility organic aerosol (OA). The CHARON inlet will be coupled to a proton-transfer-reaction time-of-flight mass spectrometer (PTR-ToF-MS Ionicon Analytik GmbH), which quantitatively detects most of organic analytes using soft chemical ionisation, to minimize compounds' fragmentation (Gkatzelis, et al. 2018, Leglise et al., 2019; Müller et al., 2017). Using the CHARON-PTR-MS of the MASSALYA platform, experiments will be conducted by switching between the CHARON-PTR-MS mode (condensed phase analysis) and the PTR-MS mode (gas phase analysis). This will allow investigating the partitioning and the volatility parameters of the target semi- and intermediate volatility organic compounds. Complementary analysis of the particles' inorganic content and total organic content will be monitored by a High-Resolution Aerosol Mass Spectrometer (HR-AMS) from the MASSALYA[1] platform (Brégonzio-Rozier et al., 2016; Giorio et al., 2017; Wu et al., 2021).

The candidate will operate these instruments during the campaigns, he/she will prepare each campaign with small test experiments, he/she will treat the corresponding data and will participate to the consortium meetings for work discussions, data interpretation, report writing as well as article writing for publication of the results in international peer-reviewed journals.

The project's outputs will assess the influence of gas-to-particle partitioning of semi-volatile organic compounds on cloud droplets activation. The candidate will take benefits from scientific collaborations, and data acquired by the other groups participating in the campaigns (IRCELYON-CNRS-Université Lyon and ETH-Zurich).

We offer

The position will be located at Marseille, France, at LCE, in the downtown university campus (St Charles). The initial appointment will be for one year, starting in October 2022, with the expectation of renewal for a second year upon satisfactory performance. The Salary will be based on experience and performance according to the Aix-Marseille university salary scale (approx. 30,000 € to 33,000 € net per year). The post-doc position is an opportunity for further application to academic positions, thus highly motivated candidates are encouraged to apply.

Requirements for the applicant

A Ph.D. in atmospheric sciences, analytical chemistry, environmental sciences, technical instrumentation, or a related discipline is required. Experience in mass spectrometry and monitoring instrumentation is required. Experience in complex data analysis using for example Igor Pro is highly desirable. Independence, drive, and collaboration are important and will be encouraged to develop the candidate's career.

To apply, please apply via email to **anne.monod@univ-amu.fr** with a cover letter describing your research interests, a CV, date of availability, list of publications (submitted and in preparation papers can also be included), and a list of reference persons.

References:

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- Leglise, J., et al., Bulk organic aerosol analysis by proton-transfer-reaction mass spectrometry: An improved methodology for the determination of total organic mass, O:C and H:C elemental ratios, and the average molecular formula, Anal. Chem., 91, 12619-12624., 2019
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- Wu J., et al., Substantial organic impurities at the surface of synthetic ammonium sulfate particles. Atmos. Meas. Tech. Discuss., 2021. doi.org/10.5194/amt-2021-327