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PhD proposal

Photo-oxidation of organic compounds present in particles of marine origin and influence on the hygroscopic properties. Study on individual particles in levitation

Context

According to the Intergovernmental Panel on Climate Change, the effect of aerosols on climate change is not very precisely estimated because many heterogeneous processes lead to changes in the physicochemical properties of the particles. The aging of atmospheric particles affects undeniably their optical and hygroscopic properties. As a result, light scattering and cloud condensation nuclei are difficult to estimate.[1] To study the aging processes of aerosol at the single particle scale is an added value to better understand the physicochemical mechanisms involved in heterogeneous atmospheric processes because they are complex and remain unresolved.[2]

Project description

During his/her PhD in LASIRE laboratory, the student will study the photo-oxidation of sea salt single-particles containing soluble organic compounds in order to understand the physicochemical processes during the transport of the particles in the atmosphere. In addition, the role of the photo-oxidation on the hygroscopic properties of particles will be investigated.

To undertake such study, the student will have access to an original approach combining levitation techniques (optical and acoustic) and spectroscopic characterization. Levitation systems are equipped with an environmental cell that permits environment and humidity control inside the cell and irradiation of the levitated droplet with UV-Visible light.[3,4] Composition, structure and morphology of single droplets will be studied by infrared and µ-Raman spectroscopy.

This thesis will provide elements for understanding the photo-oxidation of organic compounds contained in individual particles, the role of the sea salt, and the influence of the reactivity on the hygroscopic properties of aerosols.

The position is granted for 3 years and ***it is available from October 2020***, although ***starting date can be delayed*** for a few months due to the current sanitary crisis.

This project is in the framework of the Labex CaPPA (ANR-11-LBX-0005-01) and the CPER Climibio and Climense (under evaluation) in which the LASIRE laboratory is involved.

Keywords : Single particles, sea salt aerosols, organic aerosols, aerosol reactivity, photo oxidation, hygroscopicity, Raman spectroscopy

Candidate Profile: Master's degree or equivalent in chemistry, chemical physics, etc. The candidate must be highly motivated and rigorous. Experience in analytical chemistry, atmospheric chemistry and / or vibrational spectroscopy will be appreciated.
Grant/ funds: Labex CaPPA – région Hauts-de-France
Application procedure: Students are invited to send a CV and motivation letter as well as the Master record before May 31, 2020
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[1] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (Eds.)]. IPCC, Geneva, Switzerland, 151 pp.
[2] Krieger, U. K.; Marcolli, C.; Reid, J. P. Exploring the Complexity of Aerosol Particle Properties and Processes Using Single Particle Techniques. Chem. Soc. Rev. 2012, 41 (19), 6631–6662.
[3] Gómez Castaño, J. A.; Boussekey, L.; Verwaerde, J. P.; Moreau, M.; Tobón, Y. A. Enhancing Double-Beam Laser Tweezers Raman Spectroscopy (LTRS) for the Photochemical Study of Individual Airborne Microdroplets. Molecules 2019, 24 (18), 3325.
[4] Tobon, Y. A.; Seng, S.; Picone, L. A.; Bava, Y. B.; Juncal, L. C.; Moreau, M.; Romano, R. M.; Barbillat, J.; Sobanska, S. Photochemistry of Single Particles Using Acoustic Levitation Coupled with Raman Microspectrometry. Journal of Raman Spectroscopy 2017, 48 (8), 1135–1137

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