The Lille Ice Nucleation Chamber (LINC). A practical approach to investigate the heterogeneous nucleation of ice on soot emitted by jet airplane engines

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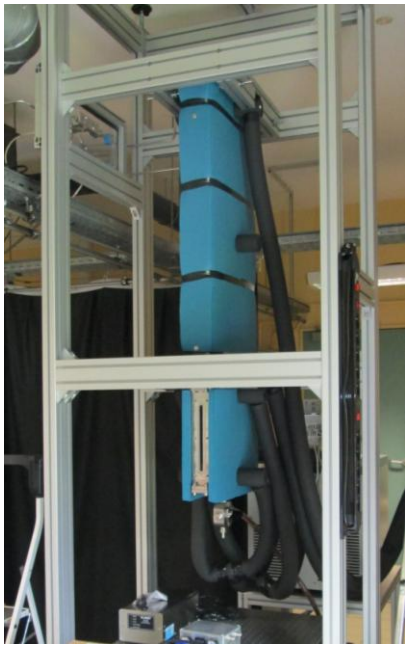
Among other pollutants, aircraft jet engines release in the high troposphere soot (nano)particles that potentially act as condensation nuclei for either ice or supercooled water. The nucleated ice particles and water droplets that form the so called condensation trails (*contrails*) may evolve in persistent cirrus–like clouds when the conditions are favorable, and therefore have an impact on the local albedo thus on the radiative balance of the atmosphere especially in high density air traffic regions.

Within this project we aim to a better understanding of the indirect role of soot aerosols on persistent cloud formation. In particular, in order to provide information on the onset of thermodynamic condition at which heterogeneous nucleation of ice occurs, a dedicated experiment, the *Lille ice nucleation chamber* (LINC), has been built at PC2A laboratory and it is currently in early testing stage. The LINC facility is a continuous flow diffusion chamber based on the system first developed at the Colorado State University (CDU-CFDC)[1] and then improved at the Swiss Federal Institute of Technology in Zurich (ZINC)[2]. Briefly, the LINC main nucleation chamber is defined by two parallel plates vertically mounted that are covered by thin layers of ice during operation. An externally imposed temperature gradient between the walls grants an indirect control over the ice and water supersaturation between the walls. The seeding aerosols are injected from the top inlet of the nucleation chamber, while ice particles are detected by optical counting at the bottom outlet after a permanence time in the supersaturated region of about 10 s. With this setup temperature as low as –45°C and ice supersaturation as high as 130% can be reached.

As mentioned above, at this stage of the project particular attention is devoted to aircraft engine exhausts. The investigated soot aerosols are generated in laboratory flames and have morphology close to that of aeronautics soot[3]. In a typical experiment, soot aerosols are injected into the LINC main nucleation chamber at controlled temperature, pressure and ice supersaturation. The onset of thermodynamic conditions at which heterogeneous nucleation occurs and the nucleation rates are then investigated as a function of the size distribution, morphology and surface chemical composition of the seeding soot aerosol.

The experimental data are expected to provide useful information on the heterogeneous ice nucleation mechanisms, and to help validating theoretical models representative of the ice formation dynamic in the high troposphere. The comparison of the data obtained from different measurements is expected to provide original and useful information on the interaction between soot aerosols and water.



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