Toward a more detailed physico-chemical and biological characterization of cloud water

Abstract: Transformations happening in cloud droplets are influenced by light and oxidants and potentially drive atmospheric chemistry more than expected. Photochemical transformations lead to a modification of the composition of the dissolved organic matter. Microorganisms detected in clouds can also alter the chemical composition of droplets by using dissolved organic matter as substrate for their metabolic activity, but the transformation pathways are mostly unknown.
For over 20 years clouds are sampled at the puy de Dôme observatory (France) using a collector specifically designed for high volume sampling. Physico-chemical analysis coupled to backtrajectory calculations enabled to perform statistical study to classify clouds in different classes: highly marine, marine, continental and polluted. Target analysis were developed to quantify the concentration of inorganic compounds, short chain carboxylic acids, amino acids and, more recently, sugars. In parallel, high resolution mass spectrometry has been used to have an overview of cloud organic composition and drive the future research.
The use of FT-ICR mass spectrometry to explore the chemical composition of clouds is a real challenge, because cloud water is a very complex matrix, where the compounds are present in low concentration. This instrument enabled us to identify a few thousand molecular formulas representative of several classes of compounds from primary emissions (lipids, peptides, carbohydrates, unsaturated hydrocarbons), or produced in the clouds by oxidation of organic matter. This instrument has also enabled us to show that the microorganisms present in the clouds are capable of using organic compounds as a substrate for their development, opening up a new research theme.

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After the master's degree in Environmental Chemistry at the University of Turin (2011-2013), she continued with a PhD in Physical Chemistry at the Institute of Chemistry of Clermont-Ferrand (2013-2016) on photochemical reactivity of organic compounds in cloud water. She continued working on cloud chemistry and microbiology as post-doctoral student between the Physical Meteorology Laboratory (LaMP) and the CEA (Commissariat de l'Energie Atomique) until 2017-2019. She then focused her attention on the development of a methodology for the analysis of nanoplastics at INAR (Institute for Atmospheric and Earth System Research) (2019-2020). Since 2021 she is researcher at LaMP.