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Towards a more detailed characterization of cloud chemistry composition

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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. Chemical and biological transformations may lead to a potential variation of the physico-chemical properties of aerosol released in the atmosphere after cloud evaporation, mainly through a variation of the hygroscopic properties of aerosol. This could have an impact, in the big picture, to the role of clouds in the radiative balance of Earth.

Since more than 20 years clouds are sampled at the puy de Dôme observatory (France) using a collector specifically designed for high volume sampling. The physico-chemical analysis and the backtrajectory calculation enabled the classification of cloud water samples in four classes: highly marine, marine, continental and polluted. Target analysis were developed to quantify the concentration of short chain carboxylic acids, amino acids and, more recently, sugars. In parallel, high resolution mass spectrometry have been used to have an overview of cloud composition and drive the future research. Recently, during the BIOMAÏDO campaign, clouds have been collected in La Réunion Island (Indian Ocean): the concentrations of the main constituents have been compared to the long-term series of samples collected at the puy de Dôme station, highlighting differences and similarities.

Despite this research effort, cloud composition is extremely complex and still not fully characterized. Moreover, chemical reactivity and microbiological transformations move up a notch the complexity of this matrix. The cloud chemistry model CLEPS (Cloud Explicit Physico-chemical Scheme) was developed in parallel to better understand the transformations in cloud droplets and the exchanges with the gaseous and particulate phases. Only an enhanced multidisciplinary approach will provide a better understanding of this medium.