Advances on the development of innovative, floating, disposable radioprobes for atmospheric monitoring in warm clouds

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Characterization of clouds properties is still a latent challenge for weather forecasting and climate models. This is mainly because clouds depend on multidisciplinary natural processes ranging from the nanometer scale, where the collision of droplets and particles take place, to the thousand-of-meters scale of airflow dynamics. Turbulence plays an important role in particle dynamics inside clouds and rain initiation since it facilitates the growth of rain droplets through collisions and coalescence, however, turbulence mechanisms are not yet fully understood and fundamental questions are still unanswered. To address these knowledge gaps, the interest of turbulence Lagrangian statistics has risen significatively during the last decades, nevertheless, Lagrangian measurement techniques are mainly laboratory procedures.

In contrast to most of the traditional approaches, this work presents the advances of an experimental method for measuring in-situ the influence of turbulence in cloud formation and producing an infield cloud Lagrangian dataset by means of the development of ultra-light disposable radioprobes. These light-weighted (about 20 grams) devices will be able to float and passively track small-scale fluctuations in warm clouds and surrounding air. Each tiny radioprobe embeds a set of compact size microprocessors, controllers and sensors for the measurement of atmospheric parameters inside clouds (e.g. velocity, acceleration, pressure, temperature, humidity) after been released into the atmosphere. In order to enable them to float, the balloons containing the electronics are filled with helium gas and air to reach a buoyancy force equal to the system weight. The data obtained during the flight will be collected, stored and sent in bursts to different base stations located on ground through a dedicated radio transmission link. Due to the radioprobes' physical constrains and the environmental conditions that can be found inside warm clouds, a power-saving and long-range wireless communication technology has been selected and tested. The development of the first operational prototypes for both, the radioprobes and the receiving stations, are presented together with results of the first measurement experiments both, in laboratory and field campaign.