Geophysical Research Abstracts
Vol. 18, EGU2016-7999, 2016
EGU General Assembly 2016

Experimental Study of Aerosol-Cloud Interactions using a 5-hole Probe with Remotly Piloted Aircraft

Radiance Calmer (1), Greg Roberts (1,2), Kevin Sanchez (1,2), Keri Nicoll (3), Jana Preissler (4), Jurgita Ovadnevaite (4), Jean Sciare (5), and Murat Bronz (6)

(1) CNRS/Météo-France, France, (2) Scripps Institution of Oceanography, CA, United States, (3) University of Reading, UK, (4) National University of Ireland Galway, Ireland, (5) The Cyprus Institute, Cyprus, (6) Ecole National de l'Aviation Civile, France

Abstract

Enhancements in Remotely Piloted Aircraft Systems (RPAS) have increased their possible uses in many fields for the past two decades. For atmospheric research, ultra-light RPAS ($<$ 2.5kg) are now able to fly at altitudes greater than 3 km and even in cloud, which opens new opportunities to understand aerosol-cloud interactions. The European project BACCHUS (Impact of Biogenic versus Anthropogenic Emissions on Clouds and Climate: towards a Holistic Understanding) focuses on these specific interactions.

Field experiments in Cyprus and Ireland have already been conducted as part of the BACCHUS project to study aerosol-cloud interactions in climatically different environments. The RPAS are being utilized in this study with the purpose of complementing ground-based observations of cloud condensation nuclei (CCN) to conduct aerosol-cloud closure studies by characterizing the vertical distribution of aerosol, radiative fluxes, 3D wind vectors and meteorological state parameters. Cloud microphysical properties such as cloud drop number concentration and size can be predicted directly from the measured CCN spectrum and the observed updraft, the vertical component of the wind vector. On the RPAS, updraft measurements are obtained from a 5-hole probe synchronized with an Inertial Measurement Unit (IMU). The RPA (Remotely Piloted Aircraft) are programmed to fly at a level leg just below cloud base to measure updraft measurements while a scanning CCN counter is stationed at ground level. Vertical profiles confirm that CCN measurements on the ground are representative to those at cloud base. The 5-hole probe to measure 3D wind vectors has been calibrated in wind tunnel and comparison of flight results has been done with sonic anemometer located on meteo mast. And flights in different wind conditions contribute to validate 5-hole probe measurements. An aerosol-cloud parcel model is implemented to model the cloud droplet spectra associated with measured updraft velocities. The model represents the particle size domain with internally mixed chemical components, using a fixed-sectional approach. The model employs a dual moment (number and mass) algorithm to calculate growth of particles from one section to the next for non-evaporating species. Temperature profiles, cloud base, updraft velocities and aerosol size and composition, all measured during RPAS flights, constrain the parcel model. The measured thermodynamic and microphysical properties constrained the simulated droplet size distribution sufficiently to match the observed cloud microphysical properties.