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**Vertical wind measurements using a 5-hole Probe  
with Remotely Piloted Aircraft  
for studying aerosol-cloud interactions**

**par Radiance CALMER (GMEI/MNPCA)  
en salle Joël Noilhan**

**Résumé:**

The European project BACCHUS (impact of Biogenic versus Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding) focuses on aerosol-cloud interactions. Vertical wind velocities near cloud base, and cloud condensation nuclei (CCN) spectra, are the two most important input parameters for aerosol-cloud parcel models in determining cloud microphysical and optical properties. Therefore, the present study focuses on the instrumental development for vertical wind measurements to improve aerosol-cloud closure studies. Enhancements in Remotely Piloted Aircraft Systems (RPAS) have demonstrated their potential as tools in atmospheric research to study the boundary layer dynamics, aerosols and clouds. However, as a relatively new tool for atmospheric research, RPA require instrumental development and validation to address current observational needs. A 5-hole probe is implemented on a remotely piloted aircraft (RPA) platform, with an inertial navigation system (INS) to obtain atmospheric wind vectors. The 5-hole probe is first calibrated in a wind tunnel (at Météo-France, Toulouse, France), and an error analysis is conducted on the vertical wind measurement. Atmospheric wind vectors obtained from RPA flights are compared with wind vectors determined from sonic anemometers located at different levels on a 60 m meteorological mast (Centre de Recherches Atmosphériques, Lannemezan, France).

As the RPA equipped with a 5-hole probe is developed for aerosol-cloud observations, updraft velocities near cloud base are compared with cloud radar data during a BACCHUS field campaign (Mace Head Research Station, Ireland). Three case studies illustrate the similarity of in-cloud updrafts measured between the RPA and the cloud radar. A good agreement between vertical velocities of both instruments over a range of different meteorological conditions is found. Updraft velocity measurements from the RPA are implemented in the aerosol-cloud parcel model to conduct a closure study for stratocumulus case with convection sampled during a BACCHUS field campaign in Cyprus. Results of the case study for the Cyprus field experiment are consistent with results for similar closure studies conducted during the Mace Head field campaign (Sanchez et al., 2017), and reinforce the significance of including entrainment parameterization in Aerosol-Cloud Parcel Model to reduce uncertainties in cloud optical properties closure studies.

**Jury de thèse:**

**Rapporteurs** : Bruno Neiningger, Wolfgang Junkermann, Andrea Flossmann

**Examineurs**: Céline Mari, Marie Lothon

**Directeur de thèse**: Greg Roberts

**Pour tout renseignement, contacter Y. Poirier (05 61 07 96 55) ou J.L. Sportouch (05 61 07 93 63)**  
Centre National de Recherches Météorologiques  
42, Avenue G. Coriolis - 31057 Toulouse Cedex