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Study of thermodynamic properties of trade-wind cumulus clouds with Remotely Piloted Aircrafts during the EUREC4A field campaign

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Trade wind cumulus clouds have a significant impact on the earth's radiative balance, due to their extensive coverage in subtropical regions but due to their characteristic size are still parameterized.
The feedback of low clouds on the climate system as well as biases still existing in their representation of Global Climate Models (GCMs) results in a climatic response with relatively large uncertainty and induce a significant divergence in GCMs. Many studies and campaigns have focused on a better understanding of the thermodynamic and macroscopic properties of cumulus clouds with ground-based and satellite-based remote sensing
and also in-situ observations from aircraft flights, but few provide information on the three-dimensional properties of individual cumulus clouds. Our understanding of cumulus clouds is also based on high-resolution numerical simulations (LES: 25m, 5m of resolution) that reproduce the average characteristics of cumulus clouds fairly reliably, yet these simulations still depend on parametrizations (turbulence and microphysics).
The development of a fleet the sampling of RPAs (Remotely Piloted Aircraft) contributes to the increase in the resolution of the sampling of the evolution of cloud microphysical properties. Recent studies have permitted to have an autonomous adaptive sampling and a mapping using Gaussian
Process Regression to interpolate missed values during exploration.
An experimental strategy has been developed and tested in a cumulus cloud field simulated in a LES simulation with the Meso-NH model by implementing a simulator of RPA flights. During the EUREC4A field campaign in Barbados in January-February, more than forty RPAs flights have been conducted and thermodynamic properties of cumulus clouds were studied in three dimensions using miniaturized instruments installed on-board (PTU probe, cloud sensor). We validate first the results of cloud sensor with an other microphysics instrument. Several clouds were followed for about ten minutes and their thermodynamic evolution have been compared to cumulus clouds simulated in the LES.