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An observational study of the detrainment layer of a flower system during EUREC4A

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The global radiative budget is strongly linked to cloud microphysical processes. In numerical models, the liquid cloud microphysics is usually parameterised, and the radiative forcing from shortwave radiation due to liquid cloud is controlled overall by liquid water path, effective radius, cloud droplet number concentration, solar zenith angle, and surface albedo. Previous studies have shown that many cloud liquid optical property computations in weather and climate models have uncertainties due to not accounting for the drop size distribution and from averaging single scattering properties over wide spectral bands. Low-level clouds are the primary cause of uncertainty in cloud feedback in climate model projections. EUREC4A is a coordinated international effort that aims to address the current lack of understanding of the processes controlling the response of trade-wind cumulus clouds to changing environmental conditions in a warmer climate. The EUREC4A field campaign took place in the vicinity of Barbados during January and February, 2020 since clouds at Barbados are representative of clouds across the trade wind regions in observations and climate models. A flower, i.e., circular clumped features surrounded by large areas of clear air, cloud system formed on 2 February 2020. The Twin Otter aircraft of the British Antarctic Survey made airborne measurements of aerosol and cloud microphysics of the cloud system and its environment. We present here the detrainment layer analysis of the cloud system using the in-situ and the satellite data. The aircraft flew close to cloud top and across a comma-shaped area with effective radius exceeding 30 μm. The area had cloud optical depth greater than 50, indicating that the area was associated with active convection and strong warm-rain processes. The drop number concentrations were less than 140 cm^{-3} along the leg, with the concentrations being less than 40 cm^{-3} across the comma-shape. The concentrations of drops larger than 500 μm were ~ 3 L^{-1}. A reasonably good agreement was achieved between the GOES-16 retrieved effective radius and the calculated effective radius along the leg. The high values of effective radius calculated from the in-situ data were found in places where the concentrations were not great but had a reasonable amount of large drops, not the places where the largest drops existed but the concentrations of all drops were higher. The drop size distributions along the leg displayed the variations. These observations will be compared and contrasted with others made in similar cloud types.