EGU21-4953
https://doi.org/10.5194/egusphere-egu21-4953
EGU General Assembly 2021

In-situ estimates of the role of radiative cooling for shallow convective organization

Benjamin Fildier, Caroline Muller, Ludovic Touze-Peiffer, and Anna Lea Albright
Laboratoire de Météorologie Dynamique, École Normale Supérieure, Paris, France

This study investigates the role of radiative processes in shaping the spatial distribution of shallow clouds, using in-situ measurements retrieved during the EUREC4A field campaign. Horizontal gradients in atmospheric radiative cooling above the boundary layer had been advanced as important drivers of shallow circulation and low-level winds, through their effect on surface pressure gradients. Modeling studies first recognized their importance in idealized simulations of deep convection in radiative-convective equilibrium, then found a weaker role for idealized cases of very shallow convection; but recent work using remote-sensing data argued for their importance in strengthening the circulation close to the margin between dry and moist regions, on synoptic scales, arguing for a possible significance for these radiative effects on observed cloud structures.

Here we investigate cases of intermediate scale, observed during the EUREC^{4}A field campaign, where shallow convection extends vertically up to 4 km, and whose spatial organization can be described on mesoscales as “fish” or “flower” patterns. We perform careful radiative transfer calculations, using state-of-the-art spectroscopic data and over two thousand of dropsondes and radiosondes launched, to capture the fine details of radiative cooling profiles usually missed by satellite measurements. The large number of sondes allows us to sample radiative cooling information for the organization pattern of interest and analyze it in conjunction with the direct wind and humidity measurements. We also use geostationary estimates of precipitable water in clear-sky in order to cross-check the sonde data, and connect them to the organization pattern and to the position of the moist margin.

Our results target the following relationships previously identified in idealized simulations: (a) between horizontal gradients in moisture and in top-of-the-boundary-layer radiative cooling, (b) between these radiative cooling gradients and surface wind anomalies across the moist margin, and (c) between the strength of surface winds as a function of the distance from the moist margin. These results will allow us to test the importance of radiative transfer processes in a real case of shallow convective organization.