EMS Annual Meeting Abstracts
Vol. 10, EMS2013-447, 2013
13th EMS / 11th ECAM

The formation of wider and deeper clouds through cold-pool dynamics

L. Schlemmer and C. Hohenegger
Max Planck Institute for Meteorology, Hamburg, Germany

This study investigates how precipitation-driven cold pools aid the formation of wider clouds that are essential for a transition from shallow to deep convection and how to parameterize such effects. In connection with a temperature depression and a depletion of moisture inside developing cold pools an accumulation of moisture in wet patches around the cold pools is observed. Convective clouds are formed on top of these wet patches. Larger wet patches form with time supporting more and larger clouds. Moreover, enhanced vertical lifting along the leading edges of the gravity current connected to the cold pools is found. The interplay of moisture aggregation and lifting eventually promotes the formation of wider clouds that are less affected by entrainment and become deeper.

These triggering mechanisms are investigated in a set of cloud-resolving model simulations representing different atmospheric environments that are known to influence cold-pool characteristics including both continental and maritime conditions. Although the cloud development shows a different picture in the set of simulations, the principal way by which cold pools act remains similar. The signal is merely enhanced if more moisture is available for cloud formation and a positive feedback through subsequent cloud and precipitation formation and finally cold pools again enhances the overall precipitation efficiency.

We use these findings to propose a simple way for incorporating such cold-pool effects into parametrization-schemes for convection. Hereby, the temperature depression inside the cold pool and the resulting cold pool size is prognosticated from the environmental temperature, precipitation amount and cloud top height. A link to the size of the occurring moist patch is established. From the size of the moist patch we use the strong link detected between the size of the moist patch and the cloud size to predict the maximum cloud size, which in turn yields a modified entrainment rate.