

ACPD-13-28729-28749-2013: Perturbations in relative humidity in the boundary layer by Hirsch, Koren, Altaratz, Levin and Agassi

This manuscript discusses the importance that relative humidity plays in triggering the formation of clouds at levels much below what is theoretically predicted. Sounding profiles and ceilometer observations are used as input and evaluation of a newly formulated parcel model, where experiments are run that either do or do not consider perturbations in humidity next to perturbations in temperature. I recommend rejection of this manuscript, because the material presented is in my opinion insufficient for publication in a scientific journal.

General comment

My main concern is that the authors raise an issue - relative humidity, or humidity, perturbations are important for cloud formation - that is widely known in the cloud community. The discussion presented is negligent of a couple of decades of scientific work on cumulus clouds and far behind what one could call the frontier of science. It is well known that the sub-grid variability of both temperature and humidity play a role in controlling cloud formation, and it is also well known that the lifting condensation level should really be viewed as a wide range of lifting condensation levels belonging to parcels with a wide range of temperatures and humidities due to the heterogeneity of the sub-cloud and near-surface layer. This is even mentioned in Stull's book, which the authors reference. It is also well known that parcels are not undiluted and instead feel the environmental structure through mixing and entrainment processes. Observations of that date back to the early work of Malkus et al (1953) in her discussion of how thermal models are no accurate representations of real-life cumulus clouds, despite what Scorer and Ludlam based on their laboratory work indicated. An important paper is written by LeMone and Pennell (1976) on the structure of the sub-cloud layer and trade-wind cumulus formation, preceded by the nice piece of work by Malkus (1958), who was the first to observe the so-called transition layer that is often found near the top of the mixed-layer, which the author's observe in their sounding.

Parcel models, either run offline or as part of a convection/cloud parameterization in a climate models, consider both temperature and humidity in the parcel updraft, as well as dilution of the parcel even before cloud formation, such that it would feel the temperature and humidity structure of the sub-cloud layer. Even more noteworthy is the entire collection of state-of-the-art cloud schemes that are currently used, which include the sub-grid scale variability of both temperature and humidity, most of which have suggested that observing the variability in humidity is more crucial for the accurate prediction of cloud cover than the variability in temperature is (Sommeria and Deardorff 1977, Mellor 1977 and many after e.g. Neggers 2009).

In the methods that the authors present, little reference to such statistical schemes is mentioned, neither how one could deal with the heterogeneity of the sub-cloud layer. Instead the authors present a very detailed description of the equations needed to model the thermodynamic properties of an air parcel after condensation has occurred, which appears to have little reference to the issue raised, namely how variations in temperature and humidity before condensation/cloud base height play a role in determining the location of cloud base height.

References

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