Atmos. Chem. Phys. Discuss., 13, C10468–C10470, 2013
www.atmos-chem-phys-discuss.net/13/C10468/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Perturbations in relative humidity in the boundary layer represent a possible mechanism for the formation of small convective clouds" *by* E. Hirsch et al.

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Received and published: 28 December 2013

We thank the reviewer for his effort. We read all the comments carefully and we intend to take them into consideration in the revision process of the paper. We intend to extend the discussions on topics like the structure of a shallow convection boundary layer and the interactions between the subcloud and the cloudy layers (including the citations suggested by the reviewer). However, we have a fundamental disagreement with the reviewer on the novelty of this paper's findings and the way by which the analysis is done. Specifically, this work deals with clouds that are usually overlooked, namely the smallest bins in the cloud size distribution. We provide the exact description

of the origin of the buoyancy that is responsible for the formation of such small clouds when the standard forecast predicts clear sky. This work demonstrates that the origin of the convective motion is in the middle of the mixing layer. It is in contrast to the commonly considered source of convective motion by thermals originating near the surface (LeMone and Pennell, 1976; Nicholls and LeMone 1980; Neggers et al. 2009a,b, Stull 1988; Pruppacher and Klett, 1998; Turner, 1969; Siebesma et al, 2006). In addition we show that the initial perturbation for starting the convective motion is perturbation in the relative humidity (and not in the temperature), supporting previous studies that demonstrated fluxes of moisture from the subcloud layer upward (LeMone and Pennell, 1976) but without giving the exact location of the motion initiation. Such types of perturbation are overlooked in many cases. Note that in the paper we are developing an analytical framework to determine both which perturbation is likely to create a given cloud at a given elevation and the origin of the parcel. As for the approach used in this analysis: the parcel model developed for this study solves the basic thermodynamic and microphysical equations taking into consideration the environmental conditions. It is tuned to be sensitive to processes before droplet activation therefore we solve energy budget equations by their definition. More specifically our analysis takes in account the first law of thermodynamics, diffusional growth of both haze and cloud droplets, the temporal behavior of the relative humidity within the parcel and the driving updraft. It is a good approach for studying the very small clouds formation. The entrainment process is taken into consideration in the model as well in a reasonable way for studying the case of small clouds formation under weak updrafts conditions. There are of course other parcel and single column models that are currently being used. In fact we are using few bin-microphysics models in many scales and resolutions in other studies. We tuned our parcel model to be sensitive and to fully resolve processes in a very unique thermodynamic regime that drives the formation of clouds of 100's m scale that live only a few minutes.

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Interactive comment on Atmos. Chem. Phys. Discuss., 13, 28729, 2013.