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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Coupled vs. decoupled boundary layers in VOCALS-REx" *by* C. R. Jones et al.

Anonymous Referee #2

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The authors present an analysis of decoupling as observed in VOCALS-REx flight data for stratocumulus capped boundary layers. Among several interesting insights, their main finding is that decoupling is well correlated with depth between the lifting condensation level and the capping inversion, and relatively insensitive to other potentially relevant parameters.

The paper is very clearly written, interesting and relevant to anyone with an interest in the dynamics and physics of stratocumulus clouds. I have some minor comments, as detailed below, but recommend it be accepted once these have been addressed.

1. given the potential for different approximations for θ_l (eg linearised?) it seems odd to give a definition only of q_t

2. in (4) I don't think $T_{da}(z_b)$ is actually well defined by saying "the subscript "da" indicates a dry adiabatic and hydrostatic vertical displacement". Only one level is indicated (ie z_b) so where is the displacement from, or to? I think this may be why I don't really understand what you are doing in (4). The final result in (5) makes sense, though!

3. p.8444: from a quick skim back through Bretherton and Wyant (1997) it looks like ΔF_R varied there only from 33 to 42 Wm^{-2}. That study also used diurnal mean SW radiation so perhaps the quantitative agreement could also be improved with a better incorporation of the effects of SW radiation in that idealised framework?

4. p.8445, the definition of inversion top and base for the inversion jump calculations: both the profiles shown (Figs.2 and 10) suggest to me that there can be issues defining both the top and bottom values. The visual estimate for inversion top in Fig.10 is actually pretty well defined but the strong gradient in θ_l from cloud base to inversion base is still a cause for concern. In Fig.2, θ_l increases fairly steadily above the inversion so how well defined is the top value? Given this, I wonder if it is really appropriate to attempt to give a single value to these jumps? I would have thought it should be possible to give a range instead and thence show a range of κ?

5. p.8446: it would be very interesting if Fig. 11 could distinguish between well-mixed and decoupled observations (eg, use the same symbols as Fig.8, red/blue for decoupled/coupled and open symbols for POCs). The Lock (2009) study considered only the regime of stratocumulus over cumulus, ie decoupled stratocumulus, and already commented on previous stratocumulus observations with large cloud fraction and large κ: "A possible explanation for a more rapid transition [here] as κ increases, then, is that the additional generation of cloud-top mixing as shallow cumulus clouds penetrate the inversion alters this balance compared with the stratocumulus regime, in favour of more rapid evaporation of the cloud".

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Interactive Comment

It would be interesting (and very easy!) to see if this data supported that possible difference between coupled and decoupled layers.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 8431, 2011.