Representation of moist downdrafts in shallow cloud parameterizations

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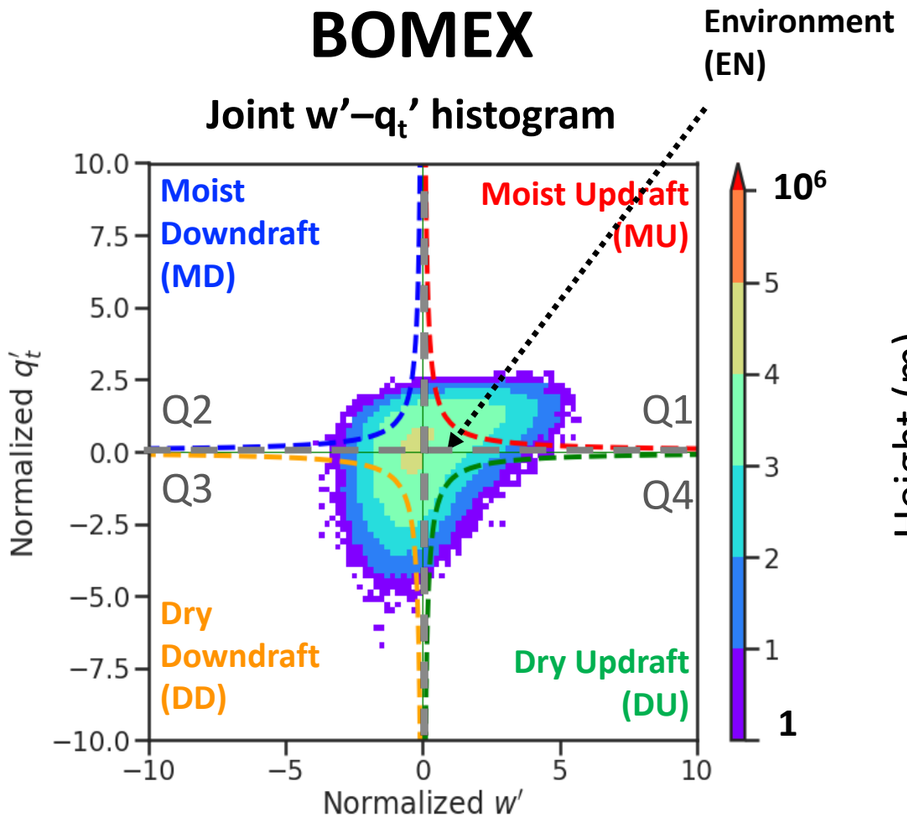
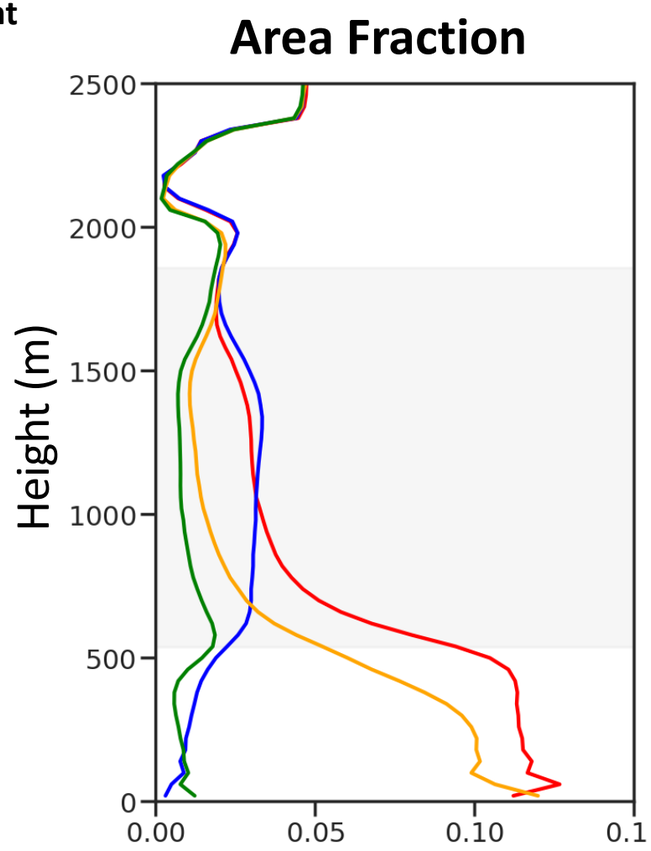
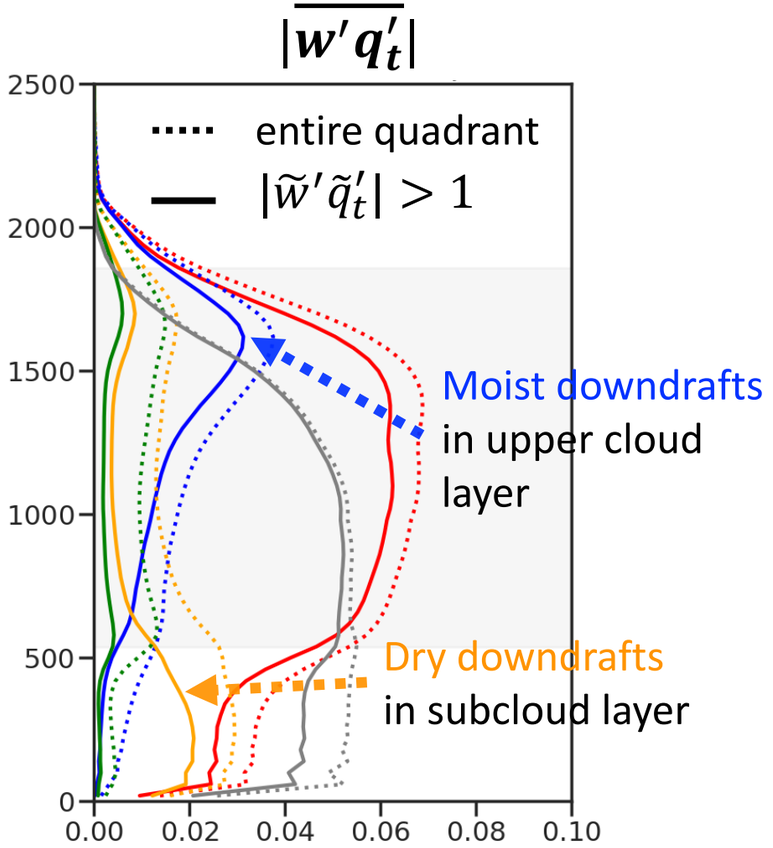
We use a q_t-w quadrant analysis technique to identify the "coherent structures" of moist and dry up/down-drafts (MU, MD, DU, DD) and the environment (EN) in LESs.







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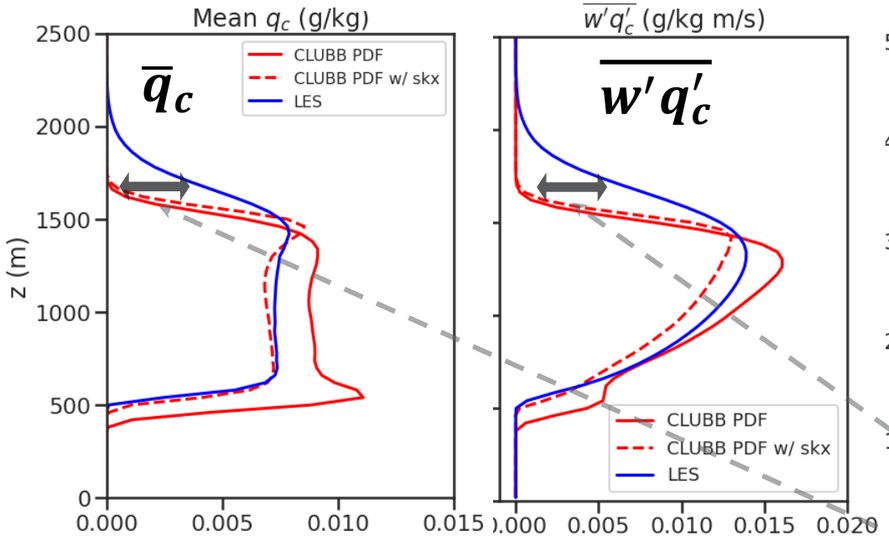
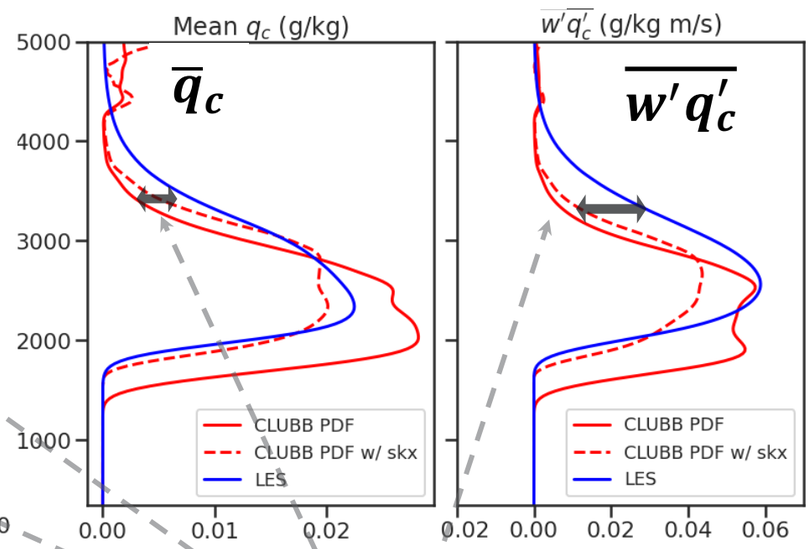
The simplified double-Gaussian PDF used in CLUBB and SHOC can represent dry downdrafts (with good q_t/θ_l skewness parameterizations), but not moist downdrafts associated with overshooting.

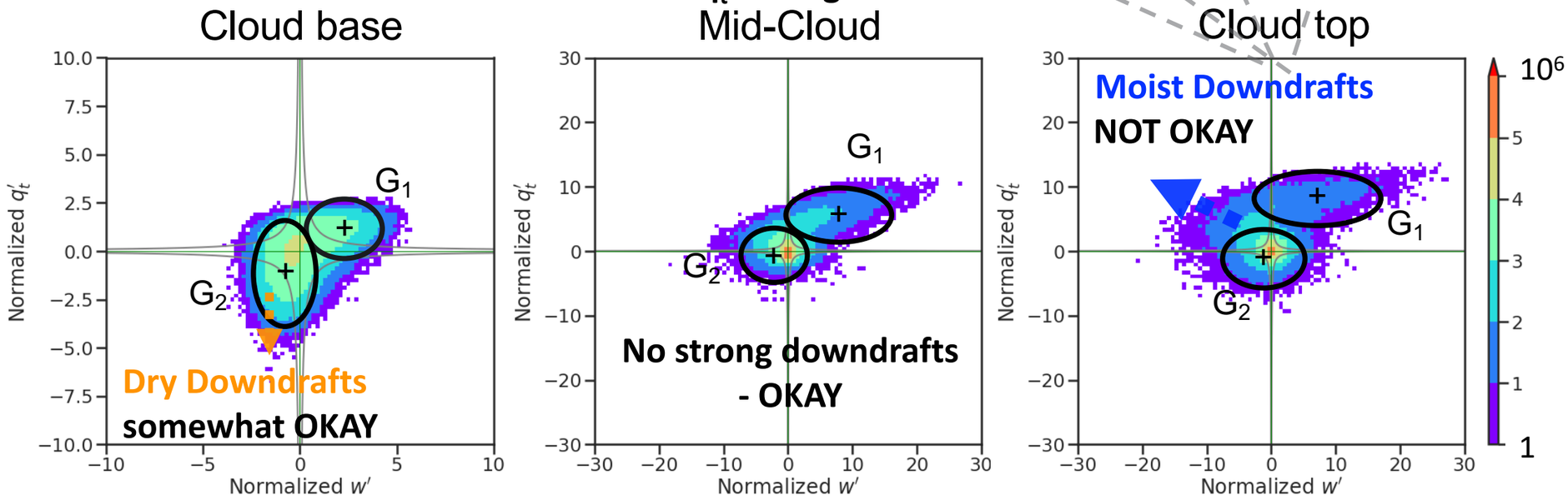
BOMEX



HI-SCALE



Joint w'–q_t' histogram - BOMEX



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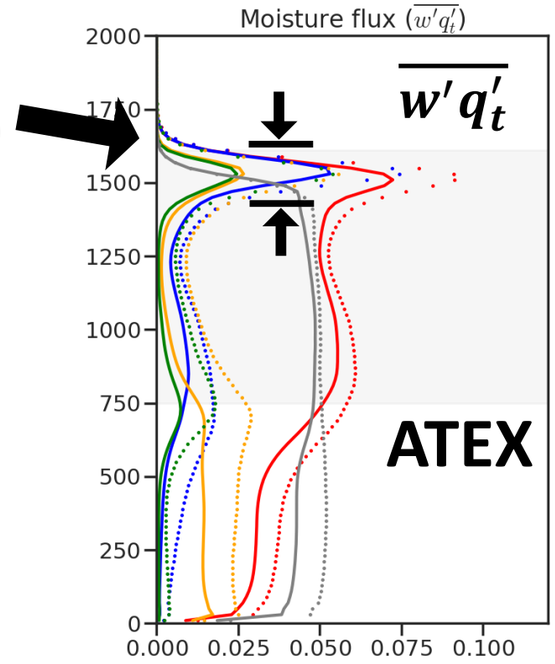
Stronger inversion
More squeezed MD



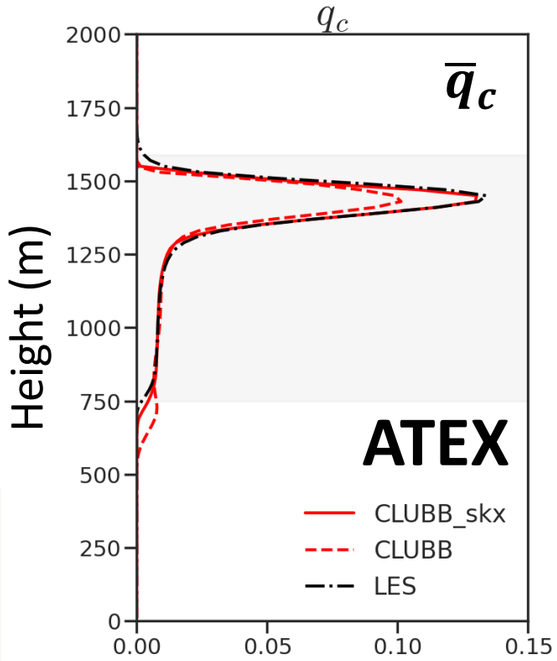
- When moist downdrafts are "squeezed" into a thin layer (due to strong inversion) **in a stratocumulus or cumulus-under-stratus regime, the Double-Gaussian PDF performs OK and captures the stratus cover reasonably well …**

- **Performance of the Double-Gaussian PDF closure improves at higher resolution (<5 km for HISCALE)**

Huang, M., H. Xiao, M. Wang, and J. D. Fast, 2020: Assessing CLUBB PDF Closure Assumptions for a Continental Shallow-to-Deep Convective Transition Case Over Multiple Spatial Scales. Journal of Advances in Modeling Earth Systems, 12, e2020MS002145.

- **Representing both moist and dry downdrafts in the cloud-topped PBL is challenging for mass-flux parameterizations as well.**

See my poster for ongoing work on contributions to downward moisture transport associated with individual clouds in a shallow cloud population.



Xiao, H., M. Ovchinnikov, L.K. Berg, and J. Muelmenstaedt, 2023: Evaluating shallow convection parameterization assumptions with a q_t-w quadrant analysis. Journal of Advances in Modeling Earth Systems, *Accepted*.