# ARE MORE ORGANIZED TRADE CUMULUS CLOUDS DEVELOPING MORE EFFICIENTLY?

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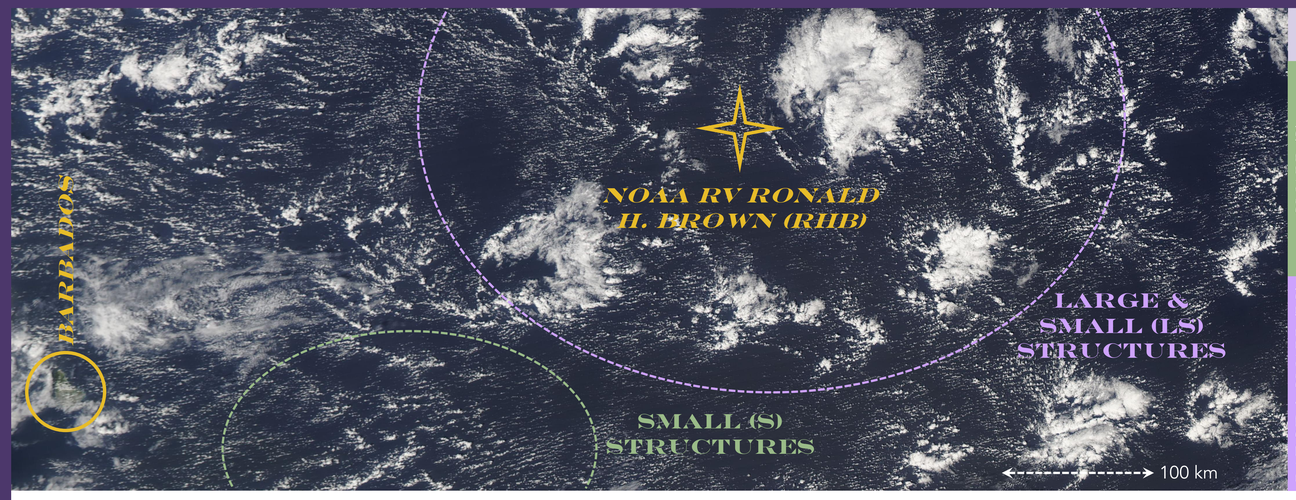
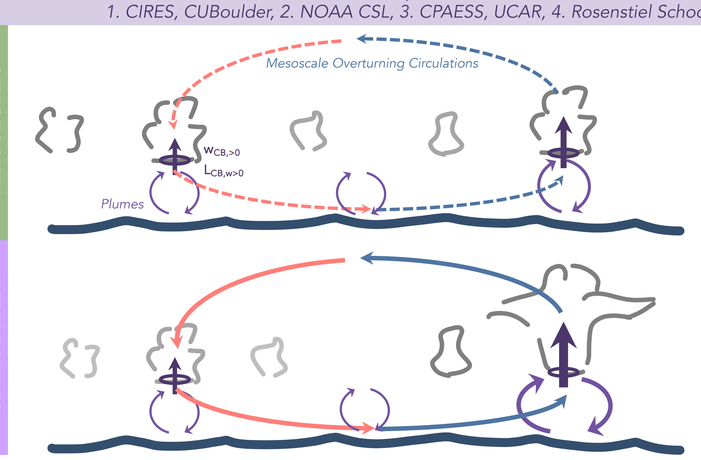



## KEY POINTS

- Using *in situ* observations we find that organized trade wind clouds have more dynamically-efficient development.
- This is likely a signature of mesoscale circulations reinforcing the development of organized clouds.
- These differences have important implications for cloud radiative properties, feedback, hydrologic cycle contributions, and our understanding of how to simulate clouds in present and future climates.

## MOTIVATION

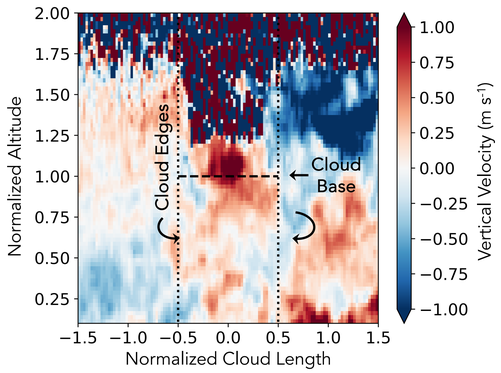
- Mesoscale organization of boundary layer clouds (patterns O(100 km)) globally modulates shortwave cloud radiative effects, feedback [e.g., 1-2], and (tropical) hydrologic cycles [3].
- Trade-wind clouds exhibit varied mesoscale morphologies [e.g., 2, 4-5] and a dynamic dependency in their development that is poorly captured by GCMs, impacting cloud feedback estimates [e.g., 6].
- Continued investigation of low, organized cloud system dynamics is important for accurately capturing present and future cloud impacts.

## METHODS

- Observations are from the RHB platform during the 2020 ATOMIC and EUREC$^4$A Joint Campaign in the trade-wind region near Barbados. [7, 8]
- Updrafts, cloud base core (w>0) velocities and sizes, and plume statistics are identified from the NOAA CSL motion-stabilized Doppler-wind Lidar aboard the RHB.
- Days when small (S) and large and small (LS) structures were sampled are hand identified from MODIS *Aqua* imagery (consistent with [5]).

## RHB OBSERVATIONS

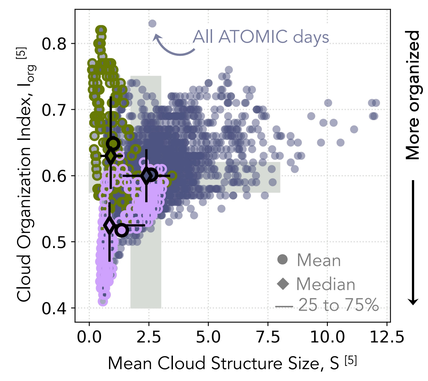
### Doppler-Wind Lidar Cloud Velocity




*We focus on cloud column observations. Updrafts are defined as where w>0 m/s.*

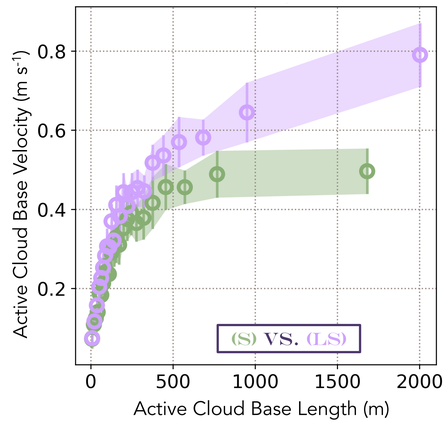
*Plume widths are the maximum length of a contiguous area where w>0.05 m/s*

### Mesoscale Cloud Organization

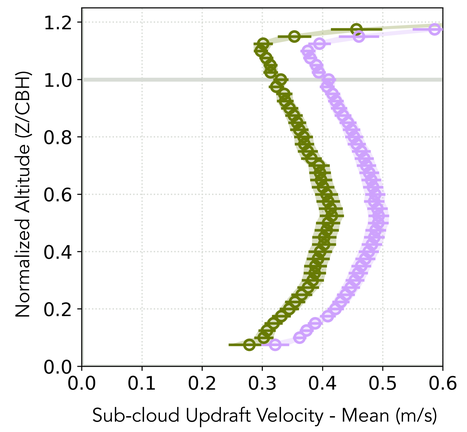



*Hand-identified LS and S days have similar structure sizes but are well separated by organization: LS is more organized than S.*

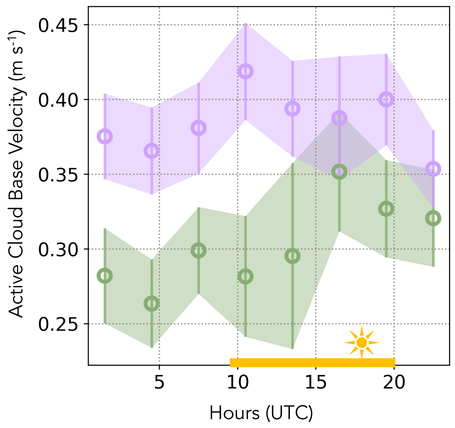
## RESULTS



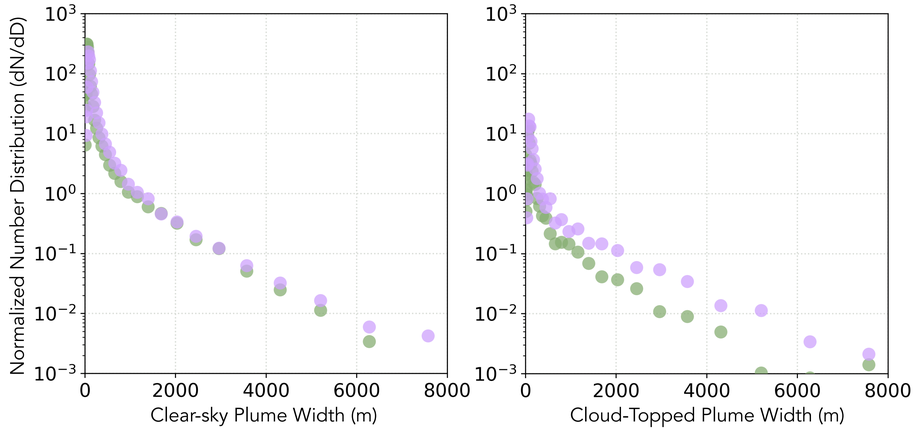

Yes! More organized clouds have stronger updrafts for a given cloud base core size (i.e., they more efficiently flux mass/moisture into cloud).




This also extends through the sub-cloud: More organized clouds also have larger mean velocity and variance (i.e., greater turbulence) profiles.




More organized cloud updrafts evolve less diurnally, peaking at the end of the night, suggesting internal drivers are more important for them.




"Unsuccessful", clear-sky thermals have similar widths but more organized clouds tend to develop from *wider* thermal plumes.

## ACKNOWLEDGEMENTS

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## REFERENCES

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