Cloud-surface decupling over land and ocean: observations and LES

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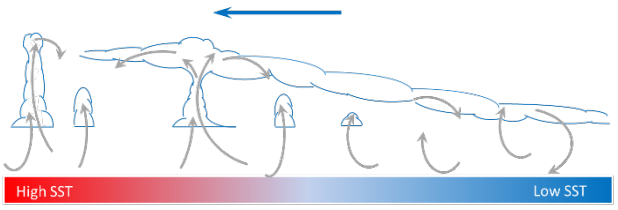
Motivation: Cloud-surface decoupling is important for understanding (1) cloud physics, (2) aerosol-cloud interactions, and (3) GCM representation of shallow clouds

Methods:
ARM observations: MARCUS, MAGIC, ENA, SGP
LES: System for Atmospheric Modeling (SAM)

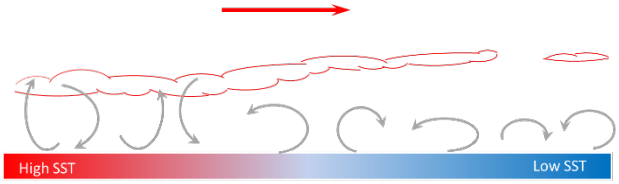
- **Goal # 1**

Test the hypothesis: **only** warm air advection causes **unambiguous** cloud-surface decoupling over the ocean.

Cold air advection (CAA)



Warm air advection (WAA)



Zheng et a., 2020, GRL

- **Goal # 2**

Test the hypothesis: clouds may last longer in decoupled conditions of warm air advection.

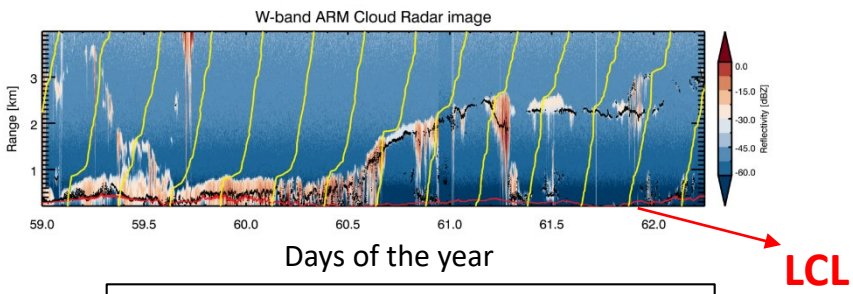
- **Goal # 3**

Develop a new remote sensing methodology for determining different regimes of cloud-surface coupling/decoupling over land.

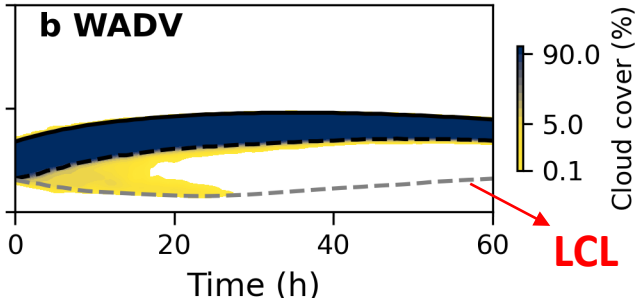
Results

- **Goal # 1**

Hypothesis: **only** warm air advection causes **unambiguous** cloud-surface decoupling over the ocean.



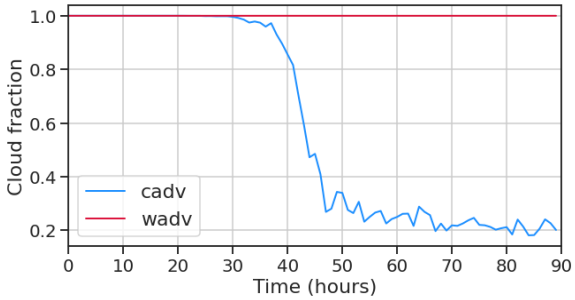
W-band radar observations from MARCUS (Zheng and Li, 2019)



Idealized large-eddy simulations (Zheng et al., under revision, 2021)

- **Goal # 2**

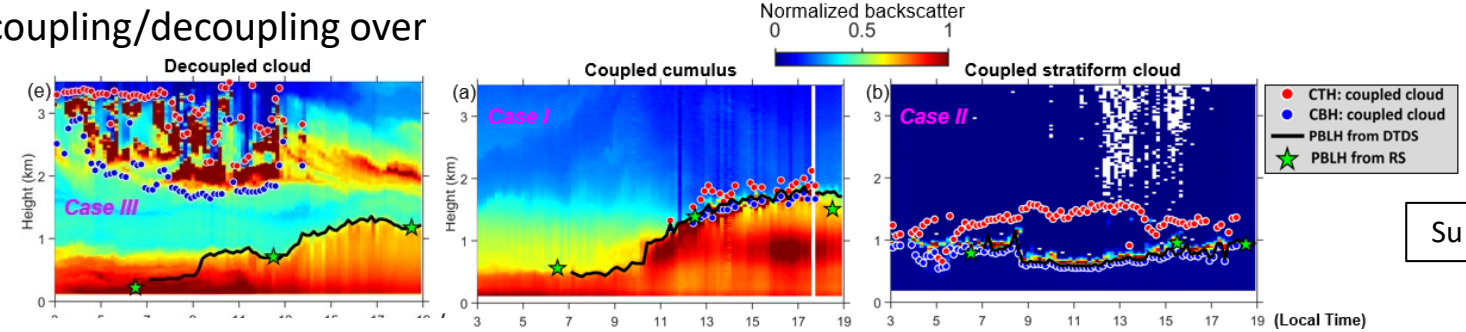
Hypothesis: clouds may last longer in decoupled conditions of warm air advection.



Idealized large-eddy simulations (Zhang et al., in prep., 2021)

- **Goal # 3**

Develop a new remote sensing methodology for determining different regimes of cloud-surface coupling/decoupling over



Su et al., ACPD, 2021

- **The presented works can be found in:**

Zheng Y. and Z. Li (2019), Episodes of warm air advection causing cloud-surface decoupling during MARCUS, Journal of Geophysical Research: Atmospheres.124. doi: 10.1029/2019JD030835.

Zheng, Y., D. Rosenfeld and Z. Li (2020), A more general paradigm for understanding the decoupling of stratocumulus-topped boundary layers: the importance of horizontal temperature advection, Geophysical Research Letters, e2020GL087697.

Zheng, Y., H. Zhang, D. Rosenfeld, S.S. Lee, T. Su, and Z. Li (2021), Idealized large-eddy simulations of stratocumulus advecting over cold water. Part 1: Boundary layer decoupling, Under revision, Journal of the Atmospheric Sciences. [Link for early print]

Zhang, H., Zheng, Y., et al. (2021), Idealized large-eddy simulations of stratocumulus advecting over cold water. Part 2: Cloud response, In preparation, Journal of the Atmospheric Sciences.

Su T., Y. Zheng and Z. Li (2021), A methodology to determine coupling and decoupling of continental clouds from lidar and meteorological data,. ACPD