Satellite remote sensing of cloud base updraft for marine stratocumulus

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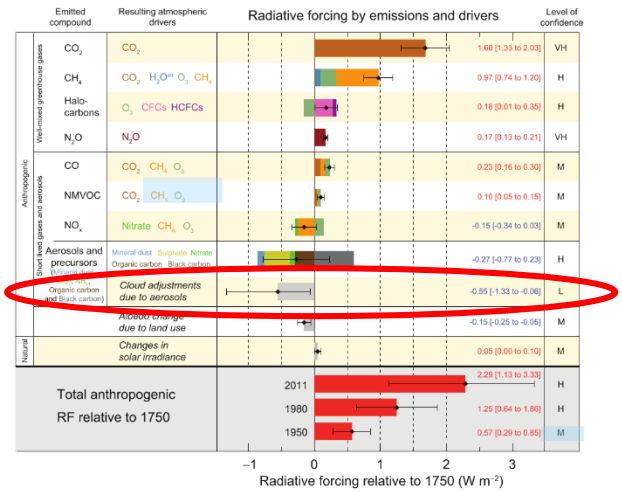
Why cloud base updraft?



IPCC, 2013

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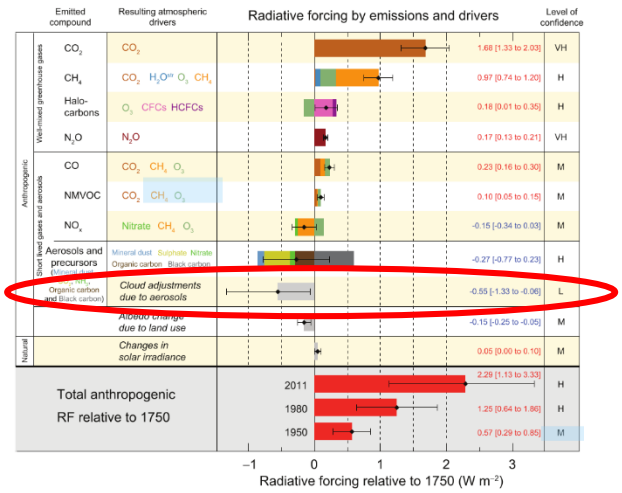
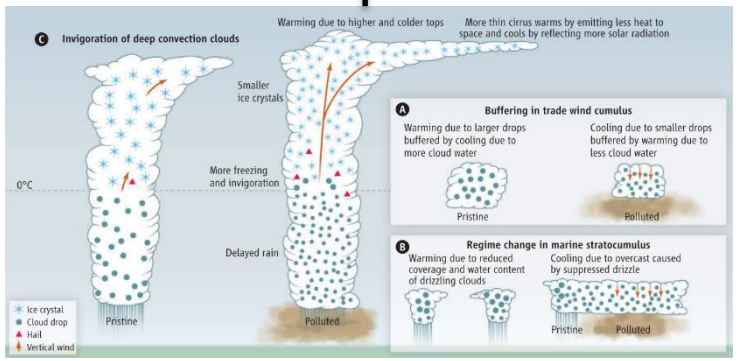


IPCC, 2013



Rosenfeld et al, 2014

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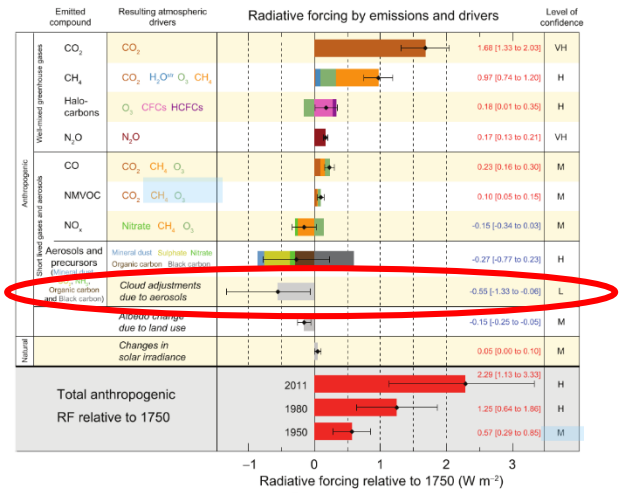

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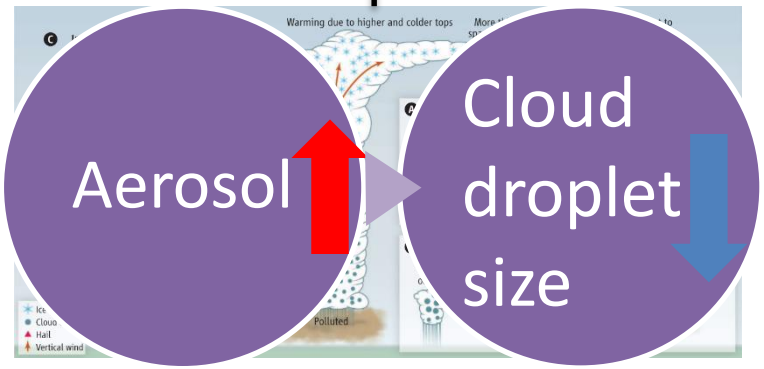

Rosenfeld et al, 2014

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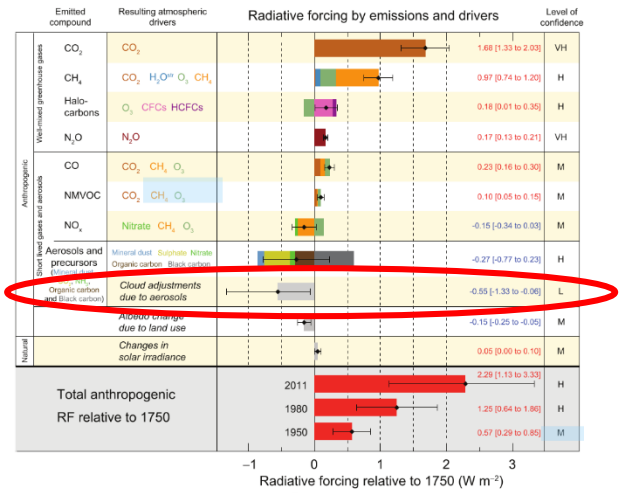

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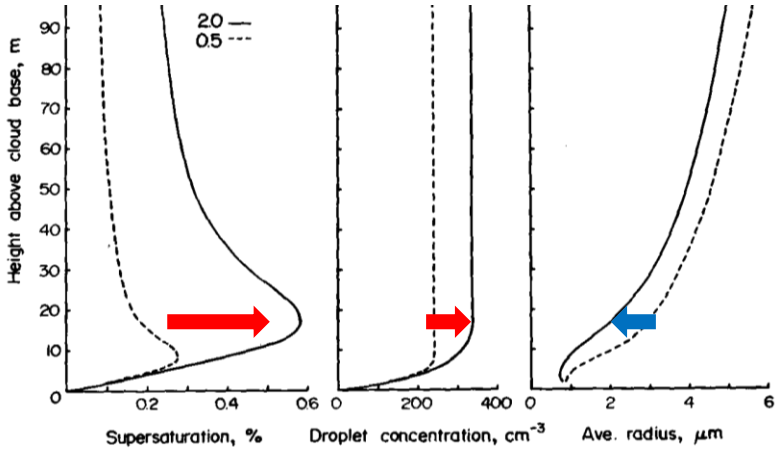
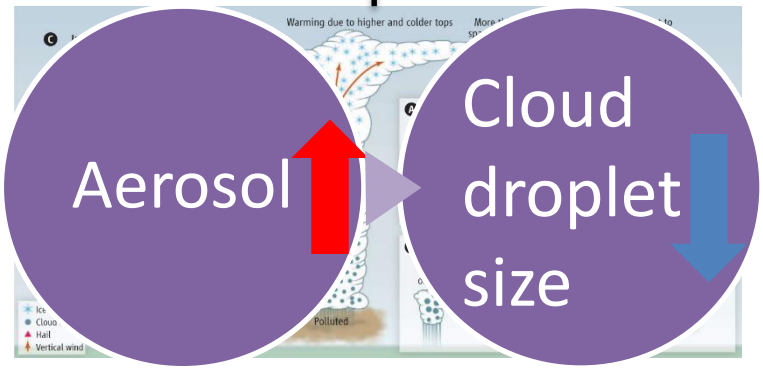


Rogers and Yau, 1988



Rosenfeld et al, 2014

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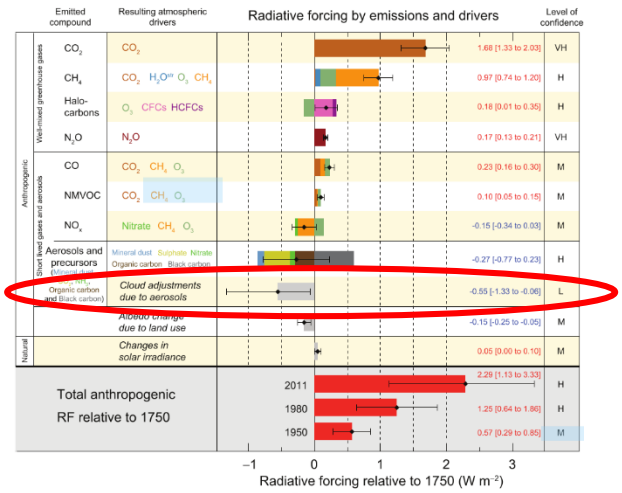

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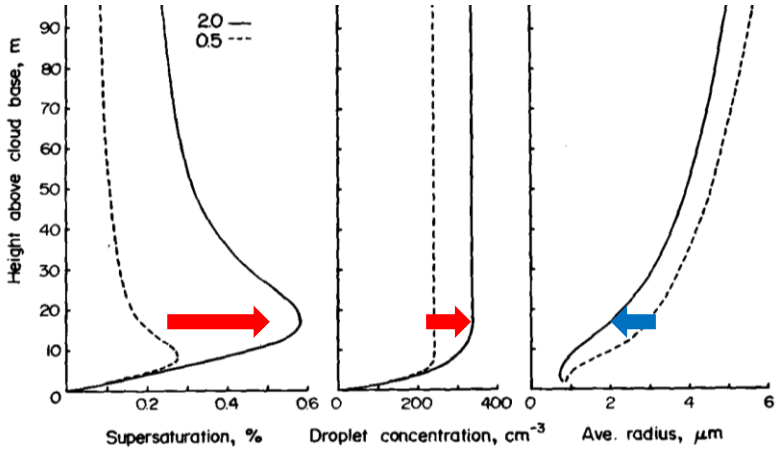

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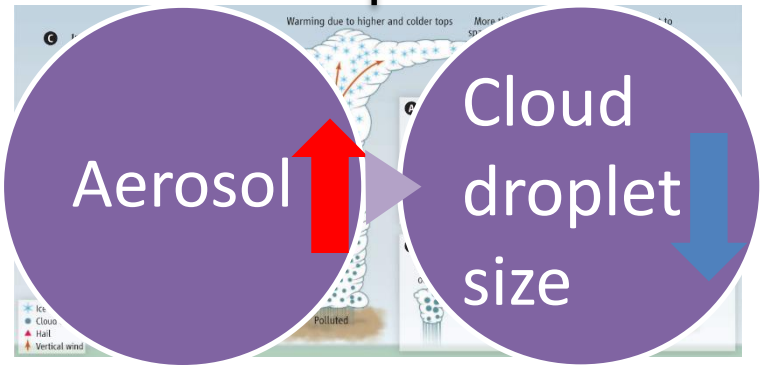
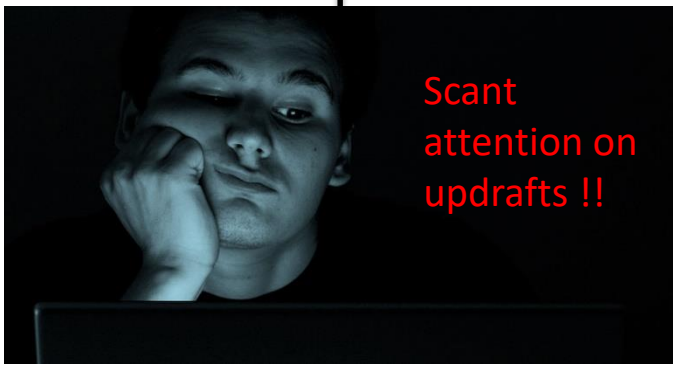


Rosenfeld et al, 2014



Why cloud base updraft?

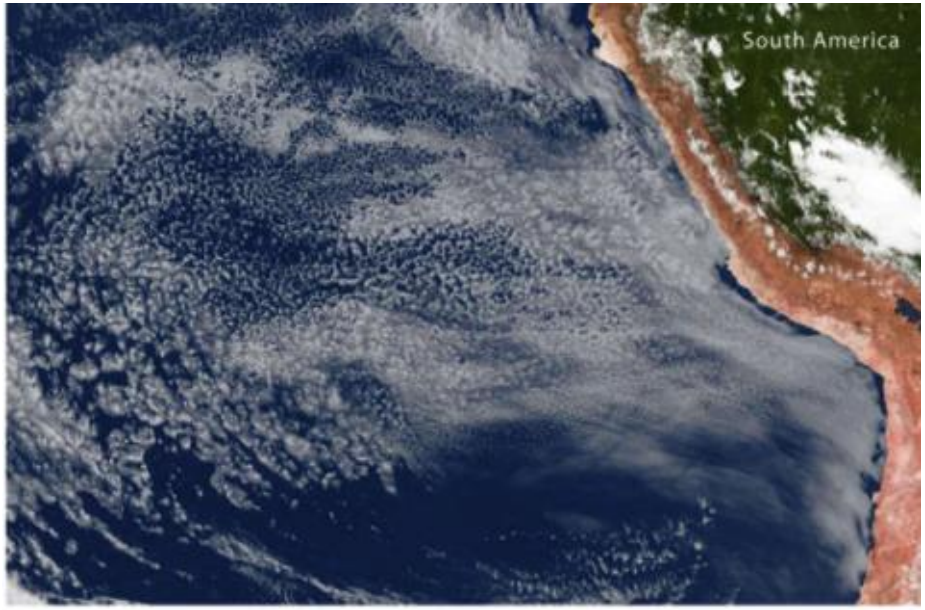
"Are atmospheric updrafts a key to unlocking climate forcing and sensitivity ?"

----------by Leo Donner et al., 2016

Why marine stratocumulus?

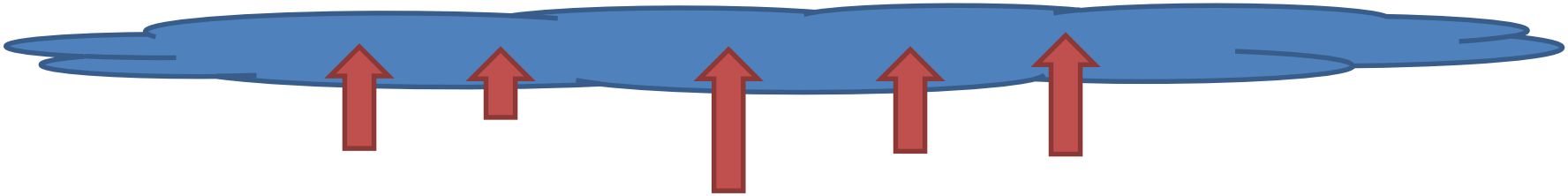
Most **dominant** cloud type by area covered

Low clouds: **strong** negative net radiative effect



R Wood, 2012

How to measure cloud base updrafts of stratocumulus from space?



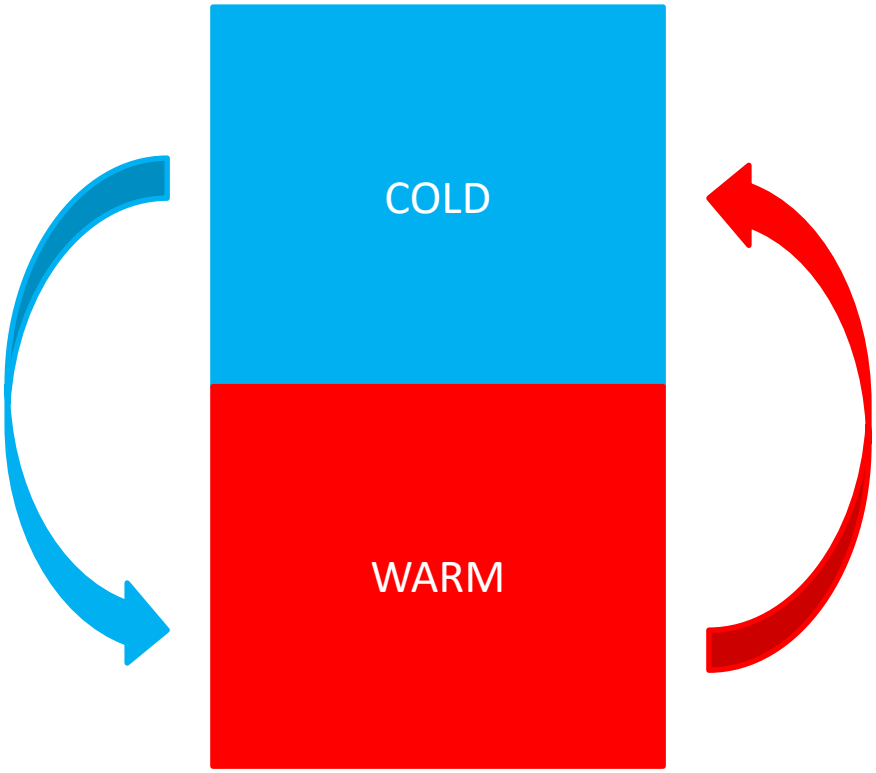
Convective nature of stratocumulus

Stratocumulus

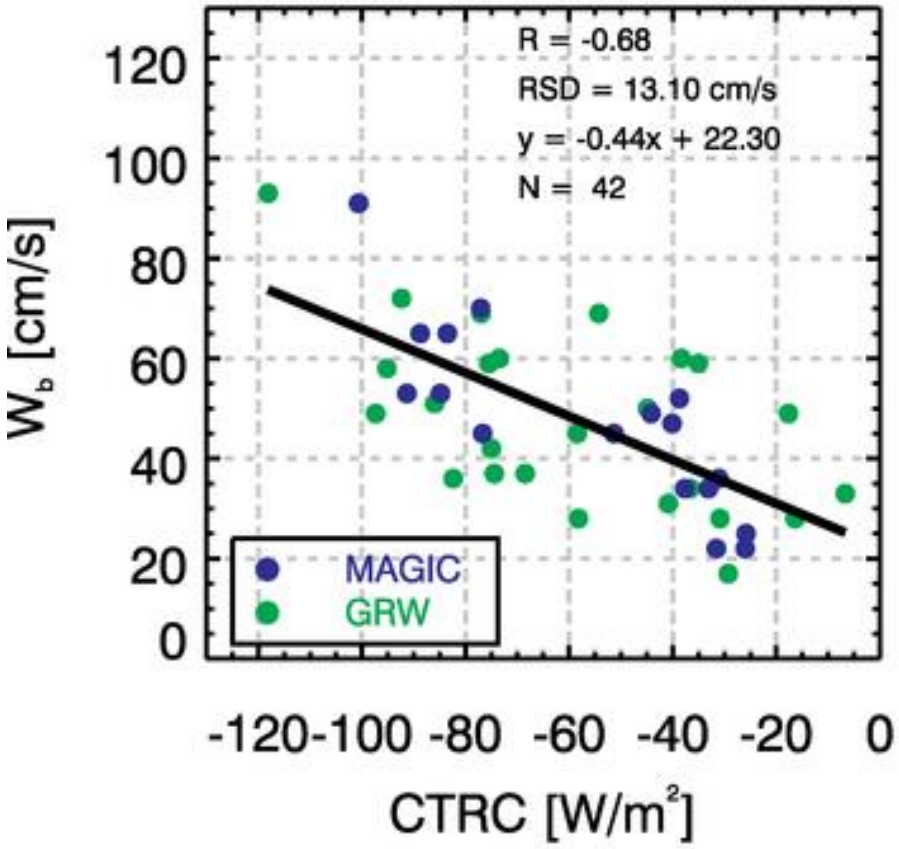
"Layer" "Heap"

R Wood, 2012

Cloud top radiative cooling (CTRC) drives updrafts



W_b versus CTRC

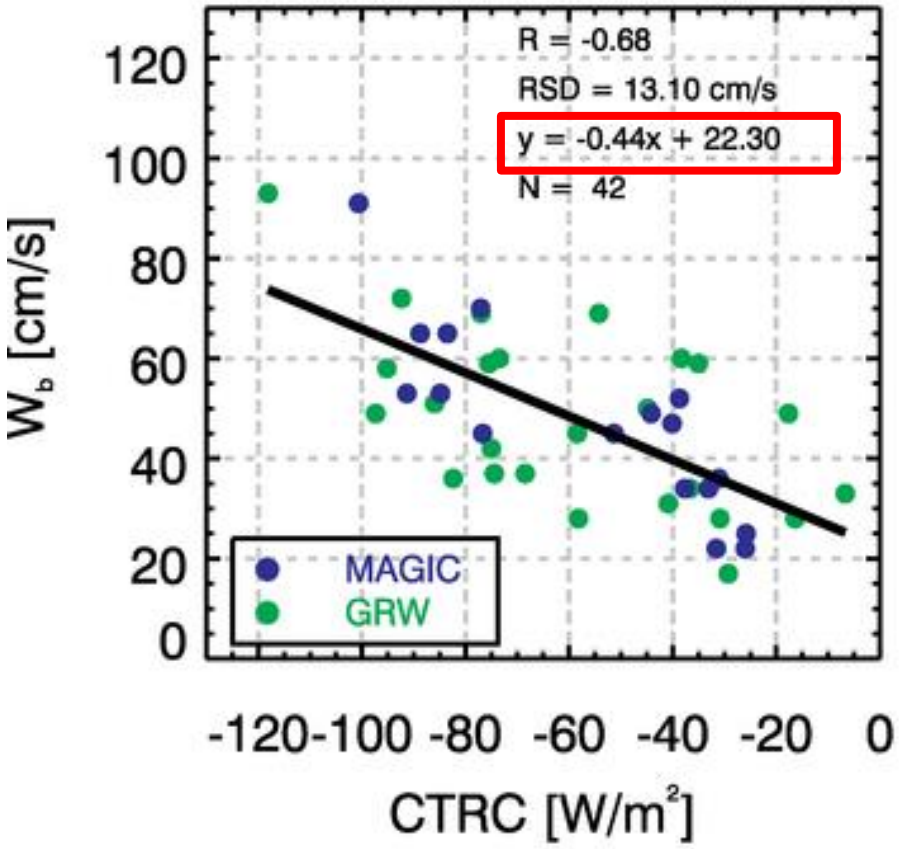


W_b – Cloud base updrafts

CTRC – **C**loud **T**op **R**adiative **C**ooling

Zheng et al., 2016, GRL

W_b versus CTRC

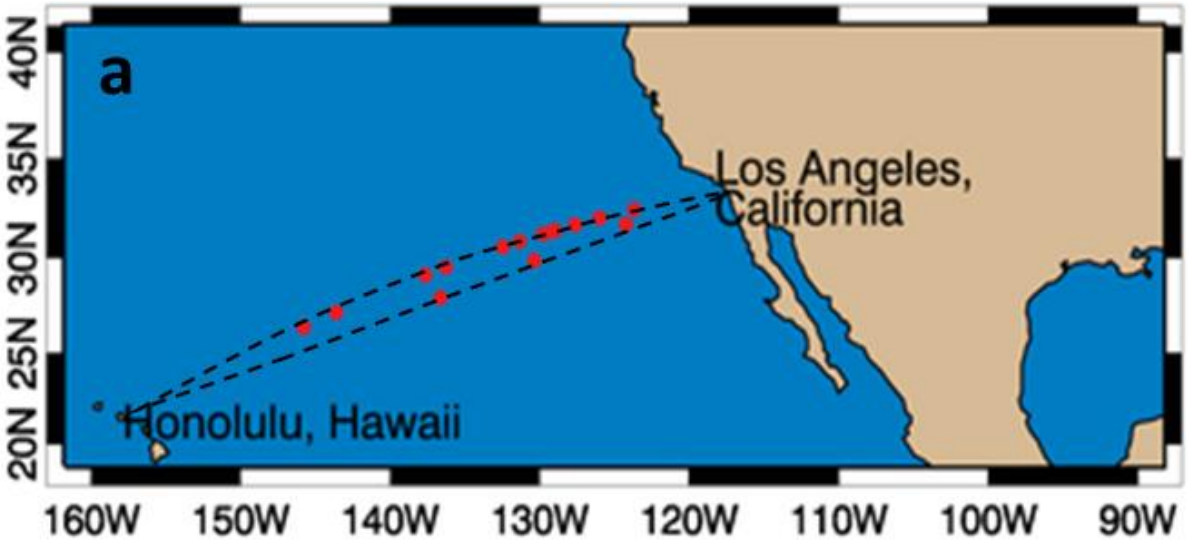


W_b – Cloud base updrafts

CTRC – **C**loud **T**op **R**adiative **C**ooling

Zheng et al., 2016, GRL

Study region



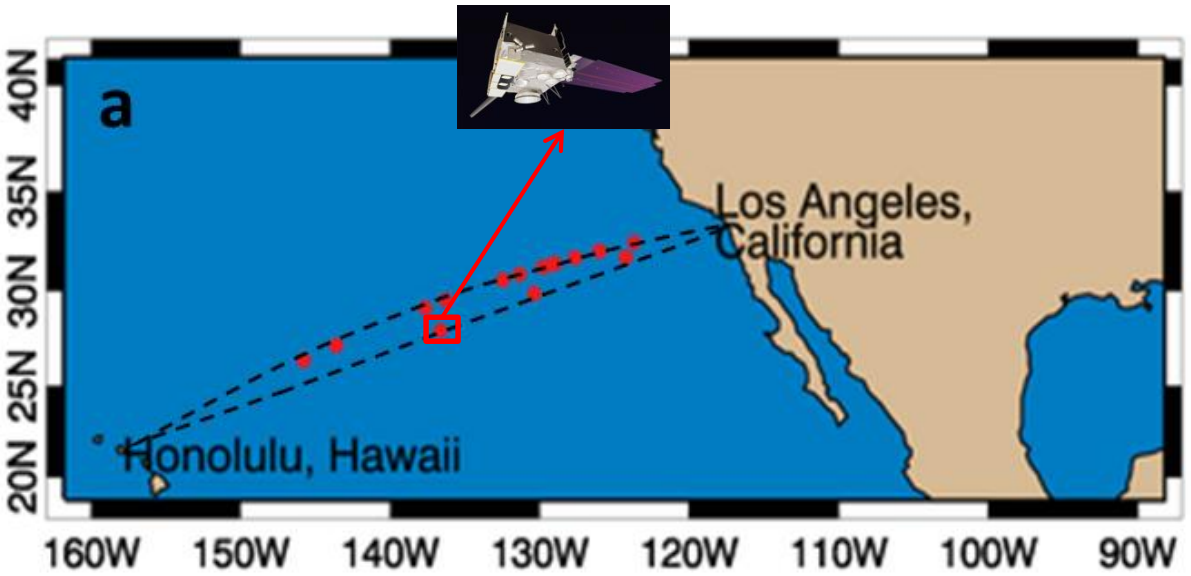
MAGIC: Marine **A**RM **G**PCI **I**nvestigations of **C**louds

Study region

ARM CLIMATE RESEARCH FACILITY

U.S. DEPARTMENT OF ENERGY | Office of Science

GOES-15



MAGIC: Marine **A**RM **G**PCI **I**nvestigations of **C**louds

GOES-15

- 15th Geostationary Operational Environmental Satellite: GOES-15

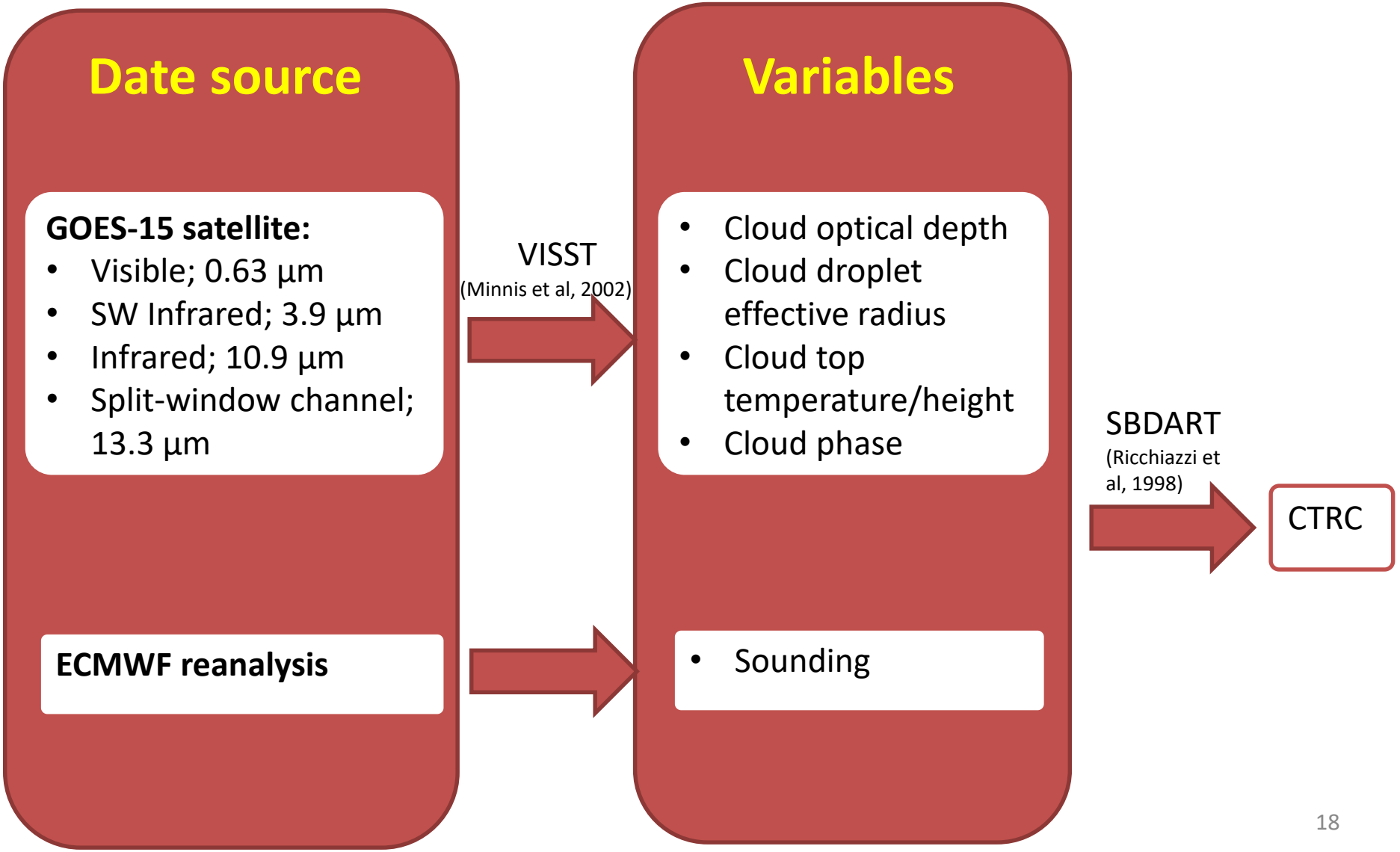
GOES Imager Band	Name	Central Wavelength (µm)	Resolution (km)
1	Visible	0.63	1
2	Shortwave Infrared	3.9	4
3	Water vapor	6.48	4
4	Infrared	10.7	4
6	Split window	13.3	4

GOES-15

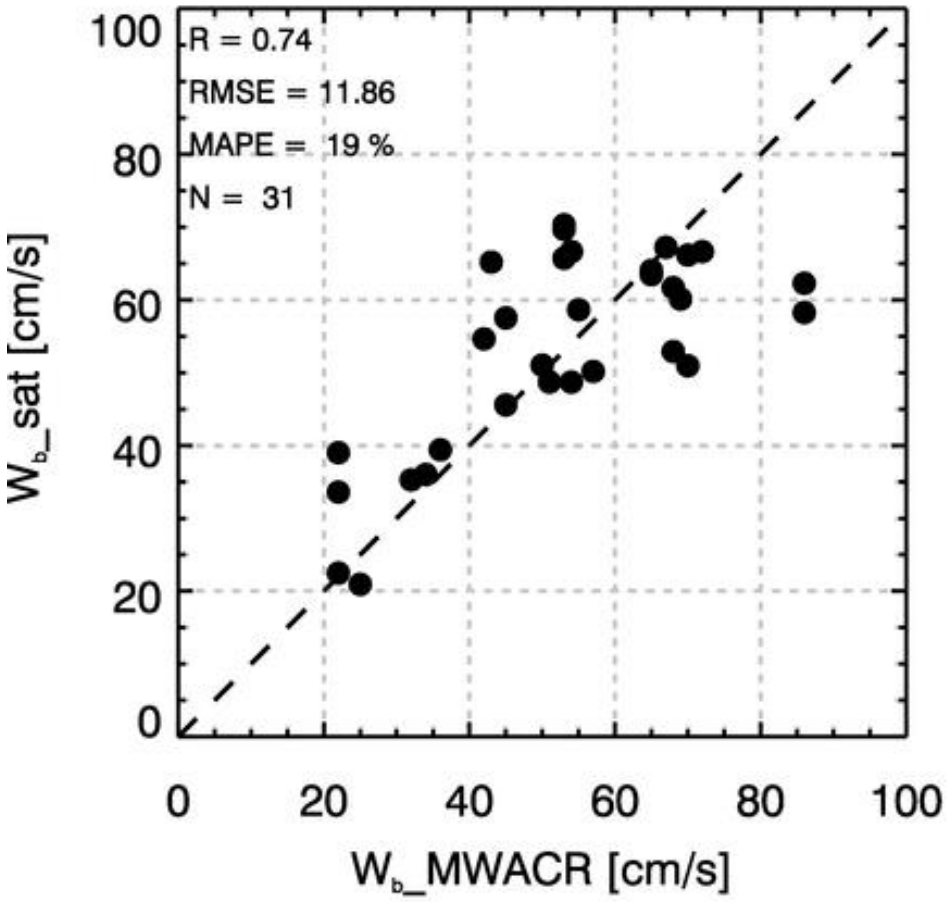
- 15th Geostationary Operational Environmental Satellite: GOES-15

GOES Imager Band	Name	Central Wavelength (μm)	Resolution (km)	
1	Visible	0.63	1	Cloud optical depth
2	Shortwave Infrared	3.9	4	Droplet effective radius
3	Water vapor	6.48	4	
4	Infrared	10.7	4	Cloud top temperature
6	Split window	13.3	4	Cloud phase

Calculating CTRC



Validation results



Zheng et al., 2017, in prep

Conclusions

- More attentions needed for updrafts observation.
- First study demonstrating the possibility of retrieving updrafts of marine stratocumulus from space.
- This, in combination with CDNC, allows for the satellite retrieval of CCN concentration for marine stratocumulus.

THANK YOU!