Satellite observations during MAGIC

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NASA-LaRC retrievals

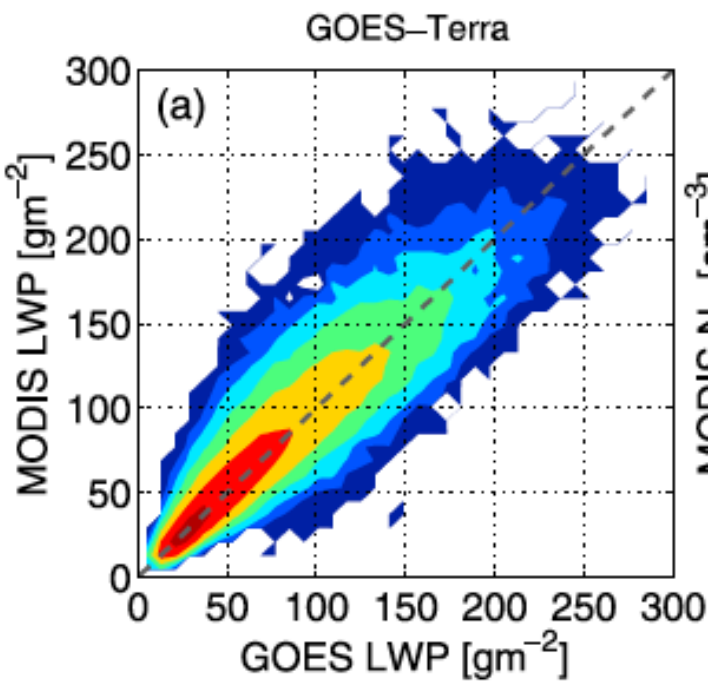
- Visible/near-IR retrievals
- Geostationary Operational Environmental Satellite (GOES-15)
  - 4 km pixel resolution
  - Every 30 min
- Aqua and Terra
  - MOderate Resolution Imaging Spectroradiometer (MODIS)
  - 1 km
- NOAA satellites
  - AVHRR (Advanced Very High Resolution Radiometer)
  - 4 km

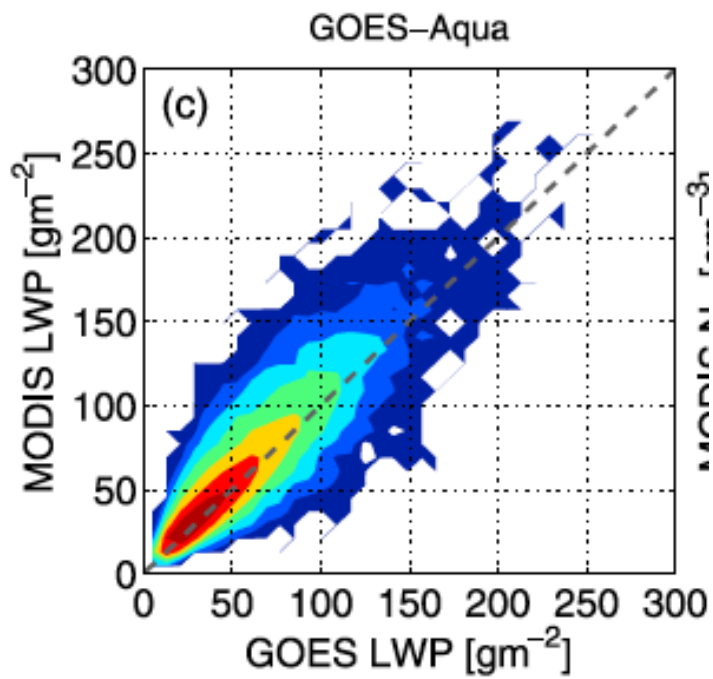
NASA-LaRC retrievals

- Cloud properties:
  - Cloud fraction (CF), droplet size (r_e), optical thickness (τ), liquid water path (LWP), temperature (T), and cloud top height (H_T)
  - Satellite scans and retrievals collocated with the ship track.
- GOES-15
  - r_e retrieved using 3.9 μm channel
  - τ retrieved using 0.64 μm channel
  - LWP ~ $\tau \cdot r_e$

GOES-retrieval: Previous results over the SE Pacific

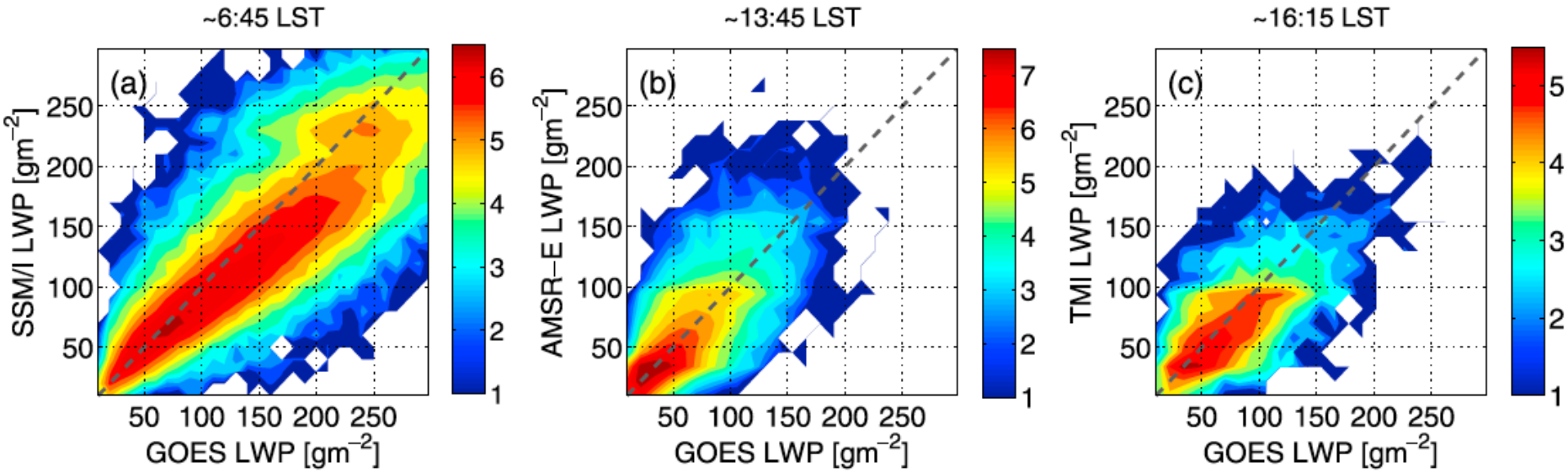
- Good agreement between GOES and MODIS (Goddard retrievals) (Painemal et al., 2012, JGR)



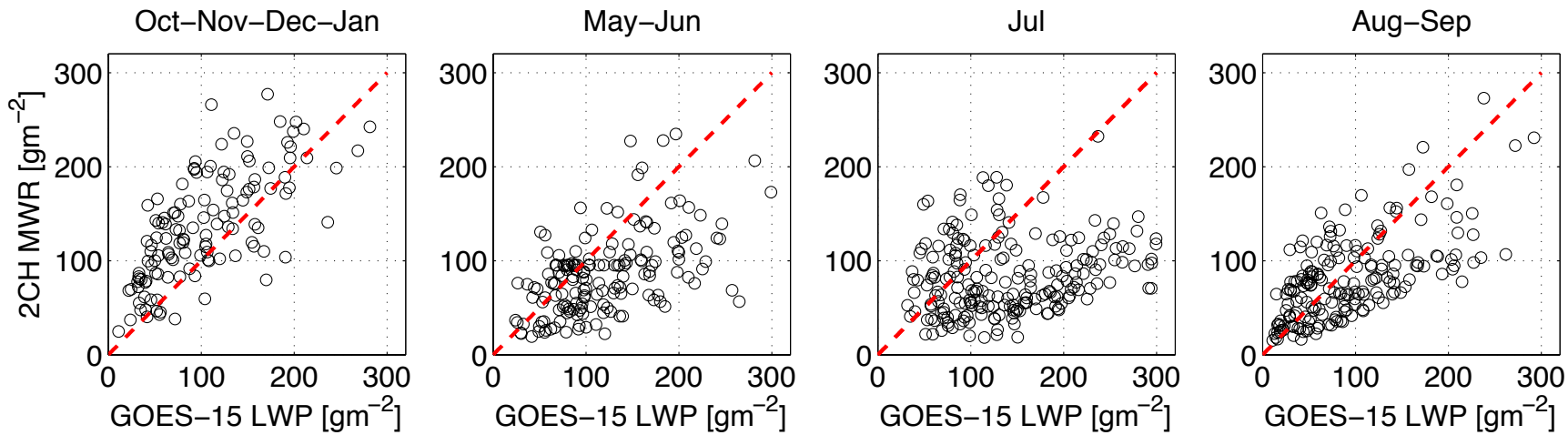


GOES-retrieval: Previous results over the SE Pacific

- Good agreement with satellite μ-wave LWP (Painemal et al., 2012, JGR)



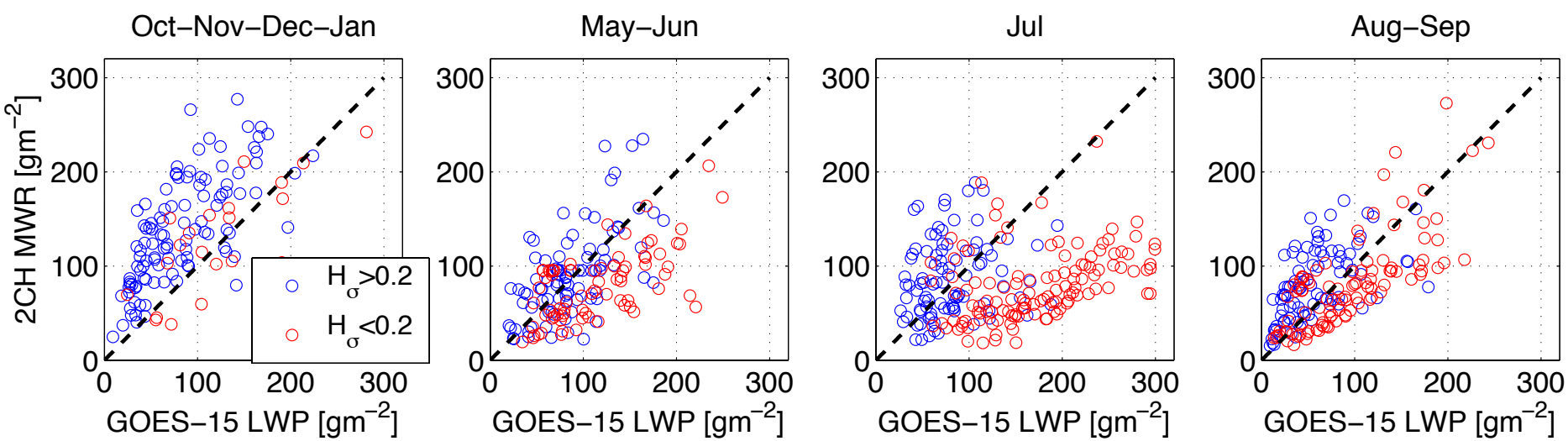
GOES-15: Comparison during MAGIC



- Cloudy scenes only, GOES retrievals collocated and averaged within 10 km of the ship observations
- Hourly-averaged shipborne microwave radiometer
- Correlations higher than 0.5, except for July
- Without July: Mean bias=22.5 gm^{-2}, r =0.55
- Mean bias (with July)=3.1gm^{-2}, r = 0.4

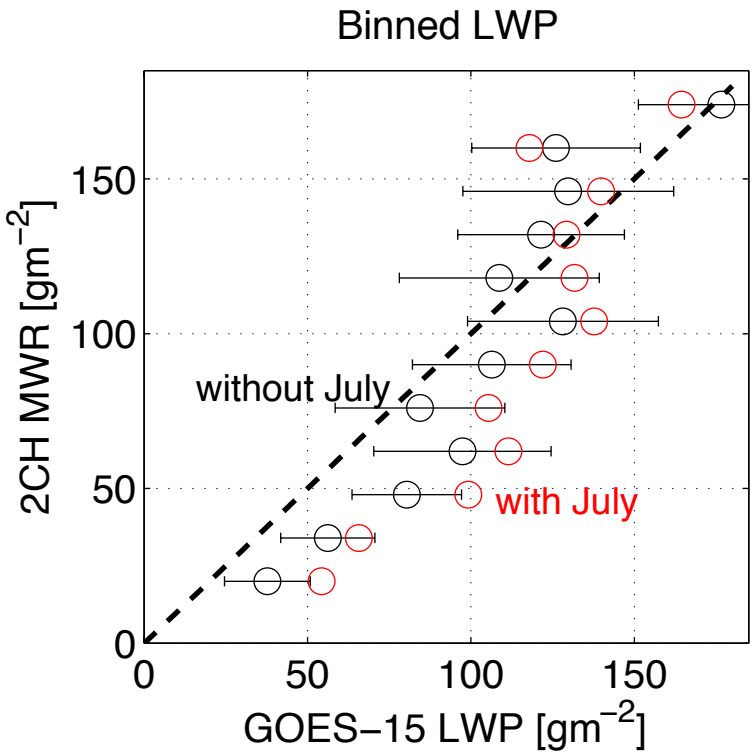
GOES-15: Comparison during MAGIC

- Sensitivity of the retrievals to spatial heterogeneity
- H_σ=std(reflect$_{0.65\mu m}$)/mean(reflect$_{0.65\mu m}$) (Liang et al., 2009, GRL)
- Heterogeneity determines the bias sign.



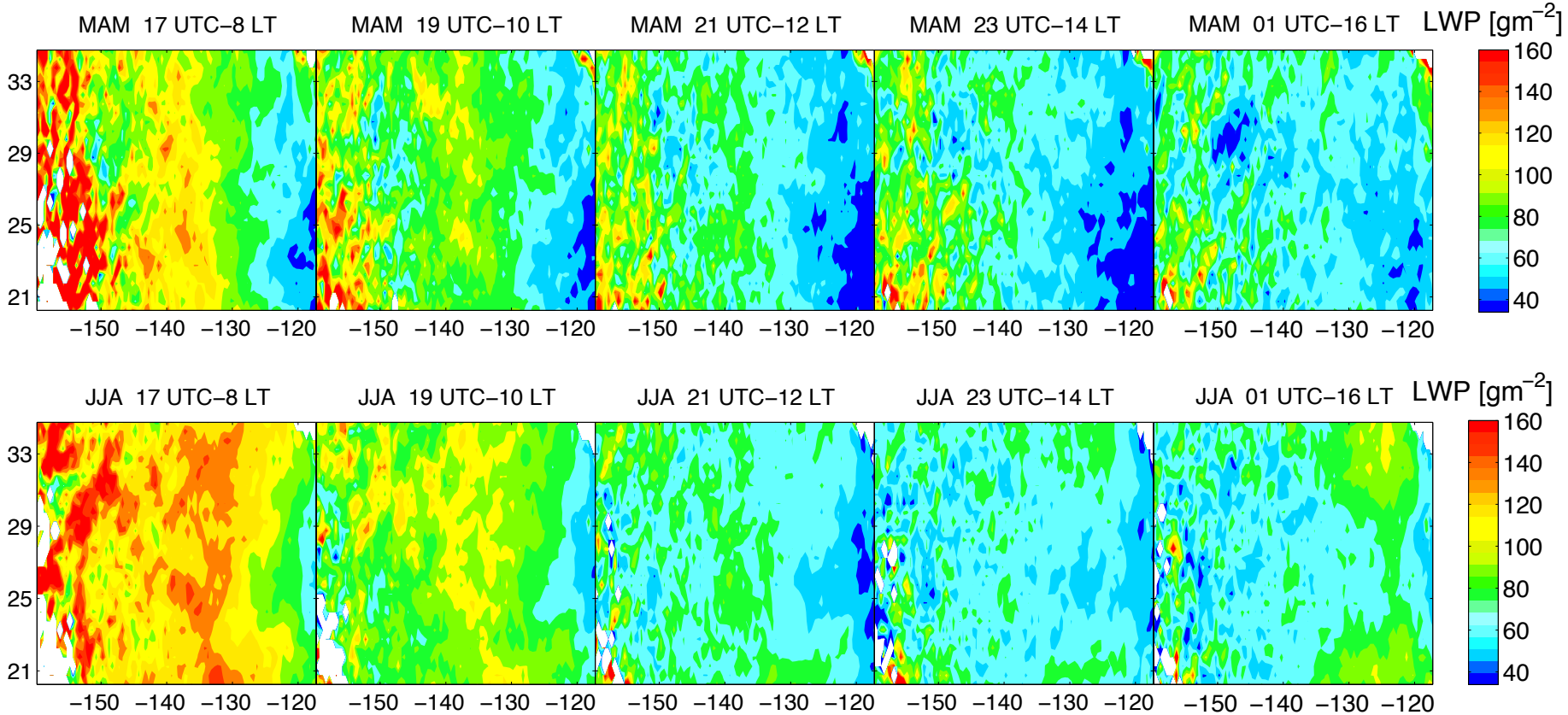
Binned LWP

- Consistency between satellite and observations
- July: suspicious month
- GOES LWP slightly higher
  - Retrieval assumes a vertically homogeneous cloud:
    - LWP=2/3*$\rho \cdot \tau \cdot r_e$ (extinction effic.≈2)
  - Water content slightly increases with height, then:
    - LWP=5/9*$\rho \cdot \tau \cdot r_e$ (extinction effic.≈2)
    - GOES bias decreases



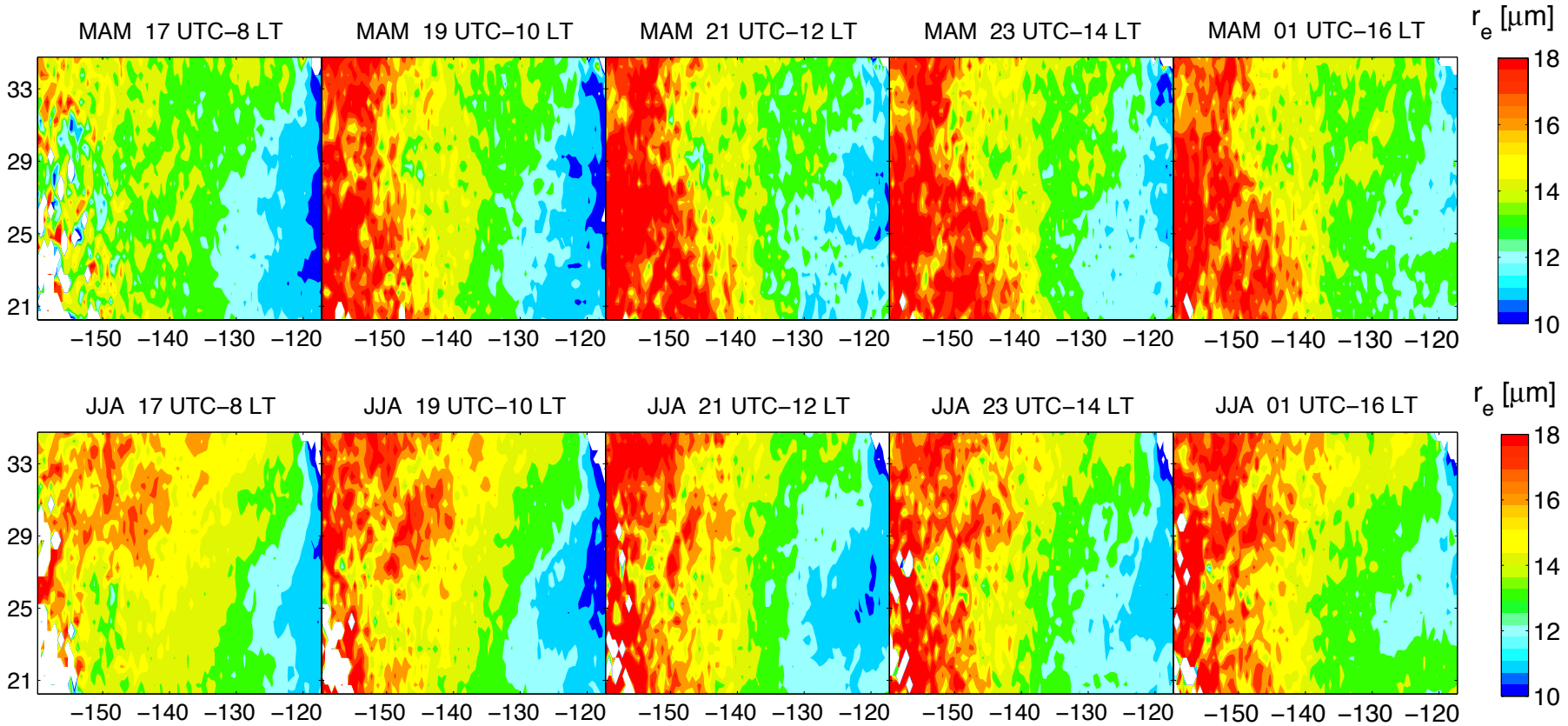
Diurnal cycle

- Liquid water path

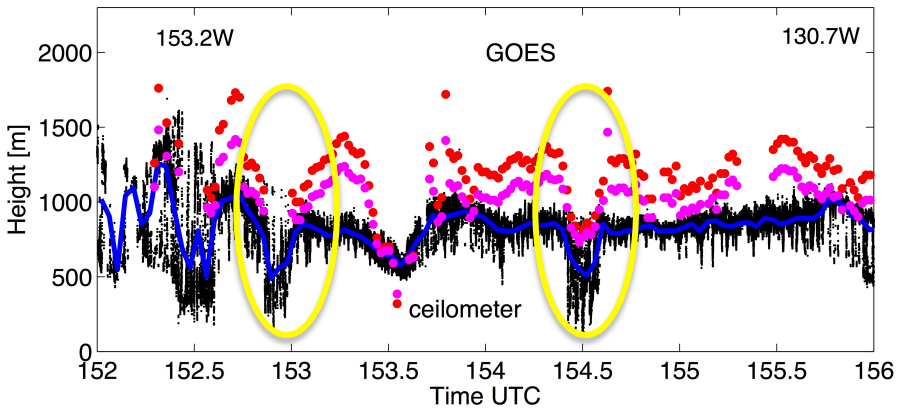


Diurnal cycle

- Cloud effective radius

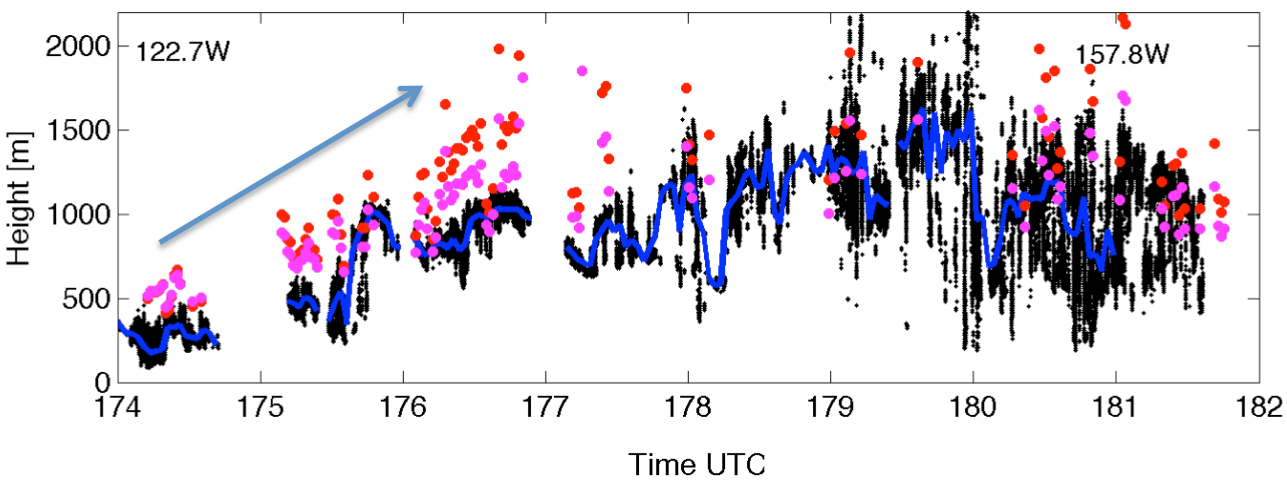


Boundary layer

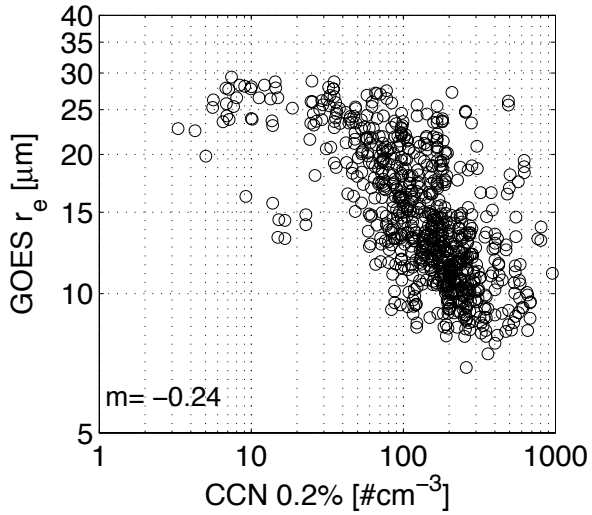


- Red: Sun-Mack et al. (2014 JAMC)
- Magenta: Painemal et. al. (2013 JAS)

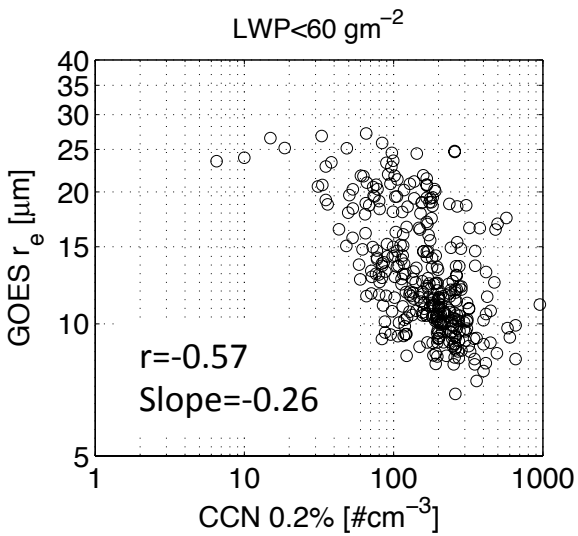
- GOES height follows changes of the cloud base
- Suitable dataset to study regional scale processes

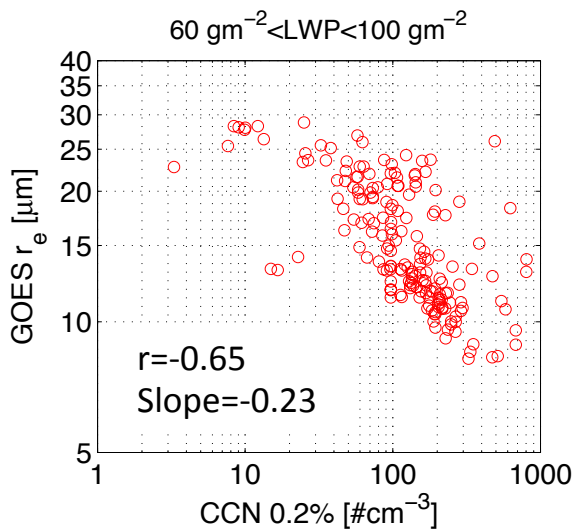


Cloud aerosol interactions



- Warm overcast scenes, CCN (0.2%)<1000/cc
- Strong correlation CCN-r_e, r=-0.65
- Slope =dln(r_e)/dln(CCN)=-0.24
- Strong interactions compared to McComiskey et al. (2009, JGR)
- Diurnal cycle?
- Comparison with in-situ µ-physics?





- <u>When binning the data:</u>
- Low LWP: slope: -0.26
- High LWP: -0.23
- Correlations persist for non-precipitating clouds

Future work

- Recent ARM-ASR MAGIC proposal funded
- Perform additional satellite in-situ intercomparisons
  - AVHRR, MODIS, and VIIRS
  - Revised GOES (new 3.9-µm models for r_e retrievals), summer 2014
- Estimate satellite and in-situ cloud-aerosol interaction metrics
  - Determine albedo susceptibility due to changes in microphysics
- Analyze potential bias in satellite proxies
- Seasonal, diurnal dependence?
- Precipitation signature in satellite retrievals?
- MAGIC-related manuscript to be submitted in summer.

GOES dataset: http://www-pm.larc.nasa.gov

NASA LaRC Satellite Imagery and Cloud Products

www-pm.larc.nasa.gov

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NASA LARC Satellite Imagery and Cloud Products

NASA LANGLEY CLOUD AND RADIATION RESEARCH

(Minnis Group)

User Warning, Please read !

Minnis Group Homepage

Real Time References

Satellite Calibration:

Langley Satellite Calibration

Viewers/Tools:

Contrail Forecast

NOAA AVHRR Viewer

MODIS Viewer

Mid-Atlantic NEXRAD

ARM-SGP NEXRAD

Angles Viewer

Plot RAP Sounding

Gridded VISST Products

Satellite Overpass Predictor

Supported Programs:

ASR Atmospheric System Research

Field Experiments:

New!! HIWC

SEAC4RS

ACCESS

MAGIC

MC3E

AMIE (Dynamo & Cindy)

MACPEX 2011

Satellite Imagery And Cloud Products Page

Real-time and Historical Cloud Product Loops: The cloud products are derived with VISST/SIST algorithm. Select a domain from the table below to access the real-time (blue cells) and archived products.

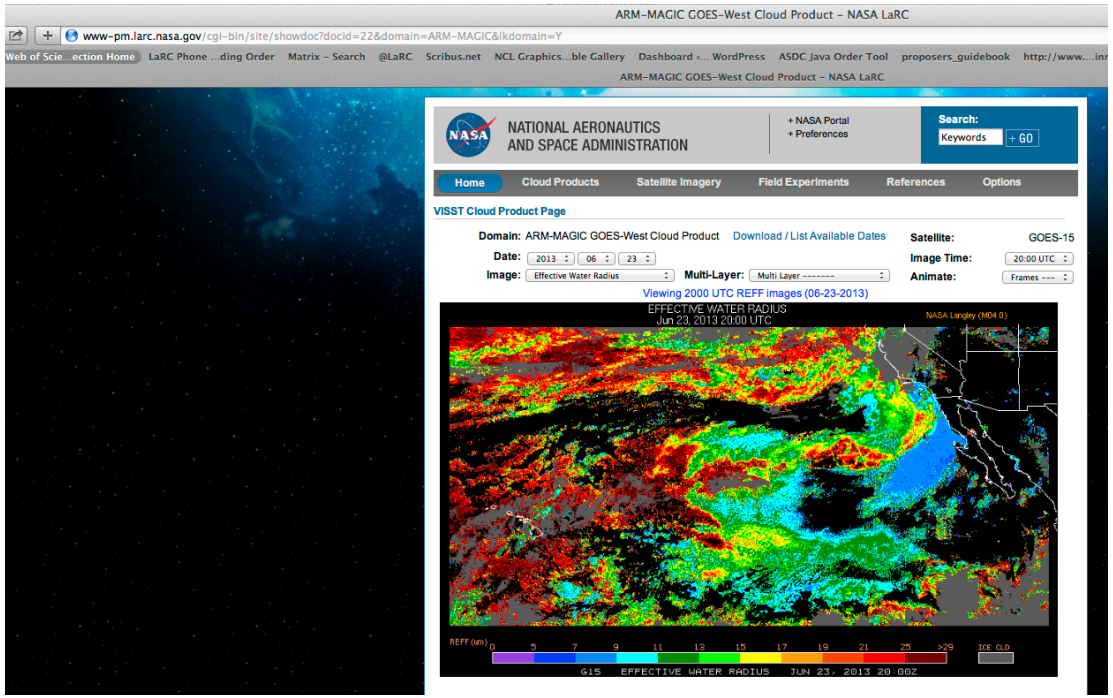
FULL-DISK CLOUD PRODUCTS (Real Time)				
GOES-WEST	GOES-EAST	METEOSAT	FENG-YUN	MTSAT
New!! Merged Global Geostationary Gridded Cloud Products New!!				

CLOUD PRODUCTS				
GOES WEST	GOES EAST	METEOSAT	TWP DOMAIN	NOAA 15/16/17 and TERRA/AQUA
North America (RR)		WEST EUROPE	MTSAT	ARM-SGP
West CONUS	East CONUS	EUROPE	MANUS	ARM-NSA
MERGED CONUS		ARM-NIAMEY	AMIE (MTSAT and FENG-YUN)	COVE
ARM-SGP	ARM-SGP		HIWC	New!! Alaska/NPacific
ARM-NSA	MACPEX		GOES-9	
New!! Alaska/NPacific	COVE		NAURU	
Monterey			DARWIN	

Real-time and Historical Satellite Imagery Loops: The links from the table below provide access to the real-time (blue cells) and historical image loops for various satellites.

SATELLITE IMAGERY				
Mid-West US (SGP)	Northeast US	Mid-Atlantic US	Southeast US	CONUS
E. Pacific GOES-E	Pacific/West	TWP DARWIN MTSAT	TWP DARWIN FY2C	TWP DARWIN MTSAT & FY2C
	Florida		GMS-5 TWP	PACS EPIC
N. America GOES-W	N. America GOES-E			
	SGP 1KM VIS GOES-E			

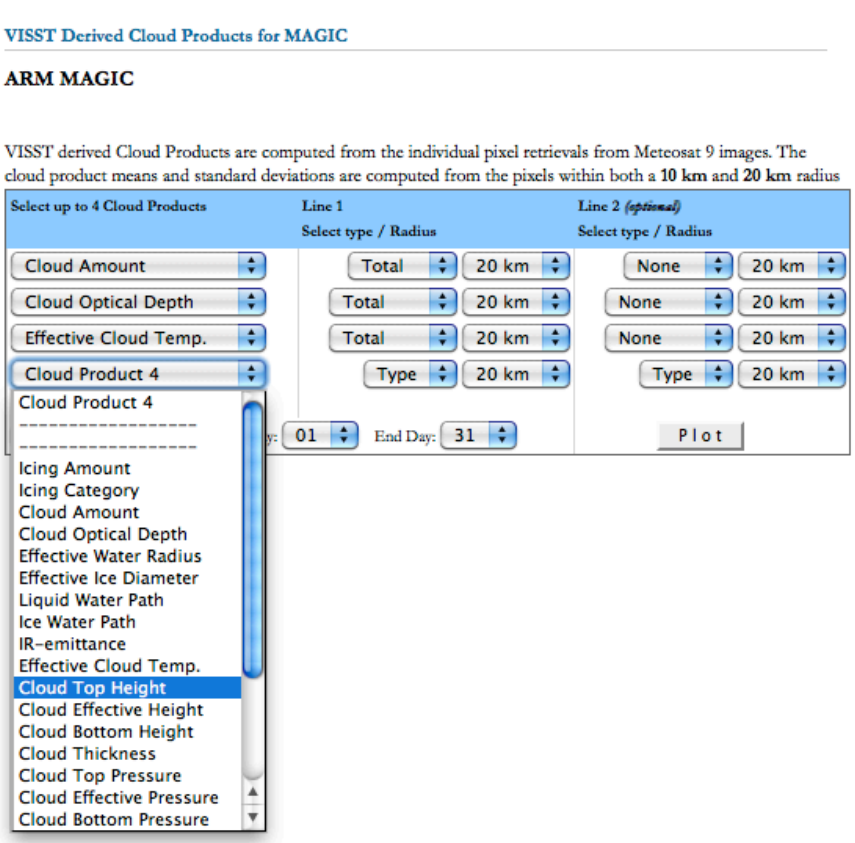
- Jpeg figures for the MAGIC period, and hourly netcdf files for July 2013.
- Netcdf files for the full MAGIC period will be available soon at the ARM's site
- If users need files ASAP, please contact Pat Minnis: p.minnis@nasa.gov

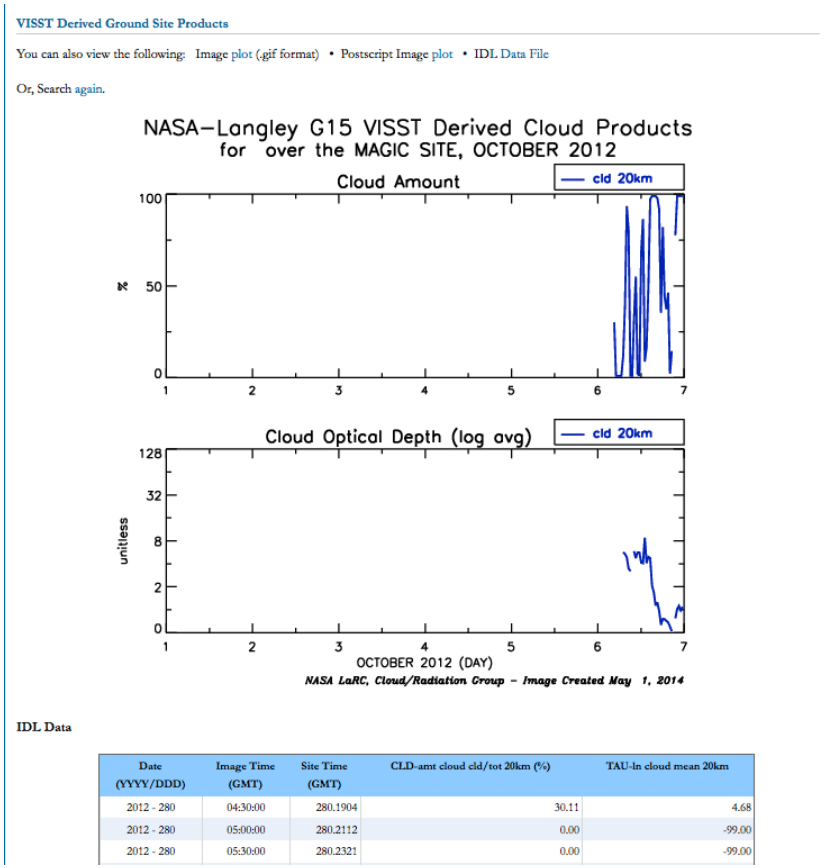


GOES collocated data:

- http://www-pm.larc.nasa.gov MAGIC link
- Link: Ground Site Cloud Products

+ ARM MAGIC





Date (YYYY/DDD)	Image Time (GMT)	Site Time (GMT)	CLD-amt cloud cld/tot 20km (%)	TAU-ln cloud mean 20km
2012 - 280	04:30:00	280.1904	30.11	4.68
2012 - 280	05:00:00	280.2112	0.00	-99.00
2012 - 280	05:30:00	280.2321	0.00	-99.00