GPM/GMI Polarimetric Observations of Cloud and Precipitation

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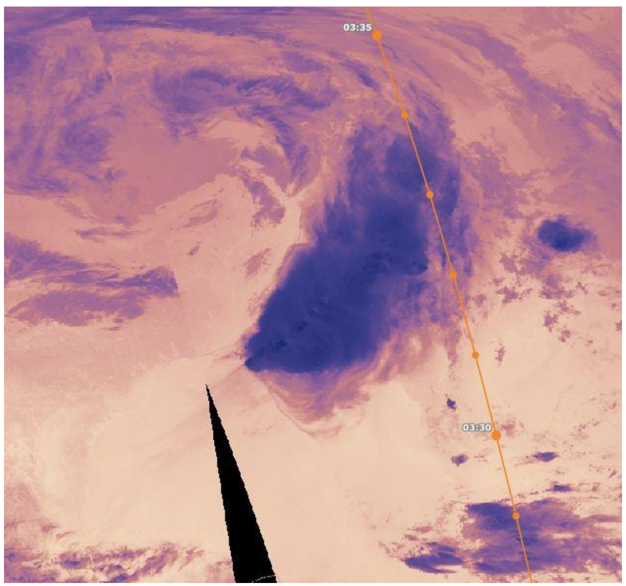
- Ice cloud microphysical properties as observed by GMI
- Cloud—precipitation processes in severe weather systems
- Sensitivity gaps and observational needs

Caltech/JPL workshop Pasadena, California September 26, 2017

Squall Line Storm Case in the US East Coast

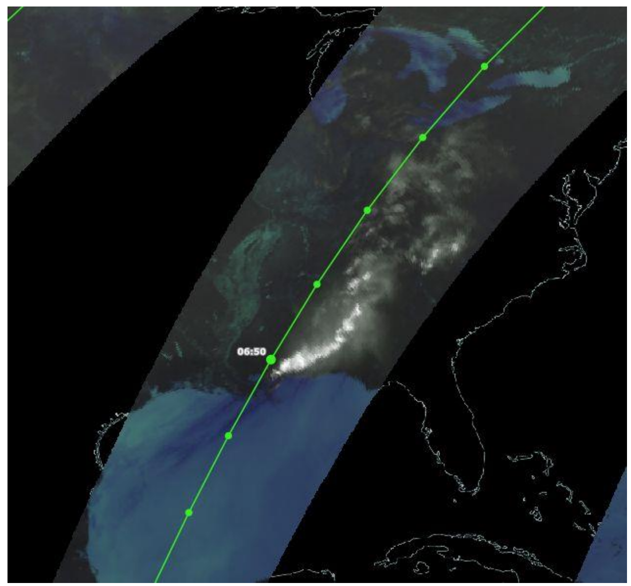
on April, 29, 2014

Terra 03:30



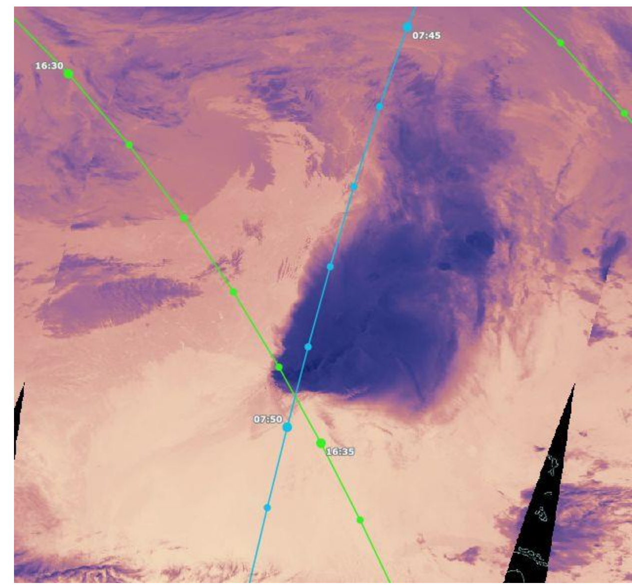
Channel 31

GPM 06:50



Pseudo color
(37, 89 GHz)

Aqua 07:10

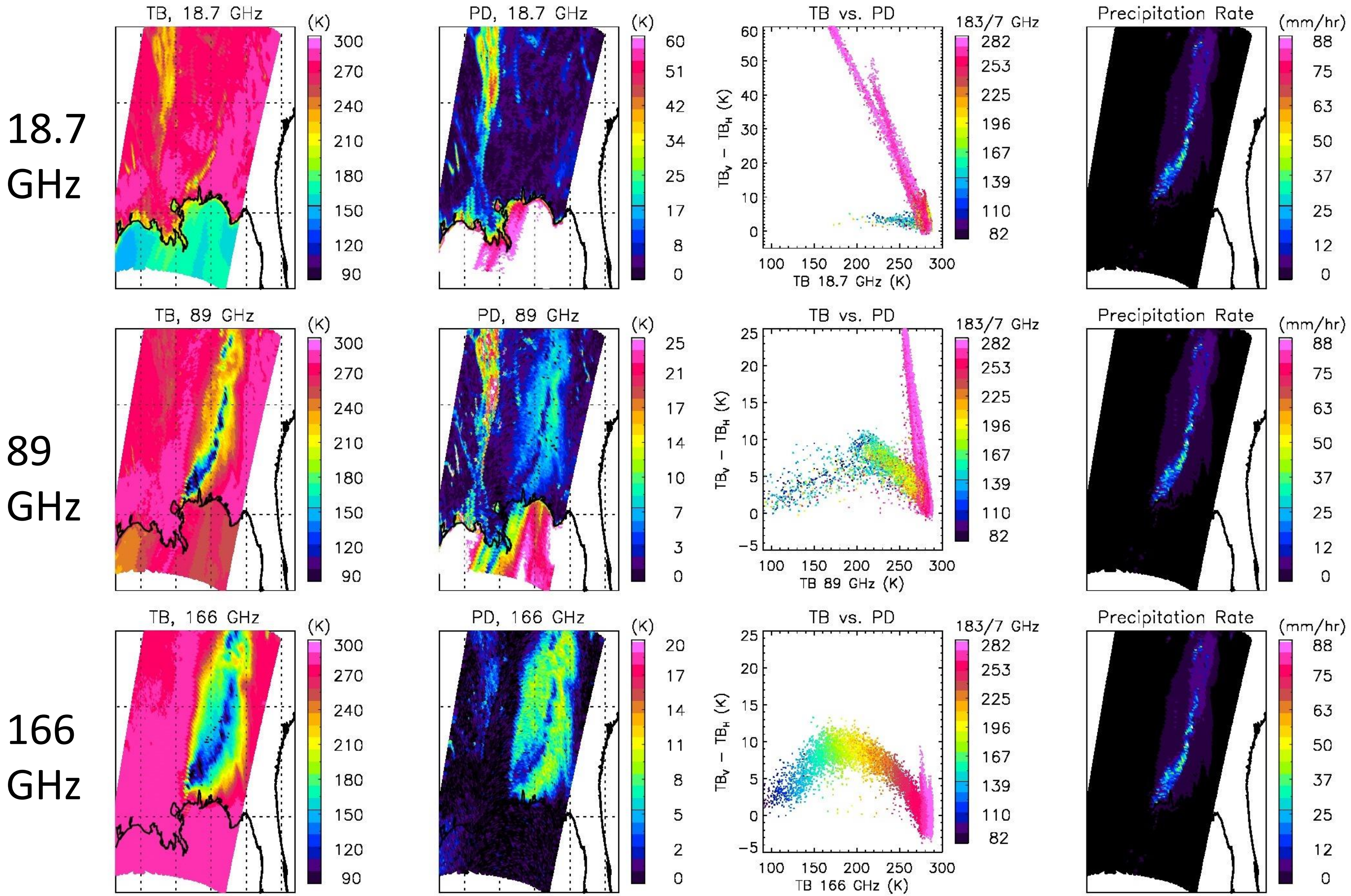


Channel 31

GMI Polarimetric Observations at 18.7, 89 and 166 GHz

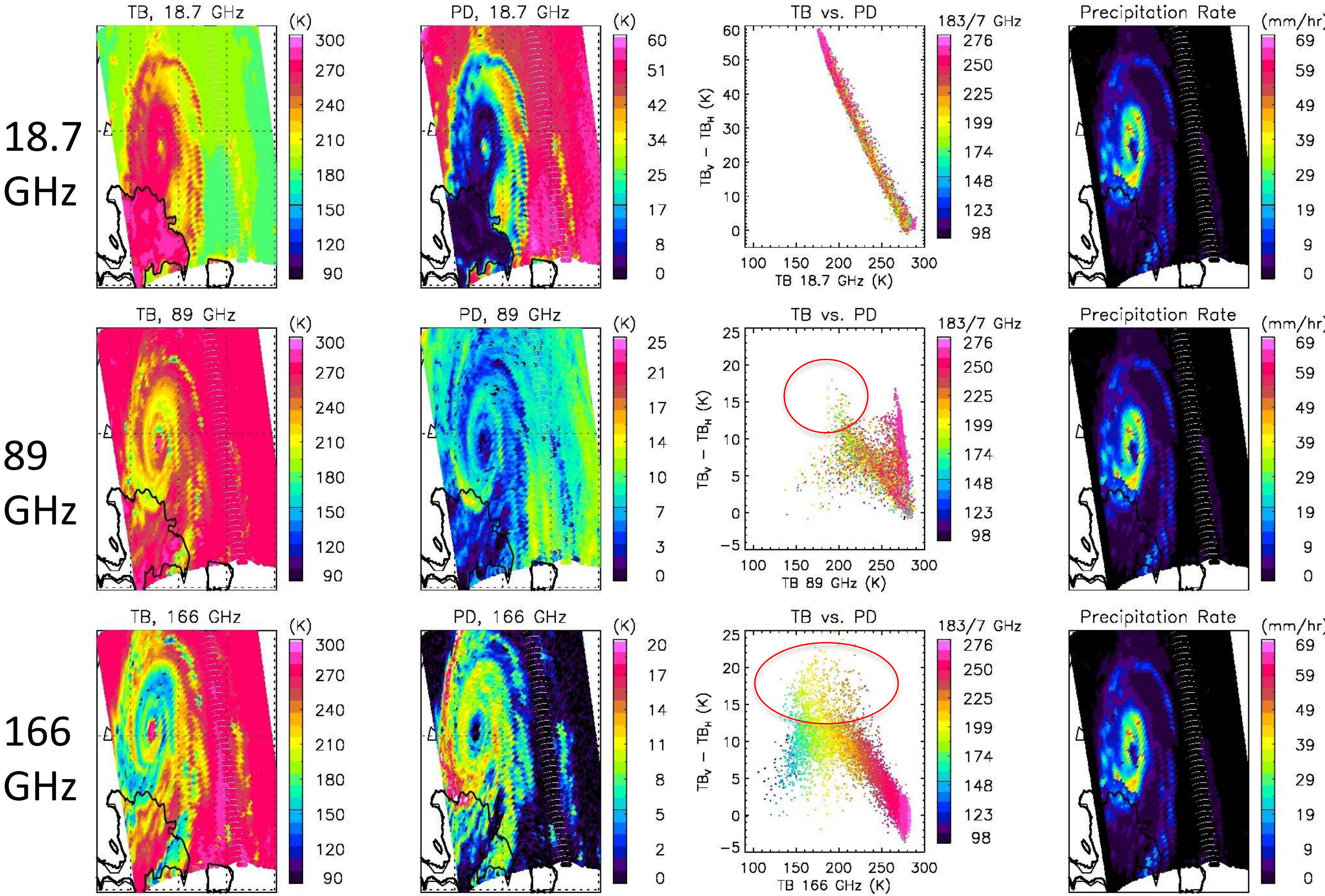
(Squall line on April 29, 2014)

Gong and Wu (2017)



GMI Polarimetric Observations at 18.7, 89 and 166 GHz

(Hurricane Irma on September 7, 2017) Courtesy of J. Gong



Radiative transfer models have difficulties to re-produce the observed polarization (i.e.”Bell-Curve”)

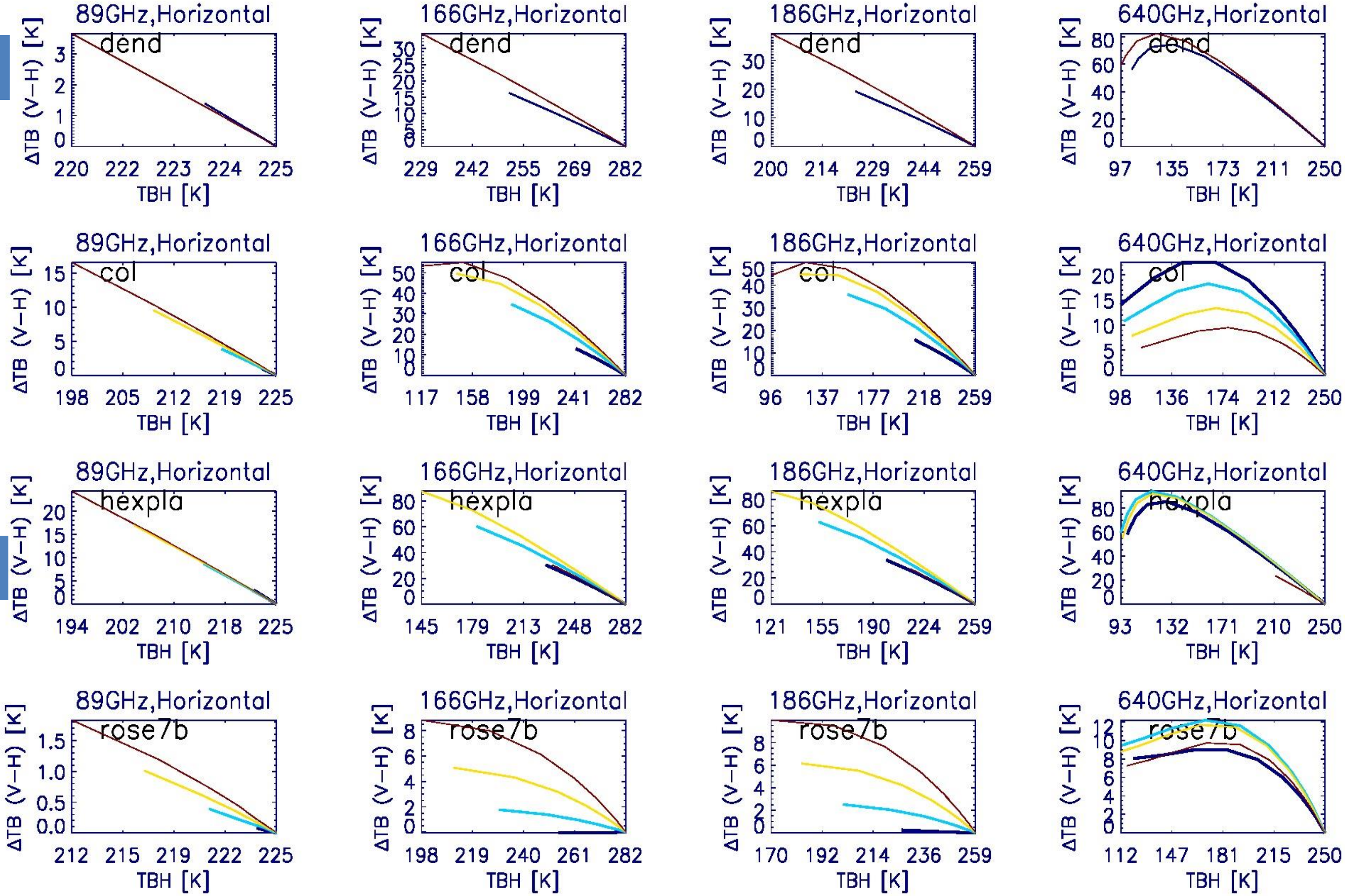
89 GHz | 166 GHz | 186 GHz | 640 GHz

Dendrite

Column

Hex-plate

Rosette



Courtesy of J. Gong

Possible Causes of the "Bell-Curve"

- Random orientation of ice particles
- Rime ice (Jerry Harrington, personal comm.)
- Radiometric saturation at deep convective cores

Cloud-Precipitation Processes

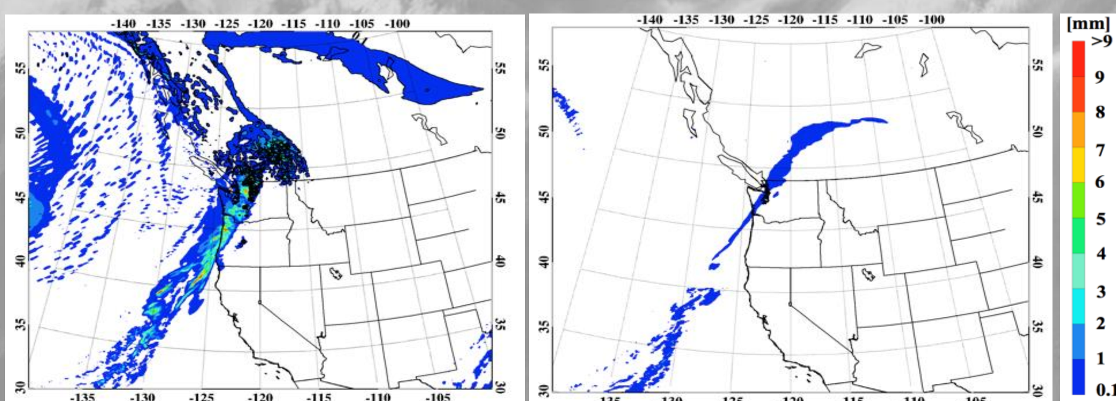
- Roles of dynamics and turbulence
- Roles of ice clouds and their microphysics
- What to improve observation techniques

Lifecycles of Precipitation and Cloud (LifePaC)

GOES WEST NORTHERN HEMISPHERE LONGWAVE IR 26 FEB 10 03:00 SSEC: UW-MADISON

A Proposed EVs Study
(Wu et al., 2014)

With Cloud Ice Processes | **Without Cloud Ice Processes**



NASA Unified WRF (NU-WRF) simulation (Courtesy of Dr. W-K Tao)

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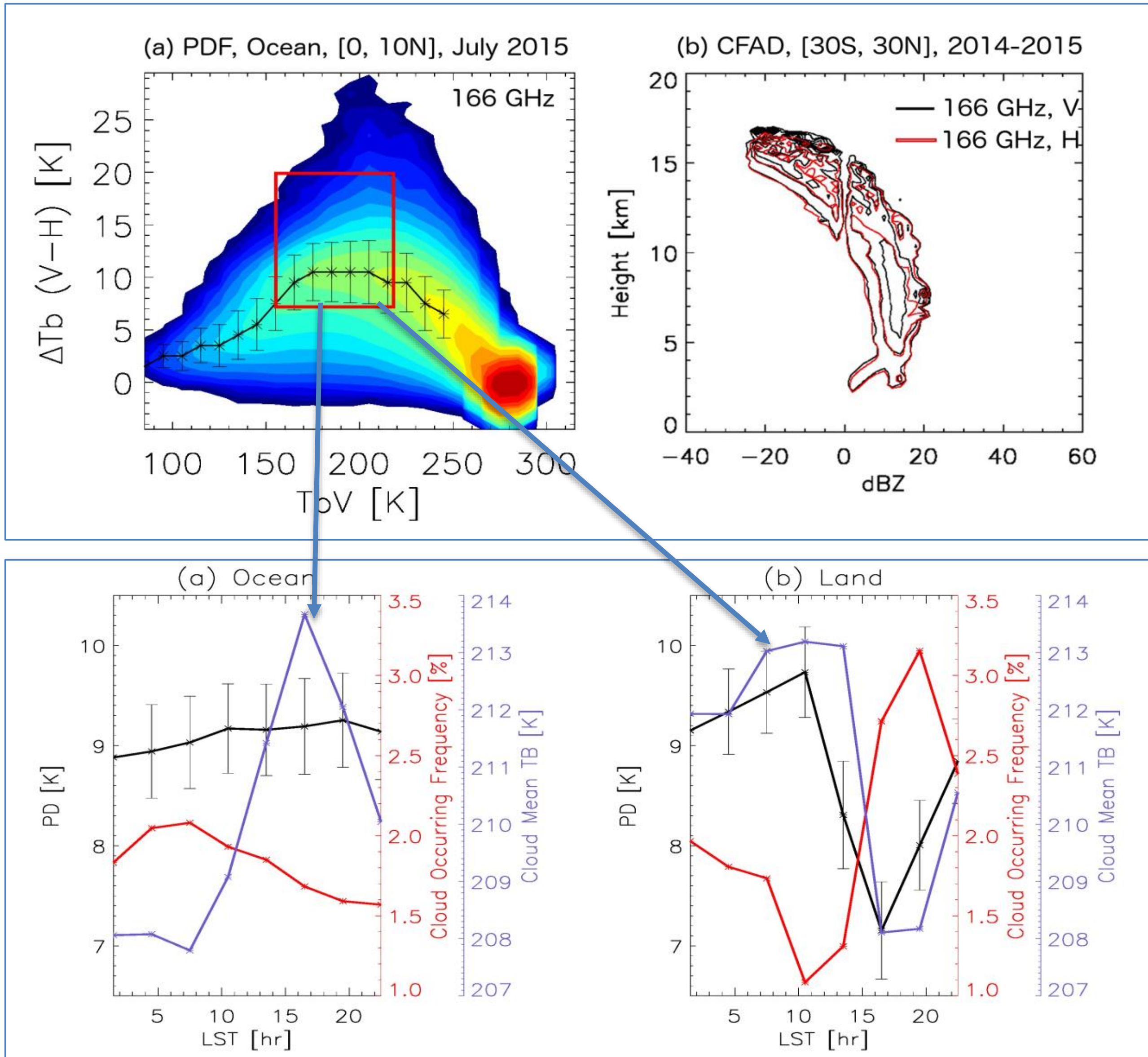
McIDAS

Diurnal Variations of Ice Cloud Microphysical Properties

- GMI 166-GHz polarization difference (PD) anti-correlated with high-cloud amount
- Ice particular orientation likely causing the PD and its diurnal variation
- Important implication for cloud-precip processes: when and where clouds will produce rainfall/snowfall

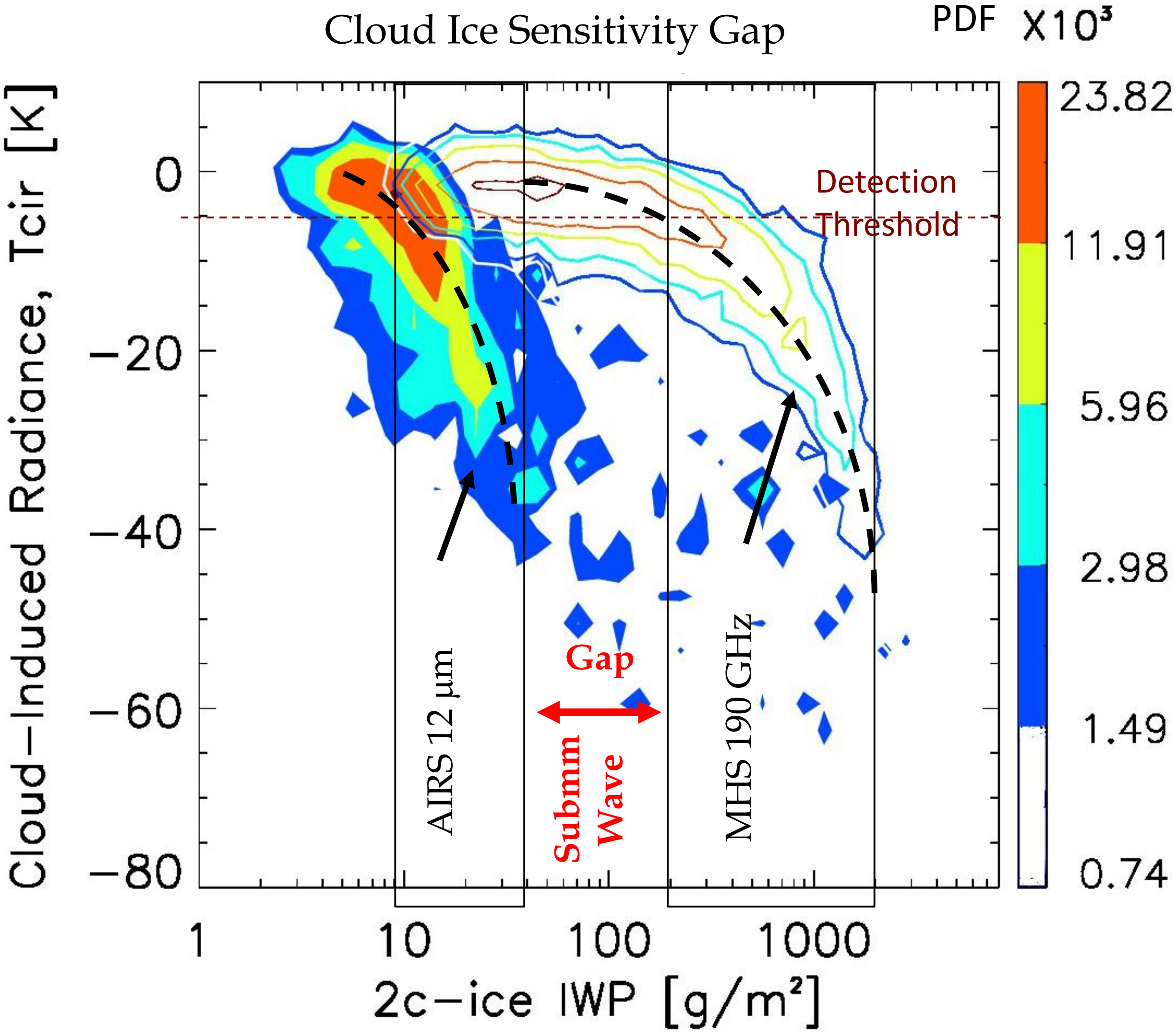
Gong et al. (2017)



Cloud Ice Sensitivity Gap

- Clouds, ice clouds in particular, are a major source of uncertainty in climate models
- Submm-wave sensors fill the sensitivity gap between MW and IR.
- Cloud microphysical properties (particle size and shape) account for large (~200% and 40%) measurement uncertainty.

$$T_{cir} = T_b - T_{b\_clear}$$



Ice Water Path (IWP) from CloudSat/CALIOP