# Evaluating the Accuracy of Model Parameterization Schemes in Convection-Permitting Ensemble Forecasts using Synthetic GOES-13 Satellite Observations

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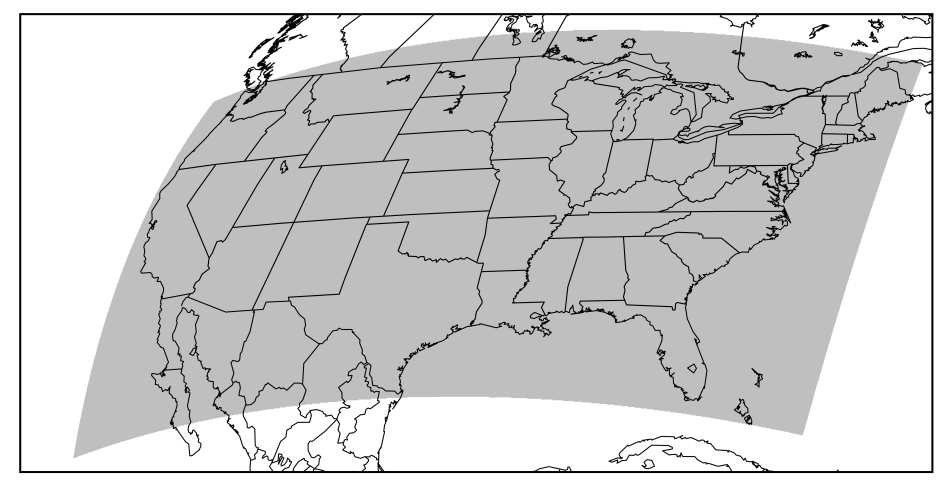
# Synopsis

- Compared real and synthetic GOES-13 infrared brightness temperatures to evaluate PBL and microphysics schemes
- Synthetic data from CAPS high-resolution ensemble for HWT 2012 Spring Experiment during May and June 2012
- 36 hour forecasts started at 00 UTC for 20 forecast days with the first 6 hours excluded as spin-up time

# Model Setup



- WRF ARW v3.3.1
- 4-km horizonal grid
- 51 vertical layers
- No cumulus parameterization
- Background based on NAM
- Radar and surface observations assimilated using ARPS 3D var data assimilation and cloud analysis system
- Succesive Order of Interaction (SOI) forward radiative transfer model to compute synthetic satellite observations
- 6.7 μm and 10.7 μm synthetic brightness temperatures remapped to GOES-13 grid for direct comparison

# Ensemble Members Used

| Microphysics Scheme | PBL Scheme |
|---|---|
| Thompson | YSU |
| Thompson | MYNN |
| Thompson | ACM2 |
| Thompson | QNSE |
| Thompson | MYJ |
| Milbrandt Yau | MYJ |
| Morrison | MYJ |
| WDM6 | MYJ |

# Microphysics Schemes

All schemes are double-moment for at least one hydrometeor species

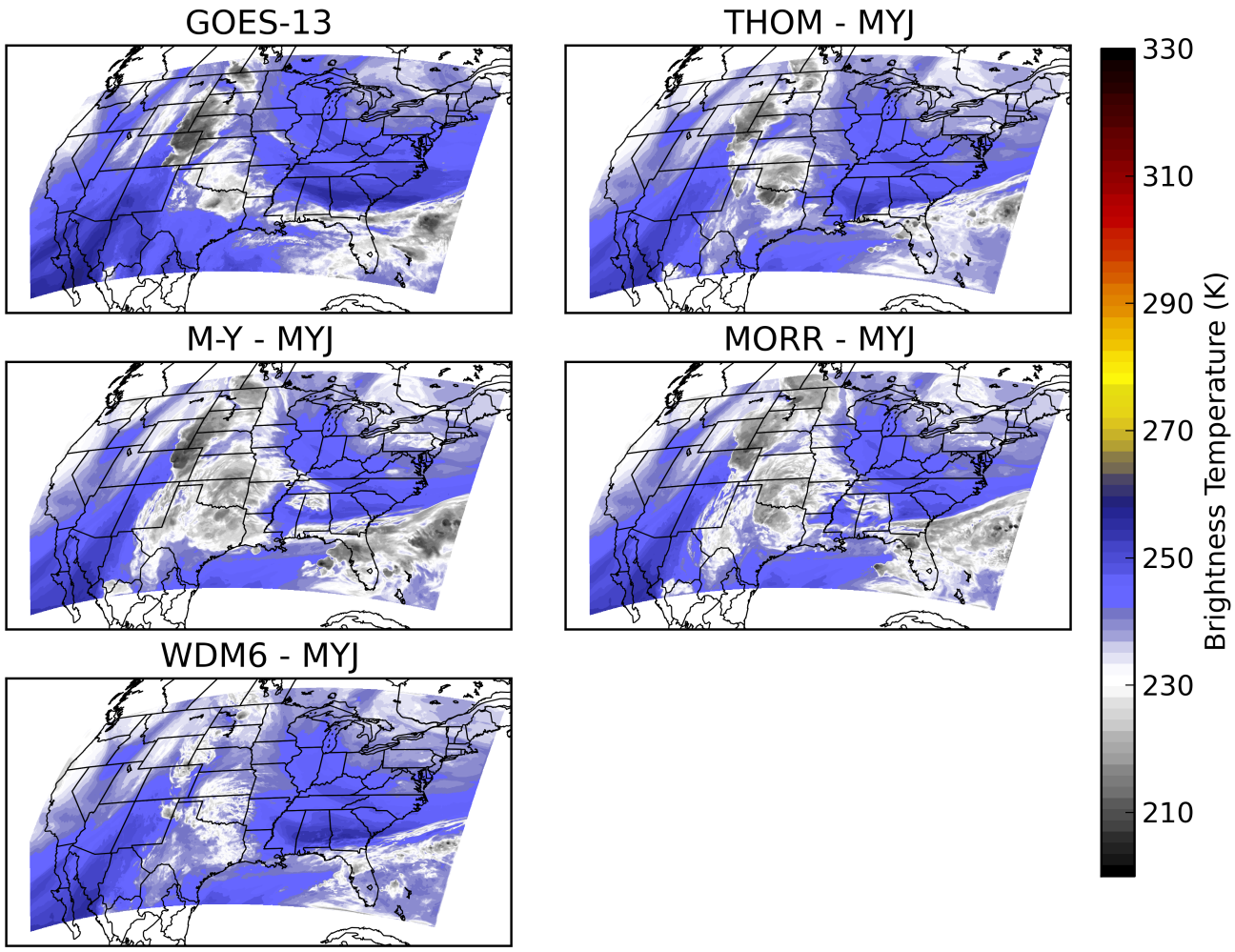
WDM6 – double-moment for warm rain processes only

Thompson – only cloud ice and and rainwater double-moment

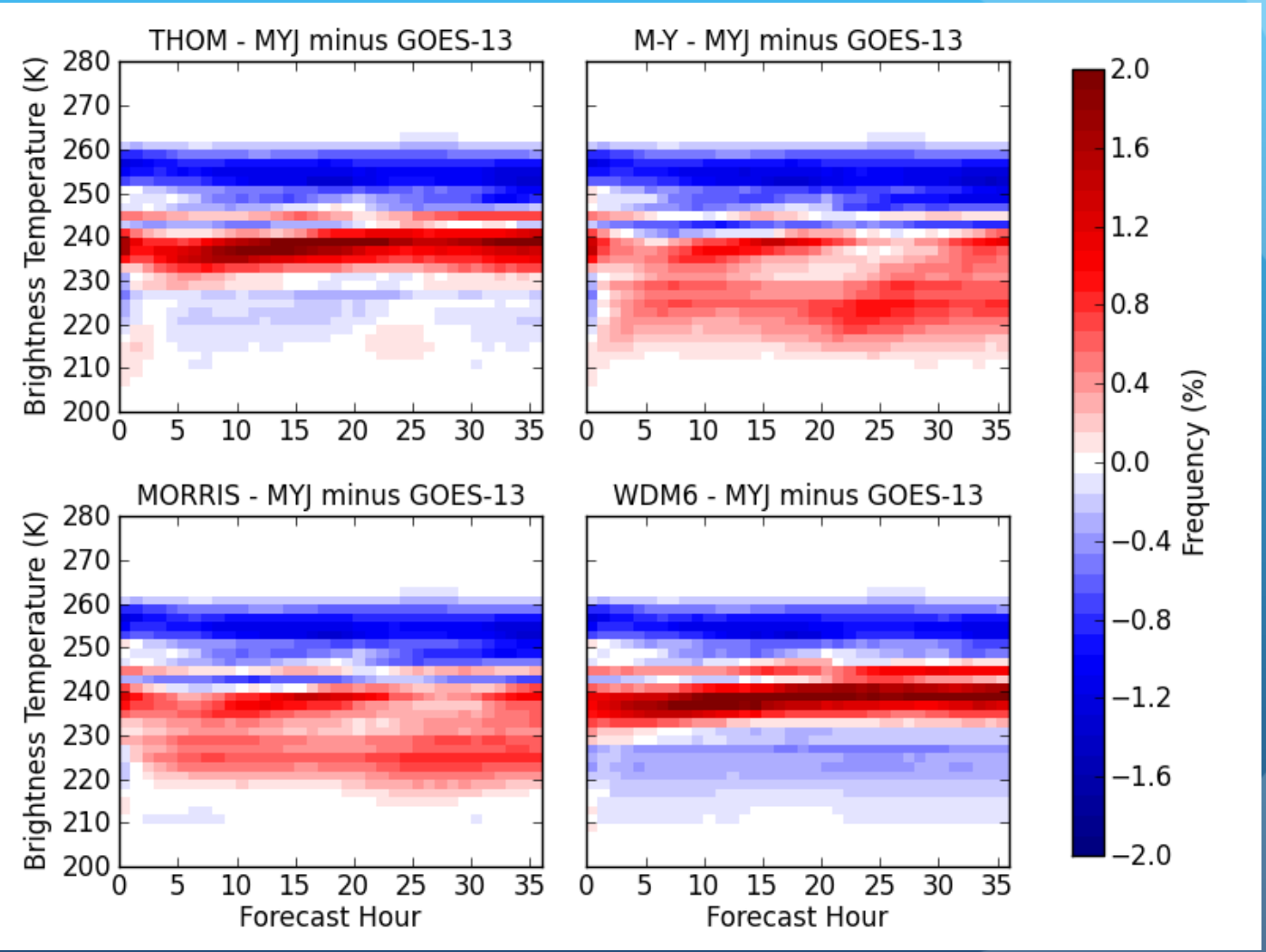
Morrison – double-moment for all species but cloud water

Milbrandt-Yau (M-Y) – double-moment for all species with separate hail and graupel classes

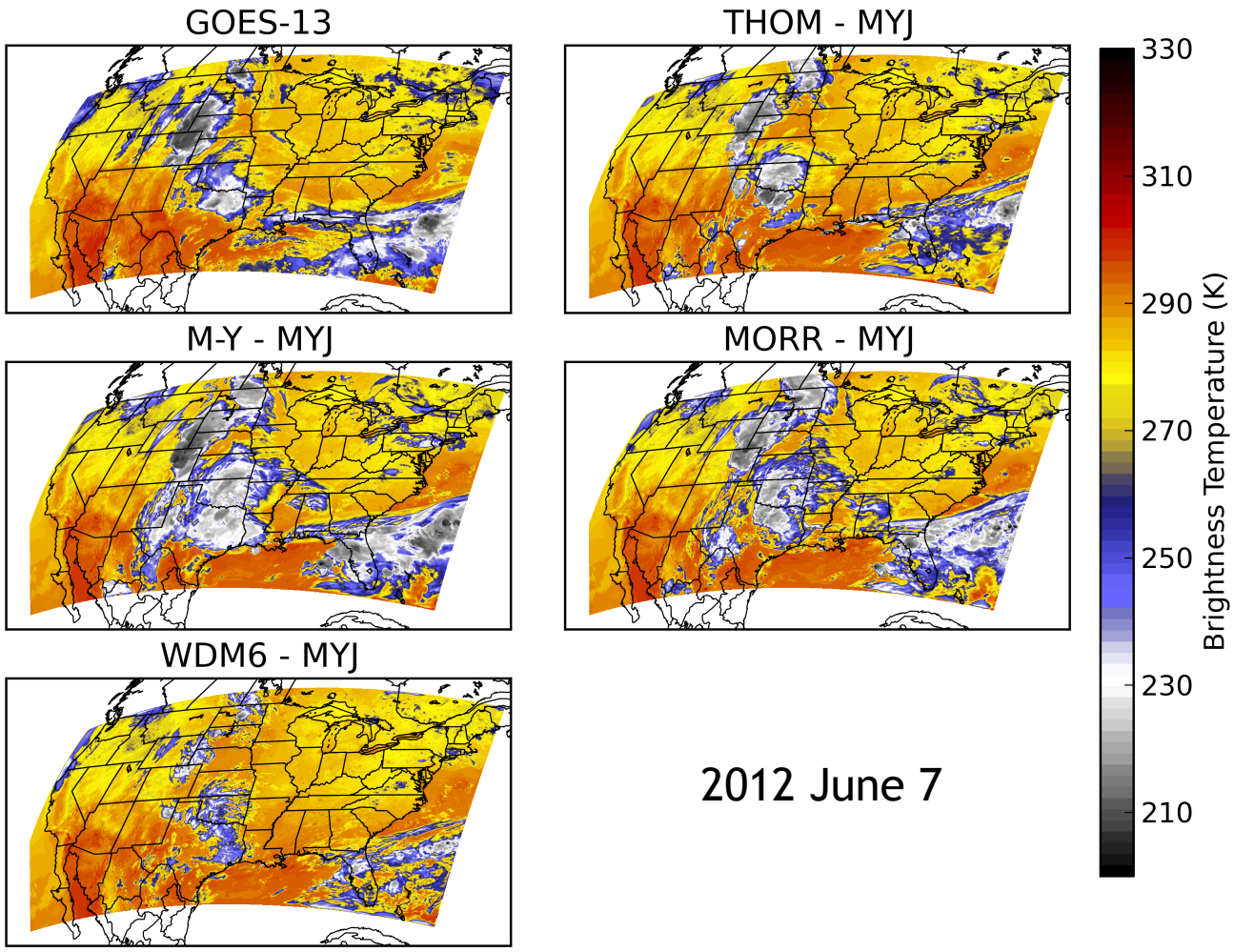
# 6.7 μm Brightness Temperature



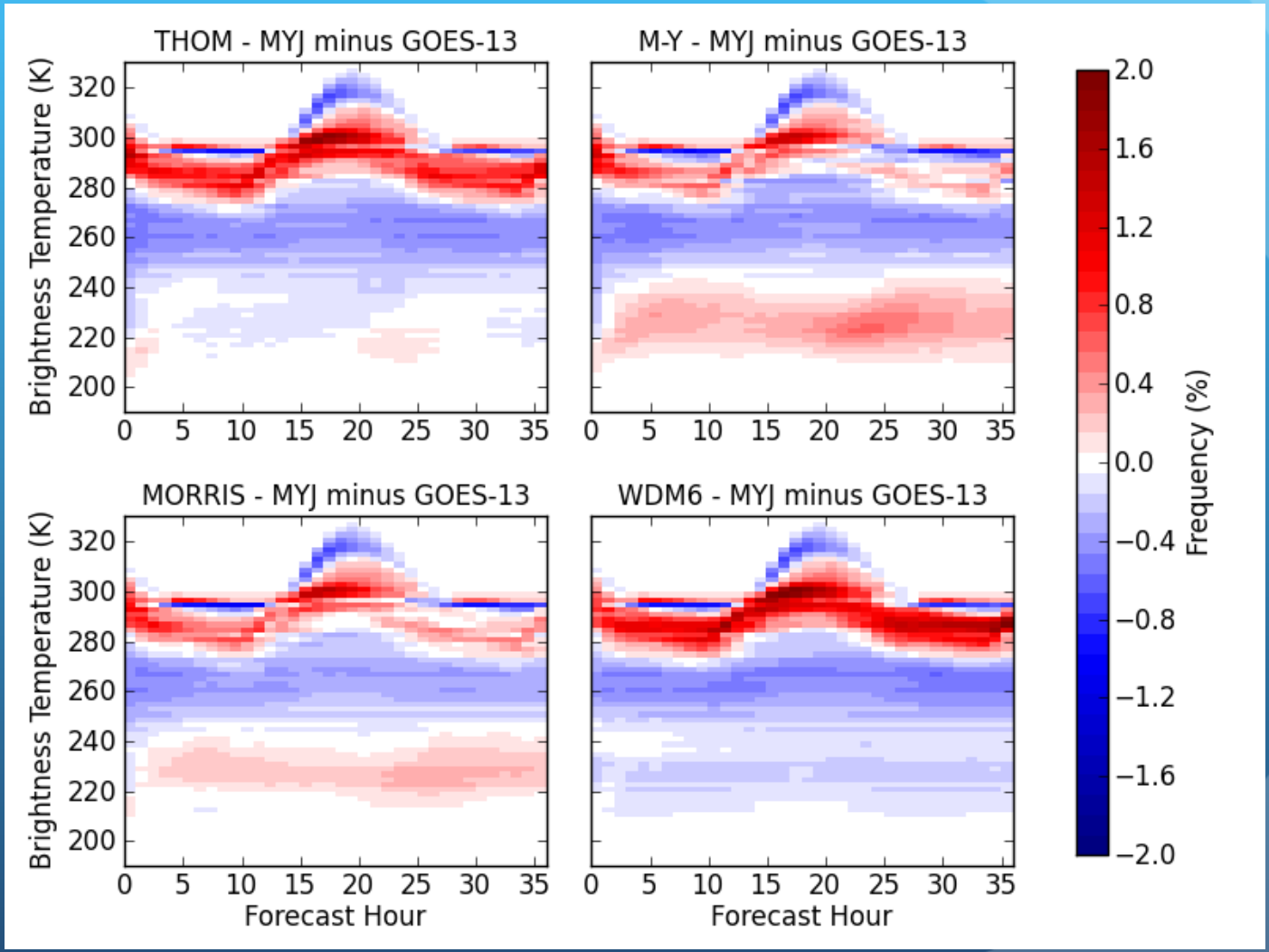
# 6.7 μm Frequency Distribution Differences



# 10.7 μm Brightness Temperature



# 10.7 μm Frequency Distribution Differences



# Planetary Boundary Layer Schemes

## Local schemes

MYJ – based on Mellor-Yamada (1982) turbulence model

QNSE – similar to MYJ but better with stable stratification

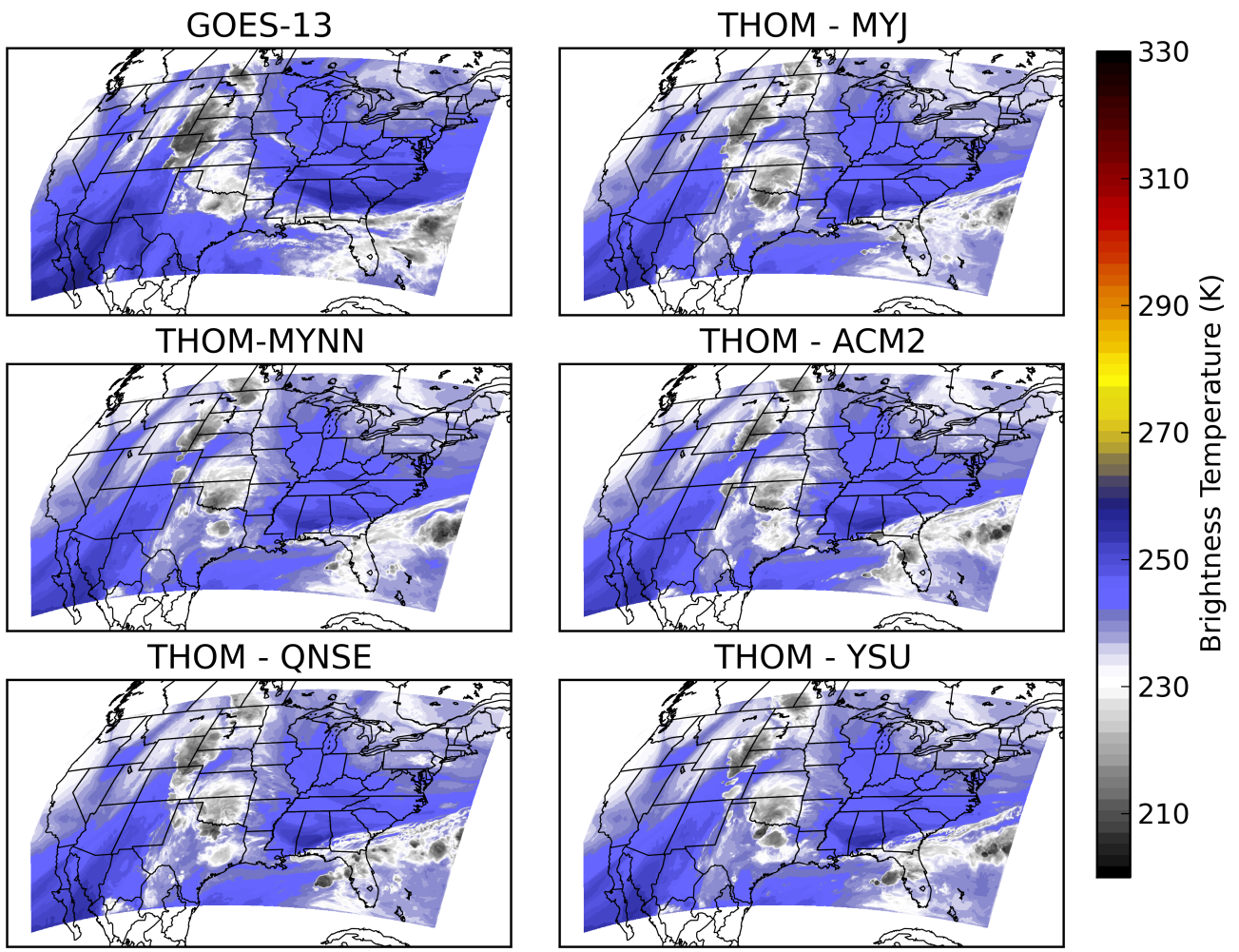
MYNN – similar to MYJ but improved PBL depth and prognostic TKE

## Non-local schemes

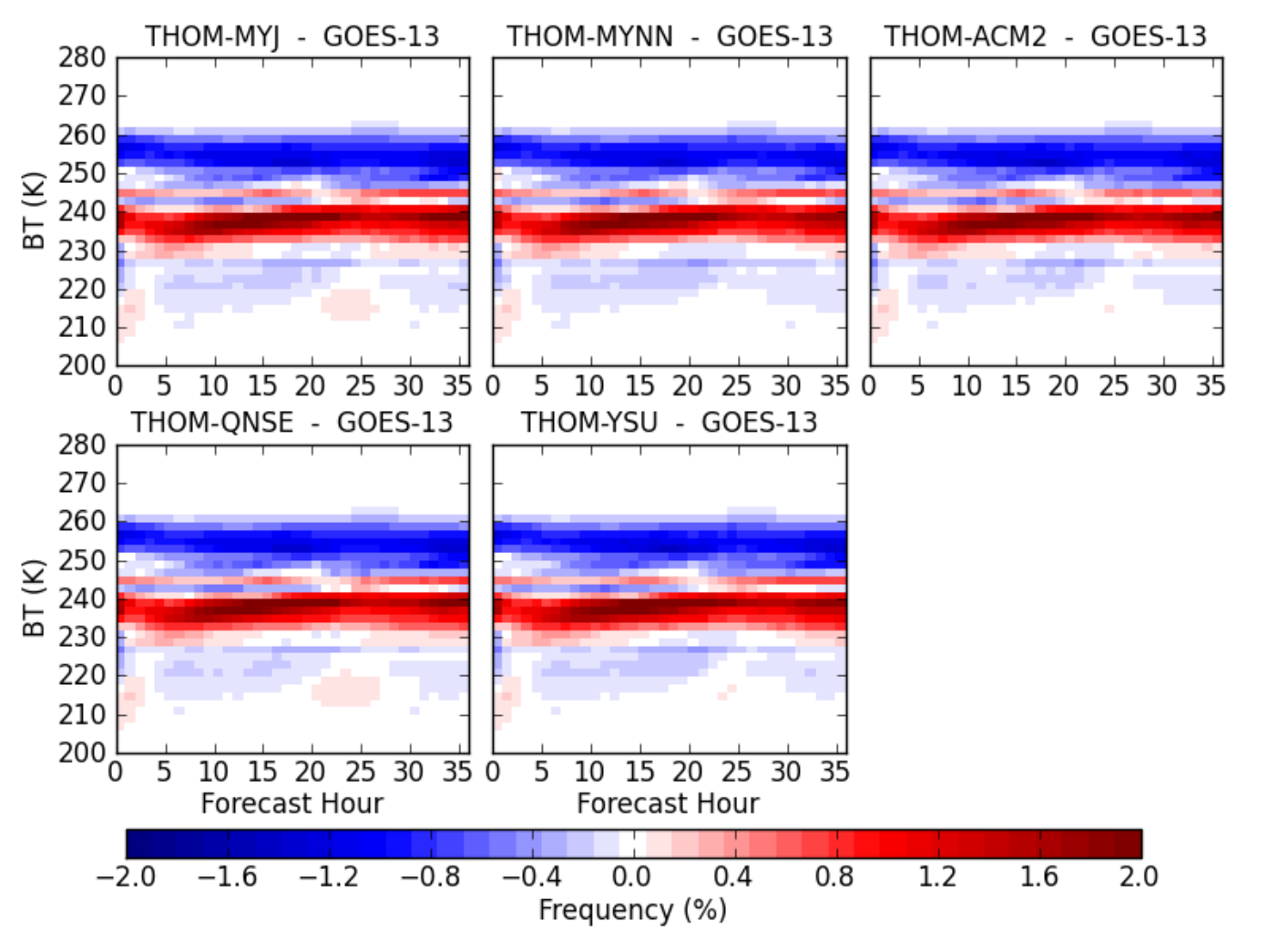
YSU – first order non-local closure

ACM2 – non-local closure, local closure if atmosphere stable or neutral

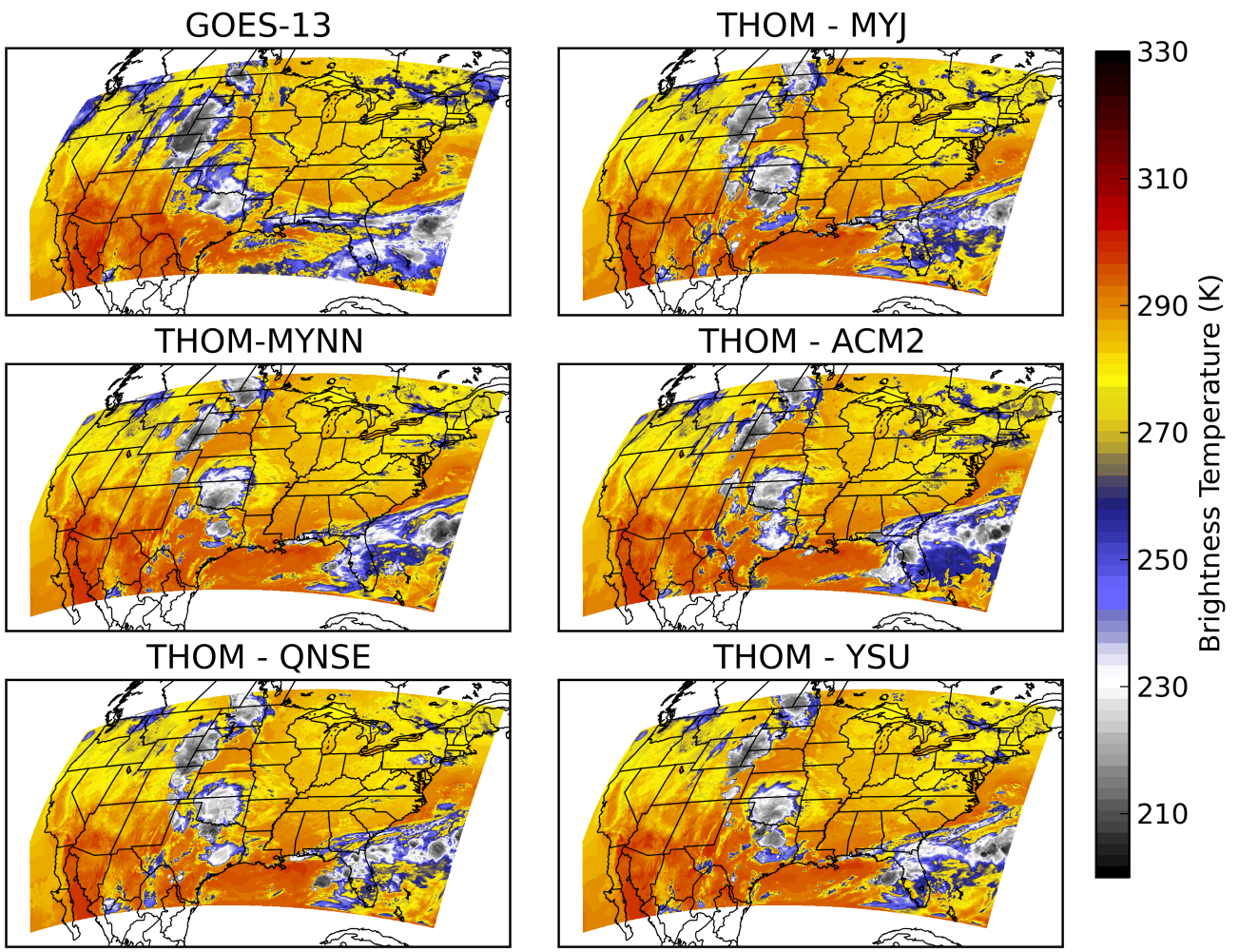
# 6.7 μm Brightness Temperature



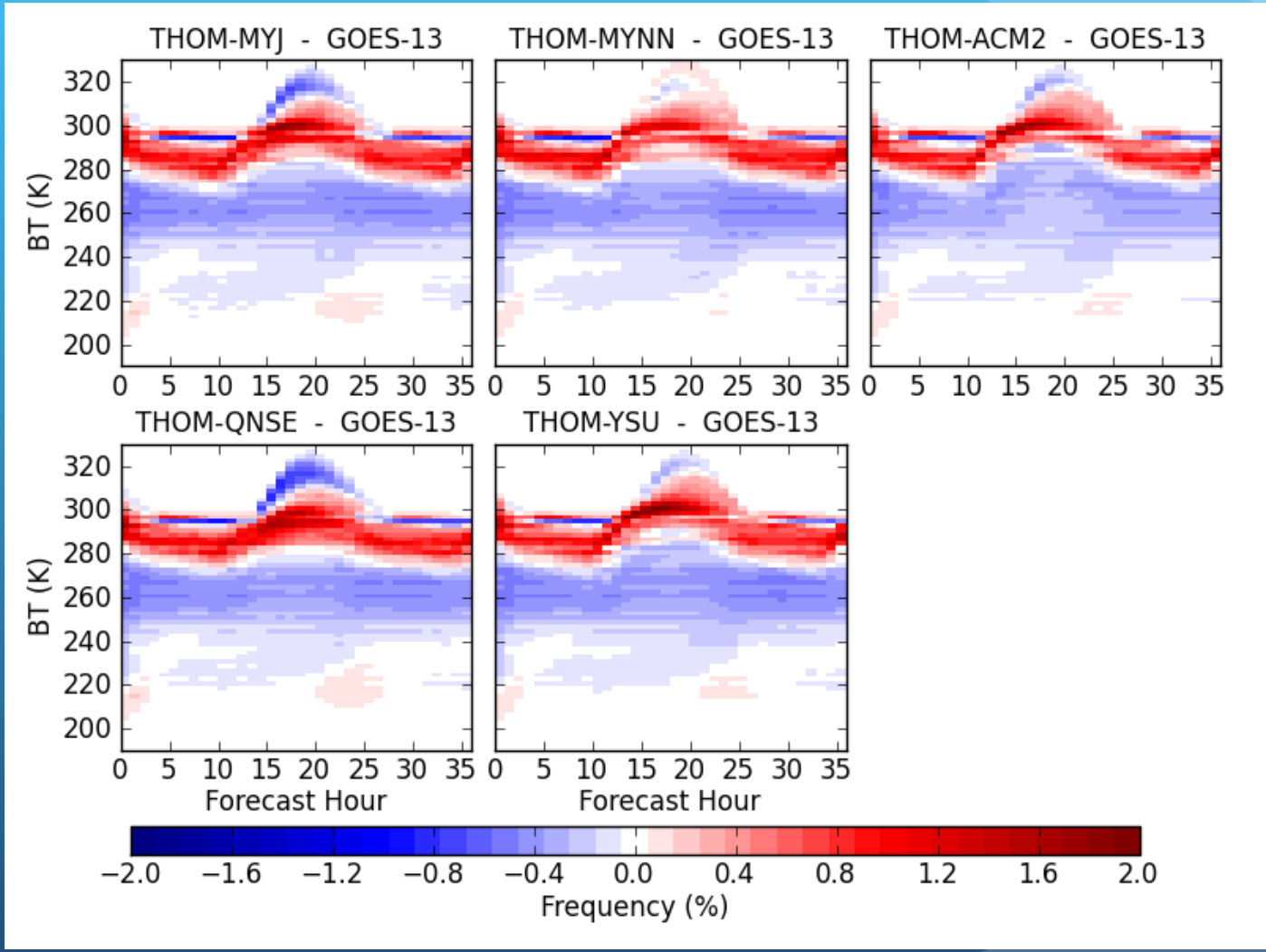
# 6.7 μm Frequency Distribution Differences



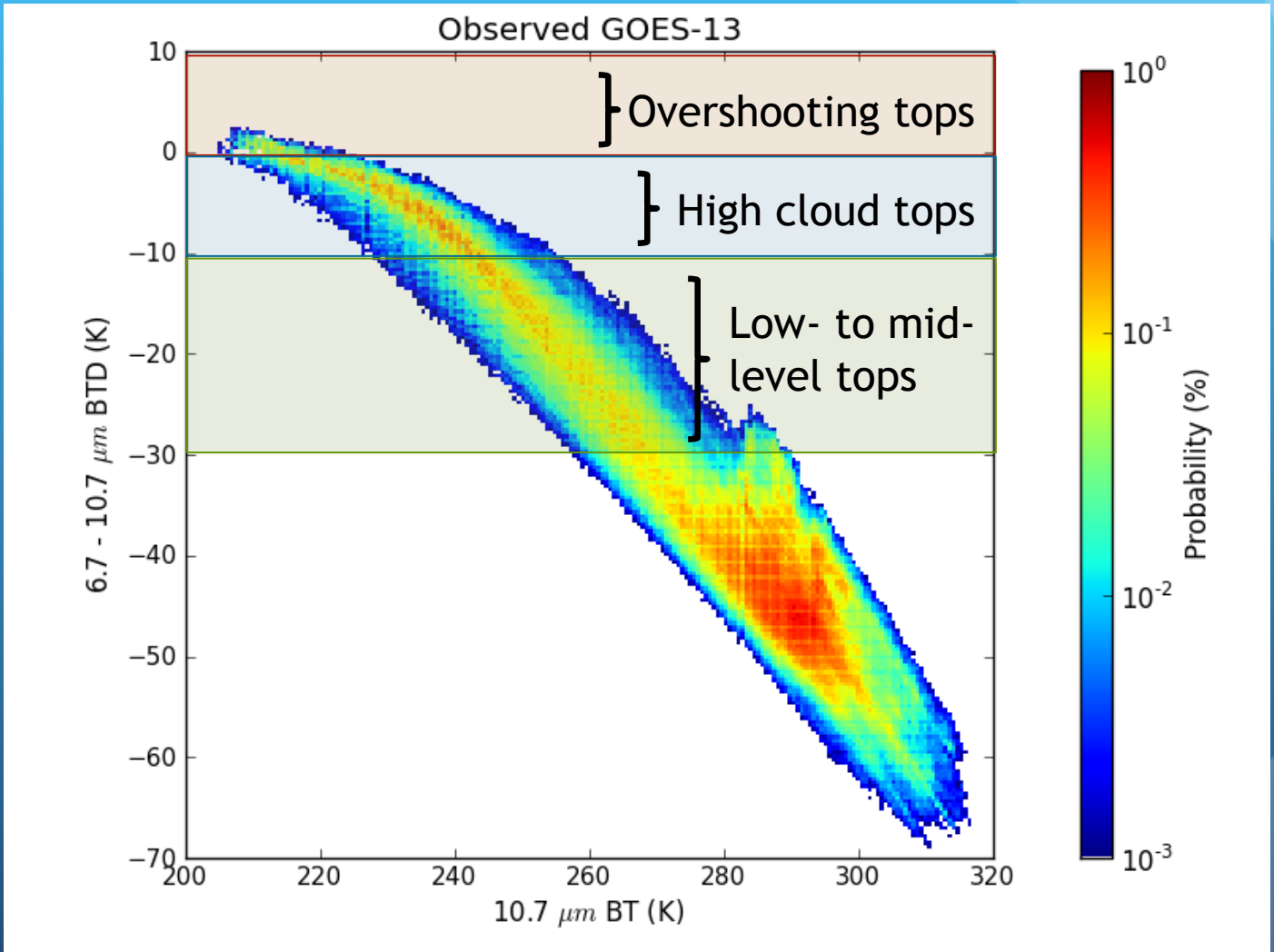
# 10.7 μm Brightness Temperature



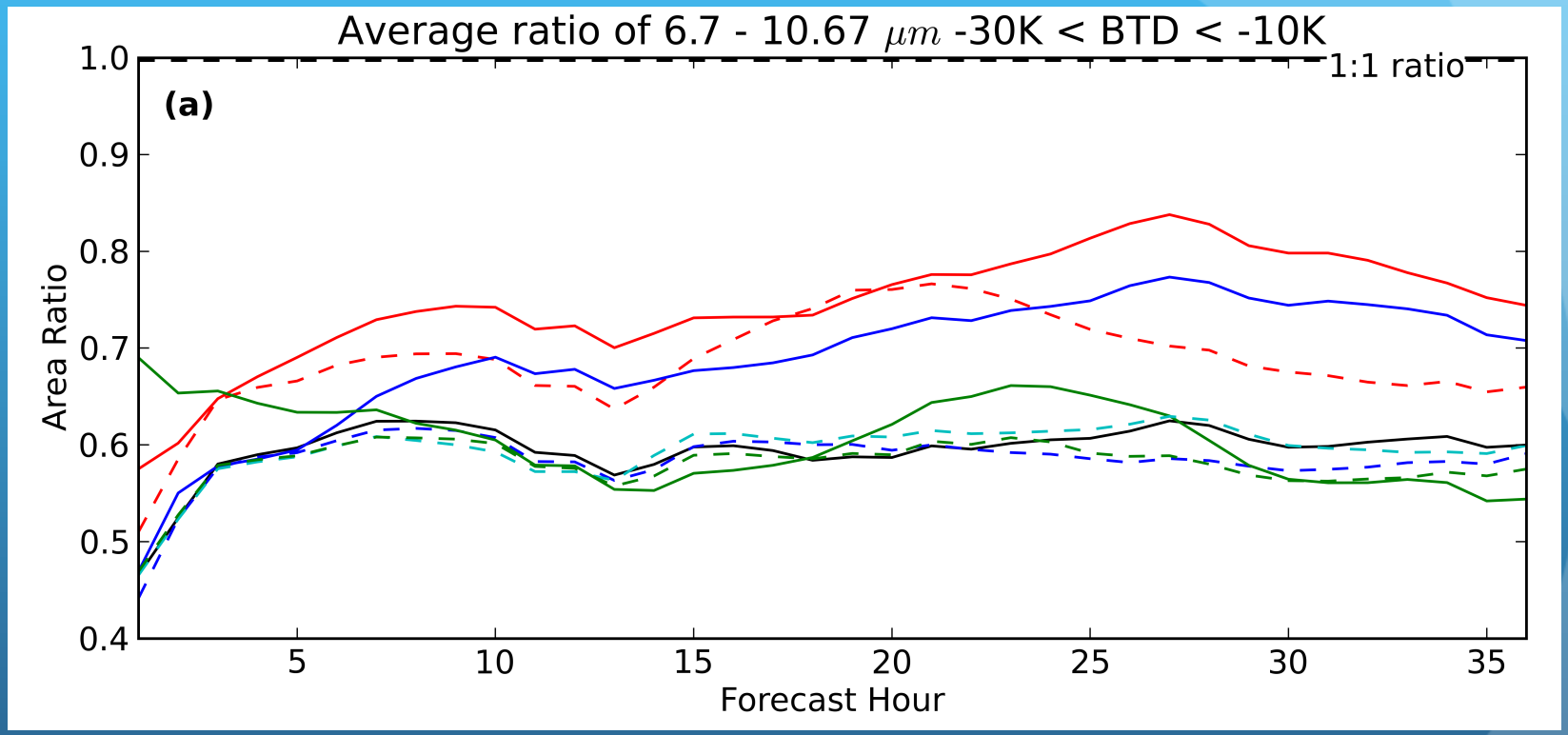
# 10.7 μm Frequency Distribution Differences



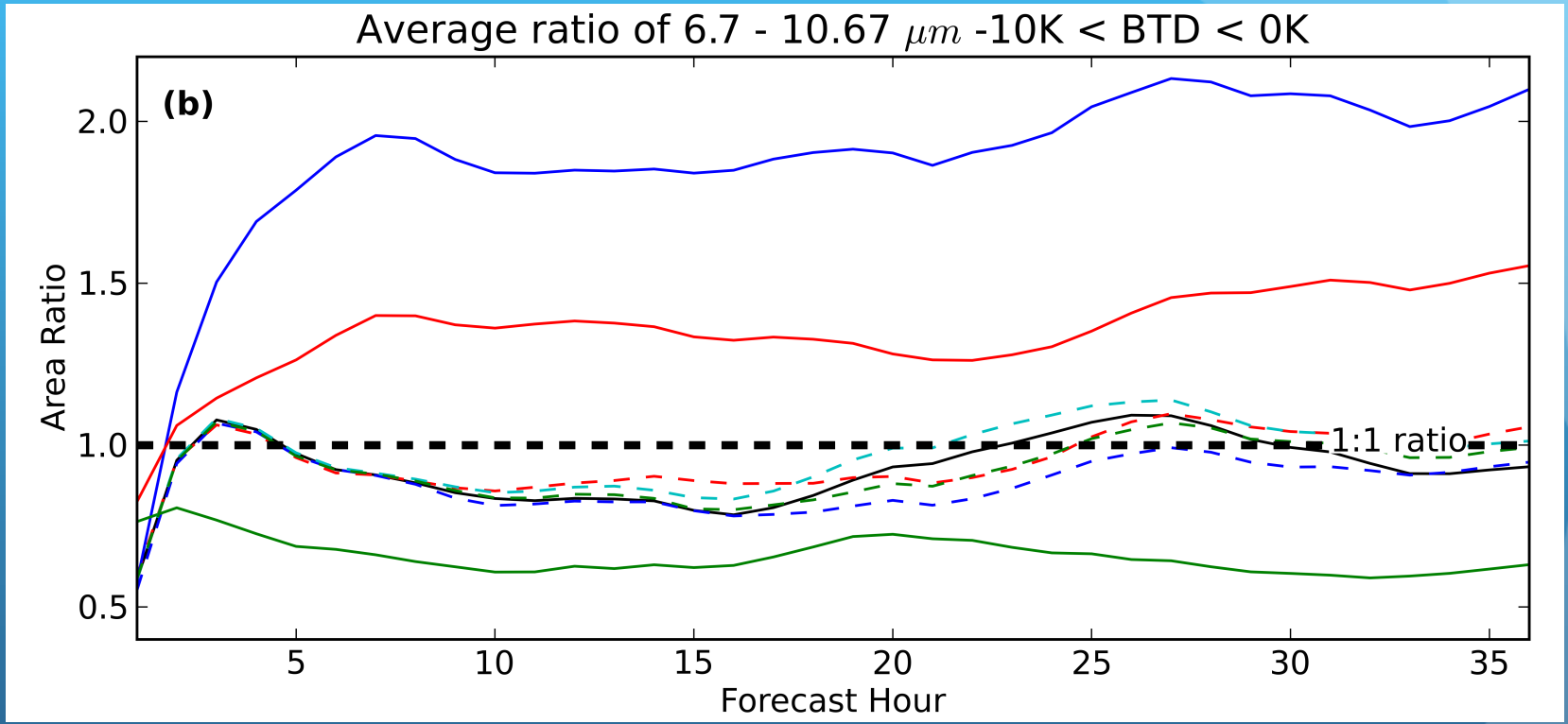
# 6.7 – 10.7 μm Brightness Temperature Differences

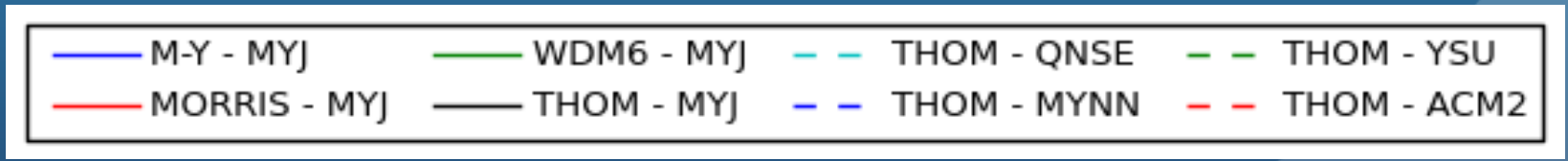


# Low- to Mid-level Cloud Tops

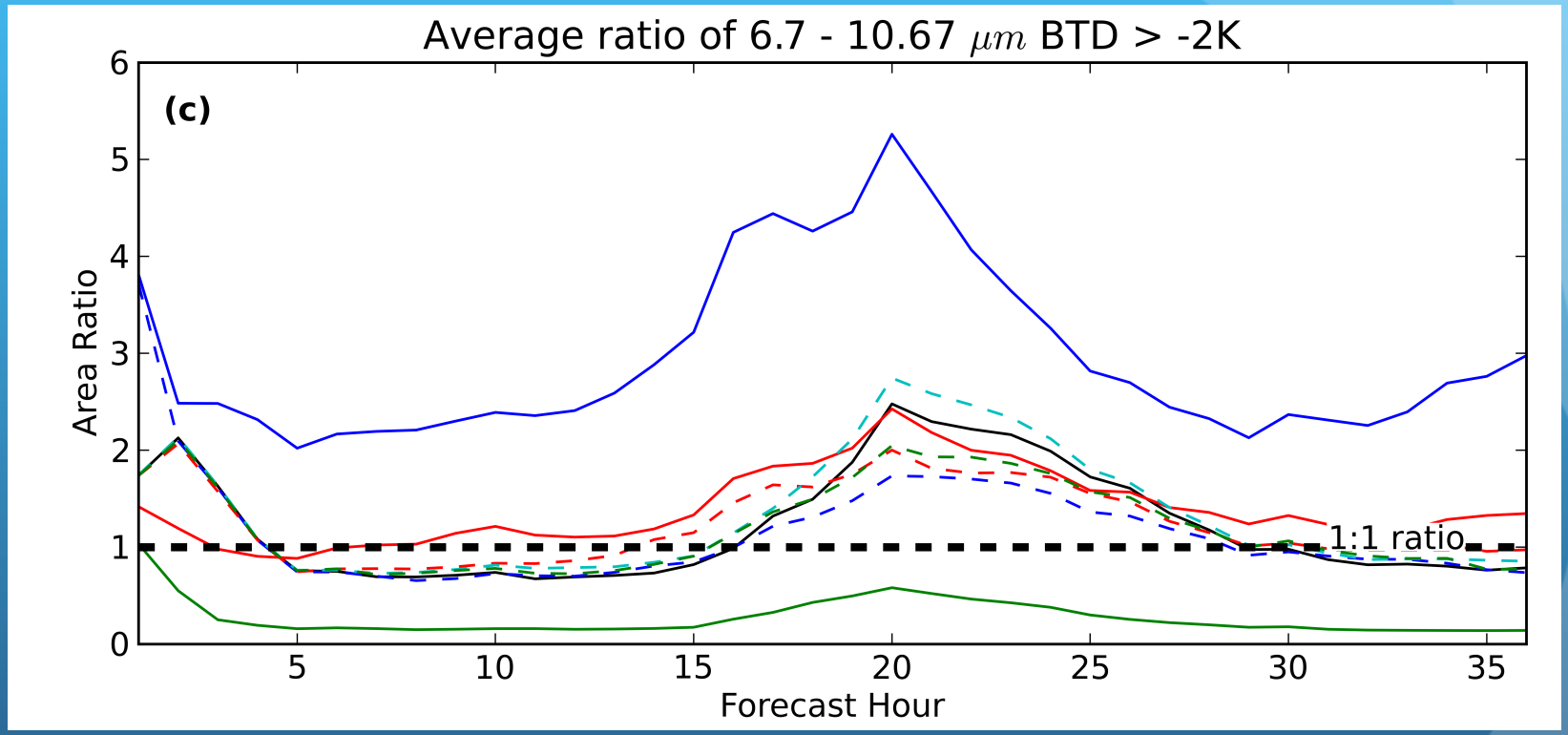


# High Cloud Tops



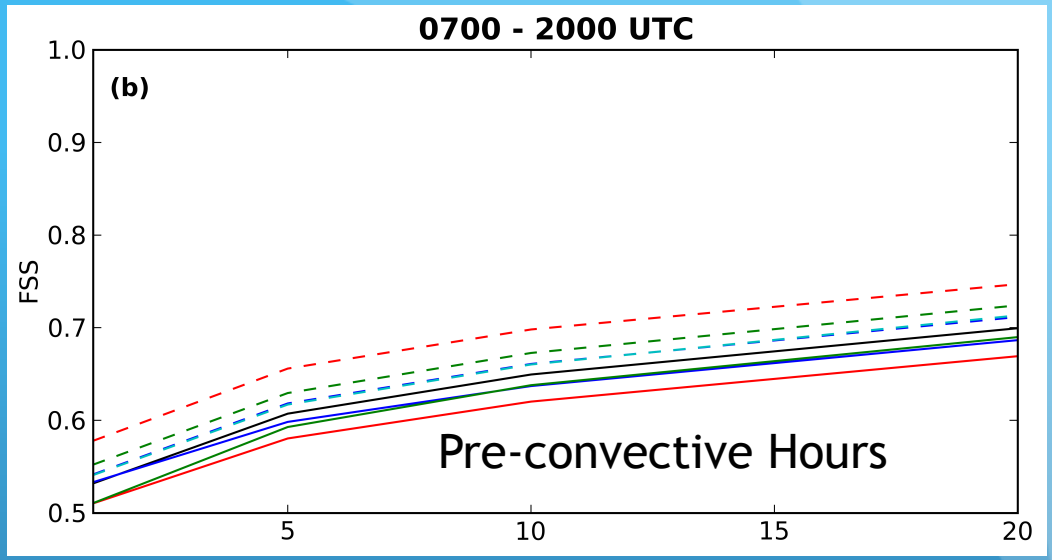



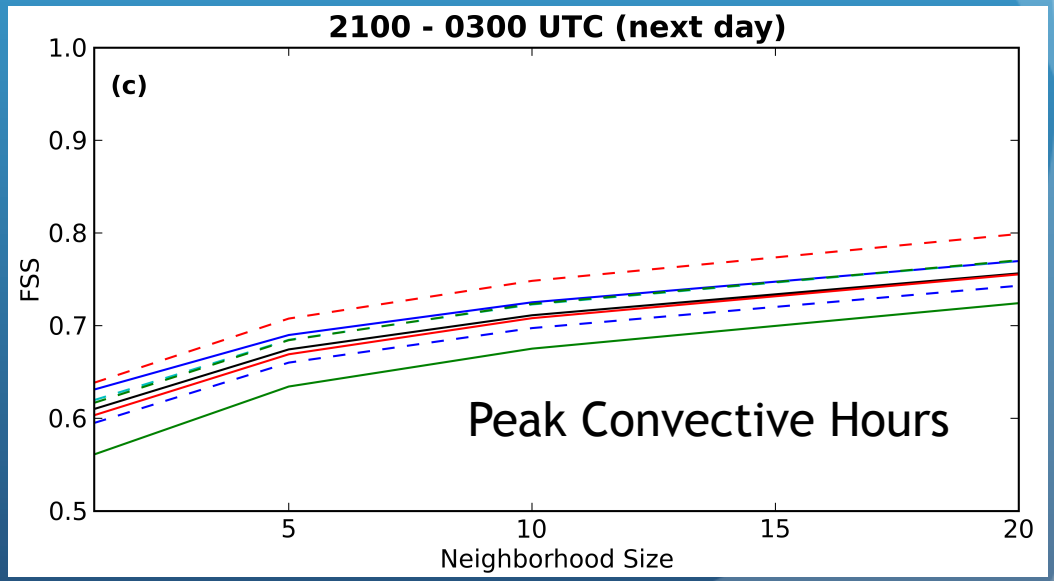
# Cloud tops at or above tropopause

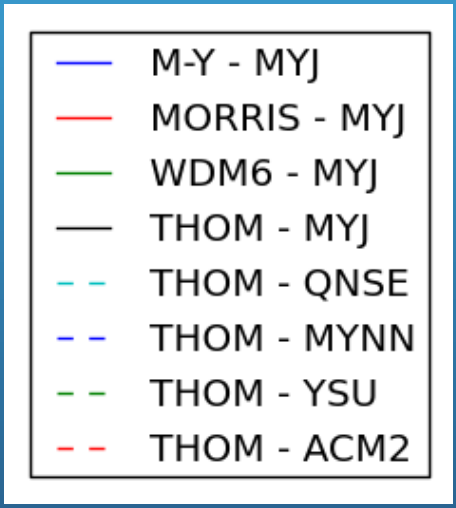


# Fraction Skill Score (FSS) All Clouds

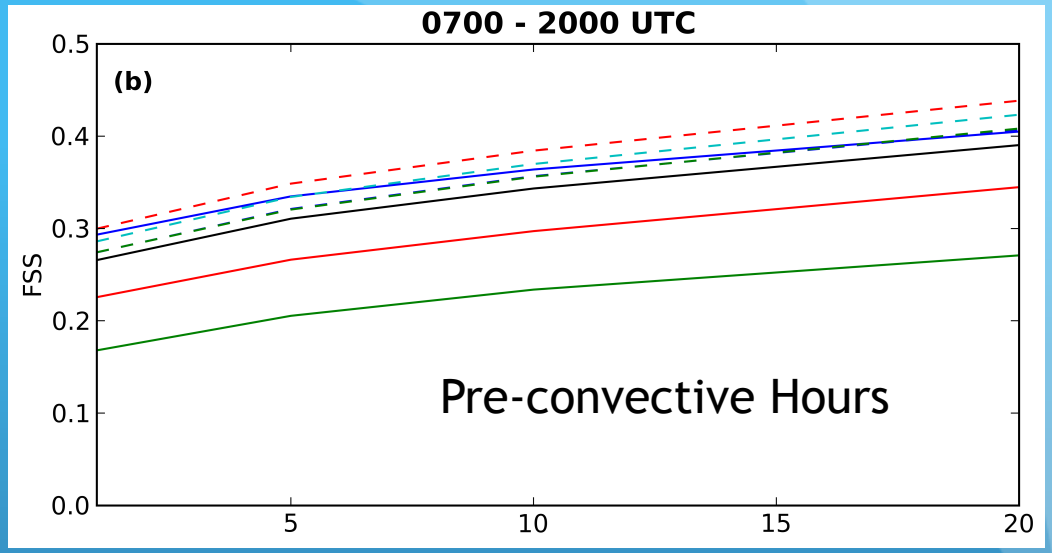
(270 K threshold)

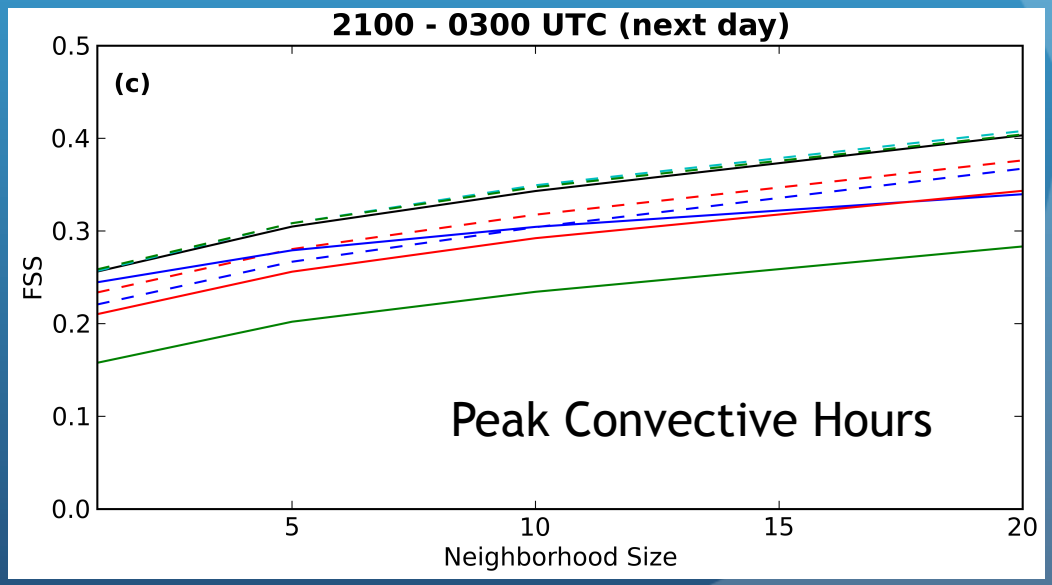


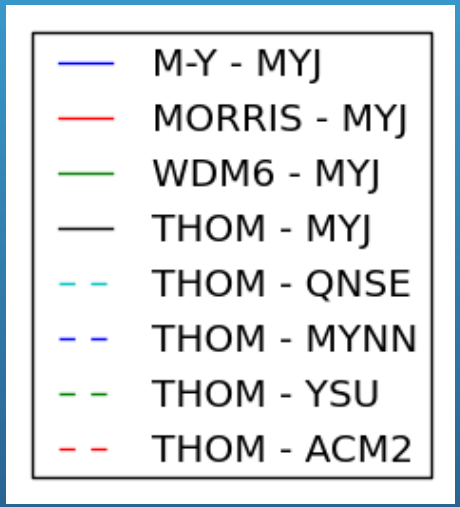



# Fraction Skill Score (FSS) High Clouds (240 K threshold)



# Summary – Microphysics Schemes

- MY and Morrison microphysics best for low-level clouds, but had too much upper-level cloud cover
- WDM6 consistently under produces all levels of clouds
- Thompson was best for upper-level clouds and still performed well for low-level clouds = most accurate microphysics scheme

# Summary – PBL Schemes

- ACM2, YSU, and MYNN schemes generally gave best forecast
- MYJ and QNSE were too cool with surface temperatures and may have had too vigorous of convection during peak convective hours
- Differences between PBL schemes not as large or consistent as differences between the microphysics schemes