

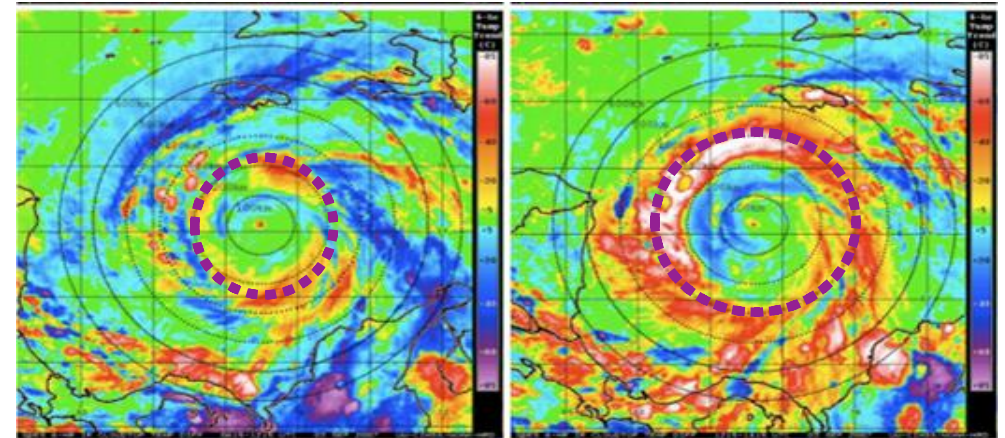
Analyzing the Tropical Cyclone Diurnal Cycle Using Synthetic TROPICS observations

Erika L. Duran
University of Alabama in Huntsville/NASA SPoRT
Tropics Applications Telecon
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Introduction

- Observations reveal a coherent tropical cyclone (TC) diurnal cycle (TCDC) that manifests throughout the TC environment.
- Daily oscillations are seen in cloud-top temperature (e.g., Dunion et al. 2014) and precipitation (e.g., Leppert and Cecil 2016).
 - Also linked to TC convection via outward propagating squall line features (Dunion et al. 2014)
- Current spaceborne observing systems lack the ability to fully resolve the TCDC
 - Makes observational analysis challenging

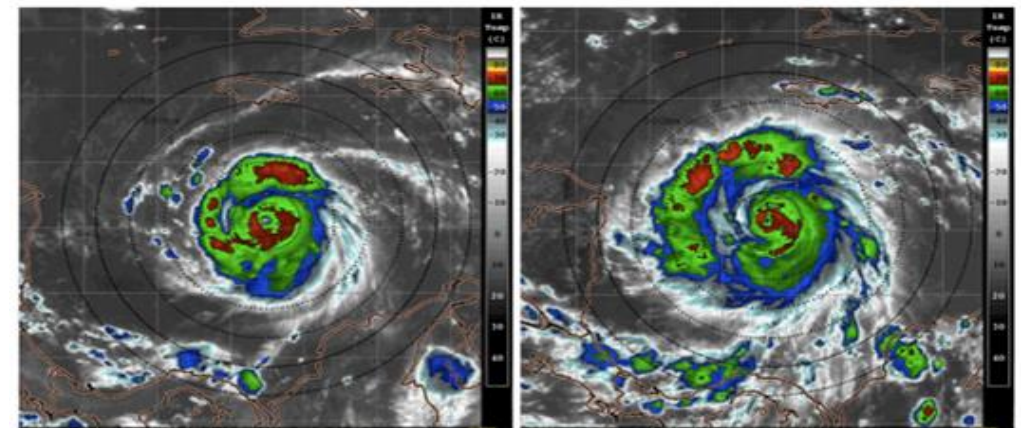
6h Differences in Brightness Temperature



07:15 LT

18:15 LT

Infrared Brightness Temperature



07:15 LT

18:15 LT

Dunion et al. 2014

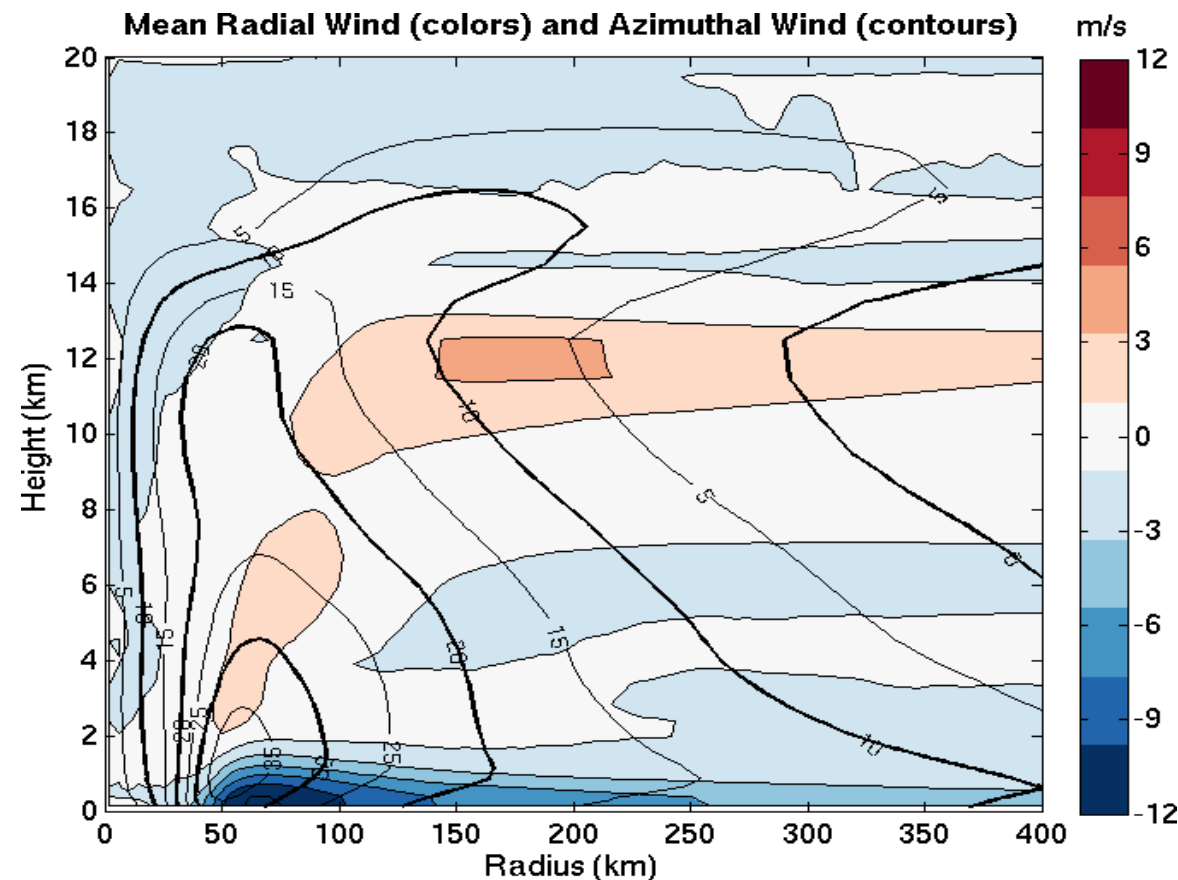
TROPICS Mission



- Rapid update observations (~ 30 min refresh) provide the opportunity to observe the full evolution of the TCDC
- Can sample multiple radial locations from the storm center at different times of the day to track TCDC evolution
- **Goal:** utilize TROPICS temperature and moisture retrievals to analyze the thermodynamics of the TCDC

Methodology

- Since analysis requires L2 proxy data products, create synthetic TROPICS observations using 2D, idealized simulation of Navarro and Hakim (2016)
 - Steady-state TC produced in Cloud Model 1 (CM1) version 15 (Bryan and Rotunno 2009)
 - Axisymmetric simulation with no external influences (e.g., land, shear, etc.)
 - 300 days of a mature TC
- Caveat: output is hourly, so actual TROPICS resolution will be **better**



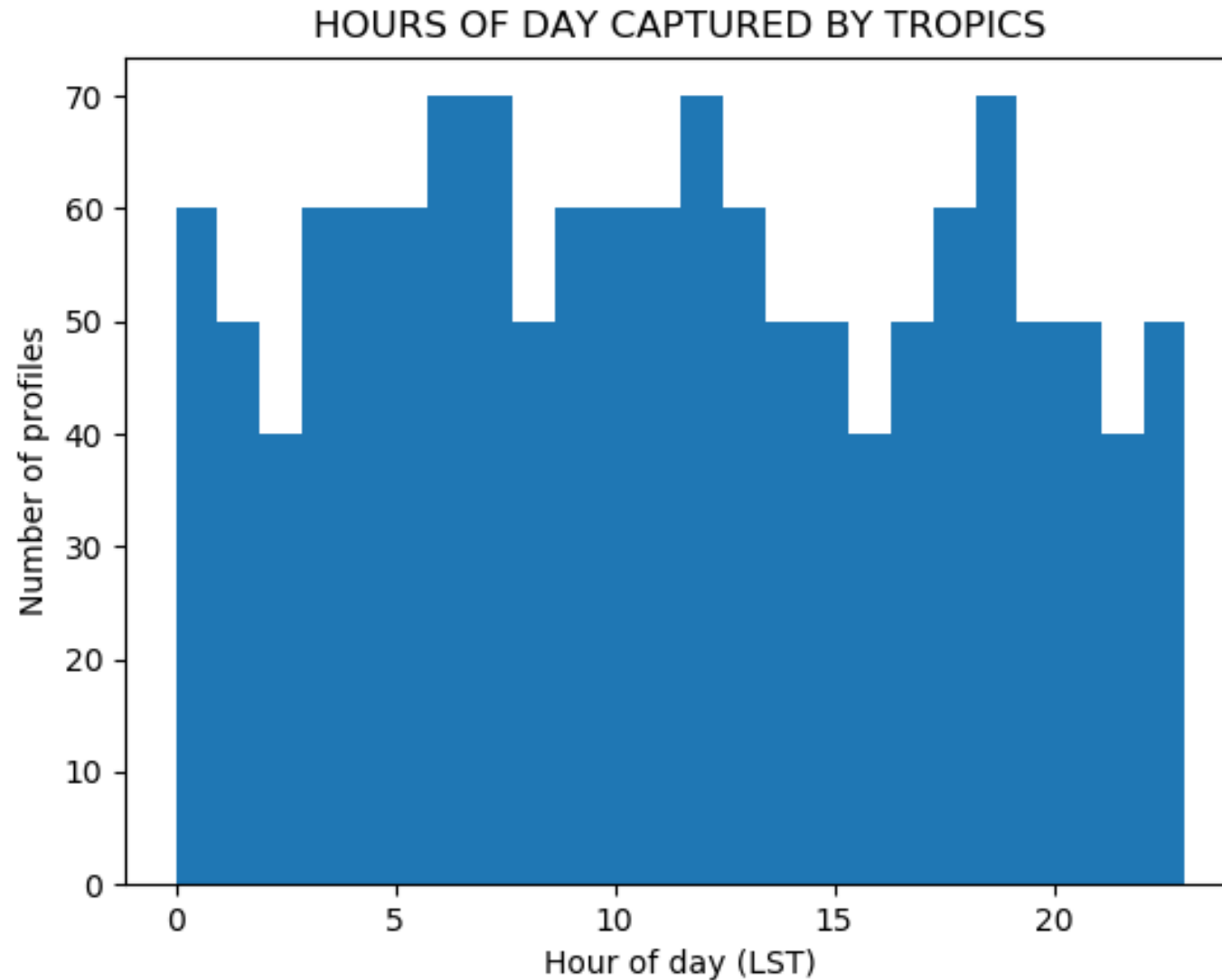
Navarro and Hakim (2016)

Synthetic L2b Data Products

- Simulate satellite overpasses using a 30-day orbital simulation of the baseline mission
 - Repeat every 30 days to match duration of model output
 - Spatially blur CM1 spatial resolution to estimates from TROPICS

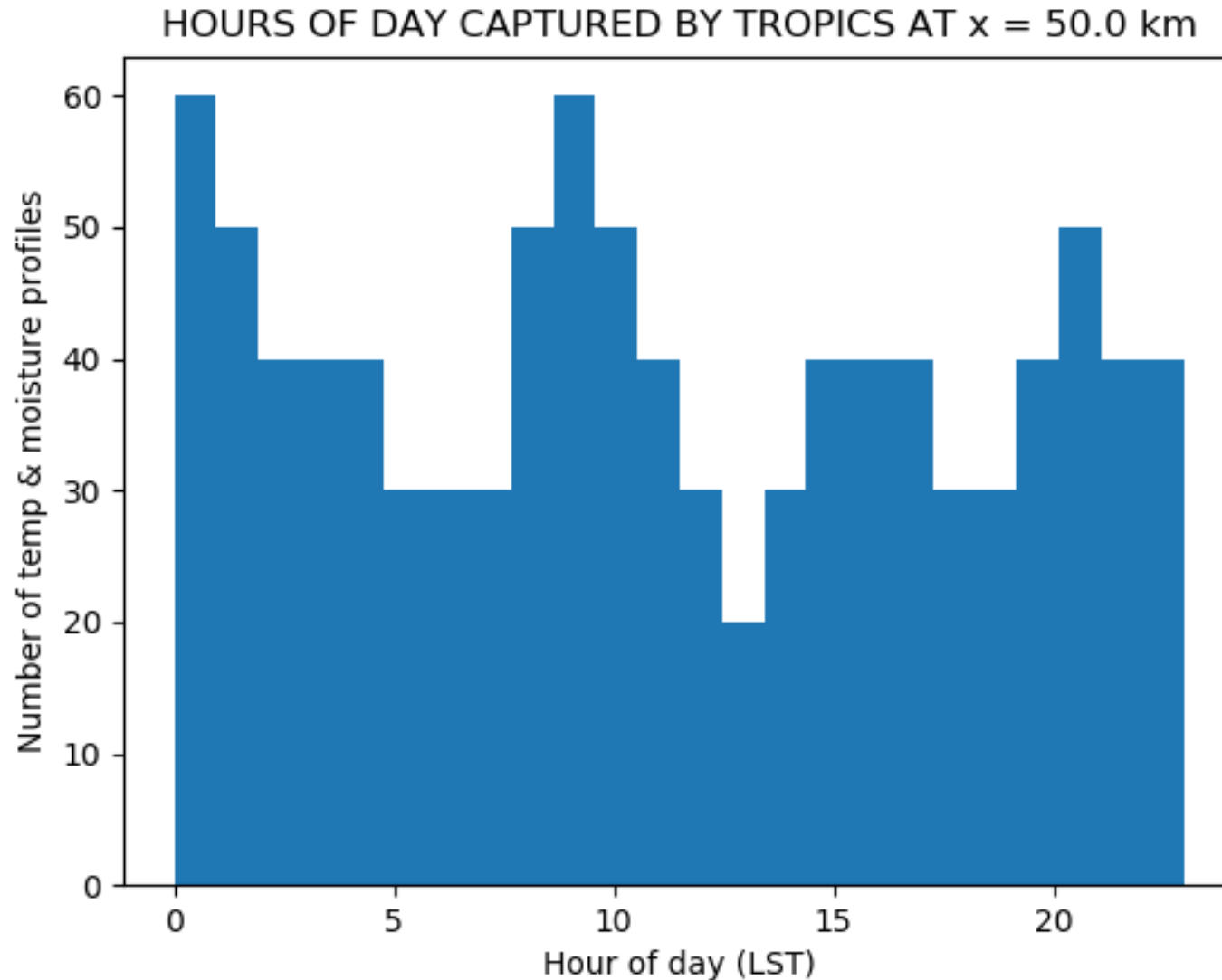
L2 Product	Resolution	Uncertainty
Vertical temperature profile (K)	50 km scan-averaged	2K r.m.s
Vertical moisture profile (g g^{-1})	25 km scan-averaged	25%
Instantaneous Rain Rate (mm h^{-1})	2.5 x 2.5 degrees	25%
TC intensity: minimum sea-level pressure (hPa)		10hPa r.m.s
TC intensity: maximum sustained wind (m s^{-1})		6 m s^{-1} r.m.s

Synthetic TROPICIS observations (full domain)



*~ 1-2 days of
TROPICS
coverage*

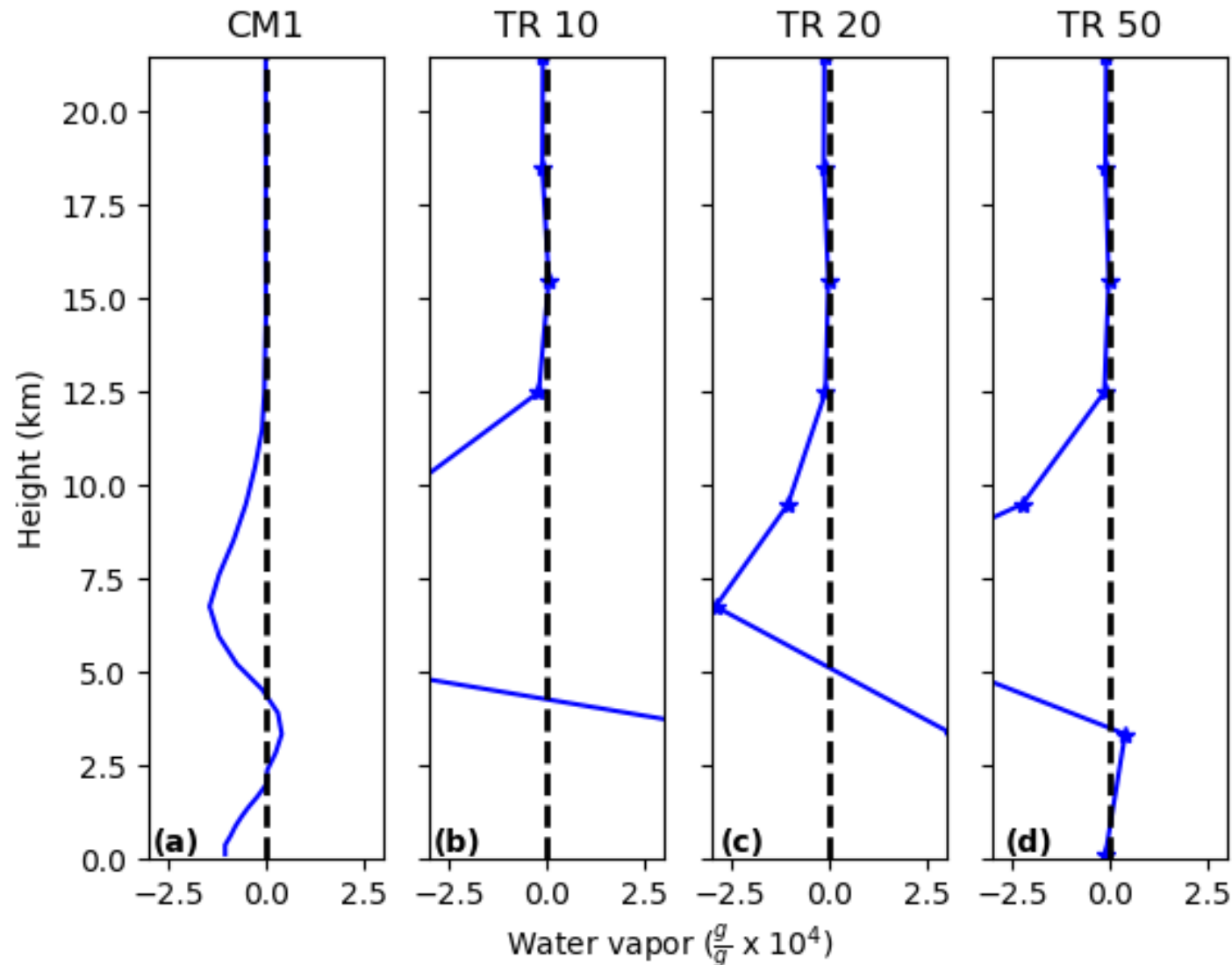
Synthetic TROPICIS observations (RMW)



*~ 1-2 days of
TROPICIS
coverage*

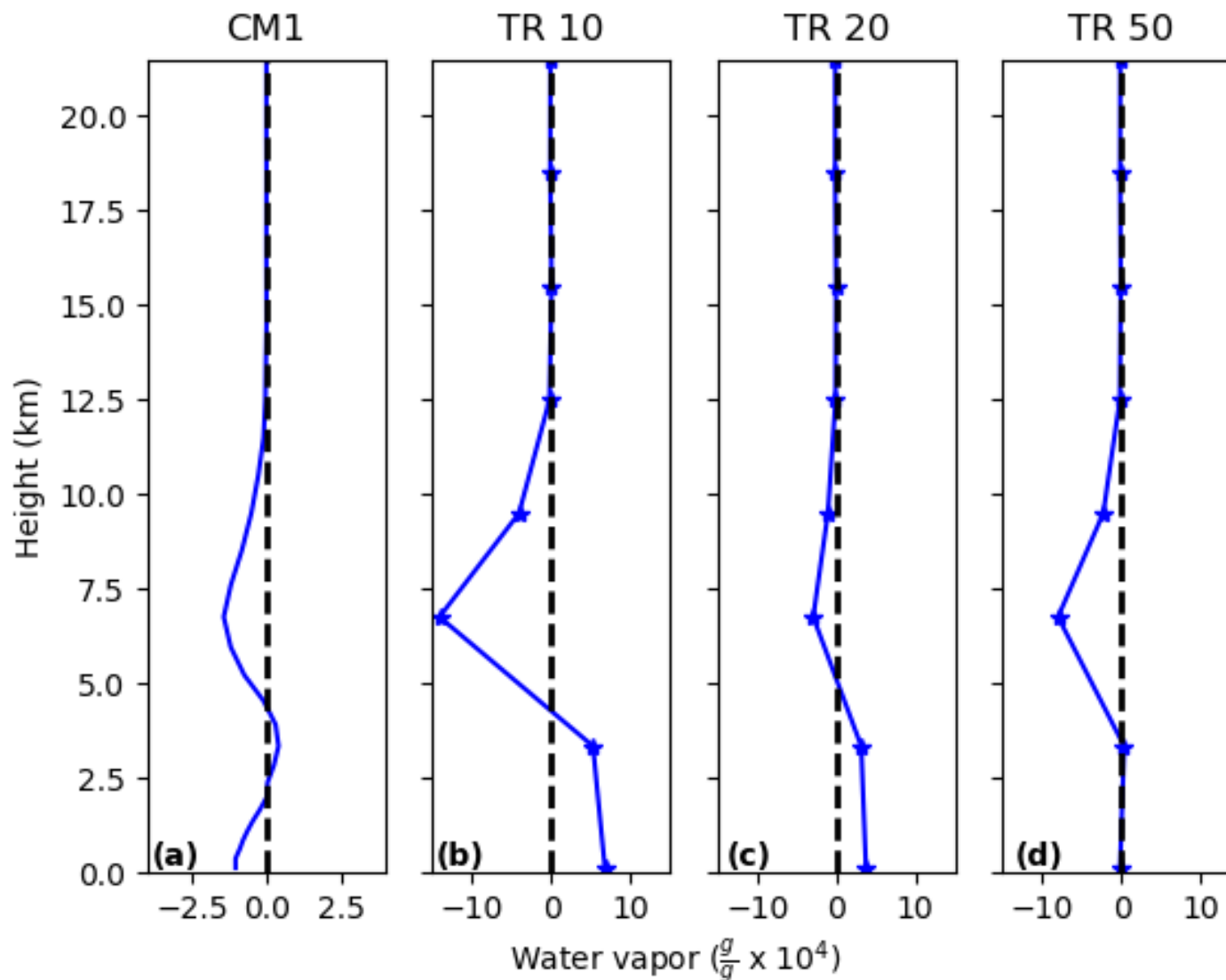
TC Diurnal Cycle Anomalies at $r = 50$ km and 00 LT

CM1 is
average of 300
anomalies



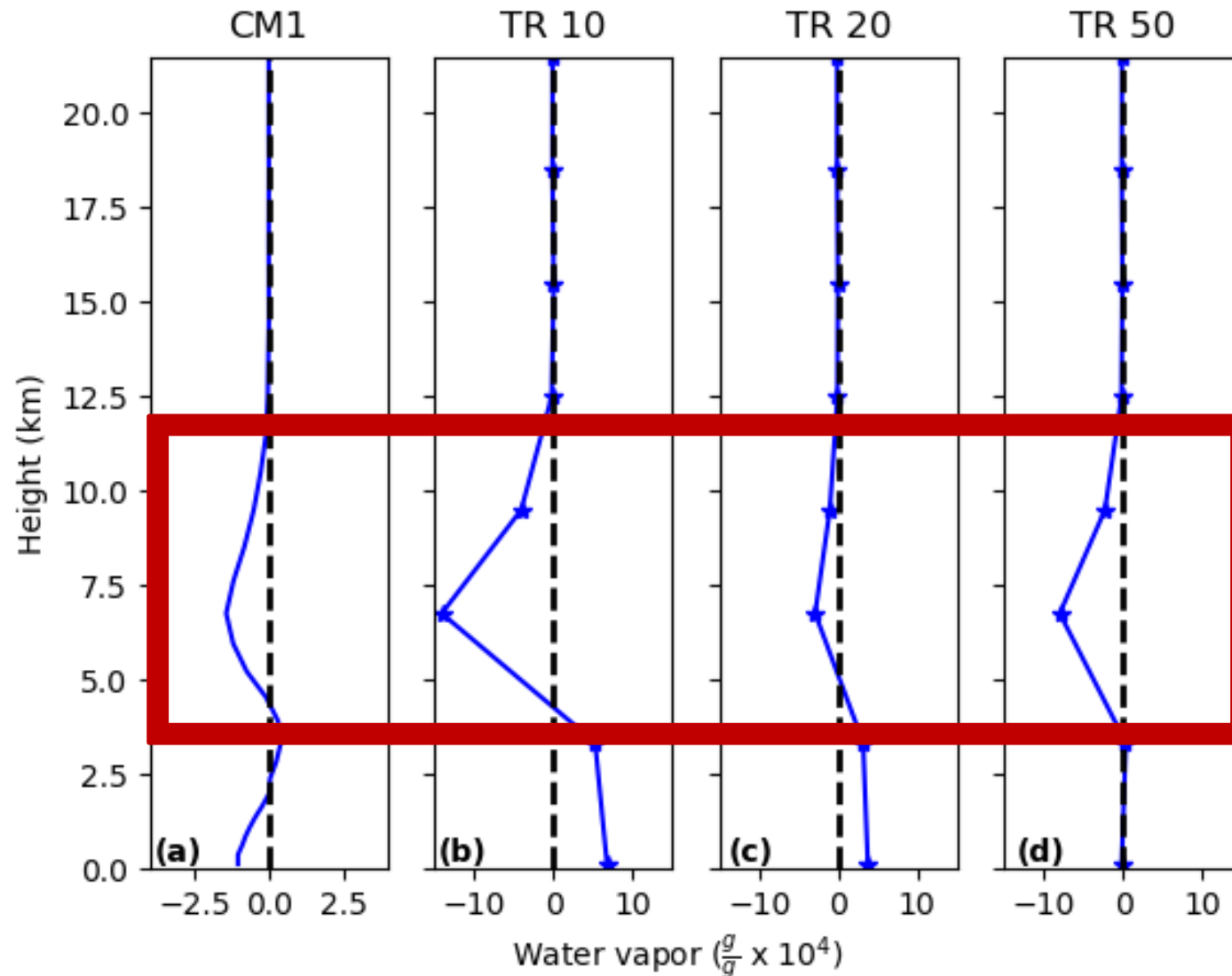
TC Diurnal Cycle Anomalies at $r = 50$ km and 00 LT

CM1 is
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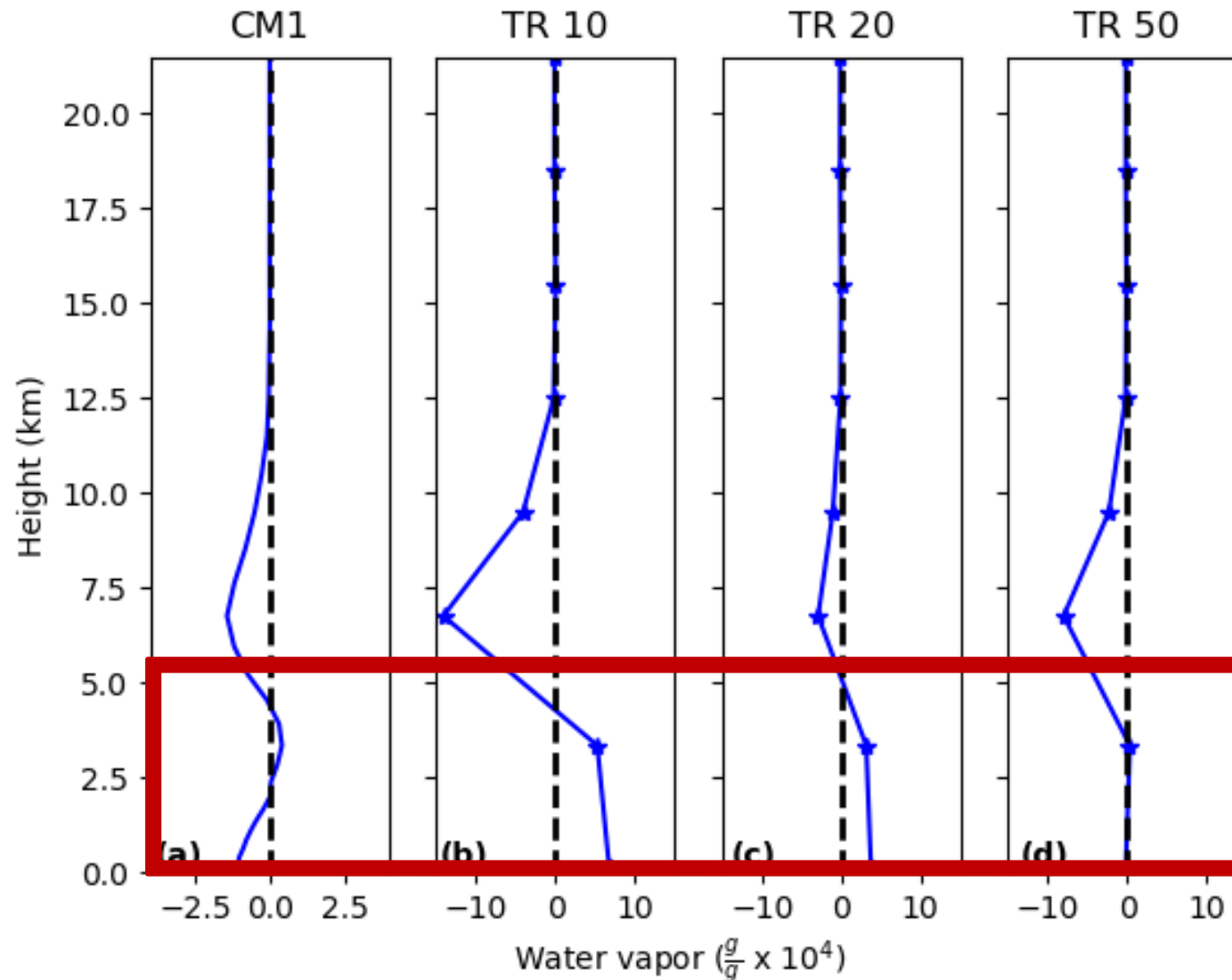
TC Diurnal Cycle Anomalies at $r = 50$ km and 00 LT

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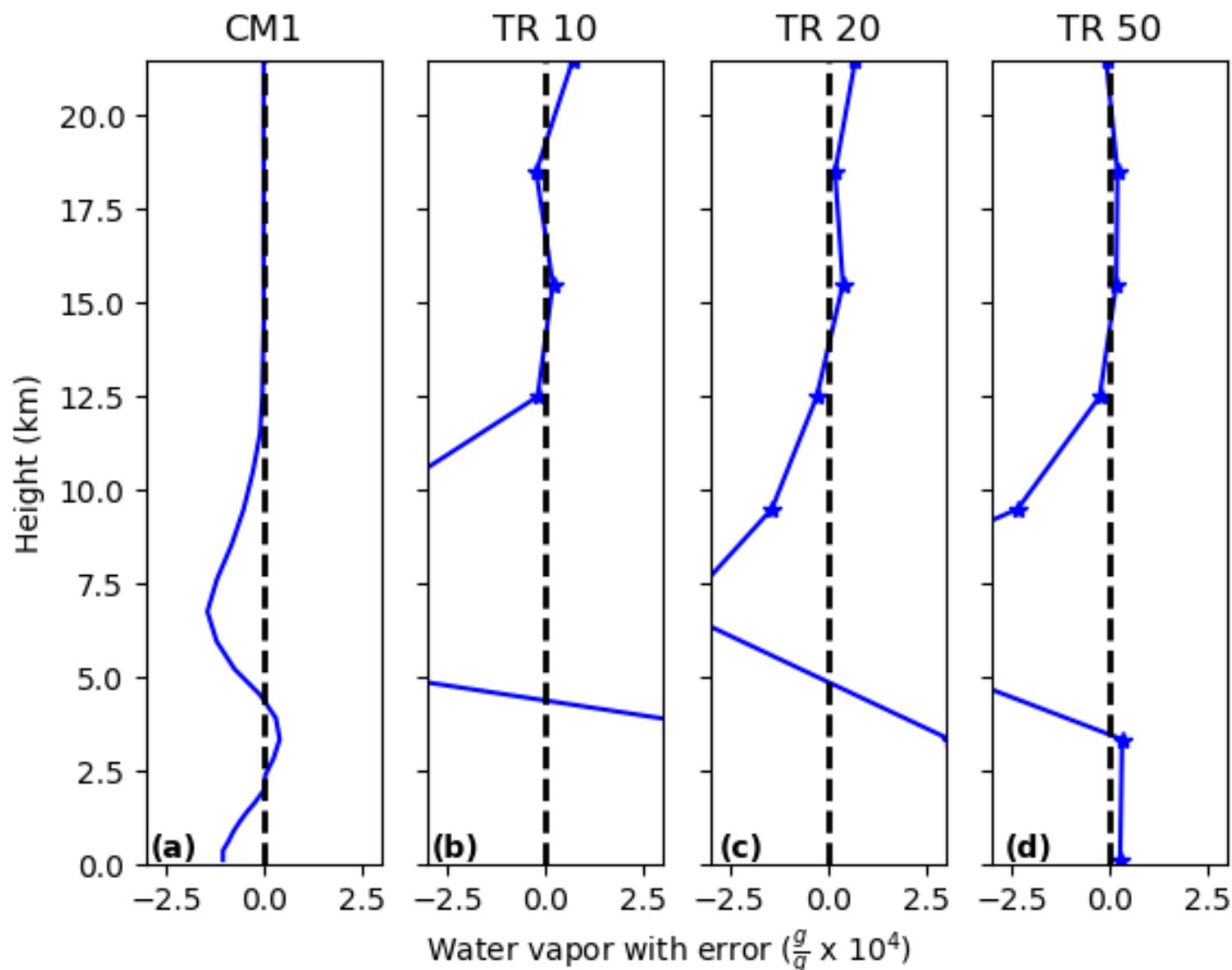


TC Diurnal Cycle Anomalies at $r = 50$ km and 00 LT

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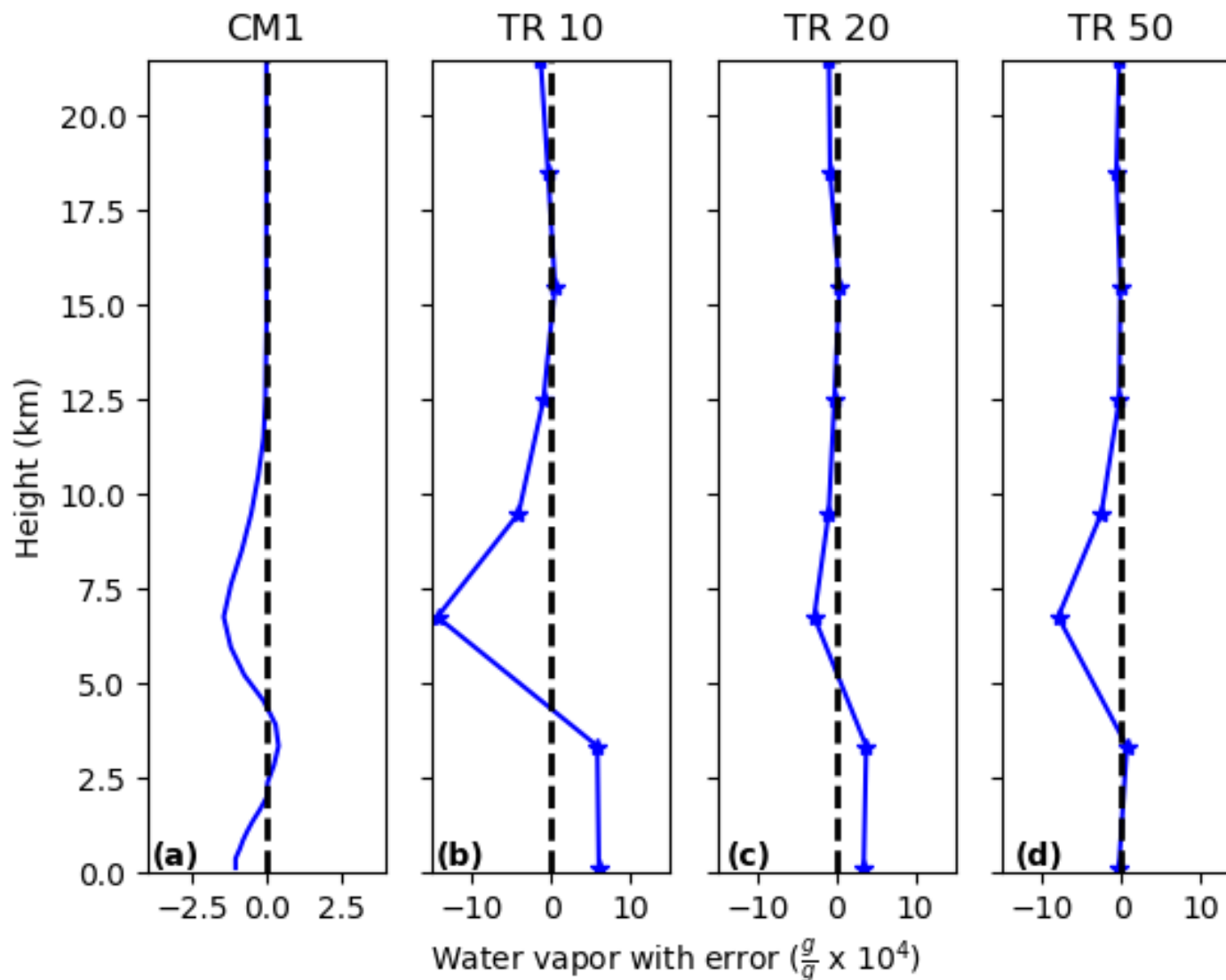


TC Diurnal Cycle Anomalies w/ Noise (50km, 00LT)



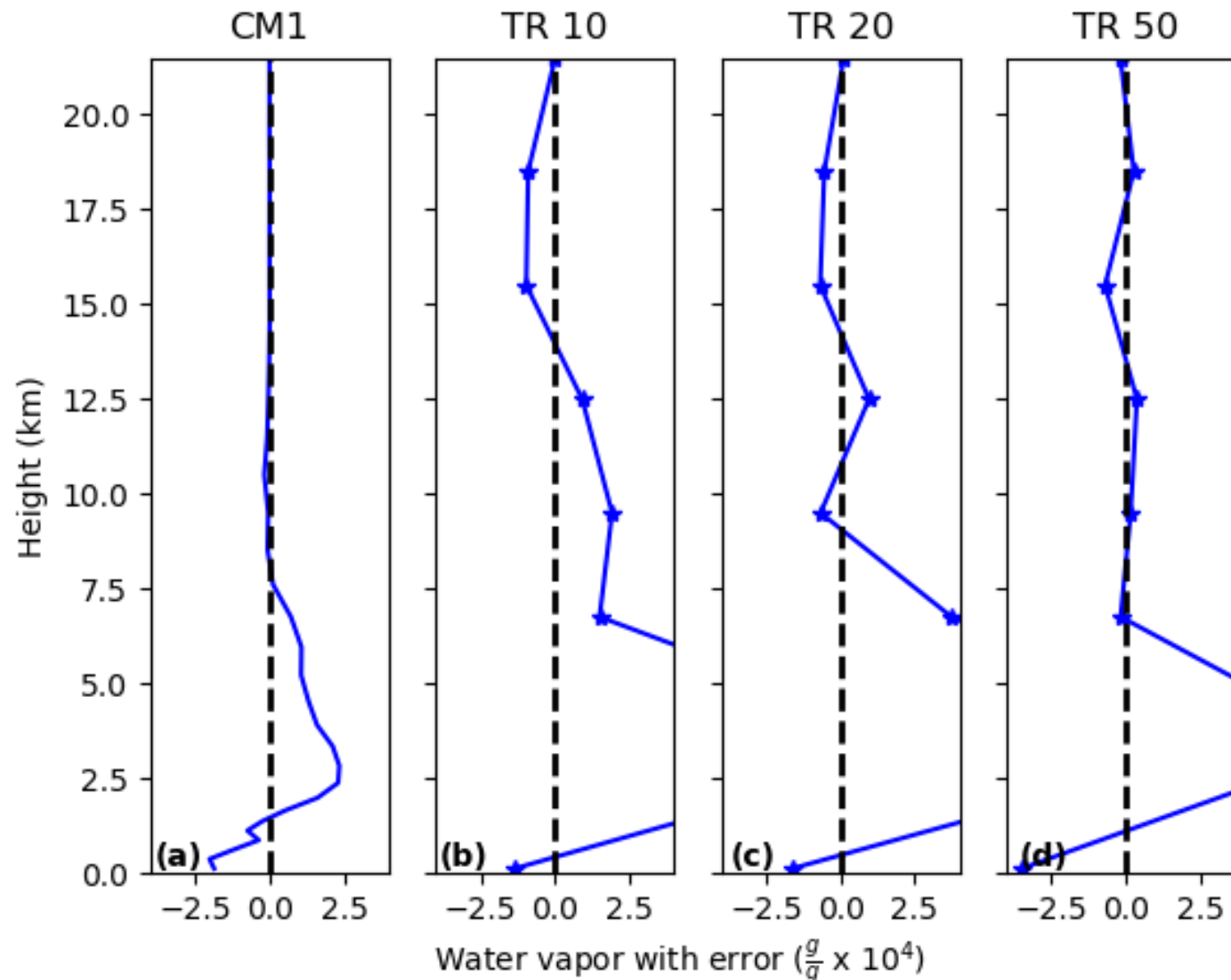
More profiles
needed to
reproduce CM1
results

TC Diurnal Cycle Anomalies w/ Noise (50km. 00LT)



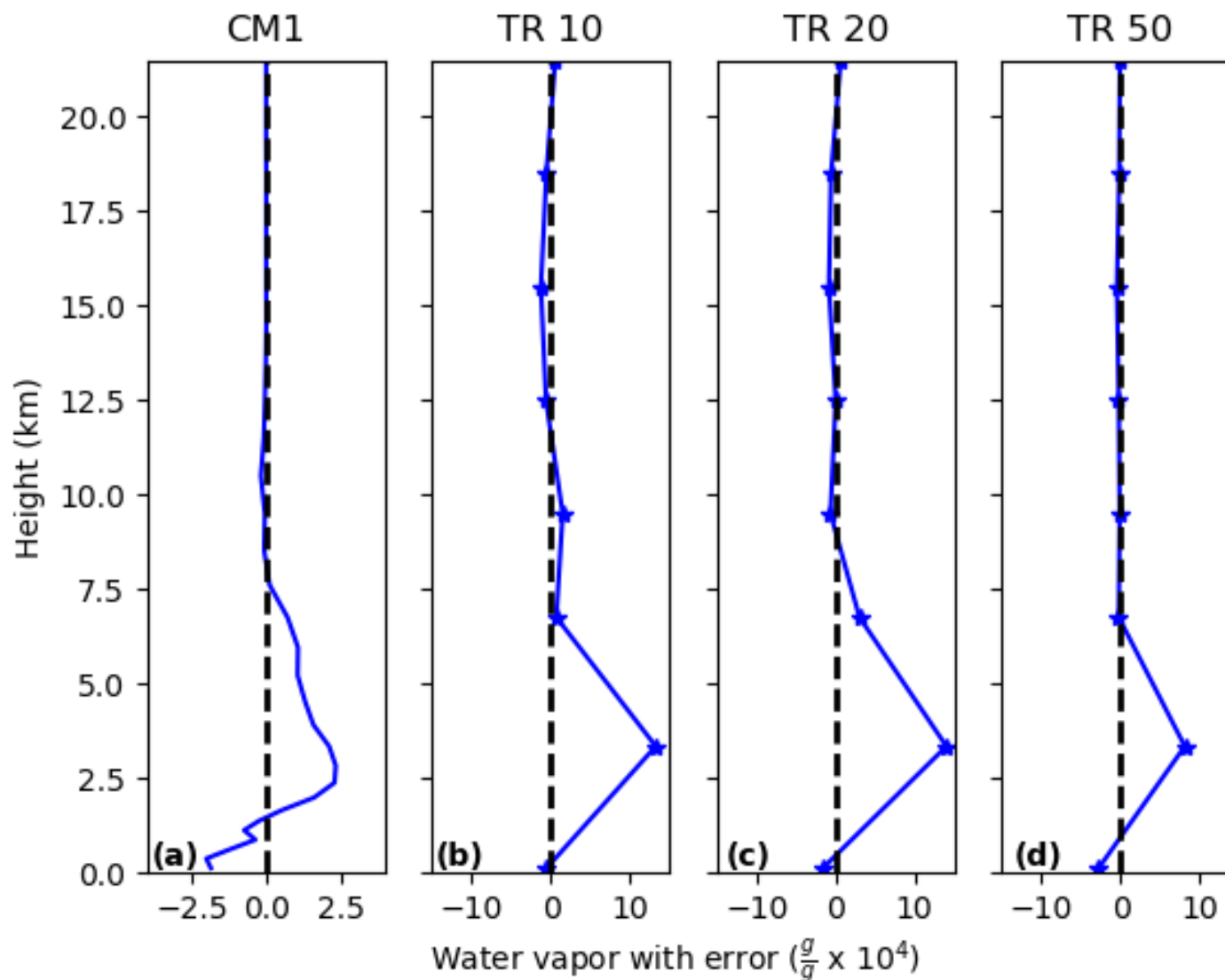
More profiles
needed to
reproduce CM1
results

TC Diurnal Cycle Anomalies at $r = 218$ km and 00 LT



Less profiles
needed to
resolve TCDC
at this radial
location

TC Diurnal Cycle Anomalies at $r = 218$ km and 00 LT



Less profiles
needed to
resolve TCDC
at this radial
location

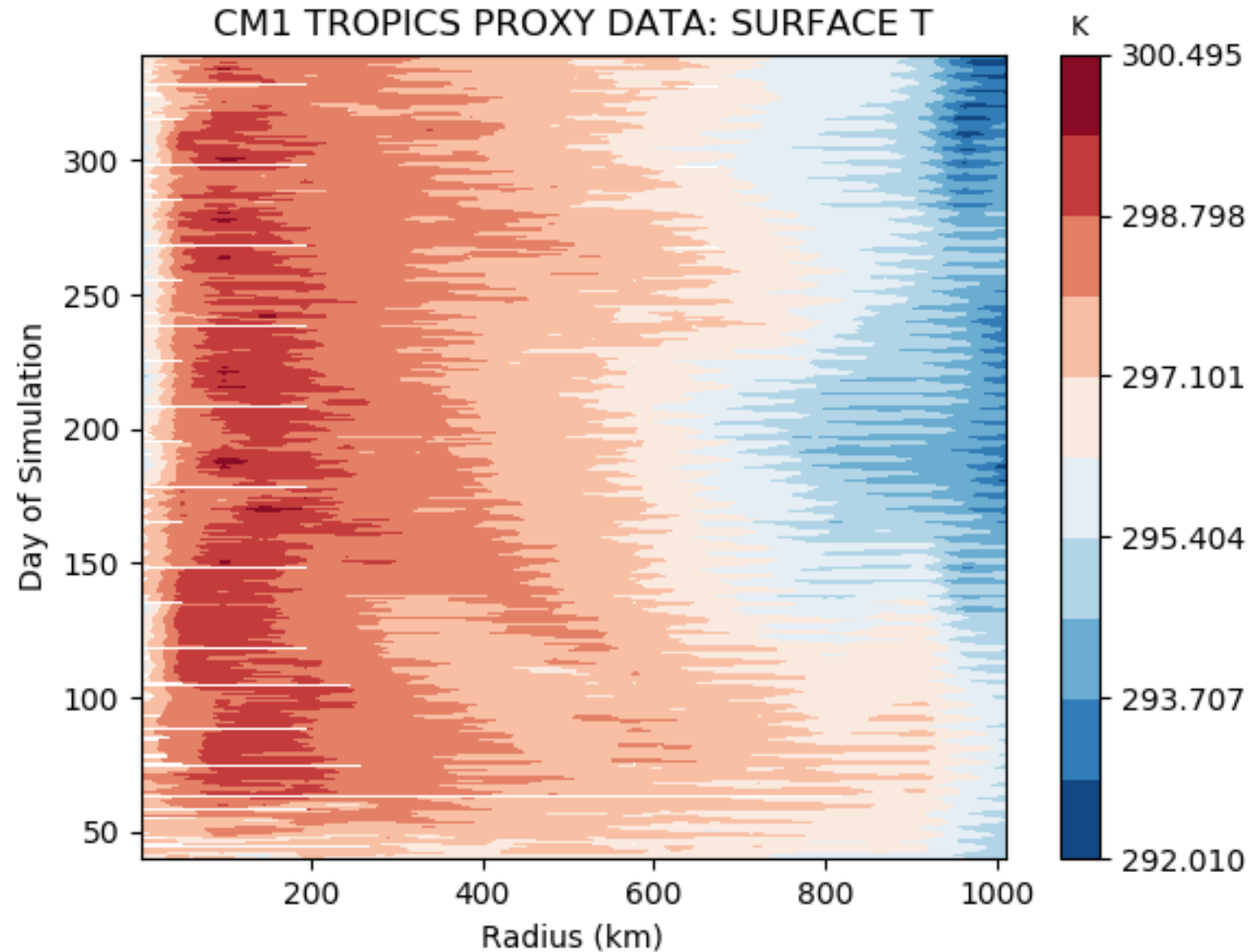
Summary

- TROPICS provides a unique opportunity to observe the full evolution of the TCDC
- Synthetic L2 data products are produced using an idealized, axisymmetric TC simulation
- Using proxy data, TROPICS shows promise in resolving anomalies that arise from TCDC
 - Motivates further study to develop algorithms in 3D

Thanks!



Example: Proxy data



*White lines
demonstrate lack of
TROPICS data at that
location*

*~70% of full TROPICS
coverage*