

# Using TROPICS observations to improve estimates of long-term tropical tropospheric temperature change?

CERES Science Team Meeting

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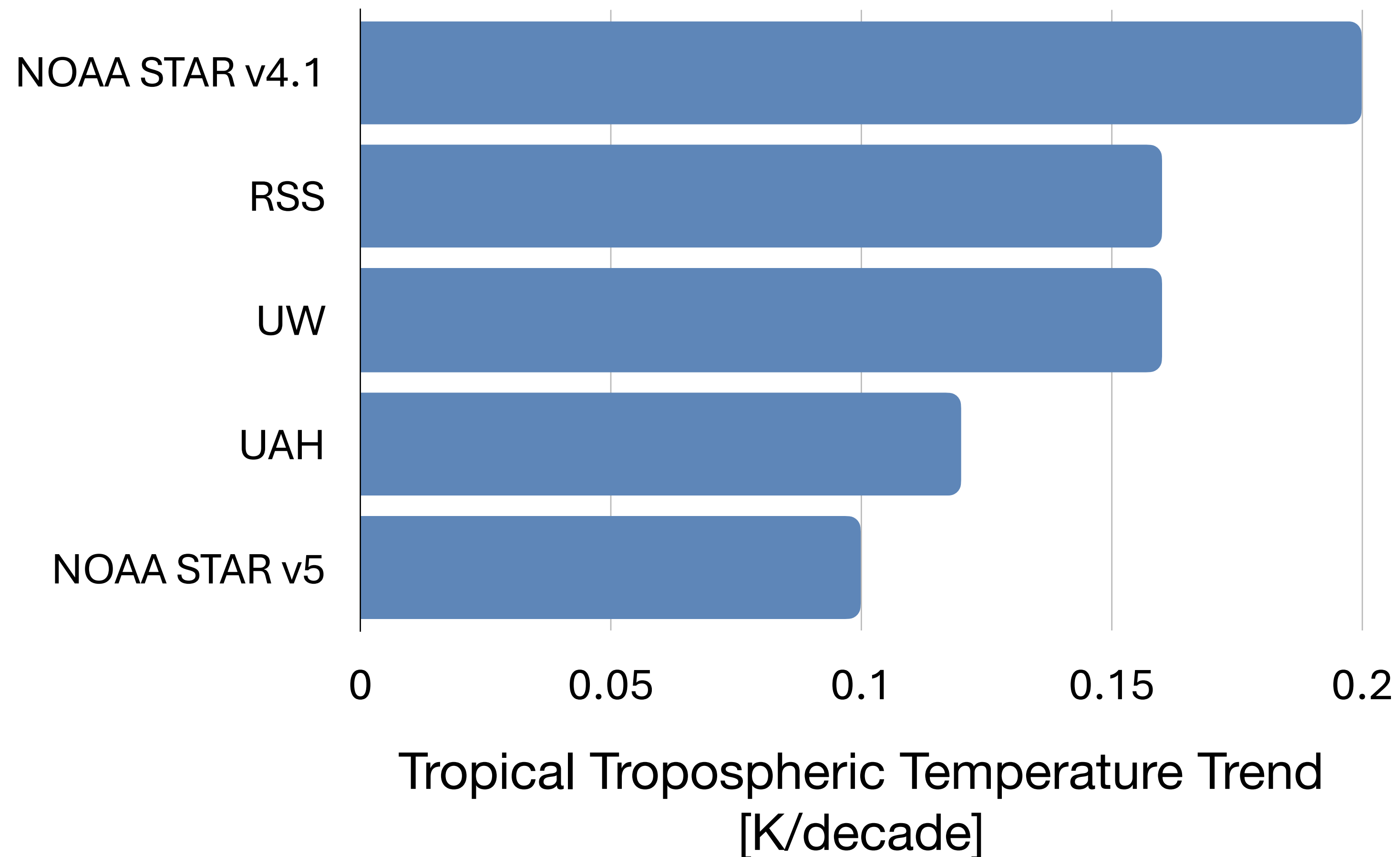
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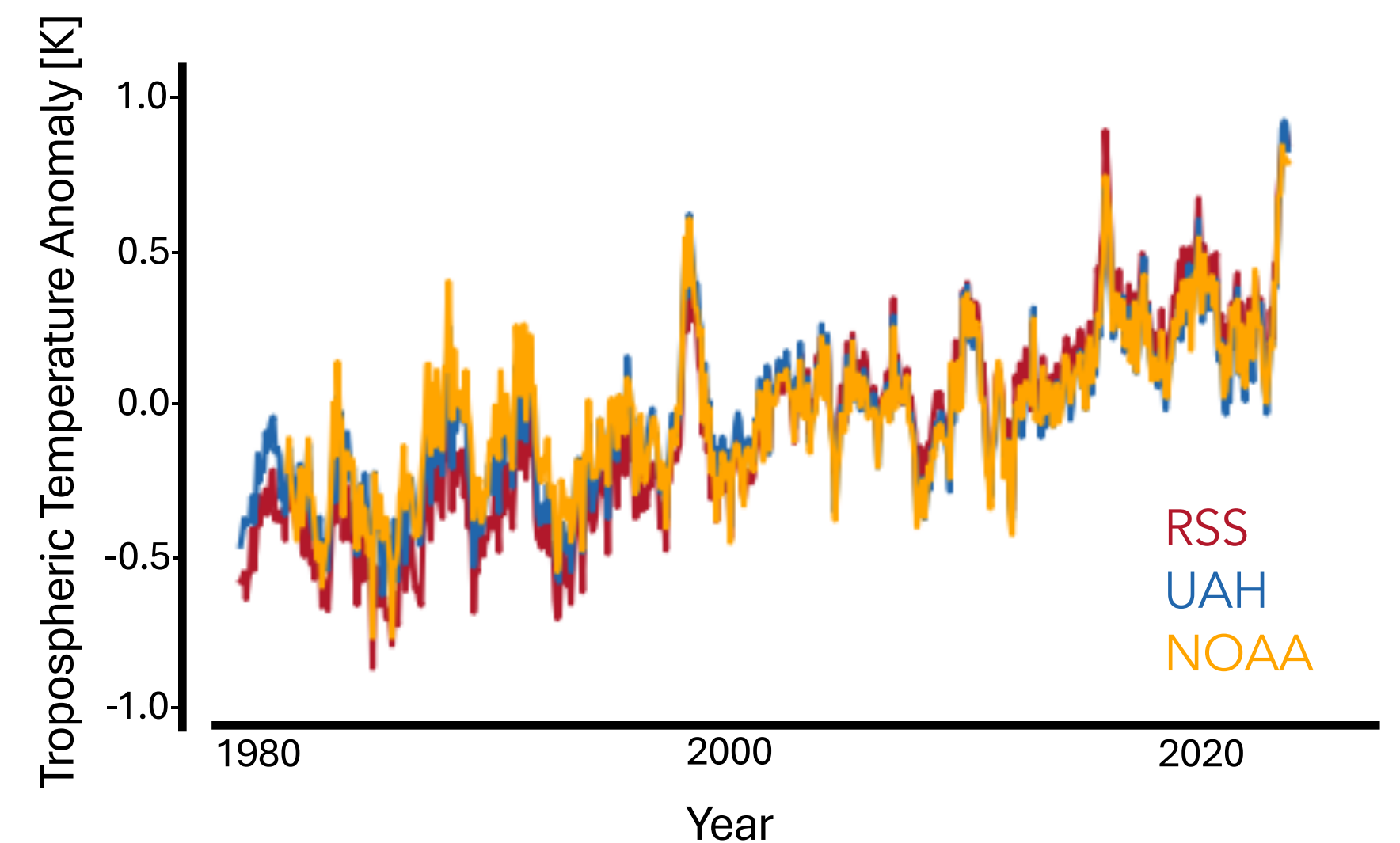
# Introduction

A persistent, controversial uncertainty

## Tropical Tropospheric Warming (1979 – 2022)

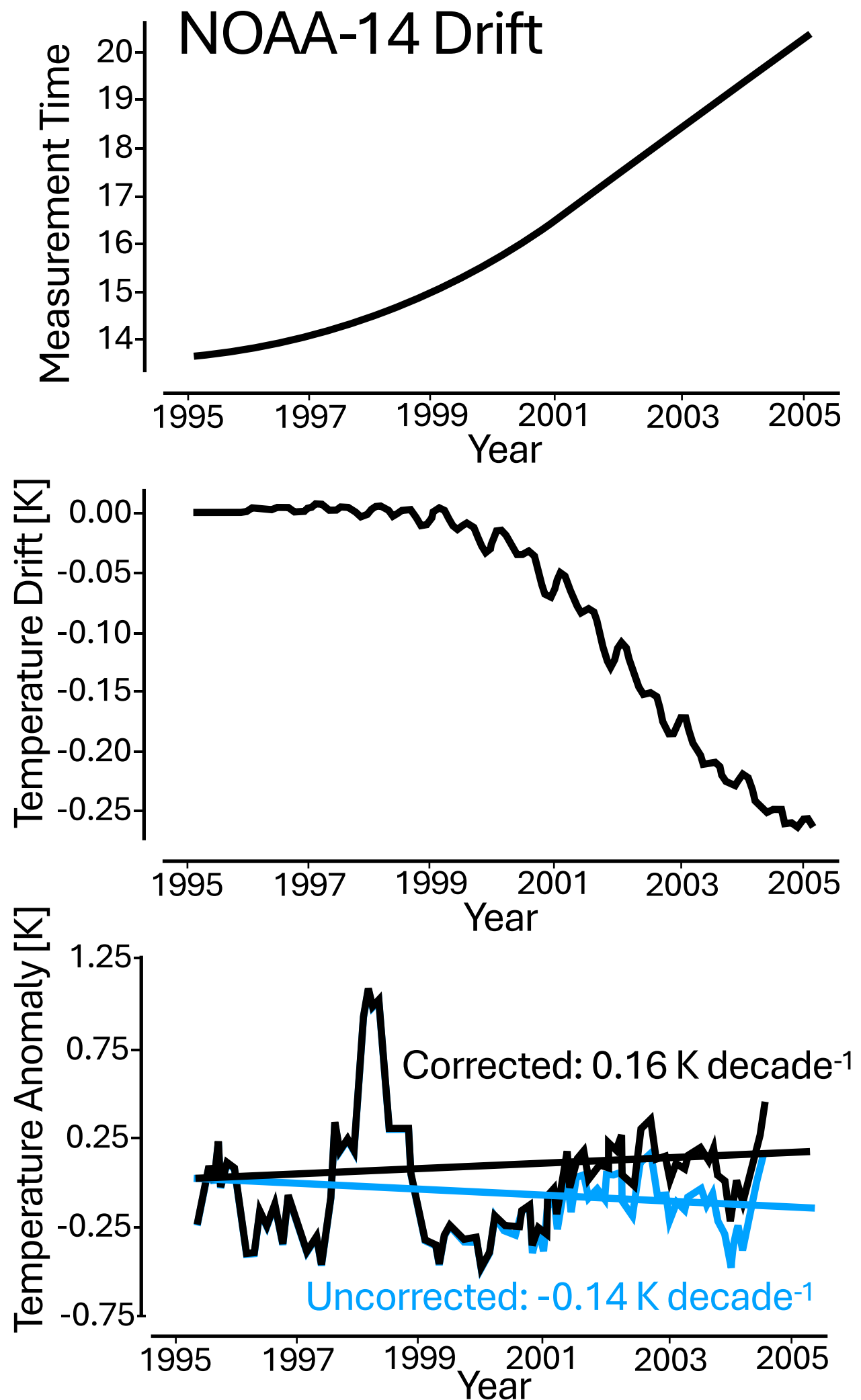
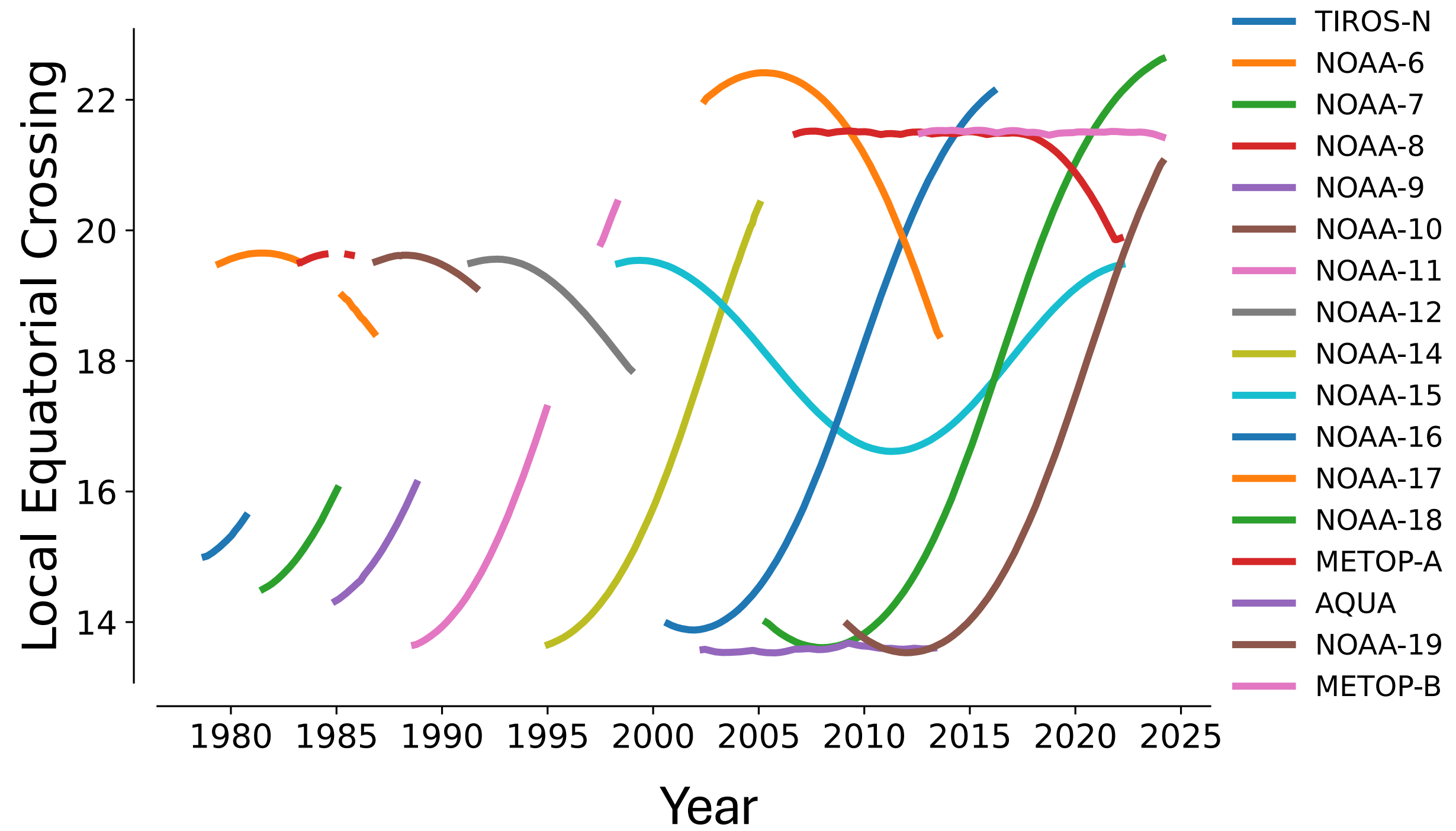


- Records are from the microwave sounding unit (MSU) and follow-on AMSU/ATMS instruments
- Observations show less warming than most climate model simulations



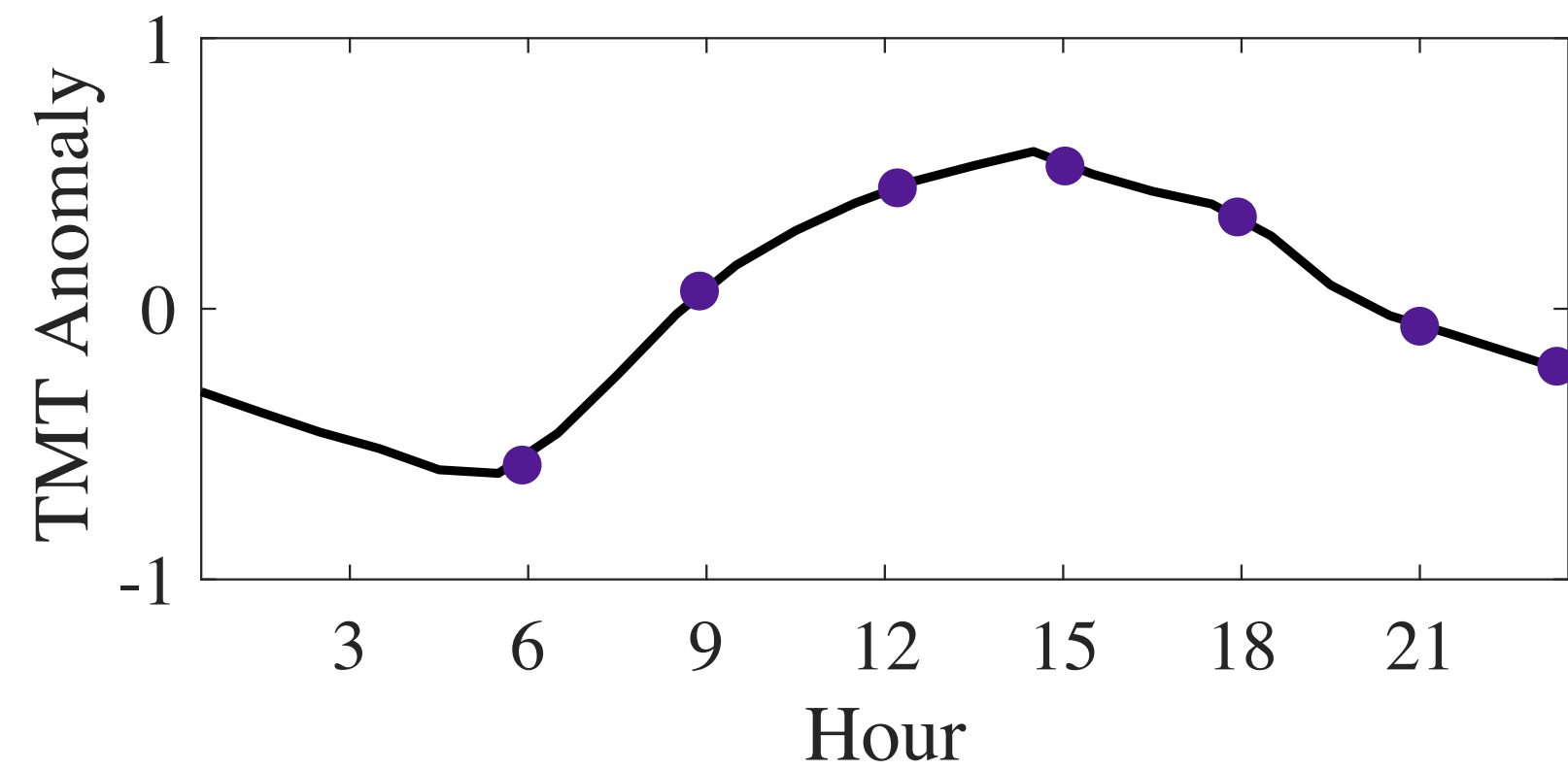
# Diurnal drift

A challenging bias

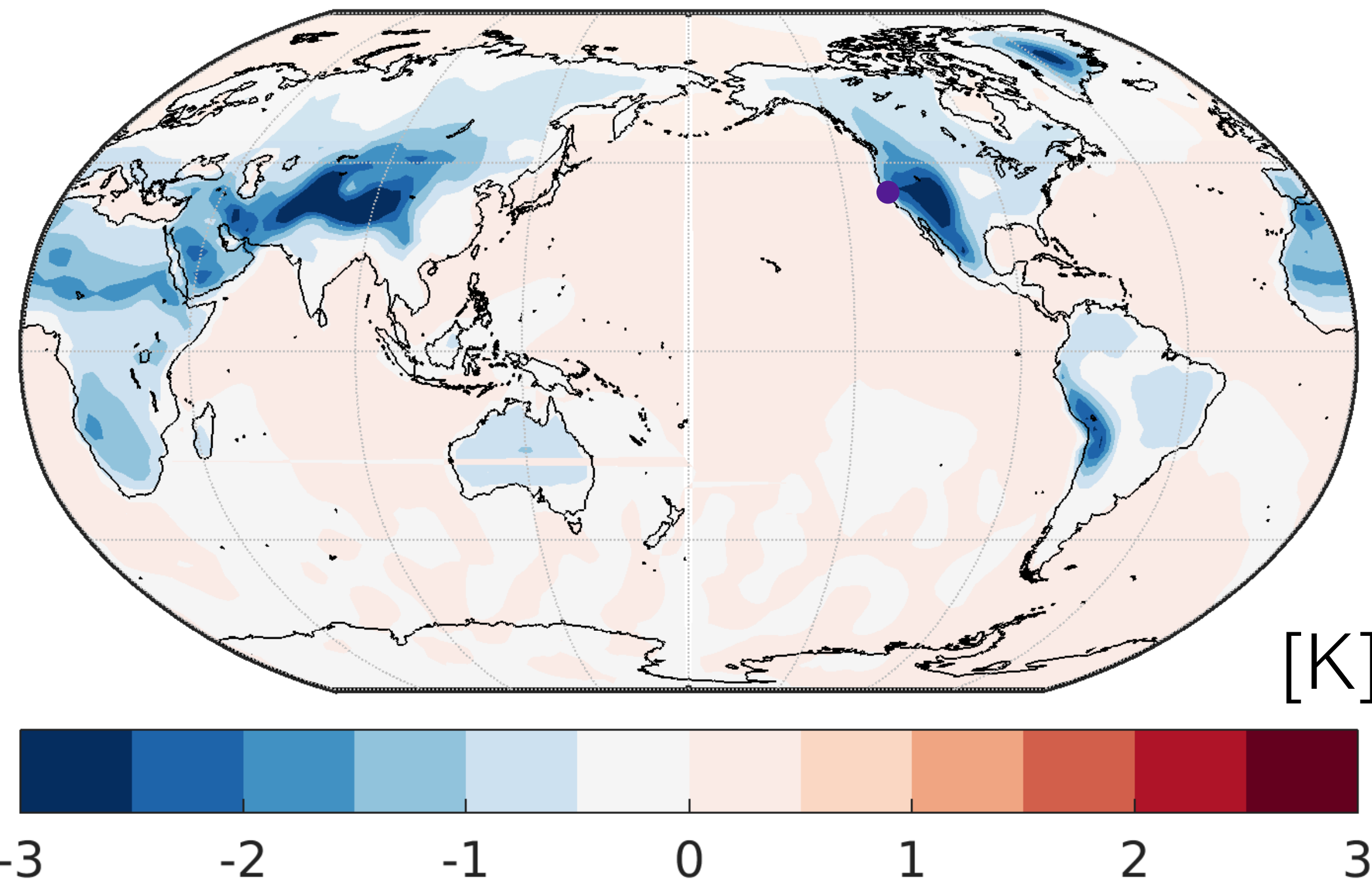


# Diurnal drift

Approach 1: Use a GCM Diurnal Cycle



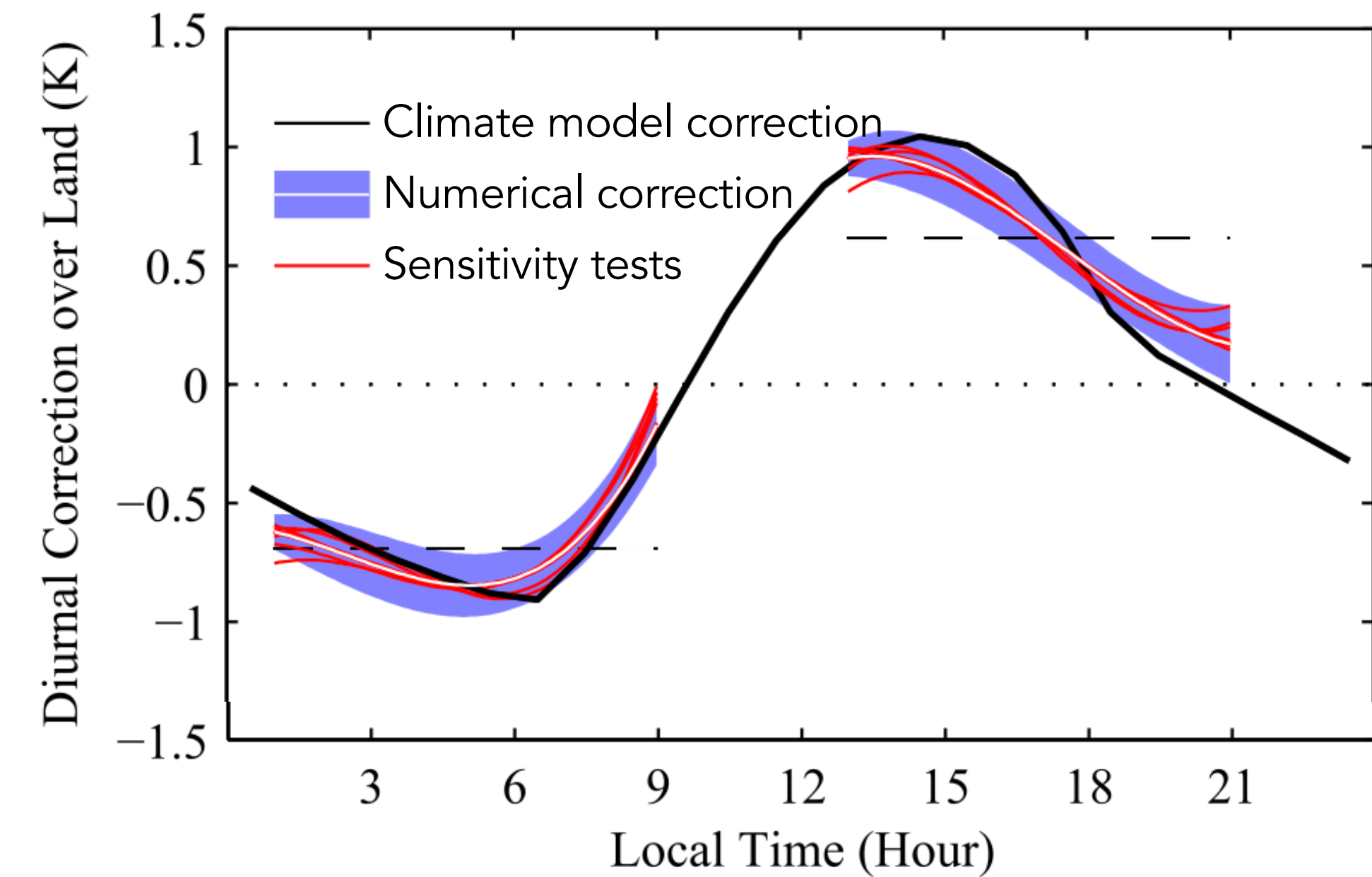
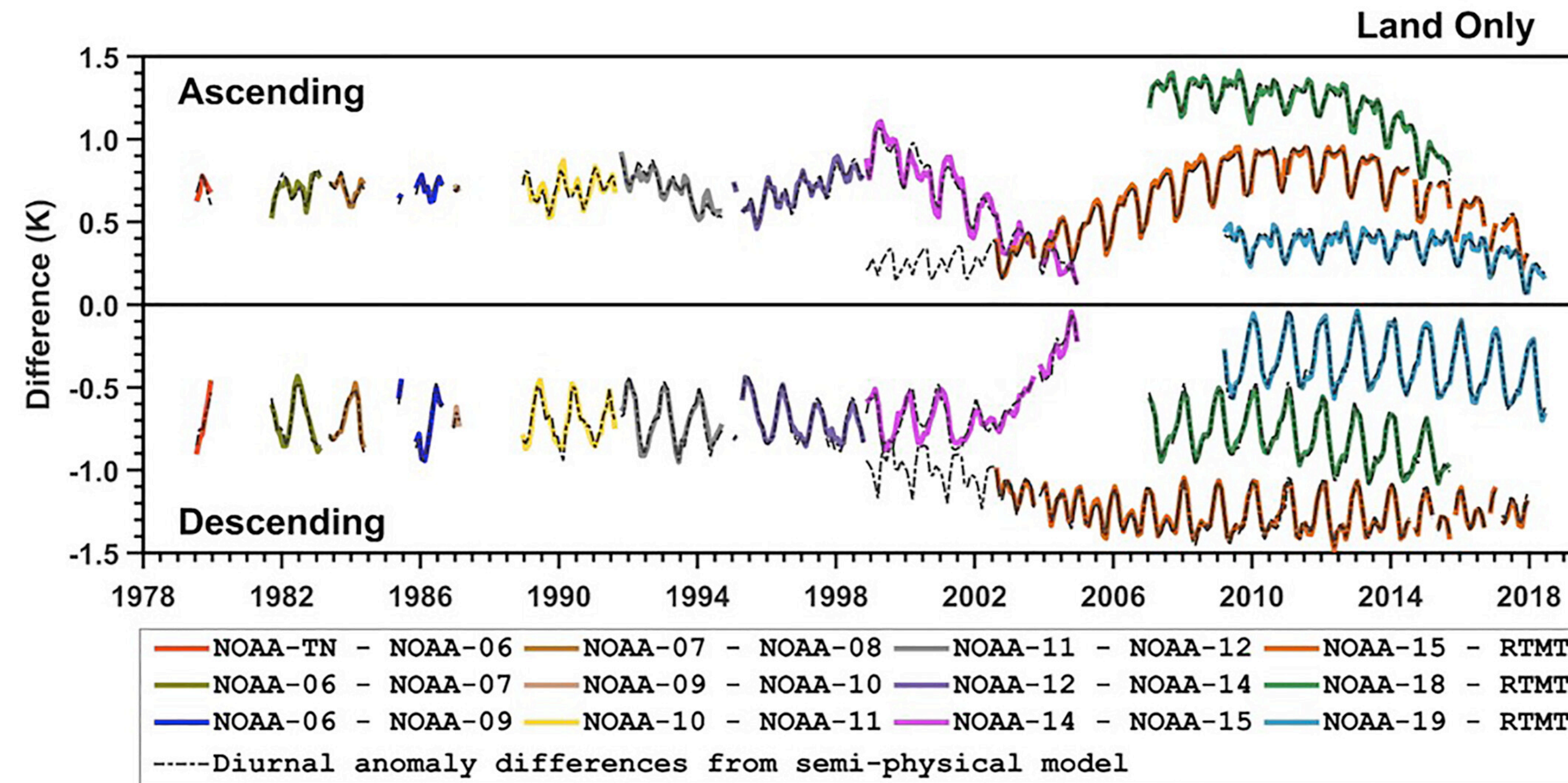
Global climate model (GCM)  
diurnal cycle.



TMT diurnal cycle anomalies (March monthly average).

# Diurnal drift

## Approach 2: Use a numerical model



# TROPICS to the rescue?

A perfect model approach

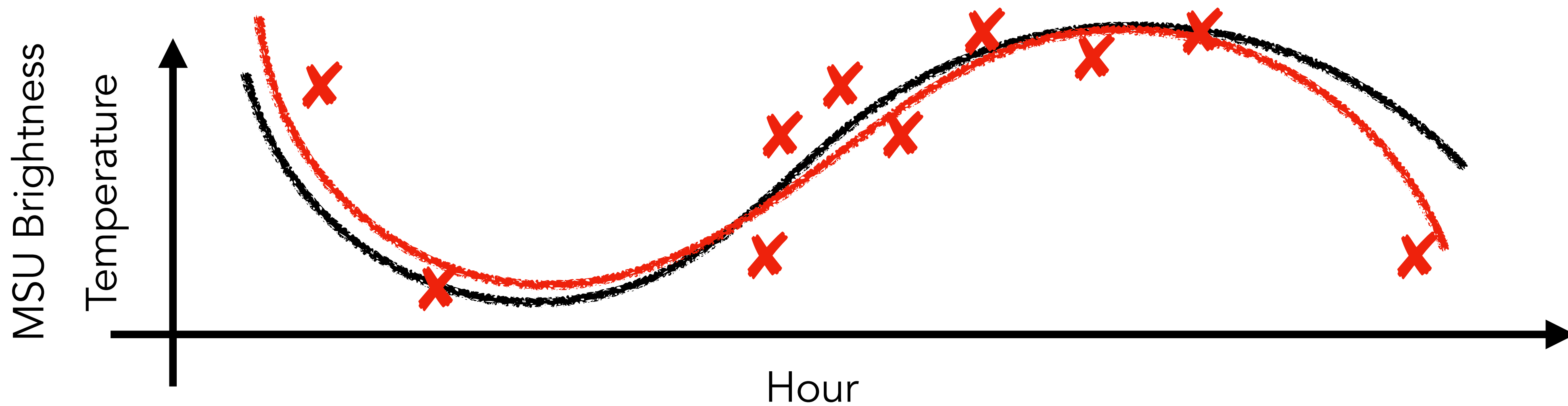
Use ERA5 as truth

Apply TROPICS sampling pattern

[Assume we can convert TROPICS brightness temperatures into MSU-equivalent]

Derive diurnal cycle from TROPICS sampling

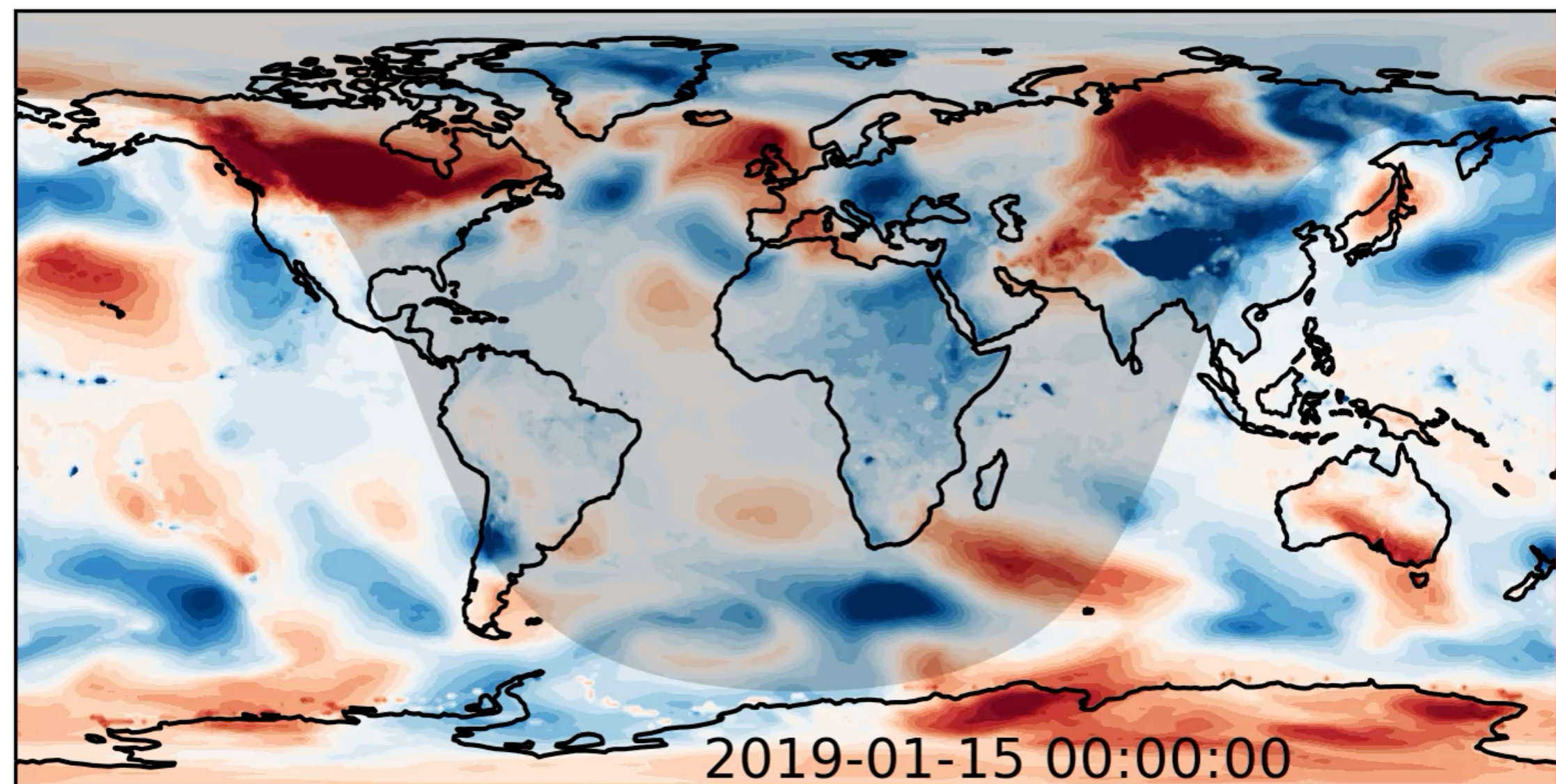
Compare to true diurnal cycle



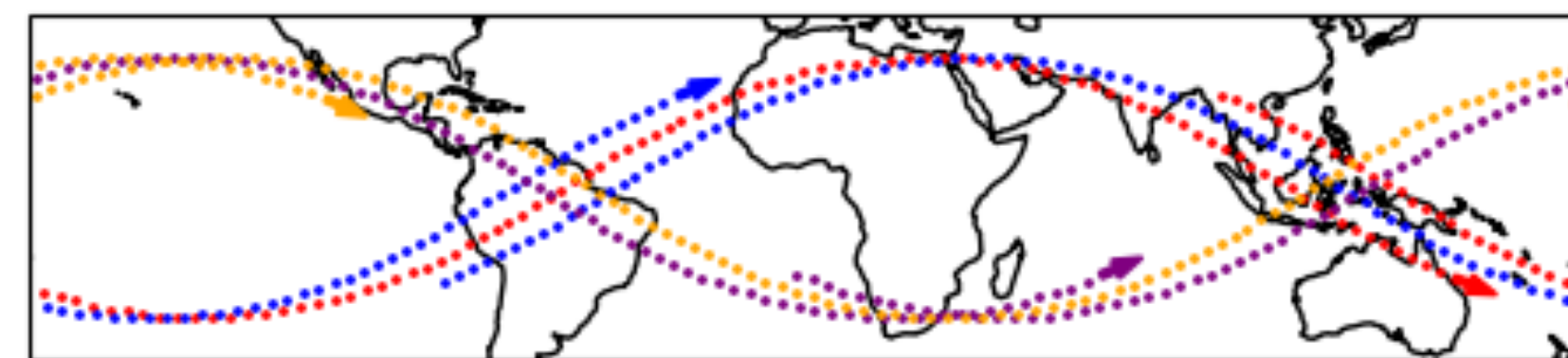
# TROPICS to the rescue?

A perfect model approach

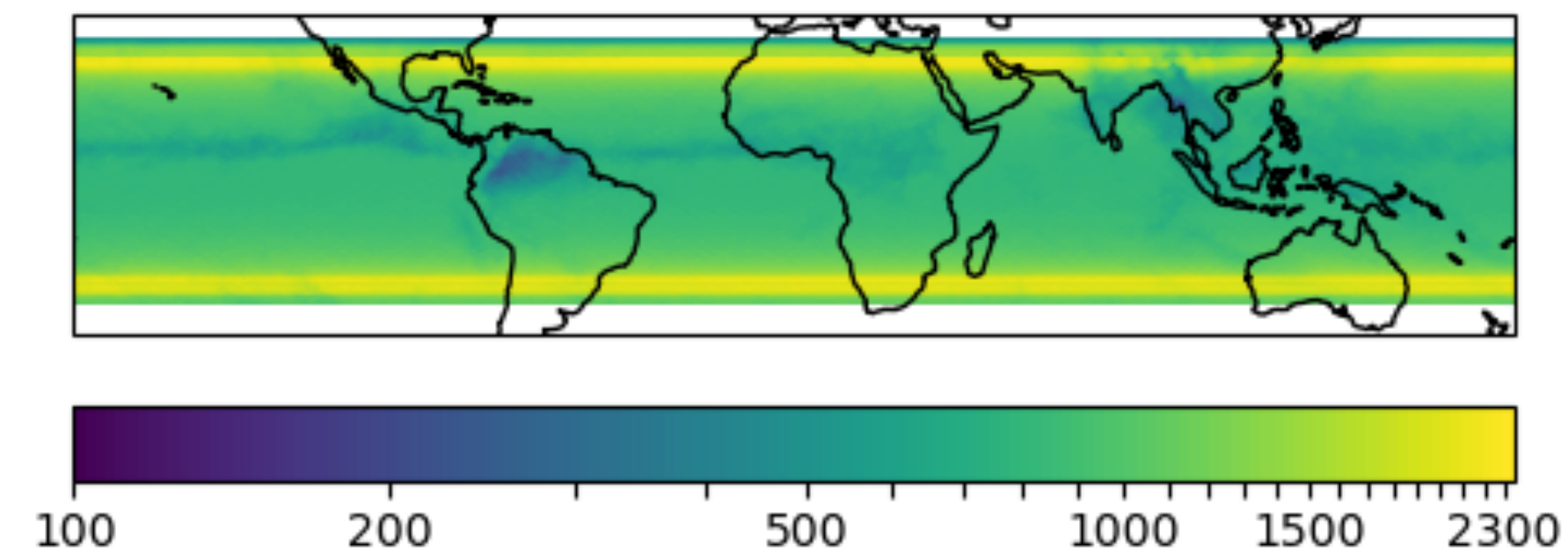
MSU Mid-tropospheric brightness temperature



A. Satellite Trajectories



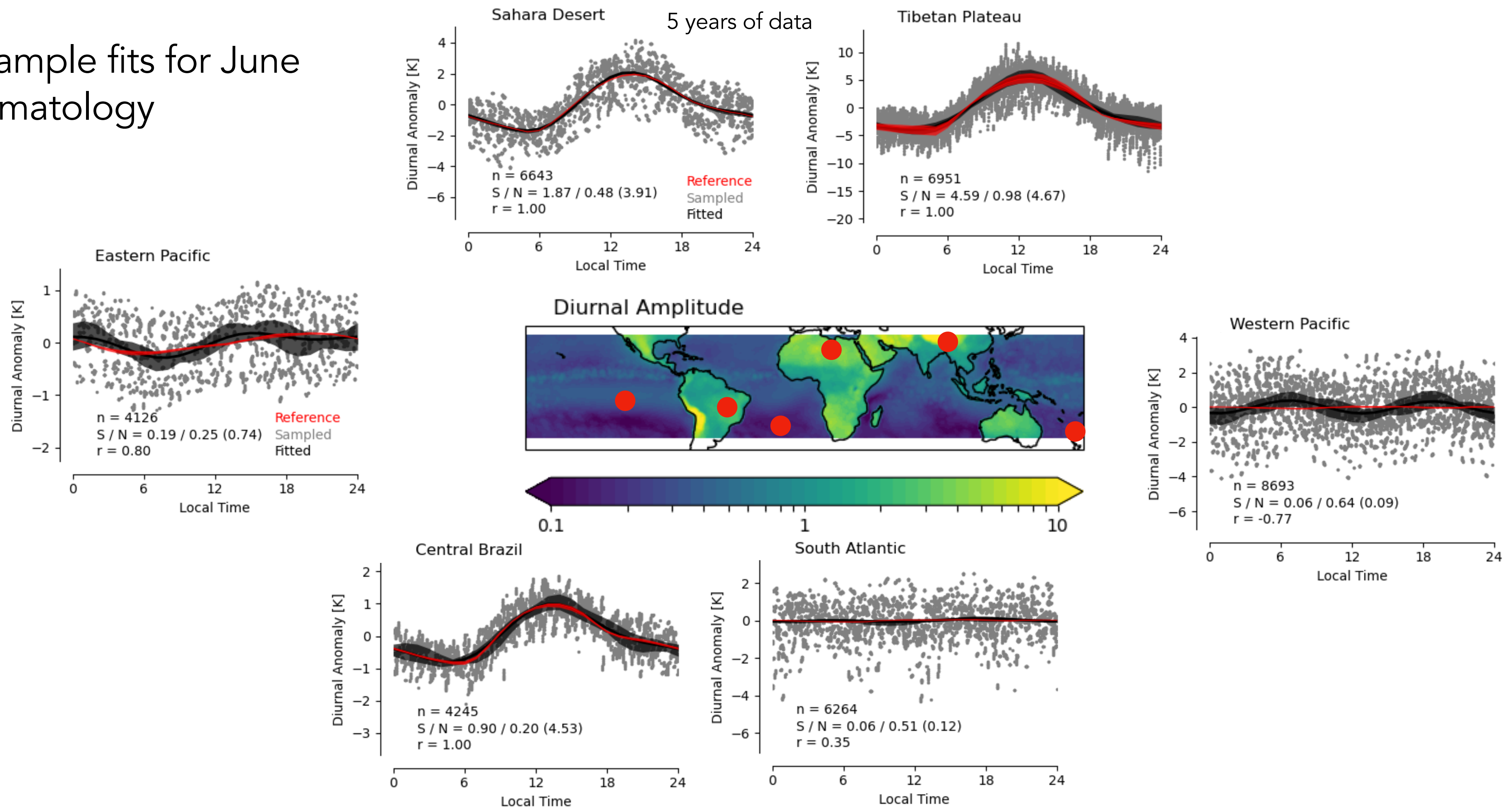
B. Monthly Sample Count



# TROPICS to the rescue?

## A perfect model approach

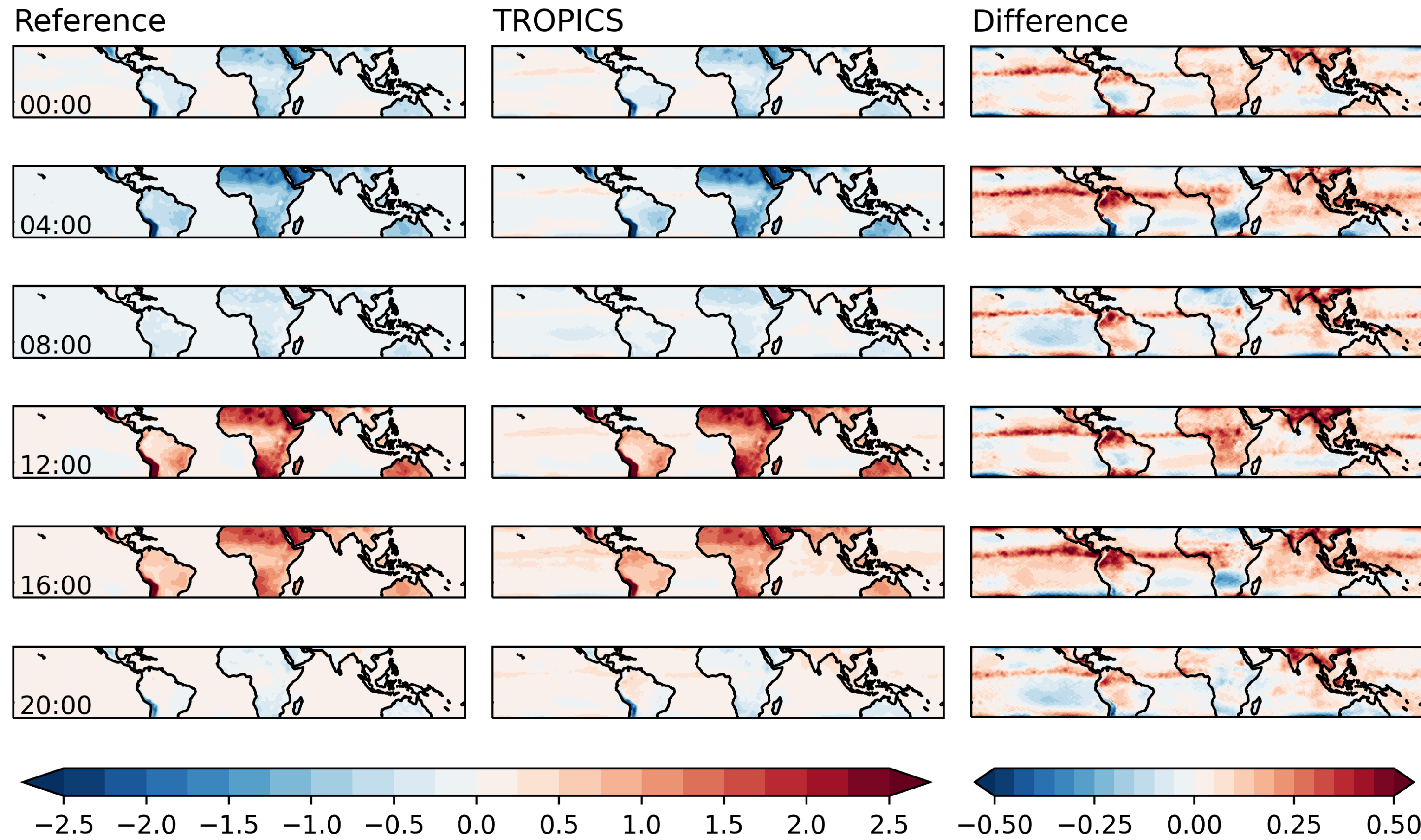
### Example fits for June Climatology





# TROPICS to the rescue?

## A perfect model approach

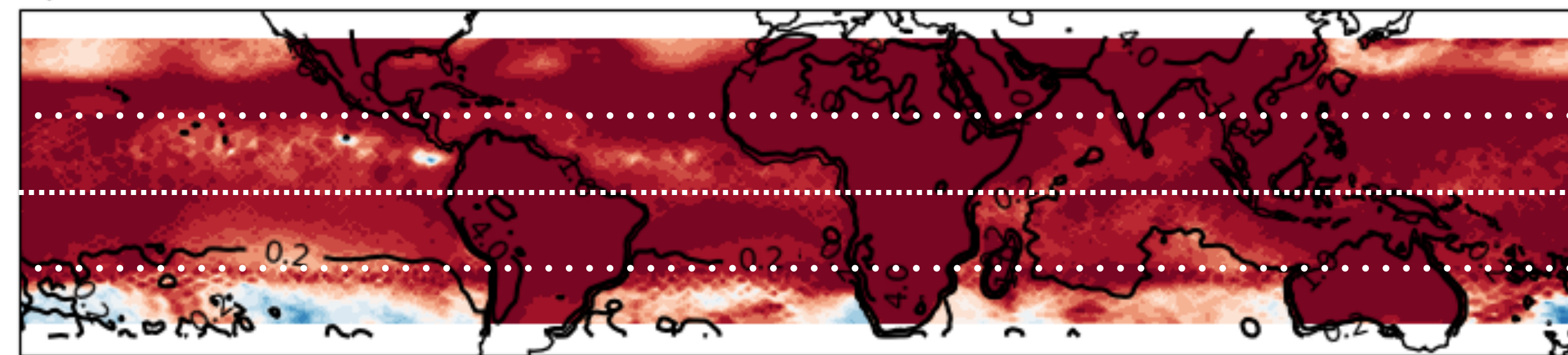


- TROPICS appears capable of capturing the dominant diurnal features
- Noticeable biases over the ITCZ, subtropics, and some land areas

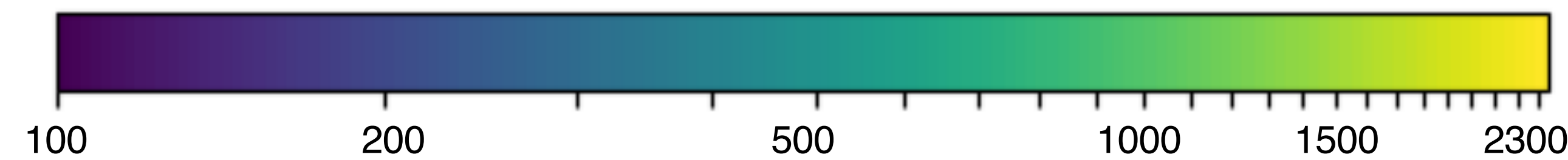
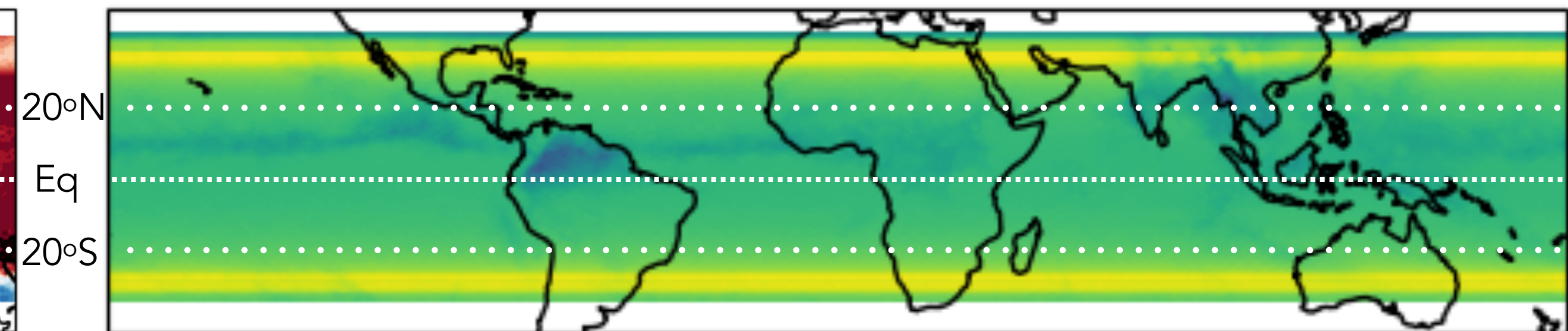
# TROPICS to the rescue?

A perfect model approach

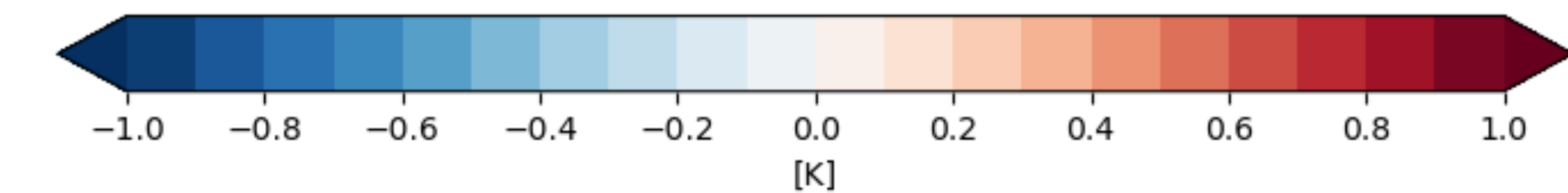
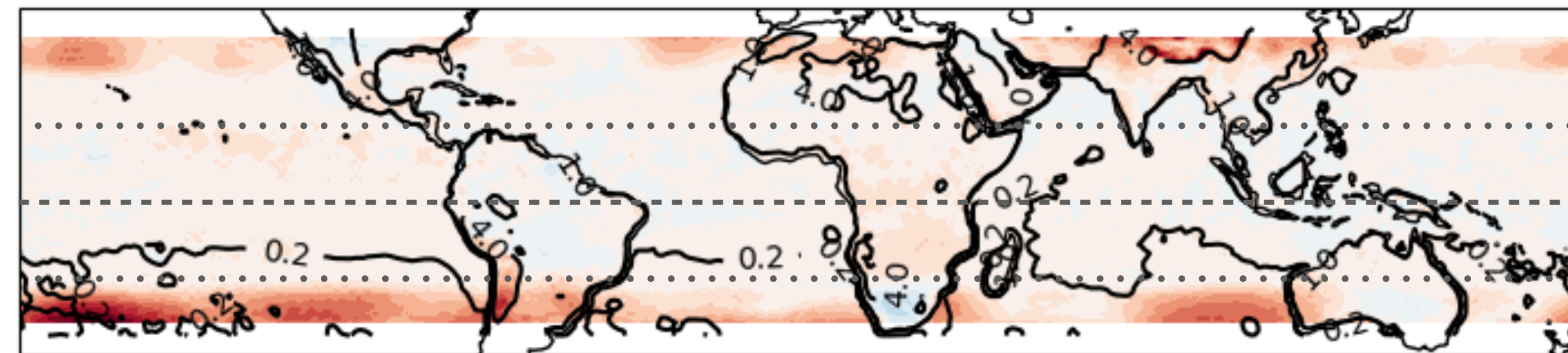
A) Correlation



C) Monthly Sample Count



B) Amplitude Bias



# Summary & Next Steps

## Summary

- The TROPICS constellation adequately samples the tropospheric diurnal cycle over land
- Skill is generally good over the *deep* tropical oceans, except in rainy regions

## Next Steps

- Develop solutions in regions of poor performance (subtropics / rainy regions)
- Perform a perfect model study simulating diurnal drift and different correction approaches
- Investigate impact of year-to-year variability in diurnal cycle