

Analysis of spatial and temporal characteristic scales using GOES-16 Land Surface Temperature

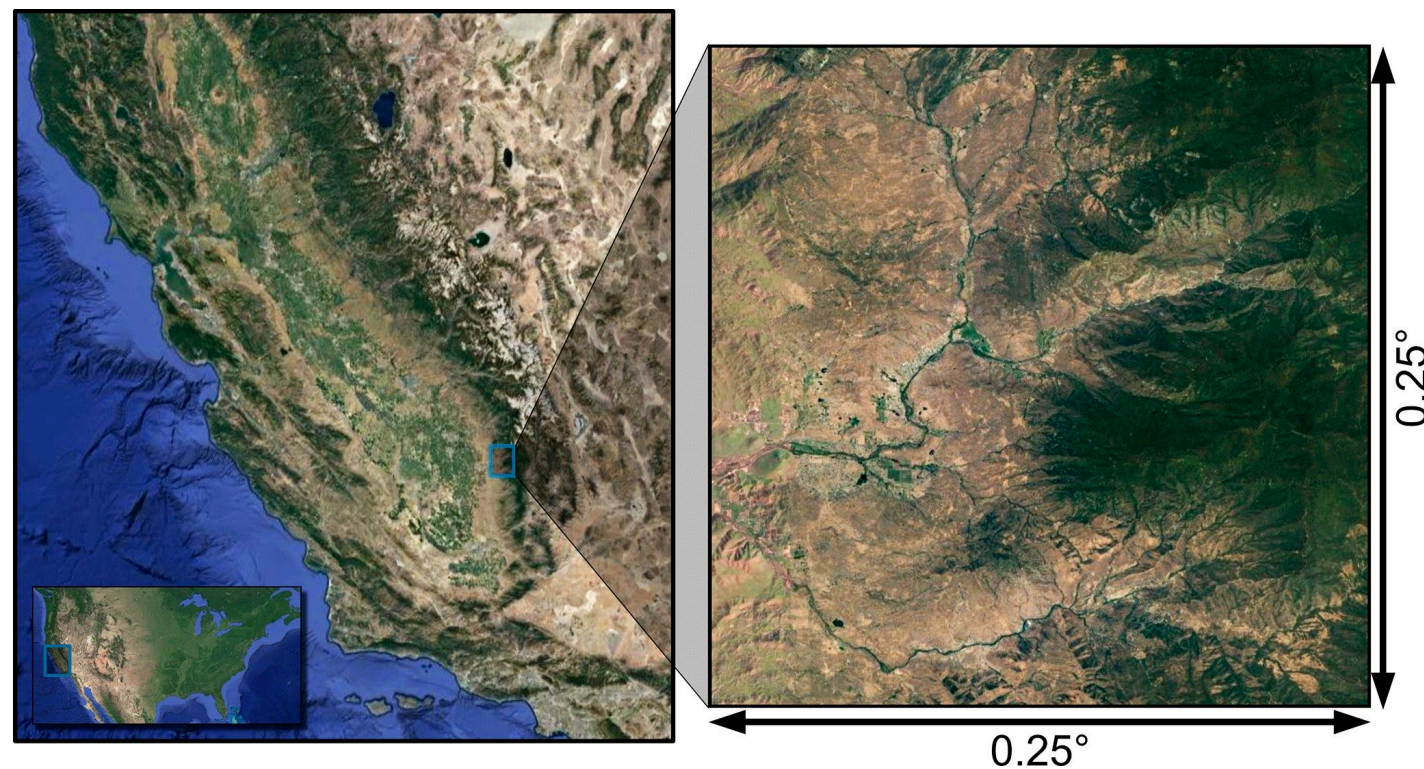
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Jiaxuan Cai, Nathaniel Chaney

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Motivation

- Land models (LM) aim to model the multi-scale spatial heterogeneity of water and energy cycles: **Land-atmospheric coupling.**
- Need to **evaluate how well models capture heterogeneity using satellite remote sensing.**
- Land surface temperature (LST) is a good candidate.

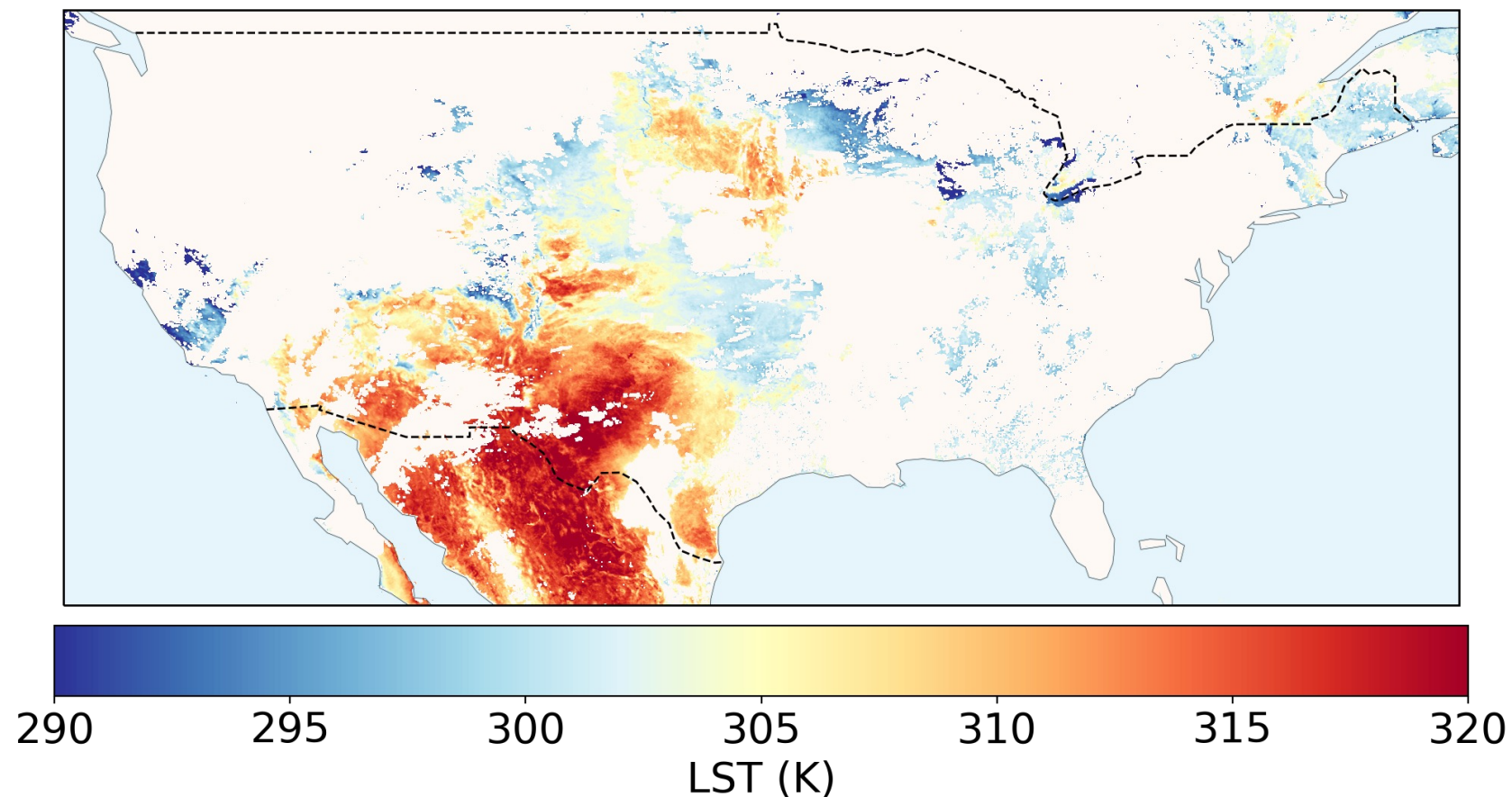


[Chaney, 2018](#)

GOES-R

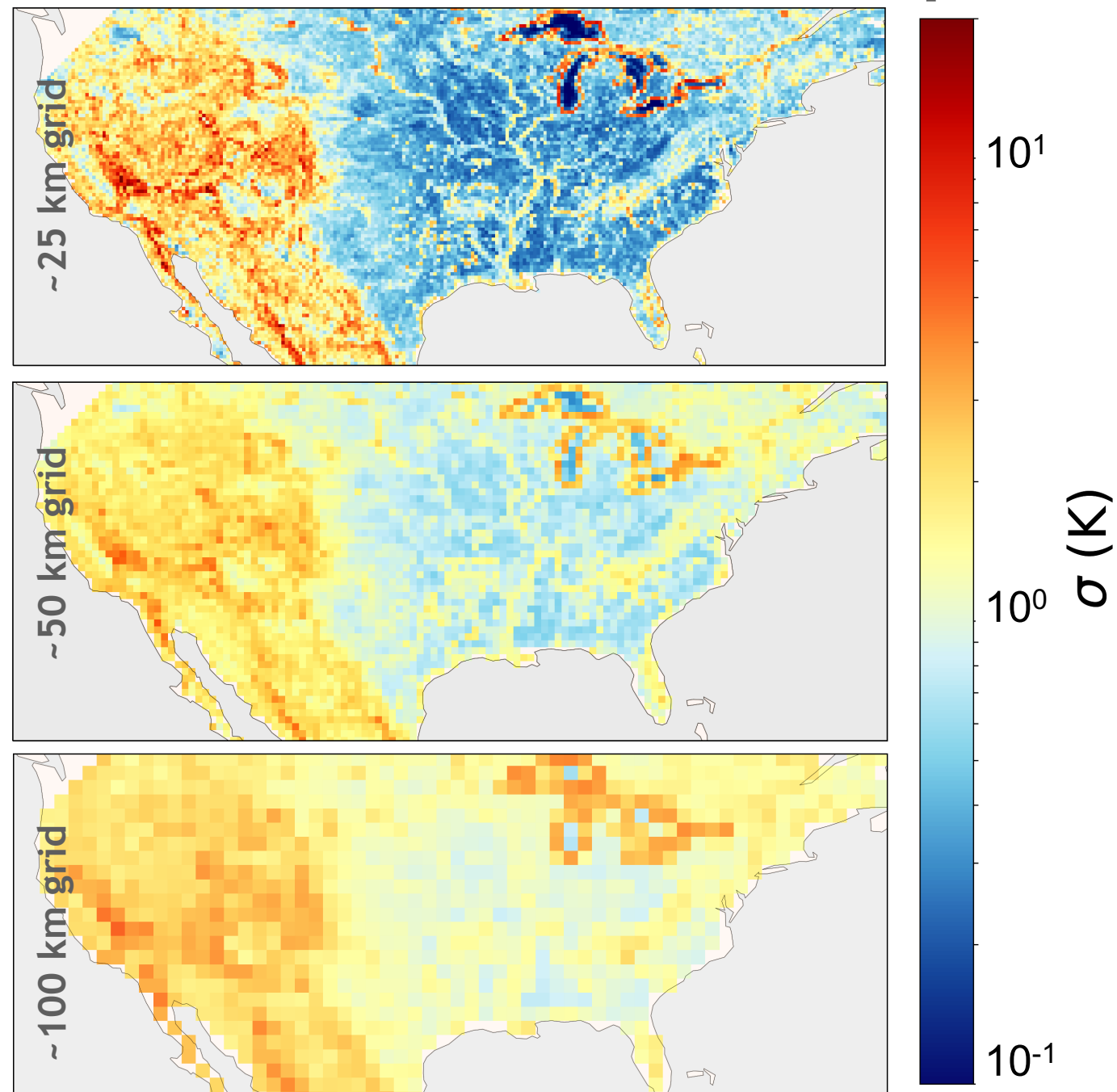
- NOAA's Geostationary Operational Environmental Satellites.
- Spatial coverage: Full disk (FD) and **CONUS**
- Time coverage: 2017-05 - present
- Resolution:
 - Time: **1 hr**
 - Space: ~5km (FD), ~2km (CONUS)

2018-05-31 16:00:00 UTC



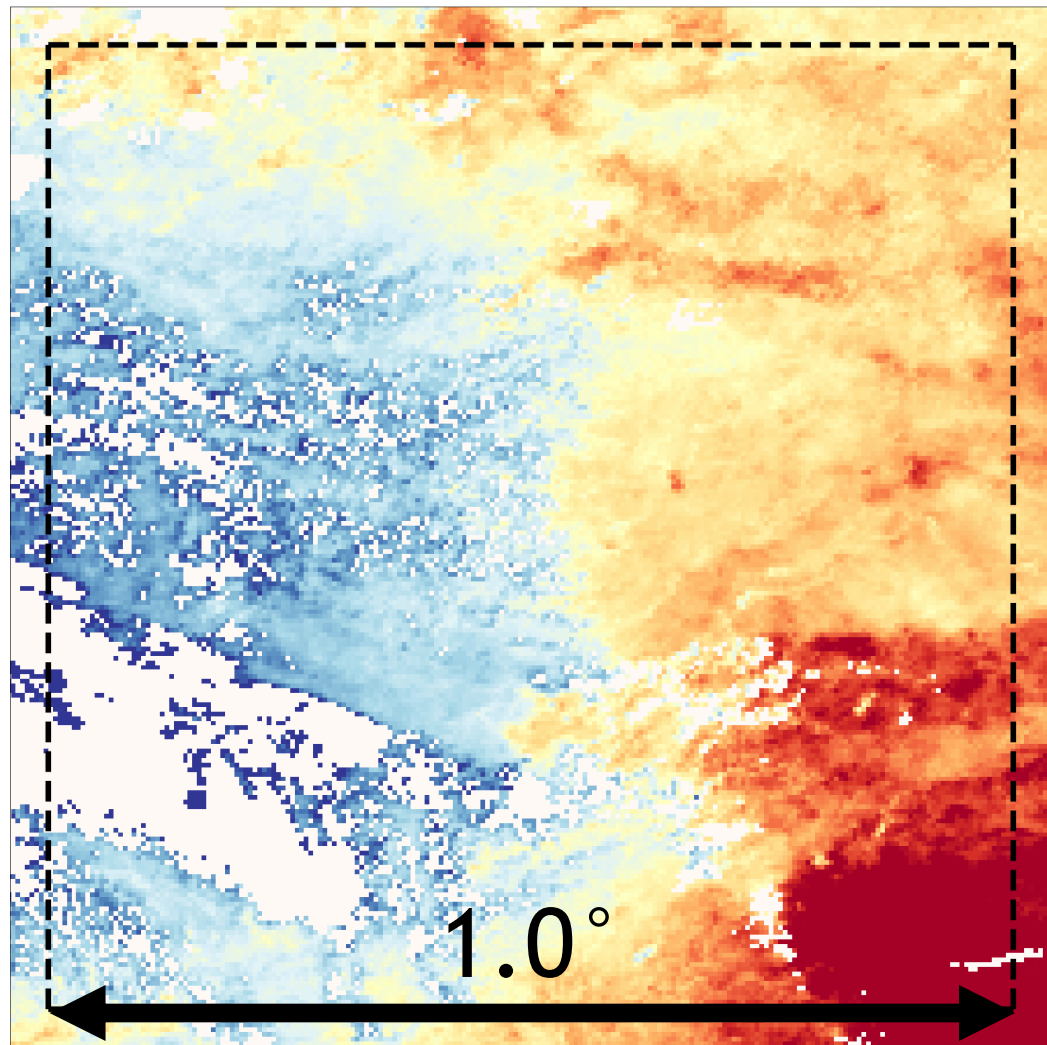
How to make the most of the data?

Summary statistics maps

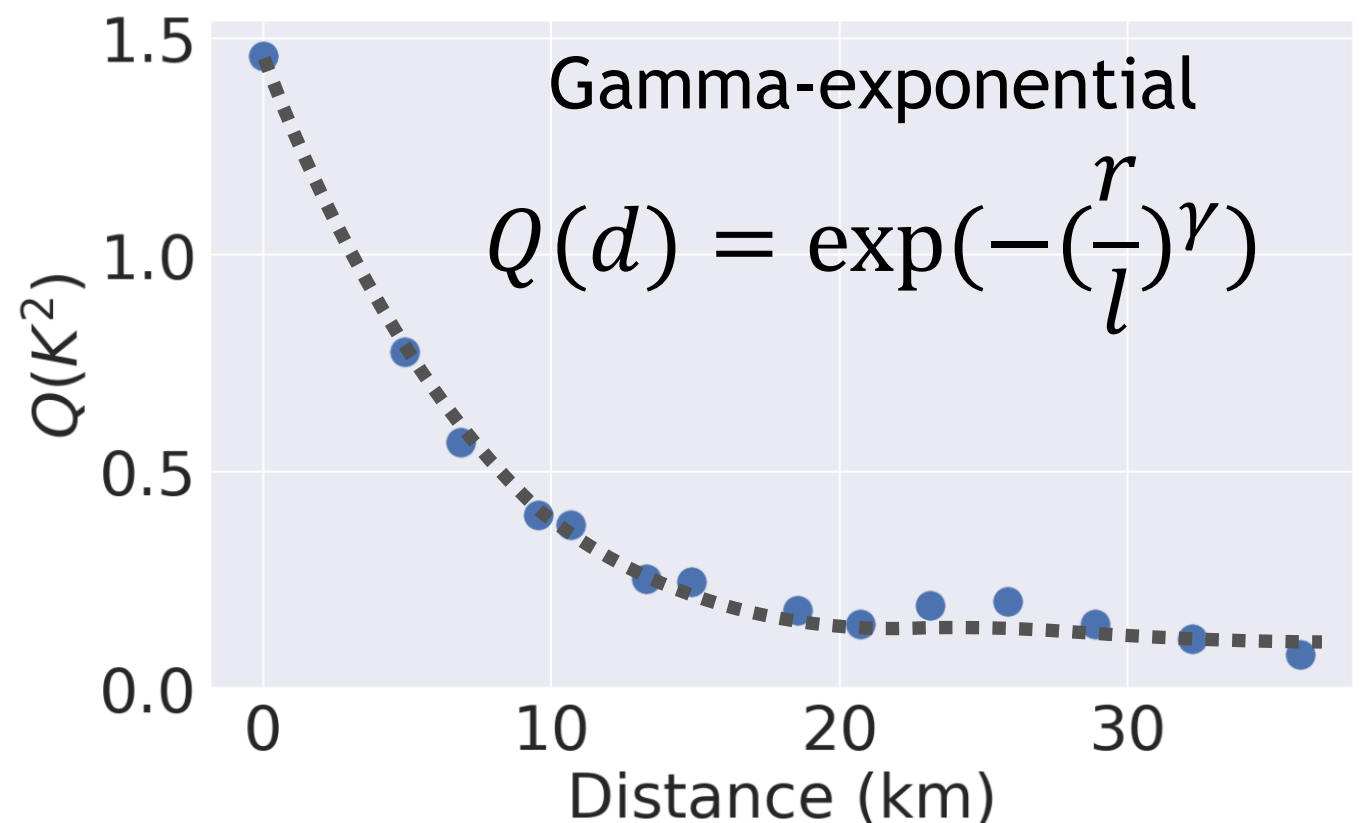


What statistics?

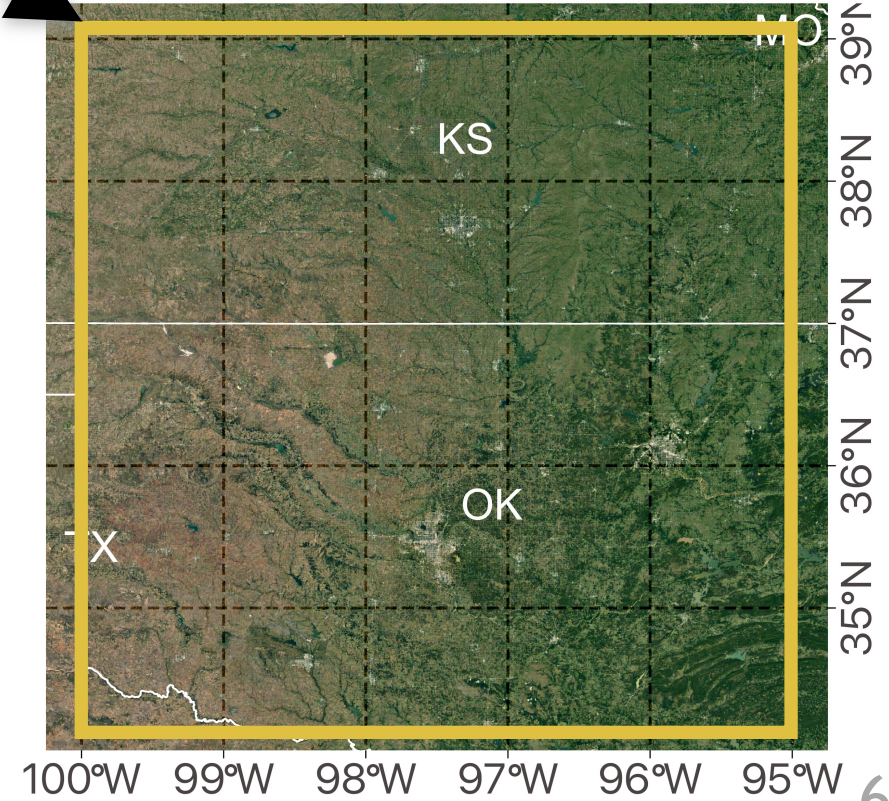
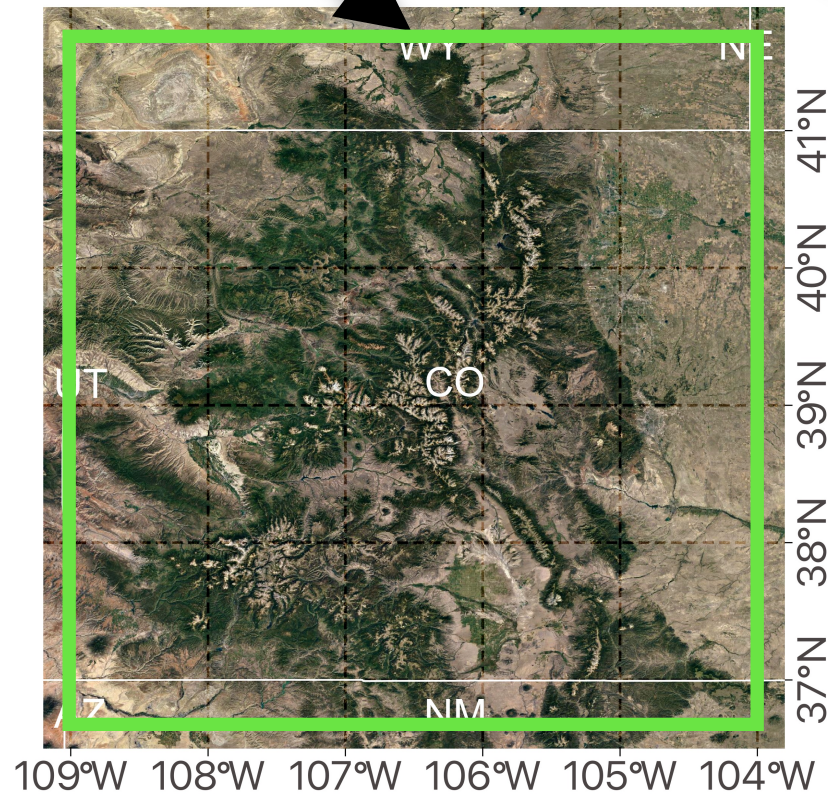
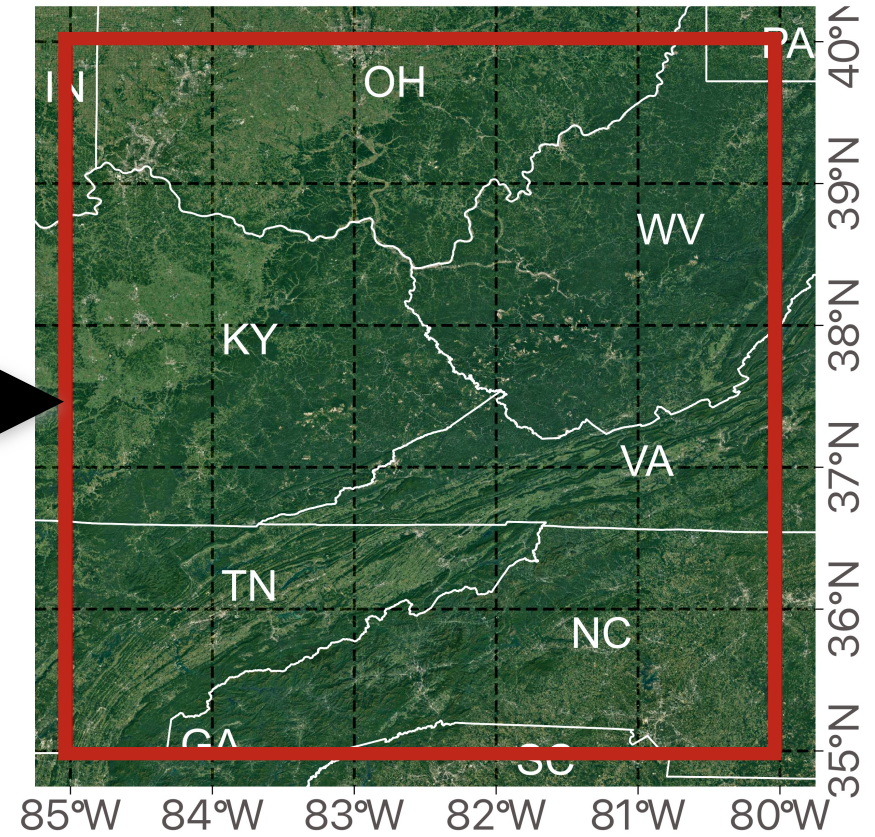
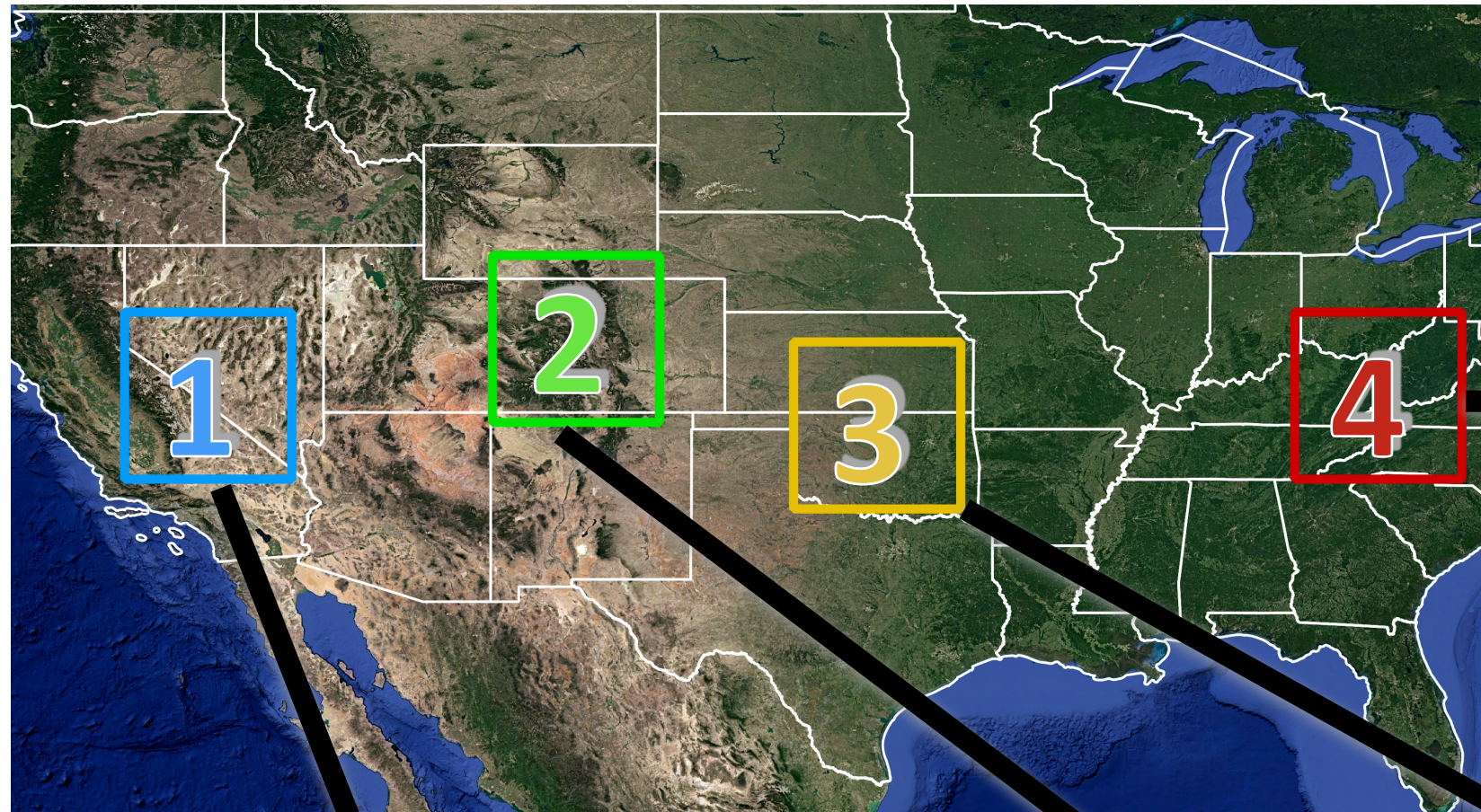
2018-05-31 16:00:00 CDT



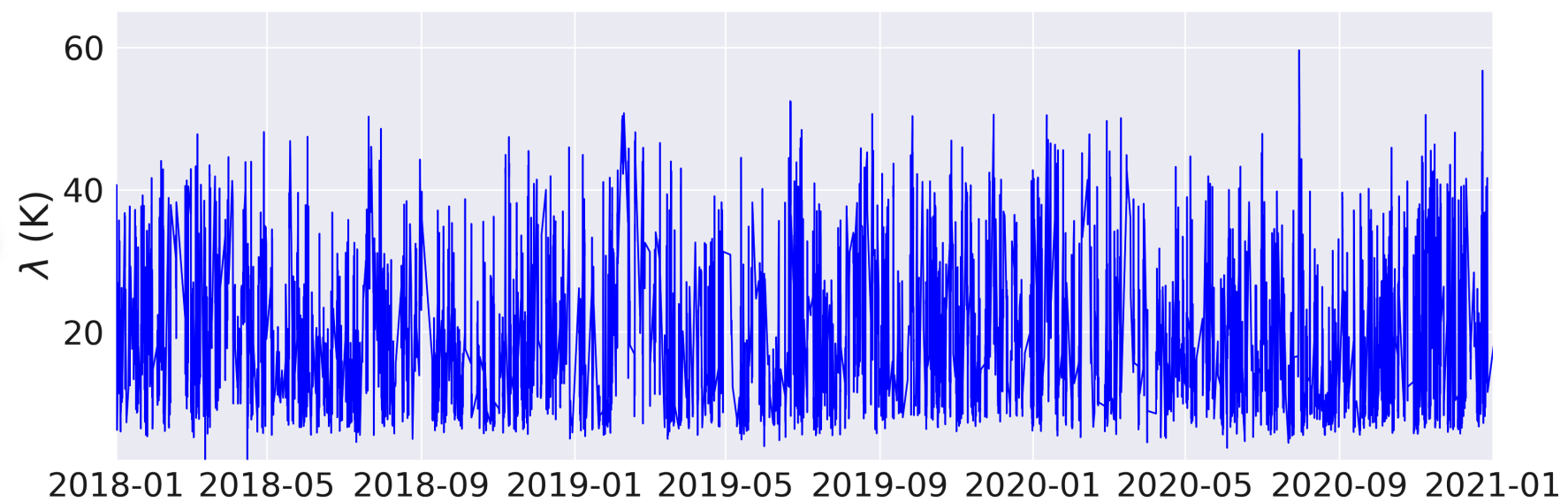
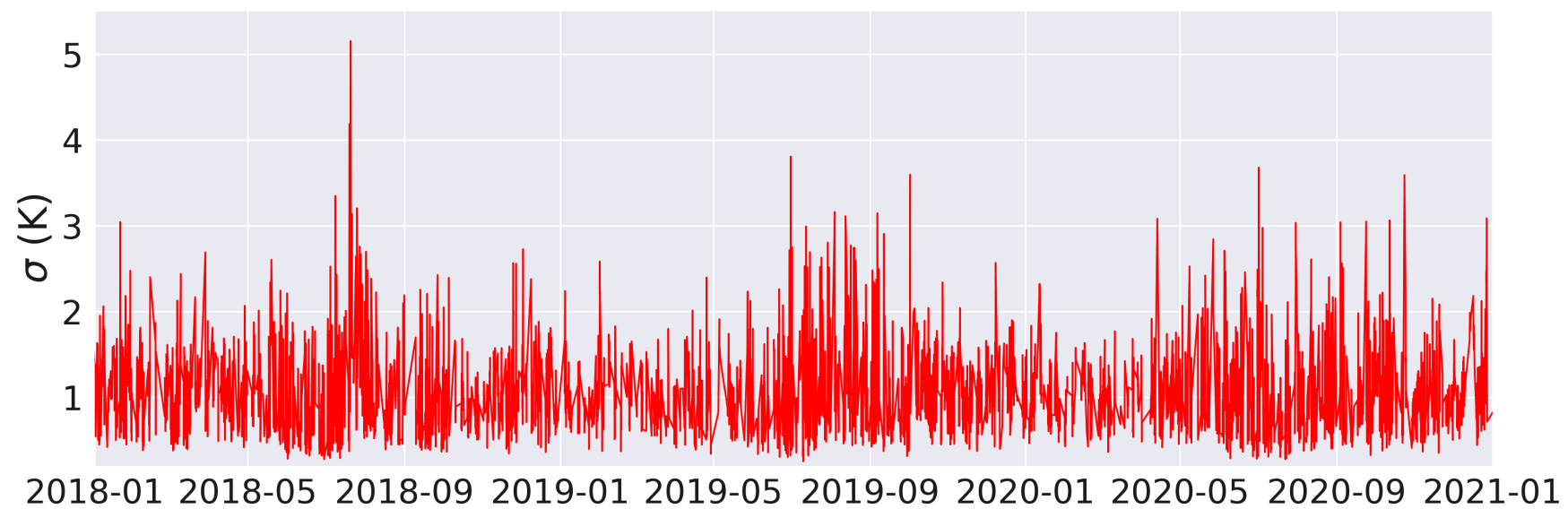
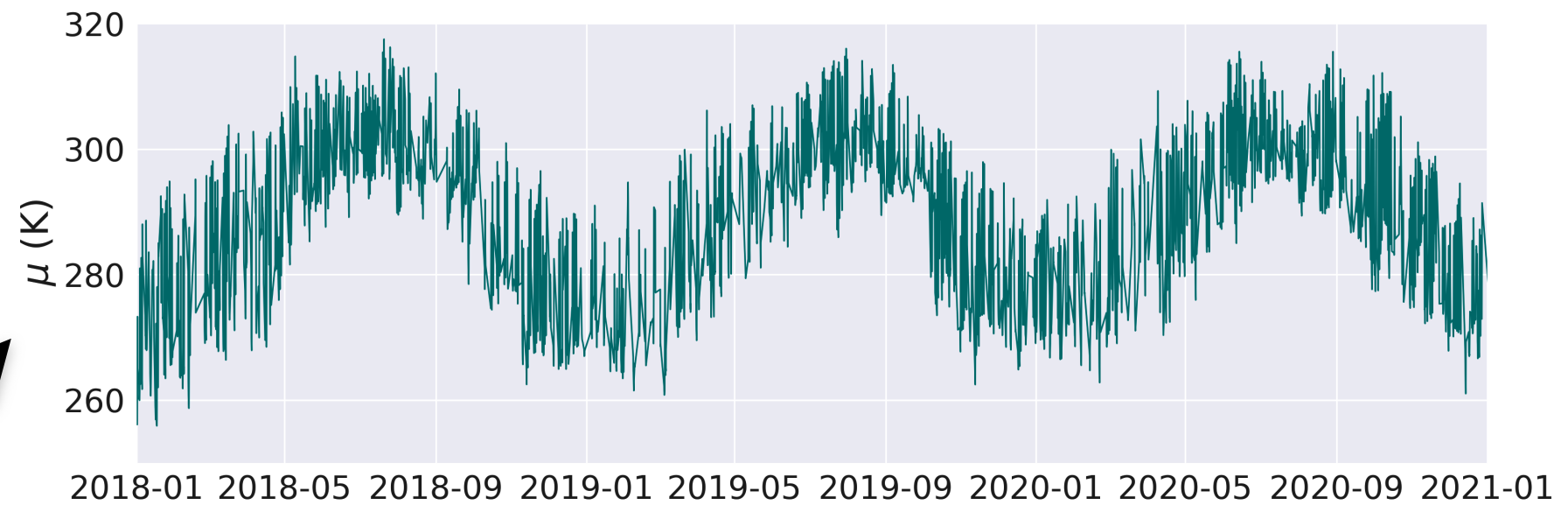
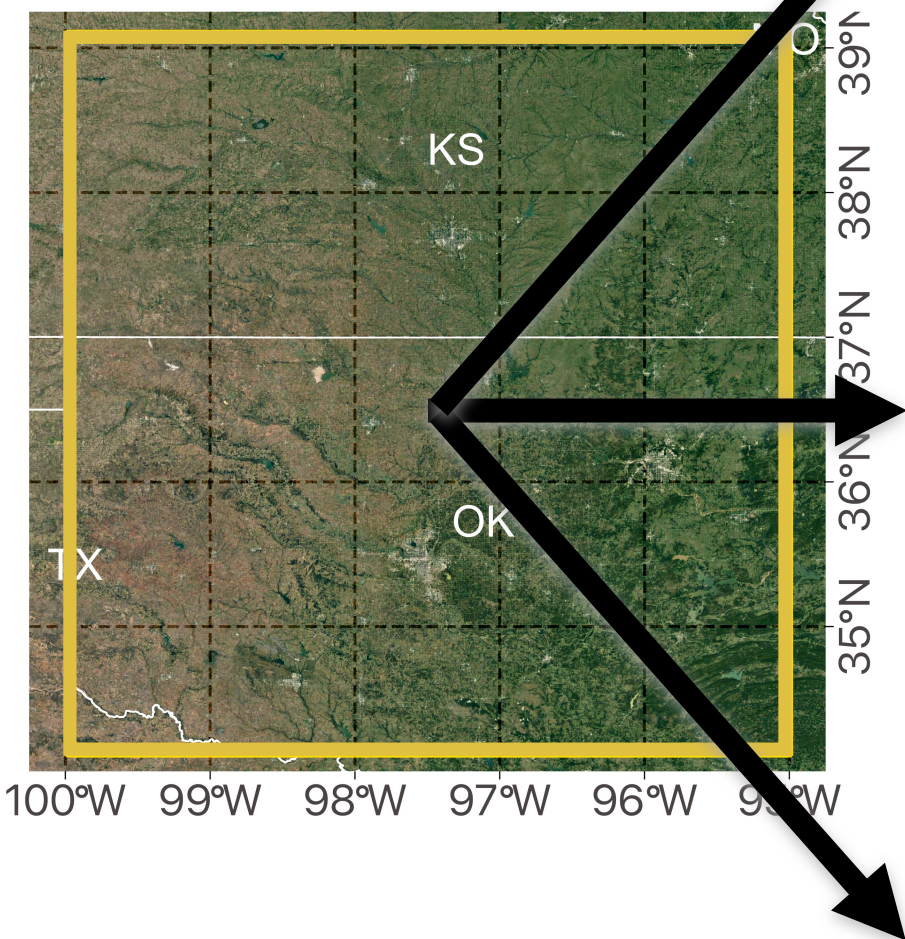
- A. Spatial mean.
- B. Spatial standard deviation
(~range/difference of LST among patches).
- C. Spatial correlation length (~size of LST patches).



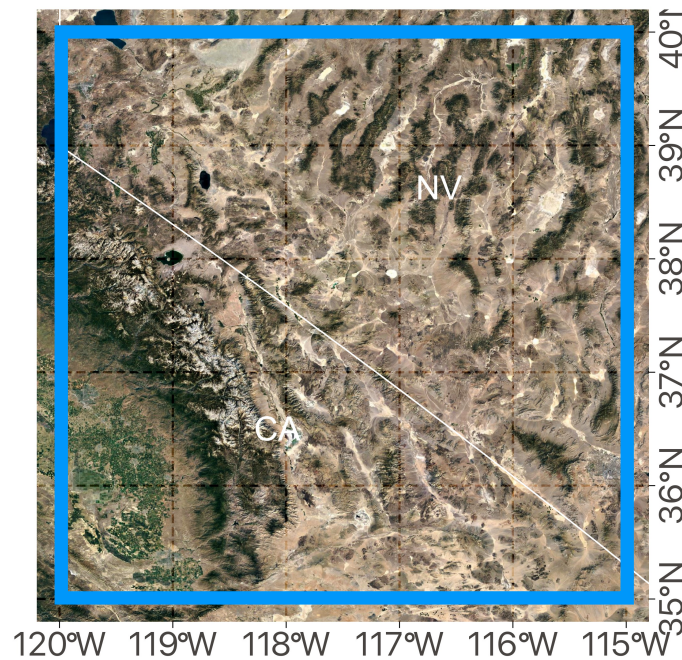
Study areas: 500km domains



Time series of stats

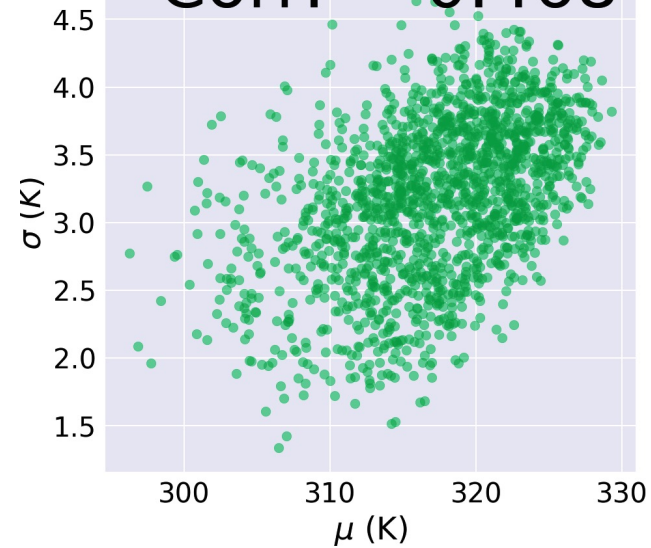


Correlation between stats



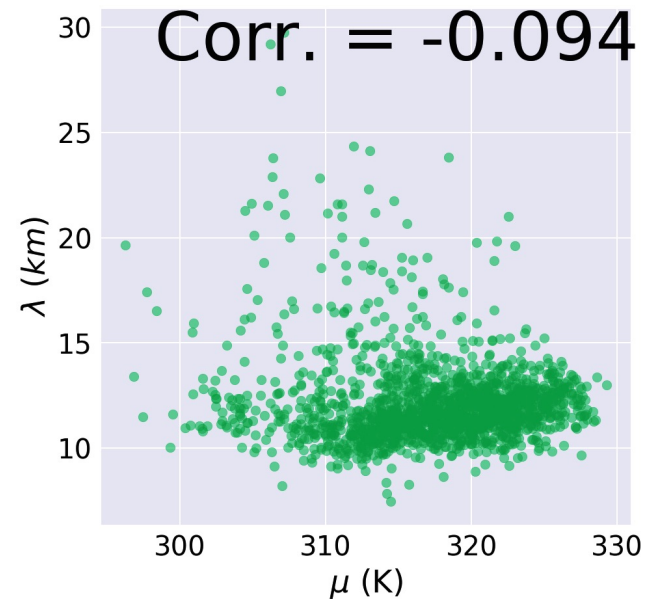
σ vs. μ

Corr. = 0.468



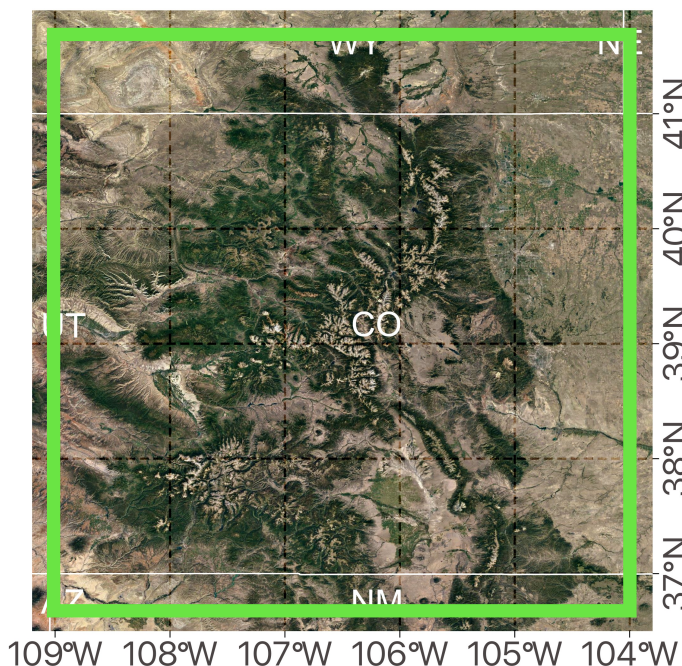
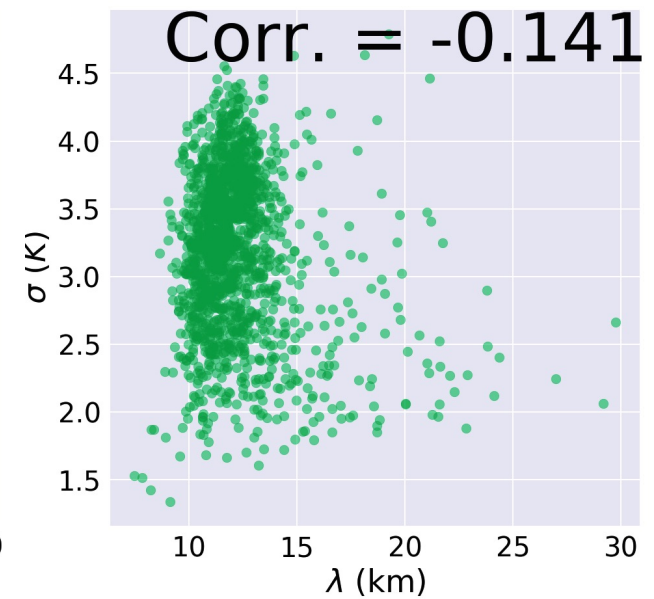
λ vs. μ

Corr. = -0.094

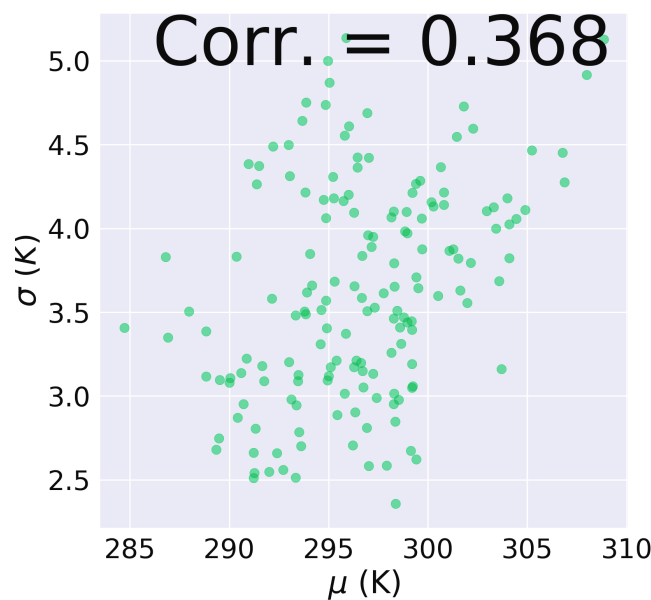


σ vs. λ

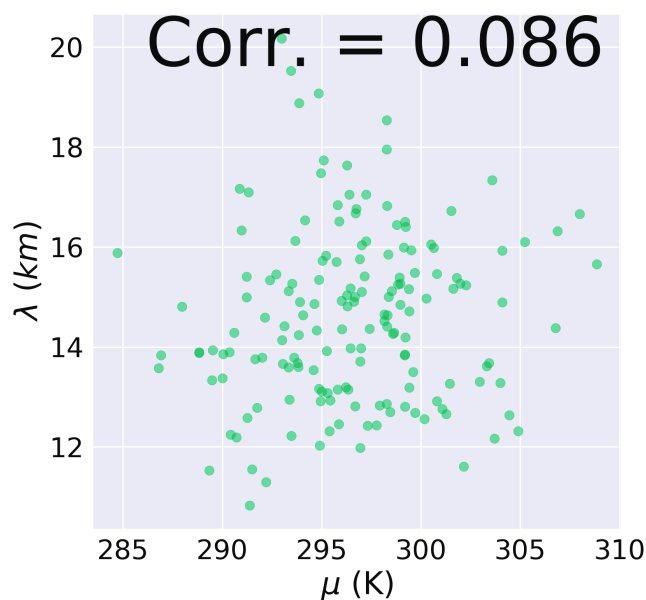
Corr. = -0.141



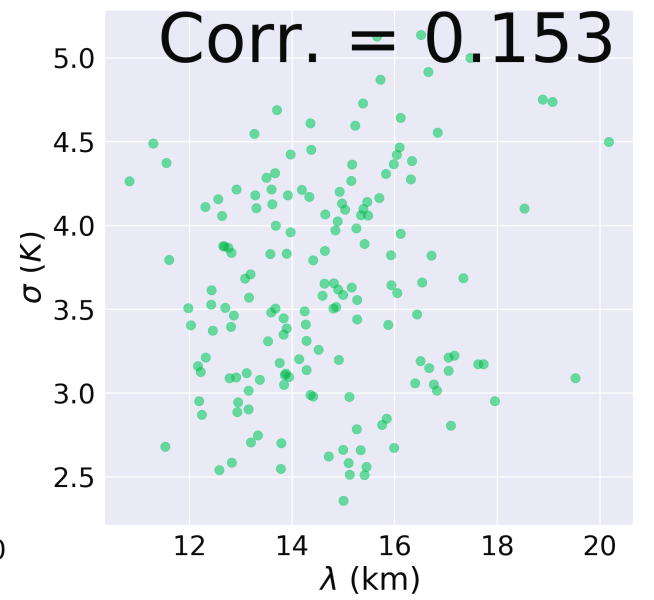
Corr. = 0.368



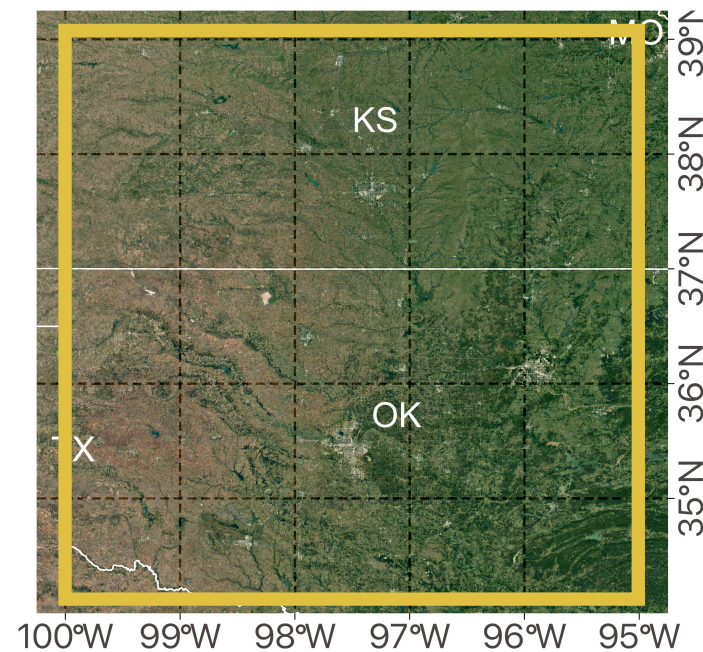
Corr. = 0.086



Corr. = 0.153

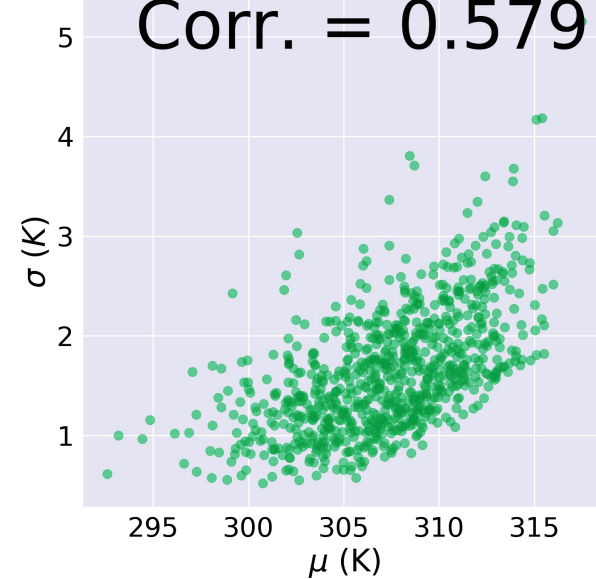


Correlation between stats



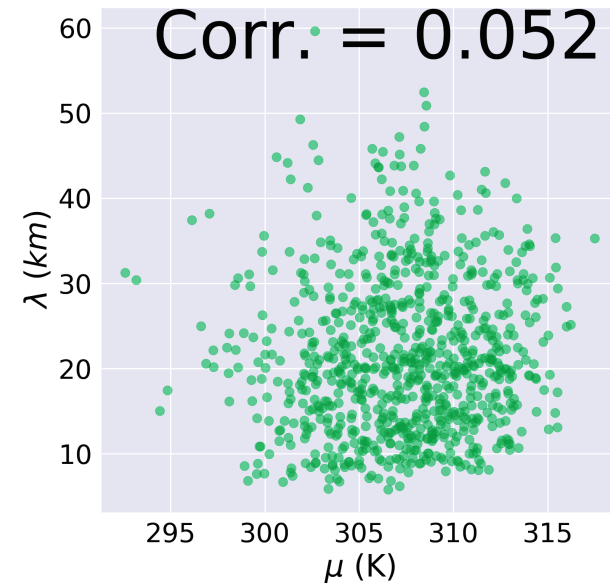
σ vs. μ

Corr. = 0.579



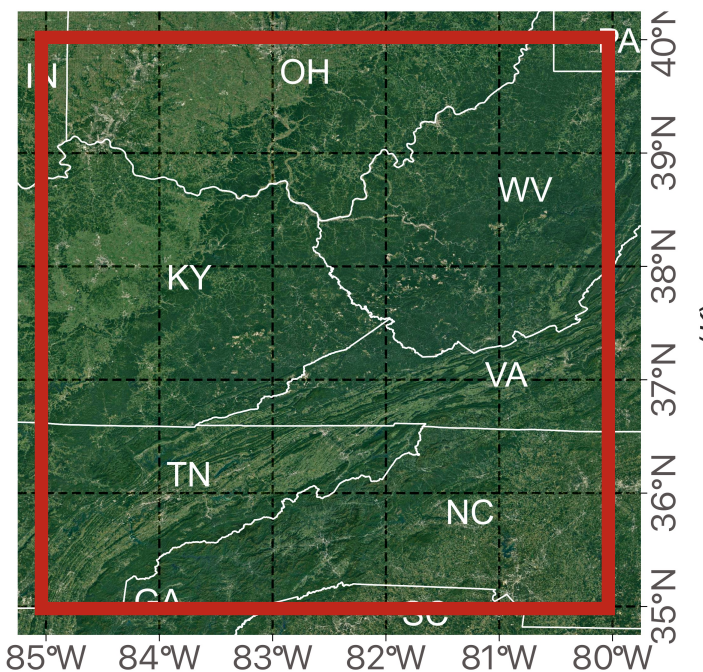
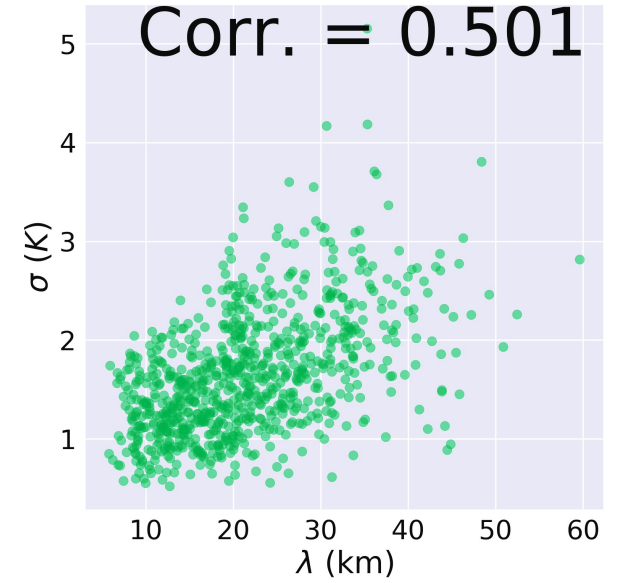
λ vs. μ

Corr. = 0.052

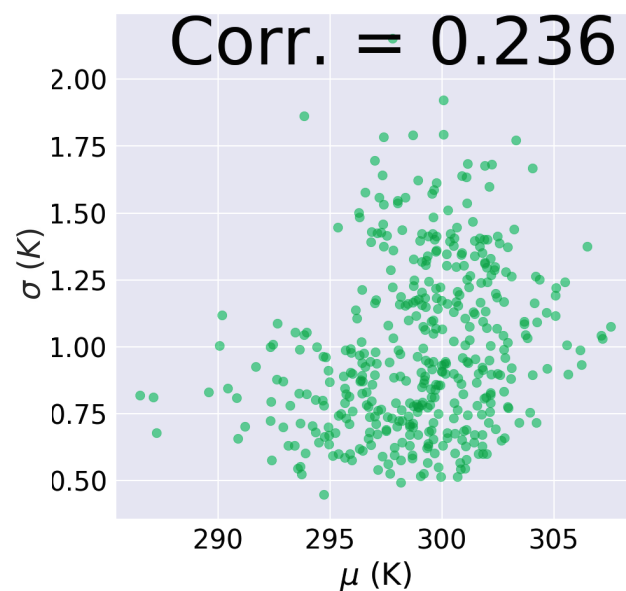


σ vs. λ

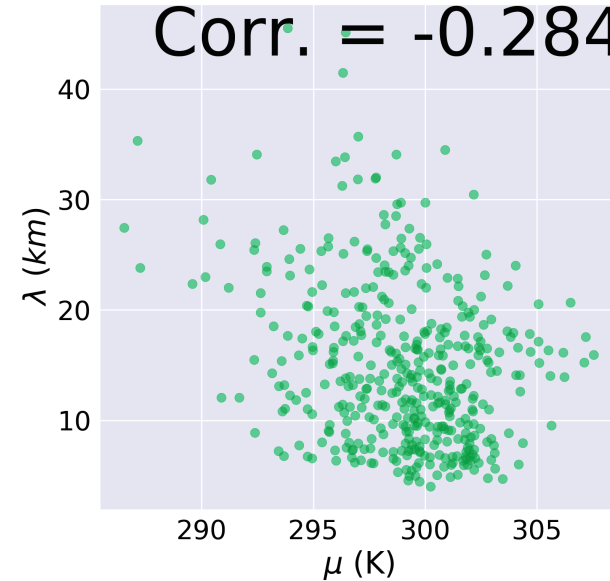
Corr. = 0.501



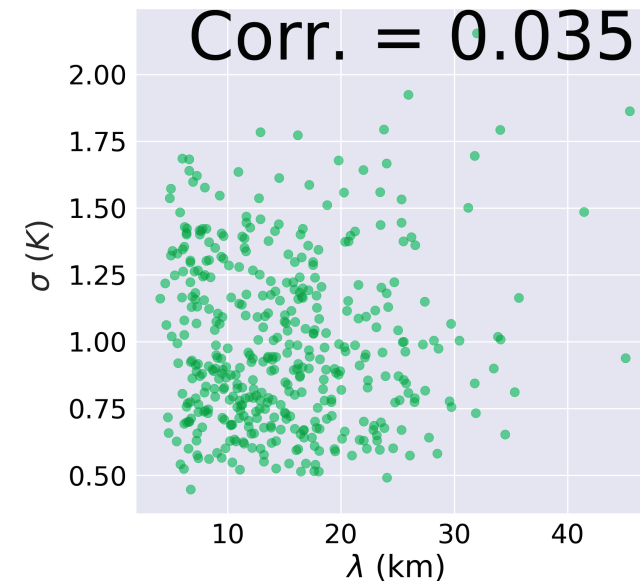
Corr. = 0.236



Corr. = -0.284



Corr. = 0.035



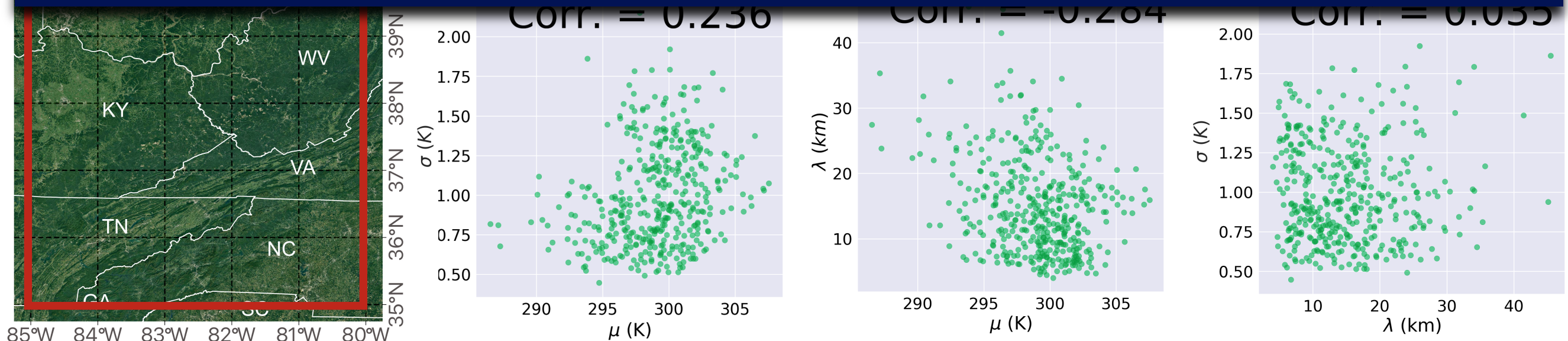
Correlation between stats

σ vs. μ

λ vs. μ

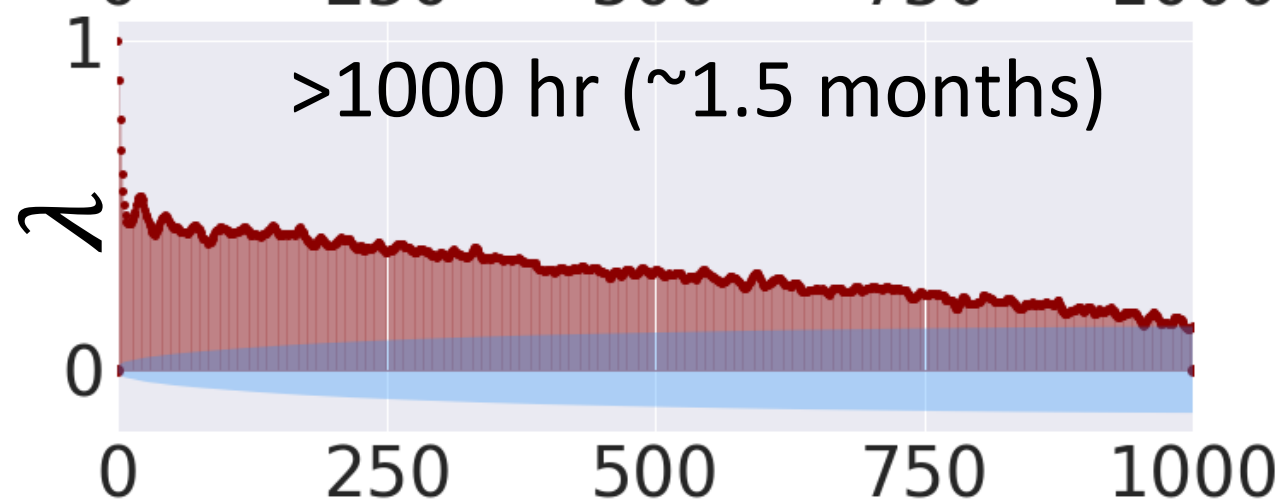
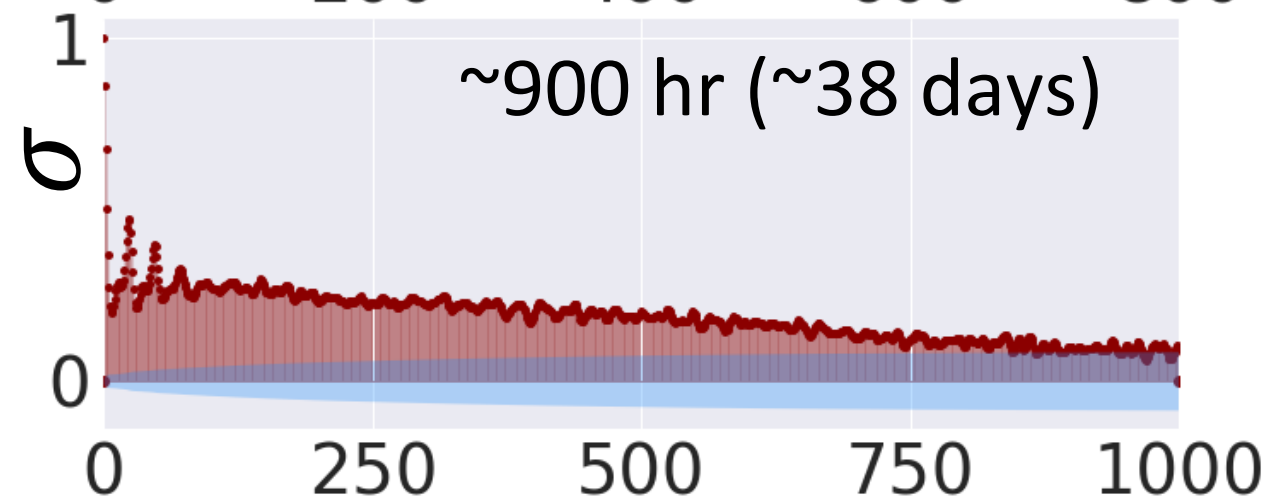
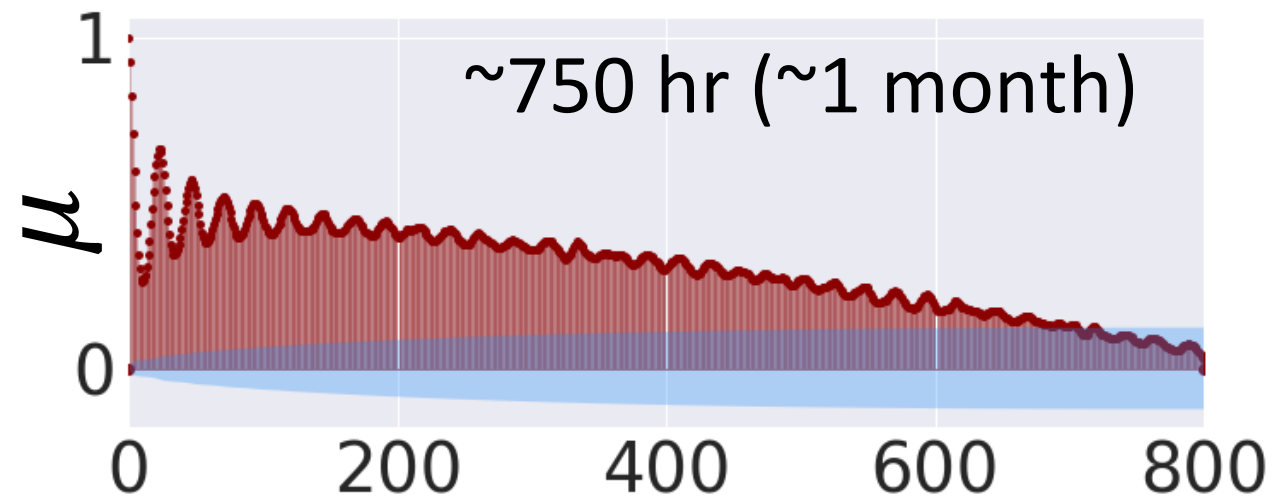
σ vs. λ

- ▶ Using mean: Significant loss of information.
- ▶ Large influence of topography and vegetation on LST fields.

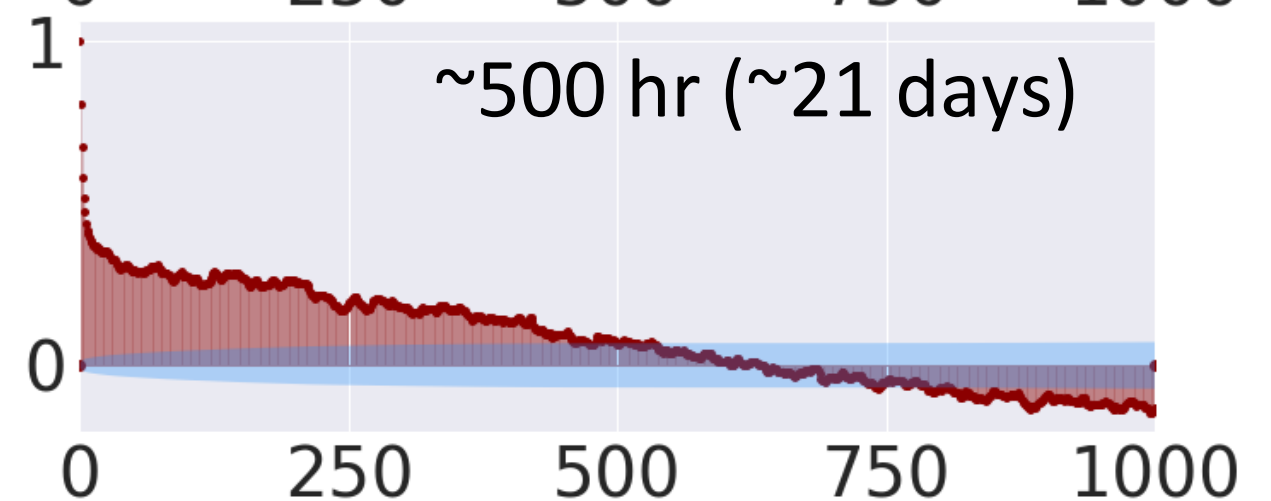
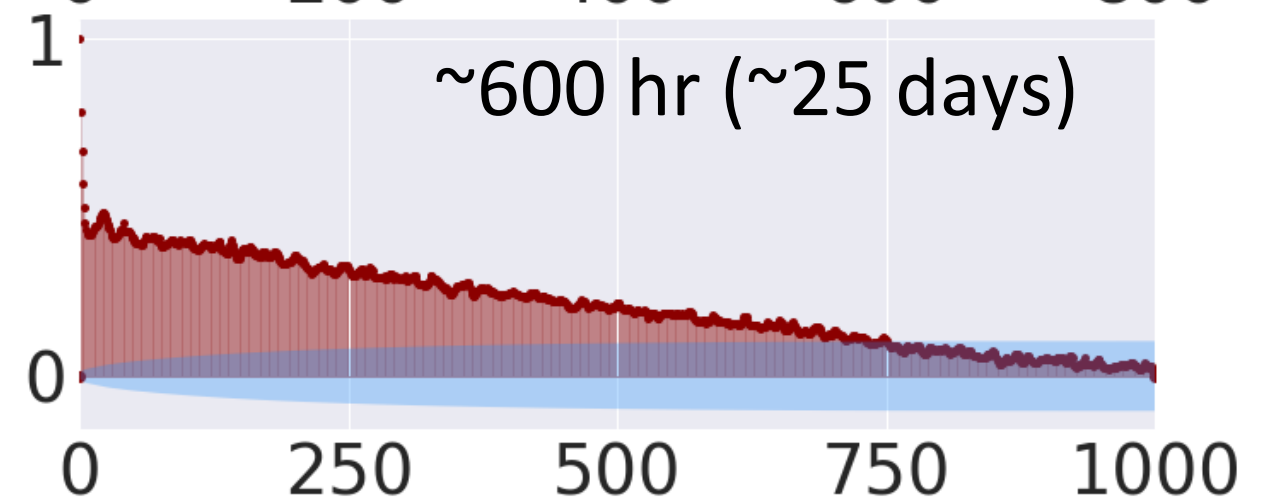
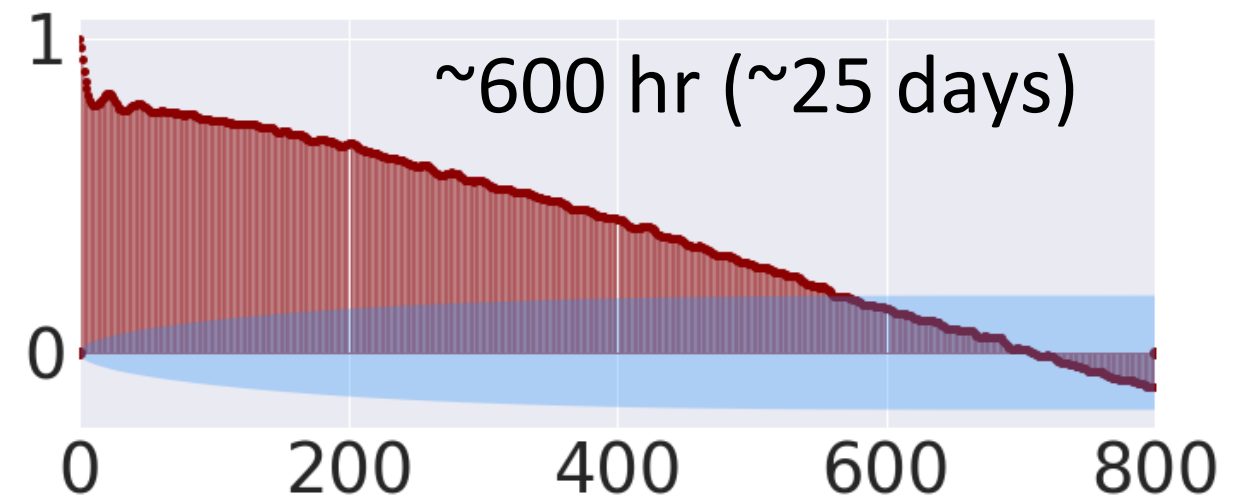


Autocorrelation: Persistence

1



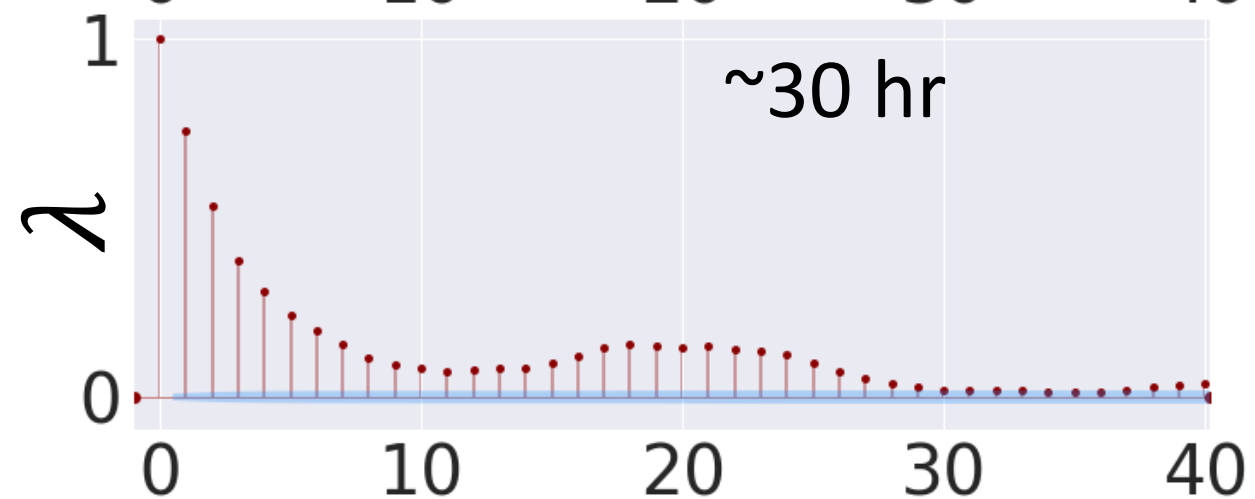
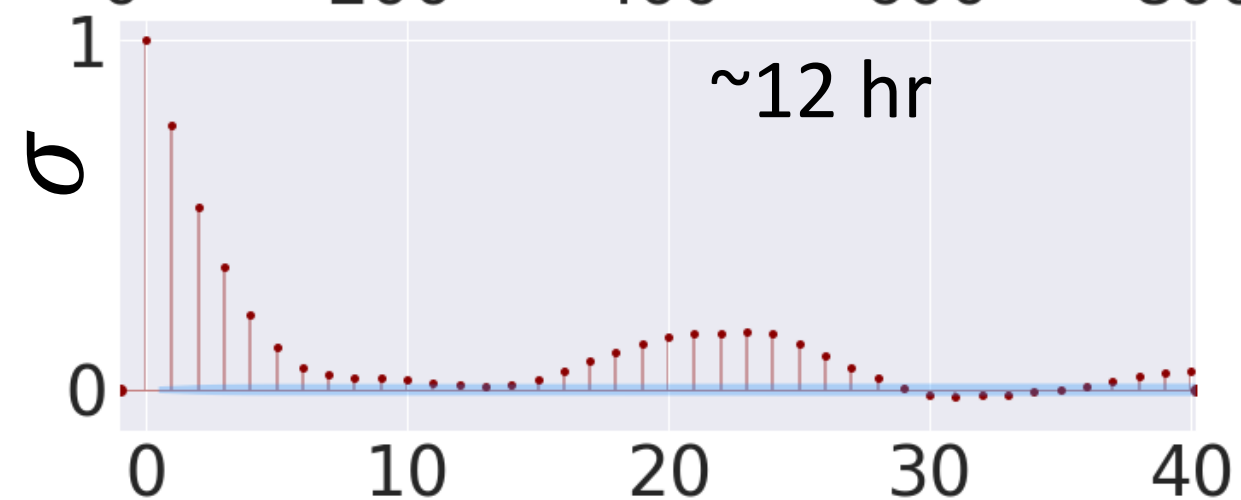
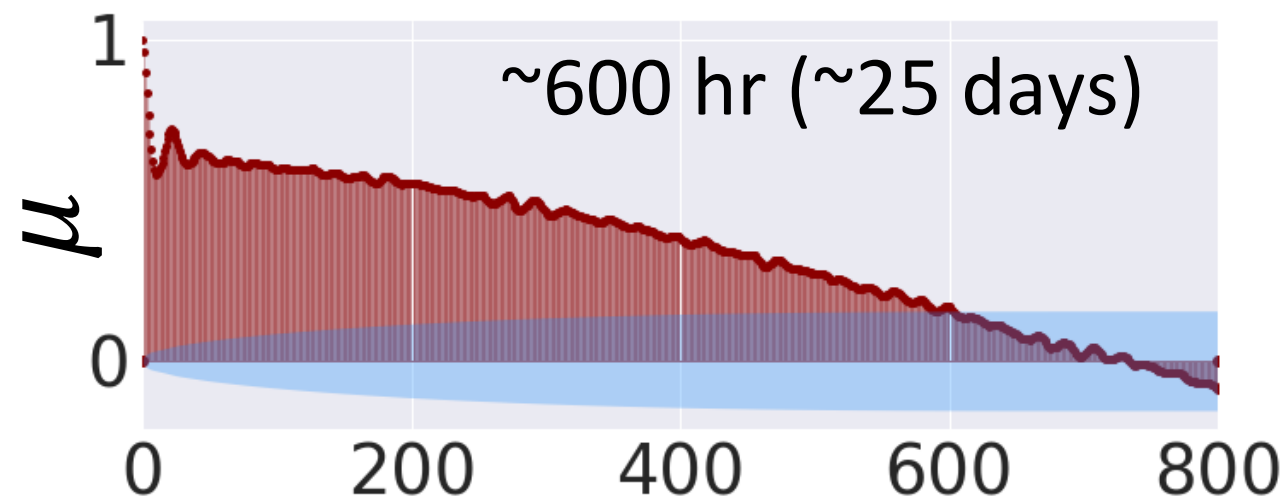
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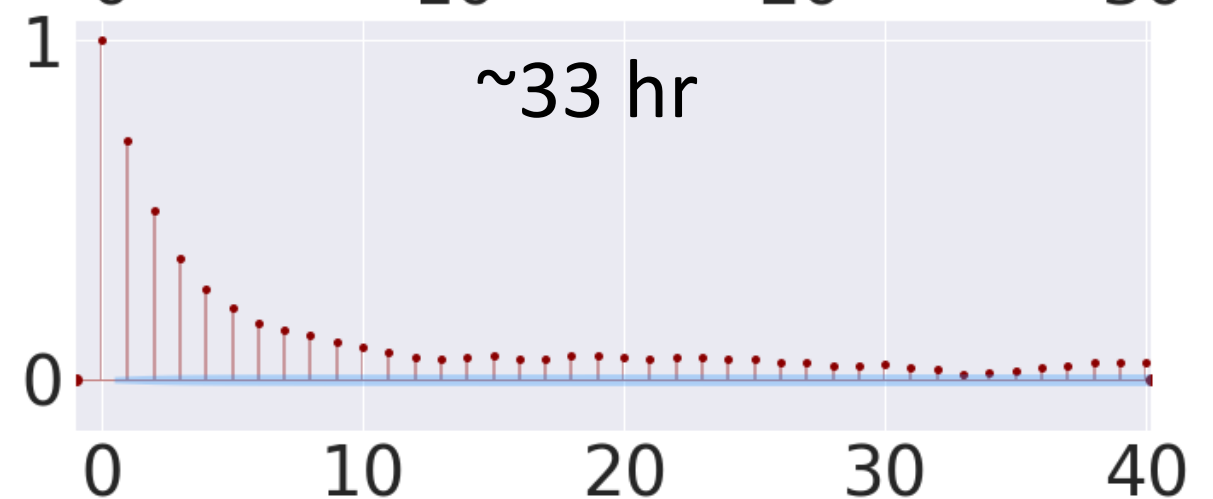
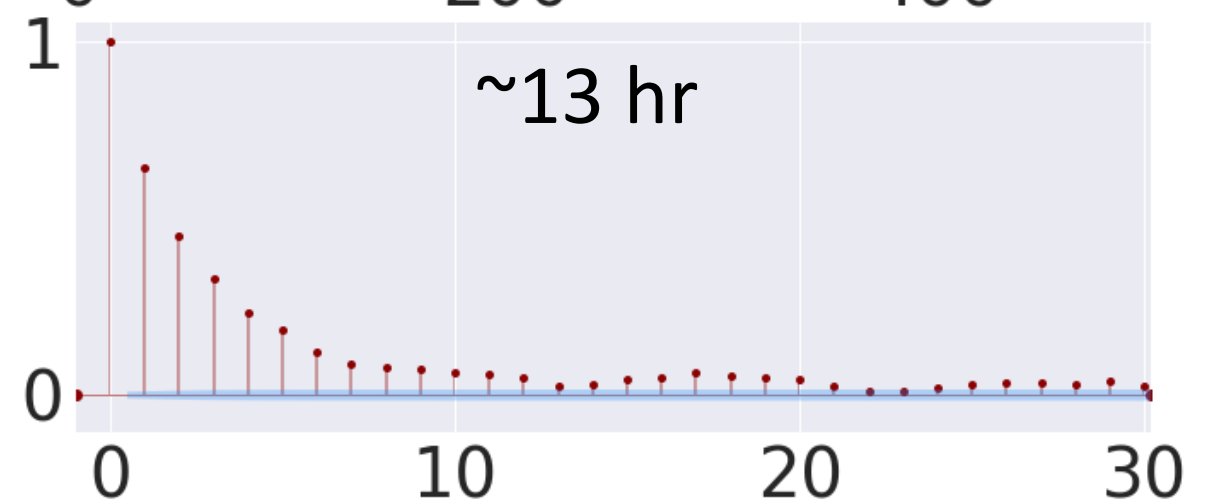
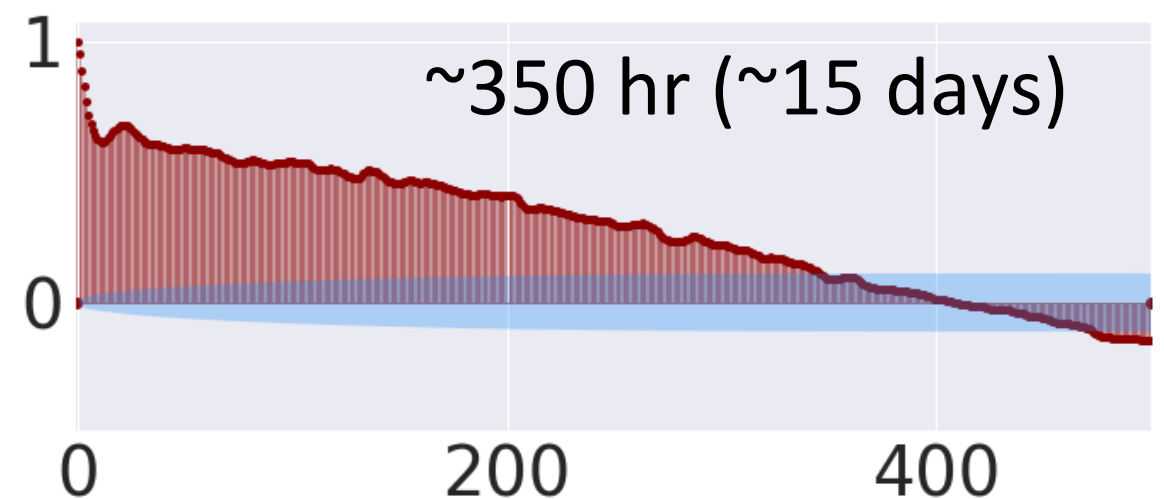
Lag (hours)

Autocorrelation: Persistence

3



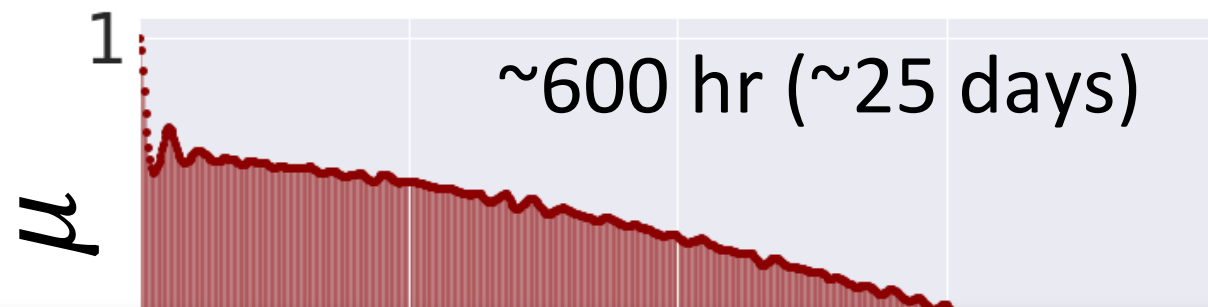
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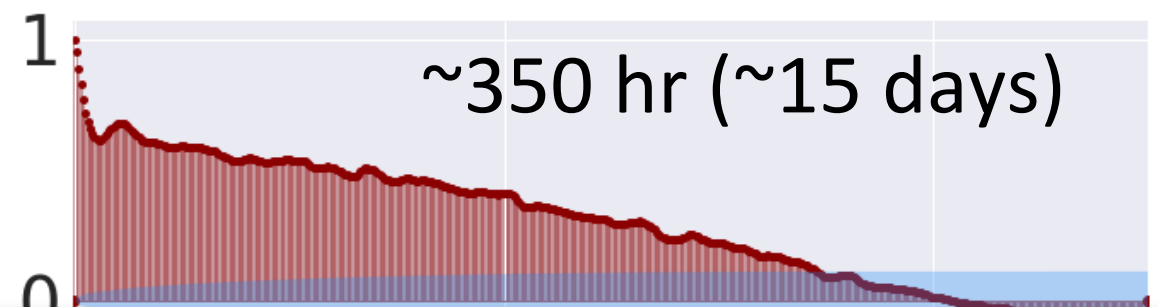
Lag (hours)

Autocorrelation: Persistence

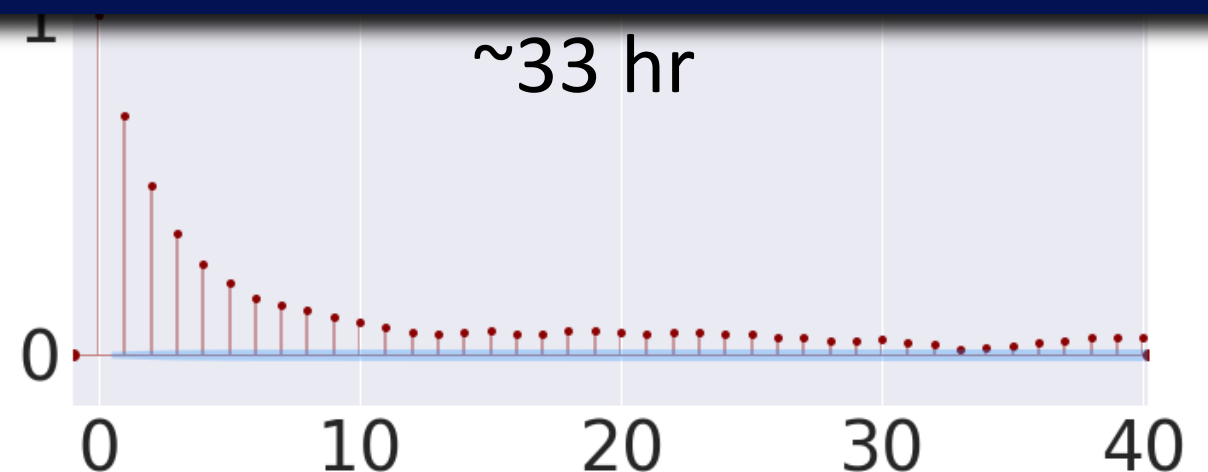
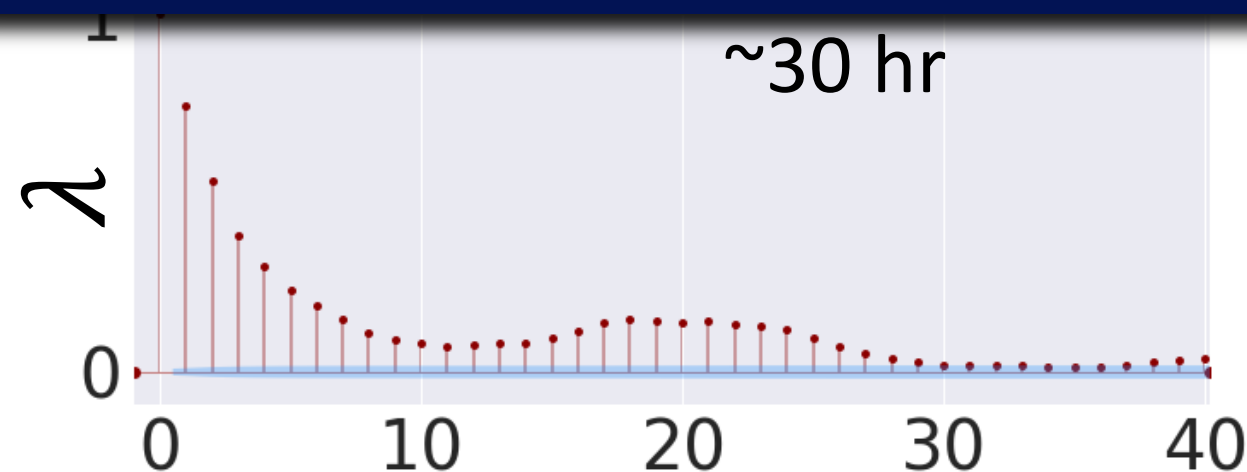
3



4



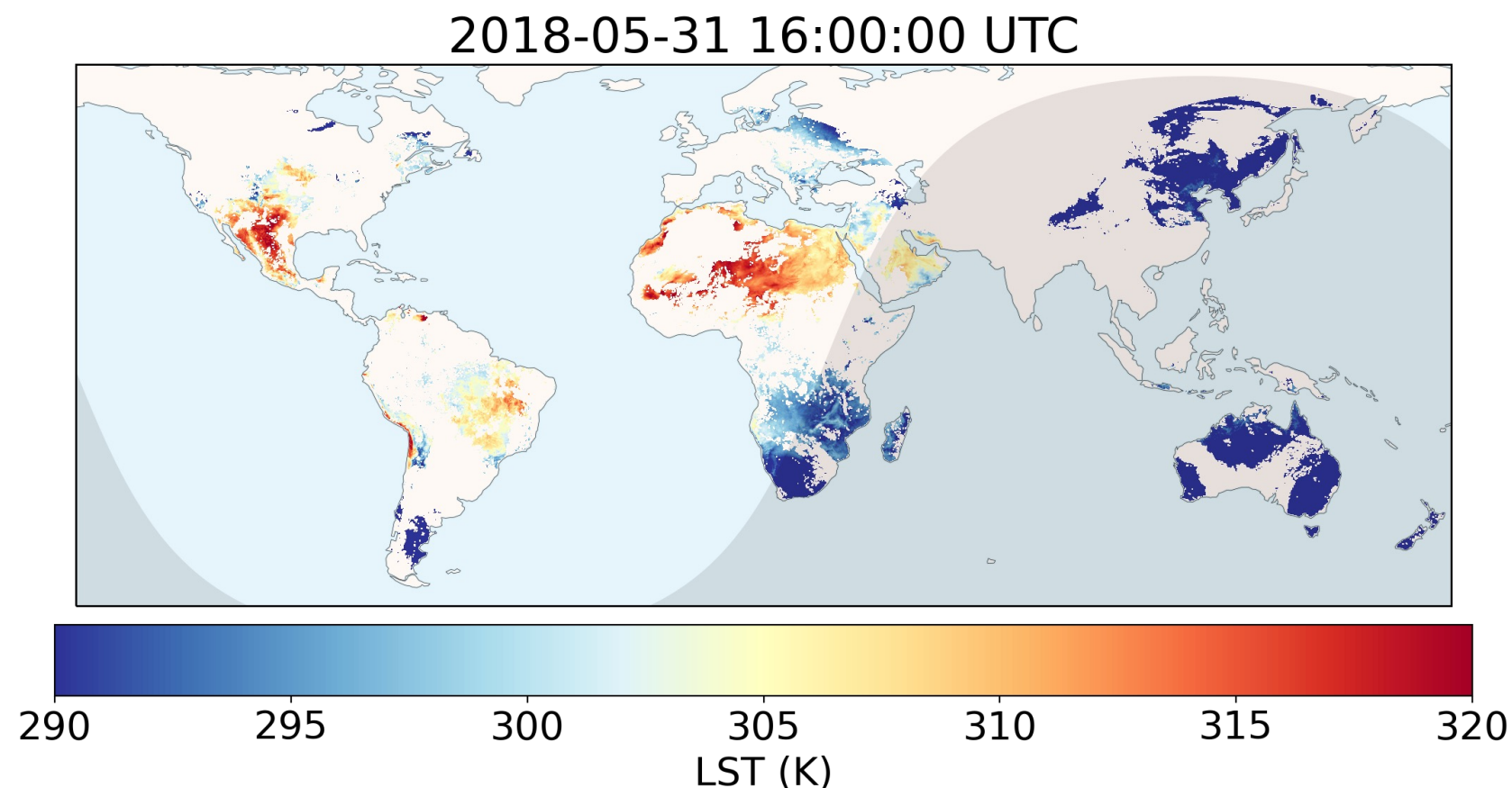
Large autocorrelation in spatial properties over mountainous/arid regions and almost 0 over flat Midwest/East coast.



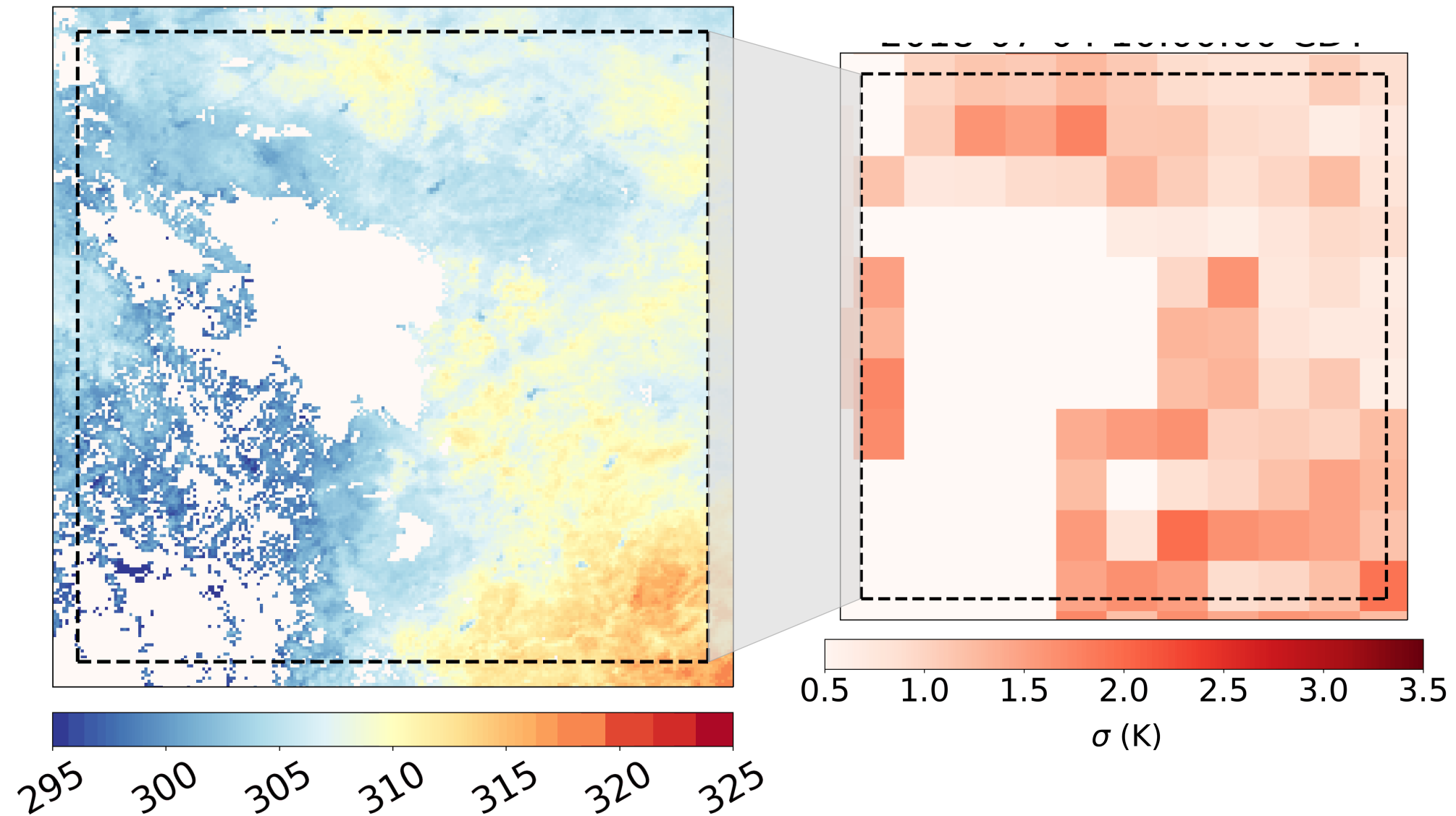
Lag (hours)

Conclusions and next Steps

- We need to be careful about taking remotely sensed data as “truth.”
- The derived spatial statistics can be used to evaluate the sub-grid representation in LMs.
- Perspectives:
 - Other variables and datasets: LAI (MODIS), reanalysis (2mT, SMC, LH, SH), other LST products.
 - Global analysis (Copernicus LST v2).



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