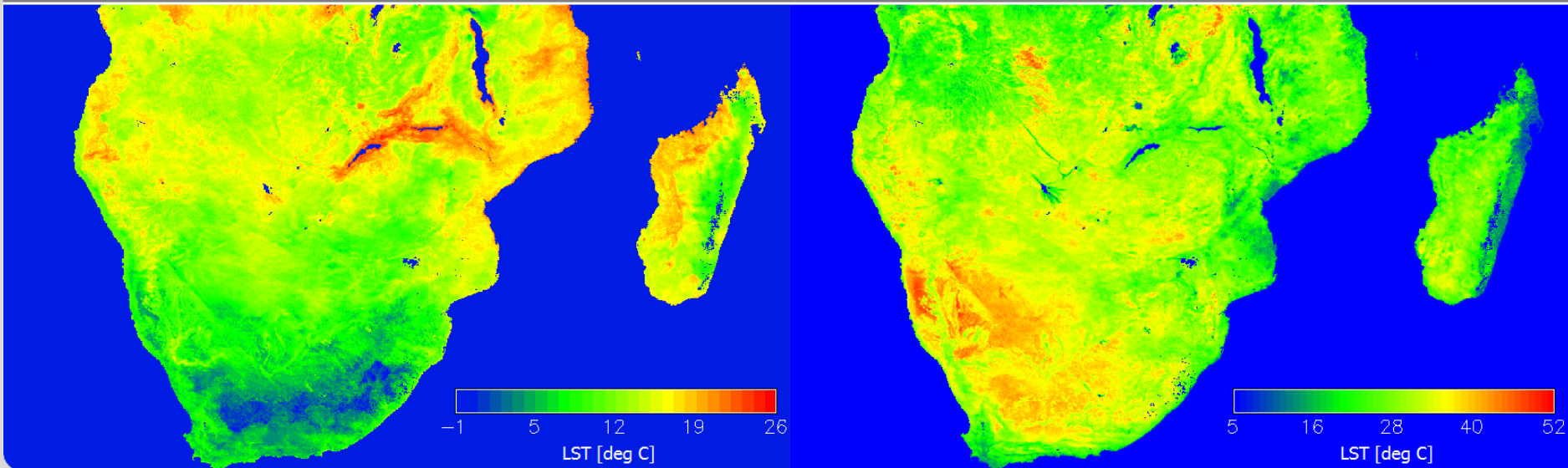


# Derived Land Surface Temperature (DLST) product for MSG/SEVIRI

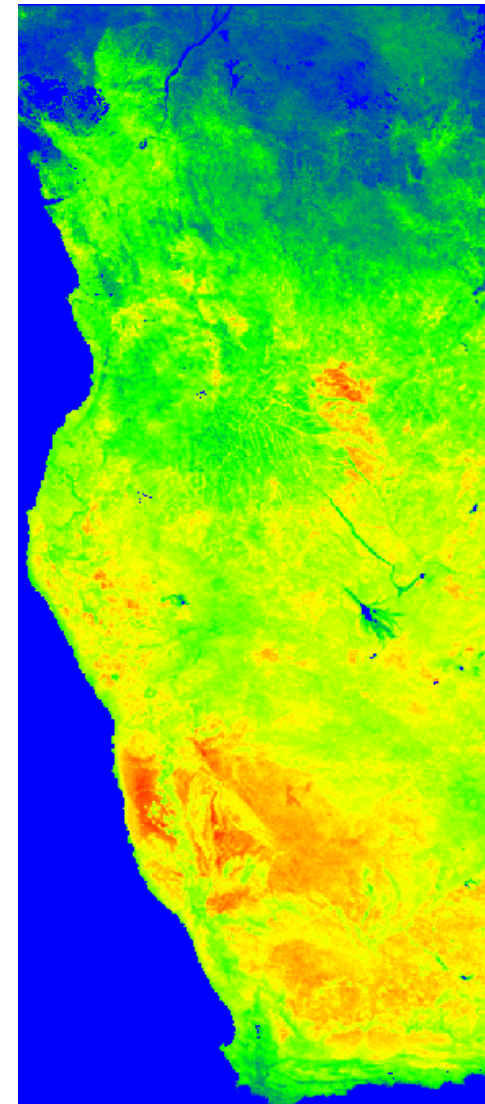
Frank-M. Göttsche

INSTITUTE OF METEOROLOGY AND CLIMATE RESEARCH (IMK-ASF)



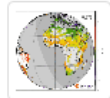
# Overview

- Derived Land Surface Temperature (DLST):  
LSA SAF's new LST product LSA-003
  - Motivation
  - Some details
  - Algorithm assessment
- DLST data examples:
  - Thermal Surface Parameters (TSP)
  - Surface Urban Heat Islands (SUHI)
- *Remote Sensing* Special Issue



# LSA SAF Land Surface Temperature Products

## NRT Products



LSA-001

### MSG Land Surface Temperature (MLST)

Land Surface Temperature derived from the SEVIRI sensor on board the EUMETSAT geostationary satellite MSG.

[Read more...](#)

Sensor: SEVIRI

Temporal Frequency: 15 min

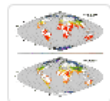
Spatial resolution: SEVIRI

[Product User Manual](#)

[Product Output Format](#)

[Validation Report](#)

[Algorithm Theoretical Basis Document](#)



LSA-002

### EPS Land Surface Temperature (EDLST)

The ELST (EPS Land Surface Temperature) provides a day-time and night-time retrievals of LST based on clear-sky measurements from the Advanced Very High Resolution Radiometer (AVHRR) on-board EUMETSAT polar system satellites, the Metop series.

[Read more...](#)

Sensor: AVHRR

Temporal Frequency: 2x/day

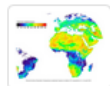
Spatial resolution: 1 Km<sup>2</sup>

[Product User Manual](#)

[Product Output Format](#)

[Validation Report](#)

[Algorithm Theoretical Basis Document](#)



LSA-003

### Derived Land Surface Temperature (DLST)

Median and maximum Land Surface Temperature composites and Modelled diurnal LST cycle.

[Read more...](#)

Sensor: SEVIRI

Temporal Frequency: 10-day

Spatial resolution: SEVIRI

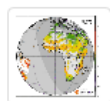
[Product User Manual](#)

[Product Output Format](#)

[Validation Report](#)

[Algorithm Theoretical Basis Document](#)

## Data Records



LSA-050

### MSG Land Surface Temperature (MLST-R)

Data Record obtained with the best version of its equivalent NRT product (MLST).

[Read more...](#)

Sensor: SEVIRI

Temporal Frequency: 15 min

Period: 2004-2015

Spatial resolution: SEVIRI

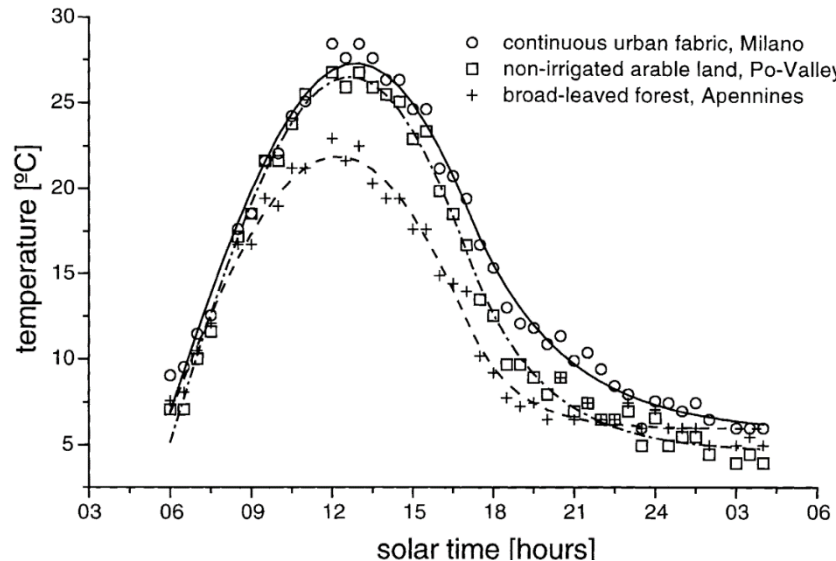
[Product User Manual](#)

[Product Output Format](#)

[Validation Report](#)

[Algorithm Theoretical Basis Document](#)

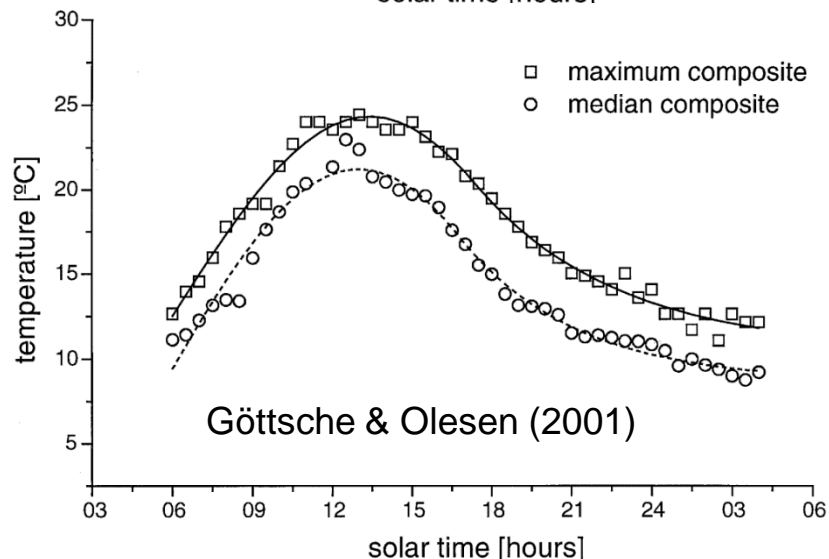
# Motivation for Derived LST product (LSA-003)



## Diurnal Temperature Cycle (DTC)

- + Land Use / Land Cover (LULC) is often reflected in the DTC
- + DTC contain additional information: pixel may have identical NDVI\* but different thermal characteristics
- DTC are affected by weather (clouds, precipitation, advection, ...)

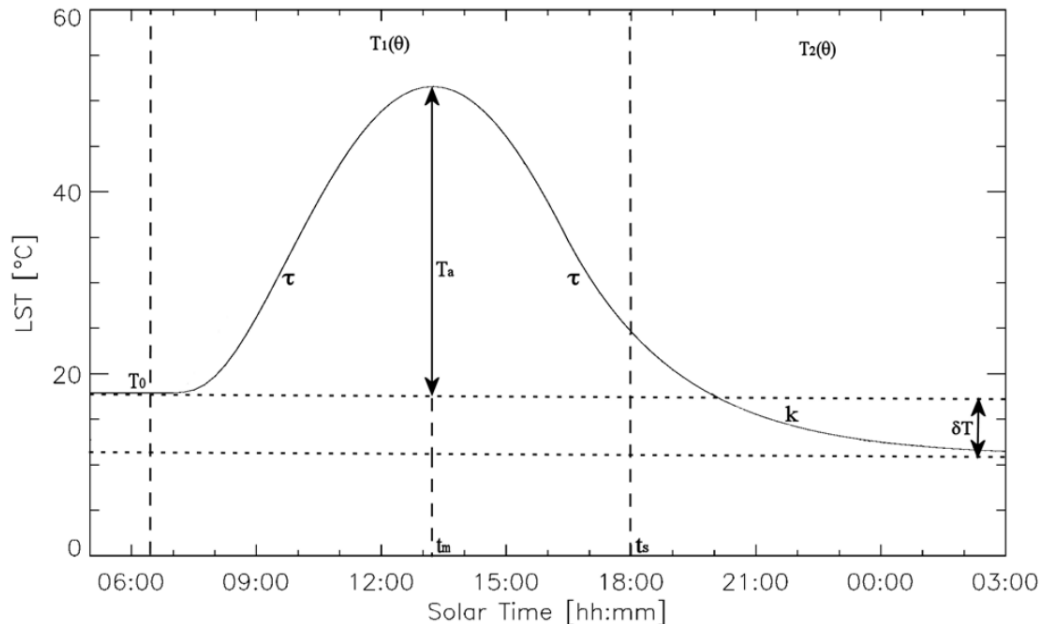
\*normalised difference vegetation index



## Temporal composites

- + Considerably fewer data gaps
- + Related to *surface characteristics*, e.g. LULC, vegetation, composition
- + Reduced impact of weather
- ‘Noisy’ sequence of LST composites
- 96 LST per pixel and composite interval

# Diurnal Temperature Cycle (DTC) model



“Daytime”  $T_1$  and “night time”  $T_2$   
are indicated by vertical lines.

Göttsche, F.-M., and Olesen, F.S. (2009). Modelling the effect of optical thickness on diurnal cycles of land surface temperature. *Remote Sensing of Environment*, Vol. 113

## Thermal Surface Parameters

Parameter		Meaning
$T_0$	[°C]	residual temperature
$T_a$	[°C]	temperature amplitude
$t_m$	[solar time]	time of the maximum
$t_s$	[solar time]	start of the attenuation function
$\delta T$	[°C]	$T_0 - T(t \rightarrow \infty)$ , where $t$ is time
$k$	[hh:mm]	attenuation constant (calculated)
$\tau$		total optical thickness (TOT)

Since 30. October 2017  
LST composites and TSP are  
operational at LSA SAF

# DLST product (LSA-003)

## Compositing Algorithm (LSA-003A)

### Input

10 days with 96 MLST each  
(960 LSA-001 products)

### Processing

**Compositing**  
(maximum / median)

### Output

1 day with 96 DLST & QC  
& number valid MLST

## TSP Algorithm (LSA-003B)

### Input

96 DLST composites  
(LSA-003A products)

### Processing

**TSP algorithm**  
Modelling of DTC

### Output

Set of 7 TSP & QC  
& mean and max errors



# Algorithm assessment

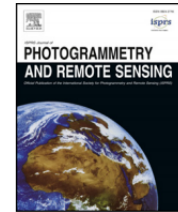
ISPRS Journal of Photogrammetry and Remote Sensing 142 (2018) 190–204



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

ISPRS Journal of Photogrammetry and Remote Sensing

journal homepage: [www.elsevier.com/locate/isprsjprs](http://www.elsevier.com/locate/isprsjprs)



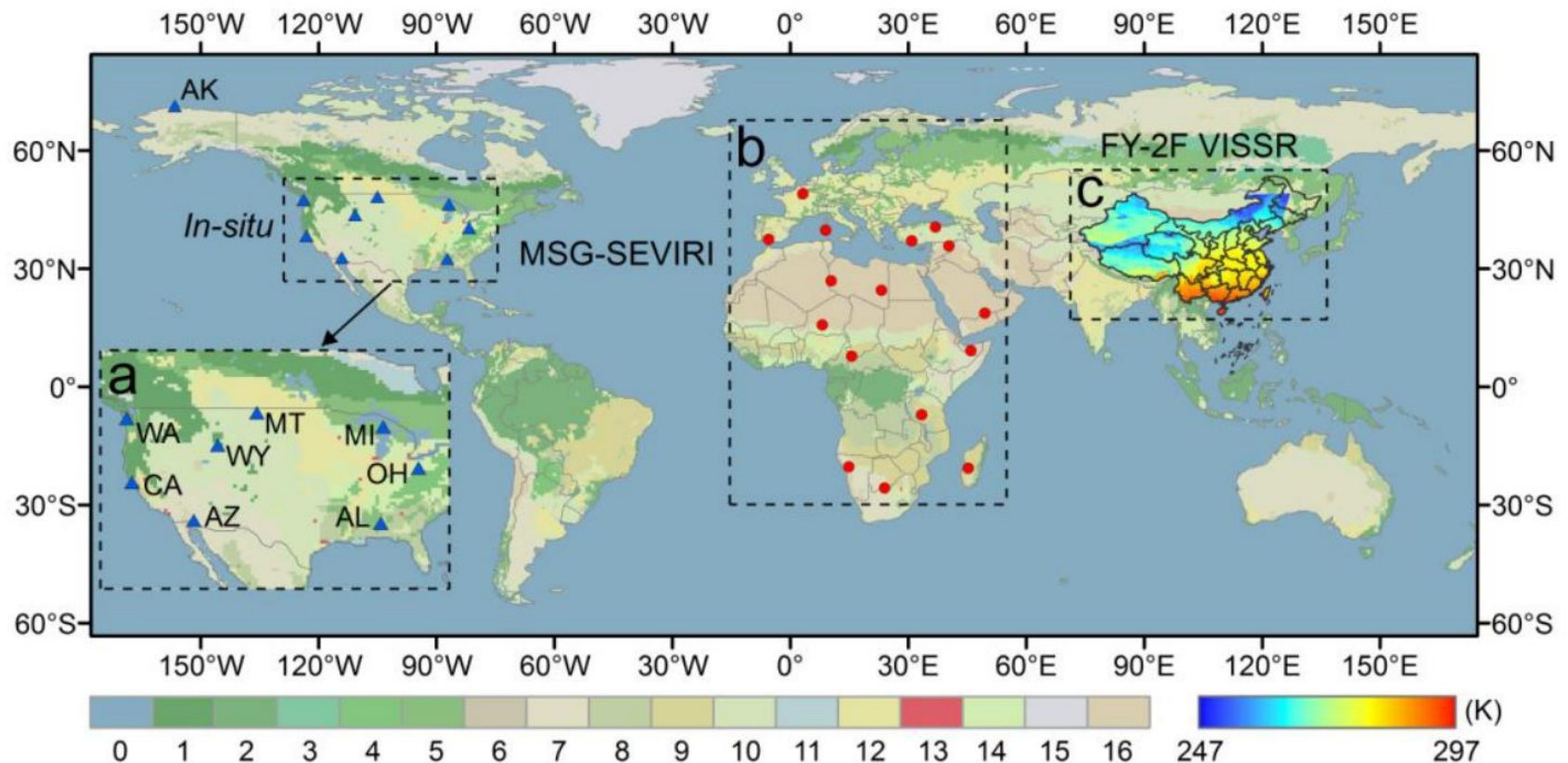
Comprehensive assessment of four-parameter diurnal land surface temperature cycle models under clear-sky

Falu Hong<sup>a</sup>, Wenfeng Zhan<sup>a,b,\*</sup>, Frank-M. Göttsche<sup>c</sup>, Zihan Liu<sup>a</sup>, Ji Zhou<sup>d</sup>, Fan Huang<sup>a</sup>, Jiameng Lai<sup>a</sup>, Manchun Li<sup>a</sup>



- Four-parameter DTC models can be applied to tandem polar-orbiting satellites if **at least four samples per day are available**.
- Find best parameter-reduction approach for various DTC models

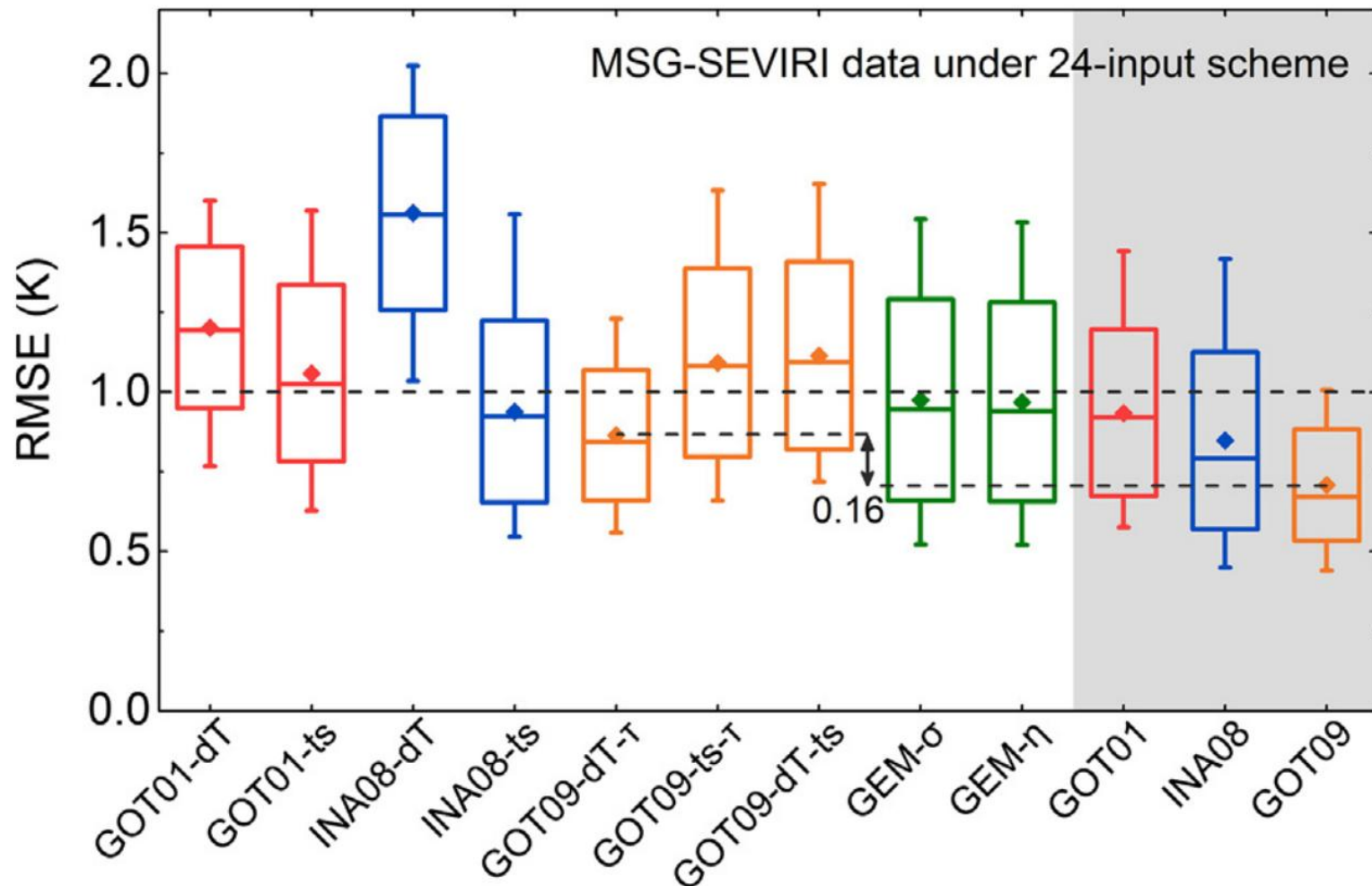
# Locations where DTCs were obtained



From Hong et al. (2018)

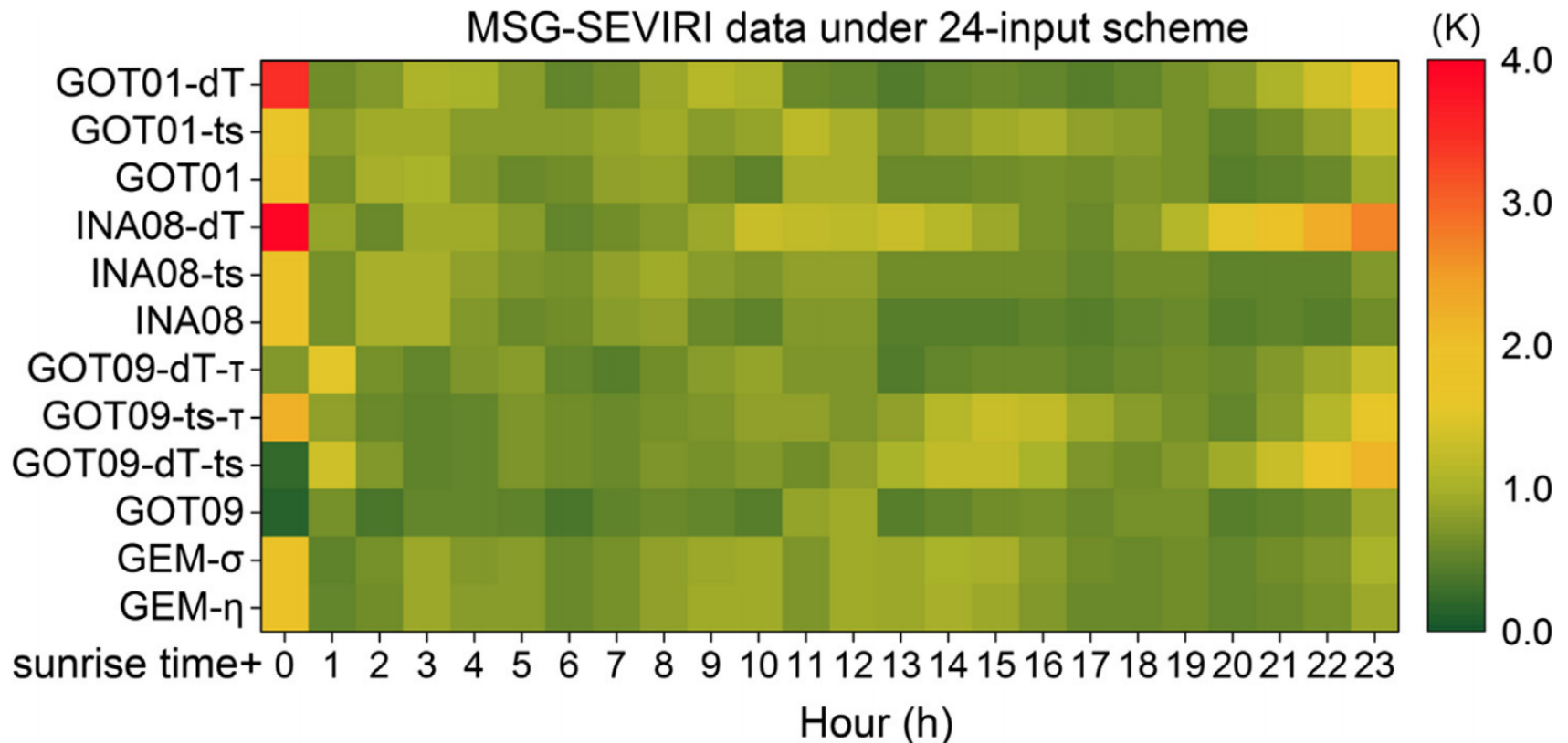


# LSA SAF LST (LSA-001) under 24-input scheme



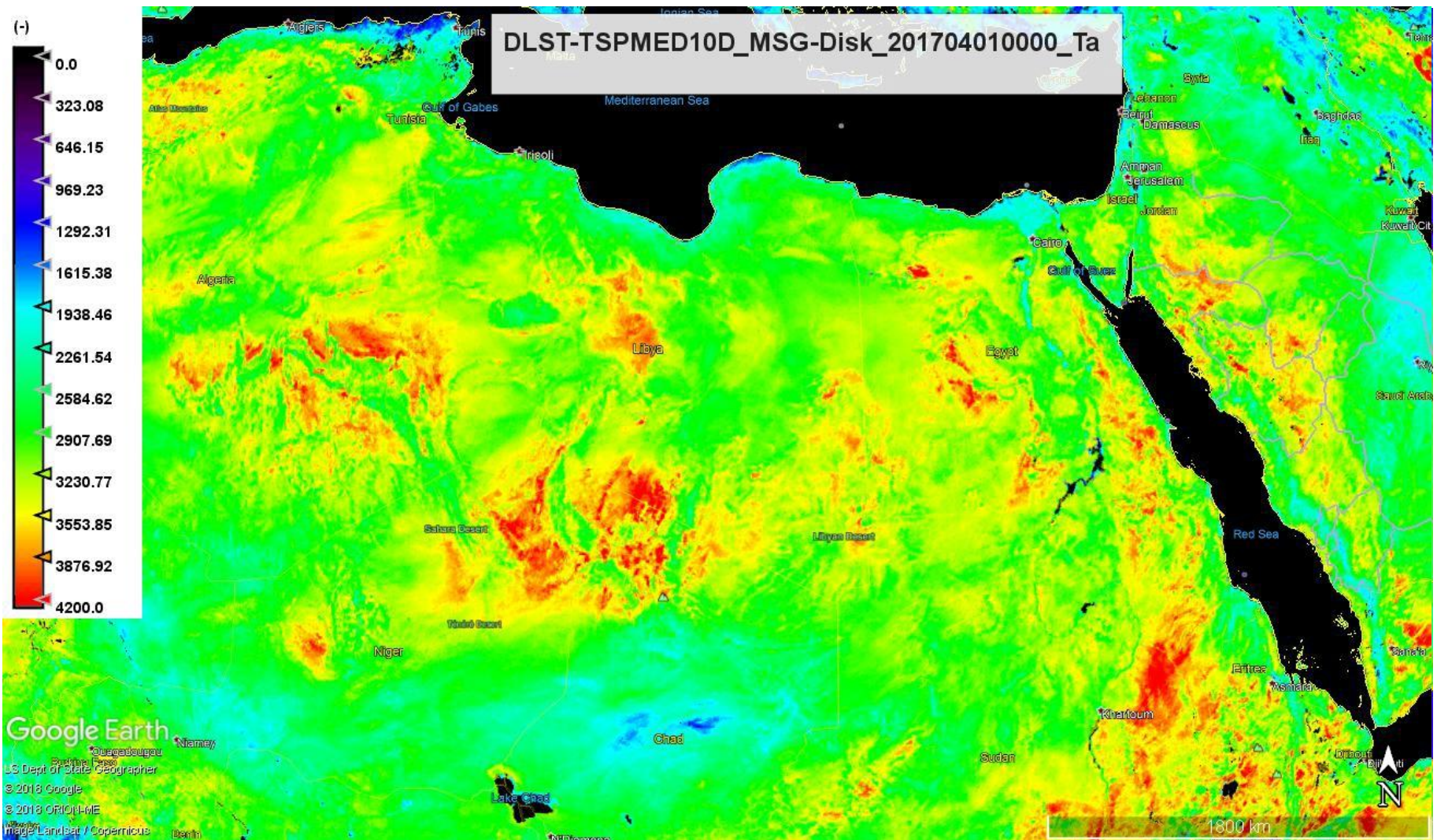
From Hong et al. (2018)

# LSA SAF LST under 24-input scheme - hourly



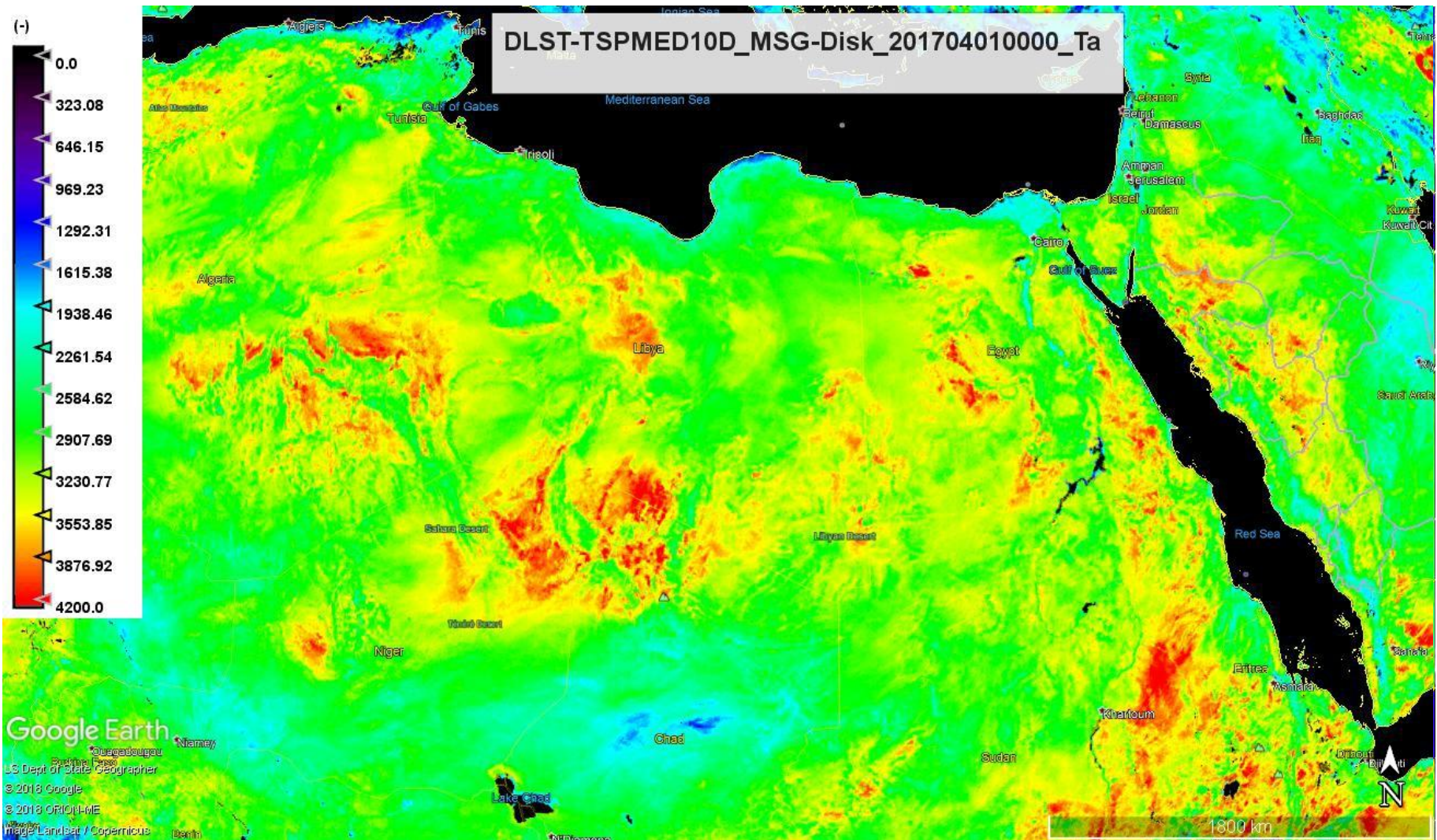
From Hong et al. (2018)

# Thermal Surface Parameters (TSP)





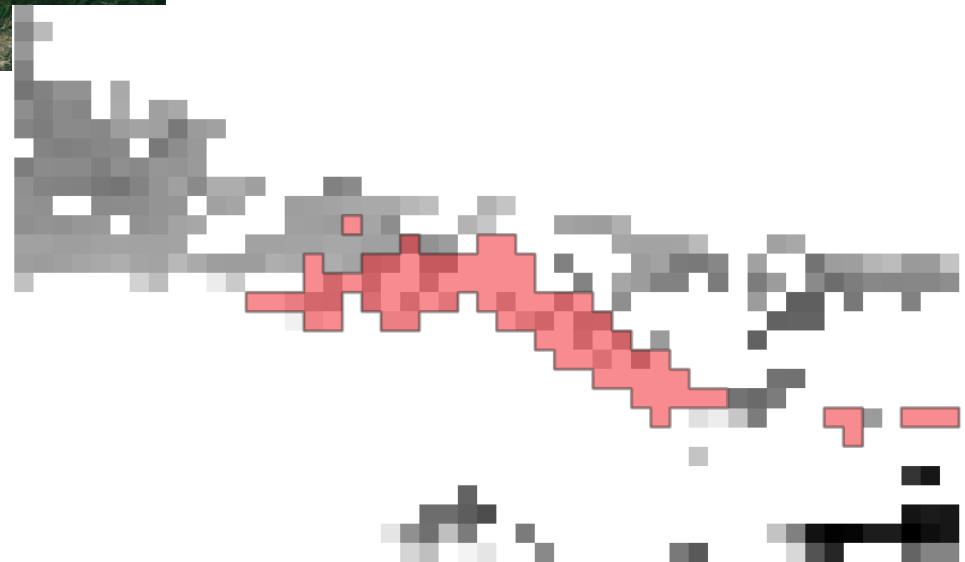
# Thermal Surface Parameters (TSP)



# Surface Urban Heat Islands (SUHI): Istanbul

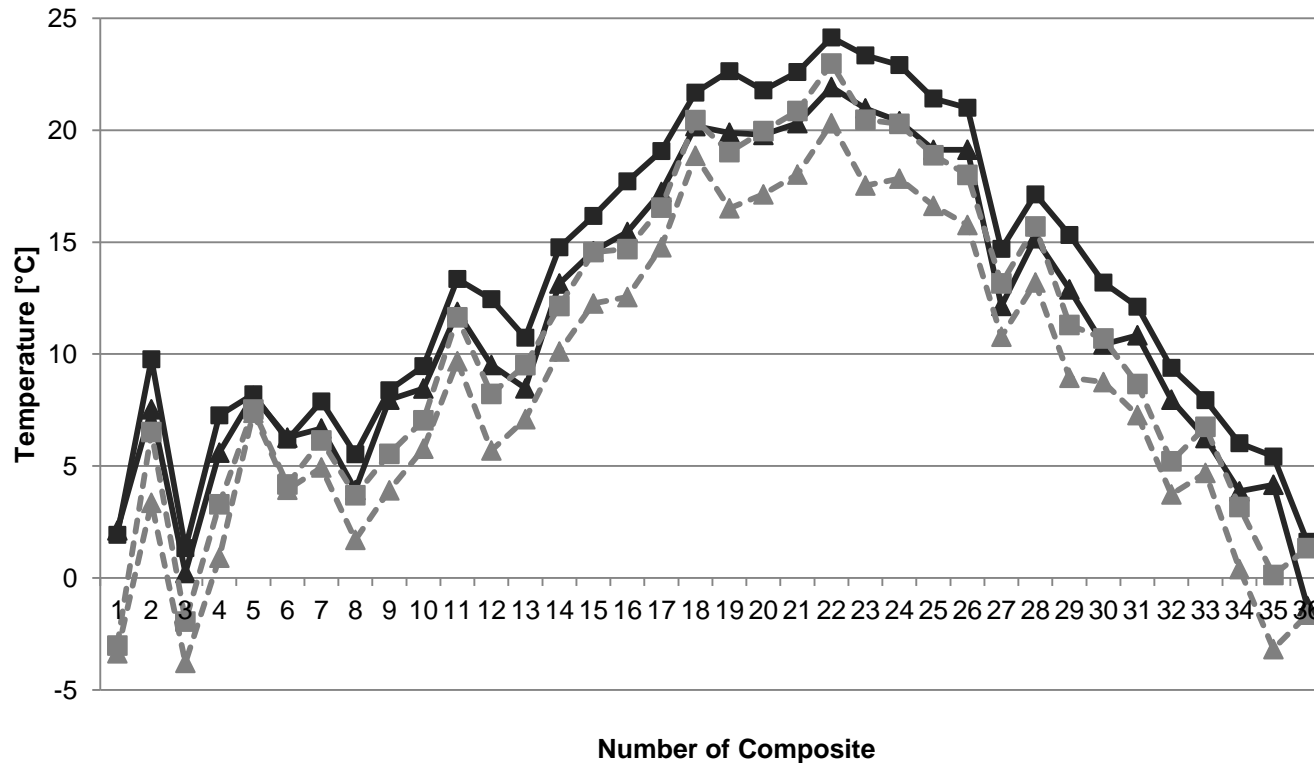


Classification of **urban & rural** area  
with CCI Landcover Data



Data courtesy: Nancy Härter (KIT)

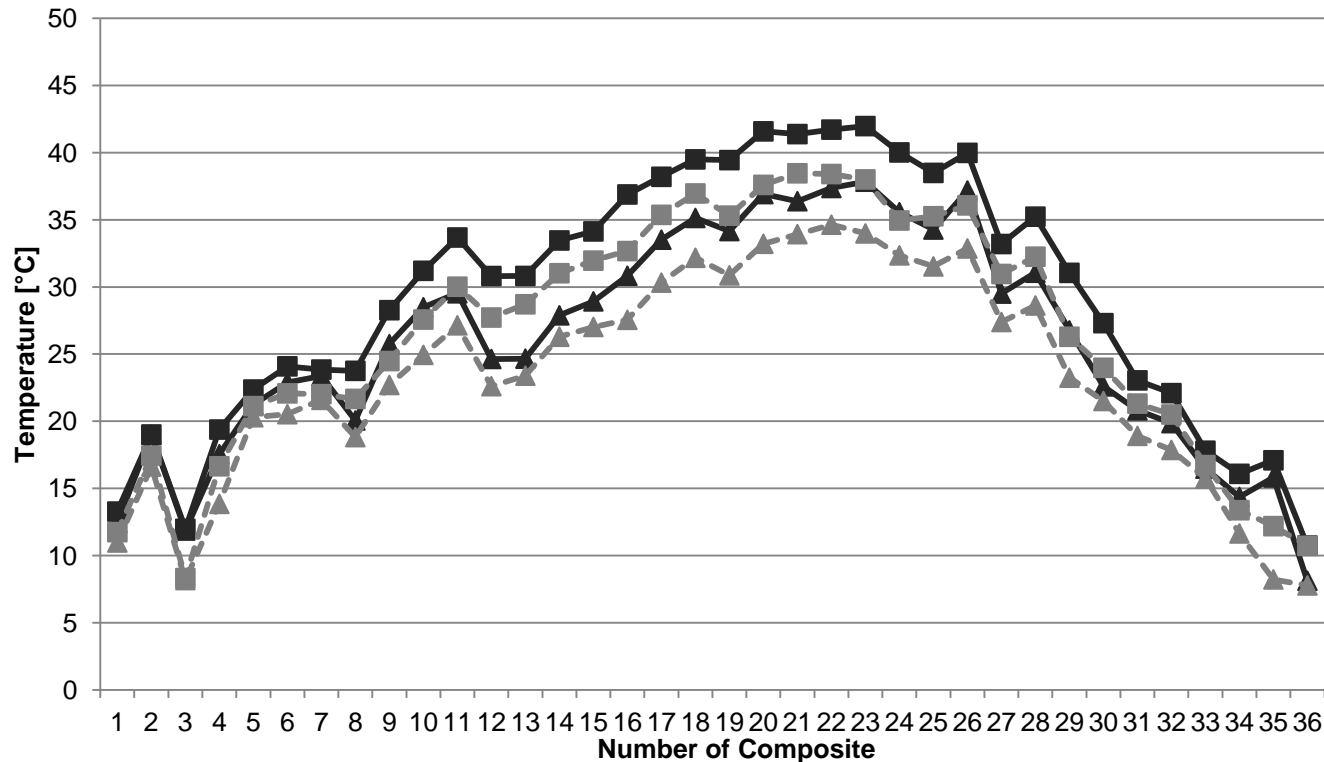
# Istanbul: Residual Temperature in 2016



Data courtesy: Nancy Härter (KIT)



# Istanbul: Maximum Temperature in 2016



## Istanbul T\_max 2016

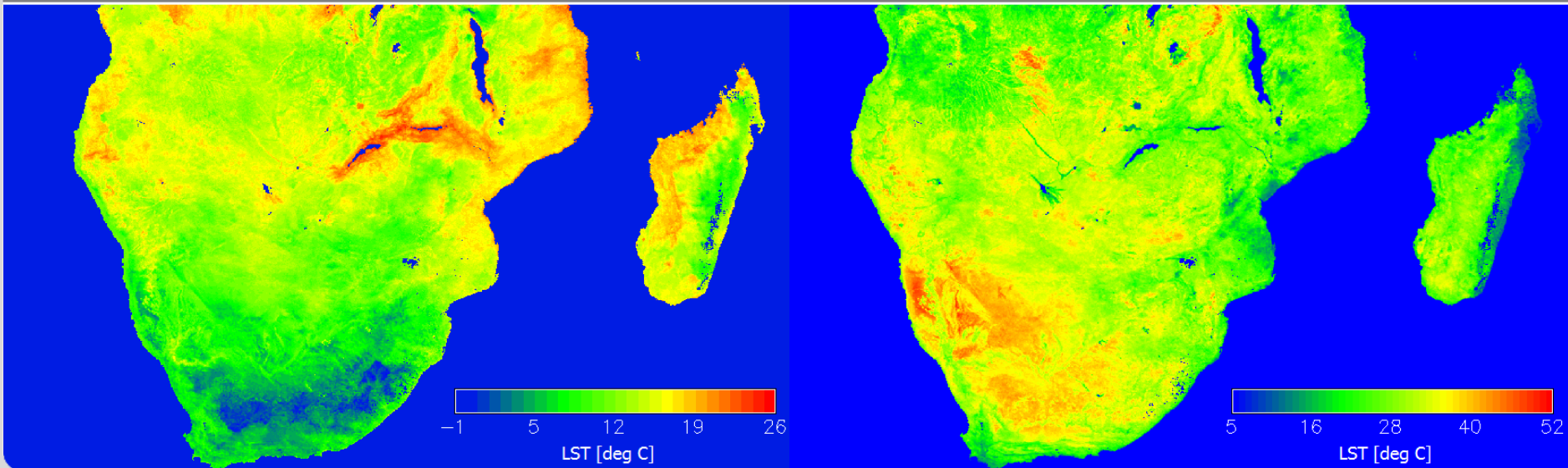
- TSPMAX Urban
- ▲ TSPMAX Rural
- TSPMED Urban
- ▲ TSPMED Rural

### Mean Difference:

TSPMAX 2016: 3,336 °C

TSPMED 2016: 3,072 °C

Data courtesy: Nancy Härter (KIT)





# “Applications of Land Surface Temperature and its Combination with other Satellite Land Products”

- Applications of multi-temporal LST and LSE data
- Studies exploring the characteristics of annual and diurnal LST cycles
- Combined applications of LST, LSE and other land products, e.g., vegetation parameters, Land-Use Land-Cover (LULC) information, etc.
- Using LST and LSE data to improve land products, e.g. fire detection, land-cover classification, soil moisture retrieval, etc.
- LST products with improved features, e.g., offering all-weather capability and corrected for surface anisotropy
- Progress in estimating near surface air temperature from satellite LST
- Novel applications of LST and LSE products

**Deadline for manuscript submissions: 15 October 2018**