

# Geostationary Satellite Assessment of Urban Heat Islands

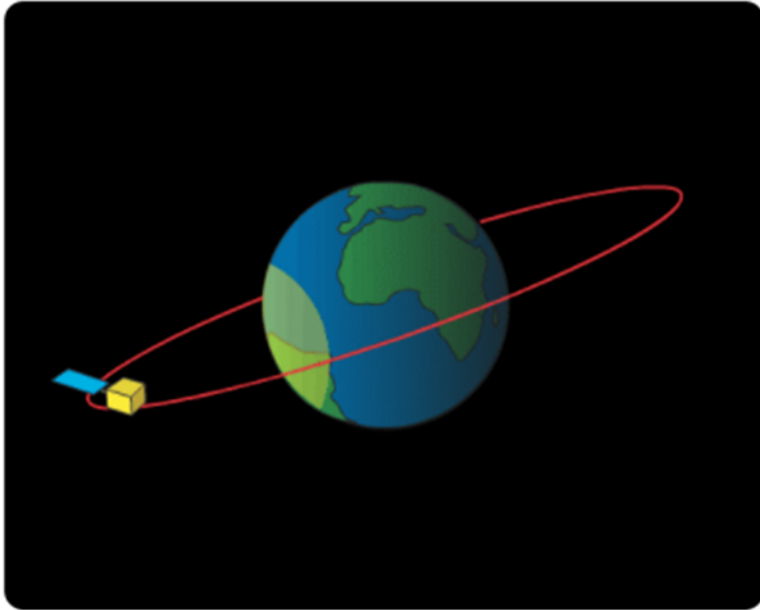
Kevin Gallo: NOAA/NESDIS/STAR

November 24, 2020

*Disclaimer: The scientific results and conclusions, as well as any views or opinions expressed herein, are those of the author(s) and do not necessarily reflect those of NOAA or the Department of Commerce.*

# Geostationary Orbit vs. Polar Orbit

Continuous views of coverage area of Earth's Surface (24 hours per day).

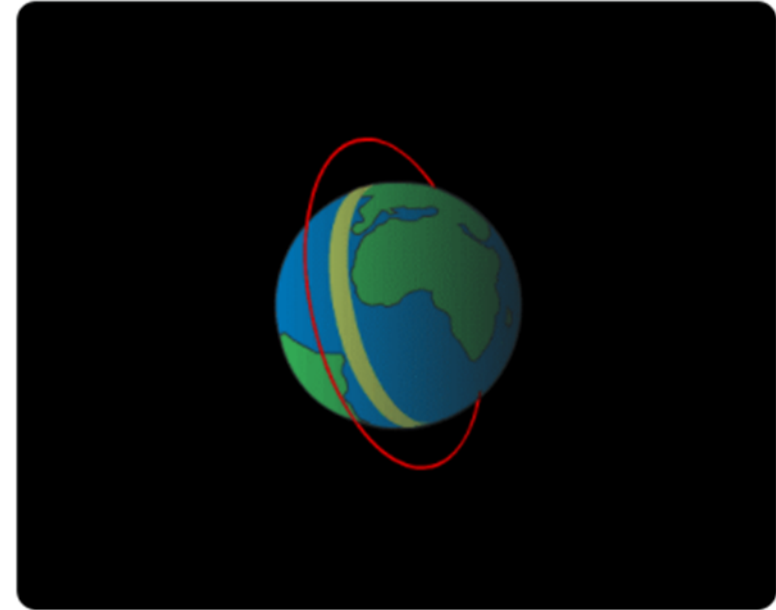


The East-West orbit of GOES satellites depicted in the yellow circle.

Spatial Resolution:  $\geq 1$  km

Temporal Resolution:  $\leq 1$  hour

Day and night views of most locations on Earth's surface (e.g., 2am and 2pm local time).



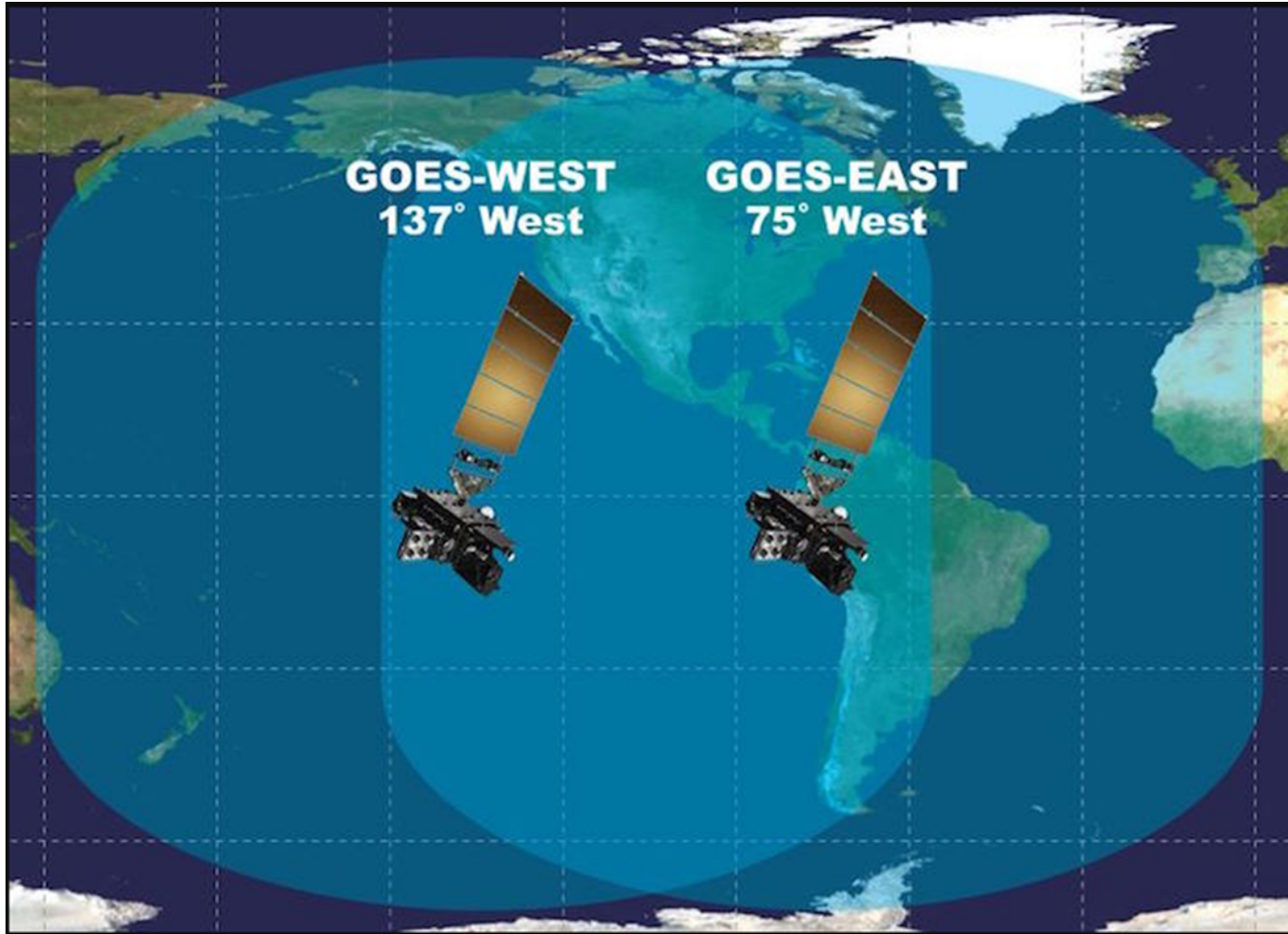
The North-South orbit of Polar orbiting satellites depicted in the yellow line.

Spatial Resolution:  $\leq 1$  km

Temporal Resolution:  $\geq$  day/night  
(Landsat 16 days)



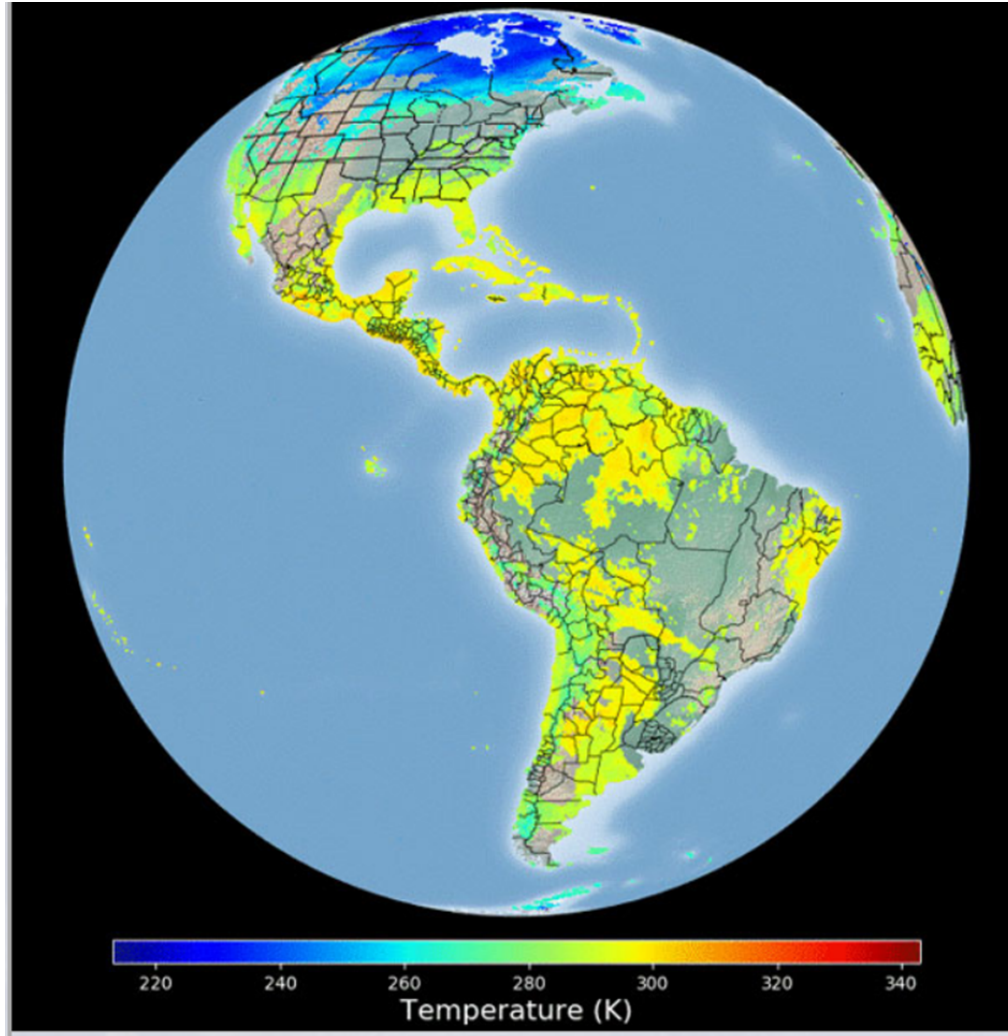
# The Geostationary Operational Environmental Satellite (GOES)



Two operational GOES satellites provide coverage of N. and S. America.



# Example of Land Surface Temperature (LST) Product



For CONUS Region:

- 2 km spatial resolution
- 1 hr temporal resolution



# Need for High Frequency of Observations (Temporal Resolution)

Greater temporal resolution allows greater frequency of observation and measurement of:

- 1) high and low temperatures, and
- 2) the diurnal temperature range and associated duration of temperatures.

## The 1995 Chicago Heat Wave: How Likely Is a Recurrence?



Thomas R. Karl and Richard W. Knight  
National Climatic Data Center, Asheville, North Carolina

### ABSTRACT

The deadly heat wave of July 1995 that affected much of the U.S. midwest, most notably Chicago, Illinois, has been put into historical perspective. The heat wave has been found to be remarkably unusual, but only partially because of the extreme high apparent temperatures (an index of the combined effect of temperature and humidity on humans), where the authors calculate a return period of the peak apparent temperature of  $\leq 23$  yr. Of greater significance were the very high temperatures that persisted day and night over an extended 48-h period. Analysis presented here indicates that for Chicago such an extended period of continuously high day and night apparent temperature is unprecedented in modern times. The authors find that the minimum temperature for the heat wave (21.5°C (70.7°F)) is related to be an extreme parameter (temperature persistence of temperature).

Such unusual was merely an extreme of trends (1948–1995) year from 26 months wide range of temperature with its persistence that because of effects of urbanization, and little trend of summer mean temperatures, it is unlikely that the macroscale climate of heat waves in the Midwest or in Chicago is changing in any significant manner.

Trends notwithstanding, the authors demonstrate the difficulty associated with projecting changes in the frequency and severity of similar types of events, even if the mean apparent temperature could be accurately predicted for the next century, for example, global warming projections. This is demonstrated using Chicago temperatures. The authors show that accurate projections of the frequency, severity, and duration of heat waves in the Midwest require accurate projections not only of the mean, the interannual variance, the intraseasonal variance, and day-to-day persistence, but also the interrelationships among these quantities within different synoptic-climatic regimes.

### 1. Introduction






lyzed the impacts and responses to the 1995 heat wave, and Kunkel et al. (1996) have reviewed the

Karl TR, Knight RW. The 1995 Chicago heat wave: How likely is a recurrence. *B Am Meteorol Soc.* 1997;78(6):1107–1119.

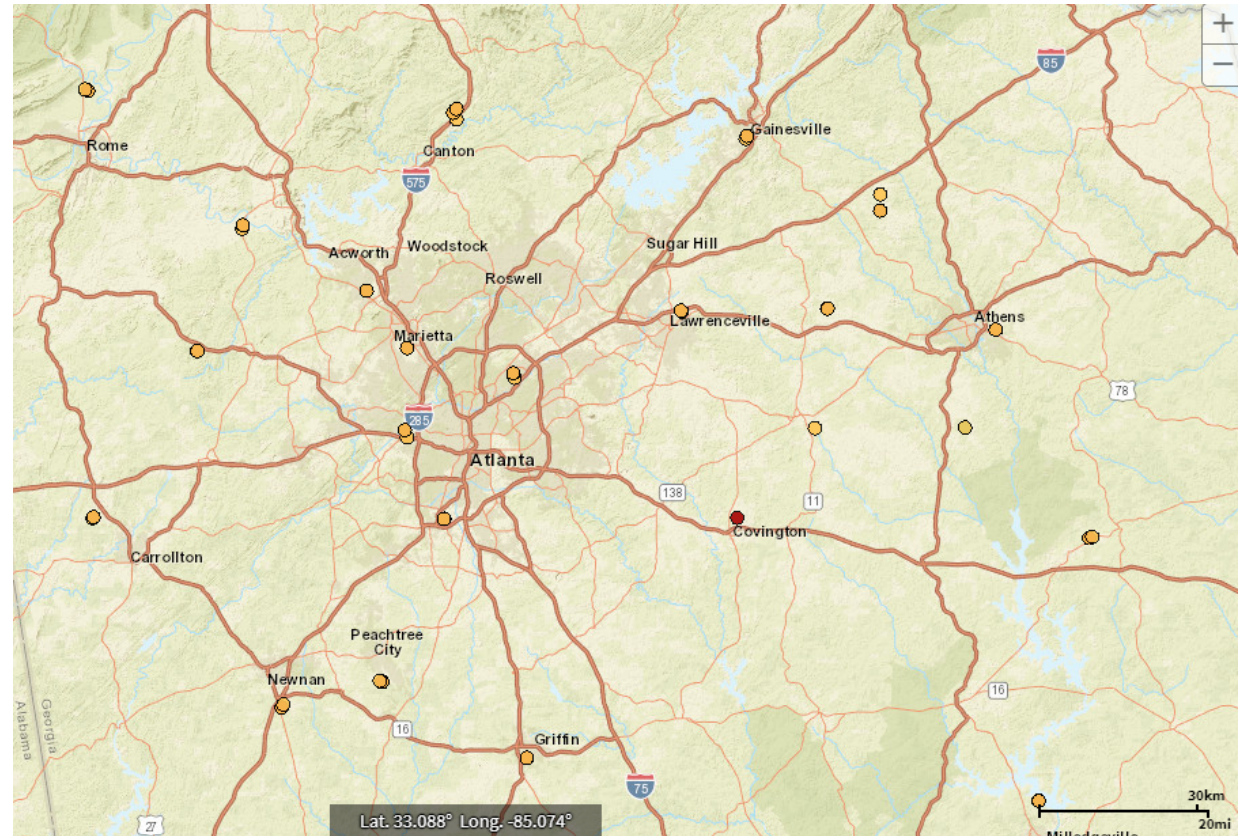


# Need for High Frequency of Observations (Temporal Resolution)

Diurnal temperature observations at standard climatological network locations are relatively few, even in major metropolitan regions.

LEGEND	
Hourly Global	
Climate Reference Network	 CRN  AL HCN-M  US HCN-M
Local Climatological Data	

## Diurnal Temperature Stations: Atlanta Region

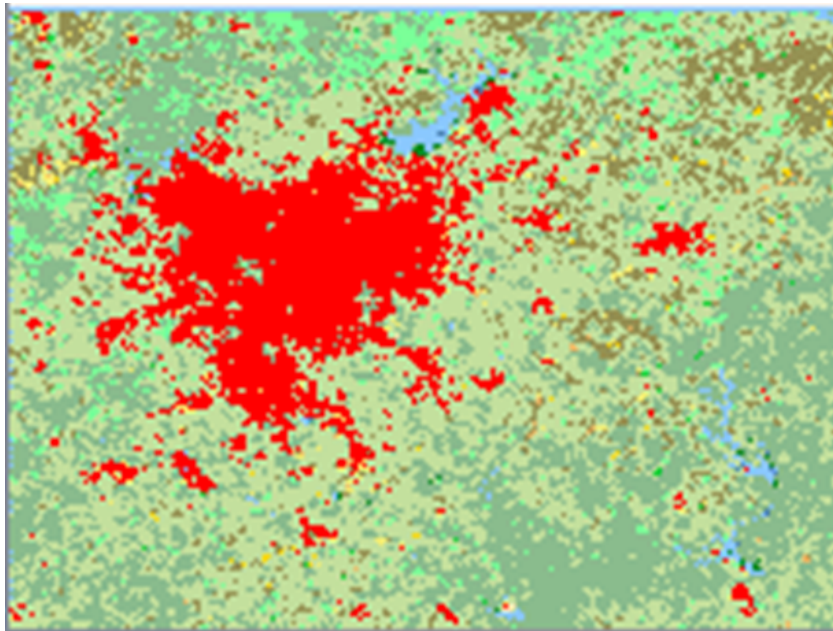






<https://gis.ncdc.noaa.gov/maps/ncei/cdo/hourly?layers=001>



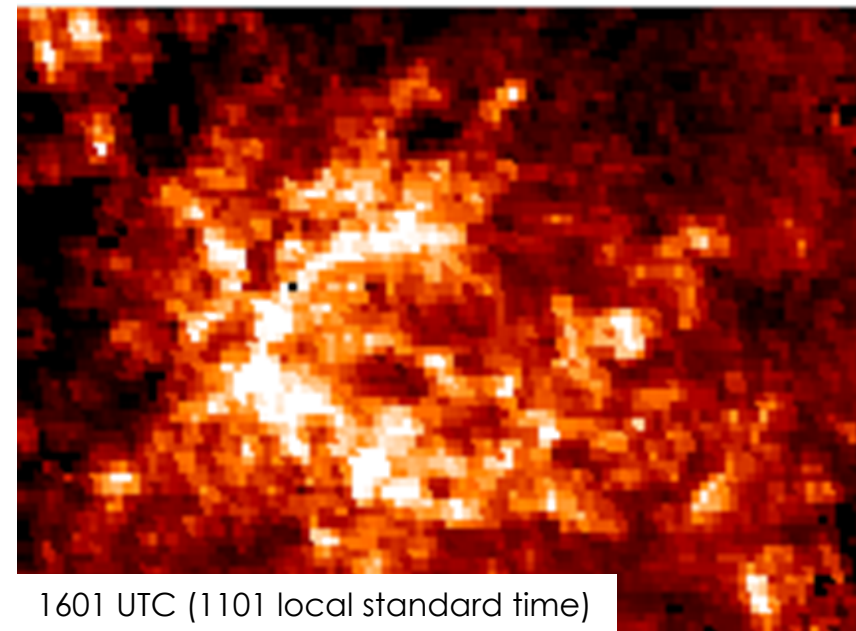
# Atlanta Regional Land Cover Observations and Land Surface Temperature

Visible Infrared Imaging Radiometer Suite (VIIRS) Land Surface Type Product



- Urban & built up 
- Woody Savana 
- Mixed Forest 
- Water 

GOES-16 Advanced Baseline Imager Land Surface Temperature:  
16 Aug 2019

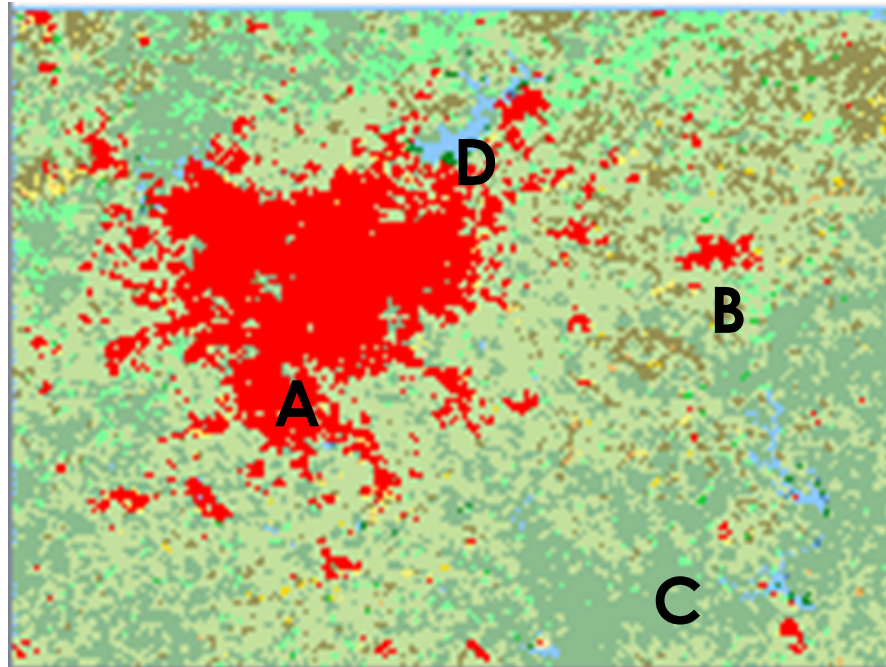


Low High  
Land Surface Temperature



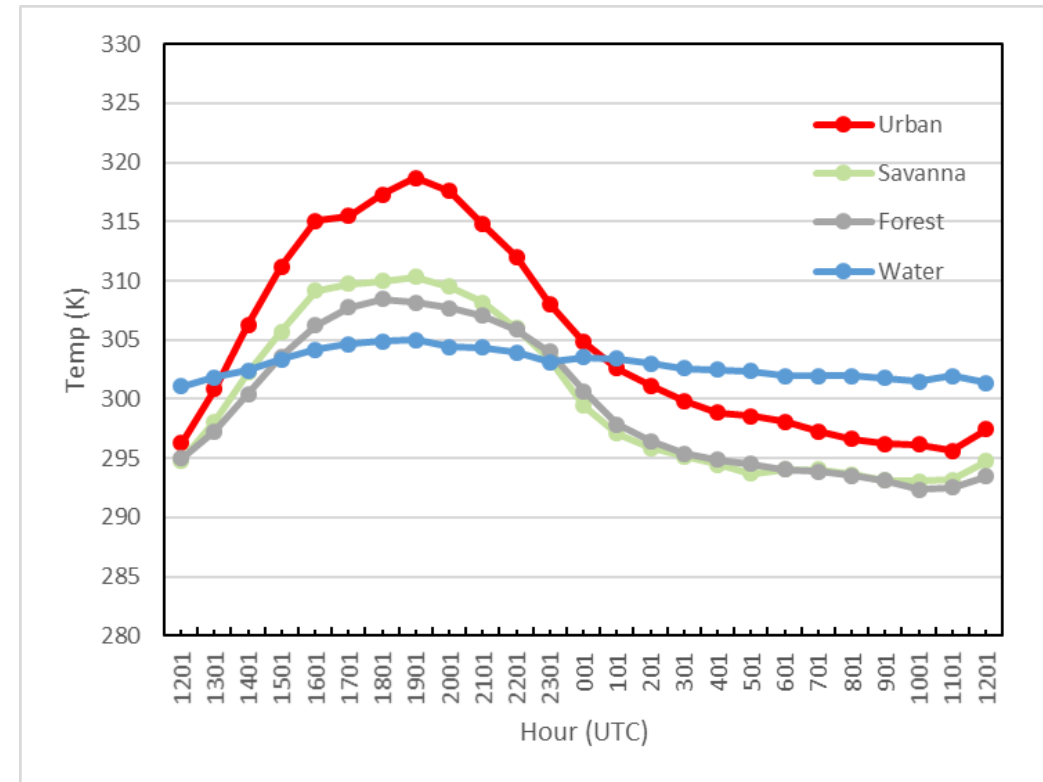
# Land Cover Observations of Diurnal Land Surface Temperature

Land Surface Type



- A** Urban & built up
- B** Woody Savanna
- C** Mixed Forest
- D** Water

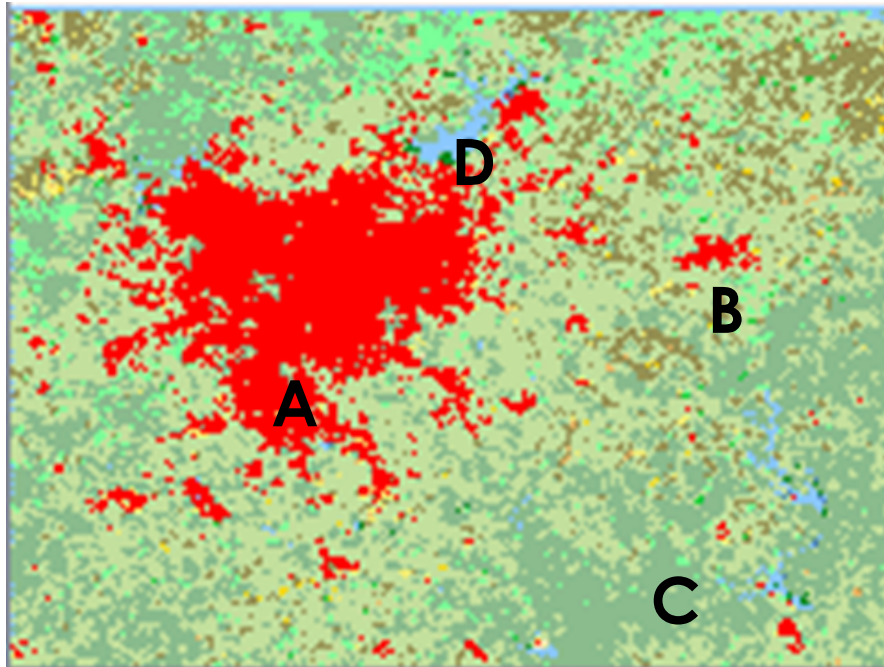
Land Surface Temperature:  
16-17 August 2019



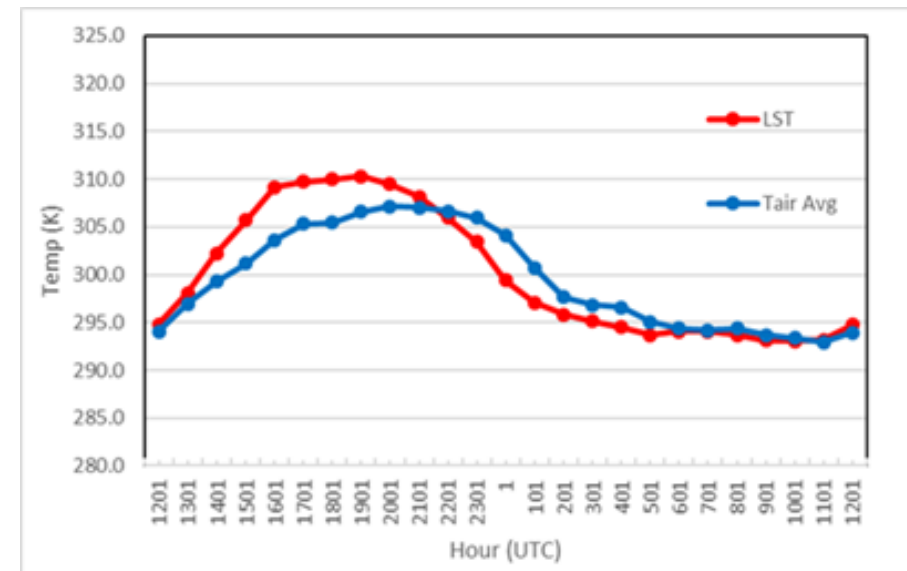
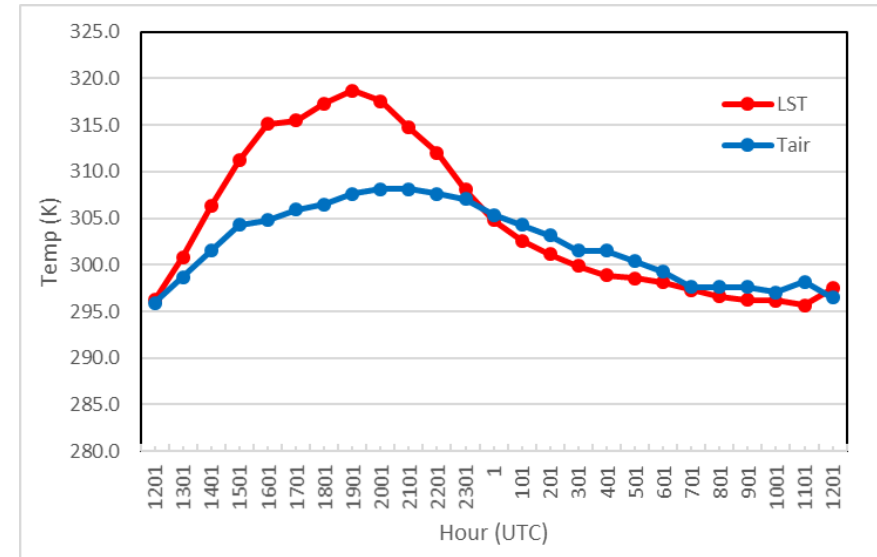


# Land Cover Observations of Diurnal Air and Land Surface Temperature

Land Surface Type



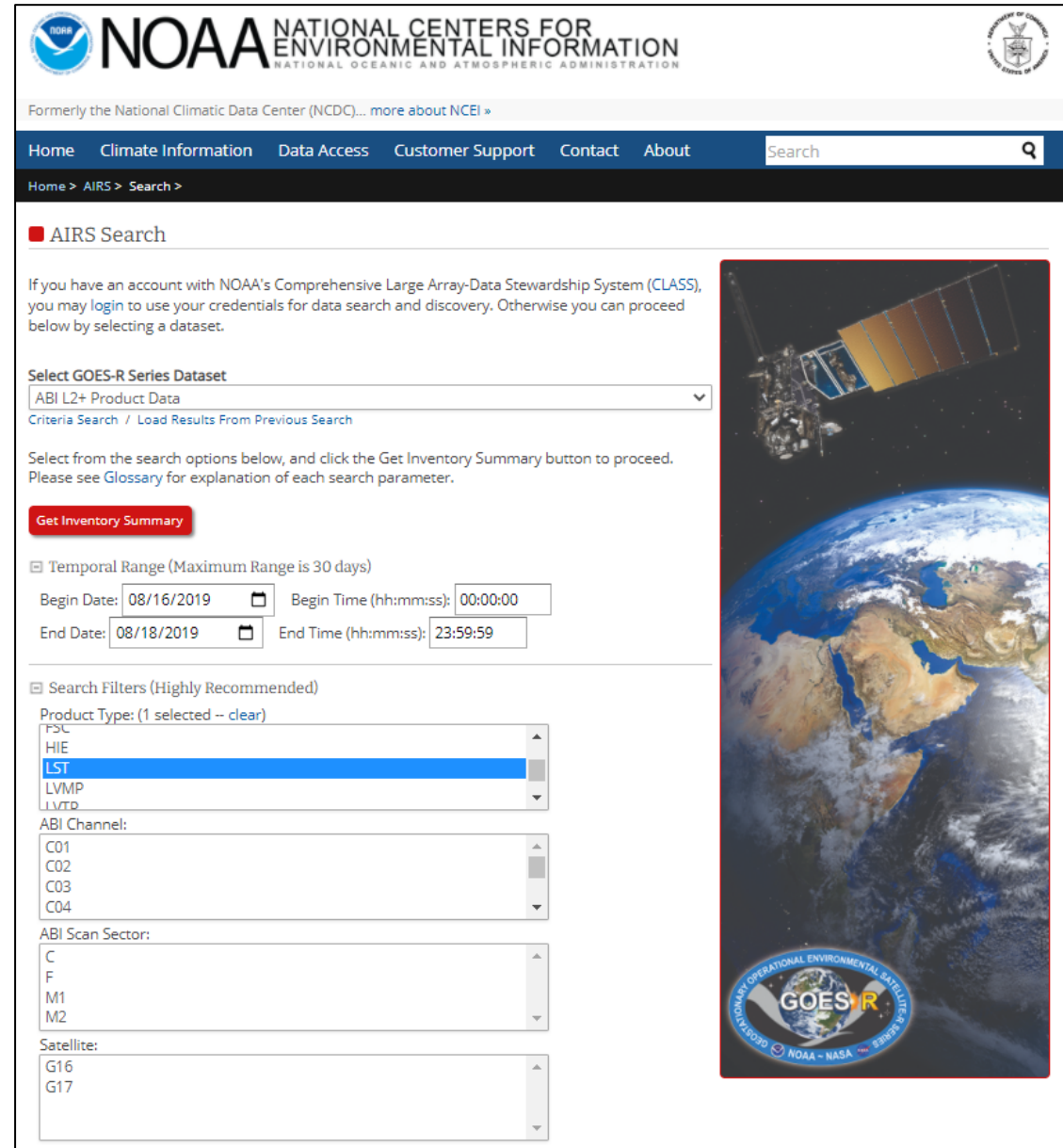
- A** Urban & built up
- B** Woody Savanna
- C** Mixed Forest
- D** Water



# How to Obtain the GOES Land Surface Temperature (LST) Product

NOAA's Archive Information Request System (AIRS)

<https://www.ncdc.noaa.gov/airs-web/search>



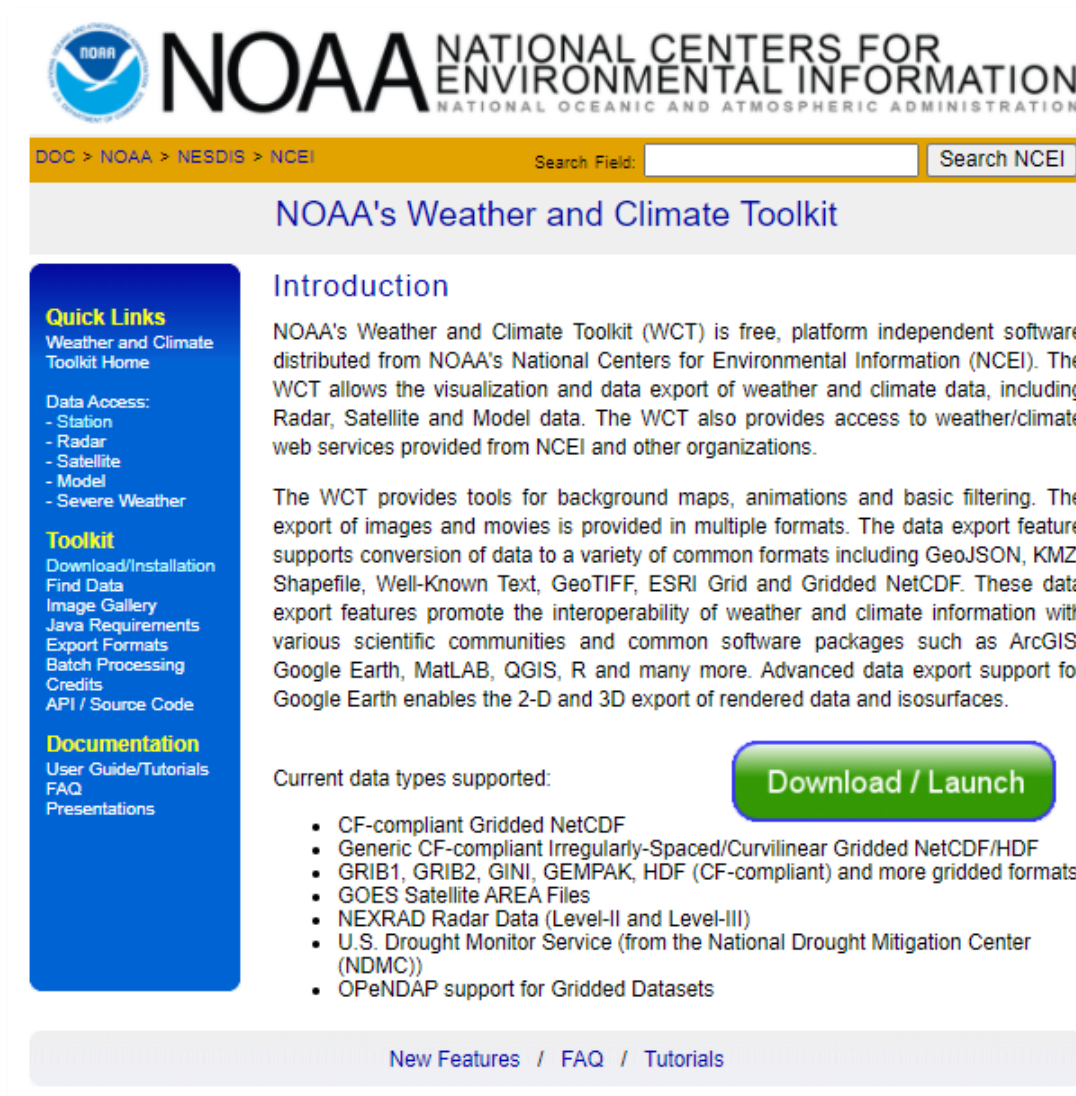
The screenshot displays the NOAA AIRS Search interface. At the top, the NOAA logo and "NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION" are visible. Below the navigation bar, the "AIRS Search" section is active. A dropdown menu for "Select GOES-R Series Dataset" is set to "ABI L2+ Product Data". A red "Get Inventory Summary" button is prominent. The "Temporal Range" section shows a date range from 08/16/2019 to 08/18/2019. The "Search Filters" section includes a "Product Type" dropdown with "LST" selected, and other filters for "ABI Channel" (C01-C04), "ABI Scan Sector" (C, F, M1, M2), and "Satellite" (G16, G17). A large image of the GOES-R satellite orbiting Earth is on the right side of the page.



# How to Obtain the GOES LST Product

## NOAA's Weather and Climate Toolkit

<https://www.ncdc.noaa.gov/wct/>



**NOAA** NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

DOC > NOAA > NESDIS > NCEI Search Field:  Search NCEI

### NOAA's Weather and Climate Toolkit

**Quick Links**  
Weather and Climate Toolkit Home  
Data Access:  
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- Radar  
- Satellite  
- Model  
- Severe Weather

**Toolkit**  
Download/Installation  
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Image Gallery  
Java Requirements  
Export Formats  
Batch Processing  
Credits  
API / Source Code

**Documentation**  
User Guide/Tutorials  
FAQ  
Presentations

### Introduction

NOAA's Weather and Climate Toolkit (WCT) is free, platform independent software distributed from NOAA's National Centers for Environmental Information (NCEI). The WCT allows the visualization and data export of weather and climate data, including Radar, Satellite and Model data. The WCT also provides access to weather/climate web services provided from NCEI and other organizations.

The WCT provides tools for background maps, animations and basic filtering. The export of images and movies is provided in multiple formats. The data export feature supports conversion of data to a variety of common formats including GeoJSON, KMZ, Shapefile, Well-Known Text, GeoTIFF, ESRI Grid and Gridded NetCDF. These data export features promote the interoperability of weather and climate information with various scientific communities and common software packages such as ArcGIS, Google Earth, MatLAB, QGIS, R and many more. Advanced data export support for Google Earth enables the 2-D and 3D export of rendered data and isosurfaces.

Current data types supported:

[Download / Launch](#)

- CF-compliant Gridded NetCDF
- Generic CF-compliant Irregularly-Spaced/Curvilinear Gridded NetCDF/HDF
- GRIB1, GRIB2, GINI, GEMPAK, HDF (CF-compliant) and more gridded formats
- GOES Satellite AREA Files
- NEXRAD Radar Data (Level-II and Level-III)
- U.S. Drought Monitor Service (from the National Drought Mitigation Center (NDMC))
- OPeNDAP support for Gridded Datasets

[New Features](#) / [FAQ](#) / [Tutorials](#)

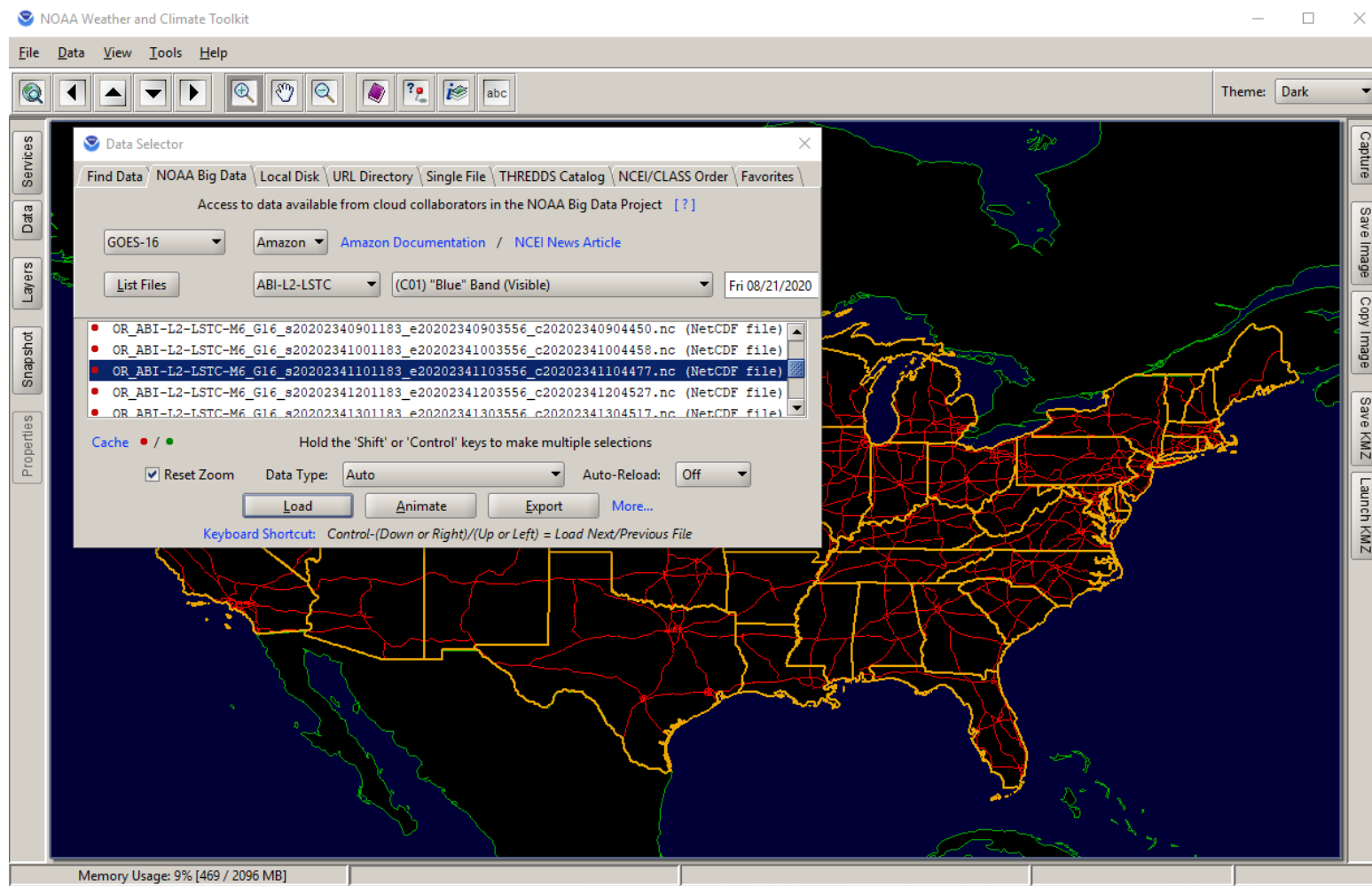


# How to Obtain the GOES LST Product

NOAA's Weather and Climate Toolkit

Data are:

- Retrieved

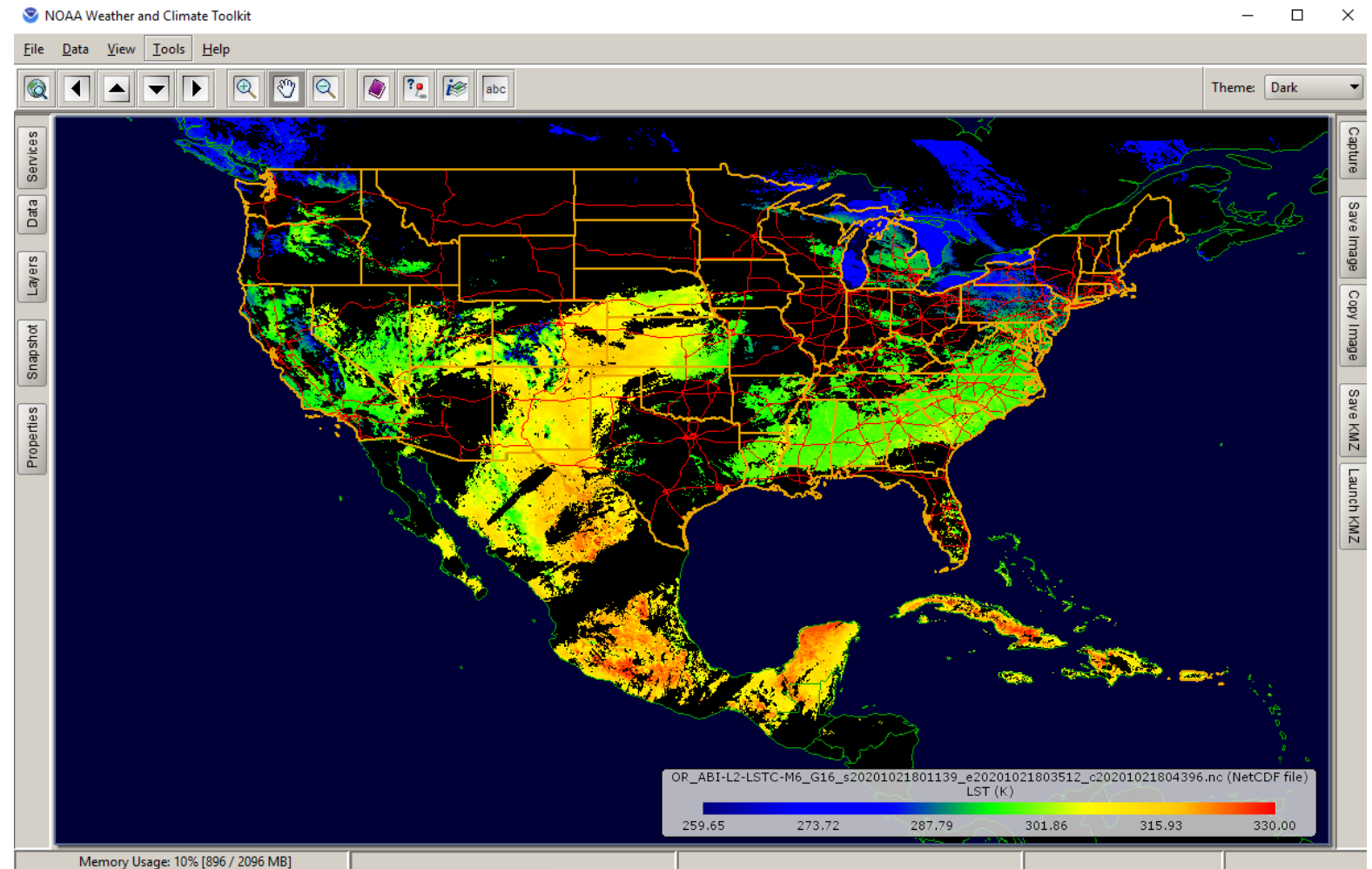


# How to Obtain the GOES LST Product

NOAA's Weather and Climate Toolkit

Data are:

- Retrieved
- Viewed

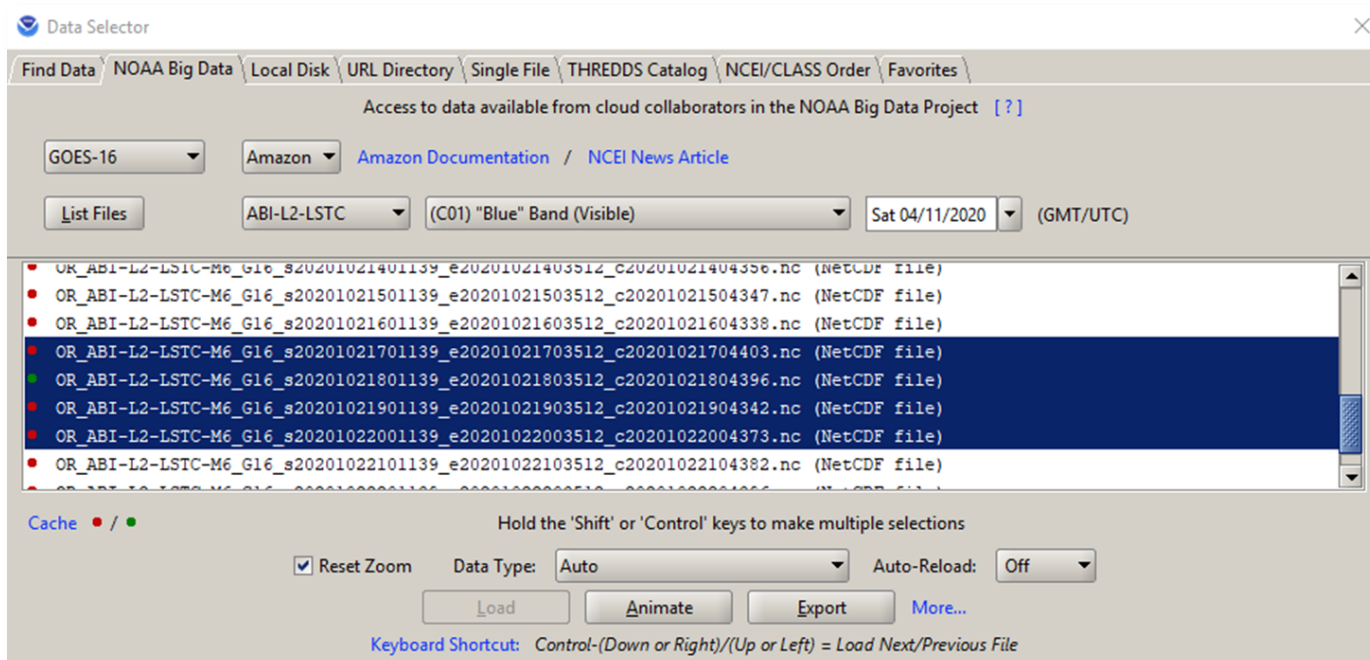


# How to Obtain the GOES LST Product

## NOAA's Weather and Climate Toolkit

Data are:

- Retrieved
- Viewed
- Custom Processed

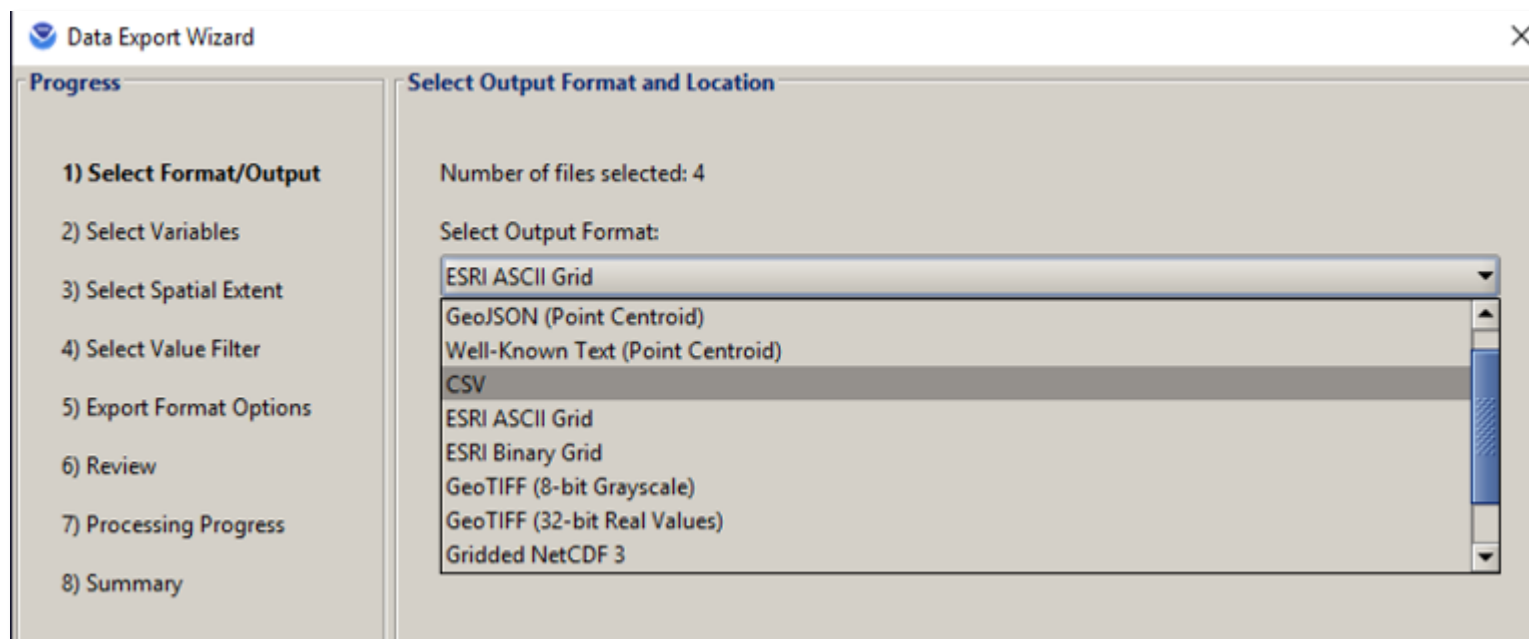


# How to Obtain the GOES LST Product

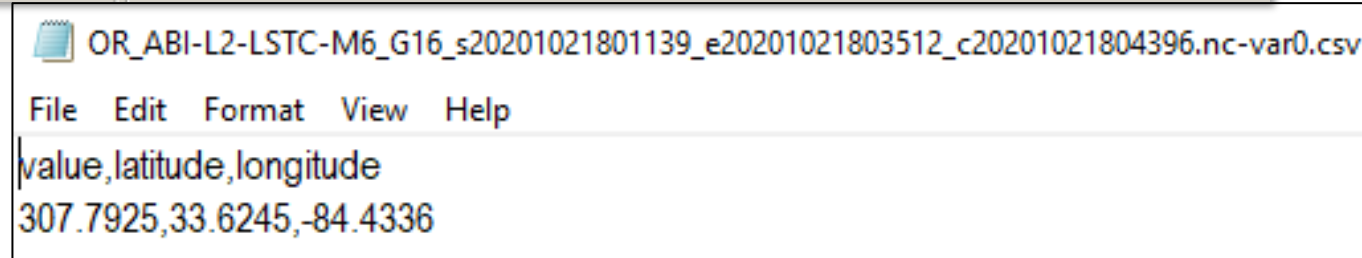
NOAA's Weather and Climate Toolkit

Data are:

- Retrieved
- Viewed
- Custom Processed
- Exported in Several Formats



**CSV  
Format  
(single  
location)**

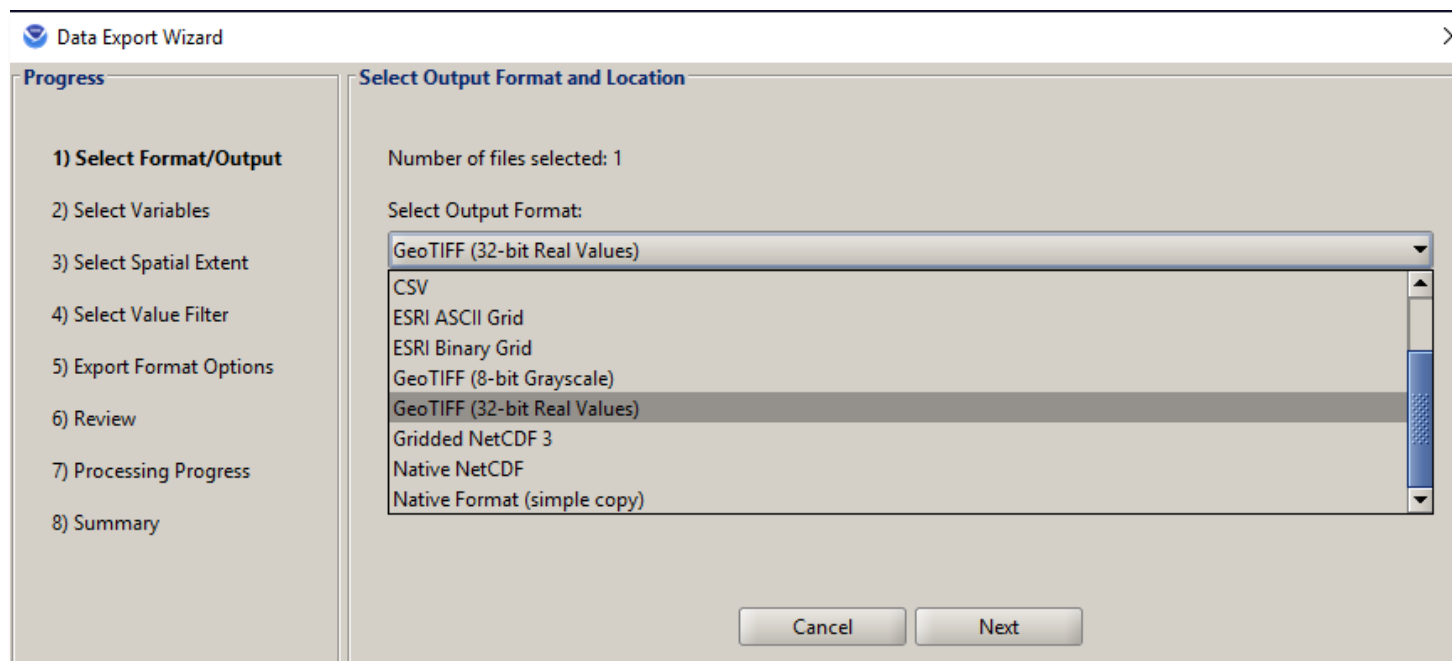


# How to Obtain the GOES LST Product

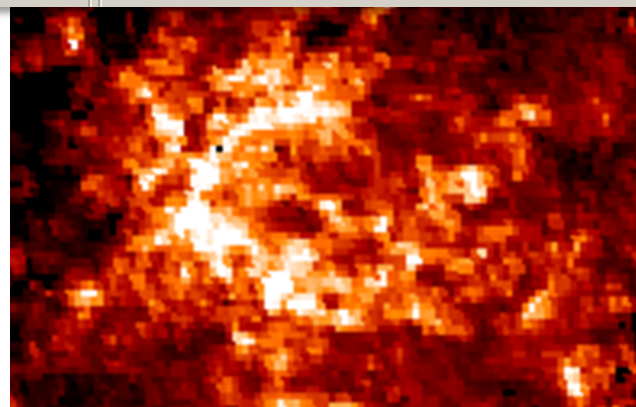
NOAA's Weather and Climate Toolkit

Data are:

- Retrieved
- Viewed
- Custom Processed
- Exported in Several Formats



**GeoTIFF  
Format**







**Thank You!**

