

# **Satellite Remote Sensing for Measuring Urban Heat Islands and Constructing Heat Vulnerability Indices**

**Format:** Online (Advanced)

**Dates:** August 2, 4, 9, 11 (2022)

**Times:** 11:00-12:30 ET and 15:00-16:30 ET

Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated and greenery is limited, become "islands" of higher temperatures relative to outlying areas. These pockets of heat are referred to as "heat islands." The rapid growth of urban populations, the urban heat island effect, and increase in the frequency and duration of heat waves due to climate change, raise a series of issues about the increased health risks of sensitive urban populations to extreme heat and the effective means of mitigating the impacts of heat waves.

Remote sensing provides global, timely, objective observations to monitor the effects of urban heat islands (UHI) over time. Thermal mapping from satellites can be used to monitor land surface temperature (LST), while optical data collected from satellites can inform where and when land use and land cover have changed over time and can be used to approximate air temperatures. Once UHIs have been mapped, incorporating socioeconomic data pertaining to population, demographics, and health information into heat vulnerability indices (HVI) can help guide interventions to manage heat related risks to public health. This 3-part advanced webinar will build on ARSET's urban heat island training held in November 2020 with hands-on exercises for participants to measure UHI and construct HVIs for their areas of interest.

This webinar series is a collaboration between NASA's Applied Remote Sensing Training Program (ARSET) and the National Integrated Heat Health Information System (NIHHIS).

## **Objectives:**

By the end of this training, participants will be able to:

- Define what an urban heat island is and why it matters to urban planners and public health experts
- Map land surface temperature from Landsat 4, 5, 7, 8, & 9 using Google Earth Engine and source complementary urban heat measurements
- Engage with local decision-makers to identify the socioeconomic inputs appropriate for constructing heat vulnerability indices

- Apply common techniques used to create heat vulnerability maps for an urban area of interest

**Audience:** Community, municipal, city, state, federal, and private institutions involved in urban planning, health care, energy supply and demand management, and climate mitigation.

**Trainers:** Sean McCartney, Amita Mehta, Kathryn Conlon, Evan Mallen, Cascade Tuholske

**Prerequisites:**

- Fundamentals of Remote Sensing  
<https://appliedsciences.nasa.gov/join-mission/training/english/arset-fundamentals-remote-sensing>
- Satellite Remote Sensing for Urban Heat Islands  
<https://appliedsciences.nasa.gov/join-mission/training/english/arset-satellite-remote-sensing-urban-heat-islands>

**Course Format:**

- Four, one and a half-hour parts including presentations and question and answer sessions
- Identical sessions held in the morning and afternoon
- A certificate of completion will be provided to participants that attend all live webinars and complete all homework assignments

**Satellites/Sensors:**

- Landsat 4-9: TM, ETM+, OLI (1/2), TIRS (1/2)
- Terra: MODIS
- Aqua: MODIS
- NPP & JPSS: VIIRS
- ISS: ECOSTRESS
- Ancillary data: SEDAC, US Census

**Software:**

- Google Earth Engine
- QGIS
- Python (Jupyter Notebook)

**Part 1: *Land Surface Temperature-Based Surface Urban Heat Island Mapping* (Aug 2)**

Materials: 1 Presentation, 1 Homework

Presenters: Sean McCartney & Amita Mehta

5 min: Overview of ARSET

10 min: Background on UHI

15 min: Demonstration of using Landsat 4-9 LST and Suomi-NPP VIIRS for measuring SUHI

30 min: Lab time for participants to analyze LST and SUHI for their area of interest

30 min: Question & Answer Session

***Part 2: Integrating Socioeconomic Data with Satellite Imagery for Constructing Heat Vulnerability Indices - Section 1 (Aug 4)***

Materials: 1 Presentation

Presenters: Kathryn Conlon, Evan Mallen

5 min: Review previous session and introduce guest speakers

20 min: Introduction to common methods used to create heat vulnerability indices (HVI)

20 min: Techniques for effectively using HVI results to inform exposure and mitigation efforts

15 min: Case studies showing how heat vulnerability mapping informed urban planning

30 min: Question & Answer Session

***Part 3: Integrating Socioeconomic Data with Satellite Imagery for Constructing Heat Vulnerability Indices - Section 2 (Aug 9)***

Materials: 1 Presentation, 1 Homework

Presenters: Kathryn Conlon, Evan Mallen

5 min: Review previous session

25 min: Demonstration on constructing HVI

40 min: Lab time for participants to construct HVI

20 min: Question & Answer Session

***Part 4: Using High-Resolution, Satellite Derived Hot-Humid Heat Estimates and Gridded Population Data to Map Extreme Heat Exposure Worldwide***

Materials: 1 Presentation

Presenter: Cascade Tuholske

5 min: Review previous session and introduce guest speaker

10 min: Introduction to Wet Bulb Globe Temperature

10 min: Overview of Global High Resolution Daily Extreme Urban Heat Exposure (UHE-Daily), v1 (1983–2016)

10 min: Overview of Annual Global High-Resolution Extreme Heat Estimates, 1983-2016

35 min: Jupyter Notebook Demonstration

20 min: Questions and Answer Session