



## Sarasota Climate

*Monitoring Heat and Assessing Heat Vulnerability to Identify Locations for Mitigation Efforts in Sarasota, Florida*

### Project Team

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### Project Overview

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#### **Project Synopsis:**

Heat vulnerability is a substantial issue in Sarasota County, Florida, that affects communities differently based on several climatological, demographic, and health factors. This project is focused on developing a Heat Vulnerability Index (HVI) for the government of Sarasota County to bolster mitigation efforts by identifying areas of highest impact versus lowest risk. The completed HVI identified three areas of highest cumulative vulnerability: Northern City of Sarasota, Venice, and North Port. It is these three areas that mitigation efforts should be focused on in descending order of priority, with Northern Sarasota City being overall the most vulnerable region of Sarasota County to heat hazards.

#### **Abstract:**

The coastal county of Sarasota, Florida, is located within the humid subtropical climate region and experiences an average of 250 days of sunshine every year. The county has large, urbanized communities which are vulnerable to urban heat island (UHI) effects. These rapidly growing communities contribute to the increasing surface temperatures and placing more residents at risk of heat-related illness. In partnership with Sarasota County Sustainability, the Sarasota Climate team utilized Earth observation data from NASA Landsat 8 and Landsat 9's Thermal Infrared Sensors (TIRS), and the International Space Station's Ecosystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) to model UHI effects within the county during the Summer for the last five years, 2019 to 2023. Data analysis with the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) and Urban Heat Exposure Assessment Tempe 1.0 (UHEAT 1.0) models and within ModelBuilder produced maps that identified the land surface temperature (LST) variance within the county, the regions that are most susceptible to extreme heat, and areas least capable of mitigating the effects of UHI. The results revealed that heat intensity varies significantly across Sarasota County with the highest temperatures in the more developed western part of the county. Additionally, the team identified that there are at least three vulnerable communities that exist in high-heat regions, including North Sarasota, Venice, and North Port. These regions have an overlap between socioeconomic sensitivity and environmental hazard that indicate a high priority in future heat mitigation efforts.

**Key Terms:**

Remote sensing, urban heat island, land surface temperature, Landsat, ECOSTRESS, InVEST, UHEAT

**Application Area:** Climate

**Study Location:** Sarasota County, FL

**Study Period:** June-August, 2019-2023

**Community Concerns:**

- Overall annual temperatures and frequency of heatwaves have both been increasing in Sarasota County, Florida, and are exacerbating existing UHI effects within communities there. This is contributing to increases in heat vulnerability across the county, with certain demographics being particularly at risk.
- Heat vulnerability is particularly important in Sarasota County because of the collective influence of substantial and increasing existing heat hazards with a large number of groups that are disproportionately at risk from these hazards. It combines these climatological and demographic factors with environmental features such as tree cover and evapotranspiration rates, as well as with land cover (since development increases UHI substantially). This work is particularly crucial to Sarasota communities because it allows for the most vulnerable people and places – those who stand to be most affected by heat – to be identified and subsequently given the tools to protect themselves from heat hazards in the future. Additionally, mitigation efforts, though they have the potential to have some economic drawbacks depending on the methods selected by the partners, should substantially increase the safety of Sarasota County residents, thereby increasing their overall quality of life.
- Sarasota County Sustainability partnered with DEVELOP to assess and pinpoint high-vulnerability zones for targeted mitigation efforts after county residents expressed interest in combatting Urban Heat Island (UHI) effects within their communities. The main goal of this project is to understand the factors contributing to varying levels of vulnerability across different demographic groups and locations. By developing HVI, Sarasota County Sustainability aims to identify strategic locations for public outreach initiatives, establishment of cooling centers, and implementation of tailored mitigation strategies to address specific requirements of each area.

**Project Objectives:**

- Assess land surface temperature variance across Sarasota County
- Explore the relationship between vulnerable populations and severe heat
- Visualize heat anomalies, heat mitigation capacity, and heat vulnerability to support community outreach

**Partner Overview****Partner Organization:**

Organization	Contact (Name, Position/Title)	Partner Type	Sector
Sarasota County Sustainability	Alia Garrett, Sustainability Outreach Coordinator	End User	Local Government

**Decision-Making Practices & Policies:**

The current process undertaken by Sarasota County Sustainability in order to identify and mitigate heat vulnerability involves researching information sourced from a number of government sites (CDC, EPA, Heat.gov, etc.) and redistributing that information amongst Sarasota residents in the form of heat infographics and flyers on their website and social media. These handouts contain an overview of extreme

heat statistics, symptoms of heat illness, highly vulnerable groups, location of cooling centers, and when to call 911 during a heat event. As a whole, these efforts do an effective job of providing important information directly to residents about the threat that is posed to them by heat hazards. However, these strategies lack a spatial component that would make them even more engaging and pinpoint more specifically what areas and groups are the most vulnerable. The undertaking and implementation of new outreach and alleviation efforts regarding information from a spatial analysis would bolster existing informatics and allow Sarasota County Sustainability to more efficiently determine where heat vulnerability is primarily clustered and how to remedy it.

## **Earth Observations & End Products Overview**

### ***Earth Observations:***

<b>Platform &amp; Sensor</b>	<b>Parameters</b>	<b>Use</b>
<b>Landsat 8 OLI</b>	LST, Band 2,4,5,6,7	Generation of daytime LST and albedo for models.
<b>Landsat 8 TIRS</b>	LST, Band 2,4,5,6,7	Generation of daytime LST and albedo for models.
<b>Landsat 9 OLI-2</b>	LST, Band 2,4,5,6,7	Generation of daytime LST, albedo, and provisional evapotranspiration (ET <sub>a</sub> ) for models.
<b>Landsat 9 TIRS-2</b>	LST, Band 2,4,5,6,7	Generation of daytime LST, albedo, and provisional evapotranspiration (ET <sub>a</sub> ) for models.
<b>ISS ECOSTRESS</b>	LST, Cloud Mask	Generation of nighttime LST for models.

### ***Ancillary Datasets:***

- USGS National Land Cover Dataset (2021) – land cover data for input in InVEST, UHEAT 1.0, and ModelBuilder analysis
- NOAA C-CAP Tree Canopy Data (2022) – tree canopy data for input in InVEST, UHEAT 1.0, and ModelBuilder analysis
- NOAA C-CAP Impervious Surface Data (2022) – impervious surface data for input in InVEST, UHEAT 1.0, and ModelBuilder analysis
- Sarasota County GIS Portal (2021) – building footprint data for input in InVEST, UHEAT 1.0, and ModelBuilder analysis
- METRIC EE-FLUX (August 22<sup>nd</sup>, 2023) – Reference evapotranspiration data for Crop coefficient (K<sub>c</sub>) calculation and input in InVEST, UHEAT 1.0, and ModelBuilder analysis

### ***Models:***

- Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Model (POC: Dr. Kenton Ross (NASA DEVELOP Program Manager) – Cooling capacity index creation for model comparison
- Urban Heat Exposure Assessment Tempe 1.0 (UHEAT 1.0) (POC: Dr. Kenton Ross (NASA DEVELOP Program Manager) – Principal Component Analysis for model comparison

### ***Software & Coding Languages:***

- Google Earth Engine – Landsat-derived daytime LST, albedo, and provisional evapotranspiration
- NASA AppEEARS – ECOSTRESS-derived nighttime LST
- Esri ArcGIS Pro 3.2 – ModelBuilder analysis and outputs, final maps for deliverables
- Microsoft Visual Studio Code – ECOSTRESS data cloud masking with Python
- Rstudio 4.3.3 - Principal Component analysis

**End Products:**

End Products	Earth Observations Used	Partner Benefit & Use
<b>Cumulative Heat Vulnerability Index (Mitigation Priority) Map for Sarasota County</b>	Landsat 8 OLI/TIRS, Landsat 9 OLI-2/TIRS-2, ISS ECOSTRESS	Shows the overall vulnerability of all census tracts in Sarasota County according to the aggregated results of the InVEST, UHEAT (PCA), and ModelBuilder models, allowing for collective county vulnerability to be easily understood and priority areas for mitigation to be identified.
<b>North Sarasota Mitigation Priority Map</b>	Landsat 8 OLI/TIRS, Landsat 9 OLI-2/TIRS-2, ISS ECOSTRESS	Specifically identifies the most vulnerable section of Sarasota County so that the Sustainability office knows where to direct their primary mitigation efforts
<b>Venice Mitigation Priority Map</b>	Landsat 8 OLI/TIRS, Landsat 9 OLI-2/TIRS-2, ISS ECOSTRESS	Specifically identifies the second most vulnerable section of Sarasota County so that the Sustainability office knows where to direct subsequent mitigation efforts
<b>North Port Mitigation Priority Map</b>	Landsat 8 OLI/TIRS, Landsat 9 OLI-2/TIRS-2, ISS ECOSTRESS	Specifically identifies the third most vulnerable section of Sarasota County so that the Sustainability office knows where to direct subsequent mitigation efforts

**Product Benefit to End User:**

Spatial analysis allows the subject of “where” to be introduced to the outreach efforts that Sarasota County Sustainability are already undertaking. Their initial informatics give detailed information about resources and the effects of heat hazards but are more of an overall general guide to personally minimizing these hazards rather than a concentrated effort towards mitigation. This project will allow for the Sustainability office to identify *where* heat hazards are the worst within the county and therefore allow them to direct their efforts towards the communities that are the most vulnerable (as are identified in the final products section above). By providing maps that specifically show what areas require the most substantial intervention, Sarasota County Sustainability will be able to both more efficiently tackle heat risk within its various vulnerable communities but also will have the potential to conserve money and resources by providing a number of areas of highest priority towards which the majority of resources can be allocated instead of having them be distributed more uniformly across the entire county. Also, they – or other future project teams – can reproduce our methodology if they want to change the geographic area being examined or add new variables to the models, making the workflow of this project a malleable product.

**References**

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