**Yonkers Urban Development II**

*Leveraging NASA Earth Observations to Support Modeling Urban Cooling Interventions and Urban Heat Vulnerability in Yonkers, New York*

**Project Team**

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**Project Overview**

***Project Synopsis:***

The Yonkers Urban Development II project leveraged NASA Earth observations to model the cooling capacity of tree canopies and their contributions to thermal comfort in areas vulnerable to urban heat. In partnership with Groundwork Hudson Valley (GHV), the project provided data to support prioritization efforts of sustainable and equitable distribution of green infrastructure. Subsequently, heat literacy graphics were created to aid in GHV’s community education efforts. The project aimed to help city planners strategize interventions for urban cooling and further support GHV’s Climate Safe Neighborhoods initiative along with the city's commitment to New York State’s Climate Smart Communities program.

***Abstract:***

The City of Yonkers, New York, located in Westchester County, is experiencing rising temperatures which are a growing threat to the health and safety of its residents. However, the risk of heat-related illnesses and mortality disproportionately affects neighborhoods in Yonkers historically subjected to race-based housing segregation. To further understand these inequities, Groundwork Hudson Valley and NASA DEVELOP collaborated for a second term to evaluate community-level heat vulnerability, landcover distribution, street-level thermal comfort, and modeled urban cooling interventions. This team applied 2019 5-year American Community Survey (ACS) data and social and biophysical heat vulnerability variables established by the New York State Department of Health (NYSDOH), along with land surface temperature (LST) data collected from Landsat 8 Thermal Infrared Sensor (TIRS), and ISS ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station (ECOSTRESS) to identify communities in Yonkers in need of prioritized cooling intervention at the census tract level. Data from the Real-Time Mesoscale Analysis (RTMA) provided relevant meteorological data for the ENVI-met model to conduct street-level thermal observations and model tree canopy cooling interventions in the Yonkers neighborhoods of Kimball and Old 7th Ward. The project results will support the prioritization and equitable distribution of cooling infrastructure in identified neighborhoods. Additionally, Groundwork Hudson Valley will use the analyses as a heat literacy tool to improve advocacy efforts and inform both residents and officials about how investment in deliberate tree canopy improves the city’s thermal environment and helps mitigate extreme heat.

***Key Terms:***

Urban Heat Island, heat vulnerability, thermal comfort, equity, Landsat 8 TIRS, ECOSTRESS, ENVI-met

***National Application Areas*** ***Addressed:*** Urban Development, Health & Air Quality

***Study Location:*** Yonkers, NY

***Study Period:*** 2016 – 2021 (June 1st – August 31st)

***Community Concerns:***

* Yonkers, NY has seen an increase in heat-related illnesses and morbidity in response to hot-weather episodes.
* The impact of these episodes has been disproportionately prominent in neighborhoods that have been subject to historical race-based housing segregation that took place in the 1930s and 1940s.
* GHV seeks to quantify the demographics, health factors, and environmental risks that contribute to marginalized communities’ vulnerability to current and projected increases in heat, and how urban cooling interventions can mitigate the effects of Urban Heat Islands.

***Project Objectives:***

* Create a new heat vulnerability index based on factors examined by the New York State Department of Health and temperature.
* Evaluate the percentage and per capita landcover distribution for tree canopy cover and impervious surface in Yonkers census tracts.
* Conduct thermal comfort and microclimate condition analysis in identified high-vulnerability streets using ENVI-met
* Develop heat literacy graphics that demonstrate current heat conditions along with visualizations of proposed cooling interventions

***Previous Term:***

2021 Summer (AZ) – Yonkers Urban Development I

**Partner Overview**

***Partner Organization***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **Groundwork USA, Groundwork Hudson Valley** | Oded Holzinger, Climate Resilience Manager | End User | Yes |

***Decision-Making Practices & Policies:***

GHV works with the City of Yonkers on vulnerability assessments and the mitigation strategies portion of the city’s climate action plan. Currently, GHV uses various GIS layers related to demographics, health variables, and environmental risks. The non-profit also uses remotely sensed data, including a land surface temperature map, landcover, and topography data, to examine the relationship between urban heat vulnerability and historical and environmental inequities caused by redlining. Their current research, however, does not take into account thermal comfort or mean radiant temperature, which can fine-tune their vulnerability index and provide spatially explicit urban cooling capacity data.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 8 TIRS** | Land surface temperature | Temperature product was used to calculate daytime land surface temperature and hotspots for 2016–2021. |
| **ISS ECOSTRESS** | Land surface temperature  | Nighttime measurements of land surface temperature were gathered from ECOSTRESS to enhance the partners’ understanding of urban heat dissipation and consequent neighborhood-level health concerns. |

***Ancillary Datasets:***

* National Land Cover Database (NLCD) 2019 – Landcover data used to help calculate the percentage of open space, and high building intensity comprised each census tract for the heat vulnerability calculation.
* National Land Cover Database (NLCD) Percent Tree Canopy Cover and Developed Imperviousness 2016 - Tree canopy cover and imperviousness data used to calculate the percentage and landcover per capita data for each Yonkers census tract.
* Real-Time Mesoscale Analysis (RTMA) – Temperature, wind speed, and wind direction data used to provide meteorological data for the tree canopy cover modeled scenarios in ENVI-MET, collected at a 2500-meter spatial resolution.
* US Census Bureau American Community Survey (ACS) 2015 to 2019 – Socioeconomic and demographic variables from the survey used to reevaluate heat vulnerability
* US Census Bureau TIGER Dataset (2019) – Census tract shapefile used to map ACS data.

***Modeling:***

* ENVI-met Climate Model (POC: Dr. Peter Crank, Arizona State University) – Used to calculate thermal comfort based on solar radiation, wind, air temperature and humidity

***Software & Scripting:***

* Google Earth Engine – Generated Landsat 8 TIRS land surface temperature data for urban heat contribution variables derived from NASA Earth observations, and RTMA meteorological data for ENVI-met.
* ArcGIS Pro v2.8.2 – Processed ISS ECOSTRESS data, analyzed temperature, landcover, and social variables at the census tract level, and visualized how heat vulnerability varies across Yonkers.
* ArcGIS Online – Created a StoryMap to serve as a tool for advocacy and public outreach.
* R v4.1.1 – Collected TidyCensus data for the social variables used for the heat vulnerability analysis, and the Principal Component Analysis (PCA) used to calculate our updated heat vulnerability index.

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used**  | **Partner Benefit & Use** | **Software Release Category** |
| **City of Yonkers Heat Vulnerability Map** | Landsat 8 TIRSISS ECOSTRESS | The partner will use heat vulnerability maps to identify neighborhoods or corridors with highly susceptible populations to better prioritize cooling initiatives that will have the greatest societal benefit. This heat vulnerability analysis takes into account heat and biophysical variables that the NYSDOH uses to calculate heat vulnerability, in addition to a temperature component. | N/A |
| **Yonkers Landcover Per Capita Analysis** | N/A | The partner will use this data as a supplement to the heat vulnerability index to better visualize the relationships between landcover distribution and heat vulnerability in Yonkers. This product will support equitable urban cooling prioritization efforts. | N/A |
|  **Thermal Comfort Analysis and Street Cooling Intervention Models** | N/A | The partner will use results of the thermal comfort analysis to understand the microclimates of street-level heat and feels like temperatures of high heat vulnerable areas in Kimball and Old 7th Ward, in order to help city planners strategize urban cooling interventions. | N/A |
| **Yonkers Heat Literacy StoryMap** | Landsat 8 TIRSISS ECOSTRESS | The partner will integrate heat literacy graphics into their public and stakeholder communication efforts to improve heat literacy and advocacy initiatives.  | N/A |

***Product Benefit to End User:***

Groundwork Hudson Valley will utilize the results from this work to target climate adaption strategies in vulnerable communities and inform their advocacy efforts for climate change adaptation and environmental equity initiatives. Meanwhile, the educational material will help spread awareness and grain traction amongst a variety of stakeholders. The maps will support Groundwork Hudson Valley’s Climate Safe Neighborhoods initiative by helping city planners strategize equitable interventions for urban cooling. The products will also aid GHV’s prioritization of mitigation efforts throughout their partnership with the City of Yonkers to meet the goals of New York State’s Climate Smart Communities program — improving community public health and safety and building resiliency to the impacts of climate change.

**References**

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