

NASA DEVELOP National Program

2023 Spring Project Proposal

California – JPL

Los Angeles Urban Development

Utilizing NASA Earth Observations to Evaluate the Impact of Tree Coverage on Urban Heat Mitigation

Project Overview

Project Synopsis: This project aims to examine the impact of tree coverage on mitigating the urban heat island effect in Los Angeles. To accomplish this, land surface temperature from ECOSTRESS, Landsat 8 TIRS, and Landsat 9 TIRS-2 will be summarized by census block and compared to tree canopy data derived from PlanetScope, the National Land Cover Database, and the city's tree inventory data. In collaboration with Los Angeles Sanitation & Environment, USDA Forest Service, and California State University, Los Angeles, the team will create maps of heat distribution, maps of tree canopy coverage, an analysis of the relationship between tree canopy and heat distribution, and a creative communication deliverable. These products will help end-user partners at City Plants and the Office of City Forest Management identify locations to plant trees and evaluate the impact of their tree planting programs.

Study Location: Los Angeles, CA

Study Period: January 2020 – January 2023

Advisors: Glynn Hulley (NASA Jet Propulsion Laboratory, California Institute of Technology) glynn.hulley@jpl.nasa.gov; Dr. Anamika Shreevastava (NASA Jet Propulsion Laboratory, California Institute of Technology) anamika.shreevastava@jpl.nasa.gov; Benjamin Holt (NASA Jet Propulsion Laboratory, California Institute of Technology)

Partner Overview

Partner Organizations:

Organization	Contact (Name, Position/Title)	Partner Type	Sector
City Plants	Rachel O'Leary, Executive Director	End User	Non-profit
City of Los Angeles, Department of Public Works, Office of City Forest Management	Rachel Malarich, City Forest Officer	End User	Local Government
City of Los Angeles, Los Angeles Sanitation & Environment	Mas Dojiri, Assistant Director; Michelle Barton, Environmental Supervisor	Collaborator	Local Government
United States Department of Agriculture, Forest Service	Miranda Hutten, Urban & Community Forestry Program Manager	Collaborator	Federal Government
California State University, Los Angeles	Eric Wood, Assistant Professor	Collaborator	Academia

End User Overview

End User's Current Decision-Making Process & Capacity to use Earth Observations: Los Angeles's Green New Deal plans to plant 90,000 trees and increase tree canopy coverage by at least 50% by 2028. As part of the effort to support these goals, the City of Los Angeles has a public-private partnership with City Plants that brings together non-profit organizations to coordinate tree planting and management throughout the city. Additionally, the Office of City Forest Management was created in 2019 and is responsible for developing an Urban Forest Management plan for the city. City Plants and the City of Los Angeles are familiar with NASA Earth observations and have worked with remote sensing products, such as LiDAR. However, they do not regularly process satellite data and incorporate it into their current decisions regarding urban tree monitoring and planting. This project would enhance their ability to assess the impact of their tree planting programs on urban heat mitigation for the community.

Earth Observations Overview

Earth Observations:

Platform & Sensor	Parameters	Use
ISS ECOSTRESS	Land surface temperature	ISS ECOSTRESS will be used to calculate nighttime land surface temperature to summarize temperature by census block.
Landsat 8 TIRS	Land surface temperature	Landsat 8 TIRS will be used to calculate nighttime land surface temperature to summarize temperature by census block.
Landsat 9 TIRS-2	Land surface temperature	Landsat 9 TIRS-2 will be used to calculate nighttime land surface temperature to summarize temperature by census block.
Planet PlanetScope	Surface reflectance, Normalized Difference Vegetation Index (NDVI), Normalized Difference Built-up Index (NDBI)	PlanetScope will be used to calculate NDVI and NDBI to measure urban vegetation cover.

Ancillary Datasets:

- United States Geologic Survey National Land Cover Database (NLCD) – Characterize impervious surfaces, urban landcover, and percent canopy cover
- City of Los Angeles Street Tree Inventory – Calculate percent canopy cover and validate canopy cover estimated with remote sensing
- Jet Propulsion Laboratory Hyperspectral Thermal Emission Spectrometer (HyTES) – Calculate 5m land surface temperature to summarize temperature by census block
- US Census Bureau Topologically Integrated Geographic Encoding and Referencing /Line Shapefiles – US Census Bureau population and socioeconomic data for Los Angeles
- Centers for Disease Control (CDC) 500 Cities Project – Health statistics for Los Angeles

Decision Support Tool & End Product Overview

End Products:

End Product	Partner Use	Datasets & Analyses	Software Release Category
Heat Distribution Maps	Partners can use this map to understand areas of Los Angeles experiencing the heaviest effects of urban heat and identify areas heat mitigation efforts like green infrastructure are needed.	Land surface temperature data from ECOSTRESS, Landsat 8, and Landsat 9 will be summarized by census block.	N/A
Tree Coverage Maps	Partners can use this map to identify areas where tree coverage is sparse and planting efforts can be applied.	NDVI from PlanetScope, Canopy Cover from NLCD, and tree inventory data will be combined on a map to show tree presence and canopy coverage.	N/A
Tree Coverage and Heat Distribution Analysis	This analysis will help partners evaluate the impact of tree planting and characteristics (age, size, etc.) on urban heat mitigation. These results can help partners indicate the impact of their planting projects, which could be used to advocate for funding.	Summarized land surface temperature data from ECOSTRESS, Landsat 8, and Landsat 9 and canopy coverage data from NLCD and inventory data will be compared and statistically analyzed.	N/A
Heat Vulnerability Analysis	Partners can use this analysis to identify areas where populations may be at risk of heat related illness based on environmental and socioeconomic factors.	The tree coverage and heat distribution analysis will be combined with socioeconomic data from the CDC and US Census Bureau to identify census tracts that are most at risk of heat related illness.	N/A

Project Timeline & Previous Related Work

Project Timeline: 1 Term: Spring 2023

Similar Past DEVELOP Projects:

- 2021 Fall Yonkers Urban Development II – https://www.devopedia.developexchange.com/dp/index.php?title=Yonkers_Urban_Development_II_AZ_Fall_2021
- 2020 Huntsville Urban Development – https://www.devopedia.developexchange.com/dp/index.php?title=Huntsville_Urban_Development_MSFC_Summer_2020

Notes & References:

Notes: The advisors listed on this proposal need to be confirmed. Glynn has been working on street tree studies in Los Angeles and he has expressed interest in advising but needs to get back to us about his availability. Anamika is Glynn's post-doc and Ben is currently in communication about confirming advising support with her.

References:

Hulley, G., Shivers, S., Wetherley, E., Cudd, R. (2019). New ECOSTRESS and MODIS land surface temperature data reveal fine-scale heat vulnerability in cities: a case study for Los Angeles County, California. *Remote Sensing*, 11(18), 2136-2163. doi: 10.3390/rs11182136