Low-income areas shown to experience hotter temperatures in L.A. county

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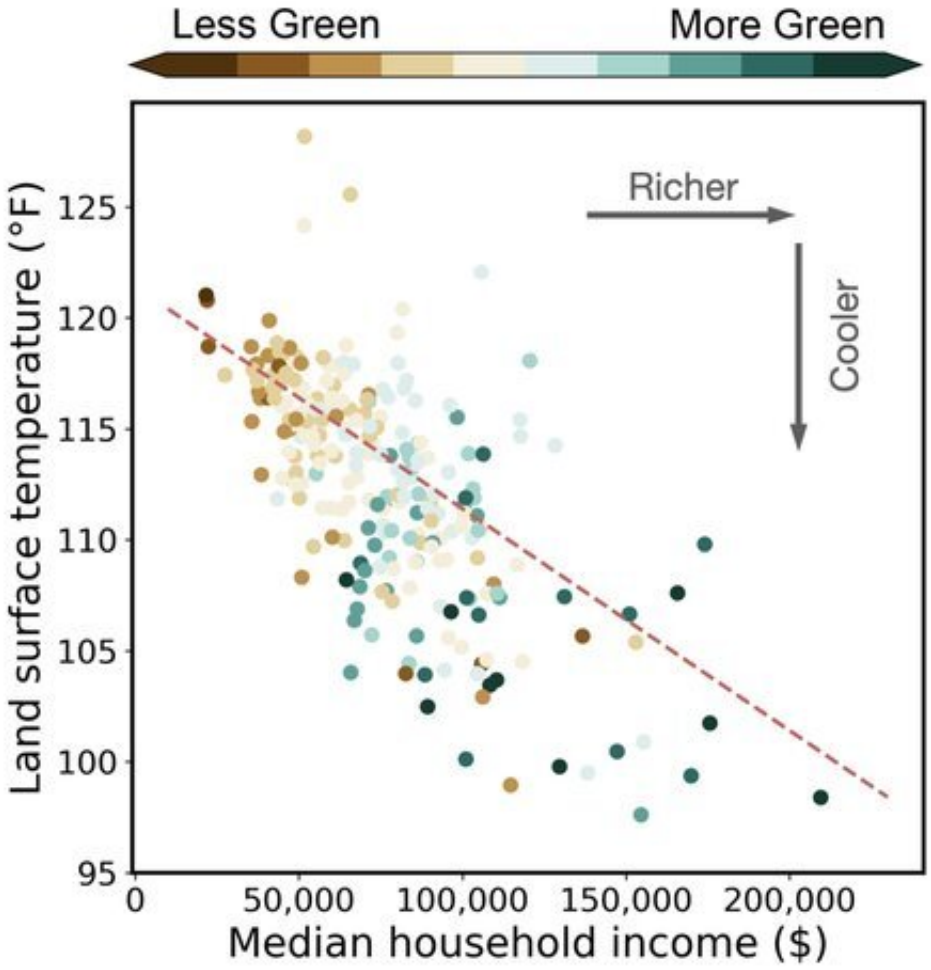

Median household income is negatively correlated with average land surface temperature and positively correlated with amount of vegetation. Credit: Y. Yin

In recent years, the Los Angeles region—home to 9.8 million people—has experienced record-breaking heat waves and steadily increasing average temperatures due to climate change. While climate change is a global problem, its effects often impact disadvantaged communities more strongly than others. A new study shows that, in L.A. County, lower-income neighborhoods have hotter surface temperatures than higher-income neighborhoods. These differences can be up to 36 degrees Fahrenheit at noon on a summer day.

The disparities, the study shows, are primarily due to higher levels of vegetation, which helps dissipate heat, in higher-income areas. Meanwhile, planting more trees and using sustainable maintenance and irrigation practices in lower-income areas could help bring surface temperatures down. In dense urban areas where planting trees is less viable, the authors suggest that increasing the reflectivity of surfaces—roofs, streets, and so on—could help to lower temperatures.

The study, described in a paper titled "Unequal Exposure to Heatwaves in Los Angeles: Impact of Uneven Green Spaces" and published in the journal *Science Advances* on April 28, was conducted in the laboratories of Christian Frankenberg, professor of environmental science and engineering and a research scientist at JPL, which Caltech manages for NASA; and Paul Wennberg, R. Stanton Avery Professor of Atmospheric Chemistry and Environmental Science and Engineering.

"Raising awareness about the risks of heat waves, and acknowledging the unequal exposure across different socioeconomic groups, is increasingly important," Frankenberg says. "Studies like ours can inform urban planning choices to promote environmental justice and increase the resilience of our cities as summers get warmer."

Led by Caltech research scientist Yi Yin, the team looked at high-resolution surface temperature measurements collected during the past

four years. This data was taken by ECOSTRESS, a satellite instrument developed at JPL and installed on the International Space Station that measures Earth's surface temperature with a resolution of individual city blocks, enabling researchers to examine intracity spatial patterns. The researchers found that median household income had a strong negative correlation with surface temperature. In other words, having a higher median household income was very likely to indicate cooler surface temperatures.

"Initially, this started as a personal interest—I was looking for housing and observed that the lush, green areas were more expensive to live in," Yin says. "This inspired me to conduct the study with the detailed temperature data from the ECOSTRESS instrument and compare it with median household income data. The correlation was shockingly strong."

What is causing these disparities? After all, the sun shines evenly on the entire Los Angeles region, so why do surfaces in some areas get hotter than others?

While geography, such as the distance from the cool ocean, plays a role, the researchers found the dominating factor in surface temperature disparities is the amount of water evaporated into the atmosphere. When water evaporates—changing from a liquid to a gas—it carries heat away from the surface. This is analogous to a person getting chilly when getting out of a swimming pool—the water evaporating from your skin is carrying heat away from you. The study finds more water is evaporating in affluent neighborhoods as a result of denser tree canopies, leading to a cooling effect.

In the semi-arid L.A. climate, vegetation is primarily supported by irrigation rather than rainfall during dry seasons. In the study, the researchers recommend planting more trees in lower-income neighborhoods and prioritizing tree cover while shifting away from turf

grass. Although turf grass increases the amount of water evaporation, it does not provide shade. "Though it can be difficult to plant and maintain trees in dense urban environments, especially those with limited open space and water availability, trees produce shade and improve the quality of life for residents," Yin says.

"While irrigation in dry urban settings is often characterized as wasteful, this study illustrates the enormous benefits that come from such water use in reducing heat exposure," adds Wennberg.

Another physical factor that can modify temperatures is how much sunlight is absorbed by surfaces. Asphalt parking lots, for example, absorb sunlight efficiently and consequently heat up quickly. In contrast, it is possible to use paints and other materials that reflect more of the sunlight and thereby reduce heating. Current Los Angeles city and county policies, for example, require reflective "cool roofs."

More information: Yi Yin et al, Unequal exposure to heatwaves in Los Angeles: Impact of uneven green spaces, *Science Advances* (2023). DOI: 10.1126/sciadv.ade8501

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