Rx FOR HOT CITIES:

MORE TREES AND SOLAR REFLECTANCE

How does heat threaten people?

Extreme heat occurs when the weather is much hotter and/or humid than usual, which can lead to heat-related illnesses and deaths.

Extreme heat causes more deaths than hurricanes, floods, tornadoes and lightning combined, in an average year.

Heat-related illness and death are more common in communities of color, and among the youngest and oldest people, outdoor workers, and the homeless. Extreme heat in these communities can cause worsened chronic conditions, such as diabetes and heart and kidney conditions, which can lead to avoidable premature deaths.

Average temperatures in Los Angeles are expected to rise 3 to 7°F by the middle of the century, and some L.A. neighborhoods will have 5 to 6 times the number of extreme heat days compared to today.

As the planet warms, cities are heating up at twice the rate of non-urban areas, making many cities increasingly dangerous places to live.

How do trees and reflective surfaces help?

Urban cooling strategies — such as trees and surfaces with high solar reflectance, including roofs, pavements, and walls — can noticeably reduce urban air temperatures.

Shade from trees can lower surface temperatures by up to 45°F. Trees also provide evaporative cooling and can lower air temperatures up to 9°F.

When highly-reflective materials are used on roofs, pavements, and walls, these surfaces can be up to 60°F cooler than conventional materials and, when used widely, can reduce air temperatures by 1 to 4°F.

We quantified how trees and reflective surfaces could help cool L.A. and save lives.

The Los Angeles Urban Cooling Collaborative (LAUCC) is a multi-disciplinary partnership of universities, climate researchers, non-profit organizations, and city officials with the goal of understanding and implementing urban cooling strategies in the Los Angeles region.

LAUCC quantified how increasing tree cover and solar reflectance of roofs and pavements in Los Angeles could reduce summer temperatures, decrease the number of oppressive air mass days leading to higher heat-health risks, and prevent heat-related deaths.

We used *synoptic climatology*, an approach that categorizes days into air mass types that tend to impact a region with unique weather characteristics for a period of a few days at a time. In Los Angeles, two air mass types are responsible for most heat-related illnesses and deaths: *dry tropical* (DT), which brings dry heat, such as during periods of L.A.'s famed Santa Ana winds; and *moist tropical plus* (MT+), which brings humid heat.

We studied four historical summer heat waves that occurred between the years 2006 to 2010, each with different characteristics from the others, to capture a range of heat events in Los Angeles. We looked at heat waves that were early vs. late season, dry vs. humid, and brought intense vs. moderate heat. We then tested the cooling power of four "prescriptions" of increased tree cover and solar reflectance. We did this for the whole of L.A. County, and in 11 smaller districts in the county most vulnerable to heat-health risk.

LAND COVER PRESCRIPTIONS TESTED

	TREE COVER	SOLAR REFLECTANCE
Rx1	Low	High
Rx2	High	Low
Rx3	Medium	Medium
Rx4	High	High

Tree Cover Prescriptions Defined
Low = 25% relative increase (baseline x 1.25)
Medium = 100% relative increase (baseline x 2)
High = 40% tree cover (regardless of baseline)
For example, the tree cover for L.A. County is approximately 16%. A low scenario would be an increase to 20%; medium to 32%; and high to 40%.

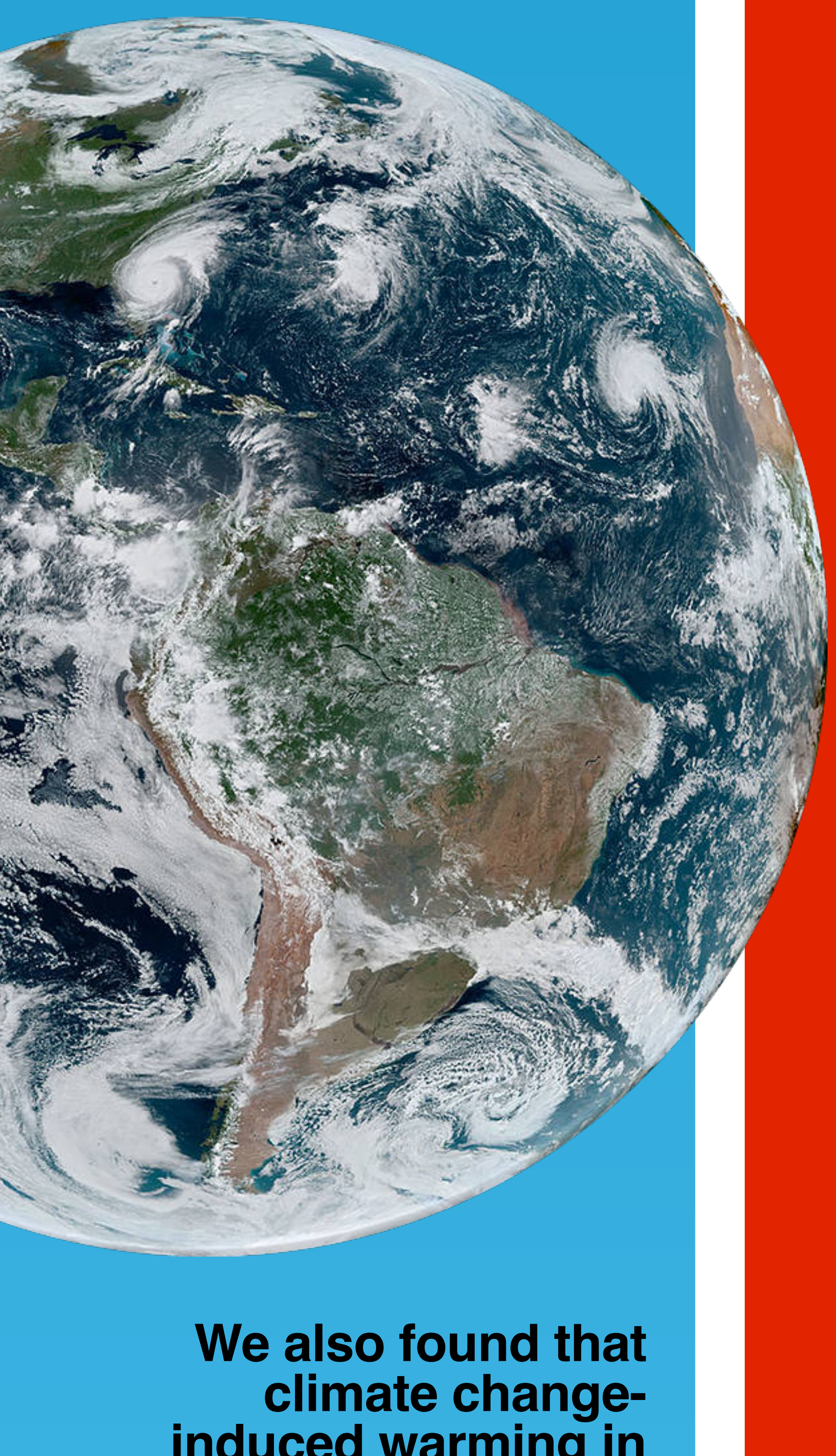
Solar Reflectance Prescriptions Defined
Baseline = All roofs combined reflect 17% of the solar energy. that falls on them. Roads, on average reflect 10%.
Low = Roofs reflect 27% of solar energy. Roads reflect 20%.
Medium = Roofs reflect 37% of solar energy. Roads reflect 25%
High = Roofs reflect 45%. Roads reflect 35%.

We found that 1 in 4 lives lost during heat waves could be saved.

For L.A. County as a whole, the results showed that 10 to 30% of lives currently lost to extreme heat could be saved. For example, one of the heat waves we studied occurred in late September 2010. That heat wave resulted in the death of 74 more Angelinos dying from all causes than if the heat wave had not happened. If L.A. County had been protected by a prescription of High Tree Cover and High Reflectance, 22 people who died would have survived — a 29% reduction in mortality.

In heat waves in Los Angeles, temperature could be decreased 2°C (3.6°F) — enough to make a life or death difference for some people. Overall, we found that 1 in 4 lives could potentially be saved from being lost to heat waves.

In several cases, changing land cover and surface reflectance in L.A. resulted in shifting the most oppressive air masses of DT and MT+ into more benign air masses. That means we could not only change microclimates, but meteorology as well.



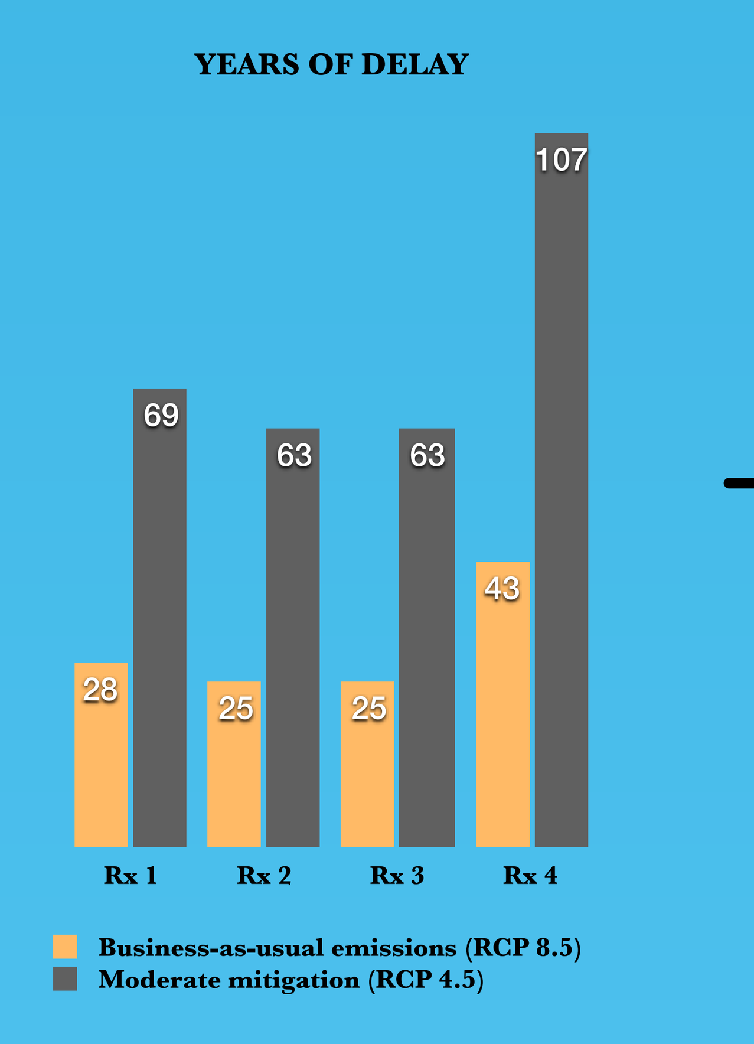
Most of the lives saved would be in low-income communities and communities of color.

For the districts analysis, we took a conservative approach in which only the district itself saw increases in tree cover and solar reflectance while the rest of the county stayed the same. Moderate mortality reductions occurred under most prescriptions. Under the High Tree Cover + High Solar Reflectance prescriptions, 1 to 2 out of every 5 heat deaths would be avoided in those districts. Districts with lower income and/or more people of color showed the most encouraging results in terms of numbers of lives saved.

We also found that climate change-induced warming in Los Angeles could be delayed 25 to 60 years.

Reducing air temperatures is not only important for L.A. County today. These strategies can also delay the negative effects of global climate change for tomorrow's residents.

We quantified how many years we could delay climate change-caused warming in Los Angeles. We found that warming could be delayed 25 to 60+ years. For example, a delay of 40+ years relative to a business-as-usual emissions scenario could occur if we were to implement a prescription of High Tree Cover + High Solar Reflectance. In this example, Angelinos could enjoy a climate in the year 2060 that is like the climate in year 2020.



We modeled the four cooling prescriptions under both business-as-usual and moderate mitigation scenarios using IPCC-approved models RCP 8.5 and 4.5. We looked at the 90th percentile of daily maximum temperature for the entire year and then just for summer (May-Oct). Using modeled data for the years 1950 to 2099, we determined the average temperature increases under the business-as-usual and moderate mitigation scenarios (+0.034°C and +0.015°C per year, respectively). We then divided the average temperature reduction of the four Tree Cover and Reflectance prescriptions by those average annual temperature increases to determine how many years of warming could be delayed. For example, implementing High Tree Cover + High Solar Reflectance would reduce temperatures by an average 1.7°C, so we find that 1.7 / 0.034 = 50 years of possible delay.

What can you do to reduce urban heat and stay safe in a heat wave?

Plant and care for trees! L.A. City residents can get free trees by visiting cityplants.org.

Install cool roofs and pavements! Learn about available products and check with your local utility for current rebates. Your electricity bill will go down while you cool your home and neighborhood.

Stay hydrated, wear-light colored, loose-fitting clothing, and find a cool indoor space! Check on elderly relatives and neighbors, especially those living alone. If you do not have air conditioning, find an air-conditioned public space by visiting lacounty.gov/heat.

Tell local and state elected officials that heat is an issue that is important to you!

Keep up with LAUCC's efforts! Visit treepeople.org/urbancooling.

About LAUCC

The Los Angeles Urban Cooling Collaborative is a multi-disciplinary, national partnership of academic researcher entities and nonprofit organizations working with communities and government agencies to research and implement data-driven, inclusive strategies for cooling urban areas and protecting vulnerable communities from heat-related health risks. Partners on this grant include: Applied Climatologists, Inc., Arizona State University Urban Climate Research Center, California State University Northridge, Climate Resolve, Global Cool Cities Alliance, Kent State University, TreePeople, David Geffen School of Medicine at UCLA, and the UCLA Center for Public Health and Disasters.

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