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Temperature

Dr. Alex Hall, Lead UCLA Researcher:

When you tack on warming of 5 – 6°F, that's a noticeable difference. If humans are noticing it, so are plants, animals & ecosystems. Our home will be fundamentally different than they are now.

For many people, climate change still feels too abstract and faraway; This makes it more real. It's eye-opening to see how much it will warm where you live. Armed with this information I'm very optimistic that we can confront and adapt to a changing climate.

Paul Bunje, Steering Committee, Climate Resolve:

L.A. is one of the first cities to get its act together, from the scientists all the way up to the Mayor. Nobody knew precisely how to adapt to climate change because no one had the data — until now. These are shocking numbers, and we have it in us as a city to adapt if we are to thrive.

What Does a Changing Climate Mean for the Communities of LA?

Until recently, city planners, advisors, leaders and residents have been unable to properly estimate and prepare for anticipated changes. In response, researchers at UCLA down-scaled dozens of global climate models to better understand the local impacts of a changing climate.

The Science

Mid- and End-of Century Warming in the Los Angeles Region: Summary of Parts I and II of the Climate Change in Los Angeles Region Project.

The Facts

Los Angeles is sure to face a warmer future as a result of climate change. Just how warm and different the future Los Angeles will be as compared to today's Los Angeles depends on what action is taken to reduce greenhouse gas emissions.

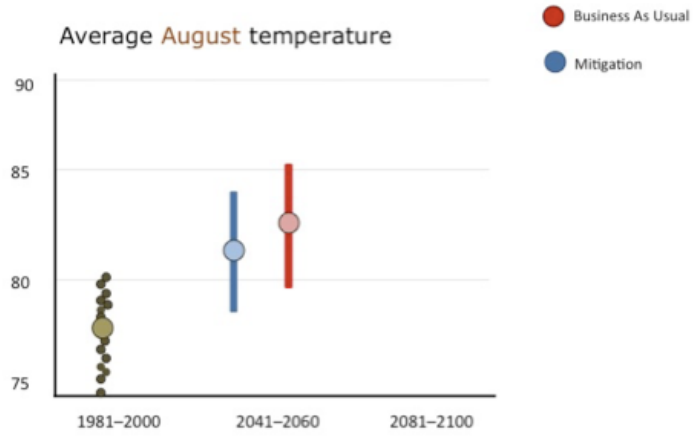
The Good News

If the world takes action to reduce greenhouse gas emissions, Los Angeles will only be moderately warmer by the end of the century—only about as much as the warmest temperatures we experience today. However, if we don't reduce global greenhouse gas emissions, Los Angeles is likely to have a new climate system by the end of this century—one where winter is replaced by spring, and summer starts earlier, extends longer into fall months, and reaches temperatures unlike any we experience today. Effectively, Los Angeles will have a new season—a "super summer" of extreme heat—and winter as we know it today will be lost. The results of this two-part study indicate specific temperature changes in Los Angeles, and demonstrate the importance of global greenhouse mitigation in preserving a livable future in Los Angeles.

How Much Warmer Will Los Angeles Get?

By mid-century, the Los Angeles region will be about 3°Fahrenheit warmer, regardless of global action to reduce greenhouse gas emissions.

We will experience hotter than normal temperatures mainly in the late summer and early fall. Trends for the month of August show just how much temperatures will change during those hotter than normal times. A future with mitigation, meaning global efforts at reducing greenhouse gases, will help us avoid some warming by mid-century, but warming is inevitable nonetheless.



Legend: The big brown dot shows present day average temps in August in Los Angeles based on several years of monthly average (brown dots). The blue dot shows the expected future average temperature in August under a scenario where there is global greenhouse gas mitigation and the blue bar shows the range of possible future temperatures within which there is a 95% chance the actual future temperature will fall. The red dot shows expected future average August temperature under a scenario where there is no major global effort to reduce greenhouse gas emissions, with the bar showing the 95% confidence range of possible temperatures.

Without mitigation of greenhouse gas emissions, the Los Angeles region will be more than 7°Fahrenheit warmer on average by the end of the century.

Looking again at the month of August, we can see just how much more temperatures could change by the end-of-century as a result of climate change. It is clear that global action to reduce greenhouse gas emissions will be extremely important to the climate in Los Angele. It will help us avoid several degrees of warming as shown by the difference between the red and the blue data points over the end-of-century time period. The temperature studies show us two possible futures, on with average monthly temperatures of ~ 81°F with global climate action or ~87°F without it. At the extremes of the possibilities, global climate action could help us return the climate system to current temperatures (bottom of the blue line) or, with no action, make August 10°F warmer than it is today.

The temperatures studies also reveal that in all cases (mid-century and end-of-century, with and without mitigation), coastal areas will warm less then inland areas, and mountain peaks will warm the most. Warming is most extreme on mountain peaks because loss of snow cover causes even more warming. When present, snow cover has a cooling effect due to its reflective surface (known as the “snow-albedo feedback”).

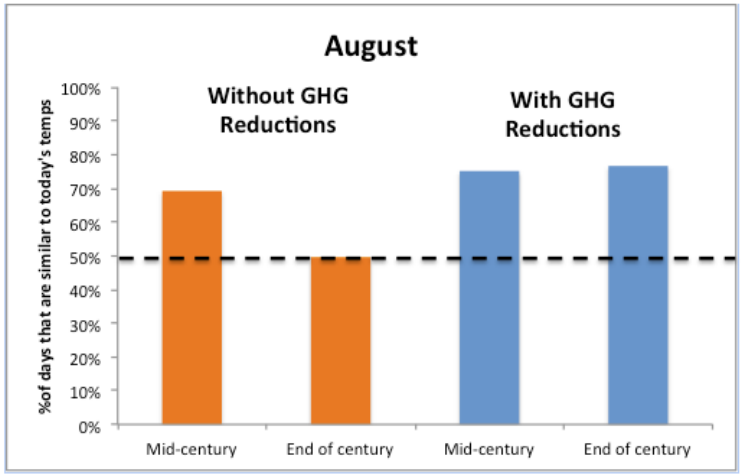
How Different Will the Future Be?

Projected changes in daily average temperature distributions

By mid-century, Los Angeles will experience temperatures similar to what we experience today about 75-80% of the time (274-292 days a year), with hotter than normal temperatures occurring mostly in the late summer and early fall. But, if we don’t reduce global greenhouse gas emissions, Los Angeles will continue to get warmer. And, by the end of the century, temperatures will be like they are today only 50-65% of the time (183-243 days a year), with December to January and July to August changing the most relative to today.

In this figure, the dotted line shows the point at which only half of the number of days in August will have temperatures similar to today, throughout the LA region, which means the rest of the days in August will be hotter than we are accustomed to today. As you can see, aggressive action to reduce greenhouse gas emissions (blue bars), keeps us well above this half-way point and we can keep August feeling

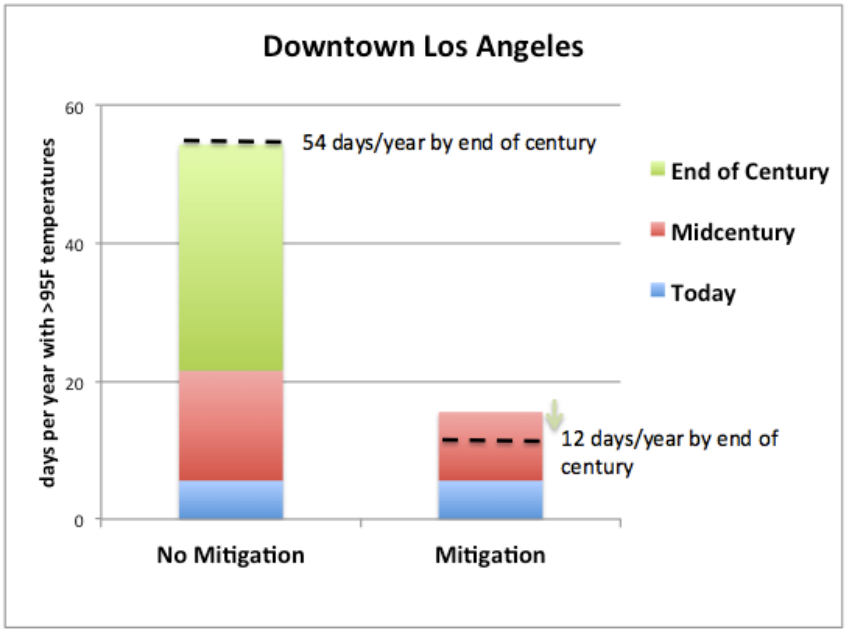
similar to today about 75% of the time by mid-century and hold it there out to the end of the century. Without greenhouse reductions, end-of-century August reaches the half way line and ~15 days of that month will be hotter than today's August temperatures.



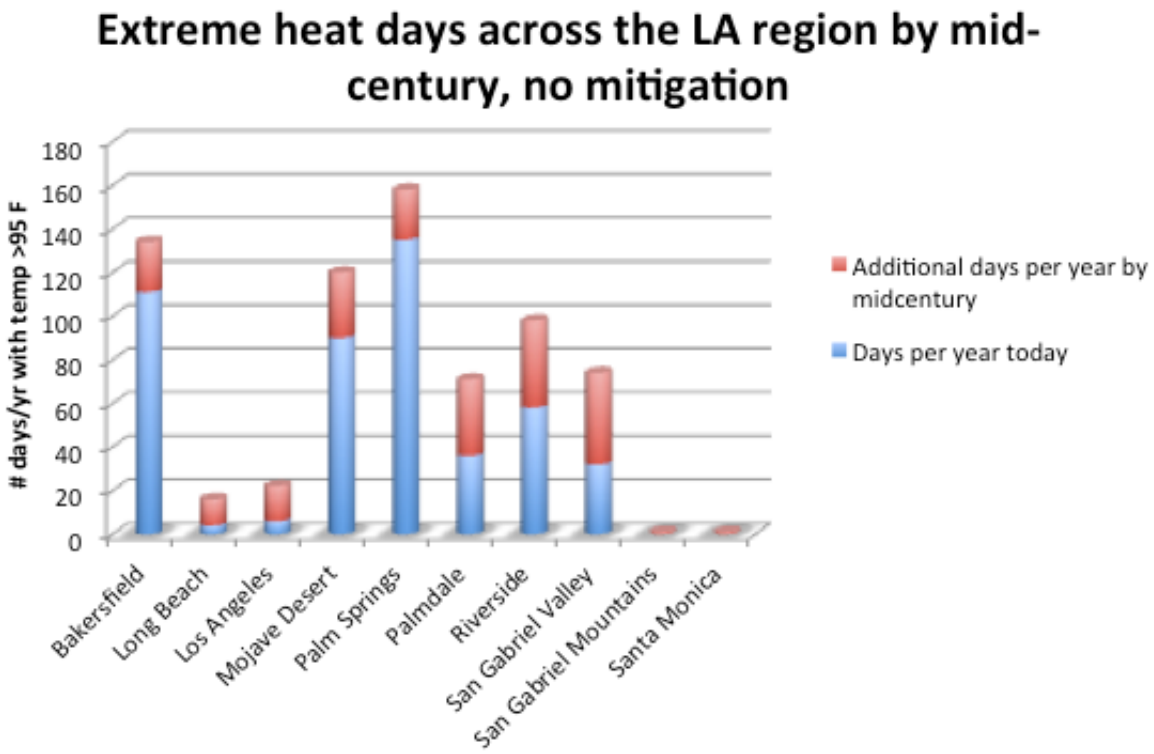
Where Exactly Will Warming be Most Extreme?
Projected changes in heat extremes by sub-regions

All of Los Angeles' neighborhoods can expect to experience many more extremely hot days in 30 years, days where temperature exceeds 95°F. Areas with the most high heat days now will experience even more in the next 30 years, with the number of extreme heat days in inland valley communities likely doubling by mid-century. Other LA neighborhoods, like downtown LA, where there are relatively few high heat days today will experience three to four more times the number of high heat days compared to today.

Today in Downtown LA, about 6 days per year exceed 95 °F temperatures. This number could increase to 22 days per year by mid-century and 54 days per year by end of century if there is no effort at greenhouse gas mitigation. In stark contrast, with greenhouse gas mitigation, Downtown LA will have something like 16 extreme heat days per year by midcentury and this number will drop down to 12 days per year by the end of the century. Mitigation will keep Downtown LA significantly cooler.



Throughout the Los Angeles region, by mid-century, all areas will experience more extreme heat days each year. For some regions there will be at least twice as many days of extreme heat compared to today.



What will happen to cold days?

In most of Los Angeles today, temperatures never reach freezing. But regions where it does, like mountains and high elevation areas, could lose a fair number of extremely cold days by the end of the century. Without greenhouse gas mitigation, some portions of the Southern Sierra Nevada Mountains, San Gabriel Mountains, and San Bernardino mountains will see roughly 50-90 fewer days per year where temperatures get below freezing. These are places that normally experience as many as 200 days per year of freezing temperatures today. So almost half of the freezing days will be gone and as much as three months a year will no longer experience days where temperatures dip below freezing.

Background on the Climate Change in Los Angeles Region Project

These findings are based on two studies in a series conducted by atmospheric scientists at UCLA, using an innovative technique for applying global climate models to the Los Angeles region to provide detailed projections of climate change. The first study in the series, "Mid-Century Warming in the Los Angeles Region," was released in June 2012. The second study, which supersedes the first, "A Hybrid Dynamical-Statistical Downscaling Technique, Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region" was published with the first in the Journal of Climate in May 2015.

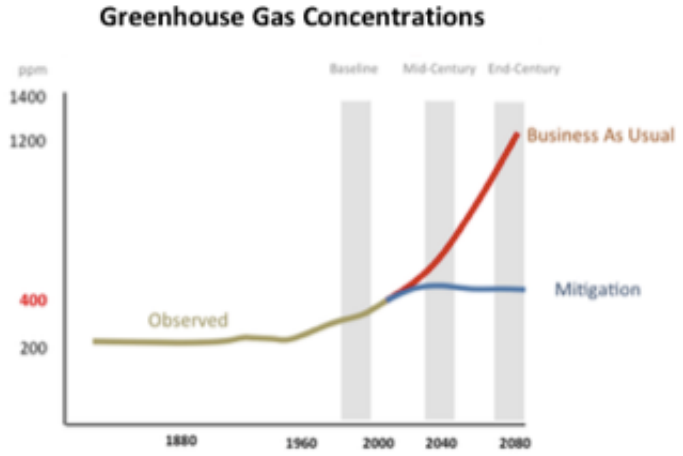
Methods Summary

Future changes in surface temperature in the Los Angeles region were estimated by comparing the very recent past (1981–2000) to mid-century (2041–2060) and end-of-century (2081–2100) temperatures under two different scenarios:

• Scenario 1: We continue along a "business as usual" path of climate change pollution

• Scenario 2: Human-caused climate change is curbed with global mitigation of greenhouse gas emissions

The scenarios correspond to "Representative Concentration Pathways" (RCPs) of projected radiative forcing, a measure of how much heat from the sun warms the planet due to greenhouse gas emissions into the atmosphere over the next century. RCPs were developed by the Intergovernmental Panel on Climate Change to ensure consistency and rigor in climate modeling. The "business as usual" and "mitigation" scenarios used in the study correspond to RCPs 8.5 and 2.6. The scenarios can be represented in terms of carbon dioxide equivalent (CO2) concentrations in part per million by volume as shown in this figure. Mitigation refers to a scenario where atmospheric concentrations of greenhouse gas emissions peak at 460 parts per million by volume (ppmv) by 2050 and decline to about 420 ppmv by 2100. Business as usual greenhouse gas emissions continue to rise to over 1200 ppmv by 2100.



State-of-the-art global climate models published in the recently released data archive called the Fifth Coupled Model Intercomparison Project (CMIP5) were employed using both dynamical and statistical techniques to downscale the relatively coarse-resolution climate information from the global models to much finer scales. An in-depth discussion of the methodology can be found in the research paper.

1 In this project, mitigation refers to a scenario where atmospheric concentrations of greenhouse gas emissions peak at 460 parts per million by volume (ppmv) by 2050 and decline to about 420 ppmv by 2100. Without mitigation, greenhouse gas emissions are expected to continue to rise to over 1200 ppmv by 2100.

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