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Climate Basics » Extreme Weather

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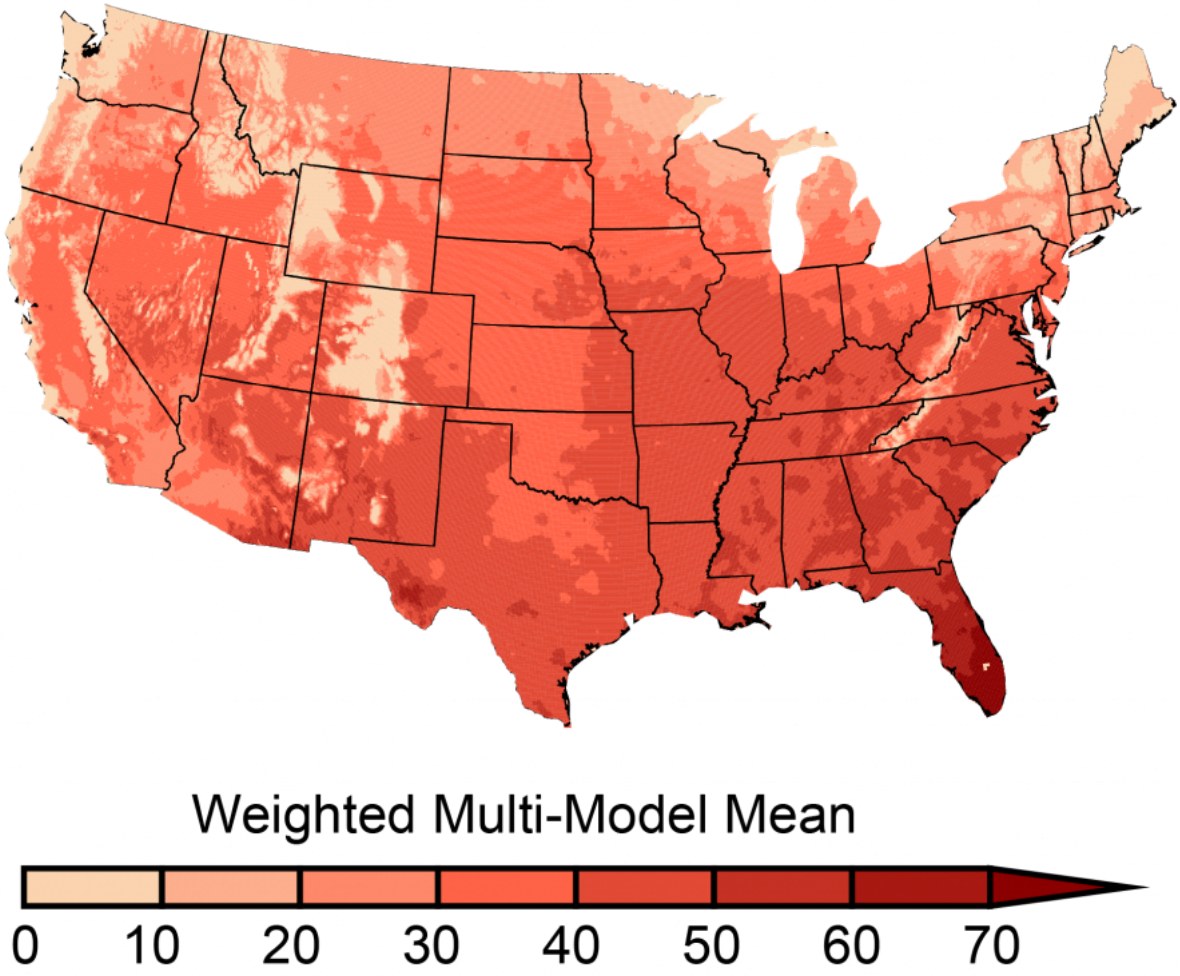
Heat Waves and Climate Change

Across the globe, hot days are getting hotter and more frequent, while we're experiencing fewer cold days. Over the past decade, daily record temperatures have occurred twice as often as record lows across the continental United States, up from a near 1:1 ratio in the 1950s. Heat waves are becoming more common, and intense heatwaves are more frequent in the U.S. West, although in many parts of the country the 1930s still holds the record for number of heat waves (caused by the Dust Bowl and other factors).

By midcentury, if greenhouse gas emissions are not significantly curtailed, the coldest and warmest daily temperatures are expected to increase by at least 5 degrees F in most areas by mid-century rising to 10 degrees F by late century. The National Climate Assessment estimates 20-30 more days over 90 degrees F in most areas by mid-century. A recent study projects that the annual number of days with a heat index above 100 degrees F will double, and days with a heat index above 105 degrees F will triple, nationwide, when compared to the end of the 20th century.

Increase in Total U.S. Heat Wave Days



NOTES

Projected changes in the number of days per year with a maximum temperature above 90°F and a minimum temperature below 32°F in the contiguous United States. Changes are the difference between the average for mid-century (2036–2065) and the average for near-present (1976–2005) under the higher scenario (RCP8.5). This map depicts a weighted multi-modal mean of 32 climate model projections.

SOURCE

CICS-NC and NOAA NCEI by Russel Vose, available in Climate Science Special Report.

Threats Posed by Extreme Heat

Extreme heat can increase the risk of other types of disasters. Heat can exacerbate drought, and hot dry conditions can in turn create wildfire conditions. In cities, buildings roads and infrastructure can be heated to 50 to 90 degrees hotter than the air while natural surfaces remain closer to air temperatures. The heat island effect is most intense during the day, but the slow release of heat from the infrastructure overnight (or an atmospheric heat island) can keep cities much hotter than surrounding areas. Rising temperatures across the country poses a threat to people, ecosystems and the economy.

Human Health

Extreme heat is one of the leading causes of weather-related deaths in the United States, killing over 600 per year more than all other impacts (except hurricanes) combined. The Billion Dollar Weather Disasters database compiled by the National Oceanic and Atmospheric Administration lists heat waves as four of the top 10 deadliest U.S. disasters since 1980.

Heat stress occurs in humans when the body is unable to cool itself effectively. Normally, the body can cool itself through sweating, but when humidity is high, sweat will not evaporate as quickly, potentially leading to heat stroke. High humidity and elevated nighttime temperatures are likely key ingredients in causing heat-related

illness and mortality. When there's no break from the heat at night, it can cause discomfort and lead to health problems, especially for those who are low income or elderly, if access to cooling is limited.

Hot days are also associated with increases in heat-related illnesses including cardiovascular and respiratory complications, kidney disease, and can be especially harmful to outdoor workers, children, the elderly, and low-income households.

In extreme temperatures, air quality is also affected. Hot and sunny days can increase ozone levels, which in turn affects NOX levels. In addition, greater use of heating and cooling of indoor spaces requires more electricity and, depending on the electricity source, can emit more of other types of pollution, including particulates. These increases in ozone and particulate matter can pose serious risks to people, particularly the same vulnerable groups directly impacted by heat mentioned above.

Agriculture

High temperatures at night can be particularly damaging to agriculture. Some crops require cool night temperatures, and heat stress for livestock rises when animals are unable to cool off at night. Heat-stressed cattle can experience declines in milk production, slower growth, and reduced conception rates.

Energy

While higher summer temperatures increase electricity demand for cooling, at the same time, it also can lower the ability of transmission lines to carry power, possibly leading to electricity reliability issues during heat waves. Although warmer winters will reduce the need for heating, modeling suggests that total U.S. energy use will increase in a warmer future. In addition, as rivers and lakes warm, their capacity for absorbing waste heat from power plants declines. This can reduce the thermal efficiency of power production, which makes it difficult for power plants to comply with environmental regulations regarding their cooling water.

How to Build Resilience

- A set of strategies to build resilience to extreme heat are laid out in our publication, "Resilience Strategies for Extreme Heat." Some strategies include:
  - Creating heat preparedness plans, identifying vulnerable populations, and opening cooling centers during extreme heat.
  - Installing cool and green roofs and cool pavement to reduce the urban heat island effect.
  - Planting trees to provide shade and evapotranspiration cools the air around trees.
  - Pursuing energy efficiency to reduce demand on the electricity grid, especially during heat waves.

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