Climate Change

Trends

Climate is defined by prevailing weather conditions, typically averaged over at least 30 consecutive years. The earth's climate has changed throughout history, including long periods of warming and cooling. However, the current warming trend is occurring at an unprecedented rate and is largely due to human activity—namely, the release of large volumes of carbon dioxide and other heat-trapping gases into the atmosphere (IPCC 2014).

Over the past several decades, California's climate has been characterized by rising air temperatures and increasingly frequent heat waves, and extreme events such as droughts and heavy storms have become more common. More precipitation has fallen as rain than snow, which has reduced snowpack and dramatically decreased glacier size (CEPA 2018). This has changed the timing and volume of water runoff from upper elevations. For instance, the Sacramento River's peak runoff now occurs almost a month earlier than during the first part of the century. Recent warming has also exacerbated drought conditions, leading to drier vegetation and an increase in area burned by wildfire (Bedsworth et al. 2018).

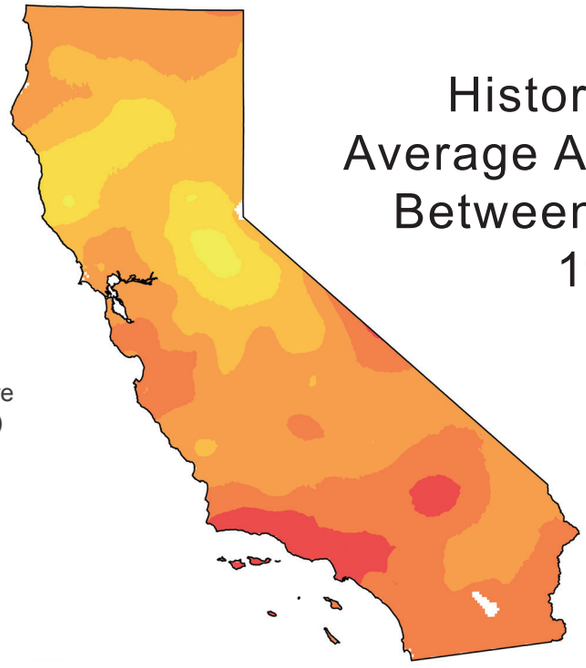
Ocean temperature off the coast of California has risen over the past century and thermal expansion in warming oceans and melting ice sheets and glaciers have contributed to local sea level rise (Sievanen et al. 2018). In addition, the frequency of strong El Niños and extreme ocean heatwaves has increased as the climate has warmed (Oliver et al. 2018). In just the past 40 years, there have been three very strong El Niños and within the past decade, the Northeast Pacific has experienced two extreme marine heatwaves: a multi-year event that extended from fall 2013 through spring 2016 (called The Blob) and a single-year event in 2019 (NOAA 2020).

Over the next several decades, California's average maximum and minimum daily temperatures will continue to increase, snowpack will continue to decline, and wildfire events are expected to increase in frequency with a trend toward more catastrophic, high-intensity fires (see the maps on the following page). Ocean temperatures are expected to rise, important ocean-atmosphere interactions (winds, currents, and coastal upwelling) will likely shift, extreme warm water events will increase, and the ocean's chemistry will change as it absorbs greater amounts of carbon dioxide from the atmosphere (Sievanen et al. 2018). Local sea levels will rise and the resulting inundation in low-lying areas such as around San Francisco Bay will be boosted by increased flooding from extreme storms (Gershunov et al. 2019).

The effects of climate change will not unfold uniformly across the landscape, but will depend on the scale in question (state, region, or locality) and will vary geographically due to differences in topography, elevation, latitude, and proximity to the ocean or other large water bodies.

Buttonwillow Ecological Reserve. This area has been studied by the Bureau of Land Management, University of California at Santa Cruz, California Department of Fish and Wildlife, and The Nature Conservancy to document the negative effects of the 2012–2014 drought. Drought events are expected to increase in frequency as the climate changes.
Photo: Mike Westphal, BLM

Historical Change in Average Annual Temperature Between 1901–1960 and 1986–2016

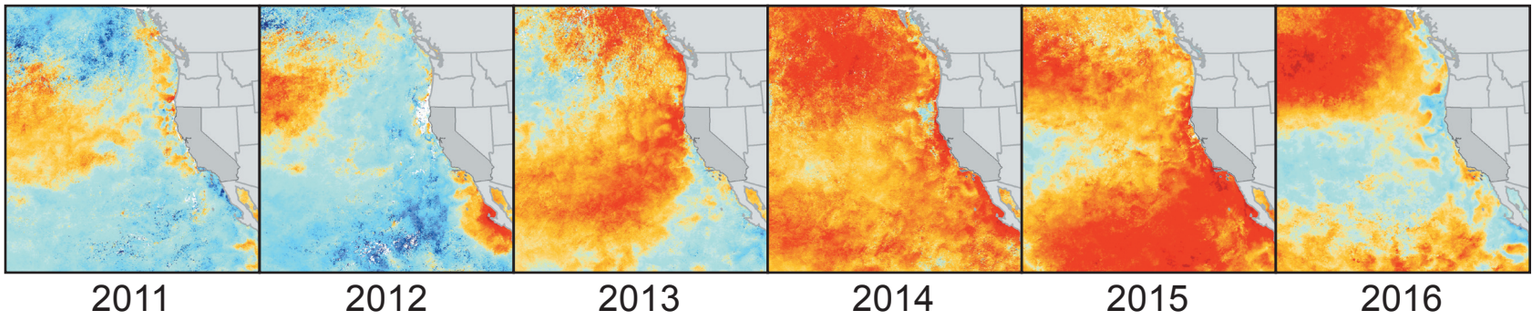


Change in Temperature
(Degrees Fahrenheit)

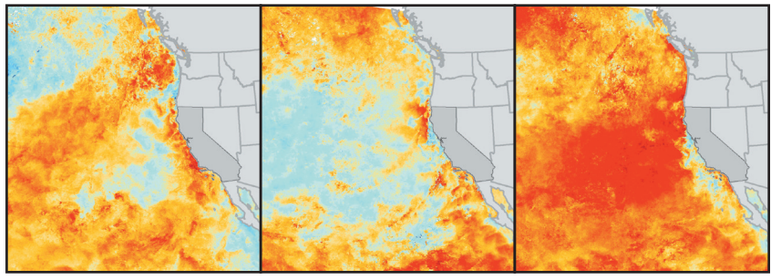
+3.2
+2.5
+2.0
+1.5
+1.0
+0.5
+0.2

Source:
Observed Changes in Annual Temperatures
Vose et al. (2017)

September Sea Surface Temperature Anomalies (2011–2019)



2011 2012 2013 2014 2015 2016



2017 2018 2019

Change from Average Temperature
(Degrees Fahrenheit)

6.3
-6.3

Source:
September Sea Surface Temperature Anomalies (2011–2019)
Ocean Ecology Laboratory (2019)

Note:
Monthly sea surface temperature (SST) anomalies were created by subtracting long-term averaged SST data from the average SST for each month shown.