

[Union of Concerned Scientists

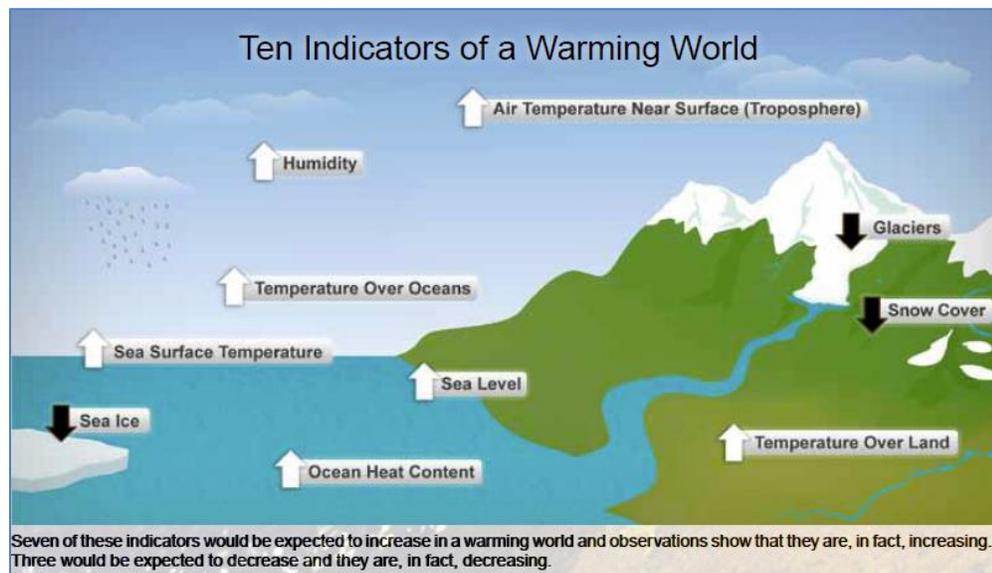
Climate Change and Extreme Weather: A Science Primer

Leading with what we know: we often advise scientists and advocates to lead with conclusions that enjoy the highest levels of certainty before discussing emerging or cutting-edge science.

Because the public is still confused about the mechanism of climate change, it's important to emphasize the fact that human-induced increases in atmospheric levels of heat-trapping gases are the main cause of observed climate change over the past 50 years.

Public discussions of climate change often focus on surface temperatures, which continue to increase, but there are *many other indicators* that the world is warming up. The “fingerprints” of human-caused climate change have been identified in many aspects of the climate system. Ten such fingerprints stand out when we examine global warming over the last half century (NOAA):

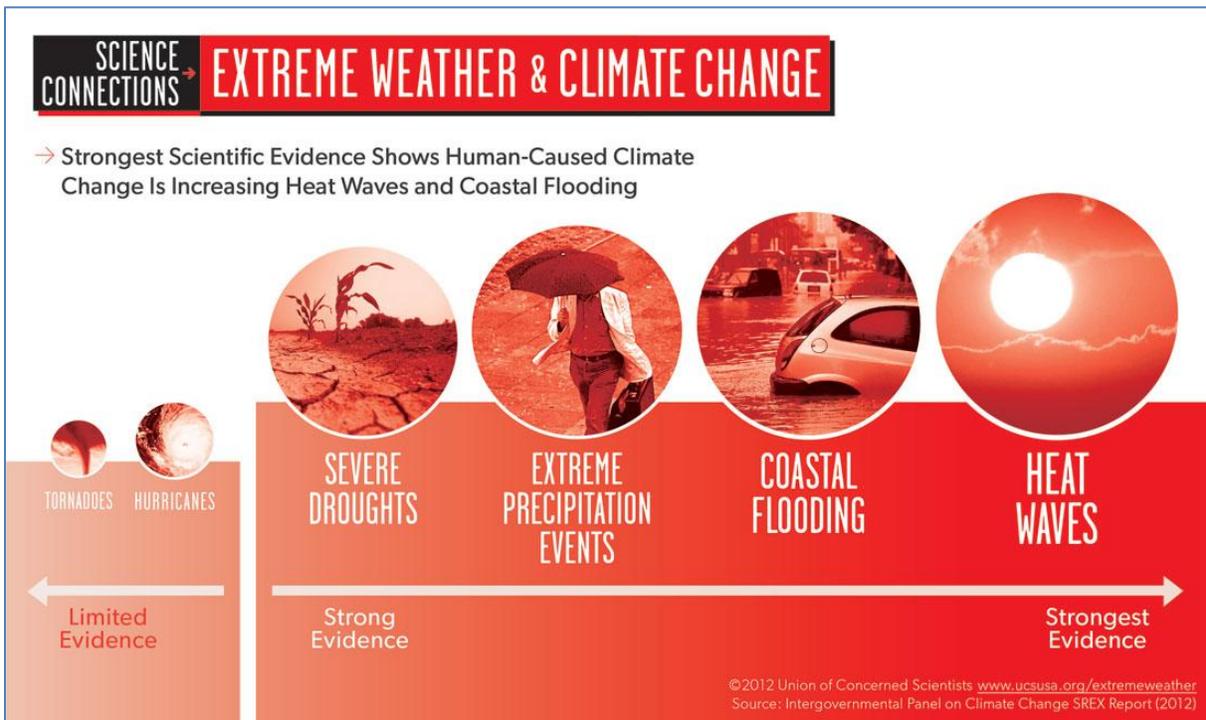
1. The lowest layer of the atmosphere where we live is warming up.
2. The air temperature over land is increasing.
3. The air temperature over the ocean is increasing.
4. The atmosphere is more humid, making hot weather more uncomfortable.
5. The top surface layer of the ocean is warming.
6. The deep layers of the ocean are warming.
7. Sea level is rising because of expansion of a warming ocean and melting of land-based freshwater snow and ice entering the ocean.
8. The amount of land covered in snow is decreasing in the northern hemisphere.
9. Most mountain glaciers are melting away.
10. Arctic sea ice is decreasing in areal extent and volume due to global warming.



Source: NOAA

Extreme Weather and Climate Change

Extreme weather events are changing, and these changes are consistent with rising temperatures. These include increases in heavy precipitation nationwide, more heat waves, and an increase in the intensity of Atlantic hurricanes (IPCC 2013). These trends are expected to continue. Research on the effect of climate change on other types of extreme events continues. (NCA Draft, 2013)



WHAT SCIENTISTS UNDERSTAND WELL ABOUT EXTREMES

Heat waves – are becoming longer and happening more often.

Coastal flooding – is becoming worse and happening more often. Sea level rise means high tides and storm surge now reach farther inland.

Extreme precipitation – heavy downpours are increasing across the country, especially in the Midwest and Northeast.

Drought – depends on region. Global and continental drought statistics average out wetter and drier areas. It's better to point to specific places like California and the U.S. Southwest, where evidence is clear that drought is likely to increase as the climate changes.

WHAT SCIENTISTS ARE STILL WORKING TO UNDERSTAND ABOUT EXTREMES

Hurricanes – Sea-level rise makes storm surges worse and warmer waters in the North Atlantic make hurricanes more intense, but we do not know how the number of hurricanes forming is being affected by climate change.

Tornadoes – There is not enough data to draw strong conclusions, though some [emerging science](#) indicates that climate change may make the conditions for tornado formation more likely to occur in the future.

Polar vortex – there's *some evidence* that outbreaks of Arctic air are hitting the United States as the Arctic rapidly melts and affects air circulation patterns above North America, however models *do not agree with observational evidence* on this phenomenon and scientific research is continuing on this topic.

Fair Language to Describe Certainty

Evidence linking climate change to extreme heat is **crystal clear**. It's **absolutely certain** that rising seas are making coastal flooding worse, but the science linking climate change to hurricanes is **mixed**. When it comes to tornadoes, **the jury is still out**, but there's **some evidence** that climate change will make them more likely to form in the future and it's what **scientists would expect** under a warming world.