



Climate Change

PURDUE
EXTENSION

Climate Variability and Climate Change

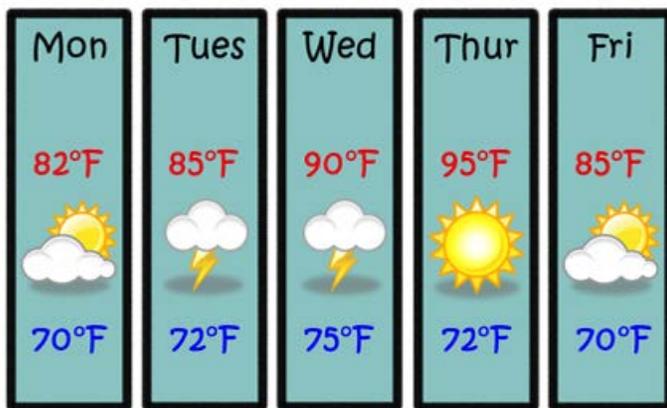
What is the difference between weather and climate?

Weather is the daily or hourly change in the atmosphere. We characterize the weather by looking at variables like temperature, precipitation, wind, humidity, pressure, clouds, and other weather elements. Our atmosphere, and therefore our weather, is constantly changing. For instance, it can be sunny and 82°F today, but tomorrow there is a chance for thunderstorms.

Weather is to climate as a page is to a book. A few days of weather do not give the entire story of climate, just as a single page does not tell the entire story from a book.

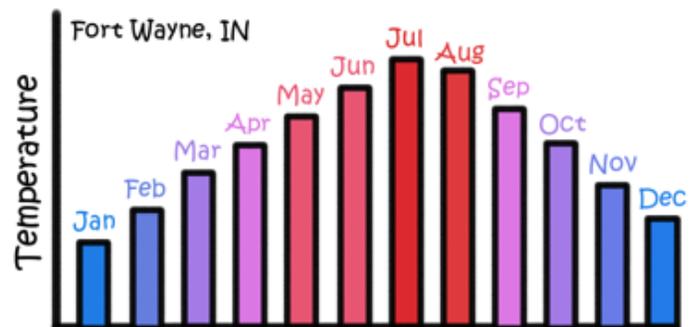
You might see a climate described like this: "The normal high temperature on July 27th in Fort Wayne is 84°F, but the highest temperature ever recorded in Fort Wayne on that day was 99°F in 1956."

Indianapolis 5-Day Forecast



You might see a daily weather report that looks like this: "The high today was 85°F, the low was 72°F, and there was a thunderstorm in the afternoon."

On the other hand, *climate* is the average, long-term weather over many years for a specific location. Climate tells you what type of weather you may expect at a location during a certain time of year. For instance, the summer in Fort Wayne, Indiana, is typically hot and sunny. However, winter months are generally cold and sometimes snowy. Climatologists use 30-year *climate normals* to describe the climate of a location as well as the type, intensity, and frequency of extreme events that a location may receive.



What is climate variability and how is it different from climate change?

Earth’s climate is dynamic and has been changing for billions of years. Climate variability refers to variations in climate on timescales of seasons to decades. Climate variability explains how one winter can be cold and snowy, while the next is milder. Climate variability can also explain how one decade is much drier than normal. Climate fluctuates over seasons and years to decades and longer.

Climate change describes long-term (decades or longer) and persistent changes in global or local climate trends. For example, climate change could show up as a change in 30-year climate normals for a given place and time of year, from one decade to the next. Climate change could also be shown graphically as a consistent positive or negative trend over several decades.

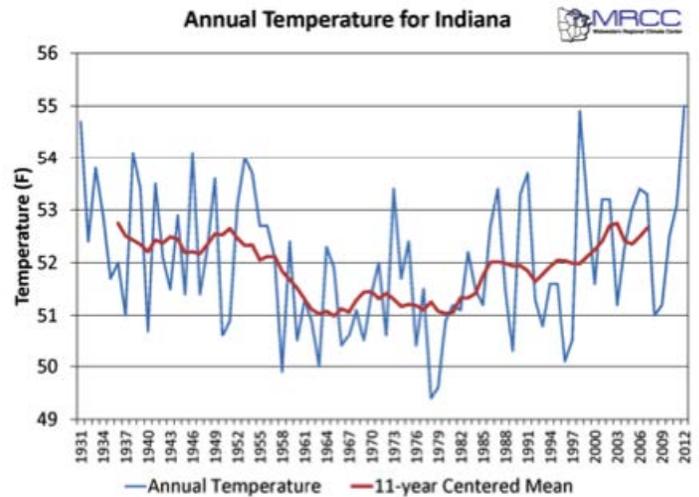
What are the main drivers of climate variability?

Climate variability is controlled by natural ocean and atmospheric processes. Examples of these natural processes include the El Niño Southern Oscillation (ENSO), the Arctic Oscillation, and the Northern Atlantic Oscillation.

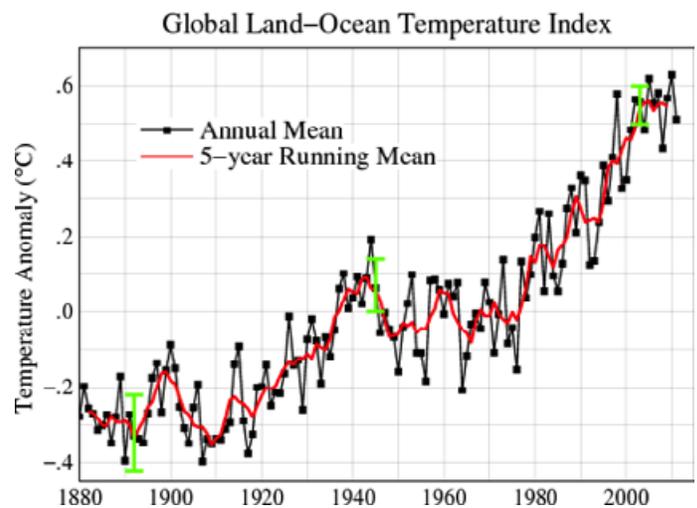
ENSO involves the oscillation of atmospheric pressure and ocean temperatures in the tropical Pacific Ocean. The Arctic Oscillation measures the difference in pressure between the North Pole and the Subtropics, which is driven by the temperature gradient between the two regions. The North Atlantic Oscillation involves pressure variations over the North Atlantic Ocean. Even though these processes occur many miles away, each can produce a change in the pattern of the jet stream over the United States. That change in the jet stream leads to short-term variations in our weather and climate. For instance, El Niño episodes tend to make Indiana winters warmer and drier than normal.

What are the main drivers of climate change?

Both natural and human processes can produce climate change. Natural processes produced dramatic changes in Earth’s climate before humans were even here. However, humans can also influence climate, because humans constantly interact with important parts of the climate system, like the atmosphere and the land. In addition, many scientists find that recent climate change cannot be explained by natural controls alone.



Data and image courtesy Midwest Regional Climate Center



Natural Processes

Before the Industrial Age, the sun and volcanic eruptions were the major change agents for Earth’s climate. Since the Sun is Earth’s main source of energy, any change in the amount of energy we receive from the Sun can have an impact on Earth’s climate. Slow orbital changes, called Milankovitch Cycles, alter the amount of solar radiation received at various points on Earth and produces climate change over much longer timescales. Volcanic eruptions impact global climate by injecting gases and ash into the atmosphere, often decreasing global temperatures and altering atmospheric circulation patterns.



Human Influence

Human activities that produce change in Earth's climate include burning fossil fuels and land-use changes. By burning fossil fuels, humans are changing the atmospheric composition—adding heat-trapping gases called greenhouse gases (see Fact Sheets 3 and 4 for more on greenhouse gases). Land-use changes can also change the climate. For instance, when we change grassland to urban neighborhoods, we are altering the climate of a location by making it warmer and possibly affecting precipitation (i.e., [Urban Heat Island Effect](#)). Deforestation and poor agricultural practices can lead to desertification. Desert areas of the world are expanding because of how humans have treated the land and used the resources. Changing to a more desert-like climate means less rain for agriculture and other resources and higher temperatures.



Resources

NASA, 2017. *Global Climate Change: Vital Signs of the Planet*. <http://climate.nasa.gov/causes> Accessed May 10, 2017.

NASA, 2008. Goddard Space Flight Center. http://www.nasa.gov/centers/goddard/news/topstory/2008/solar_variability.html

National Centers for Environmental Information, 2017. <http://www.ncdc.noaa.gov/paleo/milankovitch.html>

National Oceanic and Atmospheric Administration, 2017. El Niño & La Niña (El Niño-Southern Oscillation). <http://www.elnino.noaa.gov/>

Northwest Territories, Environment and Natural Resources. "Natural Climate Fluctuations." <http://www.enr.gov.nt.ca/state-environment/2-natural-climate-fluctuations>

National Oceanic and Atmospheric Administration, 2017. "North Atlantic Oscillation (NAO)." <http://www.cpc.ncep.noaa.gov/data/teledoc/nao.shtml>

National Oceanic and Atmospheric Administration, 2007. *What is Climate Change?* <http://www.nws.noaa.gov/om/brochures/climate/Climatechange.pdf>

NASA, 2017. GISS Surface Temperature Analysis. http://data.giss.nasa.gov/gistemp/graphs_v3/
<http://cses.washington.edu/cig/pnwc/weathervsclimate.shtml>

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