



“Climate is what we expect,

weather is what we get.”

—Robert Heinlein

## Is it Weather or is it Climate? What’s the Difference?

### Key Points

- Weather represents short-term and small-scale changes in the atmosphere.
- Climate describes the distribution of weather over longer periods.
- Humans have adapted to deal with the day-to-day changes of weather
- Changes in climate can impact every aspect of life on Earth, especially if they happen rapidly or are large changes.

### Weather and climate

Both weather and climate rely on observations of temperature, pressure, sunlight, clouds, rain, and snow. The main difference between the two is the time scale over which the conditions are described. Weather is generally a snapshot of the atmosphere at a single time or over a few days. Climate generally refers to conditions spanning months, years, and even decades. One way to remember the difference between weather and climate is: Weather tells you what to wear on any given day; climate tells you what wardrobe to own.

### Measuring the atmosphere

For most of us, weather and climate are two different ways of looking at measurements of atmospheric conditions. These measurements are taken at surface weather stations and at higher levels of the atmosphere with weather balloons. For consistency, those measurements should be taken from standard instruments at locations that are stable over long periods. In that respect, weather is easier to measure consistently. Climate scientists have to be mindful of changes in the record caused by relocation of observations sites, changes in times of observations, changes in the instruments used to collect the measurements, or changes at the sites due to construction, growth of trees, or expansion of cities over time.

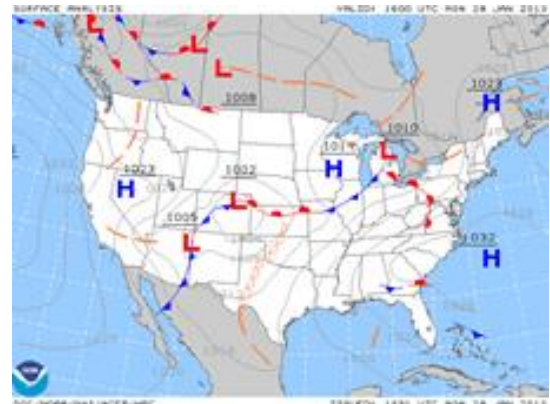


Figure 1. A weather map of the United States.  
Credit: NOAA.

## Describing the atmosphere

Atmospheric scientists use both time and space to describe weather and climate. Some of the methods they use in their descriptions are weather maps, timelines, and climate maps. A series of weather maps such as the one shown in Figure 1 shows the variability of weather across a location over a day, week, or year. A weather timeline shows how the weather at one location has changed over time (Figure 2).

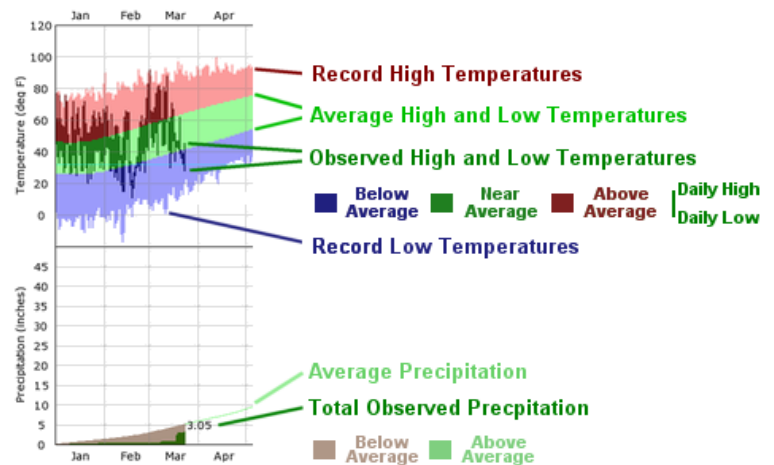
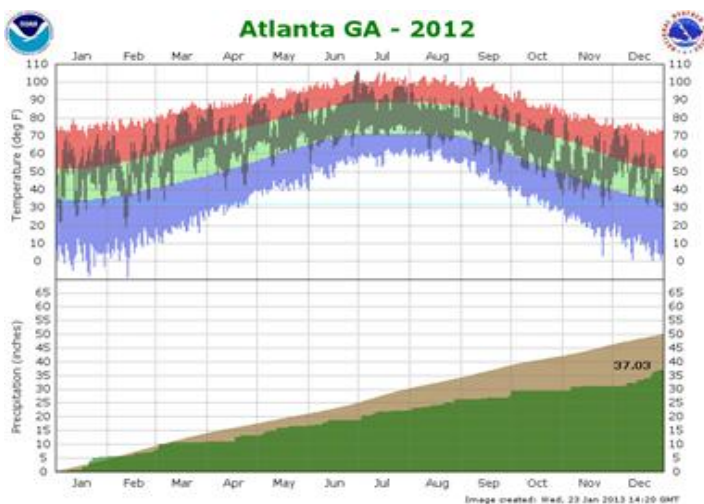
A climate map shows the spatial variations of atmospheric conditions from one location to another that are caused by elevation, presence of lakes and oceans, and latitude. A climate timeline or trend line would show changes in temperature, for example over many years.

Most people can adjust to changes in weather by choosing different clothes from their closets. But, adapting to climate change can be more difficult. Not only might people need different clothing, they might also need to transform houses, roads, and business practices to adapt to the new conditions.

## Modeling weather vs. modeling climate

Weather and climate models are used to predict future conditions. The models are created using the same physical laws of motion and energy, but they are applied over different time and space scales. A weather model must excel at getting the details of fronts and storms correct for the next week, but it is not designed to model the long-term state of the atmosphere. While climate model needs to predict expected patterns of temperature and rainfall over wide areas but it is not focused on the effects of individual storms.

Both weather and climate models have improved greatly over time, and each type performs well at the task for which it was designed; neither model is good at tasks for which it was not created.



**Figure 2.** Daily temperature and precipitation records for Atlanta, Georgia, in 2012. Daily maximum and minimum temperatures are superimposed on a graph of normal and record temperatures for each date.