Weather & Climate

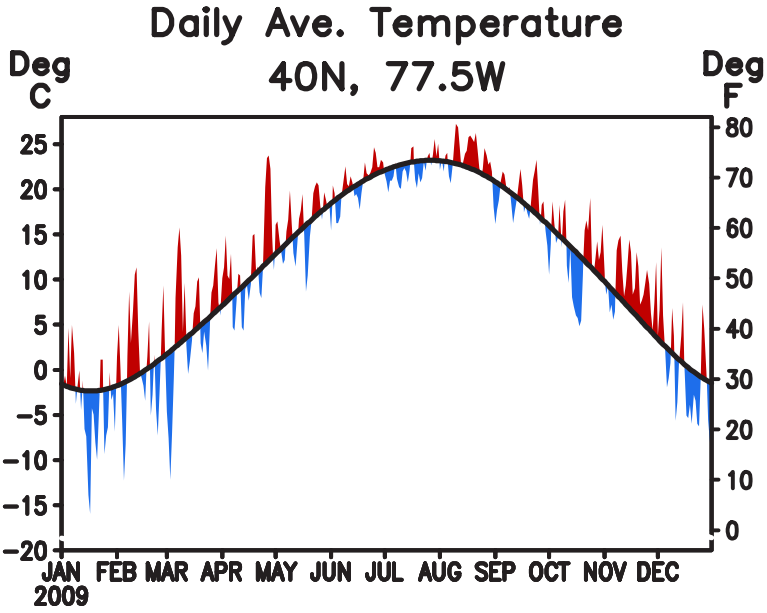
July 2018

"Weather is what you get; Climate is what you expect."

Weather consists of the short-term (minutes to days) variations in the atmosphere. Weather is expressed in terms of temperature, humidity, precipitation, cloudiness, visibility and wind.

Climate is the slowly varying aspect of the atmosphere-hydrosphere-land surface system. It is typically characterized in terms of averages of specific states of the atmosphere, ocean, and land, including variables such as temperature (land, ocean, and atmosphere), salinity (oceans), soil moisture (land), wind speed and direction (atmosphere), and current strength and direction (oceans).

Example of Weather vs. Climate

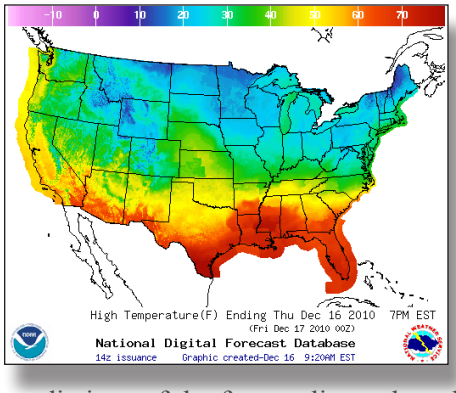


The actual observed temperatures on any given day are considered weather, whereas long-term averages based on observed temperatures are considered climate. For example, climate averages provide estimates of the maximum and minimum temperatures typical of a given location primarily based on analysis of historical data.

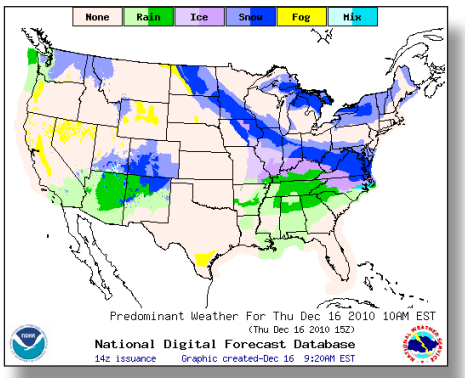
Consider the evolution of daily average temperature near Washington DC (40N, 77.5W). The black line is the climatological average for the period 1979-1995. The actual daily temperatures (weather) for 1 January to 31 December 2009 are superposed, with red indicating warmer-than-average and blue indicating cooler-than-average conditions. Departures from the average are generally largest during winter and smallest during summer at this location.

Weather Forecasts and Climate Predictions / Projections

Weather forecasts are assessments of the future state of the atmosphere with respect to conditions such as precipitation, clouds, temperature, humidity and winds.



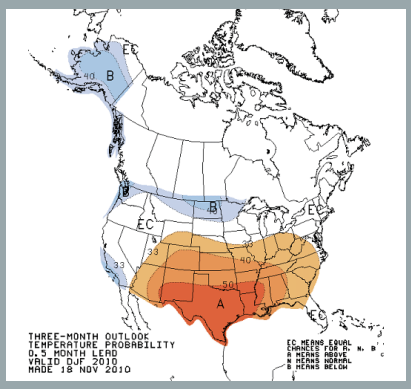
Climate predictions are usually expressed in probabilistic terms (e.g. probability of warmer or wetter than average conditions) for periods such as weeks, months or seasons. A prediction is a probabilistic statement of something that could happen in the future based only on what is known today.



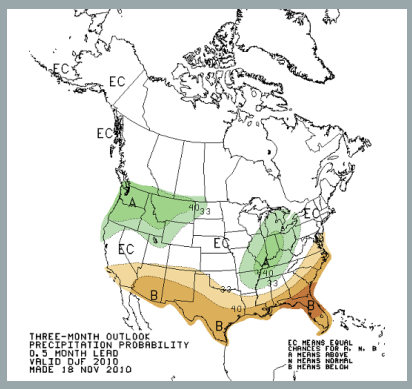
Climate projections are long-range predictions of the future climate based on changing atmospheric conditions, such as increased or decreased pollutants due to emissions from the burning of fossil fuels (coal, oil, gas).

Example of Climate Prediction: Three - Month Outlooks

Temperature



Precipitation



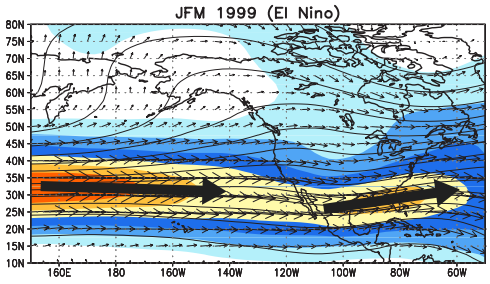
The maps above show temperature (precipitation) probabilities for above (A) and below (B) normal (median) conditions. In regions where no strong climate signals exist, a forecast of equal chances (EC) for either A, B, or near-normal conditions is made.

Climate predictions and projections never specify the occurrence of weather events.

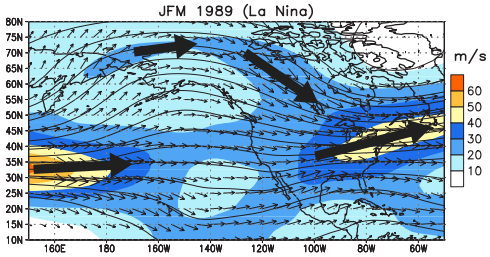
Weather-Climate Links

There are many ways in which climate and weather are connected. For example:

The frequency and intensity of tropical cyclones are influenced by changes in sea-surface temperature and upper- level wind patterns in the tropics that occur on monthly, seasonal, decadal, and longer timescales.



Shifts in the position of the jet streams in mid-latitudes can affect where storms will develop. These jet-stream shifts can occur on seasonal time scales (in association with El Niño and La Niña) and also on weekly times scales, associated with planetary scale meanders of the jet-stream that are sometimes related to changing conditions in the tropical atmosphere on sub-seasonal time scales.

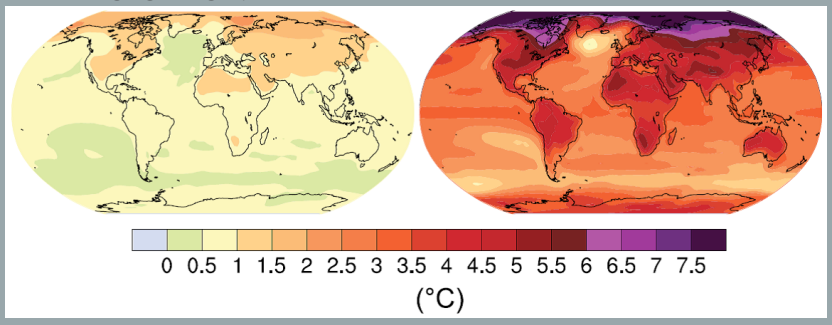


Wind in the upper troposphere (200-hPa = 11.3 km) averaged over the months of January, February and March. Thick black arrows show the locations of jet streams during the El Nino of 1999 and the La Nina of 1989.

Example of Climate Projection

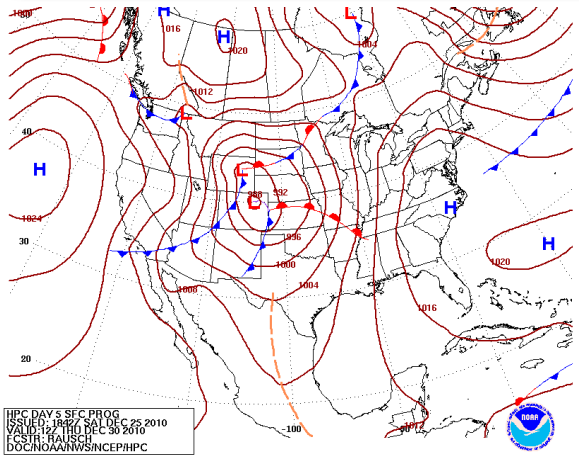
Atmosphere-Ocean General Circulation Model Projections of Surface Warming

2020 - 2029 2090 - 2099



The maps above show projected surface temperature changes (°C) for the early and late 21st century relative to the period 1980-1999. This is the average projection for the A2 scenario averaged over decades 2020-2029 (left) and 2090-2099 (right).

The A2 scenario is based on the assumption of a very heterogeneous world with high population growth, slow economic development and slow technological change.



Mid-latitude storms are steered by the jet stream and get their energy from temperature contrasts between different air masses.

Relatively slow variations in the global-scale temperature distribution are the basis for making outlooks on time scales from one month to several seasons.

References

Weather.gov
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