The **National Oceanic Atmospheric Administration (NOAA)** is charged with providing the atmospheric measurements and analyses required to track the fate of carbon dioxide emissions caused by the burning of fossil fuels and biomass, and to reducing uncertainties in how the exchange of carbon responds to the variations and trends of climate and land use.

Why Worry About Climate Change?

Temperature increases will have significant impacts on human activities: where we can live, what food we can grow, and how or where we can grow it.

To be prepared for the effects of these potential impacts we need to know how much the Earth is warming, for how long it has been warming, and the causes. Answers will provide a better basis for making decisions related to issues such as water resource management and agricultural planning.

Changes in the occurrence of weather and climate extremes are among the most serious challenges to society in coping with a changing climate.

References

NOAA/Climate Prediction Center
NOAA/Earth System Research Laboratory
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UCAR/NESL's Climate & Global Dynamics
ClimateWatch Magazine
World Climate Research Programme / CLIVAR
Encyclopedia of Natural Hazards: Article 00242
United States Global Change Research Program
International Research Institute for Climate and Society

National Weather Service Climate Variability VS Climate Change

April 2011

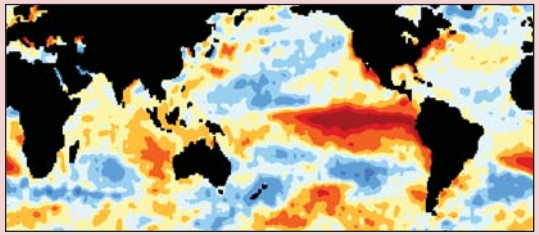
"Natural climate variability is not attributable to or influenced by any activity related to humans."

A prominent aspect of our climate is its variability. This variability ranges over many time and space scales and includes phenomena such as El Niño/La Niña, droughts, multi-year, multi-decade, and even multi-century changes in temperature and precipitation patterns.

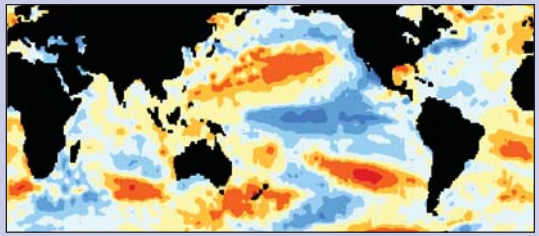
Some examples of longer time-scale variability might include a series of abnormally mild or exceptionally severe winters, and even a mild winter followed by a severe winter.

Examples of Natural Climate Phenomena

El Niño conditions occur when abnormally warm waters accumulate in tropical latitudes of the central and eastern Pacific Ocean. Consequently, tropical rains that usually fall over Indonesia shift eastward.



La Niña conditions occur when cooler-than-average waters accumulate in the central and eastern tropical Pacific and tropical rains shift to the west.

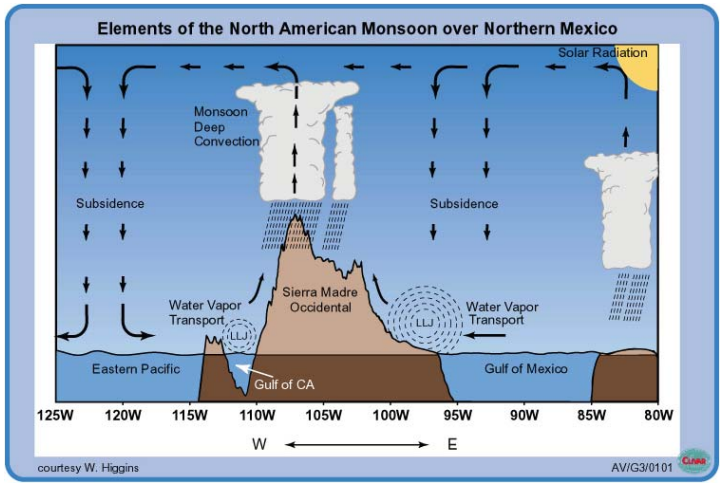


El Niño and La Niña affect rainfall distribution in the tropics that strongly influences weather patterns across the United States and other parts of the world.

This information has been compiled by the Climate Services Division at National Weather Service Headquarters and brought to you by;

National Weather Service
Austin/San Antonio Forecast Office
2090 Airport Road
New Braunfels, Texas 78130

Monsoons



Monsoons are atmospheric systems with certain well-defined characteristics. All monsoons have a life cycle characterized by distinct onset, mature, and decay phases. They feature abundant rainfall during summer and dry conditions during winter.

The strongest monsoon, the Asian summer monsoon, affects about half of the world's population. Monsoons are also found in other tropical–subtropical land areas, including Australia, Africa, South America, and North America.

Monsoon variability is often related to floods, drought, and other hazardous extreme weather and climate events.

Excessive monsoon rainfall causes floods, landslides and loss of infrastructure.

Insufficient monsoon rainfall leads to drought, and therefore scarcer freshwater supplies.

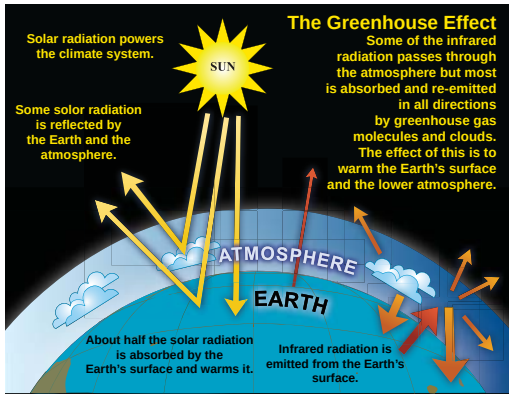
Monsoon behavior, such as the intensity and duration, influences economic planning and development, water resource management, agriculture (planting and harvesting), and emergency response.

Climate Change may result from persistent human activities, such as the burning of fossil fuels and deforestation.

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Our environment, and especially our climate, is changing. Changes have occurred in several aspects of the atmosphere and surface that alter the global energy budget of the Earth and can therefore cause the climate to change. Among these are increases in greenhouse gas concentrations and deforestation.

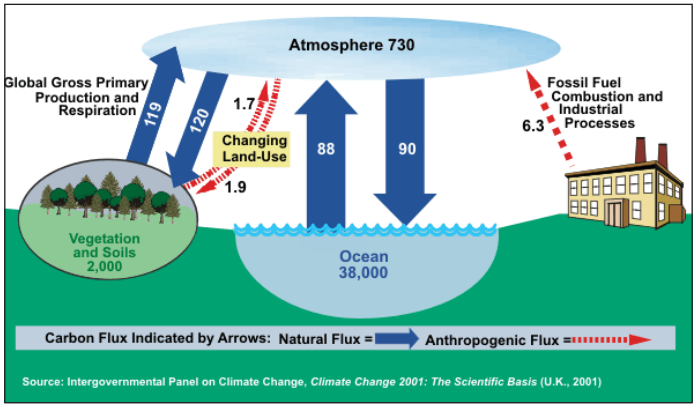
The Greenhouse Effect



Water Vapor (H_2O) is the most important greenhouse gas, and carbon dioxide (CO_2) is the second most important. Methane, nitrous oxide, ozone, and several other gases also contribute to the greenhouse effect. Adding more greenhouse gases, such as CO_2, to the atmosphere intensifies the greenhouse effect.

The Greenhouse Effect is necessary for life on Earth, as we know it, to survive. The effect is enhanced by human activities, such as the burning of fossil fuels.

Projecting climate into the future and forecasting regional impacts depends on our understanding of the exchange of carbon dioxide among the atmosphere, oceans and land ecosystems.

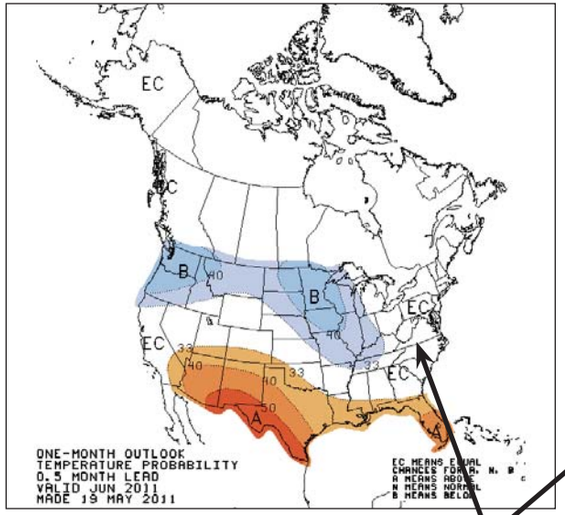


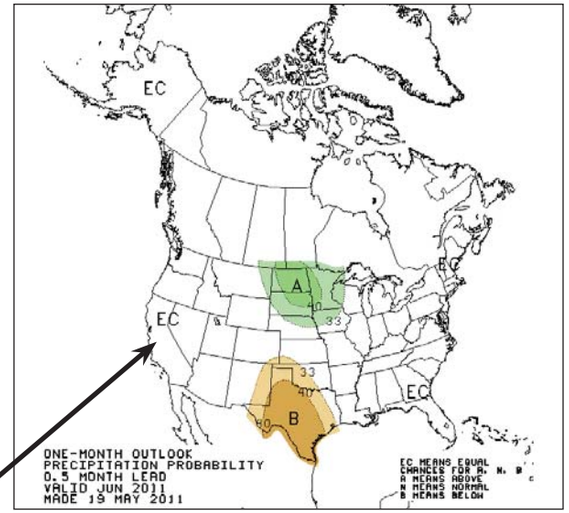
What is the Carbon Cycle?

Carbon is exchanged, or "cycled" among Earth's oceans, atmosphere, ecosystem, and geosphere. All living organisms are built of carbon compounds. It is the fundamental building block of life and an important component of many chemical processes. It is present in the atmosphere primarily as carbon dioxide (CO_2), but also as other less abundant but significant gases, such as methane (CH_4).

Long Range Outlooks (One-Month & Three-Month)

The interpretation of the categories for long range outlooks is generally the same as for the short range outlooks. However, there are three major differences in these long range outlooks maps:





1. The white areas are shown as EC (Equal Chance) on these maps. These represent areas where there are no strong climate signals from our climate tools to have skill in preferring one category over another. That doesn't mean that there are equal chances of each of the categories occurring – it means that we currently do not have skill in identifying the most likely category. In these areas, it is best to be prepared for all possibilities.

2. In the rare case when the climate tools show a forecast for enhanced probabilities in the middle category (Near-Average), the outlook will represent this as a shaded gray area.

3. There are no climatology (observations) lines on the map.

References

NOAA/Climate Prediction Center
NWS/Weather Forecast Office, Las Vegas

This information has been compiled by the Climate Services Division at National Weather Service Headquarters and brought to you by;

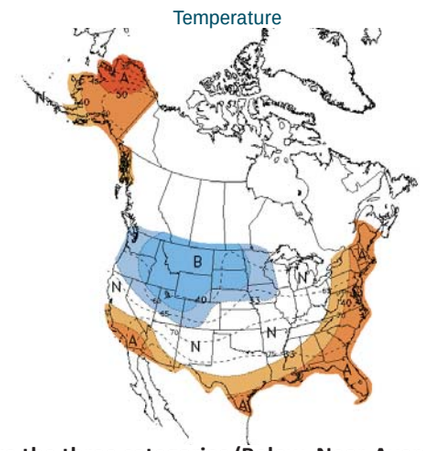
National Weather Service
Austin/San Antonio Forecast Office
2090 Airport Road
New Braunfels, Texas 78130

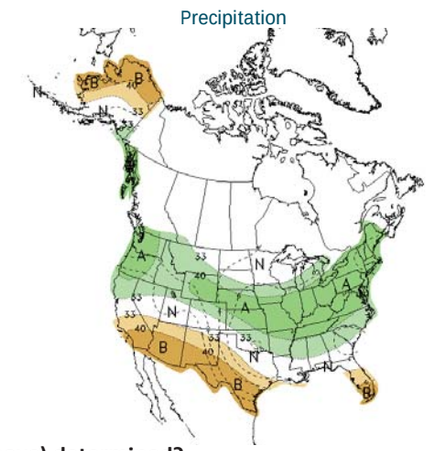
National Weather Service Climate Outlooks

November 2011

The Climate Prediction Center (CPC) outlooks are "probabilistic forecasts," which give the expectation, shown as a probability, that conditions will be in the range of one of three categories: Below, Near-Average or Above.

Why are these products called "outlooks" and not "forecasts"? The term *forecast* is generally used to describe a prediction of weather, for which there is a high degree of certainty, while the term *outlook* is generally used for future climate products, which are presented in terms of probabilities. Probabilities are used because of the inherent uncertainties associated with prediction of climate (beyond one week).





How are the three categories (Below, Near-Average, and Above) determined?
These categories are determined by taking data from a reference time period (1981-2010 is currently used), and separating this data into the lowest ⅓, the middle ⅓, and the highest ⅓. These data divisions, representing 33.3% of the data are called *terciles*.

Example for Temperature
The historical daily average temperature from 1981 to 2010 for the represented period of time is ordered from the lowest to highest values. The data is then divided in terciles and the results are:

The lowest 33.3% of the historical data is classified as Unseasonably Cold/Cool (B)
The middle 33.3% of the historical data is classified as Seasonable (Near Average) (N)
The highest 33.3% of the historical data is classified as Unseasonably Warm (A)

Without a climate signal, each of these categories has a probability of occurring 33.3% of the time in the future. Climate outlooks represent a *shift* in the odds of occurrence due to recognized climate signals. Sometimes there is a signal, and sometimes there is not. If there is a signal, the classification on the outlook maps (colors and numbers) represents the *shift* in likelihood of occurrence into one of the three categories. There is still a likelihood that actual conditions will fall in one of the other two categories, but this is not as likely as the classification indicated. *Climate outlooks represent a shift in the odds, not a 100% chance of occurrence.*

Short Range Outlooks (6-10 Day & 8-14 Day)

How To Read these Maps

Climatology: dashed black lines with very small numbers identify the average for that time period

Shift in Probability: Dotted lines with slightly larger numbers around the borders of shaded areas identify the probability of the most likely category to occur

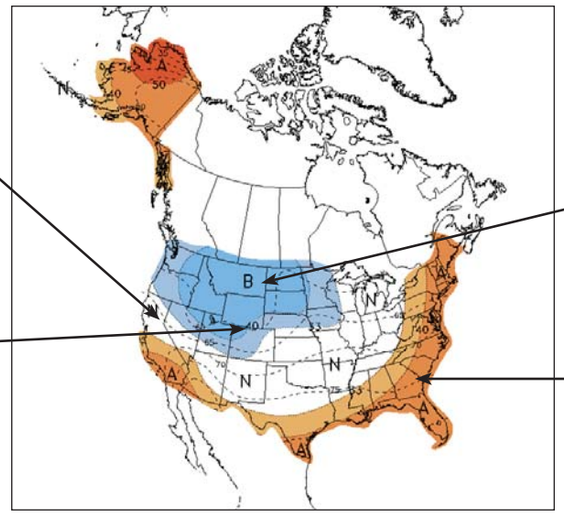
Note that it can be easy to confuse the climatology dashed lines with the shift in probability lines

A means enhanced probabilities in the highest tercile

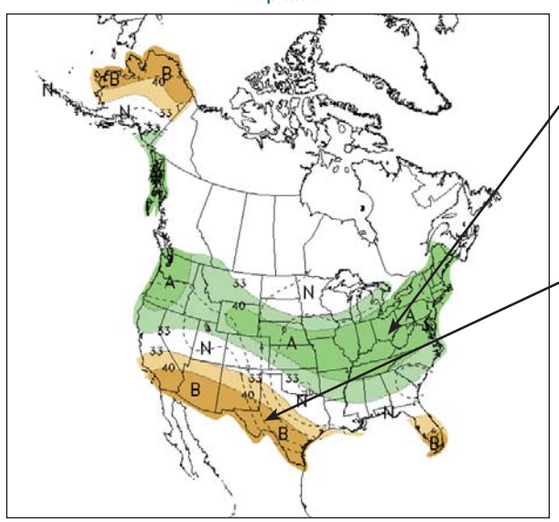
B means enhanced probabilities in the lowest tercile

N means enhanced probabilities in the middle tercile (near the climatological average, or seasonable)

Temperature



Precipitation



On the precipitation maps, the values for climatology are small and may not always be noticeable

Most likely Category: Shaded areas on map identify most likely category to occur

Light Blue to Dark Blue: Most likely category would be for Unseasonably Cold/Cool

Light Orange to Red: Most likely category would be for Unseasonably Warm

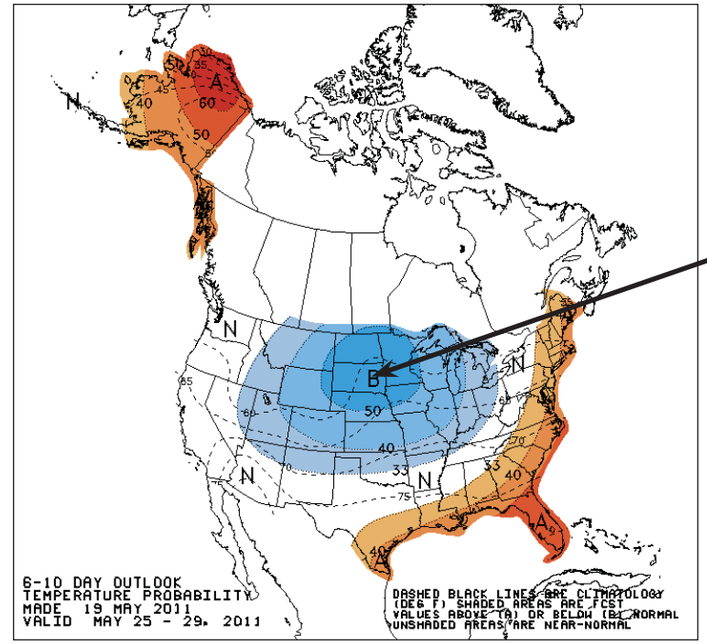
Light Green to Dark Green: Most likely category would be for Unseasonably Wet conditions

Light Brown to Dark Brown: Most likely category would be for Unseasonably Dry conditions

White: most likely to be near climatological averages for that area

Please note that the CPC outlooks are created for general areas, not for specific locations/cities.

6-10 Day Outlook dated 19 May 2011



What is the temperature outlook for South Dakota during the next 6-10 days?

The classification for South Dakota on this map represents the most likely category to occur. However the other two categories also still have some likelihood of occurrence. Since the probability of all three categories occurring needs to add up to 100%, the probability that this classification exceeds the tercile threshold of 33.3% is subtracted from the opposite end category. This represents the shift in probability from one category to another.

So, in this case for South Dakota, the most likely category is for unseasonably cold/cool conditions (shown in blue), and the probability contour shown is somewhere between 50-60%. For this example, let's say it's 52%. This represents an 18.7% shift above the tercile threshold of 33.3%, therefore the opposite end category (unseasonable warm conditions) would have a 14.6% (33.3% minus 18.7%) likelihood of occurring. The middle category (seasonable) would remain at 33.3%.

In the rare situation when a probability contour exceeds 66.6%, following the above methodology would lead to a negative probability of the opposite category. Hence, when this occurs, the likelihood of the opposite end category is held constant at 3.3% (there is always a slight chance of a rare event occurring), and the seasonable category would then decrease by the appropriate amount to keep the total probability at 100%.

Thus, the outlook for South Dakota would call for: Around a 52% likelihood for unseasonably cold conditions to occur, only a 14.6% chance for unseasonably warm conditions, and a 33.3% chance of seasonable (near average) conditions.

The interpretation for 8-14 day Outlooks is the same as the 6-10 day Outlooks.