NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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Climate Predictions: How To Interpret and Use Them

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This NebGuide explains how climate predictions are made and how National Oceanic and Atmospheric Administration forecasts can be used to plan agricultural activities.

Climate Predictions and Their Potential Use

Climate describes the time-average of weather conditions for a region and the dominant atmospheric processes, or the "weather-makers," that create the average weather condition. For example, we can calculate the average rainfall and temperature in the first week of May over a period of years to get the "climate" of that week at a particular location. We also can calculate average rainfall and temperature for May to get the climate for the month of May at that location. However, the actual condition of that week of May in a future year may be different from the long-term average. Predicting these differences ahead of time is called a climate forecast. So, climate forecasts attempt to predict the difference between future weather conditions and historical averages. If a climate forecast indicates that rainfall across Nebraska in a future period will be above average, we should expect to have either more rainy days or more intense rainfall events or both. A climate forecast cannot tell which case will occur or on which days it will rain. It is different from a weather forecast that predicts the weather for a given date, along with a quantitative amount for an area. A reason for this "lack of detail" in climate prediction is that the atmospheric processes that control climate change vary at a much slower rate than the processes that affect the daily weather patterns. Processes that affect weather often interfere with processes that govern the climate, and must be removed so that the slowly changing climate processes can be examined and used to make climate predictions. The climate forecast describes the "stage" on which the weather will develop.

Climate predictions for the future are useful in making planning and management decisions for agriculture and the utility industry. For example, if the coming growing season is predicted to have only 70 percent of average seasonal rainfall, one may consider planting more drought tolerant varieties or crops that demand less water. Another possibility would be to develop a mixture that contains drought tolerant, high and low water use, along with high-yielding hybrids in order to reduce climate risk and maximize yield. For gas and electric utility planning, if the next month is predicted to be 20 percent warmer than average, a utility plant manager may consider adjusting power supply strategies in preparation for increasing power demand.

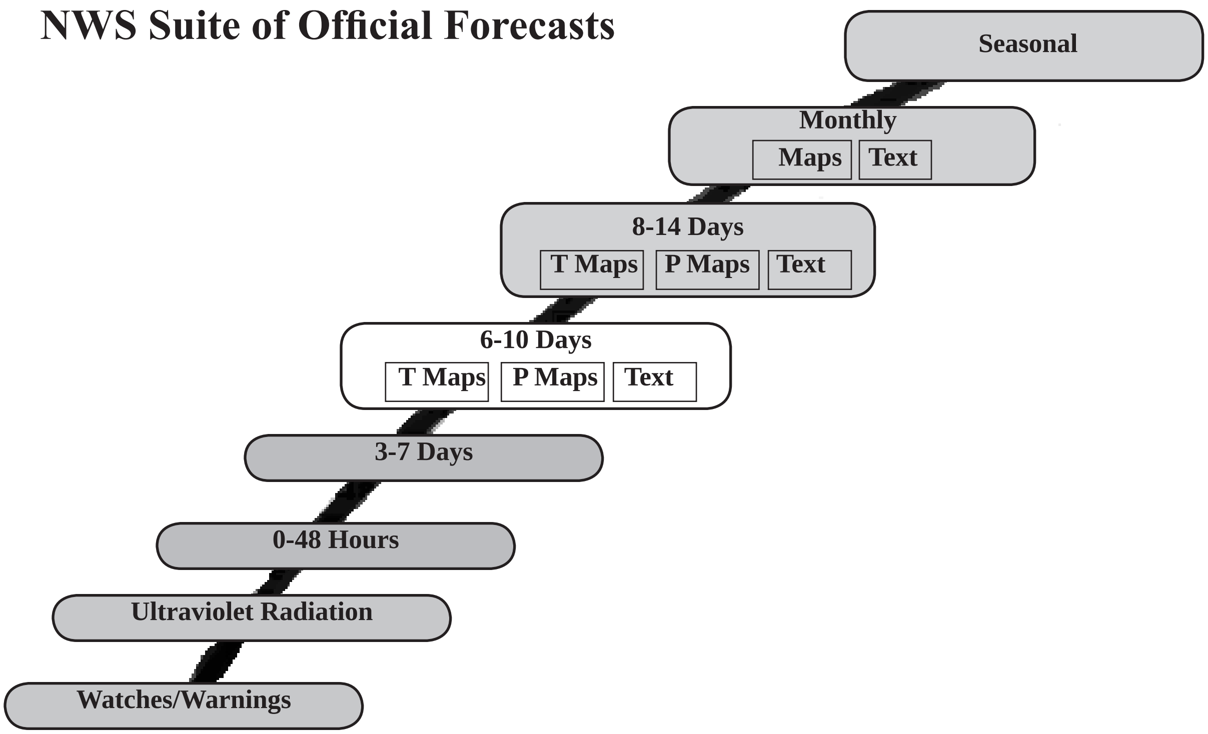
Indeed, the success and benefits of these plans rely on the prediction accuracy, which we know is far from 100 percent. However, forecast accuracy has been improved to well above 50 percent and continues to increase. Such forecasts can produce more reliable, confident plans and strategies than any system based on past conditions or coin tossing. By knowing forecast accuracy, we can develop methods to reduce impacts due to shortfalls from inaccurate forecasts, while maximizing benefits from correct ones.

Available Climate Predictions

There are many sources available to get climate forecasts and related products. Because most products are made or repackaged primarily based on the forecasts provided by the National Oceanic and Atmospheric Administration (NOAA), the nation's agency for official climate and weather forecasts, we will discuss NOAA's forecasts in this NebGuide.

NOAA's forecasts are accessible online at **http://www.cpc.ncep.noaa.gov/products/forecasts/**. At this site, you will find the following suite of official forecasts shown in *Figure 1*, including (at the bottom of the figure) wind chill forecasts and sea surface temperature forecasts. The sea surface temperature forecasts describe current El Nino/La Nina conditions, along with expectations for the equatorial Pacific Ocean. The 6-10 day, 8-14 day, monthly, and seasonal forecasts in this suite are the focal point of this paper.

Three of the four forecast icons contain options for map and text forecasts. The map option gives temperature and precipitation forecast plots for the United States, excluding Hawaii, and the text version contains a narrative to assist in your understanding of the forecasts shown on the maps.



U.S. Threats Assessment	Base-Period Means	Wind Chill Index	Monthly and Seasonal SST Forecasts Nino 3.4	Official SST Forecast	SST Base-Period Means

Figure 1. NOAA National Weather Service Suite of Official Forecasts.

If you click the "P Maps" box ("P" for precipitation) in the "6-10 Days" forecast you get a rainfall forecast map similar to the one shown in *Figure 2*. The forecast on these maps are depicted according to which is favored among the three classes: "below normal," "normal," and "above normal." In this example, the solid blue lines surrounding the letter "B" indicate regions where precipitation is expected to fall into the "below normal" class; the red solid lines around letter "A" indicate regions where precipitation is expected to fall in the class of "above normal;" and the areas around the letter "N" are where precipitation is expected to fall in the "near normal" class. The dashed blue lines on the map show the normal or average precipitation for the four-day period in the forecast (from the sixth to the tenth day from the current day which was the February 19). The unit of the average values is given in the map legend and is usually one-tenth of one inch.

From this forecast map, we see that Nebraska is within a region forecasted to receive above average precipitation during the four -day period. In addition, the eastern portion of the state is between the 33 and 40 contour lines, most of the central Nebraska falls between the 40 and 50 contour lines, and the remainder of the state falls within the 50 contour line. These numbers show the probability of the forecast, and they are explained in the next section.

If you click the "T Maps" box, a forecast map of the surface air temperature will be shown as in *Figure 3* with the similar three classes of "below" (B), "near normal" (N), and "above normal" (A) temperature for a forecast period. Blue dashed lines on the map show the normal or average temperatures for the period, and their unit is printed on the map legend in degrees Fahrenheit.

Interpreting the Forecast Precipitation and Temperature Maps

In the forecast precipitation map *(Figure 2)*, the numbers on or along the contour lines indicate the probabilities associated with the "above" and "below" classes. The long-term probability of being in either below ("B"), or near normal ("N"), or above ("A") class is 33.33 percent — they are equal probability events. When NOAA's analysis shows that a site, e.g., Grand Island, Neb., has a 7 percent *higher* probability for "above normal" precipitation in a forecast period, the total probability for the site to be in the "above normal" class increases to 40.33 percent (7+33.33), or 40 percent if we round off. At the same time, the probability for the site to have "below normal" precipitation decreases to 26 percent (33.33-7). In a similar procedure, if NOAA's analysis shows that the Scottsbluff, Neb., has a 17 percent *higher*

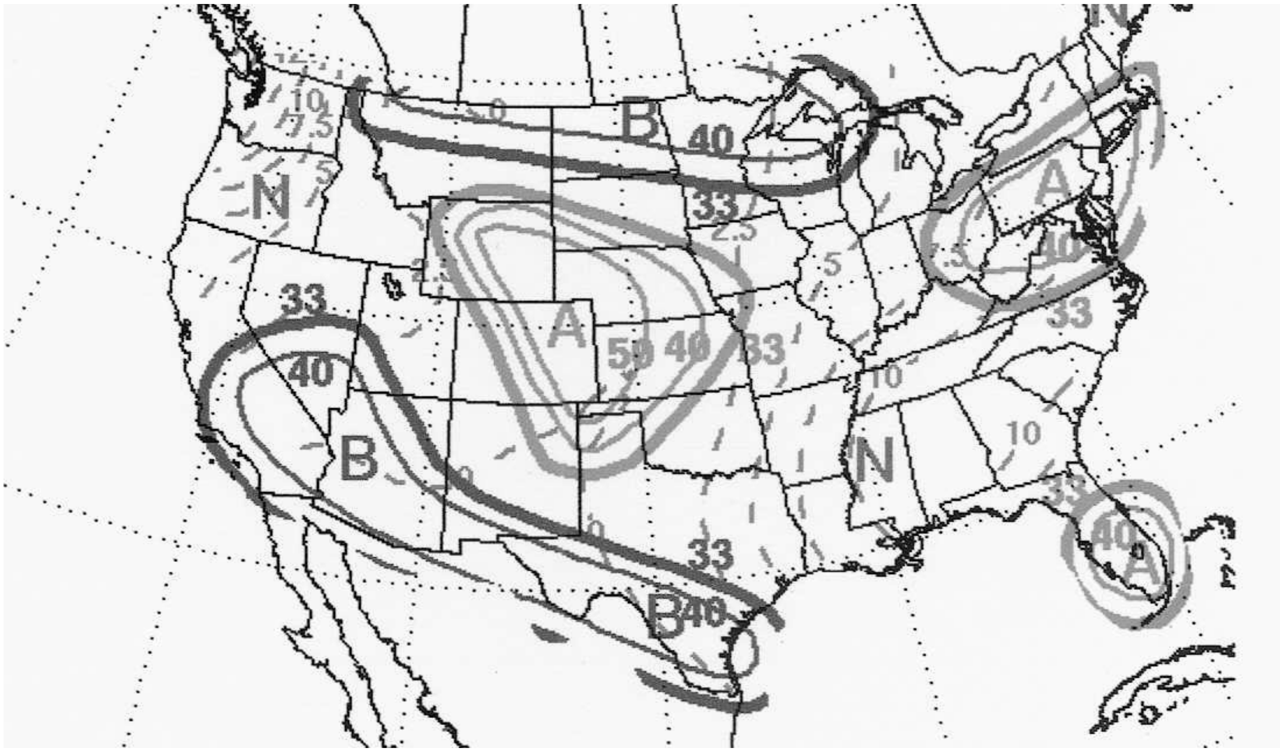


Figure 2. A 6-10 day precipitation forecast map.

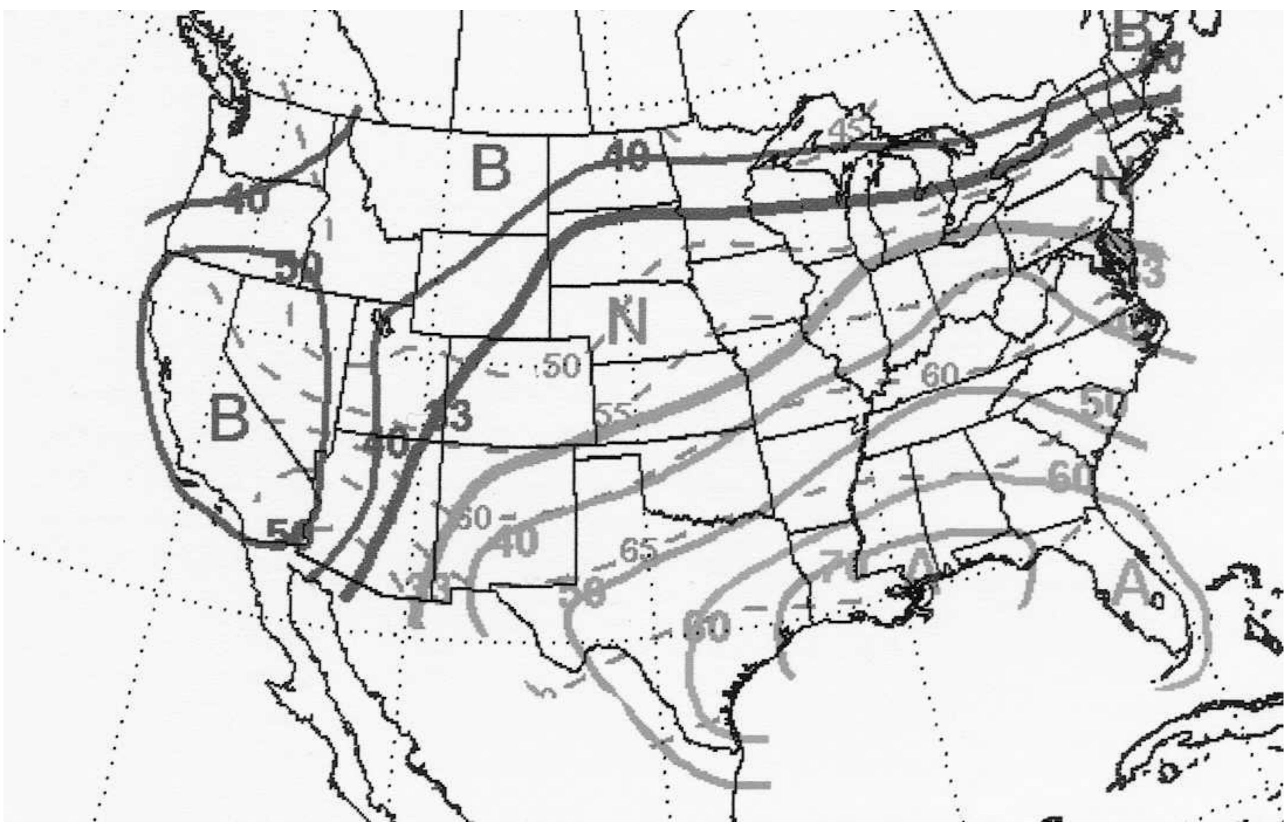


Figure 3. A 6-10 day air temperature forecast map.

probability to be in the class of “above normal” in the forecast period, the total probability for Scottsbluff to be in the class of “above normal” increases to over 50 percent (17+33.33), and its probability to have “below normal” precipitation decreases to 16 percent. The same interpretation applies to regions associate with “B,” or below normal precipitation forecasts.

There are a couple of other ways to interpret these forecasts depending on user’s purposes. We can combine the entire “near normal” class with, for example, the “above normal” class, if we are just interested in the probability of *not* falling in the “below normal” or dry conditions in a region. Using the previous example, Grand Island, which is in between the 33 percent and 40 percent contour lines, will have 66 to 73 percent (33+33 and 40+33) probability of *not* being dry. This probability increases to 83 percent for the region within the 50 percent contour line in the Nebraska panhandle. The same reasoning applies to the areas forecasted to be dry. For example, in *Figure 2* the probability of *not* being wet is over 73 percent in southern California in the four-day forecast period.

The other way of interpreting the forecast map is to divide the “near normal” class in half and put the upper half to the “above normal” class and the lower half to the “below normal” class. This is equivalent to issuing the forecasts to be either above or below median values. Again, if we apply the previous example for Grand Island, Neb., we will find from this interpretation that the probability of having above median precipitation will be about 57 percent. This probability increases to 67 percent in the panhandle areas in Nebraska.

When the forecast finds no clear trend for precipitation and/or temperature, the notation “CL” will be placed on the forecast map, indicating “Climatological Probability.” This notation means that a region could have above, near, or below normal conditions but contains no predictable probability increase or decrease for the forecast period. This situation is less ideal but not hopeless because we can still use the given climatological precipitation and temperature that may be of interest.

These interpretations of forecast probability also apply to the suite of temperature forecasts. A caveat in these NOAA forecasts is that they do not tell quantitatively the departure from the normal or average temperature or precipitation.

By knowing where to acquire climate predictions and how to interpret them, we can begin to plan weekly to seasonal production activities. For example, the short-term (six to 10 days) forecast can be used for irrigation scheduling and pesticide or fertilizer applications. Because chemical effects depend on the environmental conditions at application time, finding the best climate/weather conditions for applications should increase effectiveness, while minimizing environment damage.

This publication has been peer-reviewed.

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