Analysis of One- to Five-Day-Out High Temperature Forecasts for the United States

(January 2015 – June 2015)

By ForecastWatch.com, a Service of Intellovations, LLC
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Executive Summary

For the first six months of 2015, ForecastWatch collected one- to five-day-out high temperature forecasts from seven top providers of consumer weather forecasts for the United States. Over 4.7 million forecasts were collected for 792 locations throughout the United States and compared against the 7 a.m. to 7 p.m. local-time high temperature recorded by the observation station at each location. Mean absolute error, the number of forecasts within three degrees Fahrenheit, and the number of forecasts that matched the high temperature observation were calculated. AccuWeather's high temperature forecasts had the highest accuracy in all three measurements.

How Temperature Forecasts Are Evaluated

Temperature forecast accuracy is measured a number of ways. All accuracy calculations begin with taking the forecast high temperature and subtracting the actual observed high temperature. This number is called the error. A forecast that predicts too low a temperature will have a negative error, while a forecast that is too high will have a positive error.

Average absolute error is a measure of the accuracy of temperature forecasts. This measure takes the absolute value of the error of each forecast, so that all errors are positive, and then averages all errors. This is a measure of how far off, on average, the set of forecasts is, regardless if they are too high or too low.

High temperature forecasts and observations are integer numbers in degrees Fahrenheit. If the mean absolute error is three degrees or less, the forecast is within three degrees Fahrenheit. If the mean absolute error is zero, then the forecast matches the observation.

Most providers forecast the high temperature that will occur between 7 a.m. and 7 p.m. local time, because most consumers of weather forecasts expect to see that high that will occur during the day. These forecasts are then compared with the high temperature observations that occurred during that time period.

Results of Temperature Forecast Comparison

The mean absolute error for one- to five-day-out high temperature forecasts for the period January 1, 2015 through June 30, 2015 are shown in Table 1. There is a difference of nearly one degree Fahrenheit between the most accurate provider, AccuWeather, and the least accurate provider, Dark Sky. At the 99% confidence level, AccuWeather was the most accurate provider of one- to five-day-out high temperature forecasts for the study period. The Weather Channel and Weather Underground were tied for second place at the 99% confidence level. The National Weather Service and Foreca were tied for fifth at that confidence level.

Table 2 shows the percentage of one- to five-day-out high temperature forecasts within three degrees of the observation. This means the high temperature forecast was within the range of three degrees lower and three degrees higher than the observed high temperature. Three degrees is often used by meteorologists, as differences in forecasts greater than three degrees can often be noticed by consumers, hence the often-heard "three degree guarantee". AccuWeather had the highest percentage of forecasts within three degrees, at 64.99%, whereas Dark Sky had the fewest at 52.44%. This means that AccuWeather forecast nearly 25% more high temperatures within three degrees than Dark Sky.

Finally, Table 3 shows the number of one- to five-day-out high temperature forecasts that matched the high temperature observations. This means that the high temperature forecast was exactly the same as the 7 a.m. to 7 p.m. observed high temperature for the location. AccuWeather again had the highest

percentage of forecasts without error, at 11.93%, while Dark Sky again had the fewest at 8.31%.

Rank	Provider	Mean Abs Error
1	*AccuWeather*	3.269
2*	*The Weather Channel*	3.326
2*	*Weather Underground*	3.327
4	*Intellicast*	3.444
5*	*National Weather Service*	3.525
5*	*Foreca*	3.535
7	*Dark Sky (forecast.io)*	4.186

Table 1: One- to five-day-out high temperature forecast mean absolute error for period 1/1/2015-6/30/2015

Rank	Provider	% within 3°F
1	*AccuWeather*	64.99%
2	*Weather Underground*	64.30%
3	*The Weather Channel*	64.29%
4	*Intellicast*	62.75%
5	*Foreca*	61.61%
6	*National Weather Service*	61.08%
7	*Dark Sky (forecast.io)*	52.44%

Table 2: One- to five-day-out high temperature forecasts within 3 degrees for period 1/1/2015-6/30/2015

Rank	Provider	% no error
1	*AccuWeather*	11.93%
2	*The Weather Channel*	11.33%
3	*Weather Underground*	11.33%
4	*Intellicast*	10.94%
5	*Foreca*	10.58%
6	*National Weather Service*	10.57%
7	*Dark Sky (forecast.io)*	8.31%

Table 3: One- to five-day-out high temperature forecasts without error for period 1/1/2015-6/30/2015

Forecast Collection Methodology

Daily high temperature forecasts were collected from each provider starting at 22:00 UTC (6 p.m. Eastern Standard Time) and continued until all forecasts were collected. For each location, forecasts from all providers were collected at the exact same time.

Forecasts were considered valid if they were complete (i.e. they contained a high and low temperature forecast), and if they passed both manual and automated audits. These audits checked for out-of-bounds values and other indicators that suggested the forecast should be marked as invalid. Forecasts that were simply bad were not considered invalid. However, forecast issues caused by system bugs or delivery problems (such as a -32768 degree high temperature) were declared invalid.

Collecting AccuWeather Forecasts

Forecasts from AccuWeather were collected from http://www.accuweather.com using the Premium, ad-free 15-day forecast page in January. The location parameters used to retrieve the specific forecasts were of the form {number}_PC. However, beginning in February, forecasts were collected using the AccuWeather API at http://api.accuweather.com.

Collecting Foreca Forecasts

Forecasts from Foreca were collected from http://www.foreca.com using the ten-day forecast page. The location parameter used was the city and state of the observation location.

Collecting Intellicast Forecasts

Forecasts from Intellicast were collected from http://www.intellicast.com using the extended forecast page. The location parameter used was a site-specific code for the location.

Collecting National Weather Service Forecasts

Forecasts from the U.S. National Weather Service were collected from the National Digital Forecast Database using the SOAP interface documented here http://graphical.weather.gov/xml/. Forecasts were requested using the latitude and longitude of the observation station location.

Collecting The Weather Channel Forecasts

Forecasts from The Weather Channel were collected from http://www.weather.com using the ten-day forecast page. The latitude and longitude of the observation station were used to retrieve specific forecasts.

Collecting Weather Underground Forecasts

Forecasts from Weather Underground were collected from the Weather Underground API at http://www.wunderground.com/api. The location parameter used to retrieve specific forecasts was the ICAO code or SYNOP of the observation station.

Collecting Dark Sky Forecasts

Forecasts from Dark Sky were collected from the forecast.io API at http://api.forecast.io. The latitude and longitude of the observation station were used to retrieve specific forecasts.

Observation Collection and Calculation Methodology

Observational data was procured from the primary ASOS weather observation network. The data were quality controlled by National Climatic Data Center (NCDC) systems and personnel prior to delivery to ForecastWatch via the Quality-Controlled Local Climatic Data (QCLCD) product data set. This product consisted of both hourly and daily observation parameters.

The maximum temperature from the 7 a.m. to 7 p.m. local time hourly observations was used to construct the 7 a.m. to 7 p.m. (MOS) high temperature. No attempt to curve fit or otherwise determine an intra-hour temperature estimate was performed.

Provider	Number of Forecasts	Percent of Possible Forecasts
AccuWeather	673,314	93.9%
Dark Sky (forecast.io)	678,288	94.6%
Foreca	672,092	93.8%
Intellicast	678,632	94.7%
National Weather Service	673,100	93.9%
The Weather Channel	678,625	94.7%
Weather Underground	677,017	94.5%

Table 4: Number of one- to five-day-out forecasts analyzed and percent of possible, by provider

Table 4 shows the number of forecasts collected and compared for each provider for the one- to five-day-out forecasts. There were around 675,000 forecasts used for each provider for the period. The percent of possible forecasts collected and compared is less than 100% because of invalid forecasts, problems in collecting forecasts successfully, and days in which observations were not available for a particular site.

Differences in the forecast count are due to a number of factors. First, invalid forecasts are removed. Second, occasionally a provider's website or feed would be off-line or not be complete due to network issues, production issues in the provider's forecast creation, or other issues. Finally, observations stations are down and don't provide data for a day or two every few months due to maintenance. Overall, around 94% of the possible forecasts and observations that could be compared for each provider were able to be compared.

About ForecastWatch.com

ForecastWatch is the nation's premier weather forecast monitoring and assessment company. A full-service, technology consulting firm, ForecastWatch compiles weather forecasts and observations at more than 1,200 locations around the world, including the U.S., Canada, Europe, South America, Central America, Africa and Asia Pacific. ForecastWatch also maintains a historical database of over 500 million weather forecasts from a number of providers.

ForecastWatch data and analysis has been used by meteorologists, utilities and energy companies, the agriculture industry, futures traders, and others whose business success depends on being right about the weather. Our data meets the highest standard of scientific inquiry, and has been used in several peer-reviewed studies, including a paper published in the Monthly Weather Review.

ForecastWatch services have been used to evaluate weather forecast providers, improve decision-making where weather forecasts are used as input, improve weather forecasts by providing useful feedback, compare weather forecast performance between providers, educate customers with unbiased reporting, and improve the quality of weather forecast websites.