Three Region Accuracy Overview

2010 through June 2016

By ForecastWatch.com,
a Service of Intellovations, LLC

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Executive Summary

Companies that specialize in weather prediction have an investment in accuracy and in establishing their capability to provide that accuracy. Their clients, in turn, require access to accurate weather forecasting which is critical to success in many industries, both public and private. Understanding and evaluating the past is a key to assessing future risk and opportunity.

Forecasts from three regions and three days-out groupings were analyzed. Forecasts were collected from 2010 through June of 2016 for the United States, and from 2013 through June of 2016 for Asia-Pacific and Europe. Accuracy was measured as the combination of the percentage of high temperature forecasts within three degrees, the percentage of low temperature forecasts within three degrees, and the percent correct of precipitation forecasts. Forecasts from eleven different providers were collected for a total of over 142 million forecasts analyzed.

In the seven years, three regions, and three forecast time periods in the study, only four out of eleven forecasting companies collected were found to be the most accurate: The Weather Channel, MeteoGroup, Weather Underground, and Foreca. The Weather Channel was the most accurate in 27 of the 45 region/days-out/year groupings, while The Weather Channel tied with Weather Underground for one period. Weather Underground was the most accurate in an additional 6 periods, all of which occurred after The Weather Company (the parent company of The Weather Channel) purchased Weather Underground in 2012. MeteoGroup came in first in seven periods (15%) while Foreca came in first four times (9%).

Results

ForecastWatch calculated one-to-three days out, three-to-five days out, and six-to-nine days out overall forecast accuracy for the Asia-Pacific region, Europe, and the United States, including Alaska and Hawaii as well as the territories. The period for the collection was 2013 through 2016 for the Asia-Pacific and European regions, and 2010 through 2016 for the United States. All data from 2016 was collected for the first half of the calendar year only, from January to June. The accuracy tables were sorted by 2016 accuracy percentages. The provider with the most accuracy for each year is highlighted.

Forecasts were collected from eight providers for all three regions, and included the BBC in Europe, and both the National Weather Service website (weather.gov) and the NWS

National Digital Forecast Database (NDFD) in the United States. ForecastWatch did not begin collecting forecasts from some providers until after the study period began, and are indicated by grayed out cells. For example, ForecastWatch began collecting forecasts from World Weather Online during 2010, Foreca and MeteoGroup in 2011, and Dark Sky in 2013. Thus the first full year of forecasts would be 2011 for World Weather Online, 2012 for Foreca and MeteoGroup, and 2014 for Dark Sky. Additionally Weather Underground only started providing a five-day out forecast in 2011, and a ten-day out forecast 2014.

Overall forecast accuracy was calculated by averaging the number of high temperature forecasts within three degrees, the number of low temperature forecasts within three degrees, and the number of icon and text forecasts which correctly predicted precipitation or not. Total forecasts collected by region were over 5 million for the Asia-Pacific Region, over 16 million for Europe, and nearly 122 million for the United States, for a total of over 143 million forecasts.

One-to-Three Days Out

	2013	2014	2015	2016
The Weather Channel	75.32%	73.16%	76.18%	75.54%
Weather Underground	70.89%	73.13%	76.10%	75.49%
AccuWeather	70.01%	70.42%	73.92%	74.30%
MeteoGroup	73.87%	73.99%	74.14%	72.41%
Foreca	70.87%	71.87%	72.72%	71.93%
Intellicast	70.73%	69.04%	71.08%	70.90%
Dark Sky		69.66%	68.15%	67.86%
World Weather Online	60.49%	58.79%	60.50%	60.91%

Table 1: Asia-Pacific 1-3 Day Out Overall Accuracy, 2013 through June 2016

As shown in Table 1 above, The Weather Channel was the most accurate provider of one-to-three day out forecasts in the Asia-Pacific region for three of the four years of the study. MeteoGroup was the most accurate in 2014, followed by The Weather Channel in second place.

Weather Underground experienced the greatest improvement in forecasting, increasing in accuracy by 4.60 percentage points from 2013 to 2016. The most accurate provider in 2014, MeteoGroup, declined in accuracy from its peak in 2014 to 2016 by 1.58 percentage points. Dark Sky and MeteoGroup were the only providers in this category to show a decrease in accuracy from the first year of collection to the last.

	2013	2014	2015	2016
Weather Underground	68.88%	75.20%	76.11%	75.24%
The Weather Channel	73.20%	75.24%	76.09%	75.13%
AccuWeather	68.81%	71.92%	75.53%	74.88%
Intellicast	71.95%	73.98%	74.84%	74.28%
Foreca	70.51%	72.21%	74.03%	73.45%
MeteoGroup	73.14%	74.29%	74.48%	73.10%
BBC	68.34%	69.25%	69.62%	68.68%
Dark Sky		69.38%	68.77%	67.19%
World Weather Online	61.80%	62.11%	63.63%	63.85%

Table 2: Europe 1-3 Day Out Overall Accuracy, 2013 through June 2016

Table 2 above shows The Weather Channel provided the most accurate forecasts for the European region in 2013 and 2014, while Weather Underground was the most accurate provider in 2015 and 2016. World Weather Online remained consistently the least accurate for all nine providers of one-to-three day out forecasts in Europe between 2013 and 2016.

For one-to-three day out forecasts for the United States (below, Table 3), The Weather Channel or Weather Underground had the highest accuracy for six of the seven study years. Only in 2012 did MeteoGroup take the top spot with an overall accuracy percentage of 74.44%, followed by The Weather Channel at 74.27%. Accuracy increased for all providers from the first year for which data was available through June of 2016. The provider with the greatest increase in accuracy was Weather Underground, with an increase of 6.25 percentage points. The provider with the smallest increase was World Weather Online, which only improved 0.06 percentage points.

	2010	2011	2012	2013	2014	2015	2016
The Weather Channel	72.08%	71.53%	74.27%	75.00%	74.98%	76.62%	76.21%
Weather Underground	69.87%	68.34%	69.44%	70.74%	75.24%	76.63%	76.12%
Intellicast	71.75%	71.18%	73.57%	74.17%	74.25%	75.98%	75.61%
AccuWeather	69.05%	68.14%	70.33%	71.26%	72.13%	75.27%	74.89%
Foreca			70.39%	70.97%	71.91%	74.22%	74.88%
MeteoGroup			74.44%	74.92%	75.17%	75.29%	74.76%
NWS Web	69.43%	68.73%	70.06%	70.34%	70.27%	71.30%	71.92%
Dark Sky					66.45%	68.32%	69.33%
NWS NDFD	68.54%	67.86%	69.35%	69.87%	69.40%	69.84%	69.28%
World Weather Online		63.50%	61.44%	61.12%	63.98%	64.58%	63.56%

Table 3: USA 1-3 Days Out Overall Accuracy, 2010 through June 2016

Three-to-Five Days Out

	2013	2014	2015	2016
The Weather Channel	71.97%	69.61%	72.39%	72.11%
Weather Underground	67.34%	69.56%	72.18%	71.80%
AccuWeather	66.85%	67.19%	69.86%	70.59%
MeteoGroup	70.29%	70.23%	70.59%	68.55%
Foreca	67.32%	68.24%	69.00%	68.34%
Intellicast	67.95%	65.87%	67.75%	67.61%
Dark Sky		66.40%	64.27%	63.14%
World Weather Online	58.61%	57.02%	58.56%	59.04%

Table 4: Asia-Pacific 3-5 Day Out Overall Accuracy, 2013 through June 2016

Table 4 on the previous page shows overall accuracy for three-to-five day out forecasts in the Asia-Pacific region. Like the one-to-three day out accuracy, The Weather Channel was the most accurate provider for three of the four study years, with MeteoGroup the most accurate provider in 2014. MeteoGroup, Intellicast, and Dark Sky all displayed a reduction in accuracy over the four-year period captured in this table.

	2013	2014	2015	2016
Weather Underground	62.70%	69.26%	70.01%	69.10%
The Weather Channel	67.09%	69.22%	69.93%	69.01%
AccuWeather	63.20%	66.16%	69.11%	68.42%
Intellicast	66.15%	68.16%	68.95%	68.32%
Foreca	64.31%	65.51%	67.18%	67.42%
MeteoGroup	67.49%	68.72%	68.45%	67.21%
BBC	64.87%	65.96%	66.57%	65.42%
Dark Sky		63.74%	63.45%	61.45%
World Weather Online	57.43%	58.45%	60.06%	59.55%

Table 5: Europe 3-5 Day Out Overall Accuracy, 2013 through June 2016

Table 5 above shows three-to-five day out overall accuracy for Europe. MeteoGroup was the most accurate provider in 2013. However, from 2014 onward, Weather Underground was the most accurate provider. In 2013, the most accurate provider, MeteoGroup, was 4.79 percentage points or 7.09% more accurate than Weather Underground, which was the seventh-most accurate for that year. But in 2016, the ranking of these two providers was effectively reversed, with MeteoGroup the sixth-most accurate provider.

Table 6 on the following page shows three-to-five day out accuracy for the United States. The National Weather Service does not provide a full fifth day forecast on it's website, so they are not represented. The Weather Channel was the most accurate provider in 2010, 2011, and 2016, while tying with Weather Underground in 2015. MeteoGroup took the top spot from 2012 through 2014. Like the one-to-three day out results for the United States, the three-to-five day forecast accuracy increased for all providers. As with the one-to-three

day out results, the provider with the largest improvement in accuracy was Weather Underground, improving from 62.42% to 69.55%.

	2010	2011	2012	2013	2014	2015	2016
The Weather Channel	64.96%	64.77%	67.46%	68.29%	68.23%	69.98%	69.63%
Weather Underground		62.42%	63.55%	64.74%	68.43%	69.98%	69.55%
Intellicast	64.77%	64.54%	67.01%	67.73%	67.73%	69.39%	69.16%
MeteoGroup			68.59%	69.02%	69.20%	69.76%	69.04%
AccuWeather	62.87%	62.34%	63.85%	64.80%	65.46%	68.53%	68.25%
Foreca			64.60%	65.01%	65.57%	67.69%	68.08%
NWS NDFD	61.64%	61.60%	62.62%	63.39%	62.59%	63.40%	62.71%
Dark Sky					62.50%	62.63%	62.61%
World Weather Online			56.91%	56.49%	60.23%	60.83%	60.22%

Table 6: USA 3-5 Day Out Overall Accuracy, 2010 through June 2016

Six-to-Nine Days Out

The Weather Channel was the most accurate provider for six-to-nine day out forecasts for the Asia-Pacific region from 2013 through 2016, as shown in Table 7 on the following page. ForecastWatch did not collect MeteoGroup forecasts past seven days due to collection limitations and website layout of the provider, and Dark Sky only provided forecasts out to seven days.

The Weather Channel was the most accurate provider over all three days out ranges in the Asia Pacific region, only ceding the top spot to MeteoGroup in 2014 for the one-to-three and three-to-five days out ranges.

	2013	2014	2015	2016
The Weather Channel	65.73%	63.42%	66.31%	65.79%
Weather Underground		63.36%	66.08%	65.41%
AccuWeather	59.80%	60.13%	62.13%	63.00%
Foreca	62.37%	61.46%	62.30%	62.12%
Intellicast	62.59%	60.53%	62.65%	62.08%
World Weather Online	54.58%	53.93%	53.42%	53.94%

Table 7: Asia-Pacific 6-9 Day Out Overall Accuracy, 2013 through June 2016

	2013	2014	2015	2016
Foreca	56.39%	56.77%	57.31%	58.36%
Weather Underground		58.36%	59.04%	58.31%
The Weather Channel	56.24%	57.99%	58.99%	58.20%
Intellicast	55.71%	57.32%	58.33%	57.70%
AccuWeather	50.01%	53.78%	56.91%	56.95%
World Weather Online	50.25%	50.63%	52.09%	51.38%

Table 8: Europe 6-9 Day Out Overall Accuracy, 2013 through June 2016

	2010	2011	2012	2013	2014	2015	2016
The Weather Channel	54.12%	54.26%	56.16%	57.29%	56.92%	58.55%	58.79%
Weather Underground				54.56%	56.65%	58.54%	58.77%
Intellicast	53.99%	54.09%	55.93%	57.05%	56.63%	58.15%	58.44%
Foreca			57.44%	57.16%	57.24%	58.14%	58.19%
AccuWeather	52.47%	51.72%	51.71%	52.91%	53.23%	55.05%	55.85%
World Weather Online			48.93%	48.76%	51.17%	53.19%	52.86%

Table 9: USA 6-9 Day Out Overall Accuracy, 2010 through June 2016

Foreca showed strength in the long range forecast, having the most accurate forecasts from six-to-nine days out in Europe in 2013 and the first half of 2016, as shown in Table 8 on the preceding page. Weather Underground had the most accurate forecasts in 2014 and 2015, while coming in second place in 2013 and the first half of 2016. MeteoGroup, Dark Sky, and BBC are not represented due to either not providing or ForecastWatch not collecting forecasts out to nine days.

Table 9 on the preceding page shows the six-to-nine day out overall forecast accuracy for the United States. The Weather Channel was the most accurate provider in every year except 2012 and 2014, where Foreca was the most accurate. All providers improved their accuracy over time, from the first year for which data was available through 2016. MeteoGroup, Dark Sky, and the NWS NDFD are not represented due to either not providing or ForecastWatch not collecting forecasts out to nine days.

Data Collection

Tables 10 through 18 show the total number of forecasts collected for this report across all three world regions, as well as for all three categories of days-out. All data from 2016 was collected for the first half of the calendar year only, from January to June. An empty field in the table indicates that the data was unavailable, either because ForecastWatch did not collect forecasts for that provider for the entire period, or because the provider did not provide forecasts for the entire days-out range for the period. Overall, over 142 million forecasts were analyzed.

One-to-Three Days Out

Tables 10, 11, and 12 on the following two pages show the number of forecasts collected, matched to an observation, and determined to be valid for each provider for one-to-three day out forecasts for each year and region. Over 1.7 million forecasts were collected for Asia-Pacific for all providers and years, over 5.6 million forecasts for Europe, and over 49.1 million forecasts for the United States. A total of over 56 million one-to-three day out forecasts were collected from 2010 through June 2016.

	2013	2014	2015	2016
AccuWeather	61,706	63,435	65,300	32,482
Dark Sky		66,549	65,611	32,706
Foreca	63,486	65,705	65,537	32,664
Intellicast	63,725	66,440	65,506	32,651
MeteoGroup	63,739	65,518	64,512	32,196
The Weather Channel	63,762	66,373	65,606	32,706
Weather Underground	63,767	66,203	65,339	32,506
World Weather Online	63,231	65,046	65,233	32,460

Table 10: Asia-Pacific 1-3 Day Out Forecast Counts 2013 through June 2016

	2013	2014	2015	2016
AccuWeather	176,800	171,635	196,614	96,304
BBC	142,098	143,569	148,535	72,353
Dark Sky		194,536	198,722	96,408
Foreca	185,824	192,243	198,813	96,325
Intellicast	186,562	194,434	198,126	96,120
MeteoGroup	185,549	191,033	196,871	95,409
The Weather Channel	183,266	193,143	199,092	96,420
Weather Underground	186,205	185,317	193,883	95,276
World Weather Online	186,054	190,254	197,030	96,138

Table 11: Europe 1-3 Day Out Forecast Counts 2013 through June 2016

	2010	2011	2012	2013	2014	2015	2016
AccuWeather	839,863	781,077	807,929	805,924	818,434	815,393	398,691
Dark Sky					819,141	818,752	399,422
Foreca			805,367	802,518	811,871	813,769	398,242
Intellicast	843,680	816,164	808,760	807,271	819,865	818,964	399,428
MeteoGroup			782,161	780,039	792,916	790,505	385,602
NWS Web	778,545	746,761	773,951	781,800	791,917	789,267	387,207
NWS NDFD	829,839	784,538	780,730	768,868	810,176	804,708	397,434
The Weather Channel	842,735	813,839	807,182	806,578	815,131	818,965	399,425
Weather Underground	831,873	811,111	808,489	806,233	814,929	817,338	396,080
World Weather Online		597,274	802,664	801,785	806,869	806,696	397,605

Table 12: USA 1-3 Day Out Forecast Counts, 2010 through June 2016

Three-to-Five Days Out

	2013	2014	2015	2016
AccuWeather	61,798	63,432	65,162	32,486
Dark Sky		66,544	65,477	32,706
Foreca	63,587	65,718	65,395	32,666
Intellicast	63,809	66,442	65,376	32,648
MeteoGroup	63,810	65,513	64,362	32,196
The Weather Channel	63,848	66,376	65,471	32,706
Weather Underground	63,856	66,185	65,194	32,631
World Weather Online	63,343	65,045	65,087	32,460

Table 13: Asia-Pacific 3-5 Day Out Forecast Counts 2013 through June 2016

	2013	2014	2015	2016
AccuWeather	176,848	171,623	196,293	96,351
BBC	94,641	95,701	98,879	48,252
Dark Sky		194,236	198,378	96,437
Foreca	185,829	192,221	198,495	96,355
Intellicast	186,507	194,413	197,808	96,151
MeteoGroup	185,512	190,983	196,558	95,437
The Weather Channel	183,216	193,110	198,774	96,449
Weather Underground	186,228	185,267	193,558	95,331
World Weather Online	185,959	190,265	196,686	96,229

Table 14: Europe 3-5 Day Out Forecast Counts 2013 through June 2016

	2010	2011	2012	2013	2014	2015	2016
AccuWeather	839,831	781,426	807,829	805,902	818,397	815,369	398,688
Dark Sky					819,066	818,765	399,399
Foreca			805,267	802,704	811,742	813,731	398,210
Intellicast	843,699	816,335	808,676	807,263	819,831	818,976	399,404
MeteoGroup			782,071	780,047	792,885	790,515	385,582
NWS NDFD	827,807	784,859	778,419	768,472	810,112	804,547	397,525
The Weather Channel	842,767	814,103	807,017	806,566	815,181	818,975	399,402
Weather Underground		710,653	808,360	806,245	814,778	817,340	396,062
World Weather Online			802,598	801,925	806,820	806,635	397,569

Table 15: USA 3-5 Day Out Forecast Counts, 2010 through June 2016

Tables 13, 14, and 15 on the preceding two pages show the number of forecasts collected, matched to an observation, and determined to be valid for each provider for three-to-five day out forecasts for each year and region. Over 1.5 million forecasts were collected for Asia-Pacific for all providers and years, nearly 5.5 million forecasts for Europe, and over 38.2 million forecasts for the United States. A total of over 45 million three-to-five day out forecasts were collected from 2010 through June 2016.

Six-to-Nine Days Out

	2013	2014	2015	2016
AccuWeather	82,095	84,576	86,949	43,316
Foreca	84,468	87,594	87,253	43,552
Intellicast	84,719	88,584	87,228	43,528
The Weather Channel	84,773	88,501	87,358	43,608
Weather Underground		73,226	87,010	43,352
World Weather Online	84,178	86,688	86,861	43,308

Table 16: Asia-Pacific 6-9 Day Out Forecast Counts 2013 through June 2016

	2013	2014	2015	2016
AccuWeather	235,641	228,800	261,712	128,454
Foreca	247,377	256,168	264,641	128,469
Intellicast	248,242	259,175	263,739	128,186
The Weather Channel	243,847	257,425	265,027	128,584
Weather Underground		207,304	257,996	127,011
World Weather Online	247,680	253,613	262,212	128,286

Table 17: Europe 6-9 Day Out Forecast Counts 2013 through June 2016

	2010	2011	2012	2013	2014	2015	2016
AccuWeather	1,119,555	1,042,014	1,077,296	1,074,556	1,093,154	1,086,355	531,402
Foreca			1,073,900	1,070,835	1,083,807	1,084,036	530,651
Intellicast	1,124,191	1,088,248	1,078,429	1,076,360	1,095,070	1,091,185	532,292
TWC	1,123,269	1,085,233	1,075,949	1,075,376	1,088,802	1,091,186	532,300
WU				1,074,321	1,086,945	1,088,621	530,665
WWO			1,070,279	1,069,614	1,077,325	1,074,476	529,788

Table 18: USA 6-9 Day Out Forecast Counts, 2010 through June 2016
TWC – The Weather Channel, WU – Weather Underground, WWO – World Weather Online

Tables 16 and 17 on the preceding page, and table 18 above show the number of forecasts collected, matched to an observation, and determined to be valid for each provider for six-to-nine day out forecasts for each year and region. Over 1.7 million forecasts were collected for Asia-Pacific for all providers and years, over 5 million forecasts for Europe, and over 34.5 million forecasts for the United States. A total of over 41 million three-to-five day out forecasts were collected from 2010 through June 2016.

Methodology

Accuracy

Total forecast accuracy was determined by four components that were equally weighted to arrive at the final percentage presented in the tables:

- Percentage of high temperature forecasts within three degrees Fahrenheit.
- Percentage of low temperature forecasts within three degrees Fahrenheit.
- Percent correct of icon precipitation/non-precipitation forecasts.
- Percent correct of text precipitation/non-precipitation forecasts.

Parameter for this report, both forecast and observed, were defined as follows:

- High temperature: The highest temperature that occurred between noon and midnight.

- Low Temperature: The lowest temperature that occurred between midnight and noon.
- Precipitation: Measured or observed precipitation for the full 24-hour day, local time, midnight to midnight was considered a precipitation observation, otherwise it was considered a non-precipitation observation. A precipitation forecast icon showed precipitation, and a precipitation text forecast mentioned precipitation, however likely. If precipitation was not shown or mentioned, it was considered a non-precipitation forecast. In the event a provider did not provide icons, the text forecast was substituted as the icon forecast and weighted twice.

Validity

Forecasts were considered **valid** if they contained a high and low temperature forecast, icon, and text 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** (inaccurate or wrong) were not considered invalid. However, forecasts issues caused by system bugs or delivery problems (such as a -32768 degree high temperature) were declared invalid.

Providers

Forecasts were collected from the following providers as discussed:

- **AccuWeather** http://api.accuweather.com. Forecasts were collected using the using the AccuWeather API at http://api.accuweather.com.
- **BBC** http://www.bbc.co.uk/weather/. Not all cities collected in Europe are provided.
- **Dark Sky** http://api.darksky.net. Latitude and longitude of the observation station were used to retrieve specific forecasts.
- **Foreca** http://www.foreca.com. 10-day forecast page. Location parameter used was the city and state of the observation location.
- **Intellicast** http://intellicast.com. Extended forecast page. Location parameter was a site-specific code for the location.

- **MeteoGroup** http://www.weathercast.co.uk/ Forecast taken from the first page graph.
- **NWS NDFD** http://graphical.weather.gov/xml/. Forecast collected from the National Digital Forecast Database using the SOAP interface.
- **NWS Web** http://www.weather.gov. Forecast taken from the Extended Forecast.
- **The Weather Channel** http://www.weather.com. 10-day forecast page. Latitude and longitude of the observation site were used to retrieve specific forecasts.
- **Weather Underground** http://www.wunderground.com/api. Location parameter used to retrieve specific forecasts was the International Civil Aviation Organization (ICAO) code or surface synoptic observations (SYNOP) of the observation station.
- **World Weather Online** https://www.worldweatheronline.com/. Latitude and longitude of the observation site were used to retrieve specific forecasts.

Forecasts were collected from each of the three regions at specific times during the day. For each location, forecasts were requested at the exact same time from each provider.

Region	Collection Time	Station Count (as of 2016)
United States	22:00 UTC	792
Europe	16:00 UTC	193
Asia Pacific	08:00 UTC	64

Table 19: Forecast collection times and regions.

Observation Data

Observation data was collected from the primary Automated Surface Observing System (ASOS) network in the United States as well as international equivalents. United States data were quality controlled by the National Climatic Data Center (NCDC) prior to delivery to ForecastWatch via the Quality-Controlled Local Climatic Data (QCLCD) product data set. International data came from the Integrated Surface Database product. Both products consisted of hourly and daily observation parameters.

About ForecastWatch.com

ForecastWatch has been the nation's premier weather forecast monitoring and assessment company since 2003, when it released the largest public weather forecast accuracy study at the time. ForecastWatch compiles weather forecasts and observations from more than 1,200 locations around the world, including the United States, Canada, Europe, South America, Central America, Africa and the Asian Pacific. ForecastWatch maintains a historical database of over 600 million weather forecasts from a number of providers.

Meteorologists, utilities and energy companies depend on ForecastWatch's accurate data and unbiased analysis. Agriculture, futures traders and other companies whose business depends on being right about the weather put their trust in us to help them achieve success. The data meets the highest standard of scientific inquiry and has been used in several peer-reviewed studies.