Peak Performance

Spring/ Early Summer Edition

Performance Branch, NWS Office of Climate, Water, and Weather Services, Silver Spring, Maryland

This Issue: June 2013

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Aviation and Marine Stats on Demand "Did You Know?"

By Brent MacAloney, NWS Headquarters

Here in the Performance Branch we are always looking for ways to make your life easier when looking at performance data. Did you know that you can now copy the color-coded content of the contingency tables in the aviation and marine Stats on Demand report output into an Excel spreadsheet? Believe it or not, using the latest version of Google Chrome, users can highlight the whole contingency table (or parts of it), copy it to your computer's clipboard, and past it into an Excel spreadsheet within seconds. When the content of the contingency table is copied over, unlike with Mozilla Firefox or Microsoft Internet Explorer which will only copy the text, Google Chrome copies the text, as well as the color coding over to the spreadsheet.

Here are the instructions on how to do this.

1) Go to the Performance Management website located at https://verification.nws.noaa.gov/, log in, go to either the Aviation Stats on Demand or Legacy Marine Stats on Demand programs, and run a report.

2) Once the report has been run, scroll down to the contingency table. Single left click your mouse to the left of the "Observations\Forecast" cell text, and continuing to hold down the mouse drag the arrow to the bottom most right corner of the contingency table as shown in **Figure 1**. This will highlight the entire contents of the table as

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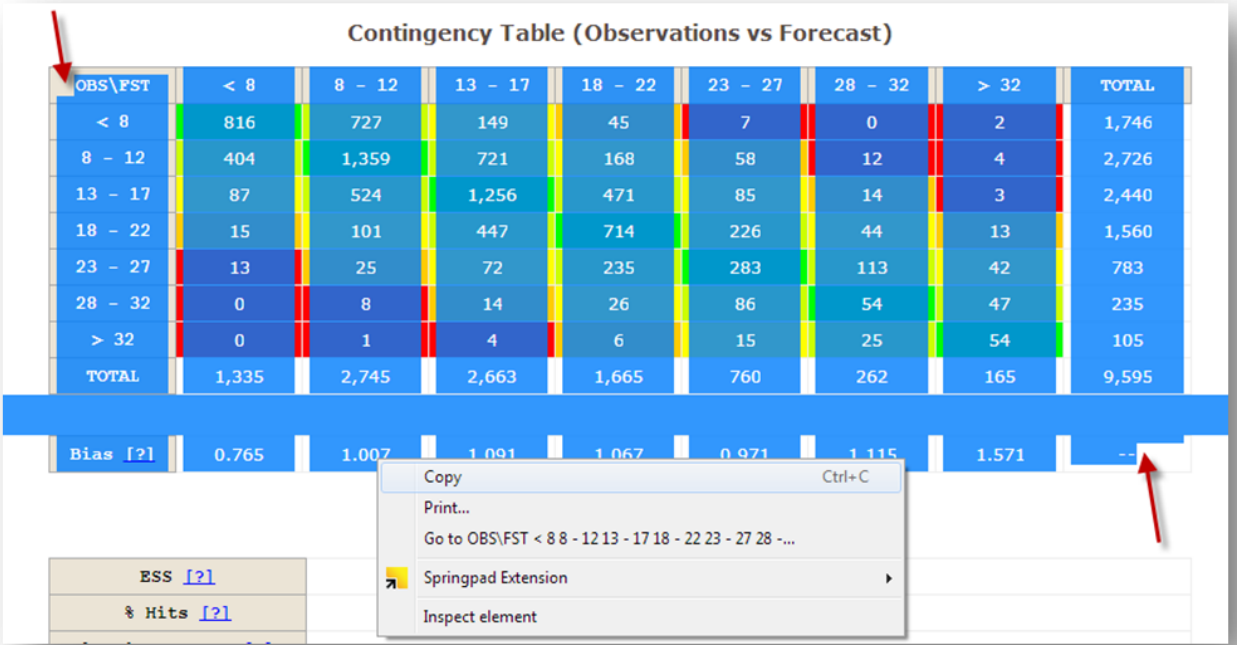
Aviation and Marine Stats on Demand "Did You Know?" – Continued from Page 1



Contingency Table (Observations vs Forecast)

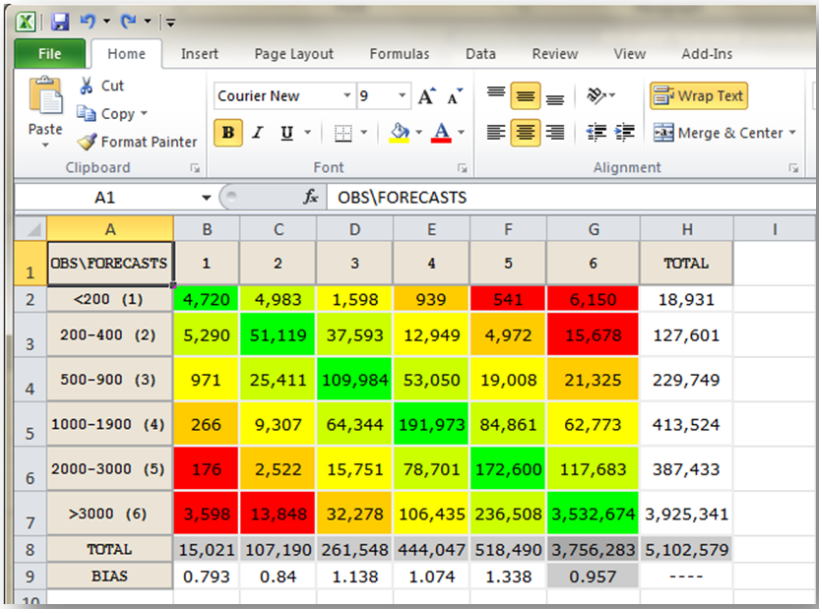
OBS\FST	< 8	8 - 12	13 - 17	18 - 22	23 - 27	28 - 32	> 32	TOTAL
< 8	816	727	149	45	7	0	2	1,746
8 - 12	404	1,359	721	168	58	12	4	2,726
13 - 17	87	524	1,256	471	85	14	3	2,440
18 - 22	15	101	447	714	226	44	13	1,560
23 - 27	13	25	72	235	283	113	42	783
28 - 32	0	8	14	26	86	54	47	235
> 32	0	1	4	6	15	25	54	105
TOTAL	1,335	2,745	2,663	1,665	760	262	165	9,595
Bias [?]	0.765	1.007	1.091	1.067	0.971	1.115	1.571	--

Figure 1: Graphic showing contingency table from the Stats on Demand report being highlighted and the data being copied to the clipboard.

shown. Next, before clicking anything else, single right click your mouse anywhere in the area you just highlighted and select "Copy" from the drop down window that pops up. Instead of single right clicking your mouse, you could also use "Ctrl+C."

3) Open your Microsoft Excel program to a blank spreadsheet or the spreadsheet which you wish to copy the data from the contingency table into. Select the cell which you wish to paste the contents of the contingency table into. By selecting the "Paste" button from the tool bar or using "Ctrl+V" you will paste the contingency table from the Stats on Demand report into the Excel spreadsheet as shown in **Figure 2**.

This quick trick should help you easily move data from the Stats on Demand tables to your Excel spreadsheet for easier analysis and number crunching. If you have other "Did You Knows?" that you feel might benefit other users of the Performance Management website, please send them along to NWS.Verification@noaa.gov and let us know. We may feature your tip or trick in a future edition of *Peak Performance.*



OBS\FORECASTS	1	2	3	4	5	6	TOTAL
<200 (1)	4,720	4,983	1,598	939	541	6,150	18,931
200-400 (2)	5,290	51,119	37,593	12,949	4,972	15,678	127,601
500-900 (3)	971	25,411	109,984	53,050	19,008	21,325	229,749
1000-1900 (4)	266	9,307	64,344	191,973	84,861	62,773	413,524
2000-3000 (5)	176	2,522	15,751	78,701	172,600	117,683	387,433
>3000 (6)	3,598	13,848	32,278	106,435	236,508	3,532,674	3,925,341
TOTAL	15,021	107,190	261,548	444,047	518,490	3,756,283	5,102,579
BIAS	0.793	0.84	1.138	1.074	1.338	0.957	----

Figure 2: Graphic showing the data which was pasted from the Stats on Demand report into an Excel spreadsheet.

Statistical Correlations of Cloud Ceiling Heights and Surface Visibilities: Climatological TAF Guidance

By Lance VandenBoogart and Michael Jamski,
NWS Cheyenne, WY

Creating accurate Terminal Aerodrome Forecasts (TAFs) is critical to providing decision support for aviation customers. Forecasting Visual Flight Rules (VFR) versus Instrument Flight Rules (IFR) conditions has significant implications for the aviation community. TAFs can be challenging when complex atmospheric flow patterns are present, and terrain features may further complicate correct prediction of cloud ceilings and visibility. Nevertheless, model forecast soundings, surface weather observations (METARs), and other real-time tools provide valuable information for the forecaster.

One additional, sometimes overlooked, source of information comes from local climatology. The following research at seven airports serving the Cheyenne WFO (Cheyenne, Laramie and Rawlins, WY; Alliance, Chadron, Scottsbluff, and Sidney, NE) shed light on the connections between cloud ceiling height and surface visibility.

Let's hypothesize that there is a positive correlation between low cloud ceiling heights and low visibilities, (i.e., if ceiling heights are low, visibilities will probably be low, and vice versa). Although this appears to be logical, the goal was to quantify this statement scientifically. Location and season would undoubtedly complicate the extent to which this hypothesis would be supported, so these factors were taken into account by differentiating between location and time of year.

As a first step, quality-controlled METARs for a given site were compiled for a 5-year period (2007-2011). This amounted to a total of approximately 60,000 METARs over the 5-year period. An algorithm searched through all reports and identified those which contained a ceiling, (i.e., either broken or overcast sky cover). Wherever a ceiling was observed, the algorithm noted the cloud ceiling height and the concurrent surface visibility.

A second algorithm then went through the ceiling/visibility pairs, and noted which flight condition category (IFR, MVFR, or VFR) the ceiling height and surface visibility matched. The two conditions could be the same or different, resulting in nine possible combinations. Based on their combination (IFR ceiling height with IFR visibility, or VFR ceiling height with MVFR visibility, etc.), pairs were binned and put into a table as exemplified in **Figure 1** on next page. Although the climatological information and strength of correlation is contained in such a table, for ease of viewing and understanding, a final step converted the raw data table **(Figure 1)** into a bar plot **(Figure 2)** that shows the "percent of time" a IFR, MVFR, or VFR visibility condition (represented by the three distinct bars) corresponds to a IFR, MVFR, or VFR ceiling height condition (represented by the fraction of the bar).

A couple examples serve to demonstrate the usefulness of such a plot. In **Figure 2**, given an IFR visibility, an IFR ceiling height occurs 40 percent of the time, as shown by the red

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Statistical Correlations of Cloud Ceiling Heights and Surface Visibilities: Climatological TAF Guidance – Continued from Page 3

Category Matches, CYS, AllMo

CEILING HEIGHT				
VFR	8901	723	581	7597
MVFR	6040	2025	941	3074
IFR	4749	1869	1082	1798
	19690	4617	2604	12469
		IFR	MVFR	VFR
		VISIBILITY		

Figure 1: Based on their combination (IFR ceiling height with IFR visibility, or VFR ceiling height with MVFR visibility, etc.), pairs were binned and put into a table.

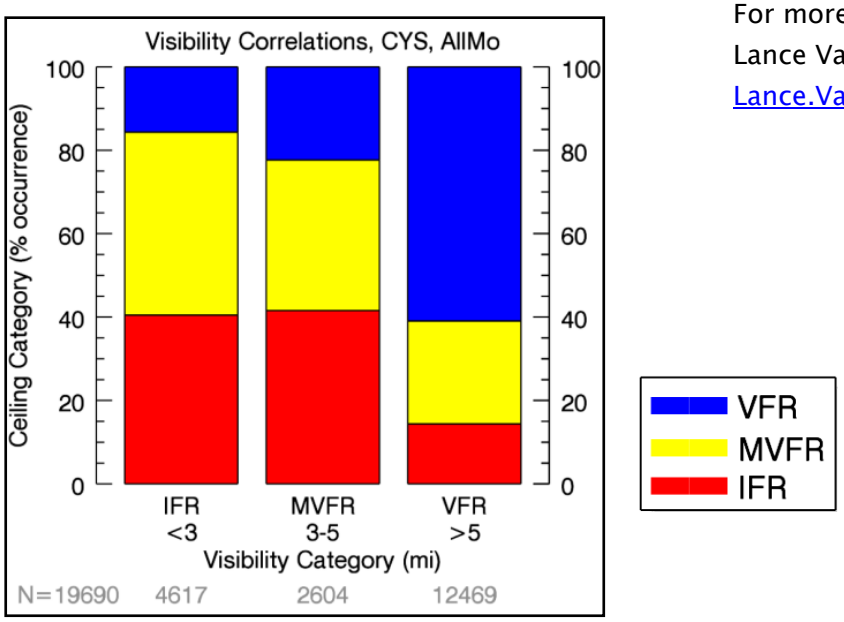

Figure 2: Converted raw data into a bar plot that shows the "percent of time" a IFR, MVFR, or VFR visibility condition (represented by the three distinct bars) corresponds to a IFR, MVFR, or VFR ceiling height condition (represented by the fraction of the bar).

leftmost bar. Another usage of **Figure 2** would be to say, "If the visibility conditions are VFR, there is only a 14 percent chance that ceiling heights conditions will be IFR", which is shown by the red portion of the rightmost bar.

A more complete explanation of the research results is beyond the scope of this article. However, the resulting plots, when properly interpreted, provide the user with a large amount of information regarding the likelihood that a site will have "x" ceiling height conditions with "y" visibility conditions. Generally, the hypothesis is supported across the seven airports studied. Interesting exceptions or strong correlations often occur at locations where local topography plays a major role.

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Fly...with Ointment

By Beth McNulty, NWS Headquarters

Non-TAF Aviation Verification Part 2:
AWC Verification

In the last issue we covered how CWSUs directly support the FAA Air Route Traffic Control Centers (ARTCCS). Aviation Weather Center (AWC) is the source for most en-route aviation weather services. The AWC focuses on the overall national airspace system (NAS). AWC creates products and provides forecasts for all CONUS, works directly with elements of FAA and coordinates with the CWSUs.

The majority of forecast products issued by AWC do not have direct observations associated with them. Examples are the three major advisory and warning products for flight level hazards. The Airmen's Meteorological Information (AIRMET), and Significant Meteorological Information (SIGMET) products alert flyers to the potential for icing, turbulence, low ceilings and mountain obscuration, and other hazards to aviation. The Collaborative Convective Forecast Product (CCFP) is the third hazard product issued by AWC.

AWC became ISO9000 certified for its quality management system this past fall. Certification means AWC has established a systematic process for management oversight of forecast production and quality, and supporting activities which meets the ISO 9001 standard requirements.

Quality management is more than meteorological verification, which depends on the availability of observed or measured data. AWC forecast products cover flight level airspace which has sparse data coverage at best. The AWC products show the likely occurrence of hazardous conditions, such as icing or turbulence, based on an analysis of models, upper air soundings, satellite imagery, and radar data. The difficulty with meteorological verification for AIRMETs, SIGMETs, and CCFPs is that hazards like icing and turbulence are not directly observable like temperature, or rain in a rain gage. These weather hazards are also not remotely detected with tools like satellite or radar. Additionally, the occurrence and intensity of these hazards are dependent on airframe and time exposed to them.

A quality review of AWC products can emphasize format and timeliness of issuance, which is different than meteorological verification. The timely production of AWC products depends on functional workstations, incoming data resources, forecaster skill and knowledge, and reliable communication circuits. The AWC QMS manages all of these elements to assure the best possible service to the FAA and the flying public.

AWC provides non-TAF en-route forecasts. These forecasts are monitored for meteorological soundness, and format quality to assure consistent, reliable forecast services to the FAA and flying public. The AWC QMS process systematically manages all functions in AWC that affect forecast production.

Next Issue: Aviation-related Surveys, Part 1: Getting Feedback from Users!

Service Assessment Program

By Sal Romano, NWS Headquarters

Another One Completed

The Hurricane and Post-Tropical Cyclone Sandy, October 22-29, 2012 Service Assessment is now publicly available.

Sandy was first identified as a disturbance in the Caribbean by the National Hurricane Center on October 19, 2012. Sandy reached hurricane status on October 24. It made landfall across the Caribbean—first Jamaica, then eastern Cuba and the Bahamas before moving generally northward parallel to the U.S. eastern seaboard. Sandy made landfall just south of Atlantic City, NJ, around 8:00 p.m. EDT on October 29. The storm brought a record water level of 13.88 feet to New York City's Battery Park and isolated total rainfall amounts of 10 inches to extreme southern New Jersey, Delaware, and Maryland. Wind gusts reached 90 mph along the New Jersey shore and Long Island, NY. Gusts in the Baltimore and Washington metropolitan areas reached over 70 mph, and gusts exceeded 60 mph as far away as Boston and Chicago. The same storm was also responsible for over a foot of snow across portions of the Central Appalachians from North Carolina to Pennsylvania, with parts of West Virginia experiencing blizzard conditions and up to three feet of snow. Sandy's central pressure of 940 millibars was the lowest recorded pressure for a landfalling tropical cyclone north of Cape Hatteras. When Sandy made landfall, it broke Philadelphia's, Harrisburg's, and Baltimore's all- time low pressure records.

The Service Assessment Team was composed of 10 members. In addition, there were eight subject-matter experts/consultants. The Service Assessment Team conducted the majority of its fieldwork January 6-12, 2013, focusing on the New York/New Jersey region, which was the most heavily impacted by Sandy.

The NWS Director cleared the Hurricane and Post-Tropical Storm Sandy, October 22-29, 2012 Service Assessment document on May 7, 2013. The NOAA Deputy Under Secretary for Operations signed the document on May 14, 2013.

The public release for this service assessment occurred on May 15, 2013 and is available at here.

Add a Review of Your Office's Flood Warning Verification to Your Spring To-Do List

By Brent MacAloney, NWS Headquarters

While you are going around your office conducting a spring cleaning and preparing for the upcoming severe weather season, one of the other tasks you may wish to take part in is checking out your office's flood warning performance. Several years ago, the Performance Branch and the Hydrologic Services Branch got together to create a point-based Flood Warning Verification Stats on Demand program. This program includes one of the most graphically intensive displays of verification data that the Performance Management website has to offer.

For those of you who are not familiar with the Flood Warning Verification Stats on Demand program, the first place we recommend starting would be the training module on the Commerce Learning Center (CLC). The training module is located here: http://goo.gl/jMISJ. This training module provides a great overview of the flood warning verification program, the objective and history of flood warning verification, where events and warnings used by the verification program originate, the verification methodology and limitations, how to run verification reports, and analyzing the verification data output. This training **(Figure1)** module is only 20-minutes long and will give you the tools needed to run reports with confidence.

Once you have a good understanding for the inter-workings of the Flood Warning Verification Stats on Demand program, you are ready to start generating reports. This can be done by going to the Performance Management website, located at: https://verification.nws.noaa.gov/, logging in, and clicking on the Verification >> Hydrology link in the menu. This will take you to a page of all the hydrologic verification programs the Performance Management website has to offer. Once on that page, select the Point-based Flood Warning (FLW) Verification Stats on Demand Interface link. As soon as you are on the Point-based Flood Warning (FLW) Verification Stats on Demand selection interface, select the time period, area (start with your WFO), river response (start with all responses checked), initial grouping (click on WFO if selecting your office), and change report type to Include Warnings. Once you click "Get Report" you will receive a report giving you all the warning and event data meeting your selection criteria.

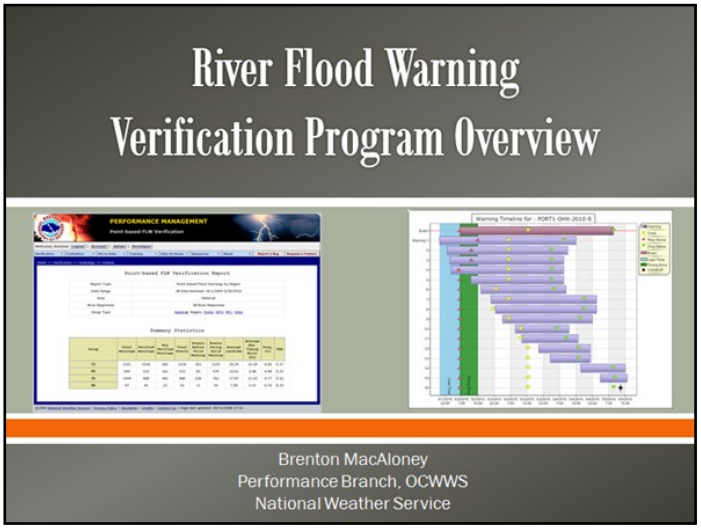

Figure1: Image of River Flood Warning Verification Program Overview training module.

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Add a Review of Your Office's Flood Warning Verification to Your Spring To-Do List-

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The report returned will come with a header on it, repeating all of the information you selected on the Flood Warning (FLW) Verification Stats on Demand selection interface. Below that you will get a summary of the data contained in the report. Fields such as how many warnings were issued during that period, how many of those were verified/unverified, how many events occurred during that period, how many of those occurred before/during a valid warning, an average lead time, absolute timing error, frequency of hit (similar to a probability of detection), and false alarm ratio as shown in **Figure 2**.

Although this summary statistic information is useful in understanding the overall performance of the area you selected over a given time, one must dig a little deeper to find the details of how your office performed from event to event. This information can be found in the warning details. Remember back to when you were selecting your reporting criteria from the Flood Warning (FLW) Verification Stats on Demand selection interface, we had you select the "Include Warnings" option in the report type. By selecting this option, the system will give you the warning by warning details on how your office performed. The output looks like what is shown in **Figure 3**.

Summary Statistics

Group	Total Warnings	Verified Warnings	Non Verified Warnings	Total Events	Events Before Valid Warning	Events During Valid Warning	Average Lead Time (hr)	Average Abs. Timing Error (hr)	Freq. Hit	FAR
ALL	43	30	13	30	3	27	10.23	4.52	0.90	0.30

Figure 2: Summary of statistics from the Flood Warning Verification report.

National - Warnings [top]

ID	First Warning Issuance Time (UTC)	First Warning Rise Above Value (UTC)	Last Warning Issuance Time (UTC)	Last Warning Rise Above Value (UTC)	Hit	Miss	FA	Lead Time (hr)	Abs. Timing Error (hr)	Time Line
GAPA1-BMX-2013-30	5/6/2013 13:57	5/6/2013 21:00	5/8/2013 14:20	5/6/2013 21:10	1	0	0	7.22	0.17	Plot

Figure 3: Warning by warning output.

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Add a Review of Your Office's Flood Warning Verification to Your Spring To-Do List-

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Note you can see the specifics of when the first flood warning was issued, the date/time the first warning called for the river at the forecast point to rise above flood level, when the last warning update was issued, and the rise above flood stage date/time in the final warning update (i.e., when the event occurred). Users are then given statistics as to whether the event was warned (i.e., Hit), unwarned (i.e., Miss), or if the warning was a false alarm (i.e., FA). The lead time, absolute timing error (i.e., the difference between the date/time the forecaster estimated the river would flood in the original warning and date/time it was observed flooding), and a link to the time line plot are also listed.

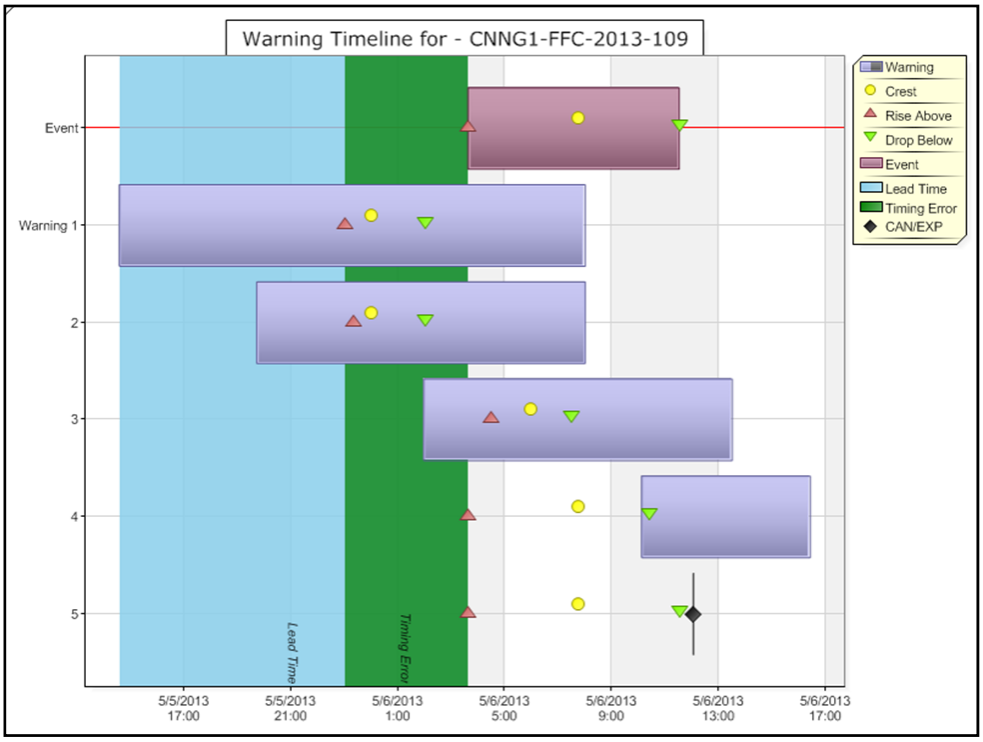

Figure 4: An example of the warning time line clearly showing how lead time and timing error were calculated.

It is recommended you look at each time line plot to get a graphical representation of all warnings and updates issued in the series, as well as see when the event ended up happening as shown in example in **Figure 4**. By looking at these timelines, it becomes very clear where you may find areas for improvement or a job well done that could be shared with others at the office.

Finally, if you find the graphical timeline of warnings, follow-up statements, and events difficult to understand, you can always review the tabular output chronologically listing all warnings and follow-up statements for this flood event as shown in **Figure 5** on next page.

Initially, all the numbers in the tables and graphs may seem a bit overwhelming. However, the best way to become more comfortable with understanding working this data is to get into the Stats on Demand system, run many reports, and explore the data the system provides you. Once you do that, it shouldn't take long before you are finding opportunities to improve your office's performance. And as always, if at any point you run into trouble understanding what you are looking at, please feel free to call any member of the Performance Branch staff and they should be able to assist you or find someone to assist you.

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Add a Review of Your Office's Flood Warning Verification to Your Spring To-Do List-

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First Issuance Time (UTC)	First Rise Above FS (UTC)	Last Rise Above FS (UTC)	Hit/Miss/FA	Lead Time	Abs. Timing Error
5/5/2013 14:35	5/5/2013 23:00	5/6/2013 3:37	Hit	13.03	4.62

Graph ID	Issuance Timestamp (UTC)	Warning Begin (UTC)	Warning End (UTC)	Rise Above FS (UTC)	Drop Below FS (UTC)	Action Code	Warning Text
1	5/5/2013 14:35	5/5/2013 23:00	5/6/2013 8:00	5/5/2013 23:00	5/6/2013 2:00	NEW	Text
2	5/5/2013 19:43	5/5/2013 23:20	5/6/2013 8:00	5/5/2013 23:20	5/6/2013 2:00	EXT	Text
3	5/6/2013 1:58		5/6/2013 13:30	5/6/2013 4:30	5/6/2013 7:30	EXT	Text
4	5/6/2013 10:07		5/6/2013 16:25	5/6/2013 3:37	5/6/2013 10:25	EXT	Text
5	5/6/2013 12:03		5/6/2013 16:25	5/6/2013 3:37	5/6/2013 11:31	CAN	Text

Figure 5: A tabular output of all the warnings and follow-up statements.

An Estimate of Southwest Airlines Fuel Costs Due to National Weather Service TAF False Alarms:

A Collaboration between Southwest Airlines Meteorology and Fort Worth Weather Forecast Office

By Dan Shoemaker, WFO Fort Worth, TX

A group from Weather Forecast Office Fort Worth (WFO FWD) met with Southwest Airlines (SWA) meteorologists on May 7, 2013. Part of the discussion was about fuel costs associated with TAF performance. The attendees decided to approximate a dollar value associated with TAF false alarms, which force the airlines to carry extra fuel when alternate required conditions are forecast but do not occur. At least one of the authors believes that (for alternate required conditions) false alarms are worse for airline customers than missed events, since flights can continue to destination even if the ceiling or visibility drops below 2000/3 and was missed in the TAF. Given that the NWS Government Performance and Results Act (GPRA) goal analyzes 1000/3 performance and is measured at all forecast offices, it seems that in many cases 2000/3 performance may be overlooked. However, 2000/3 performance is important, and may even have higher direct costs associated with it than 1000/3 performance since conditions below 2000/3 occur more often than 1000/3, and require flights to carry additional fuel.

SWA flies about 3500 flights per day or over a million flights a year. To come up with a false alarm ratio (FAR), a request was input into the NWS Aviation Stats on Demand system for every CONUS SWA and AirTran city using scheduled TAFs in 2012. A six-hour window (3-9 hours into the TAFs) was used for verification to avoid duplication of observations and to approximate the valid periods of the TAFs likely used for SWA flight planning. Flights are usually fuel planned about two hours before departure, so trip time plus two hours would mean that most TAFs would be in their 3-9 hour window for a given arrival time. This methodology has some built-in errors, such as the equal weight assigned to each terminal. Some terminals receive many more flights per day than others, and results were not weighted for this factor. There was also no time of day weighting, although lower ceilings/visibilities usually occur in the morning hours and there may be more or less flights when lower conditions tend to occur. **Figure 1** below depicts 2012 2000/3 percent occurrences for NWS TAFs and LAMP (details in caption).

	NWS TAF <2000/3	**3-9 hours** >=2000/3	
OBS<2000/3	6.6	3.6	10.2
OBS>=2000/3	**3.87**	85.93	89.8
	10.47	89.53	100

	LAMP TAF		
OBS<2000/3	6.64	3.56	10.2
OBS>=2000/3	**4.85**	84.95	89.8
	11.49	88.51	100

Figure 1: 2012 2000/3 percent occurrences for NWS TAFs and LAMP (FAR depicted in red, rows & column sums are in the far right column and bottom of table)

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An Estimate of Southwest Airlines Fuel Costs Due to National Weather Service TAF False Alarms: A Collaboration Between SWA Meteorology and WFO Fort Worth – Continued from Page 11

This table (**Figure 1**) indicates that for an average SWA flight the NWS TAFs forecast alternate required conditions over 10 percent of the time, and that 37 percent of those forecasts are false alarms. LAMP forecasts alternate required conditions over 11 percent of the time and 42 percent of those forecasts are false alarms. Given that the PODs are almost equal at about 6.6 percent (missed events also similar at 3.6 percent), the lower NWS FAR is adding value for the customers, but what costs are associated with these forecasts? SWA calculated a "back of the envelope" value of about $67 per flight of additional fuel burn costs for carrying fuel required for an alternate (**Figure 2**).

The annual costs associated with false alarms are then calculated by:

- $67/flight x FAR x 3500 flights/day x 365 days/year = total annual fuel costs

SWA Annual Cost		
NWS FAR	3.87%	$3,312,430
LAMP FAR	4.85%	$4,151,236

Figure 2: Results of above calculations for the annual costs associated with false alarms.

In simplified terms, NWS TAF false alarms cost SWA over $3.3 million a year in direct fuel costs. A one percent drop in FAR would save SWA about $800,000/year. One estimate found on the internet reports that there are over 28,000 scheduled carrier flights per day in the U.S. Using this number of flights and extrapolating the SWA results would place the NWS TAF false alarm fuel costs at over $26 million annually U.S. wide. The good news is that LAMP TAFs would have cost the airlines over $33 million annually, so there is value added by having humans write TAFs.

To ensure continued relevance in aviation forecasting, the NWS needs to provide the best service possible and any meaningful 2000/3 FAR improvement would have a great effect on the carriers' fuel costs. New initiatives in model improvement of ceiling/ visibility forecasting are needed. The NWS Office of Climate, Water, and Weather Service's Aviation Services Branch, Regional Aviation Meteorologists, Meteorologists in Charge, Aviation Focal Points, and all aviation forecasters are strongly encouraged to examine 2000/3 TAF performance to see if their offices are providing worthwhile customer service. Place additional (or new) emphasis on 2000/3 statistics and encourage forecasters to improve their awareness and performance.

"The man who does not take pride in his own performance performs nothing in which to take pride."

Thomas J. Watson — Author

Snapshot: Service Assessment Actions

- **Hurricane and Post-Tropical Cyclone Sandy** - Released May 15, 2013
  25 Total Actions, 2(8%) Closed Actions.

- **Remnants of Tropical Storm Lee and the Susquehanna River Basin Flooding of September 6-10, 2011 (Regional Service Assessment)** - Released July 26, 2012
  11 Total Actions, 1(11%) Closed Actions

- **Historic Derecho of June 29, 2012** - Released February 05, 2013
  14 Total Actions, 4(29%) Closed Actions

- **The Missouri/Souris River Floods of May – August 2011 (Regional Service Assessment)** - Released June 05, 2012
  29 Total Actions, 17(59%) Closed Actions

- **May 22, 2011 Joplin Tornado (Regional Service Assessment)** - Released September 20, 2011
  16 Total Actions, 10(62%) Closed Actions

- **Hurricane Irene in August 2011** - Released October 05, 2012
  94 Total Actions, 50(53%) Closed Actions

- **Spring 2011 Mississippi River Floods** - Released April 11, 2012
  31 Total Actions, 17(55%) Closed Actions

- **Washington, D.C. High-Impact, Convective Winter Weather Event of January 26, 2011** - Released April 01, 2011
  6 Total Actions, 6(100%) Closed Actions

- **The Historic Tornado Outbreaks of April 2011** - Released December 19, 2011
  32 Total Actions, 26(81%) Closed Actions

- **Record Floods of Greater Nashville: Including Flooding in Middle Tennessee and Western Kentucky, May 1-4, 2010** - Released January 12, 2011
  17 Total Actions, 16(94%) Closed Actions

- **South Pacific Basin Tsunami of September 29-30, 2009** - Released June 04, 2010
  131 Total Actions, 129(98%) Closed Actions

- **Southeast US Flooding of September 18-23, 2009** - Released May 28, 2010
  29 Total Actions, 29(100%) Closed Actions

- **Mount Redoubt Eruptions of March - April 2009** - Released March 23, 2010
  17 Total Actions, 17(100%) Closed Actions

- **Central US Flooding of June 2008** - Released February 03, 2010
  34 Total Actions, 33(97%) Closed Actions

- **Mother's Day Weekend Tornadoes of May 10, 2008** - Released November 06, 2009
  17 Total Actions, 17(100%) Closed Actions

- **Super Tuesday Tornado Outbreak of February 5-6, 2008** - Released March 02, 2009
  17 Total Actions, 17(100%) Closed Actions

Updated by Freda Walters- May 31, 2013

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Web Links

Stats on Demand

https://verification.nws.noaa.gov

Real-Time Forecast System:

http://rtvs.noaa.gov/

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