



The Front



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U.S. Aviation Weather-Related Crashes and Fatalities in 2004

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In 2004, weather-related airplane accidents led to 240 fatalities in the United States (U.S.) and Puerto Rico. The vast majority of these crashes were incurred by General Aviation (GA) pilots flying in Instrument Meteorological Conditions (IMC). The GA community flies under Federal Aviation Regulation (FAR) Part 91.

This segment of the pilot community frequently uses the services of Federal Aviation Administration (FAA) Automated Flight Service Stations (AFSS) to obtain preflight weather briefings and en route weather updates. The National Weather Service (NWS) Office at the FAA Academy is responsible for weather training, certifying, and evaluating AFSS employees. Reducing aviation weather-related fatalities in the U.S. is a primary goal of the NWS and of this office. To better under-

stand and to help meet this goal, the number of aviation weather-related fatalities that occur each year and under what circumstances was researched. This information helps the NWS team at the Academy highlight IMC issues to new students.

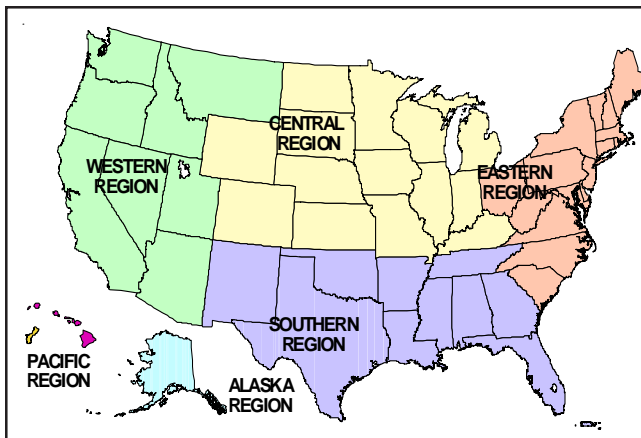
Methodology

The National Transportation Safety Board's (NTSB) website, www.nts.gov/aviation/aviation.htm, was searched for all fatal accidents for 2004 to determine if weather was at least a contributing factor in the crash.

Based on a 'yes' answer to all the following conditions, would this crash have occurred if the weather was: wind calm; sky clear; visibility unlimited; no thunderstorms; no icing; no turbulence; no low-level wind shear; and the density altitude not above field elevation?

If the answers were yes, then the crash was not included in these statistics.

The following are some statistics and conclusions from this study of the NTSB accident reports.



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The Front

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Mission Statement

To enhance aviation safety by increasing the pilot's knowledge of weather systems and processes and National Weather Service products and services.

Fatalities by NWS Region

Weather-related Aviation Crashes and Deaths by NWS Region in 2004		
Region	Crashes	Deaths
Central	25	65
Southern *	30	63
Eastern	23	53
Western	27	47
Alaska	5	9
Pacific **	1	9
Total	111	240

* Southern Region totals include one crash causing a fatality in Puerto Rico.

** Pacific Region totals only include flights near the Hawaiian Islands even though the Region includes many islands spread out over vast areas of the Pacific Ocean. The actual Pacific Region totals are probably higher than reported here.

States with Most Fatalities States With No Fatalities

Top 10 States Ranked by Number of Weather-Related Aviation Deaths in 2004			
Rank	State	Crashes	Deaths
1	TX	11	28
2	MO	3	18
3	CA	8	17
4	FL	8	13
5	GA	4	12
6	VA	2	12
7	CO	6	11
8	SC	4	11
9	MN	5	10
10	AK	5	9

Fifteen states did not have a single aviation weather-related fatality in 2004: DE, IA, IL, IN, NE, LA, MD, MS, NJ, NM, OK, RI, SD, UT and VT.

Fatalities by Operation

Approximately 83% of the aviation weather-related fatalities in 2004 occurred during FAR Part 91 General Aviation (GA) Operations.

Part 91 operations include flights by owners or operators of aircraft. This category could include operations by a large corporation flying its executives in a Boeing 747. Such a flight would be a Part 91 GA operation because it is a privately owned aircraft that does not “offer seats for sale to the public” or operate as an on-demand air taxi operation.

Weather-Related Aviation Crashes and Deaths in 2004 by Type of Operation		
Type of Operation	Crashes	Deaths
FAR Part 121 Scheduled Airlines	1	13
FAR Part 135 Air Taxi, Commuter	12	29
FAR Part 91 General Aviation	98	198
Totals	111	240

Part 135 operations are commuter airlines and on-demand air taxi operations. Part 121 operations are scheduled airlines and larger commuters.

Commercial aviation is a term frequently misused to describe airline flights. Commercial operations are flights in which the pilot may get paid to fly and is not synonymous with airline operations. Commercial flights could be conducted under FAR Part 91, 135 or 121.

Fatalities in IMC

Approximately 88% of aviation weather-related fatalities in 2004 were caused by operations in IMC. Anytime an aircraft is operating in the clouds, it is classified as in IMC.

Weather-Related Aviation Crashes and Deaths in 2004 by Flying Category		
Flying Category	Crashes	Deaths
IMC	97	212
VMC	14	28
Totals	111	240

For example, if an airport at an elevation of 1,000 Mean Sea Level (MSL) is reporting an overcast ceiling 4,000 foot Above Ground Level, the weather condition is VFR. However, if a pilot departs that airport and climbs to 5,000 feet MSL, he will enter the base of the clouds and be in IMC.

The NWS can help reduce aviation-related fatalities by educating Part 91 GA pilots about the dangers of operating in IMC, and how good weather information and briefings are essential to reducing this threat.

Fatalities Related by Month

October, 2004 had the greatest number of aviation weather-related fatalities. This statistic may reflect widespread IFR conditions that, on average, become much more frequent starting in October, after a relative lull from about April through September.

Weather-Related Aviation Crashes and Deaths in 2004 Ranked by Month		
Month	Crashes	Deaths
Oct	17	51
Jul	12	28
Jun	12	24
Jan	11	22
Aug	10	21
Dec	10	17
Nov	6	16
May	8	14
Feb	9	13
Mar	4	13
Sep	6	12
Apr	6	9
Totals	111	240

Conclusions

This study points toward IMC as an important risk factor, highlights the danger of IMC for GA, and shows NWS forecasters the importance of accurate forecasts.

This article contained only information about fatal weather-related crashes. Many of the crashes not included in this study involved injuries to people that survived. Almost all of these fatal crashes totally destroyed the aircraft involved and many of the crashes damaged property on the ground.

References

Jarboe, J. M., September 2004, PowerPoint Presentation at Western/Pacific/Alaska Regional Aviation Workshop, Seattle, WA

Jarboe, J M, January 2005. National Weather Service Aviation Weather Clinic for Flight Instructors



Operational Use of NWS Aviation Products

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In 2004, there were 111 weather-related airplane crashes resulting in 240 fatalities in the United States and Puerto Rico.

Approximately 88 percent of the aviation weather-related fatalities can be attributed to Operations in Instrument Meteorological Conditions (IMC).

This article examines a typical flight, focusing on the use of NWS data and forecasts to avoid a continued Visual Flight Rules (VFR) flight into IMC.

The VFR flight illustrated below was proposed for May 10, 2005, departing at 1930Z from Palm Springs International Airport (PSP), CA, to Bakersfield (BFL), CA. The route of flight visually follows Interstate Highway 10 (I-10) to San Bernardino.

From there the route follows I-15 through the mountain pass to get on the north side of the San Gabriel

Mountains, proceeding over to Palmdale. The remainder of the route passes over the Quail Lake airport and follows I-5 through the Tejon Pass (elevation 4,239 MSL) into the San Joaquin Valley, landing at Bakersfield. The total distance is 171 NM. (See Figure 1: Route of Flight)

The proposed flight uses a Cessna 172 Skyhawk flying at 6,500 feet mean sea level (MSL) with an average ground speed of 111 knots. The estimated time en route is one hour, 30 minutes with a 15 gallon fuel-burn out of the 40 gallons on board.

While flying at 6,500 MSL along this route, the aircraft will be 1,500 to 5,000 feet above ground level (AGL); however, between Palm Springs and Banning (BNG), there is a 11,499 feet MSL mountain peak 10 NM north in the San Gorgonio Wilderness area and a 10,834 feet MSL mountain peak 7 NM to the south in the San Jacinto



Figure 1: Route of Flight

Wilderness Area. These mountain peaks will extend 4,000 to 5,000 feet above the aircraft's altitude as it passes this area.

As the flight proceeds northward along I-15 from San Bernardino to the north side of the San Gabriel Mountains, the aircraft will cross the pass 3,500 feet below nearby mountain peaks.

Furthermore, as the aircraft proceeds from Quail Lake Airport through the Tejon Pass (4,239 MSL) above I-5, the aircraft will be 2,200 feet AGL and 1,540 feet below the mountain peak located just 4 NM southwest of the route.

To safely fly this route VFR, a pilot should closely examine NWS ceiling and visibility observations and forecasts.

Obtaining a Weather Briefing

A pilot can call **1-800-WX-BRIEF** anywhere in the United States and obtain a verbal briefing from a Pilot Weather Briefer at a Flight Service Station. Pilots can also use the FAA funded Direct User Access Terminal at either www.duat.com or www.duats.com to get a pilot weather briefing. Another option is to review aviation weather data using the NWS Aviation Digital Data Service site at: <http://adds.aviationweather.gov>.

A basic format to use to organize a Pilot Weather Briefing is:

- Hazards
- Synopsis
- Current Conditions
- Forecast Conditions

Here is a brief look at data for a flight in each category.

Hazards

There are three hazards forecast by the NWS for this flight:

First, Los Angeles Center Weather

Advisory Number 102 was issued for moderate and isolated severe turbulence, low level wind shear, and mountain wave activity on the lee side of the mountains with strong up and down drafts, continuing through 1930Z.

```
ZLA1 CWA 101730 COR
ZLA CWA 102 VALID UNTIL 101930
FROM 55ESE MZB TO 30NW TRM TO 30NE RZS TO 40ESE EHF
LINE 30NM WIDE MOD ISOL SEV TURB BLW 120. MTN WAVE ACT LEE SIDE OF
RANGES. LOCAL STG UDDF AND LLWS. CONDS CONTG BYD 1930Z. WX
```

Second, San Francisco Area AIRMET Sierra Update Number 3 has been issued for mountains occasionally obscured in clouds, ending at 02Z.

```
SFOS WA 101825 AMD
AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 102000
AIRMET MTN OBSCN...CA
FROM 70E CZQ TO 40N LAX TO RZS TO 40N RZS TO 10SSE EHF TO 70E CZQ
MTNS OCNL OBSC IN CLDS. CONDS CONTG BYD 20Z ENDG 02Z.
```

Finally, AIRMET Tango for occasional moderate turbulence below FL180 continues through 02Z.

```
SFOT WA 101345
AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 102000.
```

```
AIRMET TURB...CA NV UT CO AZ NM
FROM AKO TO TBE TO 80S ROW TO ELP TO 60S SSO TO 50SSW TUS TO BZA
TO 20S MZB TO LAX TO 40W RZS TO CZQ TO OAL TO LAS TO MTU TO AKO
OCNL MOD TURB BLW FL180. CONDS MAINLY BLW FL180 INVOF
ROCKIES...ELSW...CONDS MAINLY BLW 150. CONDS CONTG BYD 20Z THRU
02Z.
```

Synopsis from the Area Forecast

```
SFOC FA 101045
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 110500
CLDS/WX VALID UNTIL 102300...OTLK VALID 102300-110500
```

```
SYNOPSIS...UPR LVL LOW PRES SYS DOMINATES THE WRN US AND WILL BE
MOVG SLOLY EWD DURG PD.
```

The statistics show that operations in IMC are the cause of about 88 percent of the aviation weather-related fatalities in 2004.

Current Conditions

Satellite: (Figure 2)

Clouds are present over the mountains in the area of the AIRMET Sierra.

METARs:

METAR KPSP 101753Z VRB05G15KT 10SM CLR 22/03 A2987 RMK AO2 PK WND 32027/1706

METAR KRAL 101753Z VRB04KT 10SM SCT037 18/07 A2996

METAR KONT 101753Z VRB04KT 10SM SCT034 17/06 A2996

METAR KPMD 101753Z 29016KT 10SM CLR 14/00 A3000

METAR KEDW 101755Z 27016G21KT 85SM FEW050 16/00 A2996

METAR KWJF 101756Z 29015G21KT 10SM CLR 14/01 A3000 RMK AO2 PK WND

KSDB is near the Tejon pass and is critical for a VFR flight through the pass.

METAR KSDB 101752Z AUTO 33034G42KT 10SM BKN005 BKN011 04/02 A2996 RMK AO2 PK WND 33048/1738 CIG 003V008

METAR KBFL 101754Z 29008KT 10SM FEW036 15/06 A3009

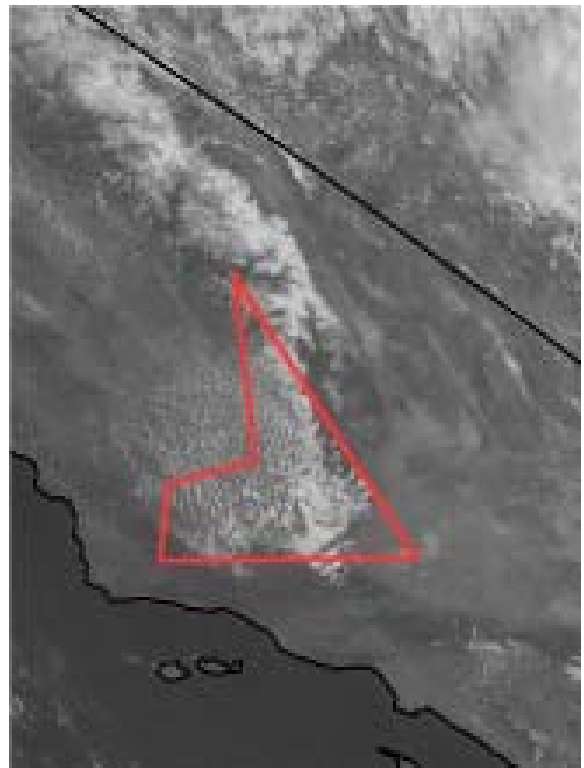


Figure 2: Satellite Imagery (1730Z 10 May 2005) with AIRMET Sierra Plotted

Pilot Reports

POC UA /OV POC-PDZ355020-DAG/TM 1743/FL065/TP BE35/TB MOD IN CAJON PASS OTW SMTH

PMD UA /OV L00-L70/TM 1710/FL045/TP PA22/TB MOD

BFL UA /OV 10W L62/TM 1830/FL065/TP PA28/SK SCT-BKN/TOP055/CLR ABV/TB NEG

Radar: No echoes along the route.

Forecast Conditions

Here's what the forecast looked like for the flight:

TAF KPSP 101720Z 101818 33020G30KT P6SM SKC
FM0600 33006KT P6SM SKC

TAF KONT 101720Z 101818 24007KT P6SM SCT030
FM2100 27015KT P6SM SKC
FM0400 VRB05KT P6SM SKC

TAF KPMD 101720Z 101818 27020G30KT P6SM SKC
FM0400 28012KT P6SM SKC
FM1200 26008KT P6SM SKC
FM1700 02008KT P6SM SKC

TAF KBFL 101740Z 101818 31010KT P6SM BKN028 BKN035
FM0100 32008KT P6SM SCT035

FM0500 33006KT P6SM SKC
FM1600 30009KT P6SM BKN030

Area Forecast (FA) for Southern California valid until 110500

SRN CA...VBG-NID-60NNW BIH LN SWD

CSTL SXNS...SCT OCNLY BKN030-050. OTLK...VFR.

INTR MTNS/DESERTS...SCT-BKN100-120. TOPS 150. BKN CI.
OTLK...VFR.

The area forecast for the route indicates that the clouds will be “scattered to broken” with bases at 10,000 to 12,000 MSL and cloud tops around 15,000 MSL. Forecasted visibilities are not included in the area forecast so by definition visibilities are well above 6 NM.

You must use the information in the Area Forecast with the AIRMET Sierra to outline the area of zero ceilings and zero visibilities obscuring the mountains.

Conclusions

The pilot would have a difficult time making this flight because of moderate and isolated severe mountain wave turbulence on the north side of the San Gabriel Mountains, along with the strong up and down drafts and low-level wind shear. Another factor making this flight risky is the mountain obscuration over the Tejon Pass as described by the AIRMET Sierra.

This forecast of obscured mountain tops is supported by the surface observation at Sandberg (KSDB, elev. 4,523 MSL) of 500 foot AGL broken ceiling varying between 300 and 800 feet AGL.

METAR KSDB 101752Z AUTO 33034G42KT 10SM BKN005 BKN011 04/02 A2996
RMK AO2 PK WND 33048/1738 CIG 003V008

With the low ceiling at Sanberg, the mountains around the Tejon Pass definitely will be obscured by clouds. The cloud bases would be near the ground through the pass. To minimize the risk of flying in turbulent, cloudy skies through a narrow pass; this flight could be rerouted over, Pomona, Flimore, San Marcus and Fellows. This re-routing will be 76 NM farther, use 7 more gallons of gas, and take 42 minutes longer but will be much safer and smoother.

As indicated in this scenario, the numerous aviation products used for pre-flight planning work together and give the pilot the big picture. No single product should be used for the “go/no go” decision.

→

Record Wind Gust Damages at Raleigh Durham Airport

By Michael Money Penny, Douglas Schneider, Meteorologists, NWS Raleigh, NC

The outer rain bands from the remnants of Hurricane Ivan moved north across central North Carolina on the afternoon of September 17, 2004. Embedded in these bands were a series of supercell and bow echo thunderstorms, several of which produced tornadoes and damaging wind gusts.

One particular storm, exhibiting a pronounced bow echo, tracked across western Wake County and directly over the Raleigh-Durham International Airport (RDU). An all-time record wind gust of 79 mph was measured at the RDU Automated Surface Observing Site (ASOS), eclipsing the 67 mph gust recorded during Hurricane Fran on September 6, 1996.



Figure 1. Damage to fixed wing aircraft, RDU Sep 17, 2004

The wind damaged, or destroyed a dozen small fixed wing aircraft and caused extensive damage to airport terminals and parking decks.

This article discusses some of the small scale meteorological features and storm signatures observed by the me-

eteorologists at Raleigh, nearly all of which are available to the aviation community on a near real-time basis via various weather and aviation sites on the Web.

The set up for this event was a heavy IFR/MVFR Ceiling, ranging

from 800 feet to 2000 feet, that lingered into mid-morning, then lifted and became scattered-to-broken by late morning over the eastern half of central North Carolina. The difference in the amount of surface heating between the west and east set up an instability boundary almost directly over the RDU airport (See Figure 2).

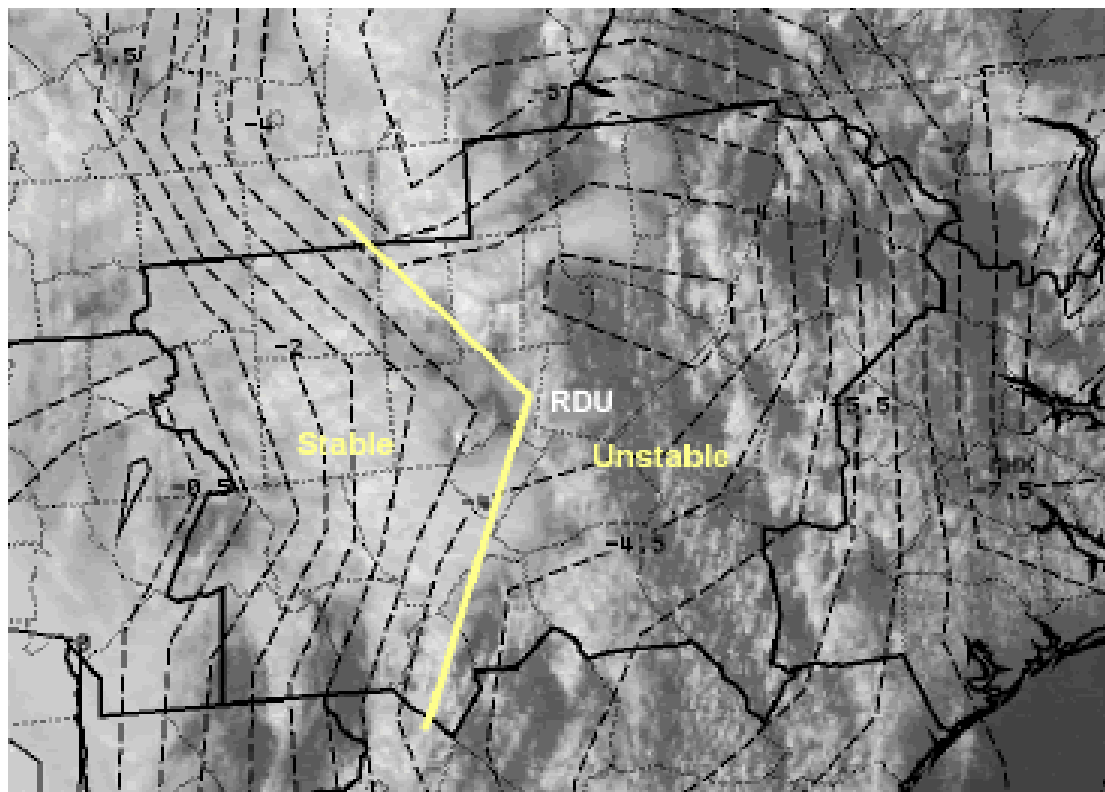


Figure 2. Visible Satellite and MSAS Lifted Indices, Sep 17, 17:45 GMT

The upper level winds were uniform with height in speed and direction on the east side of this boundary, as evidenced by the vertical wind profile from the RDU Doppler radar (See Figure 3).

The deep, unidirectional 40-55 knot winds in the profile above are indicative of fast storm motion but are not particularly favorable for tornadoes. Tornadoes typically require stronger speed and directional wind shear. Downburst winds, however, are augmented by momentum provided by the storm's forward speed. In this case, the downburst wind speed might be increased by as much as 50 knots.

These environmental factors contributed to the NWS Storm Prediction Center's (SPC) decision to include much of central North Carolina as a Moderate Risk for severe thunderstorms that afternoon and evening (Figure 4).

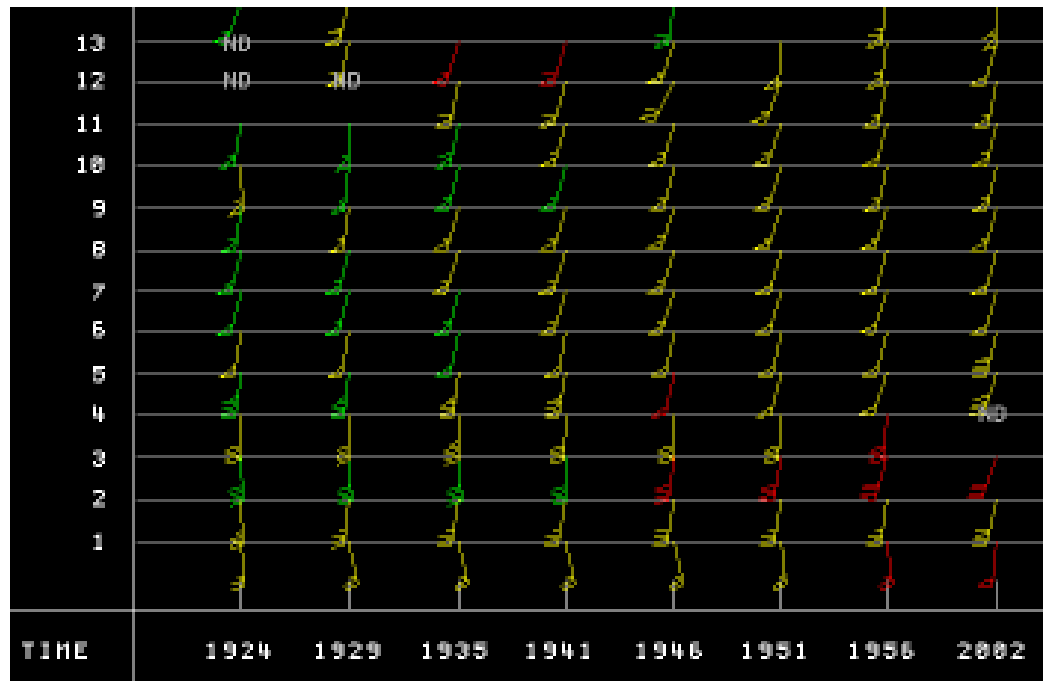


Figure 3. KRAX WSR88-D Wind Velocity and Azimuth Display

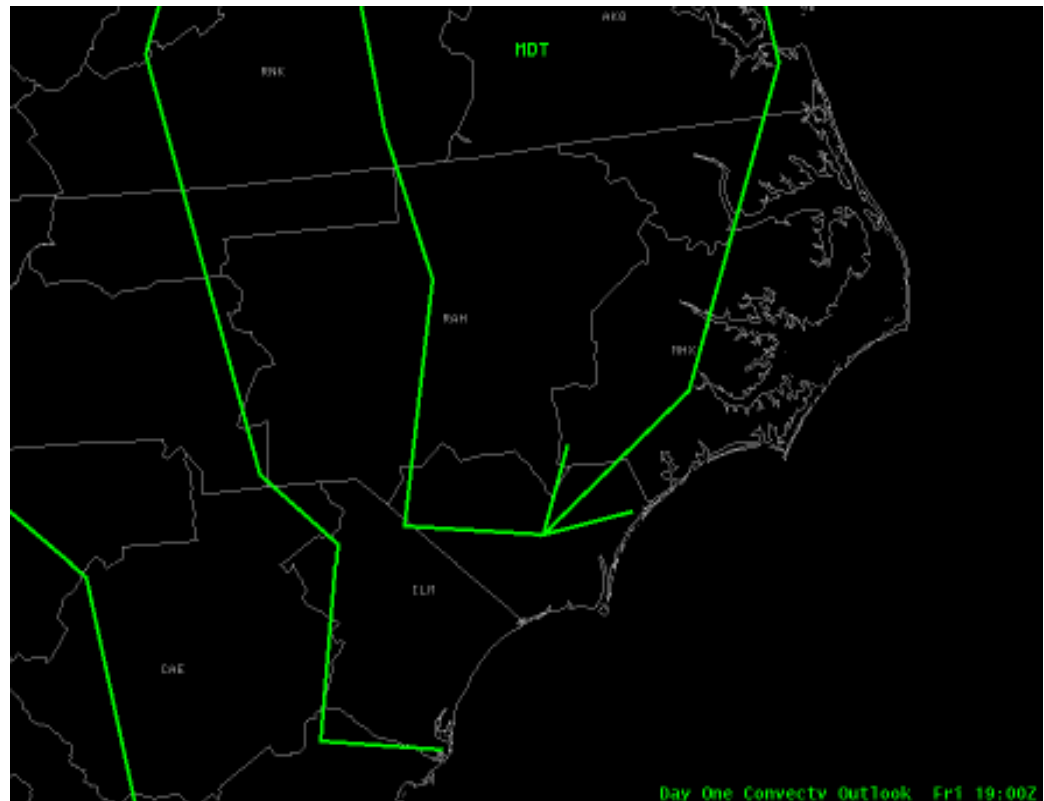


Figure 4. SPC Day One Convective Outlook for Sep 17 valid 20:00

After taking these factors into consideration, the meteorologist preparing the afternoon Terminal Aerodrome Forecast (TAF) for RDU issued the following TAF at 1728 GMT (valid from 1800GMT on the 17th through 1800 GMT on the 18th). (Figure 5 below)

```
RDUTAFRDU

KRDU 171728Z 171818 16017G27KT P6SM FEW010 BKN035
FM1900 16017G27KT 6SM -SHRA SCT010 BKN025
  TEMPO 1923 20040KT 1SM TSRA BR OVC010CB
FM2300 18013G23KT 6SM -SHRA SCT009 BKN025
  TEMPO 2302 2SM -SHRA OVC009
FM0200 20009KT P6SM BKN012
  TEMPO 0206 4SM -SHRA BR OVC007
FM0600 24005KT 4SM BR BKN012
FM1400 34015G24KT P6SM BKN028=
```

Figure 5

The line of thunderstorms aligned along the instability boundary and were moving rapidly north along the boundary (Figures 6 and 7).

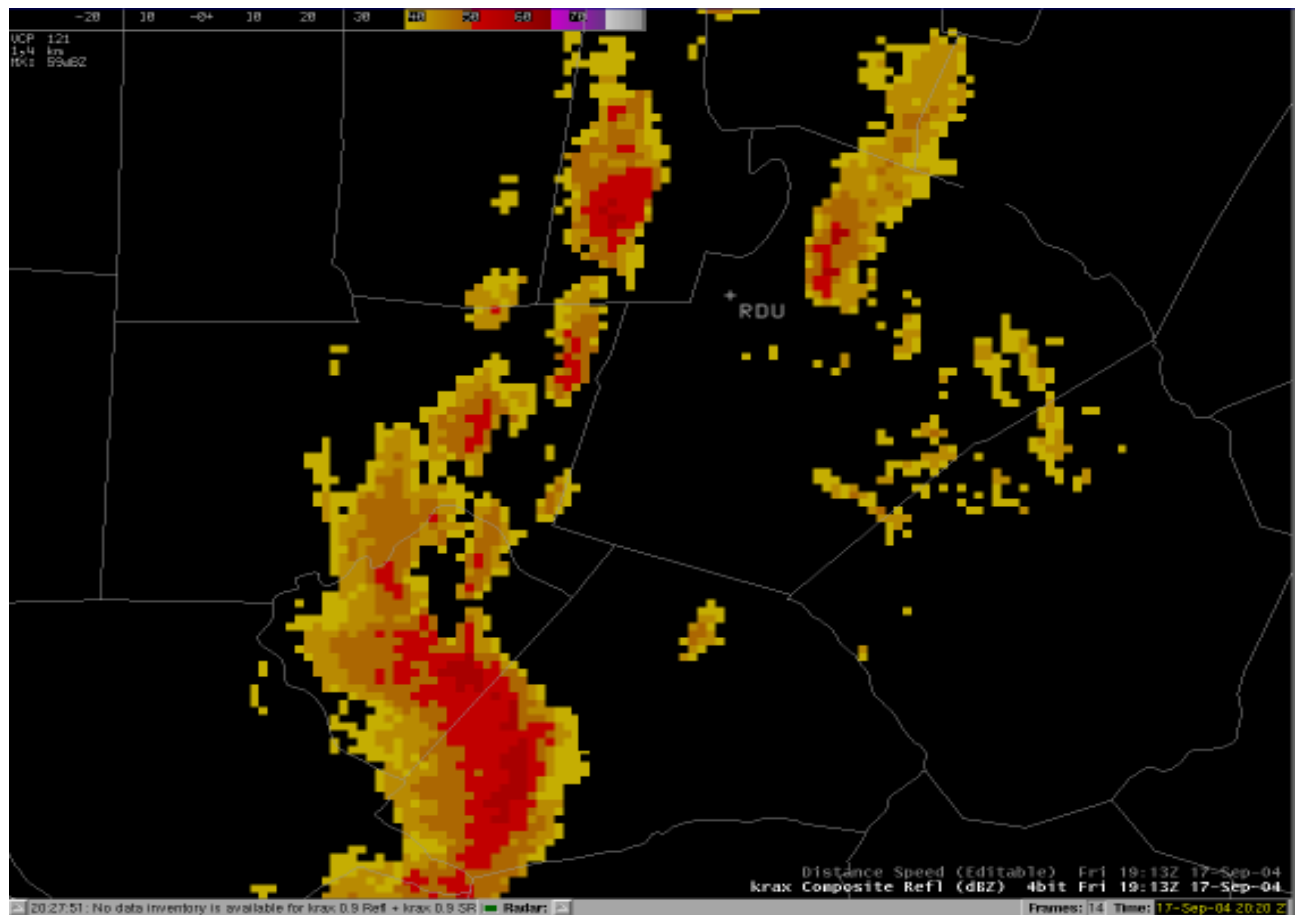


Figure 6. KRAX WSR88-D, 19:13 GMT

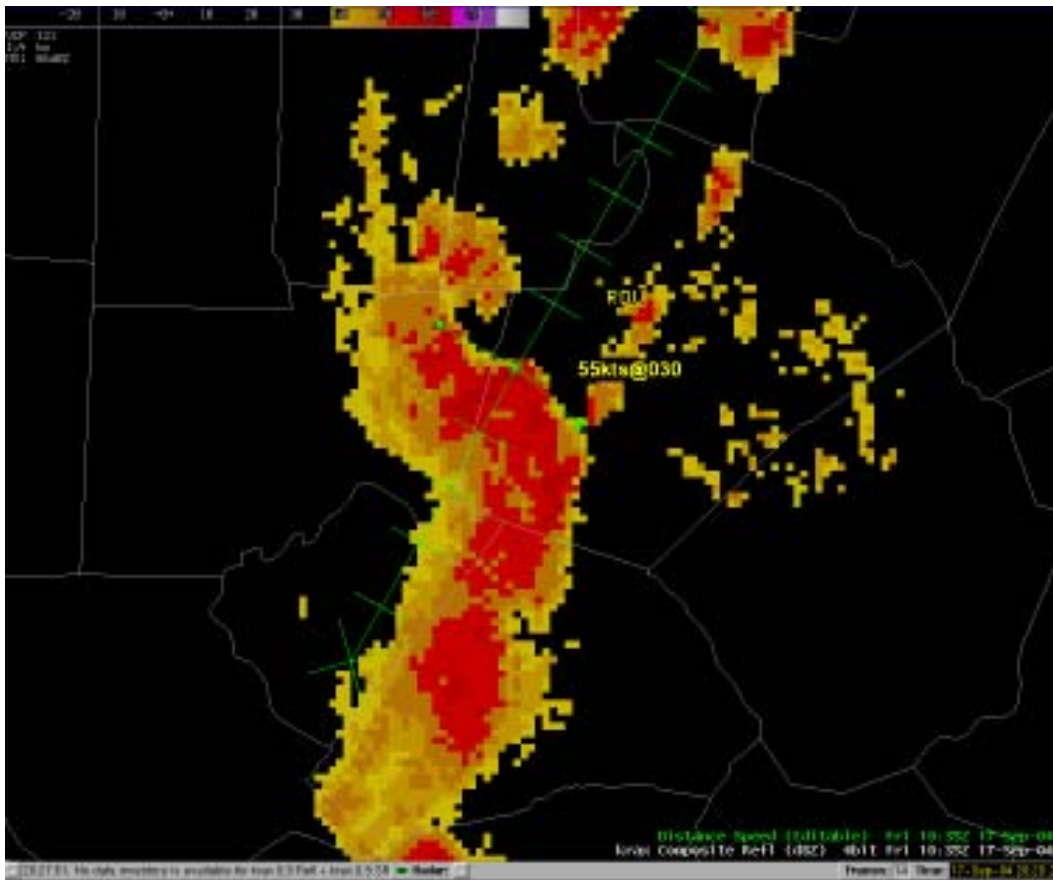


Figure 7. KRAX WSR88-D, 19:35 GMT

The forecasters on duty, upon extrapolating the storm's motion and assessing the downburst potential, issued a severe thunderstorm warning for western Wake County at 1930 GMT. The storm tracked directly over the airport (See Figure 8 below), producing the record 69 knot wind gust at 1953 GMT.

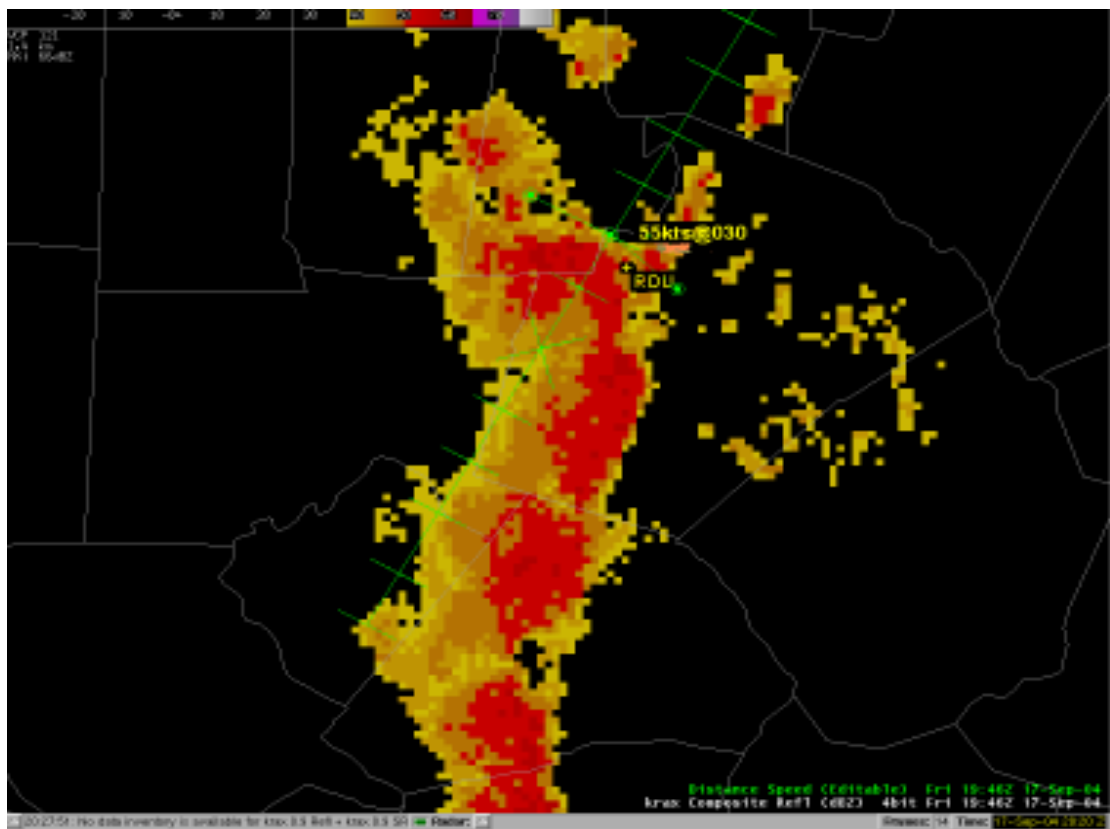


Figure 8. KRAX WSR88-D, 19:46 GMT

```

MTRRDU

METAR KRDU 171851Z 17017G25KT 10SM -TSRA FEW009 BKN038CB OVC200
28/22 A2964 RMK AO2 PK WND 16028/1805 TSB45RAB50 SLP032 FRQ LTGICCG
SW-NW TS SW-NW MOV NE P0000 T02830217

METAR KRDU 171951Z 18019G36KT 6SM -TSRA BR FEW009 SCT020 BKN032CB
OVC200 28/22 A2965 RMK AO2 PK WND 18036/1951 RAE13B46 PRESRR SLP035
OCNL LTGICCG S-NW TS S-NW MOV N CB NE-E MOV N P0000 T02780222

SPECI KRDU 171953Z 20042G69KT 170V240 1/16SM -TSRA FG SQ FEW001
27/22 A2966 RMK AO2 PK WND 18069/1953 PRESRR P0000

SPECI KRDU 172000Z 21022G69KT 1/2SM +TSRA FG SQ OVC003CB 22/22 A2965
RMK AO2 PK WND 18069/1953 FRQ LTGIC OHD TS OHD MOV NNE P0018 $

SPECI KRDU 172012Z 20017G22KT 1SM +TSRA BR SCT004 BKN017 OVC035CB
22/22 A2965 RMK AO2 PK WND 18069/1953 FRQ LTGICCG OHD TS OHD MOV NNE
P0031 $

METAR KRDU 172051Z 18010KT 10SM -TSRA FEW006 SCT024 OVC060CB 22/22
A2960 RMK AO2 PK WND 18069/1953 SLP021 OCNL LTGICCG NE TS NE MOV NE
P0076 60076 T02220217 58022 $

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Figure 9

Figure 9 shows the observations from the RDU ASOS during the event:

The FAA control tower personnel called the aviation forecaster to report that the tower had been evacuated and all flights had been suspended prior to the downburst. Despite significant damage to facilities and aircraft, no injuries were reported.

Conclusions

The NWS TAF forecast and subsequent severe thunderstorm warning highlighted the potential for damaging winds. The wind speed forecast in the TAF (TEMPO 1923 20040KT) was only 2 knots below the ASOS observation’s sustained 42 knot wind

speed reported at 171953 GMT (above). This wind forecast might have been improved by adding severe (>50 knot) wind gusts, particularly once the severe thunderstorm warning was issued for the portion of the county where the airport is located.

The general aviation community has been gravitating towards more automated or computer-generated weather briefing products for several years. All of the products used to evaluate the potential severity of convection on September 17 2004 are available in near real-time to pilots via the Web such as the NWS Aviation Digital Data Service (ADDS): <http://adds.aviationweather.gov/>

This fact means less reliance on the interpretation of an experienced weather briefer, so pilots must make more decisions based on their own weather education and experience.

Weather data is readily available from a myriad of sources, but making an informed decision based on this data requires interpretive skills and meteorological knowledge gained from additional sources including AOPA seminars and web-based self-study courses. I hope this article emphasizes the need to stay abreast of the latest advances in weather technology as well as periodically review the “weather basics” that we learned in ground school. ➔