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A METEOROLOGICAL ANALYSIS OF THE AMERICAN AIRLINES FLIGHT 1420 ACCIDENT *

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1. INTRODUCTION

On June 1, 1999, American Airlines flight 1420 (AAL 1420), arriving at Little Rock, AR from Dallas-Fort Worth, TX, was involved in a fatal accident upon landing on runway 4R at Adams Field (LIT). There were eleven casualties, including the pilot, and numerous injuries among the 145 passengers and crew on board. At the time of the accident, 0451 UTC (11:51 PM CDT), severe thunderstorms existed in the vicinity of the airport. These storms were initiated by an approaching cold front and pre-frontal trough and were developmentally aided by veering low-level wind and warm air advection, which helped to further destabilize the atmosphere. This report will focus on the meteorological conditions preceding and immediately following the accident that could have played a contributing role in the crash. However, no theories on the actual cause will be put forth.

2. DATA ANALYSIS

Data from several meteorological sources will be considered herein. Initially, the surface observations, as reported by the **N**ational **W**eather **S**ervice’s (NWS) **A**utomated **S**urface **O**bserving **S**ystem (ASOS), will be presented. The second section will focus on expert analysis of the reflectivity and velocity base data obtained from the NWS’s **Nex**t Generation Weather **Rad**ar (NEXRAD), located in North Little Rock, AR (KLZK). Finally, surface wind data, as recorded by the six-sensor **L**ow-**L**evel **W**ind Shear **A**lert **S**ystem (LLWAS), will aid in the depiction of the actual wind conditions at the surface and will also corroborate the information presented by ASOS and NEXRAD sensors. In addition to these data sources, **N**ational **T**rack **A**nalysis **P**rogram (NTAP) beacon data (courtesy of the National Transportation Safety Board) for AAL 1420 was used to determine the position of the aircraft in time and space relative to both the airport and thunderstorm complex.

2.1 Surface Observations

Transmitted observations from the ASOS located at LIT indicate that a thunderstorm was ongoing at the time of the mishap (Figure 1). The 0453 UTC observation (the nearest to the accident time) indicated heavy rain, one mile visibility, and frequent cloud-to-cloud, in-cloud, and cloud-to-ground lightning in the area of the airport. The ceiling was reported as 5,000 feet and a west (280 degree) wind was blowing at 18 knots, with gusts to 26 knots. A wind shift (from southerly to westerly) occurred at 0431 UTC (not shown), almost twenty minutes before the accident, due to the passage of an outflow from the approaching line of thunderstorms.

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KLIT 020453Z 28018G26KT 1SM +TSRA BR FEW037CB
OVC050 19/17 A2998 RMK A02 PK WND 29035/0433
WSHFT 0431 TSB23RAB24 SLP152 FRQ LTGICCC W-NW
OCNL LTGICCCCG E TS W-NW TS E MOV NE P0055
T01940167=

KLIT 020455Z 29013G26KT 3/4SM +TSRA BR BKN015
BKN035 OVC050 19/17 A2998 RMK A02 PRESRR P0021=

KLIT 020458Z 29010G76KT 210V030 1/2SM +TSGSRA BR
BKN012CB BKN035 OVC050 20/15 A2995 RMK A02 PK
WND 32076/0456 GSB58 P0061=
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Figure 1. Surface Observations from LIT ASOS.

2.2 Radar Reflectivity

The KLZK NEXRAD reflectivity confirms the ASOS reports shown above. Figure 2 shows the near-surface reflectivity values one minute after the accident occurred. In most of the following images, the three bold white (or black) lines in the center are the runways at LIT, azimuthal spacing is set to 10 degrees, and range rings are at 5-km intervals. Runway 4R, the runway on which the mishap occurred, is the right-most runway and the aircraft’s final approach path was from the southwest. Level 6 precipitation is occurring over the approach end of the north-south runway

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(northwest of runway 4R) and level 5 precipitation is occurring over runway 4R.

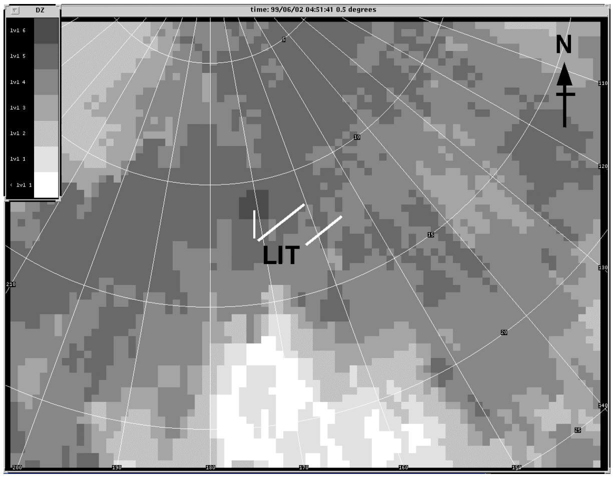

Figure 2. KLZK NEXRAD Reflectivity - 04:51:41 UTC.

A cross-section of reflectivity data was made along the final approach path of AAL 1420 and appears in Figure 3. The flight path is indicated by a solid white line in the left panel and by a dashed white line on the right. The right panel also incorporates the aircraft's approximate altitude. The cross-section ends at the runway threshold. From this image, it is possible to see that AAL 1420 encountered heavy precipitation about 9 km (5.6 mi) before reaching the runway threshold and flew through >50 dBz reflectivity for the last 7 km (4.3 mi) of flight.

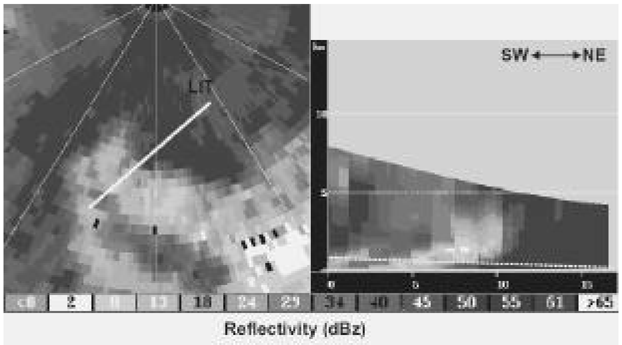

Figure 3. Reflectivity Cross-Section along the Flight Path (04:45:51-04:51:41 UTC).

2.3 LLWAS Surface Wind and Doppler Velocity

The data obtained from the six LLWAS network sensors helps provide a more detailed picture of the actual surface wind conditions at several locations surrounding the airport. The wind information is recorded every 10 seconds from the anemometers (which are positioned on 70 to 100-foot poles); thus, it also provides a finer temporal resolution than either the ASOS or NEXRAD.

At the time of the accident, all LLWAS sensors were reporting wind from the northwest at 15 to 31 knots (Figure 4) and the four sensors nearest runway 4R (numbers 1, 3, 4, and 5) all show wind speeds of less than 25 knots. Thus, there was no directional shear and very little speed shear present at this time. The Doppler velocity images shown in Figures 5 and 6 depict the surface wind field immediately following the accident. These images also have the nearest (in time) LLWAS surface winds overlaid. Wind at the airport prior to and at the time of the accident was from the northwest. However, at 04:52:13 UTC (Figure 5),

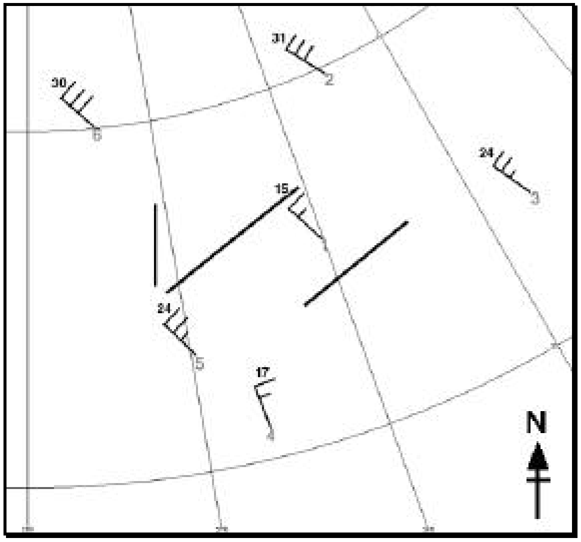

Figure 4. LLWAS Station Plot - 04:50:10 UTC.

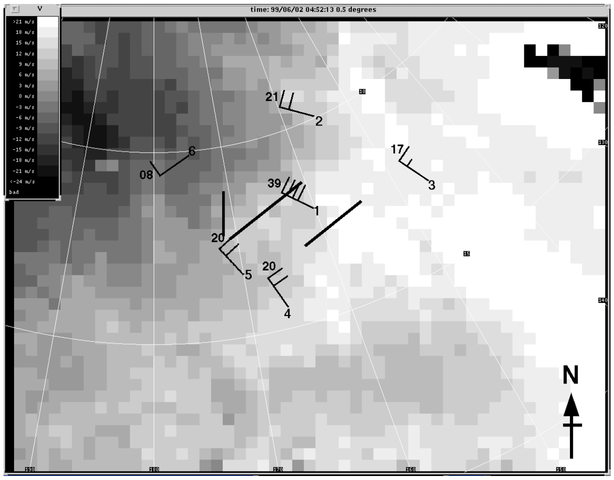

Figure 5. NEXRAD Velocity with LLWAS winds - 04:52:13 UTC.

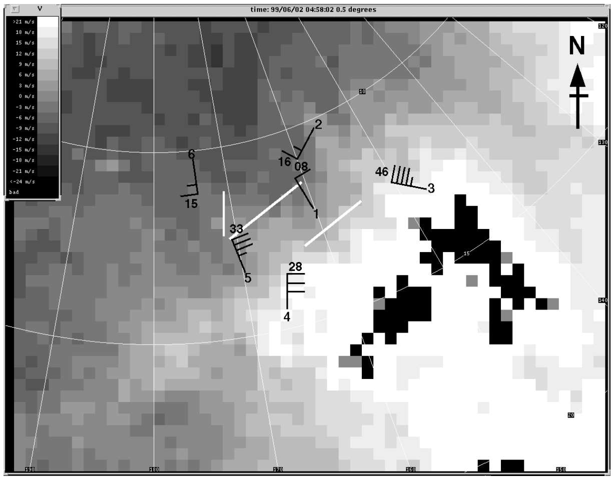

Figure 6. NEXRAD Velocity with LLWAS winds - 04:58:02 UTC.

an increasing southwesterly wind can be seen just west of the airport. This southwest wind is the result of an outflow created by a thunderstorm complex in the same area (see Figure 2). The western-most LLWAS sensor (# 6) depicts this southwesterly wind, while the other sensors continue to show a northwesterly wind. The image in Figure 6 is taken about eight minutes after the accident. By this time, the storms have moved directly over the runways and a microburst signature is present over the airport. The LLWAS sensors are more variable and indicate a definite divergent signature over the airport. The divergence is especially noticeable between sensors 5 and 6, where a 48-knot speed differential is observed. This signature was not present over the runways in Figure 5, so it is safe to assume that the microburst did not affect the airport until after the accident. It is quite likely that this divergent signature not only advected onto the airport with the storm complex, but also strengthened considerably, as the previous image does not show divergence of this magnitude. Thus, according to the NEXRAD and LLWAS data, the aircraft was experiencing a fairly significant crosswind (both in the final stages of flight and at touchdown), but there are no signs of significant wind shear until after the accident occurred.

3. SUMMARY

Just before midnight on June 1, 1999, American Airlines Flight 1420, with 145 people on board, attempted to land in a strong thunderstorm at Adams Field, Little Rock, AR. The aircraft went off the end of the runway and struck a light tower, resulting in numerous casualties. Data from the NWS's ASOS and NEXRAD Doppler radar, in addition to the **F**ederal **A**viation **A**dministration's (FAA's) LLWAS network and NTAP beacon data, was used in the analysis. The ASOS station began reporting a thunderstorm approximately twenty-five minutes before the accident, and level 5 precipitation was falling on the airport at the time of the accident. Cross-sections along the aircraft's flight path reveal that reflectivity values greater than 50 dBz (level 5) were encountered during much of the final approach. The strongest weather, though, occurred just after the accident (small hail, a 76-knot wind gust, and a 45 to 50 knot microburst). Wind data from the NEXRAD and LLWAS sensors indicate a 15 to 25 knot left-to-right crosswind during the last stages of flight and at touchdown. A strong microburst occurred some time after the accident, but divergent wind velocities were not present at the airport during the crucial landing phase.

Many of the high-profile aircraft accidents involving less-than-desirable weather conditions have been attributed to the microburst. This form of low-level wind shear has been given enough publicity that pilots are generally well-informed and trained on the consequences of flying into such an event. However, there can be other weather-related causes of near-ground aircraft accidents besides wind shear and microbursts, including excessive crosswind and heavy precipitation. It is hoped that the information presented will serve as a reminder to those in the aviation community that underestimating the effects of weather on an airborne aircraft can have serious consequences, especially in the critical phases of take-off and landing.

4. REFERENCES

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