NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington D.C. 20594

Meteorological Factual Report
DCA06MA064

A. **ACCIDENT**

Location: Blue Grass Airport, Lexington, Kentucky
Date: August 27, 2006
Time: 1007 UTC (Coordinated Universal Time)
Aircraft: Comair CRJ-100, N431CA, Flight 5191

B. **WEATHER GROUP**

Chairman: Gregory D. Salottolo, National Transportation Safety Board (NTSB), Washington D.C.

Member: Ed Puralewski, Comair, Ground Instructor, Cincinnati, Ohio

C. **SUMMARY**

On August 27, 2006, about 1007 UTC (0607 eastern daylight time), Comair flight 5191, a Bombardier CL-600-2B19 (CRJ-100), N431CA, crashed during takeoff from Blue Grass Airport, Lexington, Kentucky (LEX). The airplane, which had been cleared for runway 22, taxied onto runway 26 instead and ran off the end of runway 26. Of the 47 passengers and 3 crewmembers on board the airplane, 49 were killed, and 1 received serious injuries. The airplane was destroyed by impact forces and postcrash fire. The flight was operating under the provisions of 14 *Code of Federal Regulations* Part 121 and was en route to Hartsfield-Jackson Atlanta International Airport, Atlanta, Georgia (ATL).

D. **DETAILS OF INVESTIGATION**

Note: All times are stated as UTC based on the 24-hour clock unless otherwise noted. All heights above mean sea level (MSL) unless noted. Heights in surface weather observations and terminal forecast above ground level (AGL). All directions with reference to true north unless noted. Z = Coordinated Universal Time. Eastern Daylight Time (EDT) = Z – 4 hours.

McIDAS – **M**an **c**omputer **I**nteractive **D**ata **A**ccess **S**ystem. McIDAS is an interactive meteorological analysis and data management computer system. McIDAS is administered by personnel at the Space Science and Engineering Center at the University of Wisconsin at

Madison. Data are accessed and reviewed on a Windows XP Pro Workstation running McIDAS-X software.

Surface Weather Observations

Lexington, Kentucky (KLEX)

Automated Surface Observing System (ASOS)

The ASOS at KLEX is a Service Level C ASOS

ASOS observations are augmented and backed up by FAA personnel in the KLEX air traffic control tower.

The ASOS main sensor group is located to the right of runway 26 between taxiway C and taxiway F.

ASOS Service Level D…

This level of service consists of an ASOS continually measuring the atmosphere at a point near the runway. The ASOS senses and measures the following weather parameters: Wind, Visibility, Precipitation/Obstructions to Vision, Cloud Height, Sky Cover, Temperature, Dew Point and Altimeter. A site ranked as service level D has a stand-alone ASOS.

ASOS Service Level C...

This level consists of all the elements of Service Level D, plus augmentation and backup by a human observer on location nearby. Backup consists of inserting the correct value if the system malfunctions or is unrepresentative. Augmentation consists of adding the following elements if they are observed: Thunderstorms, Tornadoes, Hail, Virga, Volcanic Ash, Tower Visibility and any operationally significant remarks as deemed appropriate by the observer. During the hours that the observing facility is closed, the site reverts to Service Level D, stand-alone status. Generally speaking, air traffic control tower specialists provide Service Level C.

From the Federal Aviation Administration (FAA)

KLEX Surface Weather Reports August 27, 2006 …

0954Z … Winds 200 degrees at 7 knots; visibility 8 miles; few clouds at 9,000 feet, scattered clouds at 12,000 feet; temperature 24 degrees C; dew point 19 degrees C; altimeter setting 30.00 inches of Hg.

(METAR KLEX 270954Z 20007KT 8SM FEW090 SCT120 24/19 A3000 RMK AO2 SLP147 T02390194)

1054Z … Winds 220 degrees at 8 knots; visibility 8 miles; few clouds at 4,700 feet, ceiling 6,000 feet broken, 9,000 feet overcast; temperature 23 degrees C; dew point 20 degrees C; altimeter setting 30.02 inches of Hg.; rain began 1012Z and ended 1051Z; 0.01 inch of precipitation measured.
(METAR KLEX 271054Z 22008KT 8SM FEW047 BKN060 OVC090 23/20 A3002 RMK AO2 RAB12E51 SLP154 P0001 T02330200)

5-minute KLEX ASOS data …

1000Z … Winds 200 degrees at 7 knots; visibility 8 miles; few clouds at 9,000 feet, 12,000 feet scattered; temperature 24 degrees C; dew point 19 degrees C; altimeter setting 30.00 inches of Hg.; pressure altitude 910 feet; relative humidity 76%; density altitude 2,200 feet.
(08/27/06 05:00:31 5-MIN KLEX 271000Z 20007KT 8SM FEW090 SCT120 24/19 A3000 910 76 2200 200/07 RMK AO2)

1005Z … winds 200 degrees at 8 knots; visibility 8 miles; few clouds at 9,000 feet, scattered clouds at 12,000 feet; temperature 24 degrees C; dew point 19 degrees C; altimeter setting 30.00 inches of Hg.; pressure altitude 910 feet; relative humidity 76%; density altitude 2,200 feet.
(08/27/06 05:05:31 5-MIN KLEX 271005Z 20008KT 8SM FEW090 SCT120 24/19 A3000 910 76 2200 210/08 RMK AO2)

1010Z … Winds 200 degrees at 9 knots; visibility 8 miles; few clouds at 12,000 feet; temperature 24 degrees C; dew point 19 degrees C; altimeter setting 30.00 inches of Hg.; pressure altitude 900 feet; relative humidity 73%; density altitude 2,200 feet.
(08/27/06 05:10:31 5-MIN KLEX 271010Z 20009KT 8SM FEW120 24/19 A3000 900 73 2200 210/09 RMK AO2)

1-minute KLEX ASOS wind data …

Time in Z
W … Wind Direction degrees
S … Wind Speed knots
W1 … Wind Direction degrees (peak wind)
S1 … Wind Speed knots (peak wind)

Time	W	S	W1	S1
1000	201	7	202	8
1001	201	7	202	9
1002	203	8	200	9
1003	205	8	208	9
1004	204	8	203	9
1005	202	8	202	9
1006	205	8	205	10
1007	208	8	210	10
1008	205	8	201	9
1009	202	8	203	9
1010	202	9	204	10

Data from the National Weather Service.

Review of Blue Grass Airport Videos

Review by the NTSB Weather Group Chairman of videos (file Comair5191) from the Blue Grass Airport showed no evidence of significant rain or restrictions to visibility from about 1000Z to the time of the accident. Subsequent to the accident rain was evident at the airport.

Upper Air Data

Data for the location of KLEX for August 27, 2006 at 0900Z from the North American Mesoscale Model (NAM12).

Source: http://www.arl.noaa.gov/ready.html

E = Estimated Surface Height
PRESS … Pressure in millibars
HGT .. Height in meters
TEMP … Temperature in degrees C
DEW PT … Dew Point Temperature in degrees C
WND DIR …. Wind Direction degrees true
WND SPD … Wind speed in meters per second

PRESS	HGT(MSL)	TEMP	DEW PT	WND DIR	WND SPD
HPA	M	C	C	DEG	M/S

982.	278.	22.0	19.6	178.3	3.5
975.	339.	24.1	19.2	190.4	7.0
950.	568.	26.6	16.7	216.4	12.0
925.	803.	24.9	15.7	225.8	13.3
900.	1043.	23.0	14.7	233.9	12.7
875.	1288.	21.2	13.8	243.7	11.5
850.	1539.	19.2	13.1	253.5	10.7
825.	1795.	16.9	12.9	260.5	11.1
800.	2057.	14.6	12.7	265.6	12.5
775.	2325.	13.0	10.8	270.9	11.3
750.	2600.	11.5	8.9	268.9	9.9
725.	2884.	9.9	6.4	260.0	9.2
700.	3175.	8.4	2.9	254.3	9.4
650.	3784.	5.1	1.1	260.4	9.2
600.	4434.	1.7	-3.2	275.2	10.4
550.	5131.	-1.5	-7.1	261.8	11.0
500.	5886.	-4.9	-11.0	263.1	10.6
450.	6708.	-9.1	-16.7	300.4	9.7
400.	7611.	-14.0	-22.8	285.9	10.9
350.	8610.	-20.9	-28.5	275.4	11.2
300.	9729.	-29.6	-39.9	277.6	12.3
250.	11004.	-39.4	-53.0	276.9	21.8
200.	12488.	-51.9	-58.6	267.5	24.7
150.	14299.	-63.9	-72.4	293.6	22.5
100.	16712.	-70.4	-81.4	285.7	5.2
50.	20879.	-63.2	-91.2	347.7	1.1

========Relative Humidity========

HGT	RH %
278.	67.9
339.	73.9
568.	54.2
803.	56.5
1043.	59.2
1288.	62.7
1539.	67.7
1795.	77.1
2057.	88.0
2325.	86.5
2600.	83.6
2884.	78.7
3175.	68.3
3784.	75.2
4434.	70.3
5131.	65.9
5886.	62.9
6708.	55.0
7611.	48.7
8610.	51.8
9729.	37.9
11004.	24.4
12488.	47.2

Astronomical Data

(U.S. Naval Observatory)

August 27, 2006. Location: Lexington, Kentucky

Sunrise … 1103Z (0703 EDT)
Beginning Civil Twilight … 1036Z (0636 EDT)
Beginning Nautical Twilight … 1004Z (0604 EDT)
Beginning Astronomical Twilight … 0930Z (0530 EDT)
Moon is below the horizon

Twilight: Before sunrise and again after sunset there are intervals of time, twilight, during which there is natural light provided by the upper atmosphere, which does receive direct sunlight and reflects part of it toward the Earth's surface. Some outdoor activities may be conducted without artificial illumination during these intervals, and it is useful to have some means to set limits beyond which a certain activity should be assisted by artificial lighting. The major determinants of the amount of natural light during twilight are the state of the atmosphere generally and local weather conditions in particular. Atmospheric conditions are best determined at the actual time and place of events. Nevertheless, it is possible to establish useful, though necessarily approximate, limits applicable to large classes of activities by considering only the position of the Sun below the local horizon. Reasonable and convenient definitions have evolved.

Civil twilight is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 6 degrees below the horizon. This is the limit at which twilight illumination is sufficient, under good weather conditions, for terrestrial objects to be clearly distinguished; at the beginning of morning civil twilight, or end of evening civil twilight, the horizon is clearly defined and the brightest stars are visible under good atmospheric conditions in the absence of moonlight or other illumination. In the morning before the beginning of civil twilight and in the evening after the end of civil twilight, artificial illumination is normally required to carry on ordinary outdoor activities. Complete darkness, however, ends sometime prior to the beginning of morning civil twilight and begins sometime after the end of evening civil twilight.

Nautical twilight is defined to begin in the morning, and to end in the evening, when the center of the sun is geometrically 12 degrees below the horizon. At the beginning or end of nautical twilight, under good atmospheric conditions and in the absence of other illumination, general outlines of ground objects may be distinguishable, but detailed outdoor operations are not possible, and the horizon is indistinct.

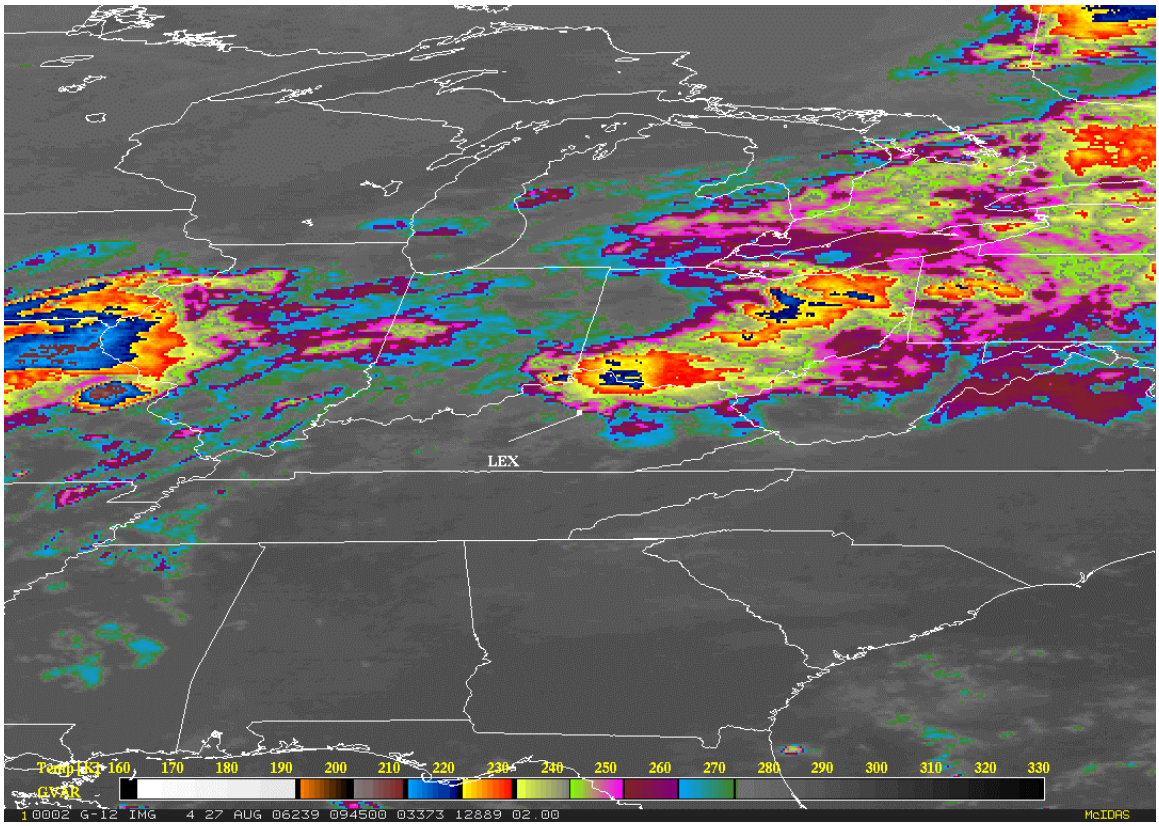
Astronomical twilight is defined to begin in the morning, and to end in the evening when the center of the Sun is geometrically 18 degrees below the horizon. Before the beginning of astronomical twilight in the morning and after the end of astronomical twilight in the evening the Sun does not contribute to sky illumination; for a considerable interval after

the beginning of morning twilight and before the end of evening twilight, sky illumination is so faint that it is practically imperceptible.

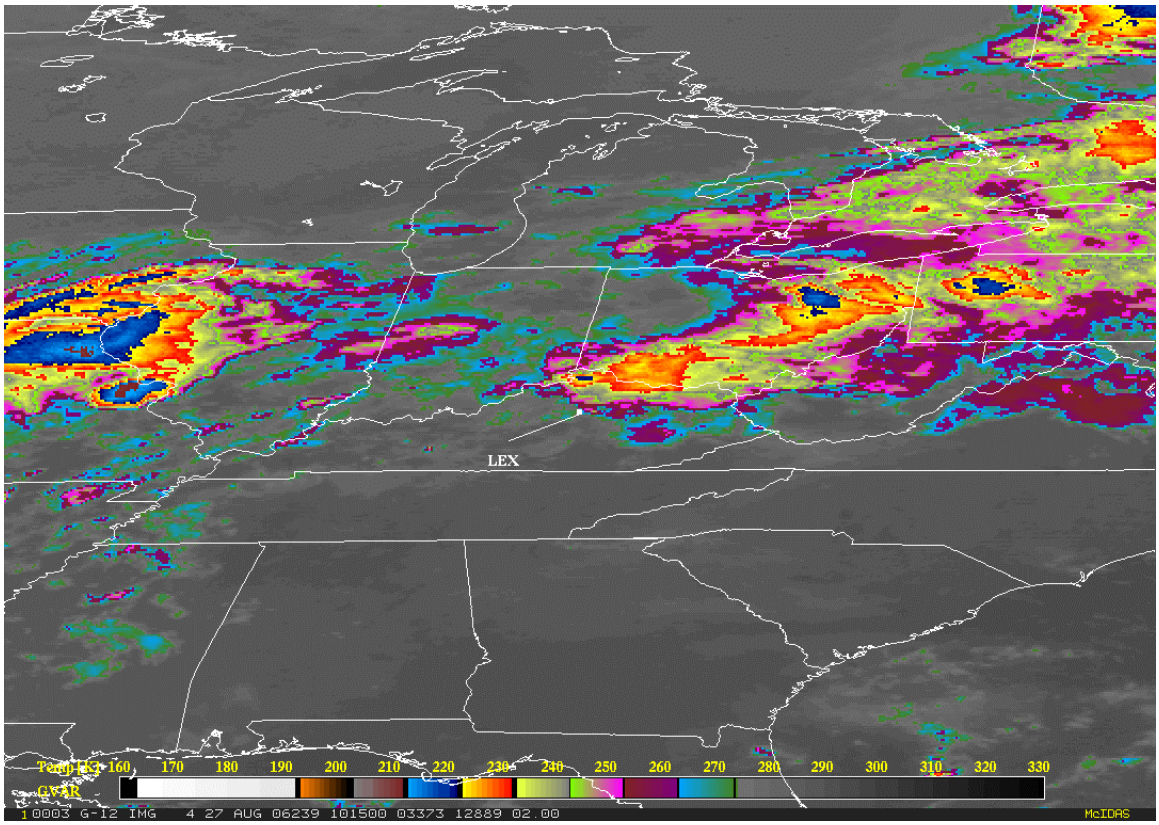
U.S. Naval Observatory ...Astronomical Applications Department

Satellite Data

Geostationary Operational Environmental Satellite (GOES)-12 data were reviewed using McIDAS.



GOES-12 infrared image (band 4) for 0945Z. The image is color enhanced. The image is at a 2-times blow up (full resolution 4-kilometers). At LEX a radiative temperature of approximately 268.1 degrees K (-5.1 degrees C) was observed. Using NMA12 upper air data this temperature corresponds to a cloud top of about 19,500 feet.



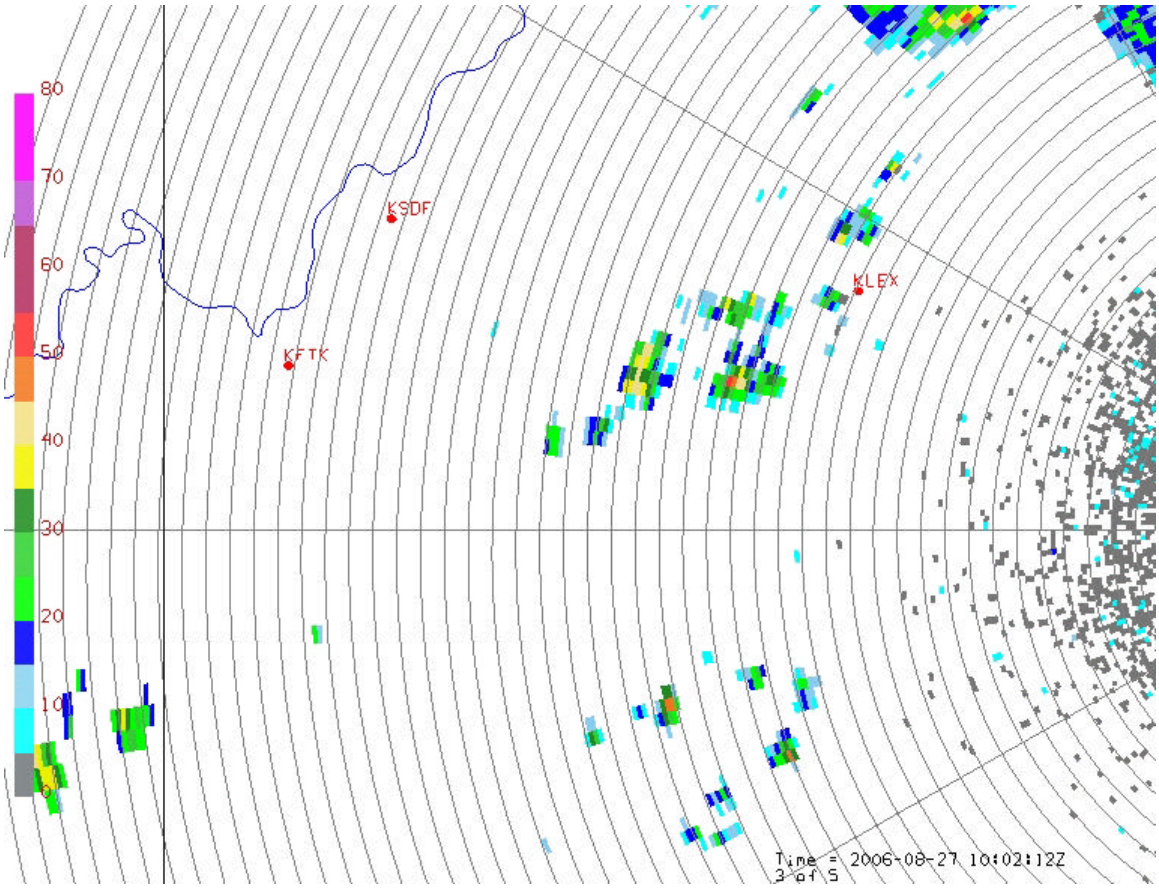
GOES-12 infrared image (band 4) for 1015Z. The image is color enhanced. The image is at a 2-times blow up (full resolution 4-kilometers). At LEX a radiative temperature of approximately 273.5 degrees K (0.3 degree C) was observed. Using NMA12 upper air data this temperature corresponds to a cloud top of about 16,000 feet.

Weather Radar Data

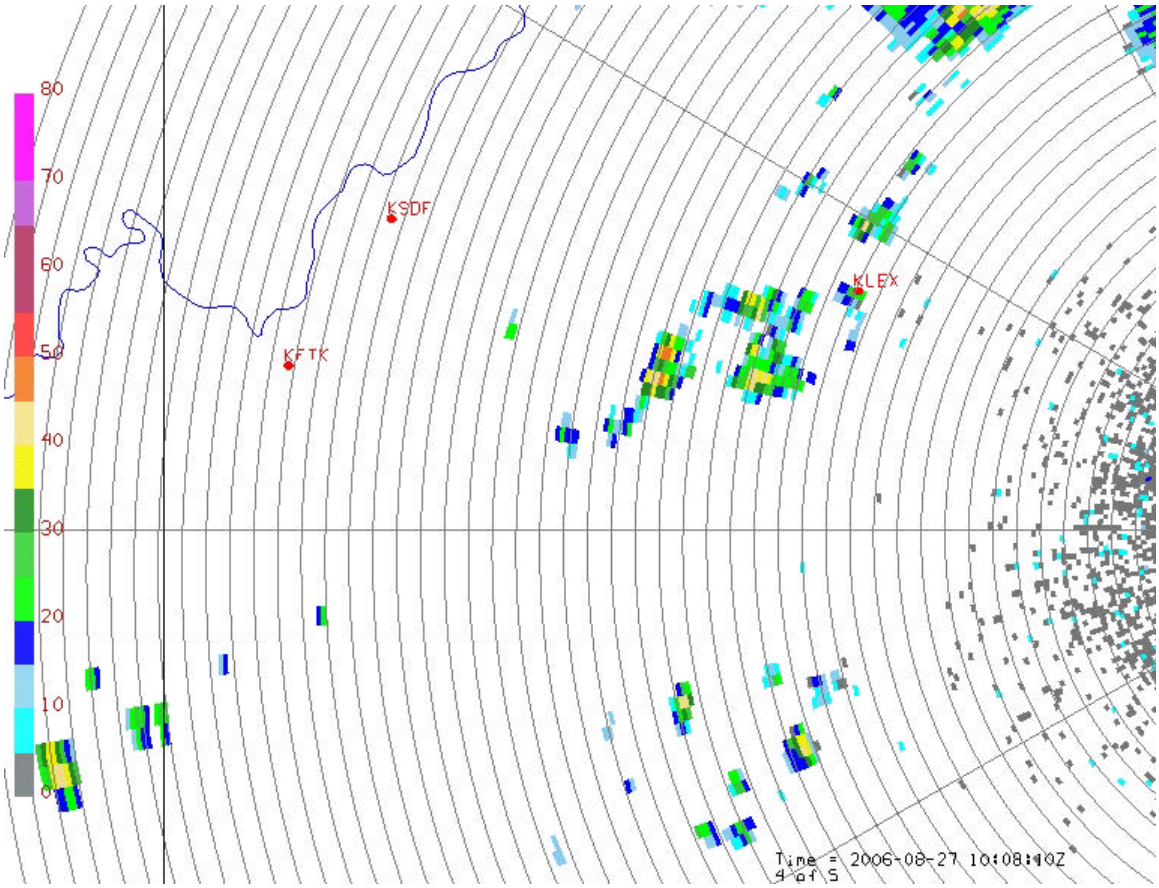
Level II Doppler weather radar data from Jackson, Kentucky (JKL) and Louisville, Kentucky (LVX) were reviewed using IDV.** These data were from the National Weather Service -- http://hurricane.ncdc.noaa.gov/pls/plhas/has.dsselect

**Murray, D., J. McWhirter, S. Wier, S. Emmerson, 2003: The Integrated Data Viewer: a Web-enabled application for scientific analysis and visualization. Preprints, 19th Intl Conf. on IIPS for Meteorology, Oceanography and Hydrology.

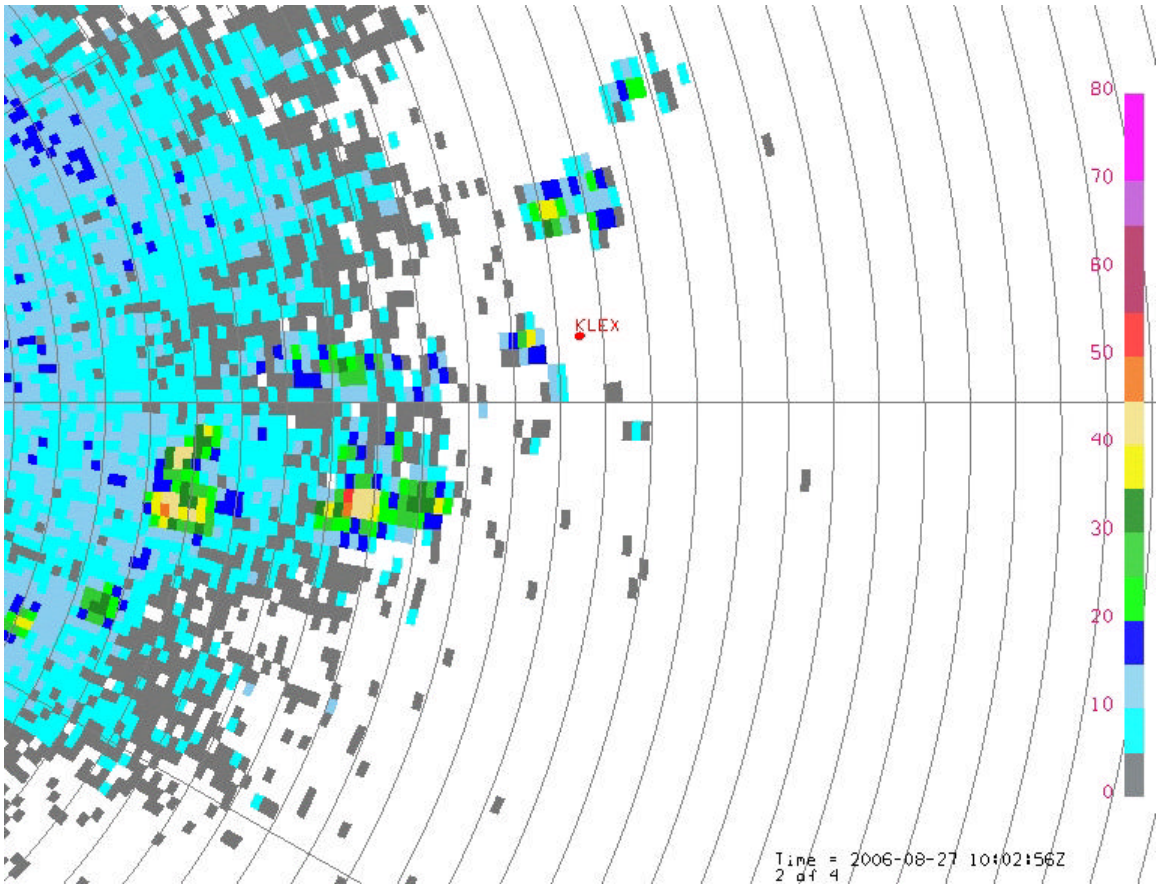
At KLEX at an elevation angle of 0.5 degree the JKL weather radar beam center is at about 8,000 feet and the LVX weather radar beam center is at about 6,800 feet.



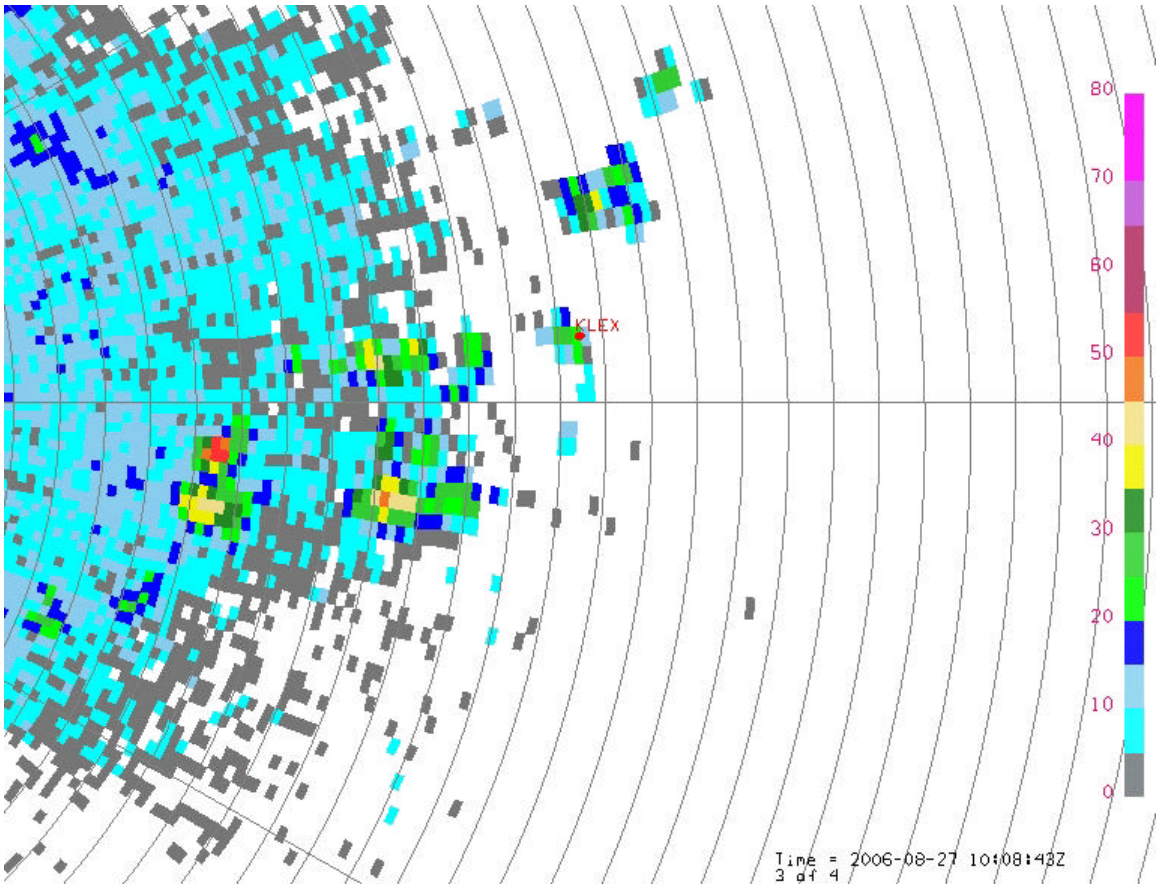
JKL Base Reflectivity Image for 1002:12Z. The elevation angle is 0.5 degree. Weather radar echo intensities are in dBZ (see color the bar on the left side of the image). Range rings are every 5-kilometers. True north is to the top of the image.



JKL Base Reflectivity Image for 1008:10Z. The elevation angle is 0.5 degree. Weather radar echo intensities are in dBZ (see color bar on the left side of the image). Range rings are every 5-kilometers. True north is to the top of the image.



LVX Base Reflectivity Image for 1002:56Z. The elevation angle is 0.5 degree. Weather radar echo intensities are in dBZ (see the color bar on the right side of the image). Range rings are every 5-kilometers. True north is to the top of the image.



LVX Base Reflectivity Image for 1008:43Z. The elevation angle is 0.5 degree. Weather radar echo intensities are in dBZ (see the color bar on the right side of the image). Range rings are every 5-kilometers. True north is to the top of the image.

VIP/DBZ Conversion Table

NWS VIP … National Weather Service Video Integrator and Processor Level.
WSR-88D LVL … WSR-88D Doppler Weather Radar Level.
PREC MODE dBZ … Precipitation Mode dBZ.
RAINFALL .. Rainfall in inches per hour.

NWS VIP	WSR-88D LVL	PREC MODE DBZ	RAINFALL
0	0 1 2	<5 5 to 9 10 to 14	
1	3	15 to 19	.01 in/hr

Very Light	4 5	20 to 24 25 to 29	.02 in/hr .04 in/hr
2 Light to Moderate	6 7	30 to 34 35 to 39	.09 in/hr .21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11 12 13 14 15	55 to 59 60 to 64 65 to 69 70 to 74 GTE 75	>5.67 in/hr

Terminal Forecasts (TAF)

Lexington, Kentucky (KLEX)
Valid August 27, 2006 at 0600Z to August 27, 2006 at 0600Z

From August 27, 2006 at 1000Z to August 27, 2006 at 1500Z … Winds 190 degrees at 6 knots; visibility 4 miles; haze; sky clear.
(KLEX 270535Z 270606 17005KT P6SM BKN200 FM1000 19006KT 4SM
HZ SKC FM1500 23010KT 6SM HZ VCTS BKN040CB)

Atlanta, Georgia (KATL)
Valid August 27, 2006 at 0600Z to August 27, 2006 at 0600Z

From August 27, 2006 at 1000Z to August 27, 2006 at 1400Z … Winds 080 degrees at 4 knots; visibility 5 miles; mist; ceiling 800 feet broken.
(TAF KATL 270531Z 270606 10005KT P6SM SKC FM1000 08004KT 5SM
BR BKN008 FM1400 10006KT P6SM BKN015 FM1700 11008KT
P6SM SCT035 FM0100 16005KT P6SM SCT250)

Terminal Forecasts are issued by the National Weather Service.

Comair Flight 5191 Weather Document

Sunday August 27, 2006, 0802Z …

The weather document contained surface weather observations for KLEX (270854Z) and KATL (270852Z) and the terminal forecast for KLEX (270535Z) and KATL (270531Z). The document also contained AIRMETs and Convective SIGMETs.

Gregory D. Salottolo
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Meteorology
September 28, 2006