NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

March 21, 2018

Weather Study

METEOROLOGY

ERA18MA099

Table Of Contents

A. ACCIDENT

Location: Flushing, New York
Date: March 11, 2018
Time: about 1908 eastern daylight time
2308 universal coordinated time (UTC)
Airplane: Airbus AS350B2 helicopter; Registration: N350LH

B. METEOROLOGIST

Don Eick
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. SUMMARY

On March 11, 2018, about 1908 eastern daylight time, an Airbus Helicopters AS350B2, N350LH, was substantially damaged when it impacted the East River and subsequently rolled inverted during an autorotation, after the pilot reported a loss of engine power near New York, New York. The pilot egressed from the helicopter and sustained minor injuries. Five passengers remained inside the wreckage and were fatally injured. Visual meteorological conditions prevailed and no flight plan was filed for the scheduled 30 minute aerial photography flight that was operated by Liberty Helicopters under the provisions of Title14 *Code of Federal Regulations* Part 91. The flight originated from Helo Kearny Heliport (65NJ), Kearny, New Jersey.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are eastern daylight time (EDT) based upon the 24-hour clock on March 11, 2018, and local time is +4 hours to UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was estimated at latitude 40.774722° N and longitude 73.939722° W.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) located in College Park, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the latest addition of the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45H.

1.1 Surface Analysis Chart

The NWS WPC Surface Analysis Chart for 2000 EDT (0000Z on March 12, 2018) is included as figure 1 with the accident site within the red circle. The chart depicted the New York area in a COL[1] between two low and high pressure systems. One of the low pressure systems was to the northeast off of Nova Scotia, Canada and the other to the southwest over Tennessee. To the west-northwest a high pressure system was located over North Dakota with a ridge extending southeast and east into northern New York, with high pressure also depicted to the east off the chart. As a result of the pressure systems, a relative weak pressure gradient existed over the area with light winds.

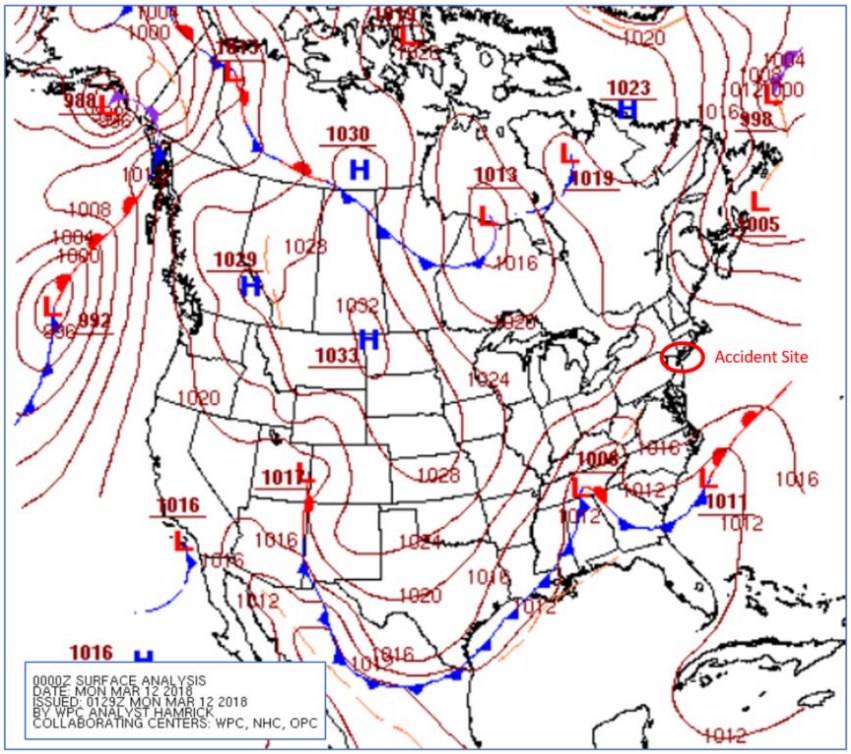

Figure 1 - Surface Analysis Chart for 2000 EDT

[1] A COL is a neutral point between two highs and two lows pressure systems and is often called a saddle back. It is an area of deformation in the wind field.

A review of the NWS National Composite Radar for the 1900 EDT depicted no significant weather echoes over the New York area.

2.0 Observations

The closest official weather observations surrounding the accident site were documented using standard Meteorological Aerodrome Reports (METAR) and special reports. Cloud heights are reported above ground level (agl) in the following section.

2.1 LaGuardia Airport

The closest weather observations to the accident site were from LaGuardia Airport (KLGA), New York, NY, located 3 miles east of the accident site at an elevation of 21 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS), which was augmented by certified weather observers. The magnetic variation is estimated at 13° W based on the latest sectional chart for the area. The following conditions were being reported at the time of the accident:

KLGA weather observation at 1851 EDT (2251Z), wind from 300° at 5 knots, visibility 10 miles or more, scattered clouds at 25,000 ft agl, temperature 7° Celsius (C), dew point -6° C, altimeter 30.05 inches of mercury. Remarks; automated observation system with a precipitation discriminator, sea level pressure 1017.5-hPa, temperature 6.7° C, dew point -5.6° C.

The raw observations in standard Meteorological Aerodrome Report (METAR) and Special (SPECI) format surrounding the period from 1500 to 2200 EDT were as follows:

METAR KLGA 111951Z 32006KT 10SM FEW050 FEW250 07/M07 A3002 RMK AO2 SLP167 T00721067=

METAR KLGA 112051Z 30006KT 10SM CLR 07/M08 A3002 RMK AO2 SLP164 T00721078 56010=

METAR KLGA 112151Z 27006KT 10SM SCT250 08/M08 A3003 RMK AO2 SLP170 T00781078=

METAR KLGA 112251Z 30005KT 10SM SCT250 07/M06 A3005 RMK AO2 SLP175 T00671056=

Accident 2308Z

SPECI KLGA 112313Z 32008KT 10SM SCT250 07/M06 A3006 RMK AO2 T00671061=

SPECI KLGA 112314Z 33007KT 10SM SCT250 07/M06 A3006 RMK AO2 T00671061=

METAR KLGA 112351Z 32008KT 10SM SCT250 06/M06 A3007 RMK AO2 SLP182 T00611056 10078 20056 53018=

METAR KLGA 120051Z 31007KT 10SM CLR 06/M06 A3008 RMK AO2 SLP186 T00611056=

A review of the observations indicated that visual flight rule (VFR) conditions[2] prevailed during the period, with wind speeds less than 10 knots, visibility unrestricted and no significant low-level clouds over the area.

[2] VFR conditions are defined as no ceiling below 3,000 ft agl and visibility greater than 5 statute miles.

2.2 AWC Weather Displays

A display of the METAR observations from the NWS Aviation Weather Center (AWC) website for the immediate area at 1900 EDT is included in figure 2. The image depicted KLGA conditions with northwest wind of 5 knots, a temperature of 44° Fahrenheit (F), dew point of 22° F, visibility 10 miles, and an altimeter of 30.05 inches of Hg. Similar conditions were also depicted over New Jersey at Teterboro Airport (KTEB), Essex County Airport – Caldwell (KCDW), Morristown Municipal Airport (KMMU), and over Long Island New York to the east at Republic Airport – Farmingdale (KFRG). At Newark Liberty International Airport (KEWR) northwest wind of 10 knots were reported, and at John F. Kennedy International Airport (KJFK) southeast of the accident site wind was from the southwest at 10 knots.

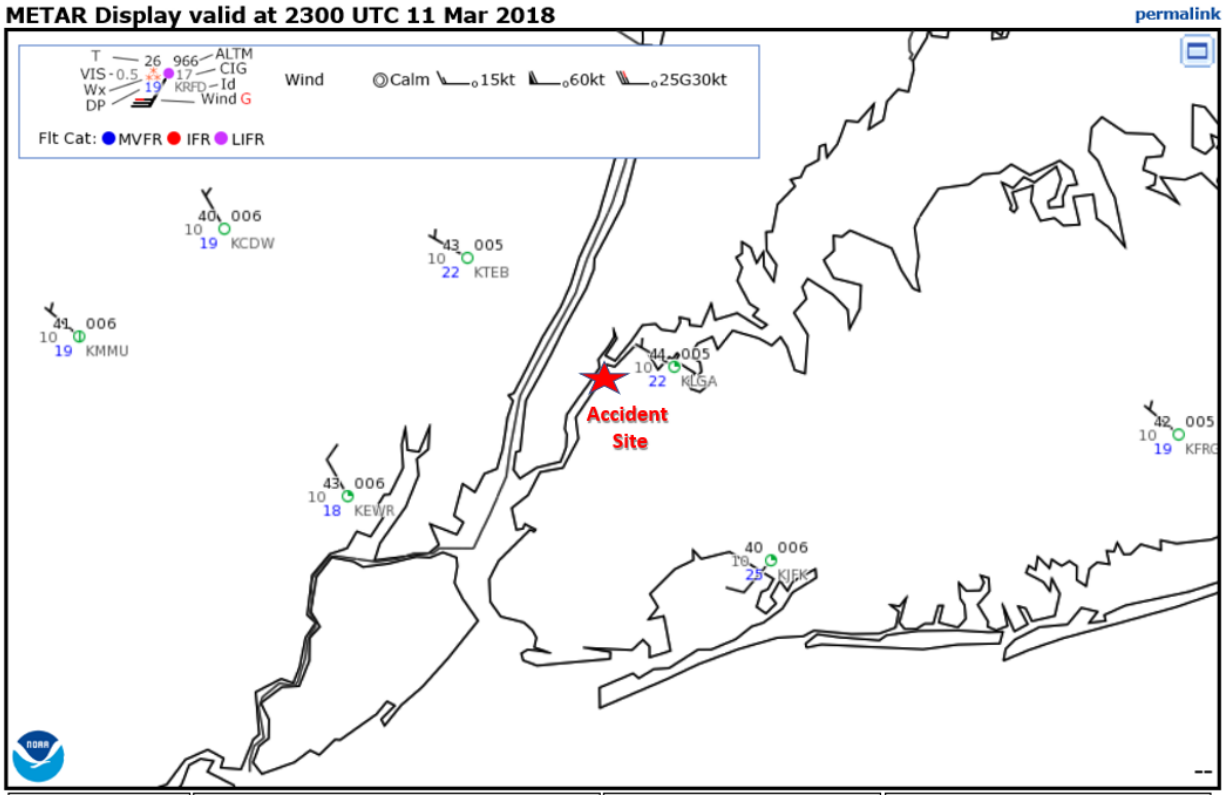

Figure 2 – AWC METAR display for 1900 EDT

A display of the NWS AWC Helicopter Emergency Medical Services (HEMS) weather tool for 1900 EDT is included as figure 3. Local heliports are also included on the chart with the major airports and weather conditions. The image also provided the general flight category of VFR conditions and the Rapid Update Cycle (RAP) wind forecast for 1,000 ft wind analysis for the period.

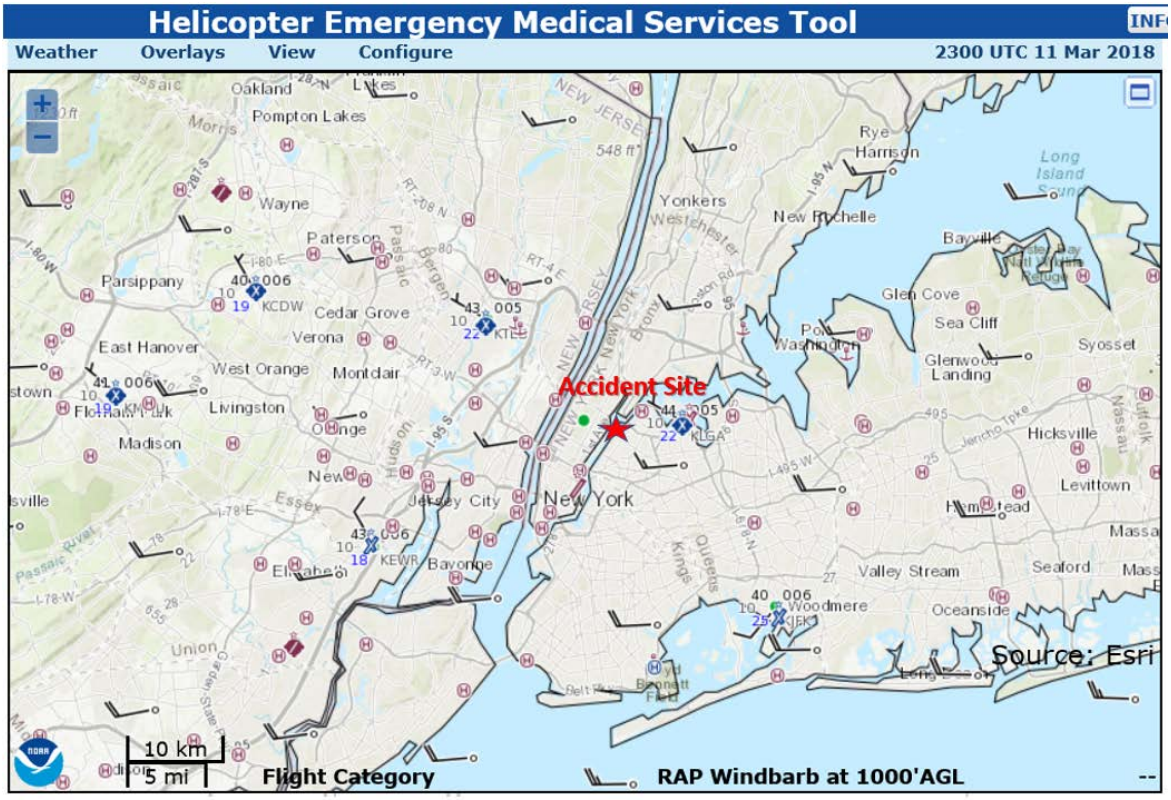

Figure 3 – AWC HEMS weather tool image for 1900 EDT

2.3 Battery Park Buoy Observation

The water temperature was documented using NWS buoy observations in the area. The Battery Park New York, BATN6 Buoy was located 5 miles south-southwest of the accident site at the entrance of the East River and reported a water temperature of 39.7° F or 4.3° C.

3.0 Sounding

A High Resolution Rapid Refresh (HRRR)[3] numerical model data was obtained from the NOAA Air Resource Laboratory for 1900 EDT over the accident site coordinates. The data was plotted on a standard skew T log P diagram[4] using RAOB software[5] from the surface to 500-hPa or approximately 18,000 ft is included as figure 4.

[3] HRRR – High-Resolution Rapid Refresh (HRRR) is a NOAA real-time 3-kilometer (km) resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by 3-km grids with 3-km radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a 1-hour period.

[4] Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

[5] RAOB software – The complete Rawinsonde Observation program is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania, for plotting and analyzing upper air data.

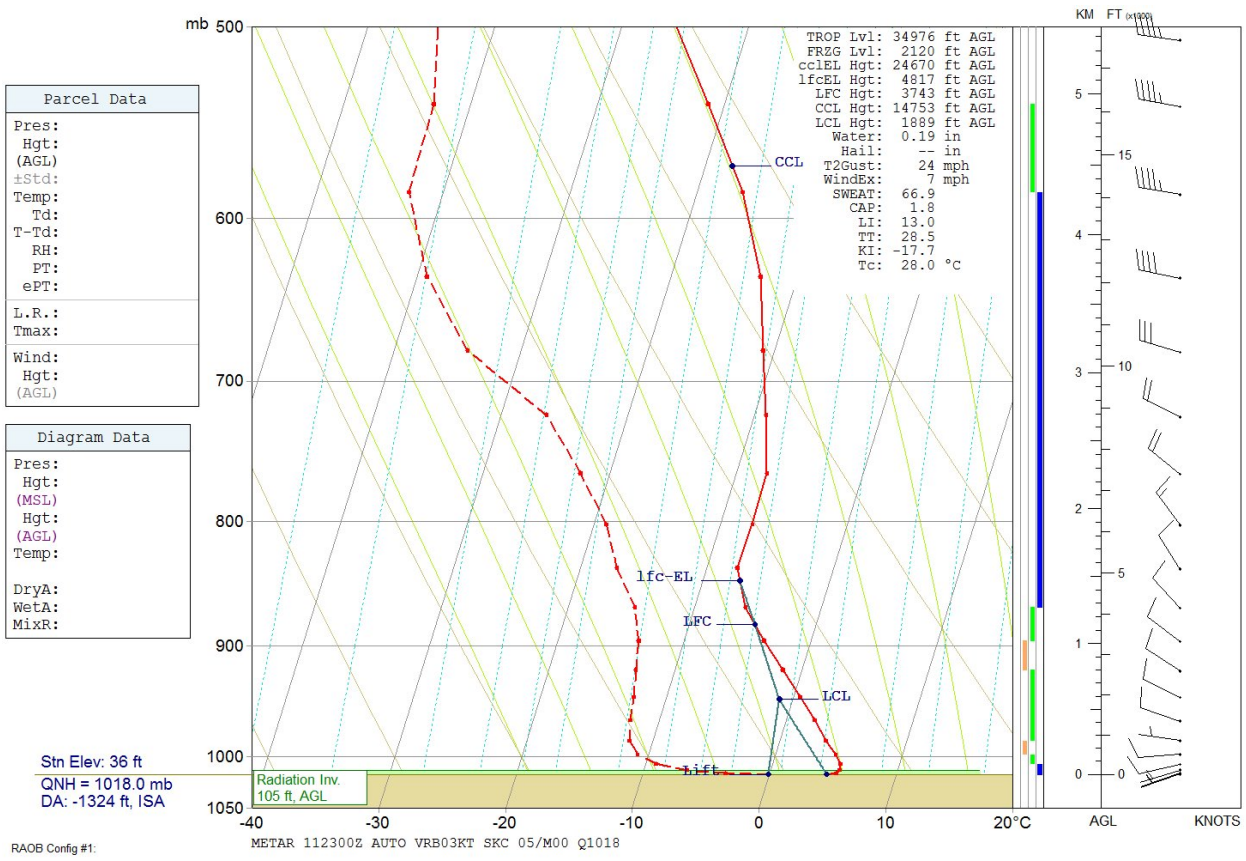

Figure 4 - HRRR numerical model over the accident site at 1900 EDT

The HRRR model sounding depicted a surface temperature of 4.5° C (40° F), a dew point temperature of -0.1° C (32° F), a surface pressure of 1017-hPa, a relative humidity of 73%, which resulted in a density altitude of -1,324 ft compared to the international standard atmosphere (ISA). A surface-based temperature inversion due to radiational cooling was identified to 100 ft with drier air above with the relative humidity dropping to 30%. The freezing level was identified at 2,156 ft, with no defined icing layers identified. The lifted condensation level (LCL)[6] at 1,889 ft agl, the level of free convection (LFC)[7] at 3,743 ft agl, and the convective condensation level (CCL)[8] at 14,789 ft agl. Another isothermal or stable layer was identified between 5,000 to 7,000 ft. The overall sounding depicted a stable atmosphere with a Lifted Index of +13.0, with the lowest layer of the atmosphere between from 100 to 3,700 ft agl conditional unstable.

[6] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

[7] Level of Free Convection (LFC) -The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

[8] Convective Condensation Level (CCL) - The height to which a parcel of air, if heated sufficiently from below, will rise adiabatically until condensation starts. This is typically used to identify the base of cumuliform clouds, which are normally produced from surface heating and thermal convection.

The HRRR wind profile indicated a surface wind from 250° at 3 knots, with wind veering to the northwest through 6,000 ft and then backing to the west with height and with increasing wind speeds. The wind speeds below 1,000 ft were less than 10 knots. The mean 0 to 6 kilometer (km) wind was from mean 285° at 28 knots. No strong vertical or horizontal wind shears were identified for any potential moderate or greater turbulence development.

A table of the HRRR model data of height, pressure (Pres), temperature (T), dew point temperature (Td), relative humidity (RH), wind direction (DD) and wind speed (FF), and RAOB derived clear air turbulence (CAT), low-level wind shear (LLWS), and icing type from the surface through 10,000 ft is included in figure 5.

Height (ft-MSL)	Pres (mb)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)
36	1017	4.5	-0.1	72	250 / 3			
62	1016	5.2	-3.5	53	250 / 3	LGT	LIGHT	
141	1013	5.4	-6.6	42	252 / 6		LIGHT	
300	1007	5.3	-9.2	34	256 / 8			
540	998	4.7	-10.9	31	265 / 8			
890	985	3.6	-11.9	31	279 / 7			
1407	966	2.2	-12.3	33	290 / 8			
1987	945	0.5	-12.6	37	298 / 8			
2662	921	-1.5	-13.1	41	305 / 9			
3378	896	-3.7	-13.6	46	310 / 10			
4197	868	-6.0	-14.7	50	320 / 10			
5159	836	-7.6	-17.1	46	330 / 10			
6219	802	-7.5	-19.0	39	326 / 13	LGT		
7459	764	-7.6	-22.3	30	311 / 18	LGT		
8863	723	-9.1	-26.4	23	298 / 22	LGT		
10414	680	-10.9	-34.2	13	288 / 29	MDT		

Figure 5 - HRRR model derived parameters at 1900 EDT

4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 16 (GOES-16) data was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared long wave (band 13) imagery at a wavelength of 10.3 microns (µm) provided a resolution of 2-km surrounding the time of the accident were reviewed and image closest to the time of the accident documented. Due to the low angle of the Sun the GOES-16 high resolution visible imagery was not useable at the time of the accident.

Figure 6 is the GOES-16 infrared image at 2X magnification at 1857 EDT with a standard MB temperature enhancement curve applied to highlight the higher and colder cloud tops. The image depicted a small band of high cirriform clouds over the accident site. The closest significant weather was depicted well south of the area over Virginia, Maryland, and Delaware as identified in the enhanced clouds.

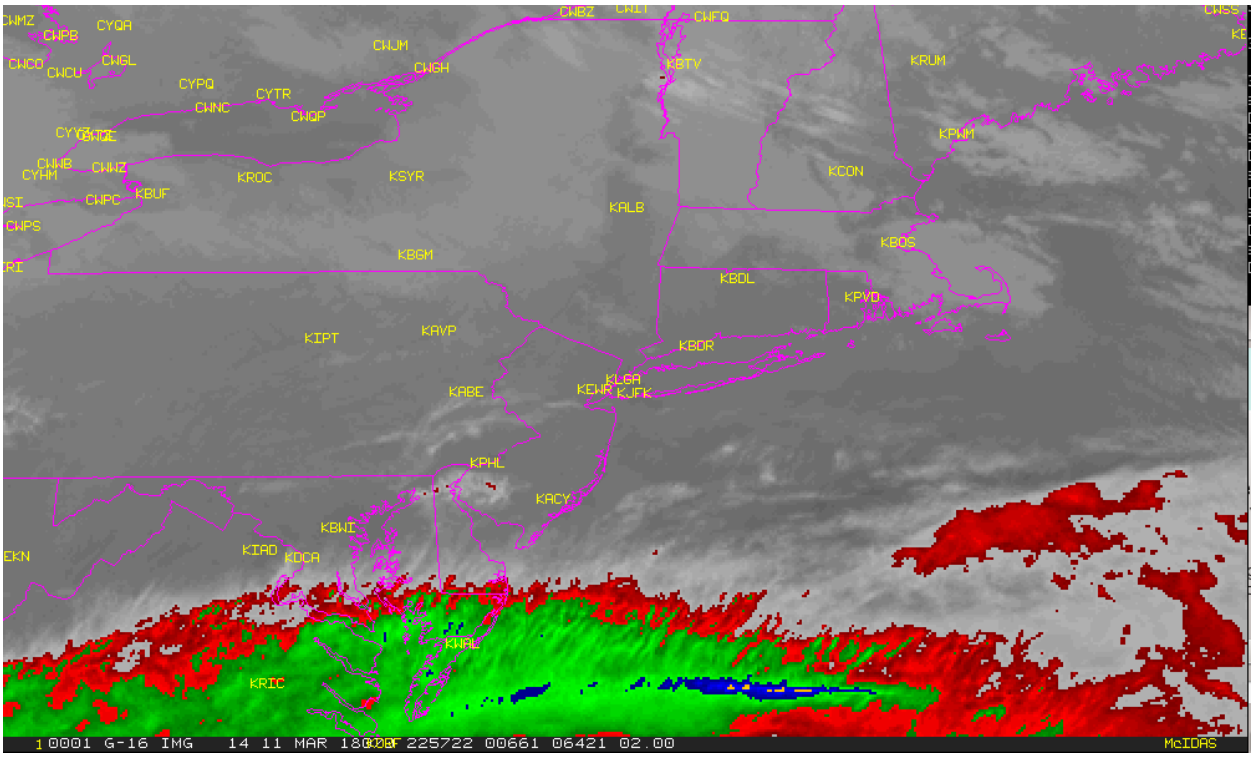

Figure 6 - GOES-16 infrared image at 1857 EDT

5.0 Pilot Reports

A search of pilot reports or PIREPs over the region provided only two relevant low altitude reports surrounding the period. One report from Islip (ISP) from a Piper Cherokee (PA28) over Deer Park (DPK) VORTAC at 1300 EDT reported encountering light to moderate turbulence at 1,300 ft. Another report from a Piper PA28 in the vicinity of Republic Airport at 2057 EDT reported clear skies and no turbulence during climb through 3,500 ft. The reports are as follows:

ISP UA /OV DPK /TM 1700/FL013/TP PA28/TB LIGHT TO MODERATE

Accident 2308Z

FRG UA /OV FRG-FRG360005 /TM 0057 /FL035 /TP P28A /SK SKC /TA M02 /TB NEG /RM DURC

6.0 NWS Forecasts and Advisories

6.1 Terminal Aerodrome Forecast

The NWS New York Weather Forecast Office in Upton, New York was responsible for issuing the Terminal Aerodrome Forecast (TAF) for KLGA, the closest location to the accident site. The following forecast was current at the time of the accident:

TAF AMD KLGA 112037Z 1121/1224 31009KT P6SM FEW050 FEW250
FM120100 32006KT P6SM FEW250
FM120300 35006KT P6SM FEW250
FM120900 02006KT P6SM FEW250

FM121400 05009KT P6SM BKN120
FM121900 07012KT P6SM BKN050=

6.2 Area Forecast Discussion

The NWS WFO Area Forecast Discussion (AFD) for the region issued at 1553 EDT was as follows.

FXUS61 KOKX 111953
AFDOKX

Area Forecast Discussion
National Weather Service New York NY
353 PM EDT Sun Mar 11 2018

.SYNOPSIS...
Weak high pressure will be in control of the weather through Monday morning. A strong coastal low will impact the area late Monday through Tuesday. High pressure then slowly returns for the late week period. A weak frontal system may approach for the weekend.

.NEAR TERM /UNTIL 6 AM MONDAY MORNING/...
The weak ridge will keep us dry during tonight. Mainly clear skies and chilly temperatures are forecast. Lows range from the lower to mid 20s across the interior, and lower 30s in and around NYC. Mos and model blend used.

.SHORT TERM /6 AM MONDAY MORNING THROUGH TUESDAY/...
Dry initially as weak ridge yields to northern stream shortwave and undercutting short-wave pivoting through the Carolinas and across the western Atlantic. Models remain well clustered with coastal low developing and tracking toward or just east of the 40N/70W benchmark. Latest 12Z ECMWF remains an eastern outlier per differences noted in shortwave progression.

Snow or a rain/snow mix begins either late afternoon or early evening. Then a transition to all snow occurs as the low deepens and tracks northeast toward the benchmark.

Timing for steadiest and heaviest snow appears to be overnight Monday night into early Tuesday. Snowfall rates of 2 to 3 inches per hour are quite possible over eastern sections, based on latest frontogenesis and likely banding. The Tuesday morning commute will be impacted.

Assuming the track and intensity forecast is correct, a 970 hpa low near or just east of the benchmark, would expect heaviest snow and highest accumulations to be placed along the coast, east of NYC.

Have expanded the Winter Storm Watch from Monday evening through Tuesday to Long Island (east of NYC) and southern CT, with highest amounts east. A foot of snow is possible in spots over SE CT and eastern LI.

Of course any wobble in track NW or SE will result in a change in amounts.

Advisory level snowfall is possible for the remainder of the area, western half, for under 6 inches of accumulations.

Temps remain cold, with temps in the 30s to near 30 Monday, falling into the 20s and lower 30s at night.

As the storm pulls away, NW winds bring in drier air, and snowfall potential tapers off during the afternoon hours Tuesday.

.LONG TERM /TUESDAY NIGHT THROUGH SUNDAY/...
The region will be under the influence of a polar low and associated troughing mid to late week. A persistent deep NW flow will remain through late week as the large and strong closed low drifting north through Eastern Canada. Models then diverge on how quickly this troughing transitions to a zonal upper flow heading into the weekend.

In terms of sensible weather, cyclonic flow will likely maintain a breezy W/NW flow, diurnal instability cloud cover, scattered snow showers/flurries and temps near to slightly below seasonable Wed through Thu.

Models in general agreement with high pressure building towards the region Friday with fair and seasonable weather. But as noted earlier, there is some divergence in upper level pattern, which results in differences in approach of weak shortwave energy and frontal system for the weekend.

.AVIATION /19Z SUNDAY THROUGH FRIDAY/...
High pressure over the terminals slides east tonight. Low pressure then develops along the Mid Atlantic coast on Monday, passing to the southeast Monday night into Tuesday.

VFR through the TAF period.

Winds will be West-Northwest around 10 kt today, right around 310 magnetic. Winds then veer to the Northeast overnight at less than 10 kt. Winds will eventually become Easterly on Monday.

.OUTLOOK FOR 18Z MONDAY THROUGH FRIDAY...
.Monday afternoon-Tuesday...VFR most of Monday afternoon, then IFR or lower possible Monday night and through Tuesday in snow.Gusty NE winds 20-25 kt backing to the NW by Tuesday.
.Tuesday night-Wednesday...Mainly VFR, although Sub VFR possible in a few rain/snow showers. NW winds G20-25 kt.
.Thursday-Friday...VFR. W winds G20-25 kt.

.MARINE...

Sub-SCA conditions expected through Monday morning as high pressure slowly retreats north and east.

An intense offshore low passing to the south and east late Monday into Tuesday will likely bring Gale conditions over the ocean waters and eastern nearshore waters Monday Night into Tuesday. There is a low potential for Storm conditions for the eastern waters during this time. To the west, occasional gale gusts possible.

A gusty SCA to marginal Gale NW flow will likely linger well into the middle of next week behind the departing storm, with rough seas continuing on the ocean.

Winds and seas should gradually subside Friday as high pressure builds towards the waters.

.HYDROLOGY...
There is potential for a moderate to heavy precipitation event Monday night into Tuesday. No hydrologic impacts are anticipated, as this would be primarily in the form of snow.

.TIDES/COASTAL FLOODING...

A coastal storm will bring mainly minor coastal impacts with the Tuesday morning high tide cycle, along LI Sound and the southern and eastern bays of LI. Surge of generally 2 1/2 to 3 ft is needed

for minor coastal flooding and 3 to 4 ft for moderate coastal flooding with the Tuesday morning high tide. Locally moderate impacts are possible across the vulnerable north shore of LI and twin forks locales due to wave action on top of elevated waters.

.EQUIPMENT...
NYC NOAA Weather Radio Station KWO-35 (162.55 MHz) is off the air for an extended period of time.

.OKX WATCHES/WARNINGS/ADVISORIES...
CT...Winter Storm Watch from Monday evening through Tuesday afternoon for CTZ005>012.
NY...Winter Storm Watch from Monday evening through Tuesday afternoon for NYZ078>081-177-179.
NJ...None.
MARINE...Gale Watch from late Monday night through Tuesday evening for ANZ330-340-345.
Gale Watch from Monday evening through Tuesday evening for ANZ350-353-355.

6.3 Inflight Weather Advisories

The NWS had no Significant Meteorological Advisories (SIGMET), Convective SIGMETs, Severe Weather Forecast Alerts (AWW), or Center Weather Advisories (CWA) current over New York during the period on March 11, 2018. The NWS AWC had an Airman Meteorological Advisory (AIRMET) Tango current for potential turbulence above 16,000 ft to 39,000 ft associated with the jet stream over the area but was not applicable to this case. No advisories were current for any high winds, low-level wind shear, icing, or IFR conditions were current for the New York area.

6.4 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft Forecast for the region for use between 1600 through 2300 EDT is included below.

WINDS ALOFT FORECASTS
DATA BASED ON 111800Z
VALID 120000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
JFK	3109	3112-08	3024-09	2841-12	2746-26	2756-39	770447	770954	274055
BDL	3313	3213-09	3118-11	2928-17	2844-27	2754-39	274951	276252	276452
ACY	3110	3013-05	2934-07	2840-11	2753-25	2660-37	772944	764055	279358
AVP	3412	3014-07	3021-10	2832-13	2841-26	2749-40	277049	277552	266454

The forecast winds at 3,000 ft at the four surrounding locations expected wind from 310° to 340° at 9 to 13 knots.

7.0 Astronomical Conditions

The United States Naval Observatory's website provided the following astronomical conditions for New York, NY for the period.

SUN	
Begin civil twilight	0647 EDT
Sunrise	0714 EDT
Sun transit	1306 EDT
Sunset	1858 EDT
Accident	**1908 EDT**
End civil twilight	1925 EDT

At the time of the accident the Sun was -3° below the horizon at an azimuth of 268°. Official nighttime began at 1925 EDT.

Submitted by:

_____

Don Eick
Senior Meteorologist