

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety Washington, D.C. 20594

July 17, 2012

Group Chairman's Factual Report

METEOROLOGY

ERA12FA385

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A. ACCIDENT

Location:	Near Lake Wales, Florida
Date:	June 7, 2012
Time:	1235 eastern daylight time (1635 UTC ¹)
Airplane:	Pilatus PC-12; registration N950KA

B. METEOROLOGY SPECIALIST

Donald E. Eick Senior Meteorologist National Transportation Safety Board Operational Factors Division, AS-30 Washington, D.C. 20594-2000

C. SUMMARY

On June 7, 2012, a Pilatus PC-12/47, N950KA, about 1235 eastern daylight time, registered to and operated by Roadside Ventures, LLC, departed controlled flight followed by subsequent in-flight breakup near Lake Wales, Florida. Instrument meteorological conditions prevailed and an instrument flight rules (IFR) flight plan was filed for the 14 Code of Federal Regulations (CFR) Part 91 personal flight from St Lucie County International Airport (FPR), Fort Pierce, Florida, to Freeman Field Airport (3JC), Junction City, Kansas. The airplane was substantially damaged and the certificated private pilot and five passengers were fatally injured.

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 National Climatic Data Center (NCDC). All times are eastern daylight time (EDT) based upon the 24 hour clock, local time is +4 hours to UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site was located at latitude 27.8233° N and longitude 81.4773° W.

¹ UTC – is an abbreviation for Coordinated Universal Time.

E. FACTUAL INFORMATION

1.0 Synoptic Situation

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 Camp Springs, 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 joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45.

1.1 Surface Analysis Chart

The south east section of the NWS Surface Analysis Chart for 1100 EDT (1500Z) on June 7, 2012 is included as figure 1 with the approximate accident site within the red circle. The chart depicted high pressure ridge extending over the Bahamas into central and southern Florida with a stationary front extending along the Gulf coast across northern Florida and into the Atlantic. The accident site was located south of the stationary front which extended along the intended route of flight, with a weak pressure gradient over the area.

The station models on the surface analysis chart depicted a general anticyclonic wind flow south of the front with winds from the south to southwest at 5 to 10 knots, variable cloud cover, with temperatures in the 80's degrees Fahrenheit (F), and dew point temperatures in the 70's.



Figure 1- NWS Surface Analysis Chart for 1100 EDT on June 7, 2012

1.2 Upper Air Chart

The NWS 500-hPA archive upper air chart for 0800 EDT on June 7, 2012 depicting the mean atmosphere at approximately 18,000 feet is included as figure 2. The chart depicted an upper level low over Newfoundland with a long-wave trough extending southwestward along the east coast into Tennessee to another cut off upper level low over Oklahoma. A general convergent flow existed over the west coast of Florida with westerly winds over the northern portion of state and southwesterly winds over the southern portion. This confluent flow with the low level warm moist air supported rising motion and thunderstorm growth.



Figure 2- NWS 500-hPA upper air chart for 0800 EDT

1.3 Weather Radar Mosaic

The NWS regional radar mosaic for 1235 EDT on June 7, 2012 is included as figure 3, with the approximate accident site marked within a red circle. The radar mosaic chart depicted a large area of scattered echoes with reflectivity's over 50 dBZ across northern and western Florida west through north of the accident site. A small band of echoes on the range of 30 dBZ extended from the Port Saint Luce to the Lake Wales area and into the Melbourne area, with no defined areas of high reflectivity echoes typically associated with thunderstorms identified at the time of the image.



Figure 3- NWS Radar Mosaic image for Florida at 1235 EDT

Figure 4 is a close up of the NWS radar mosaic centered over the accident site with a red circle placed over the accident site. Several small areas of reflectivity are identified in the area to the north of the accident site with echoes near 30 dBZ. An area of echoes of 30 to 35 dBZ extended east of the accident site to the Port Saint Lucie area and was partially over the route of flight. To the west of the accident site over the Tampa area a large area of echoes with maximum reflectivity's of 50 dBZ or intense echoes were identified associated with thunderstorms. No significant echoes were identified over the accident site; however, the radar mosaic is typically created by the NWS utilizing the lowest 0.5° base reflectivity image and may not reflect the conditions at the accident airplanes cruising level prior to the in-flight breakup or loss of control. Section 5.0 of this report will document the closest weather radar data and look at the potential of echoes along the flight track in further details.



Figure 4- Enlarged radar mosaic over the Lake Wales area

2.0 Surface Observations

The surrounding area was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and special reports (SPECI's). The following observations report cloud height above ground level (agl).

2.1 Bartow Municipal Airport (KBOW)

The closest official NWS weather reporting location to the accident site was from Bartow Municipal Airport (KBOW), located in Bartow, Florida, approximately 21 miles northwest of the accident site at an elevation of 125 feet. The airport had an Automated Weather Observation System (AWOS) which was also augmented by certified weather observations during the hours between 0730 and 1700 daily. The airport lists a magnetic variation of 4° west. Bartow reported a thunderstorm and rain showers early in the morning between 0600 and 1000 EDT, the following conditions near the time of the accident:

Bartow (KBOW) weather at 1150 EDT (1550Z), wind from 140° at 5 knots, visibility unrestricted at 10 statute miles, a few clouds at 1,200 feet, ceiling broken at 6,000 feet, overcast at 9,000 feet, temperature 24° Celsius (C), dew point temperature 23° C, altimeter 29.98 inches of mercury (Hg).

The raw observations during the period were as follows:

METAR KBOW 071015Z AUTO 00000KT 5SM -TSRA FEW042 22/22 A2994 RMK AO2 LTG DSNT SW=

- METAR KBOW 071035Z AUTO 21012G21KT 010V020 1 3/4SM VCTS +RA SCT001 BKN024 BKN031 23/23 A2995 RMK AO2 LTG DSNT ALQDS P0005=
- METAR KBOW 071055Z AUTO 27003KT 2SM TSRA BKN001 OVC010 21/21 A2996 RMK AO2 P0029=
- METAR KBOW 071115Z AUTO 23003KT 3SM TSRA SCT002 BKN029 BKN048 21/21 A2997 RMK AO2 LTG DSNT ALQDS=
- SPECI KBOW 071130Z 21004KT 5SM -RA FEW003 BKN024 OVC110 21/21 A2996 RMK FIRST=
- METAR KBOW 071135Z AUTO 00000KT 3SM VCTS -DZ FEW003 21/21 A2996 RMK AO2 LTG DSNT ALQDS P0004=
- METAR KBOW 071153Z 20008KT 3SM -TSRA SCT003 BKN014 OVC110 21/21 A2999 RMK OCNL LTGCG TSB046 TS S MOV NE=
- METAR KBOW 071254Z 21005KT 5SM -RA SCT012 BKN036 OVC100 22/22 A3001 RMK TSE48 TS DSIPTD=
- METAR KBOW 071355Z VRB04KT 4SM -RA SCT005 BKN050 OVC100 22/22 A3001=

METAR KBOW 071453Z VRB04KT 7SM SCT039 BKN060 OVC085 22/22 A2999=

METAR KBOW 071550Z 14005KT 10SM FEW012 BKN060 OVC090 24/23 A2998=

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METAR KBOW 071653Z 17004KT 10SM FEW040 BKN100 OVC200 25/23 A2997=

METAR KBOW 071754Z 17005KT 8SM SCT022 BKN100 OVC200 27/23 A2995=

METAR KBOW 071852Z 17004KT 7SM SCT042 BKN100 OVC200 26/24 A2995 RMK LAST=

2.2 Kissimmee Gateway Airport (KISM)

The next closest weather reporting location was from Kissimmee Gateway Airport (KISM) located approximately 28 miles north of the accident site at an elevation of 82 feet and a magnetic variation of 5° west. The airport had an Automated Weather Observation System (AWOS) and was augmented by a part time certified observer. Kissimmee reported a thunderstorm and rain showers between 0725 and 0830 EDT, and a rain prior to the accident. A period of missing data was noted 0950 and 1250 EDT. The observation near the time of the accident indicated the following conditions:

Kissimmee weather at 1250 EDT (1650Z), wind from 220° at 8 knots, visibility 10 miles, ceiling broken at 7,500 feet above ground level (agl), temperature 28° Celsius (C), dew point temperature 22° C, altimeter 29.96 inches of mercury (Hg).

The raw observations surrounding the period were as follows:

METAR KISM 071050Z 00000KT 4SM BR FEW030 23/23 A2995 RMK FIRST =

SPECI KISM 071135Z 23010KT 1SM +TSRA OVC020 24/23 A2996 RMK TSRAB25=

METAR KISM 071150Z 22011G20KT 4SM RA SCT006 BKN024 OVC050 22/21 A2998 RMK TSE50=

MEATR KISM 071250Z 00000KT 10SM SCT029 BKN037 OVC045 23/21 A3000 RMK RAE30=

METAR KISM 071350Z 22008KT 4SM RA SCT025 BKN050 OVC085 23/22 A3001 RMK RAB50=

Date missing

METAR KISM 071650Z 22008KT 10SM BKN075 28/22 A2996=

METAR KISM 071750Z 22006KT 10SM BKN080 27/23 A2995 =

METAR KISM 071850Z 21004KT 10SM OVC150 27/23 A2994 =

METAR KISM 071950Z 21004KT 7SM BKN034 27/24 A2995 =

METAR KISM 072150Z 27004KT 4SM -RA BR SCT046 BKN065 25/23 A2993 =

METAR KISM 072247Z 28011KT 1SM RA BR SCT007 BKN019 OVC070 23/23 A2999 =

METAR KISM 072308Z 30011G18KT 3SM -RA BR SCT006 BKN023 OVC065 23/22 A2997 =

METAR KISM 072350Z 29005KT 6SM -RA BKN070 OVC080 23/22 A2998 =

2.3 Orlando International Airport (KMCO)

The next closest official reporting site was from Orlando International Airport (KMCO) located approximately 36 miles north of the accident site at an elevation of 96 feet. The airport had an Automated Surface Observation System (ASOS) and was augmented by a full time certified weather observer. The following weather conditions were reported surrounding the time of the accident:

Orlando weather at 1153 EDT (1553Z), wind from 200° at 7 knots, visibility 10 miles, scattered clouds at 7,500 feet, ceiling broken at 12,000 feet, broken at 25,000 feet, temperature 26° C, dew point temperature 22° C, altimeter 29.97 inches of Hg. Remarks: automated weather observation system, rain began at 1109 and ended at 1121 EDT, sea level pressure 1014.6-hPa, hourly precipitation less than 0.01 of an inch, temperature 26.1° C, dew point 21.7° C.

The raw observations surrounding the period were as follows:

METAR KMCO 071153Z 34003KT 10SM -TSRA FEW009 SCT029CB BKN095 OVC150 23/23 A2998 RMK AO2 TSB51RAB50 PRESRR SLP150 OCNL LTGIC S-SW TS S-SW MOV NE P0000 60000 70015 T02330228 10239 20222 53018=

SPECI KMCO 071157Z 21019G26KT 1/2SM +TSRA FG FEW009 BKN029CB OVC095 23/23 A3000 RMK AO2 PK WND 21026/1156 PRESRR FRQ LTGICCG OHD TS OHD MOV NE P0000 RVRNO=

SPECI KMCO 071213Z 13003KT 1SM +TSRA BR FEW009 BKN028CB OVC075 22/21 A3000 RMK AO2 PK WND 22028/1201 SFC VIS 4 FRQ LTGICCG NE-SE TS NE-SE MOV NE P0048=

- SPECI KMCO 071220Z 08005KT 5SM -TSRA BR FEW009 BKN030CB OVC070 22/21 A3000 RMK AO2 PK WND 22028/1201 OCNL LTGICCG N-E TS N-E MOV NE P0049=
- SPECI KMCO 071243Z 00000KT 10SM SCT030 BKN070 OVC110 22/22 A2999 RMK AO2 PK WND 22028/1201 TSE43RAE31 CB DSNT NE P0049=
- METAR KMCO 071253Z 00000KT 10SM SCT030 BKN070 BKN100 23/21 A2998 RMK AO2 PK WND 22028/1201 TSE43RAE31 SLP151 CB DSNT NE AND DSNT S P0049 T02280211=
- METAR KMCO 071353Z 20010KT 10SM FEW022 SCT045 BKN080 BKN180 24/22 A3000 RMK AO2 SLP156 T02390217=
- METAR KMCO 071453Z 19009KT 10SM SCT050 BKN080 BKN200 24/22 A2999 RMK AO2 SLP152 60049 T02440217 50002=
- METAR KMCO 071553Z 20007KT 10SM SCT075 BKN120 BKN180 BKN250 26/22 A2997 RMK AO2 RAB09E21 SLP146 P0000 T02610217 =

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- METAR KMCO 071653Z 22010KT 10SM FEW070 SCT100 BKN180 BKN250 29/21 A2995 RMK AO2 SLP141 T02940211 =
- METAR KMCO 071753Z 22008KT 10SM BKN070 OVC150 28/21 A2995 RMK AO2 SLP139 60049 T02780211 10300 20217 56013 =
- METAR KMCO 071853Z 22006KT 10SM FEW034 SCT065 BKN150 OVC250 27/23 A2994 RMK AO2 RAB17E41 SLP136 P0000 T02720228 =
- METAR KMCO 071953Z 22005KT 10SM -RA SCT049 BKN075 OVC140 27/24 A2994 RMK AO2 RAB09 SLP138 P0001 T02670244 =
- METAR KMCO 072053Z 24003KT 6SM -RA BR SCT037 BKN095 OVC130 26/24 A2995 RMK AO2 SLP140 P0001 60002 T02610244 53001 =
- METAR KMCO 072113Z 00000KT 6SM -RA BR BKN019 BKN044 OVC110 26/25 A2995 RMK AO2 P0002=
- METAR KMCO 072130Z 25003KT 6SM -RA BR SCT019 BKN060 OVC110 26/25 A2994 RMK AO2 P0003=
- METAR KMCO 072153Z 29005KT 10SM -RA FEW034 SCT046 BKN090 OVC150 26/24 A2993 RMK A02 SLP134 P0006 T02610244 =
- METAR KMCO 072242Z 29008KT 5SM TSRA BR FEW027 SCT050CB BKN075 OVC140 24/23 A2997 RMK AO2 TSB40 OCNL LTGIC SW-W TS SW-W MOV NE P0008 =
- METAR KMCO 072253Z 28010KT 5SM +TSRA BR SCT032CB BKN055 OVC110 23/23 A2997 RMK AO2 TSB40 SLP147 OCNL LTGICCC S-W-OHD TS S-W-OHD MOV NE P0011 T02330228 =

3.0 Upper Air Data

The closest upper air sounding or rawinsonde observation (RAOB) was from the NWS Ruskin (KTBW), Florida, site number 72210, was located approximately 50 miles west of the accident site at an elevation of 43 feet. The 0800 EDT (1200Z) sounding was plotted on a

standard Skew-T log P diagram² utilizing RAOB³ software is included as figure 5 from the surface to 300-hPa or 30,000 feet. The sounding was saturated with 100 percent relative humidity at low levels due to precipitation and provided unrepresentative critical levels. A review of the most unstable conditions provided a level of free convection (LFC)⁴ at 2,700 feet agl, with an equilibrium level (EL)⁵ or expected top of convective clouds was at 44,500 feet with the tropopause at approximately 42,000 feet. The sounding had a relative humidity of 75 percent or more from the surface through 18,000 feet which resulted in a precipitable water value of 2.25 inches. The freezing level was identified at approximately 15,000 feet.

The stability indices of the KTBW sounding indicated a Lifted Index of -3.1, a most unstable (MU) LI at -4.8, and a K-Index of 35.8, which indicated an unstable atmosphere with an 80 percent probability of airmass type thunderstorms. The mean vertical velocity of convective updrafts was 39 meters per second (m/s) or near 78 knots, with the most unstable value of 59 m/s or 118 knots. The addition of deep layer of moisture and low LFC favored storm development.

The wind profile indicated surface wind from the south veering to the southwest and west with height through the troposphere. The level of maximum wind was identified above the tropopause at 47,000 feet with a wind from 305° at 63 knots. The mean 0 to 6 kilometer (18,000 feet) wind was from 234° at 21 knots. At the accident airplanes cruising altitude of 25,200 feet the wind was from approximately 265° at 23 knots, with a temperature of -18° C.

 $^{^{2}}$ Skew T log P diagram – is a standard meteorological plot 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.

³ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.

⁴ 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.

 $^{^{5}}$ Equilibrium Level (EL) - On a sounding, the level above the level of free convection (LFC) at which the temperature of a rising air parcel again equals the temperature of the environment. The height of the EL is the height at which thunderstorm updrafts no longer accelerate upward. Thus, to a close approximation, it represents the height of expected (or ongoing) thunderstorm tops. However, strong updrafts will continue to rise past the EL before stopping, resulting in storm tops that are higher than the EL. This process sometimes can be seen visually as an overshooting tops or anvil dome. The EL typically is higher than the tropopause, and is a more accurate reference for storm tops.



Figure 5 - Tampa 0800 EDT sounding

4.0 Satellite Data

The Geostationary Operational Environmental Satellite number 13 (GOES-13) data was obtained and displayed on the National Transportation Safety Board's Man-computer Interactive Data Access System (McIDAS) workstation. Both the infrared long wave and visible imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 4) at a wavelength of 10.7 microns (μ m) provided standard satellite image with radiative cloud top temperatures at a resolution of 4 kilometers. The visible imagery (band 1) at a wavelength of 0.65 μ m provided a resolution of 1 km. The satellite imagery surrounding the time of the accident at 15-minute intervals were reviewed and the closest images documented below.

Figure 6 is the GOES-13 infrared image at 1232 EDT (1632Z) at 2X magnification with a standard EMB temperature enhancement curve applied to high light the higher and colder cloud tops typically associated with deep convection. The accident site is also marked by a white square. The depicted the accident site on the eastern side of an area of enhanced cloud cover associated with high level cirrus clouds potentially from anvil from cumulonimbus clouds located to the west depicted by the enhanced areas in blue to yellow. The radiative cloud top temperature over the accident site was 235° kelvin or -38.16° C, which corresponded to cloud tops near 34,000 feet.



Figure 6 - GOES-13 infrared image at 1232 EDT

Figure 7 is the GOES-13 visible image for 1232 EDT at 2X magnification with the accident site marked. The image depicts multiple layers of clouds over the accident site producing a broken to overcast layer of clouds over the accident site. No defined cumulonimbus clouds are observed within 20 miles of the accident site; however, cumulonimbus clouds are observed to the west through northwest between Plant City (KPCM) and Ocala (KOCF), Florida, with cirrus outflow clouds or remains of the anvil from these storms extending over the accident site, with lowering cumulus clouds below.



Figure 7 - GOES-13 visible image at 1232 EDT

5.0 Weather Radar Information

The closest Weather Surveillance Radar-1988, Doppler (WSR-88D) was located at the NWS Melbourne (KMLB) forecast office, approximately 48 miles east of the accident site. The level II archive data was obtained from the National Climatic Data Center (NCDC) utilizing the Hierarchical Data Storage System (HDSS) and displayed using the NWS NEXRAD Interactive Viewer and Data Exporter software.

The WSR-88D is a S-band 10 centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95° beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width.

5.1 Volume Scan Strategy

The WSR-88D is a computer controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor (PUP). Products that require data from multiple elevation scans are not available until the end of the six minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 9 elevation scans from 0.5° to 19.5° every six minutes. This particular scanning strategy is documented as volume coverage pattern 21 (VCP-21). Mode B is the clear air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident the KMLB WSR-88D radar was operating in the quickest operational precipitation mode (Mode A, VCP-11), where the radar made 14 elevation scans every 5 minutes. The following chart (figure 8) provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



Figure 8- VCP-11 precipitation mode scan

5.2 Beam Height Calculation

Assuming standard refraction⁶ of the 0.95° radar beam of the KMLB WSR-88D with an antenna height of 116 feet and a distance of 48 miles, the following table shows the approximate beam height and width information of the radar display over the site of the accident. The heights have been rounded to the nearest 10 feet.

ANTENNA	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
ELEVATION				
0.5°	4,190 feet	1,770 feet	6,610 feet	4,840 feet
1.4°	8,770 feet	6,350 feet	11,190 feet	4,840 feet
2.4°	13,850 feet	11,430 feet	16,270 feet	4,840 feet
3.4°	18,930 feet	16,520 feet	21,360 feet	4,840 feet
4.3°	23,500 feet	21,080 feet	25,920 feet	4,840 feet
5.3°	28,570 feet	26,150 feet	30,990 feet	4,840 feet

⁶ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

Based on the radar height calculations, the 4.3° elevation scan depicts the conditions encompassing the altitude between 21,080 to 25,920 feet and best depicted the conditions at the accident airplanes altitude at the time the airplane departed control flight.

5.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors⁷ it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ⁸), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP	WSR-88D	PREC MODE	RAINFALL
	LEVEL	DBZ	
0	0	< 5	
	1	5 to 9	
	2	10 to 14	
1	3	15 to 19	.01 in/hr
Very Light	4	20 to 24	.02 in/hr
	5	25 to 29	.04 in/hr
2	6	30 to 34	.09 in/hr
Light to	7	35 to 39	.21 in/hr
Moderate			
3	8	40 to 44	.48 in/hr
Strong			
4	9	45 to 49	1.10 in/hr
Very			
Strong			
5	10	50 to 54	2.49 in/hr
Intense			
6	11	55 to 59	>5.67 in/hr
Extreme	12	60 to 64	
	13	65 to 69	
	14	70 to 74	
	15	> 75	
II			

NWS VIP/DBZ CONVERSION TABLE

⁷ Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glaze ice.

Air traffic control (ATC) weather display systems also use radar weather processors with the ability to determine precipitation intensity, with controllers instructed to describe the intensity to pilots based on the following scale:

(a) "Light"	(< 30 dBZ)
(b) "Moderate"	(30 to 40 dBZ)
(c) "Heavy"	(>40 to 50 dBZ)
(d) "Extreme"	(> 50 dBZ)

5.4 Base Reflectivity

The KMLB base reflectivity image for 0.5° at 1233 EDT (1633Z) on June 7, 2012 is included as figure 9 with the accident airplanes flight track overlaid. As in the regional radar mosaic images in figures 2 and 3 of this report, only light intensity echoes were depicted over the flight path prior to the accident. No defined high reflectivity cores that may have been associated with thunderstorms were depicted in the immediate vicinity of the flight track or accident site.



Figure 9 - KMLB WSR-88D 0.5° base reflectivity image at 1233 EDT

Figure 10 is the KMLB WSR-88D 4.3° base reflectivity image at 1233 EDT. The image depicts reflectivities of 0 to 15 dBZ over the flight track indicating the accident airplane was likely operating in clouds or instrument meteorological conditions at the time of the loss of control. Figure 11 is the Tampa's (KTBW) WSR-88D 4.3° base reflectivity⁹ image which depicted similar reflectivity's of 0 to 15 dBZ over the route.

⁹ KTBW WSR-88D was located 49 miles from the accident site with the 4.3° beam extending from 21,550 to 26,490



Figure 10 - KMLB WSR-88D 4.3° base reflectivity image at 1233 EDT



Figure 11- KTBW WSR-88D 4.0° base reflectivity image at 1231 EDT

feet over the accident site.

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6.0 Current Icing Product

The NWS Current Icing Product (CIP) was obtained from the National Center for Atmospheric Research (NCAR) who developed the product. The CIP supplemental product provides a computerized probabilistic forecast of icing conditions at specific flight levels based on observed data including WSR-88D radar, satellite, pilot weather reports, surface weather reports, lightning and Rapid Update Cycle (RUC) numerical model output from the NWS. The CIP probability of icing conditions for 1200 EDT (1600Z) and 1300 EDT (1700Z) on June 7, 2012 at 25,000 feet are provided as figures 12 and 13 below. The images depicted a small pocket of 40 to 50 percent probability of icing immediately after departure and less than 20 percent probability of icing over the accident site.

The CIP icing severity for 1200 and 1300 EDT are included as figures 14 and 15 respectively. The images depicted the best category of icing as light to moderate at 25,000 feet during the period.



Figure 12- NWS CIP for 1200 EDT at 25,000 feet







Figure 14 - NWS CIP Icing Severity for 1200 EDT at 25,000 feet



Figure 15- NWS CIP Icing Severity for 1300 EDT for 25,000 feet

7.0 Pilot Reports

The following pilot reports (PIREPs) were recorded over Florida in the vicinity of the accident site surrounding the period and within 3 hours of the accident:

St. Petersburg (PIE) routine pilot report (UA); Over – 30 miles south of Lakeland VORTAC¹⁰ (LAL); Time – 0945 EDT; Flight level – 15,000 feet; Type aircraft – Beechcraft 1900 King Air; Turbulence – moderate chop; Remarks – entered by Miami Center Weather Service Unit (CWSU).

Sarasota (SRQ) routine pilot report (UA); Over – 30 miles south of Lakeland VORTAC (LAL); Time – 0945 EDT; Flight level – 15,000 feet; Type aircraft – Beechcraft 1900 King Air; Turbulence – moderate chop.

Vero Beach (VRB) routine pilot report (UA); Over – 25 miles southwest of Vero Beach VORTAC (VRB); Time – 1046 EDT; Flight level – 15,000 feet; Type aircraft – Beechcraft King Air (BE90L) multiengine turboprop; Icing – light rime icing; Remarks – entered by Miami CWSU.

 $^{^{10}}$ VORTAC – VHF omnidirectional radio range is a radio navigation aid that provides bearing and distance information.

Whiting Field Naval Air Station (NSE) routine pilot report (UA); Over – NSE; Time – 1147 EDT; Flight level – 1,800 feet; Type aircraft – Raytheon T-6B Texan II single engine turboprop (TEX2); Sky cover – broken clouds bases at 1,800 feet.

Melbourne (MLB) routine pilot report (UA); Over – 30 miles south-southeast of Orlando VORTAC (ORL); Time – 1130 EDT; Flight level – 23,000 feet; Type aircraft – Swearingen Merlin III multiengine airplane (SW3); Icing – light rime icing; Remarks – entered by Miami CWSU.

St. Petersburg (PIE) urgent pilot report (UUA); Over – 40 miles northeast of PIE; Time – 1140 EDT; Flight level – 13,000 feet; Type aircraft – Pilatus single engine turboprop (PC12); Turbulence – severe turbulence between 13,000 and 19,000 feet; Remarks – entered by Miami CWSU.

West Palm Beach (PBI) routine pilot report (UA); Over – PBI; Time – 1348 EDT; Flight level – 3,000 feet; Type aircraft – Boeing 737 air carrier jet aircraft (B737); Sky cover – broken clouds at 3,000 feet with tops at 7,000 feet.

Gainesville (GNV) routine pilot report (UA); Over – 20 miles southwest of Gainesville (GNV); Time – 1337 EDT; Flight level – 38,000 feet; Type aircraft – Hawker (H25) business jet; Turbulence – moderate turbulence; Remarks – entered by Jacksonville CWSU.

Fort Lauderdale (FLL) routine pilot report (UA); Over – between FLL and North Bimini, Bahamas (MYBS); Time – 1431 EDT; Flight level – 3,000 feet; Type aircraft – Britten-Norman Islander (BN2) multiengine airplane; Sky cover – scatter to broken clouds at 6,500 feet; Weather – flight visibility 99 miles; Turbulence – negative; Remarks – scattered to broken clouds over Bimini during descent; Turbulence – smooth.

Vero Beach (VRB) routine pilot report (UA); Over – 15 miles southwest of VRB; Time – 1449 EDT; Flight level – 16,000 feet; Type aircraft – Piaggio Avanti (P180) multiengine turboprop; Icing – light to moderate clear icing; Remarks – entered by Miami CWSU.

St. Petersburg (PIE) routine pilot report (UA); Over – 30 miles southwest of PIE; Time – 1603 EDT; Flight level – 10,000 feet; Type aircraft – Boeing 737 air carrier jet aircraft (B737); Turbulence – moderate turbulence; Remarks – entered by Miami CWSU.

There were 3 pilot reports of icing conditions in the vicinity of the accident site, with 2 reports of light rime icing and 1 report of light to moderate clear type icing. There was also an urgent pilot report (UUA) from a pilot operating a similar PC-12 aircraft northeast of St. Petersburg (PIE), who reported an encounter with severe turbulence between 13,000 and 19,000 feet. That report is provided in bold print above.

8.0 Terminal Aerodrome Forecast

The closest Terminal Aerodrome Forecast (TAF) issued in the vicinity of the accident site was issued for Kissimmee Gateway Airport, Orlando, Florida&. The TAF provides a more time

specific forecast for wind, visibility, and clouds for a 5 mile radius of the airport. The forecast current at the time of the accident was as follows:

TAF KISM 011132Z 0712/0812 20004KT P6SM VCSH FEW040 BKN120 TEMPO 0712/0714 4SM TSRA SCT025CB BKN040 FM071400 22011KT P6SM VCSH SCT020 BKN050 TEMPO 0714/0718 3SM TSRA BKN020CB OVC040 FM080000 23006KT P6SM VCSH SCT025 BKN060

The forecast expected from 1000 EDT a southwesterly wind from 220 at 11 knots, visibility better than 6 miles with rain showers in the vicinity, scattered clouds at 2,500 feet agl, ceiling broken at 5,000 feet, with a temporary conditions between 1000 and 1400 EDT of visibility 3 miles in thunderstorms and moderate rain, ceiling broken at 2,000 feet agl in cumulonimbus clouds (CB), overcast at 4,000 feet.

9.0 Area Forecast

The Area Forecast (FA) is a forecast of visual Flight Rules (VFR) clouds and weather conditions over an area as large as the size of several states. It must be used in conjunction with the AIRMET Sierra (IFR) bulletin for the same area in order to get a complete picture of the weather. The area forecast together with the AIRMET Sierra bulletin are used to determine forecast enroute weather and to interpolate conditions at airports which do not have a terminal forecast (TAF) issued. The NWS Aviation Weather Center (AWC) located in Kansas City, Missouri, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The Miami (KMIA) regional forecast that was current at the time of the accident was issued at 0445 EDT and valid through 1700 EDT on June 7, 2012. The forecast was as follows:

 FAUS42 KKCI 070845
 2012159 0830

 FA2W
 -MIAC FA 070845

 SYNOPSIS AND VFR CLDS/WX
 SYNOPSIS VALID UNTIL 080300

 CLDS/WX VALID UNTIL 072100...OTLK VALID 072100-080300
 NC SC GA FL AND CSTL WTRS E OF 85W

SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN. TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS. NON MSL HGTS DENOTED BY AGL OR CIG.

SYNOPSIS...BROAD UPR LVL TROF NERN-E CNTRL US WILL CONT SLOLY EWD THRU PD. OTRW..SEVERAL MID LVL IMPULSES WILL CONT ACRS FL PEN/FL CSTL WTRS THRU OTLK. WNW FLOW NRN PTN..WLY FLOW SRN PTN. STNR FNT SRN PTNS DEEP S THRU PD. OTRW..HI PRES RIDGE SRN GREAT A LAKES-OH VLY-MID S WILL DMNT RMNDR.

FL

PNHDL-NRN PEN...BKN015-025 BKN040 TOPS 060. OCNL VIS 3-5SM BR. ISOL -TSRA/-SHRA. CB TOP FL400. BECMG 1316 SCT030 BKN050 TOPS 080 BKN CI. ISOL -TSRA/-SHRA. CB TOP FL420. OTLK...VFR TSRA. CNTRL-SRN PEN...SCT020 BKN040-060 LYRD FL250. WDLY SCT -SHRA/ISOL -TSRA. CB TOP FL400. BECMG 1518 SCT025 BKN050 BKN120. WDLY SCT -SHRA/-TSRA. CB TOP FL420. OTLK...VFR TSRA SHRA.

The forecast for central and southern Peninsula of Florida expected scattered clouds at 2,000 feet, broken clouds between 4,000 and 6,000 feet with layered tops to 25,000 feet, with widely scattered light rain showers and thunderstorms and light rain, with cumulonimbus cloud tops to 40,000 feet. Becoming from 1100 to 1400 EDT clouds scattered at 2,500 feet, broken at 5,000 feet, and broken at 12,000 feet, with widely scattered light rain showers and thunderstorms with tops to 42,000 feet.

10.0 In-Flight Weather Advisories

The NWS issues in-flight weather advisories designated as Severe Weather Forecast Alerts (AWW's), Convective SIGMET's (WST's), SIGMET's (WS's), Center Weather Advisories (CWA's), and AIRMET's (WA's). In-flight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions, which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft.

10.1 Convective SIGMETs (WST)

The following NWS Convective SIGMETs were issued at 1155 EDT on June 7, 2012, and were valid until 1355 EDT. A plot of the Convective SIGMETs over the satellite image at the time is included as figure 16. The advisories warned of two areas of thunderstorms with tops near 45,000 feet, moving east-northeast between 15 and 25 knots. Convective SIGMET 35E extended over the planned route of flight, but did not extend over the accident site. The advisories were as follows:

-MKCE WST 071555 CONVECTIVE SIGMET 34E VALID UNTIL 1755Z FL CSTL WTRS FROM 210E OMN-180ENE VRB-30NNE VRB-70ENE OMN-210E OMN AREA TS MOV FROM 25015KT. TOPS TO FL450.

CONVECTIVE SIGMET 35E VALID UNTIL 1755Z FL AND CSTL WTRS FROM 50NNE CTY-40NNE PIE-70WSW SRQ-170S CEW-130SSE SJI-50NNE CTY AREA TS MOV FROM 23025KT. TOPS TO FL450.

REF INTL SIGMET GOLF SERIES. OUTLOOK VALID 071755-072155 AREA 1...FROM 30E YSC-30E BOS-HAR-30W JST-ERI-30W MSS-30E YSC WST ISSUANCES POSS LT IN PD. REFER TO MOST RECENT ACUS01 KWNS FROM STORM PREDICTION CENTER FOR SYNOPSIS AND METEOROLOGICAL DETAILS. AREA 2...FROM 40SW MGM-180ESE CHS-170E PBI-80WSW EYW-70W SRQ-170S CEW-30SSW CEW-40SW MGM WST ISSUANCES EXPD. REFER TO MOST RECENT ACUS01 KWNS FROM STORM PREDICTION CENTER FOR SYNOPSIS AND METEOROLOGICAL DETAILS.



Figure 16- Convective SIGMETs issued at 1155 EDT

10.2 AIRMETs (WA)

The NWS issued the following AIRMETs at 1045 EDT. No organized areas of turbulence or icing were identified outside of convective activity. An area of instrument flight rule (IFR) conditions was expected over northern Florida, which did not impact the flight. The advisories were as follows:

WAUS42 KKCI 071445 2012159 1433 WA2S -MIAS WA 071445 AIRMET SIERRA UPDT 2 FOR IFR VALID UNTIL 072100

. AIRMET IFR...GA FL AND CSTL WTRS FROM 50SSE LGC TO SAV TO 20S CRG TO 20S TLH TO 50SE SJI TO 40W CEW TO 50SW PZD TO 50SSE LGC CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS ENDG 15-18Z.

WAUS42 KKCI 071445 WA2T -MIAT WA 071445 AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 072100 . NO SGFNT TURB EXP OUTSIDE OF CNVTV ACT. WAUS42 KKCI 071445 2012159 1435 WA2Z -MIAZ WA 071445 AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 072100 . NO SGFNT ICE EXP OUTSIDE OF CNVTV ACT. . FRZLVL...RANGING FROM 085-155 ACRS AREA 120 ALG 20ENE GQO-30ESE GQO-50SSE FLO-150ESE ILM

11.0 Weather Briefing

There was no record of the pilot of N950KA receiving a Automated Flight Service Station (AFSS) or Direct Users Access Terminal System (DUATS) weather briefing prior to departing Port Saint Lucie Airport; however, the pilot did contact AFSS to file an IFR flight plan for the accident flight segment.

The local Fixed Base Operator (FBO) at the departure airport did have some computerized system for flight planning and preflight briefing use, and it is possible the accident pilot utilized that system to familiarize himself with the weather conditions and file his flight plan. The software provider of flightplan.com was contacted; however, they had no record of the pilot utilizing their system. Therefore it is unknown what information the pilot received regarding the weather conditions for the route of flight.

12.0 Astronomical Data

The United Stated Naval Observatory website provided the following astronomical data for Houston, Harris County, Texas on June 12, 2012:

0553 CDT
0620 CDT
1322 CDT
2023 CDT
2050 CDT

MOON Moonset Moonrise

1433 CDT 0216 CDT June 13, 2012

Donald Eick Senior Meteorologist