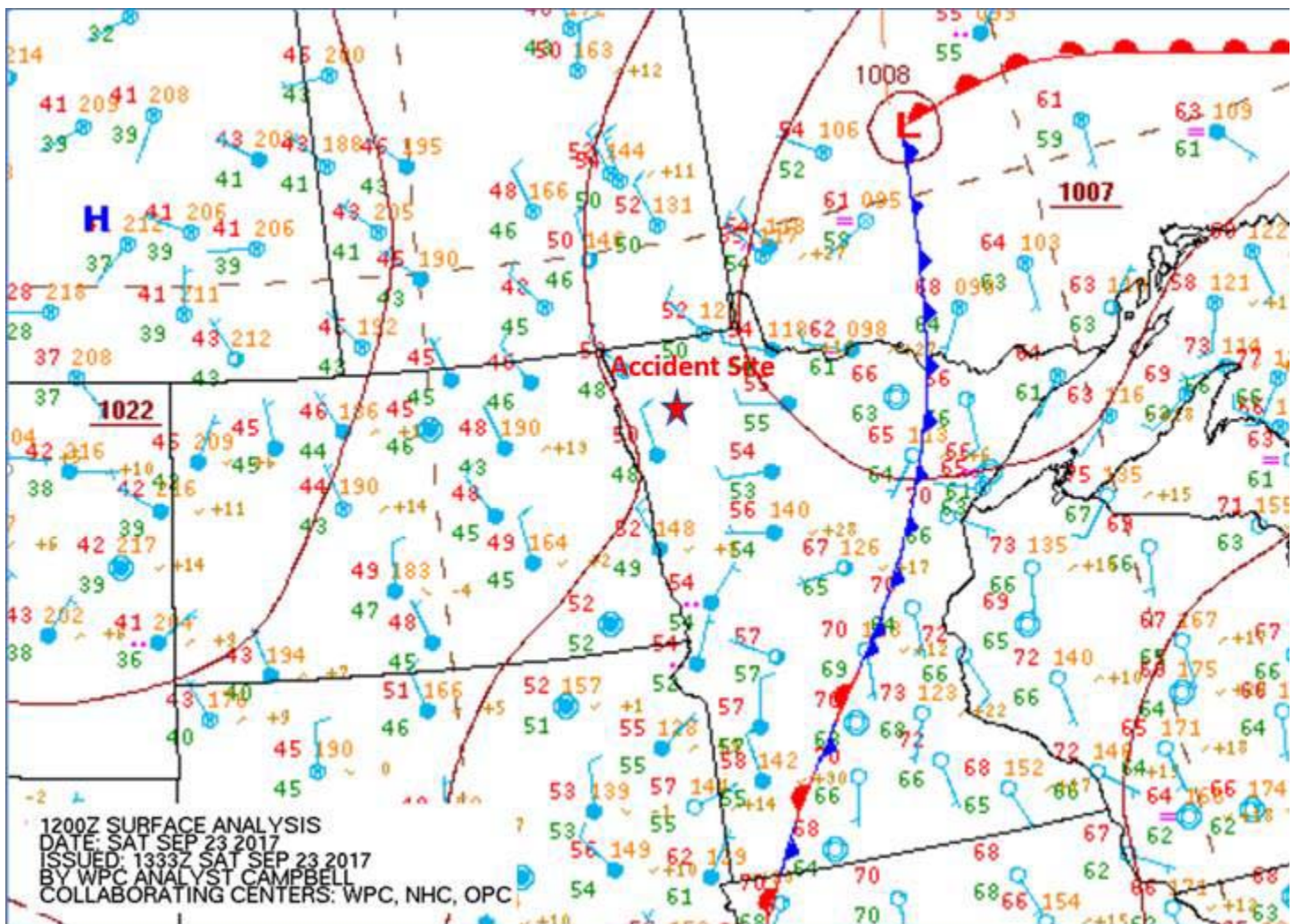


Lindberg Joshua

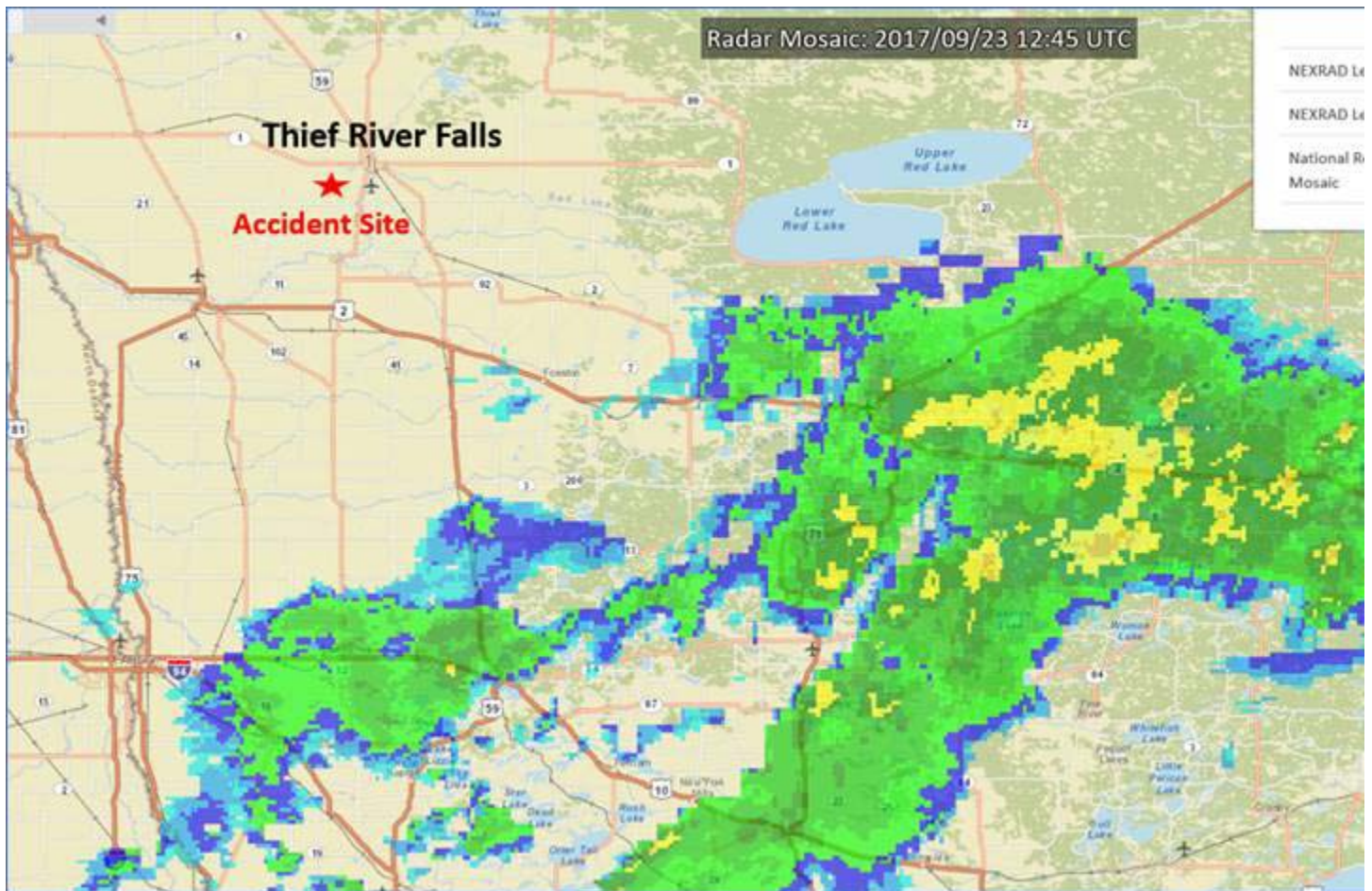
From: Eick Donald
Sent: Monday, September 25, 2017 1:52 PM
To: Lindberg Joshua
Cc: Helson David
Subject: CEN17FA361 - Thief River Falls, MN Weather

Weather Conditions on September 23, 2017

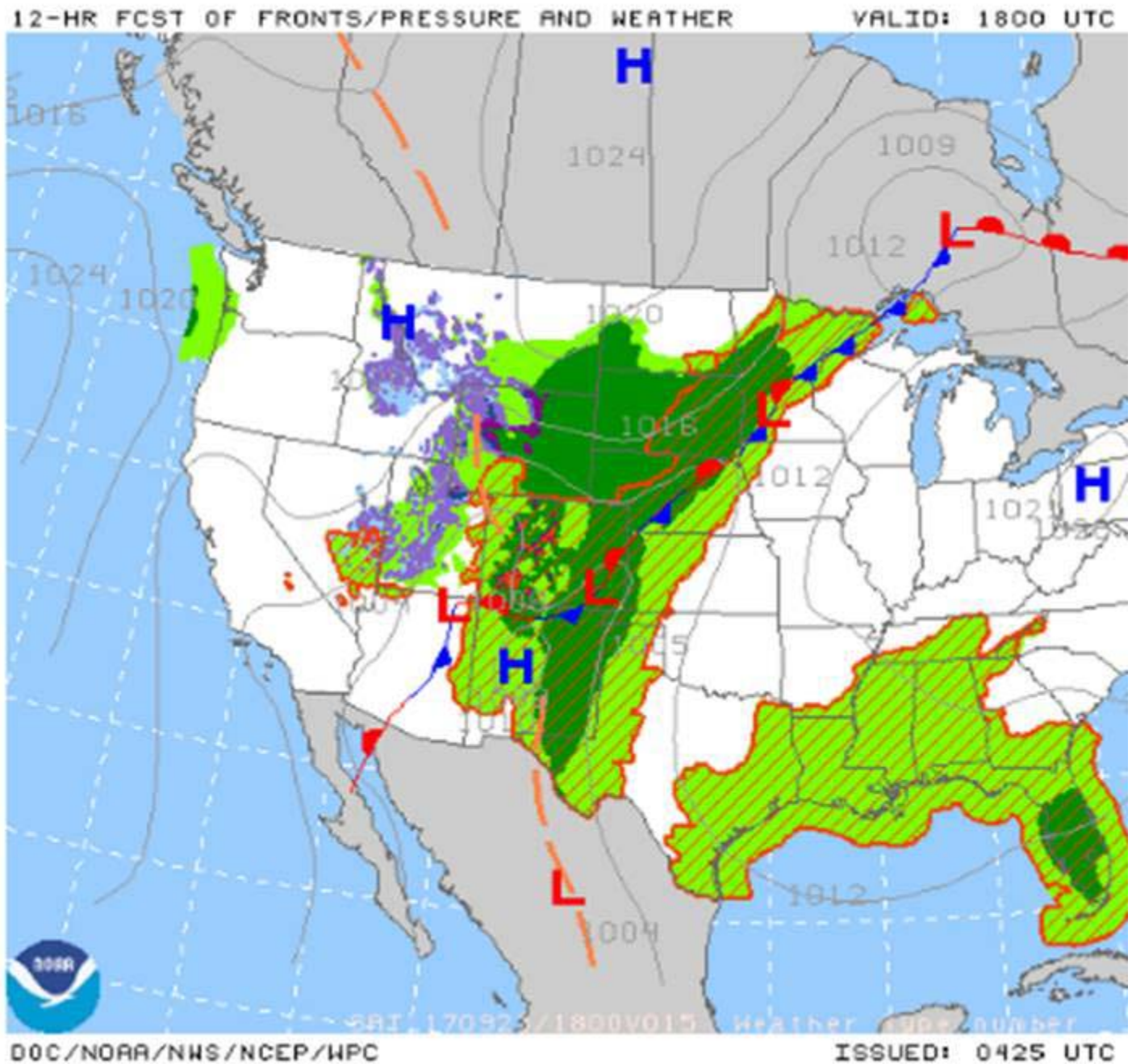
Synoptic conditions – The NWS Surface Analysis Chart for 0700 CDT (1200Z) on September 23, 2017 enlarged over the region depicted a low pressure system at 1007-hectopascals (hPa) over southwestern Ontario with a cold front extending south-southwest across Minnesota, then becoming stationary over southern Minnesota, into northwestern Iowa, and into Nebraska. A high pressure system at 1022-hPa was located to the northwest of the accident site over southern Saskatchewan, Canada with a ridge extending southeastward into the Dakota's. The station models on the chart depicted winds from the west immediately behind the front over the accident site, to the north-northwest over western Minnesota and North Dakota at 10 knots or less, overcast clouds with temperatures in the 50's degrees Fahrenheit (F), with dew points spreads of 2° F or less.



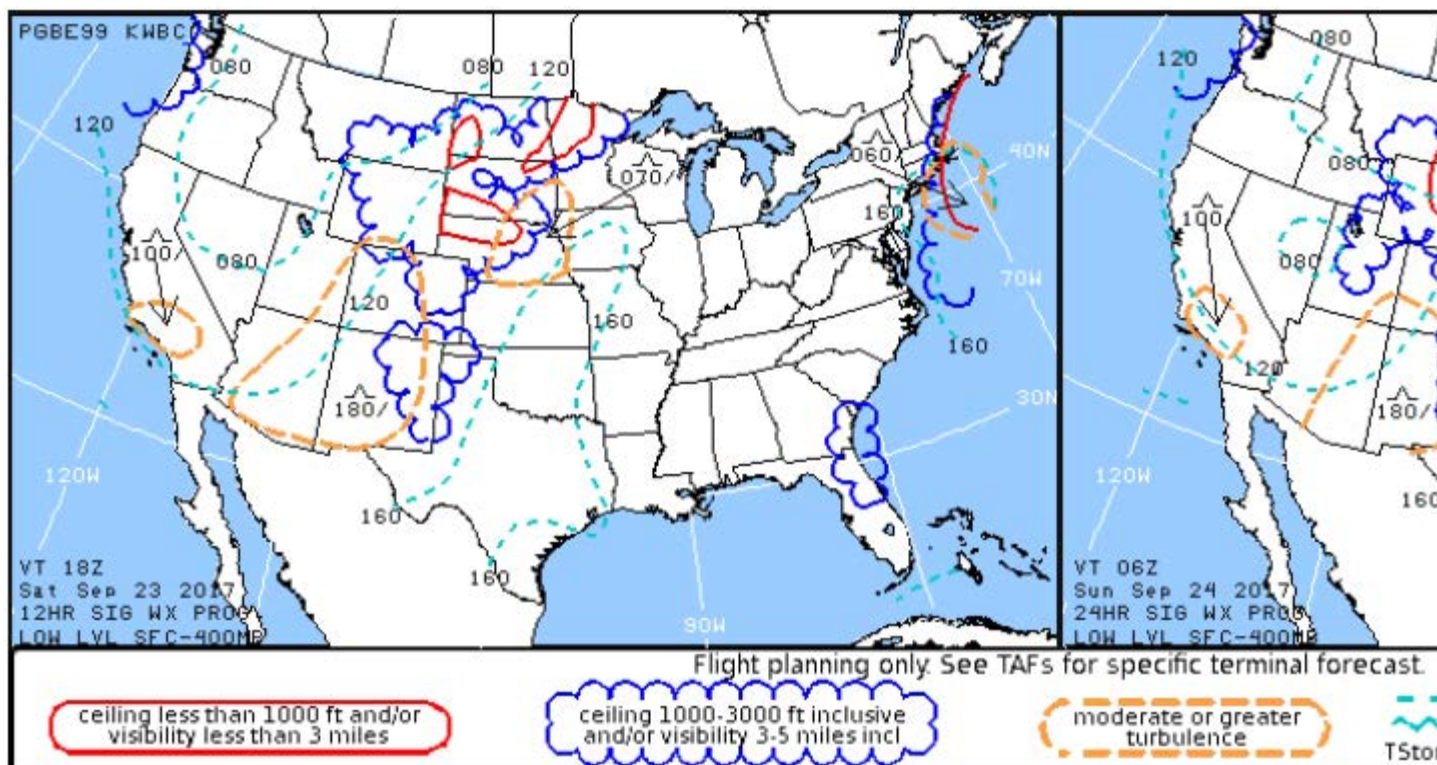
A review of the NWS National Composite Reflectivity image for 0745 CDT is included below and depicted a large band of precipitation echoes extending across Minnesota into South Dakota, to the southeast of the accident site. No significant echoes were indicated in the Thief River Falls area at the time of the accident.



12 Hours Surface Prognostic



The 12 and 24 hour Low-Level Significant Weather Prognostic chart valid at the time is included below and expected IFR to MVFR conditions over the route of flight, with IFR conditions over the accident site.



Observations – Thief River Falls Regional Airport (KTVF), Thief River Falls, MN, lists an elevation of 1,119 feet and a magnetic variation of 2° east. The airport had an Automated Weather Observation System (AWOS) and reported the following conditions during the period:

METAR KTVF 230901Z AUTO 30013G19KT 10SM OVC006 12/11 A2989 RMK AO2 CIG 004V008 SLP122 60004 T01170106 51038=

SPECI KTVF 230927Z AUTO 30013KT 10SM OVC004 11/10 A2990 RMK AO2=

METAR KTVF 231001Z AUTO 32015KT 10SM OVC004 11/09 A2990 RMK AO2 SLP128 T01060094=

METAR KTVF 231101Z AUTO 33013KT 10SM OVC004 10/09 A2992 RMK AO2 SLP132 T01000094=

METAR KTVF 231201Z AUTO 34006KT 10SM OVC004 10/09 A2995 RMK AO2 PRESRR SLP143 70004 T01000089 10128 20094 51023=

Accident 1245Z

METAR KTVF 231301Z AUTO 31007KT 10SM OVC004 10/09 A2998 RMK AO2 SLP154 T01000094=

METAR KTVF 231401Z AUTO 32007KT 5SM BR OVC004 10/09 A3001 RMK AO2 SLP165 T01000094=

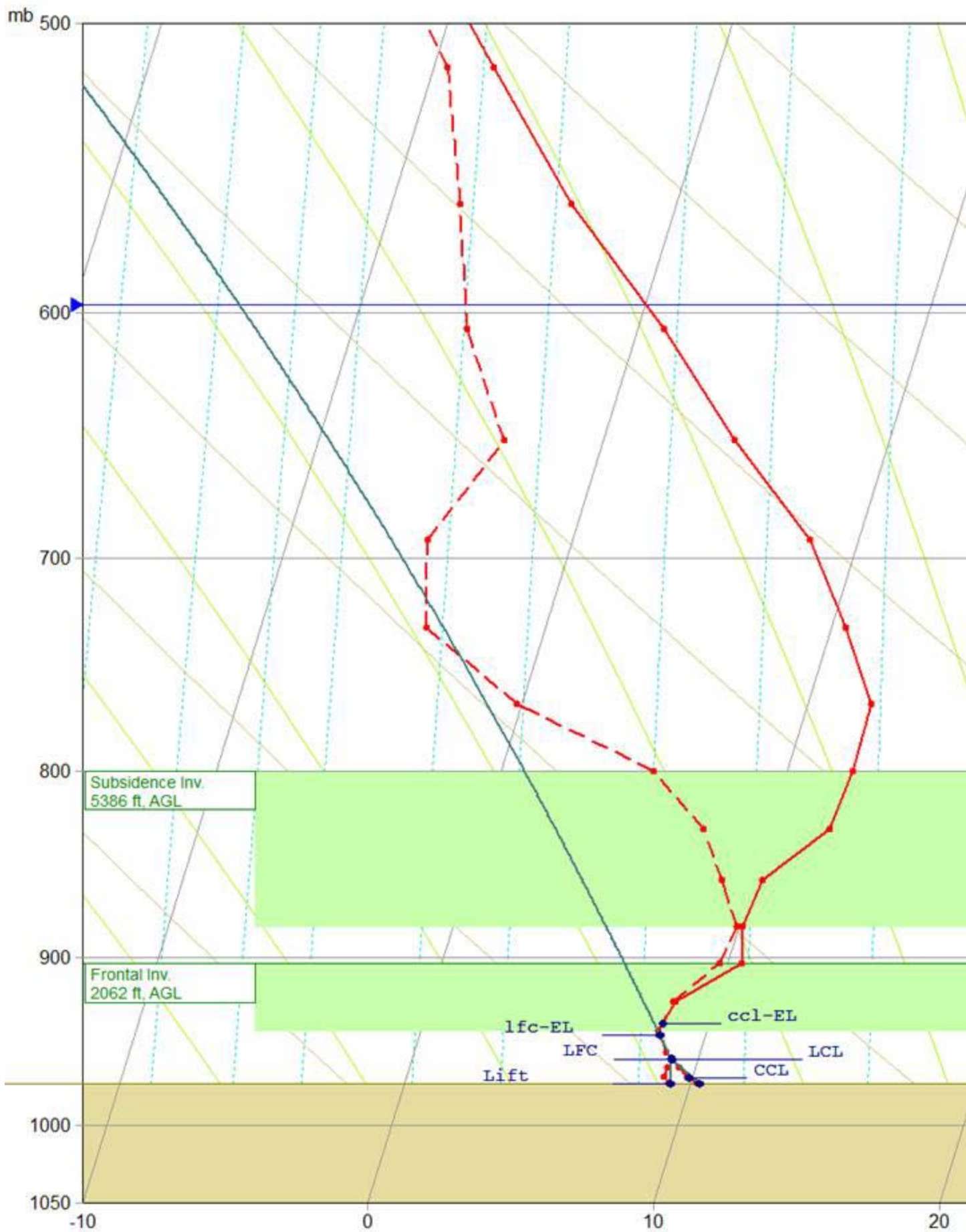
METAR KTVF 231601Z AUTO 31008KT 8SM OVC004 11/09 A3004 RMK AO2 SLP176 T01060094=

SPECI KTVF 231626Z AUTO 33008KT 10SM OVC006 11/09 A3002 RMK AO2=

METAR KTVF 231701Z AUTO 32008KT 10SM OVC008 12/10 A3003 RMK AO2 SLP174 T01170100=

The observations indicated that LIFR conditions were reported at KTVF from 0427 through 1126 CDT with ceilings overcast at 400 feet agl, visibility was reported obscured to 5 miles in mist at 0901 CDT.

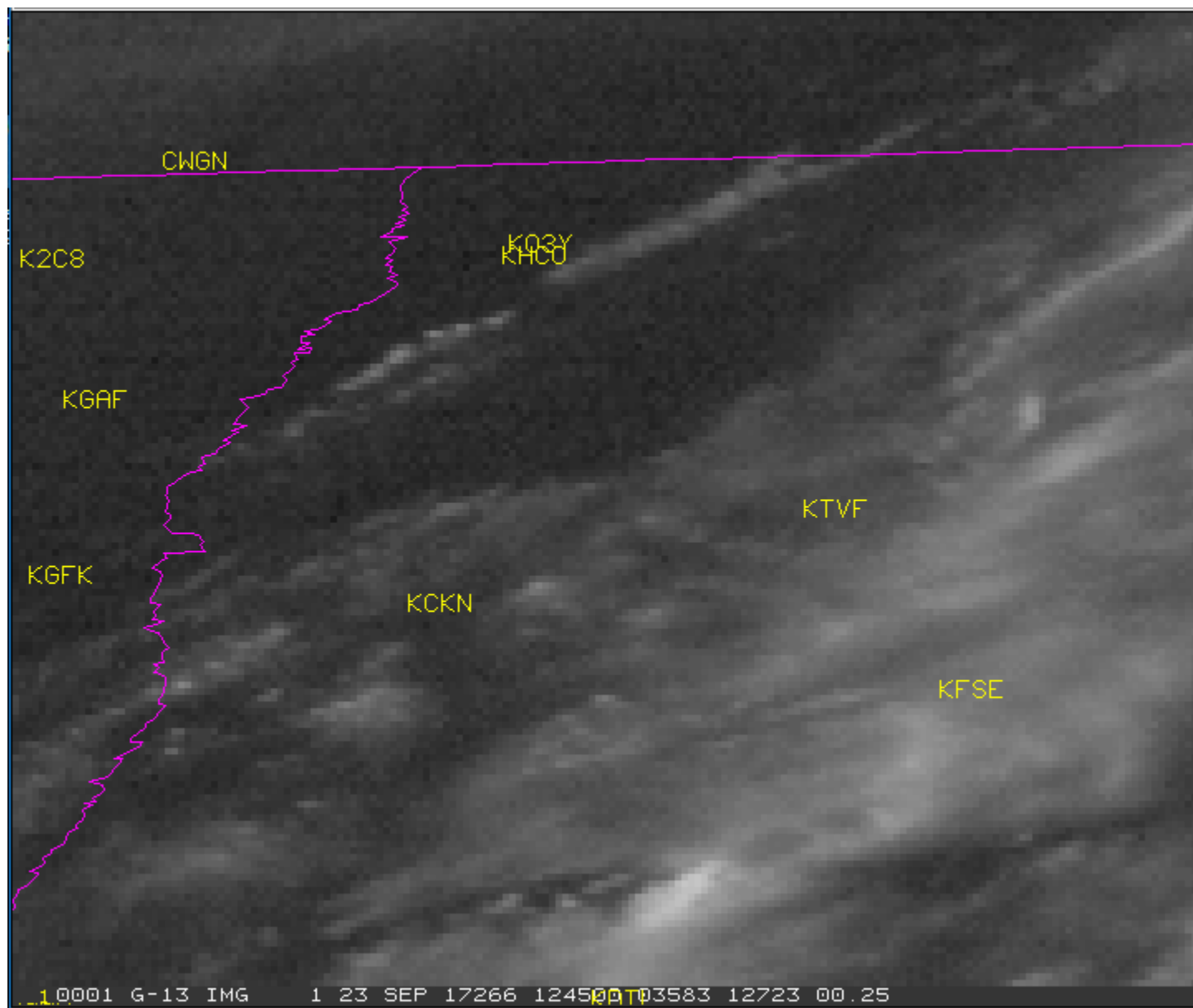
Upper air conditions – a High Resolution Rapid Refresh (HRRR) numerical model over the approximate accident site for 0700 CDT (1200Z) was obtained from the NWS Air Resource Laboratory and plotted on a Skew T log P diagram. The numerical model sounding indicated a lifted condensation level (LCL) and level of free convection at 425 feet agl approximating the cloud bases, with tops near 4,800 feet based on the layer had a relative humidity greater than 90%. The freezing level was identified at 14,400 feet. Two temperature inversions were noted between the 900 and 5,400 feet agl supporting low stratiform type clouds, the Lifted Index was +15.0 which also indicated a stable atmosphere. The expected surface temperature was 10.3° C (50° F), dew point of 9.3° C (49° F, with a relative humidity of 94%). The surface wind was from 330° at 10 knots with the wind veering to the north through 4,000 feet, and backed to the west with height through 12,000 feet. The mean 0 to 6 kilometer or 18,000 feet was from 250° at 27 knots..



METAR 231200Z AUTO 33010KT OVC006 10/09 01013

Satellite Imagery – the GOES-13 infrared and visible satellite imagery were reviewed. Below is the GOES-13 visible image at 4X magnification with a large area of low stratiform type clouds over northern Minnesota with a high band of clouds over the low stratus.

The infrared image depicted a radiative cloud top temperature of 247° Kelvin or -27° C over the accident site, which corresponded with cloud tops near 27,000 feet. Due to the low sun elevation, the low-level stratiform clouds extending over the area does not show the true extend and coverage. Later images shows a better view of the cloud coverage.



Pilot Reports – The following pilot reports or PIREPs were noted over the regions:

BIS UA /OV BIS220015/TM 1153/FL210/TP E75L/SK TOP180/TA 10/TB MOD CHOP 120-180/IC LGT RIME 120-180

NWS Forecasts and Advisories –

Terminal Aerodrome Forecast (TAF) issued by the NWS Weather Forecast Office in Grand Forks, ND during the period were as follows:

*KTVF 230944Z 2310/2406 32015KT P6SM BKN004
FM231200 32007KT P6SM OVC015*

FM231800 35009KT P6SM BKN020
FM240500 03008KT P6SM VCSH OVC015=

The forecast issued at 0444 CDT expected northwest winds from 320° of 15 knots, visibility unrestricted at 6 miles or more, with ceiling broken at 400 feet agl until 0800 CDT. Between 0800 and 1300 CDT, the winds were expected from 320° at 7 knots, visibility 6 miles or more, ceiling overcast at 1,500 feet agl, with MVFR conditions continuing after 1300 through 2400 CDT with ceilings broken to overcast at 1,500 to 2,000 feet. The forecast was updated at 0630 CDT, and was as follows:

KTVF 231130Z 2312/2412 33013KT P6SM OVC004
FM231600 34010KT P6SM OVC008
FM231800 34009KT P6SM OVC010
FM240000 02006KT P6SM VCSH OVC035
FM240800 03011KT P6SM -RA OVC008=

The forecast continued the LIFR conditions with an overcast ceiling of 400 feet agl through 1100 CDT, then lifted the ceiling to 800 feet until 1300 CDT. From 1300 through 1900 CDT the ceiling was expected to be 1,000 feet agl.

Area Forecast: for the route of flight was as follows:

FAUS43 KNCI 231015 AAA
FA3W

-CHIC FA 231015 AMD

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 240400

CLDS/WX VALID UNTIL 232200...OTLK VALID 232200-240400

ND SD NE KS MN IA MO WI LM LS MI LH IL IN KY

.

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...10Z CDFNT NERN MN-NERN NE-LOW PRES ECNTRL CO BECMG

STNR 18Z. HI PRES RDG NW PA-SRN IN-SE MO. 04Z STNR FNT FM LOW

PRES SW MN-NERN NE-NW KS-LOW PRES SE CO. WRMFNT SW MN-NERN MN-NRN

LS. HI PRES NW PA-KY-SE TX.

.

ND SD...UPDT

NW ND...OVC040 LYRD FL180. 12Z BKN060. OTLK...VFR 23Z MVFR CIG SHRA.

SW ND/NW SD...OVC035 LYRD FL200. 18Z SCT -SHRA. OTLK...IFR CIG SHRA BR.

NCNTRL ND...OVC025-030 LYRD FL250. 17Z OVC035-040. OTLK...VFR SHRA 00Z MVFR CIG SHRA.

SCNTRL ND/NCNTRL SD...OVC025-030 LYRD FL250. TIL 14Z SCT -SHRA. 21Z BKN045 SCT -SHRA. OTLK...MVFR CIG SHRA.

NERN ND...BKN020 OVC045 TOP 160. OCNL VIS 3-5SM BR. ISOL -SHRA. 14Z BKN025 OVC150 TOP FL250. 20Z BKN050.

OTLK...VFR 03Z MVFR CIG.

SE ND/NERN-SCNTRL SD...OVC020-030 TOP FL250. SCT -SHRA/SCT EMBD -TSRA. CB TOP FL450. 17Z OVC030. ISOL -SHRA. 20Z OVC030.

OTLK...MVFR CIG SHRA BR.

SW SD...OVC040-050 TOP FL250. SCT -SHRA. OTLK...IFR CIG SHRA.

SE SD...BKN020 BKN110 TOP FL250. ISOL -SHRA. 14Z BKN060 LYRD

FL250. 20Z WDLY SCT -TSRA. CB TOP FL450. OTLK...VFR TIL 00Z SHRA

TSRA.

.

NE

PNHDL...SCT050 BKN130 TOP FL220. WDLY SCT -SHRA. 11Z OVC050-060. 18Z VIS 5SM IN SCT -SHRA. OTLK...MVFR CIG SHRA.

NCNTRL...OVC035-045 TOP FL250. SCT EMBD -TSRA. CB TOP FL450. 15Z OVC040-050. SCT -SHRA. 18Z OVC035. VIS 5SM IN SCT -SHRA.

OTLK...IFR CIG RA BR.

SCNTRL...SCT045 BKN090 TOP FL250. SCT -TSRA. CB TOP FL450. 13Z SCT080 BKN120. ISOL -SHRA. 18Z BKN080. SCT -SHRA/-TSRA. CB TOP

FL400. OTLK...VFR SHRA TSRA 00Z MVFR CIG SHRA TSRA.

NERN...BKN CI. 16Z BKN140 TOP FL250. OTLK...VFR.

SE...SKC. 17Z WND S G25KT. OTLK...VFR TIL 01Z WND.

.

MN

NW...OVC020-025 LYRD 160. VIS 3SM BR. 14Z BKN025 OVC150 TOP FL250. ISOL -SHRA. 20Z BKN050. OTLK...VFR 03Z MVFR CIG.

NERN...OVC060-070 TOP FL250. SCT -SHRA. 16Z BKN050. SCT -SHRA. 21Z SCT -SHRA/-TSRA. CB TOP FL400. OTLK...VFR TSRA.

WCNTRL...BKN020 OVC080 TOP FL250. SCT-NMRS -SHRA/-TSRA. CB TOP FL390. OTLK...MVFR CIG.

ECNTRL...SKC. 13Z SCT050. 18Z OVC045. OTLK...VFR.

SW...SCT120 BKN CI. 20Z BKN040 LYRD FL250. SCT -SHRA/WDLY SCT -TSRA. CB TOP FL450. OTLK...MVFR CIG SHRA TSRA.

SE...SKC. OTLK...VFR.

.

IA

WRN...SKC. 16Z SKC. WND S G25KT. OTLK...VFR TIL 01Z WND.

ERN...SKC. 16Z SCT060. OTLK...VFR.

.

FAUS45 KPCI 231045

FA5W

-SLCC FA 231045

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 240500

CLDS/WX VALID UNTIL 232300...OTLK VALID 232300-240500

ID MT WY NV UT CO AZ NM

.

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...ALF..UPR LVL LOW PRES OVR ERN NV WITH TROF NWD TO WRN MT.

MOD STG JTST FM SERN AZ TO SERN MT. BY 21Z UPR LVL LOW PRES

NERN NV WITH JTST FM SERN AZ/SWRN NM TO NERN MT. 05Z UPR LVL LOW

PRES OVR NWRN UT WITH JTST SWRN AZ TO NERN MT. SFC..CDFNT SERN

CO-NWRN NM-NERN AZ-SWRN AZ. HI PRES ELSW. 05Z LOW PRES SERN COWxtl

WITH WRMFNT NRN AZ BECMG CDFNT NWRN CO TO SERN AZ.

.

WY

NW...

MTNS...OVC090-100 TOP 160. 18Z OVC110 TOP FL180. OTLK...MVFR CIG.

RMNDR NW...OVC070 TOP FL200. -RA. BECMG 1618 BKN070 TOP 160. OTLK...MVFR CIG.

SW...BKN120 TOP FL180. 22Z OVC100 TOP FL260. OTLK...VFR 02Z MVFR CIG SHRA TSRA BR.

NERN...OVC060 TOP FL180. SCT SHRA. 22Z OVC060 TOP FL240. VIS 3-5SM -RA R. OTLK...MVFR CIG RA BR.

SE...BKN080 TOP FL200. BECMG 1719 OVC080 TOP FL240. VIS 3-5SM -RA BR. OTLK...IFR CIG RA BR.

AIRMETs

WAUS43 KPCI 231012 AAA

WA3S

-CHIS WA 231012 AMD

AIRMET SIERRA UPDT 2 FOR IFR VALID UNTIL 231500

.

AIRMET IFR...ND SD NE

FROM 60NNE ISN TO 70NE MOT TO 30SSE BIS TO 30NNE PIR TO 70SSE RAP TO 70SW RAP TO 30WSW ISN TO 60NNE ISN
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z THRU 21Z.

.

AIRMET IFR...LM MI LH IN

FROM 20N TVC TO 30SE ECK TO DXO TO FWA TO 40WSW ROD TO BVT TO 30WSW GIJ TO GRR TO 20N TVC
VIS BLW 3SM BR. CONDS ENDG 12-15Z.

.

AIRMET IFR...MO IL IN KY TN

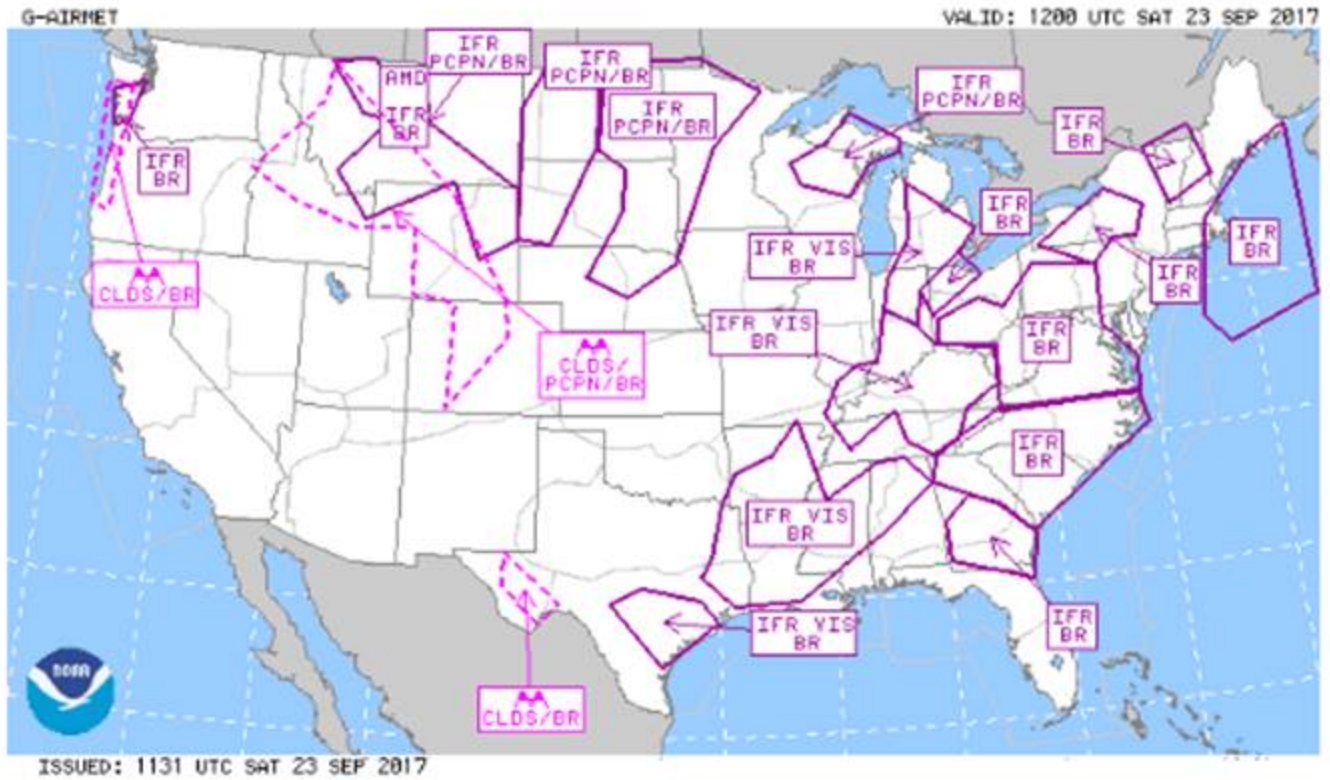
FROM BVT TO 40WSW ROD TO CVG TO HNN TO 50WSW BKW TO 40SE LOZ TO 30SSW VXV TO GQO TO 30SSE BNA TO
20WSW BWG TO 30SSE DYC TO 50S
FAM TO 40ENE FAM TO TTH TO BVT
CIG BLW 010/VIS BLW 3SM BR. CONDS ENDG 12-15Z.

.

AIRMET IFR...ND SD NE MN IA...UPDT

**FROM 90ESE YWG TO 60ESE INL TO 20W BRD TO 60SW BRD TO 30E FSD TO 60NNW OVR TO 20WSW OBH TO 30NE
MCK TO 50NNW LBF TO 20NNE PIR TO
40SSE BIS TO 70NE MOT TO 90ESE YWG
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 15Z ENDG 15-18Z.**

SIERRA 2017-09-23 12:00:00



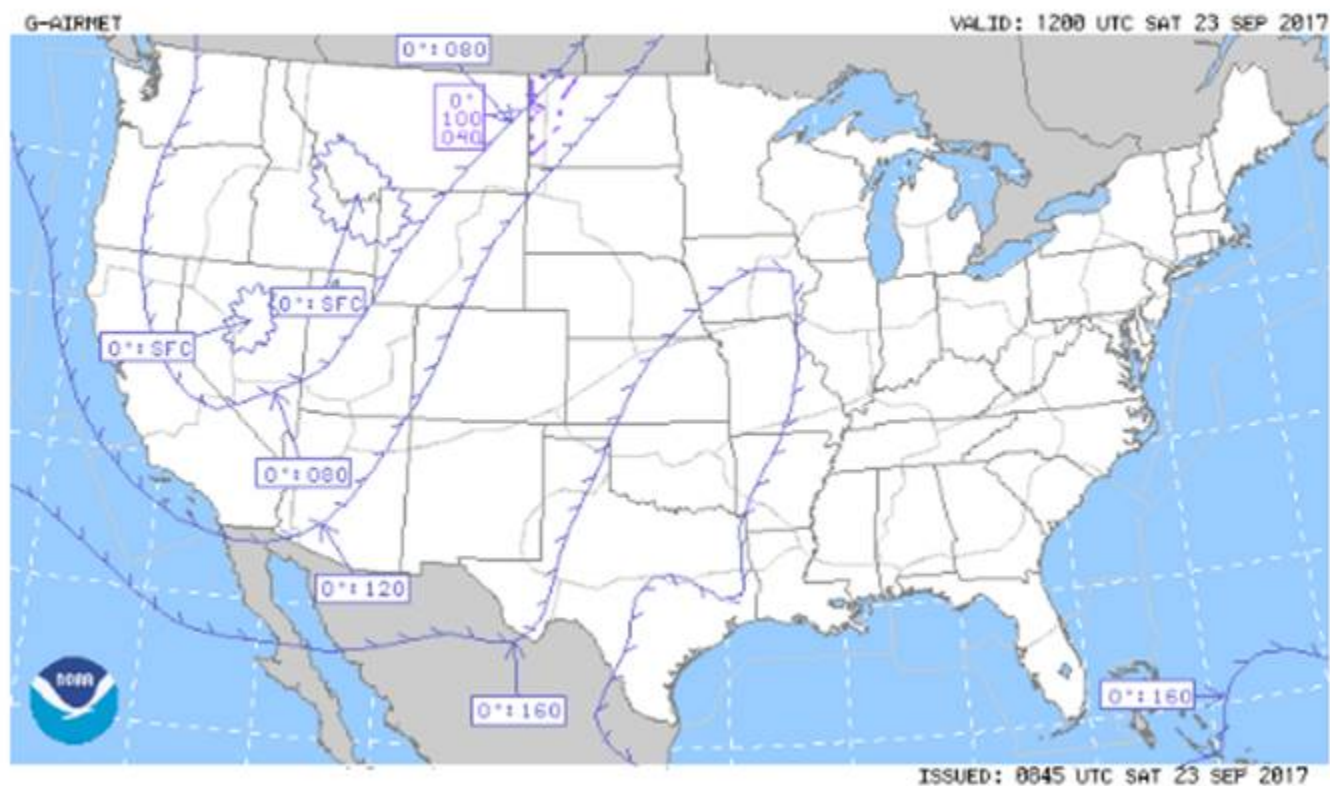
TANGO 2017-09-23 12:00:00



ZULU 2017-09-23 12:00:00



FREEZING LEVEL 2017-09-23 12:00:00



Convective SIGMETs current at the time:

chart created at 1155 UTC Sat 23 Sep 2017
SIGMETs expire at or before 1355z/23rd



Center Weather Advisories (CWA): The Minneapolis CWSU issued an advisory after the accident for convective development only.

FAUS21 KZMP 231519
ZMP CWA 101 VALID UNTIL 231600
FROM 55WNW FSD-25NNE ONL-5NNW ONL
DVLPG LINE TS WITH MOD/HVY RAIN 100NM WIDE. MOV FROM 20040KT. TOPS TO FL380.

Winds and Temperature Aloft Forecast (FD)

WINDS ALOFT FORECASTS
DATA BASED ON 230600Z
VALID 231200Z FOR USE 0800-1500Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
GFK	0121	3118+12	2316+10	2537+03	2351-10	2257-22	227337	228849	239958
ABR	0522	2312+13	2338+10	2338+04	2142-09	2156-20	236737	237147	237757
PIR		0909+11	2320+09	2232+05	2143-10	2160-21	228137	228947	228757
RAP		0413+04	1412+06	2019+02	2255-12	2171-23	219038	219547	710056
LND			9900-01	1928-03	1948-17	2054-28	218242	700248	219853
RKS			1011	1925-02	2048-17	2066-27	209541	700948	710753

Weather Briefing – a search of FAA contract FSS provider Leidos and Direct User Access Terminal System (DUATS) revealed that the pilot did not obtain any formal weather briefing for the flight on September 22-23, 2017. Therefore it is unknown what weather information and advisories the pilot was aware of prior to departure.

Astronomical Conditions – based on the United States Naval Observatory for Thief River Falls, Pennington County, MN:

Beginning civil twilight	0642 CDT
Sunrise	0713 CDT
Sunset	1920 CDT
End civil twilight	1951 CDT

At the approximate time of the accident the Sun was 4.6° above the horizon at an azimuth of 95°.

Don Eick
NTSB Senior Meteorologist