DEDICATED TO HELPING BUSINESS ACHIEVE ITS HIGHEST GOALS.

NBAA

Forecast Applications of AMDAR by Airlines and the National Weather Service

Kory Gempler – FEDEX
Richard Mamrosh – NWS

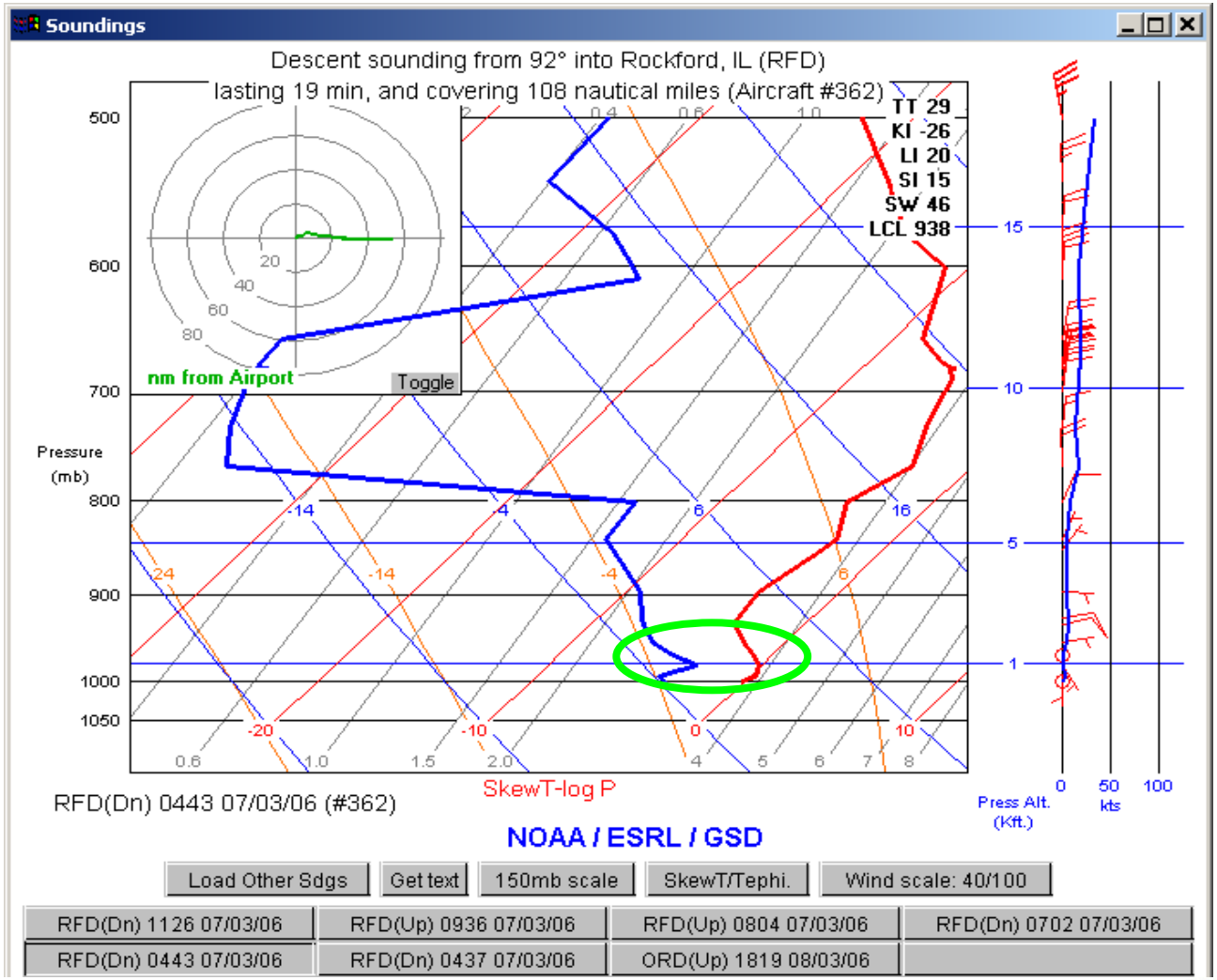
A4A Meteorology Work Group
Aircraft-Derived Meteorological Information

Kory Gempler
FedEx Meteorology
2015 A4A Meteorology Work Group Chairman
FPAW – November 19, 2015

UPS AMDAR Business Model

- **Whatever sensors are added to aircraft must:**
  - **Have low weight**
  - **Have low cost**
  - **Have no risk of grounding the aircraft**
- **Increasing Data/Increasing Air-Ground communications costs must be offset by third party.**
- **Shared Airline Data Agreement through ERSL/GSD (**NOAA Earth System Research Laboratory *Global Systems Division)* *http://amdar.noaa.gov/java/*

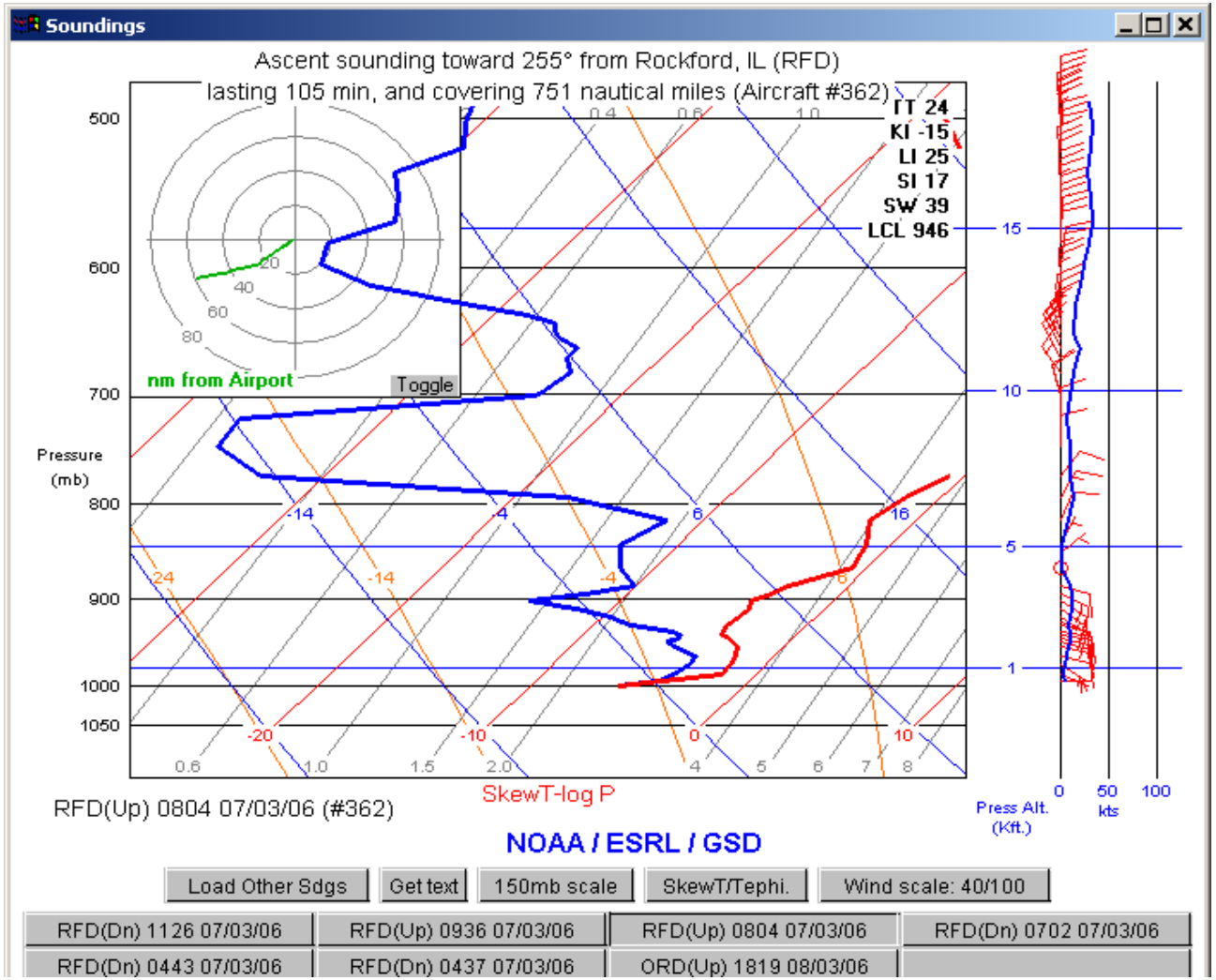
Fog Forecasting



-Moisture Increasing with Height

-Inversion/Light Winds

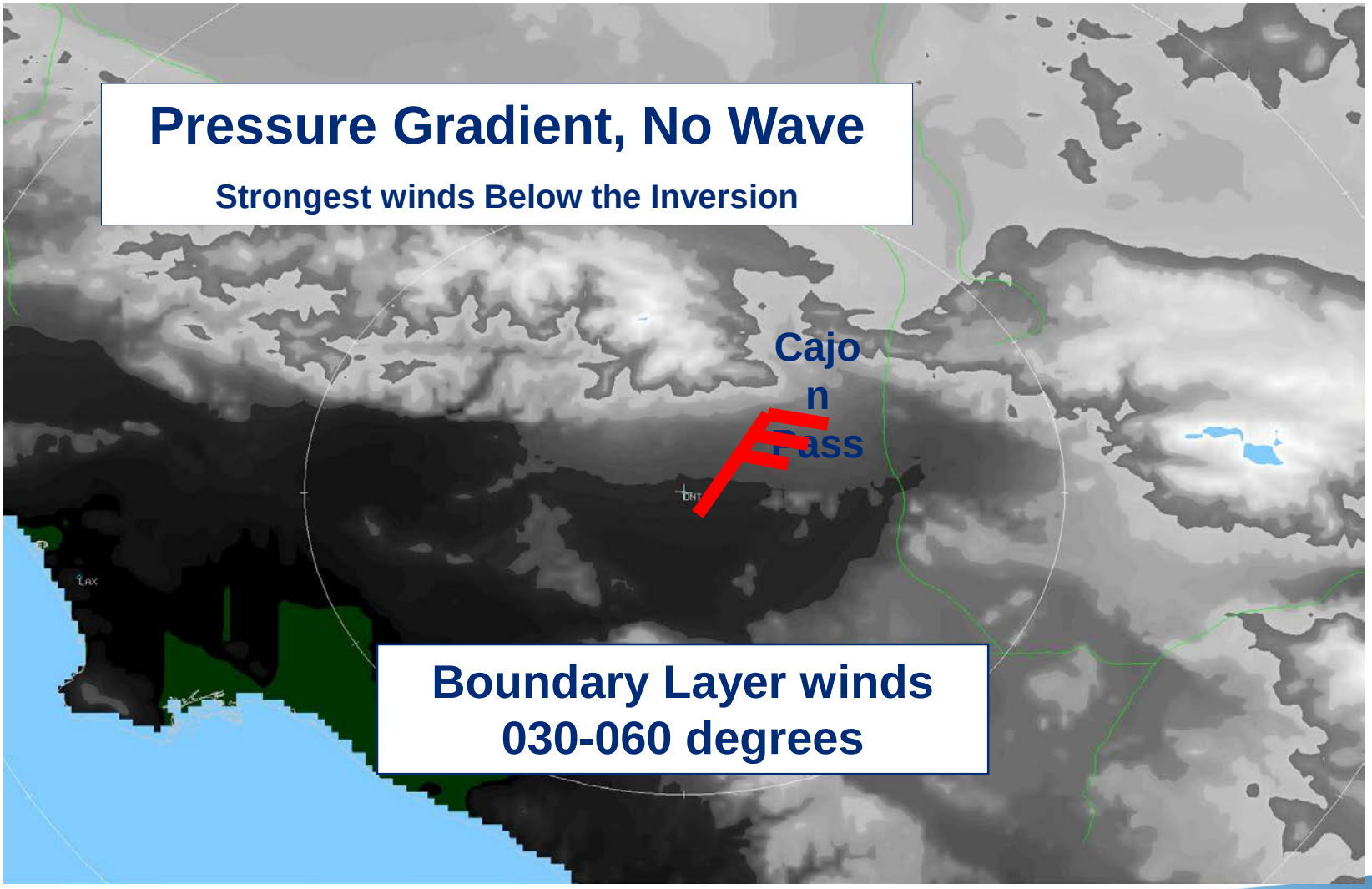
Fog Forecasting

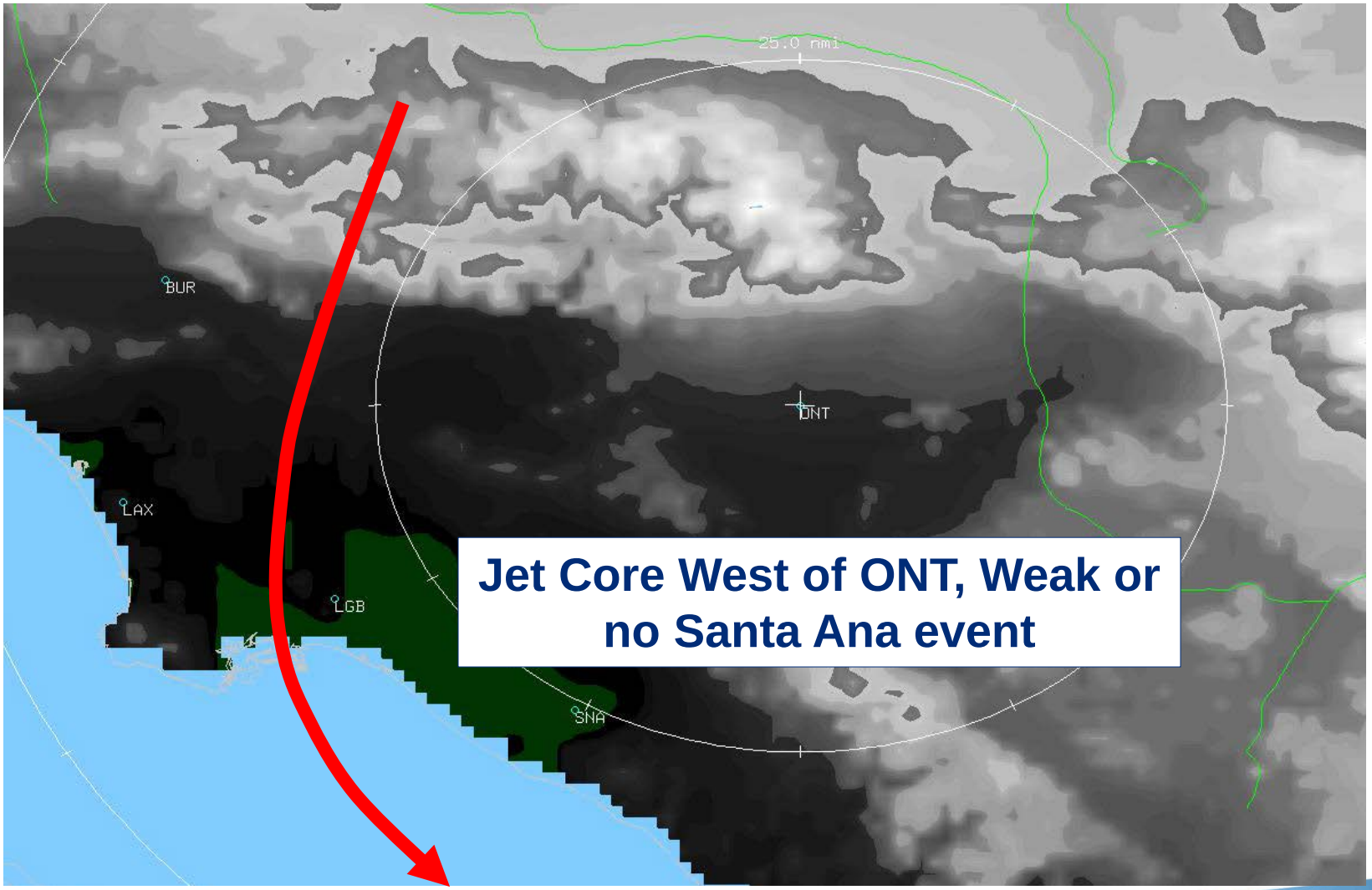


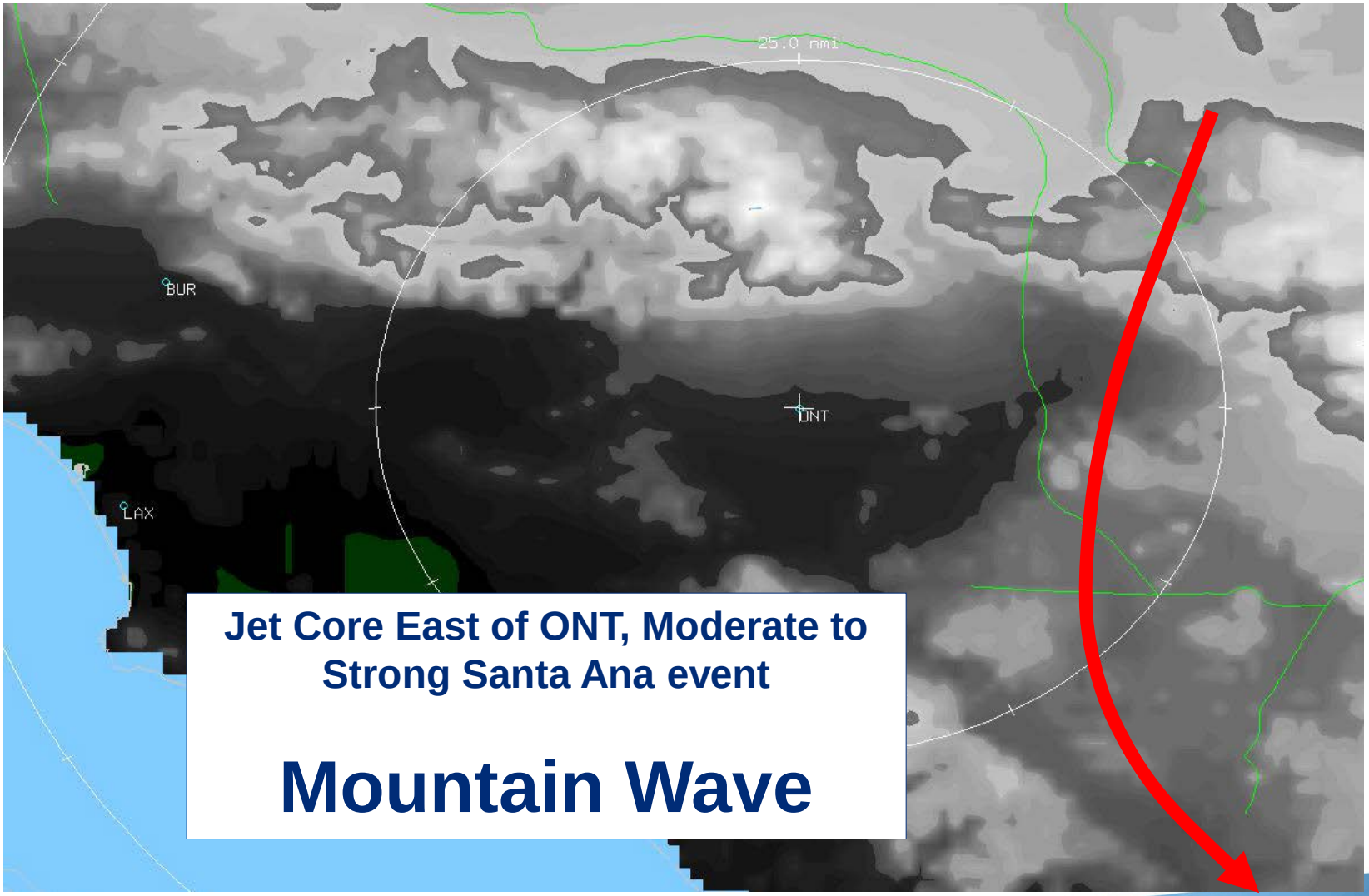
3 hours later…

0812z RVR 1000-2800

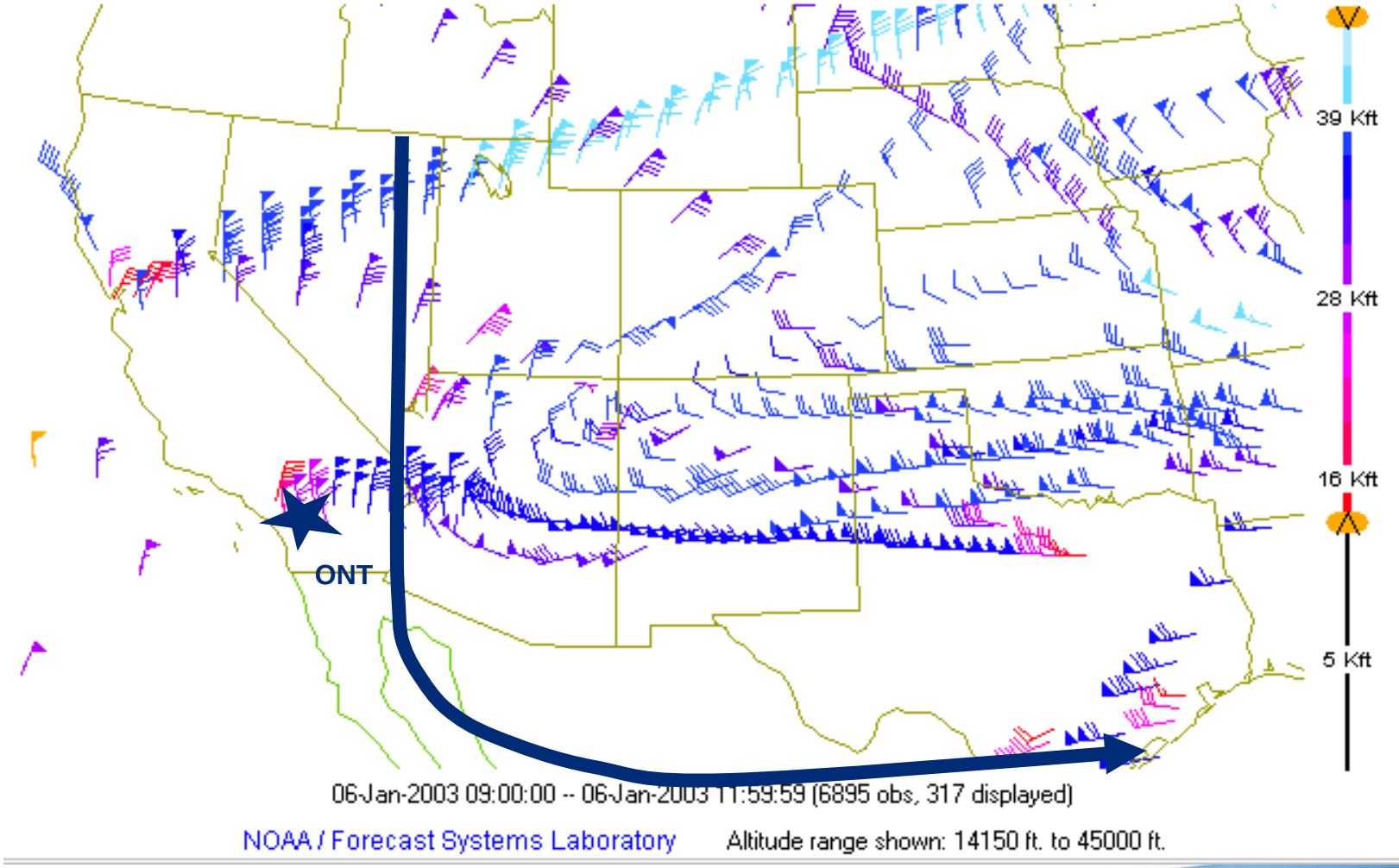
1254z RVR 600-1000


Pressure Gradient, No Wave
Strongest winds Below the Inversion
Cajon Pass
Boundary Layer winds
030-060 degrees


25.0 nmi
BUR
ONT
LAX
LGB
SNA
Jet Core West of ONT, Weak or no Santa Ana event

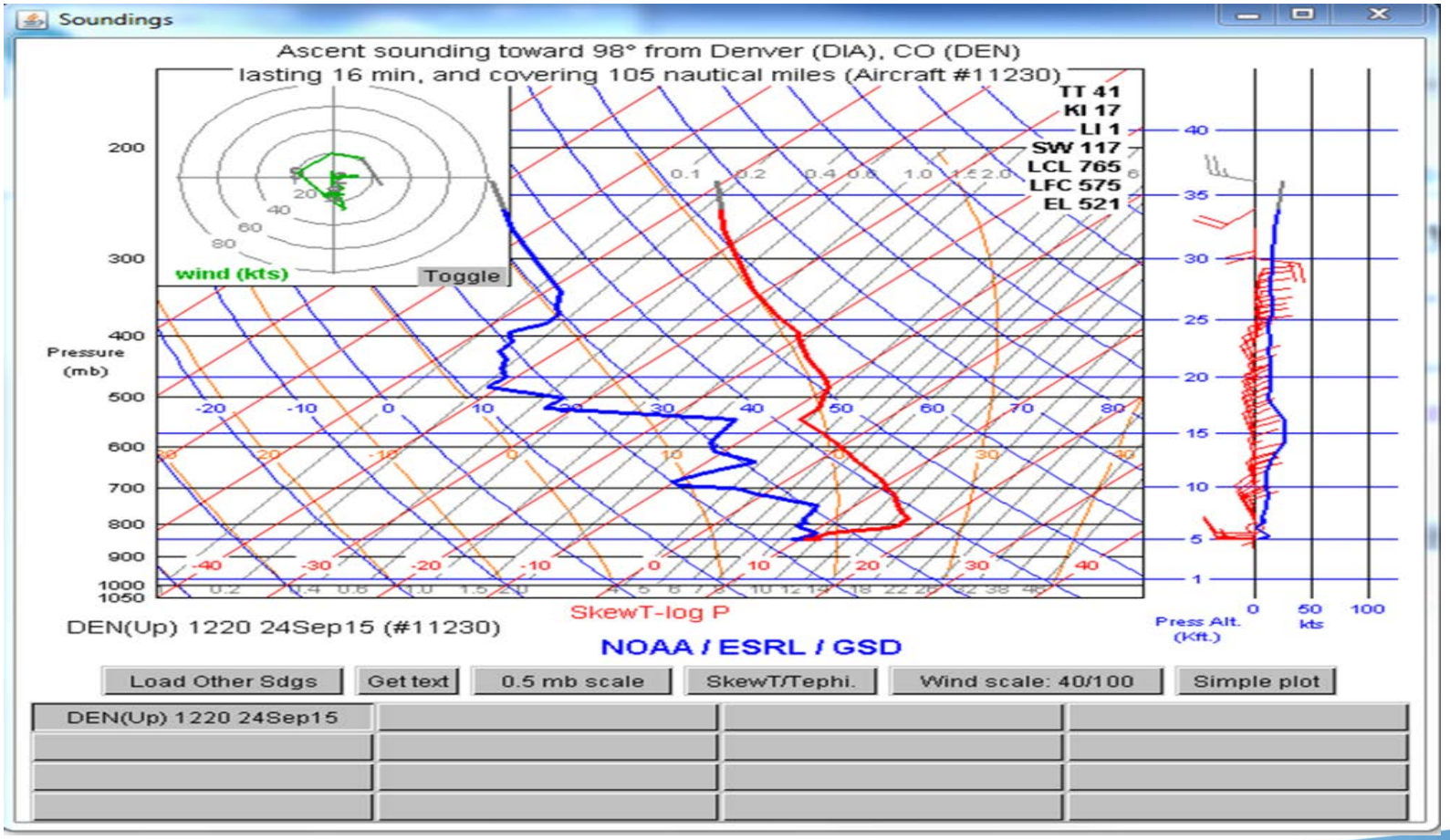

25.0 nmi
BUR
ONT
LAX
Jet Core East of ONT, Moderate to Strong Santa Ana event
Mountain Wave

Santa Ana Winds G78KT

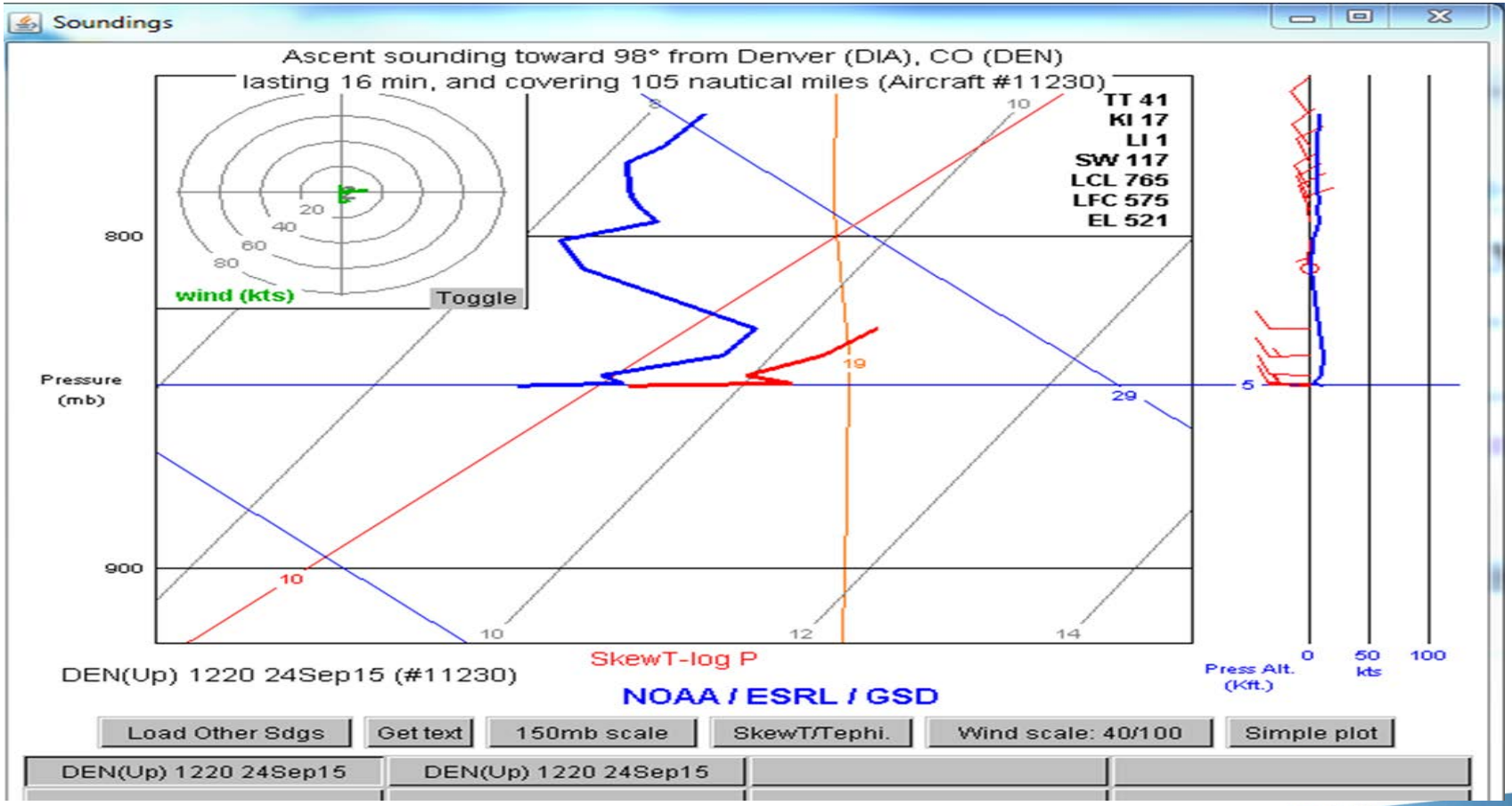


Southwest Airlines Examples

Denver Fog Sept. 24, 2015



A cool feature of AMDAR is the ability to zoom in over an area on the sounding. This zoom in suggests that the temp/dewpoint spread may be a few degrees different enough to keep the fog out



Denver Fog Event

Observations at the airport help to confirm that as well, with a 3 degree spread in the latest METAR, with a few cloud decks.

KDEN 241301Z 27009KT 10SM FEW220 12/09 A3028 RMK AO2 T01170094

KDEN 241253Z 26009KT 10SM VCFG FEW010 FEW220 12/09 A3028 RMK AO2 SLP197 VIS LWR NW-NE T01170094

KDEN 241153Z 26006KT 10SM VCFG CLR 11/09 A3027 RMK AO2 SLP183 VIS LWR NW-N T01110089 10183 20111 53016

KDEN 241053Z 26006KT 10SM CLR 12/08 A3024 RMK AO2 SLP170 T01170083

FM241500 28006KT P6SM FEW025

FM241800 07010KT P6SM FEW120 SCT220

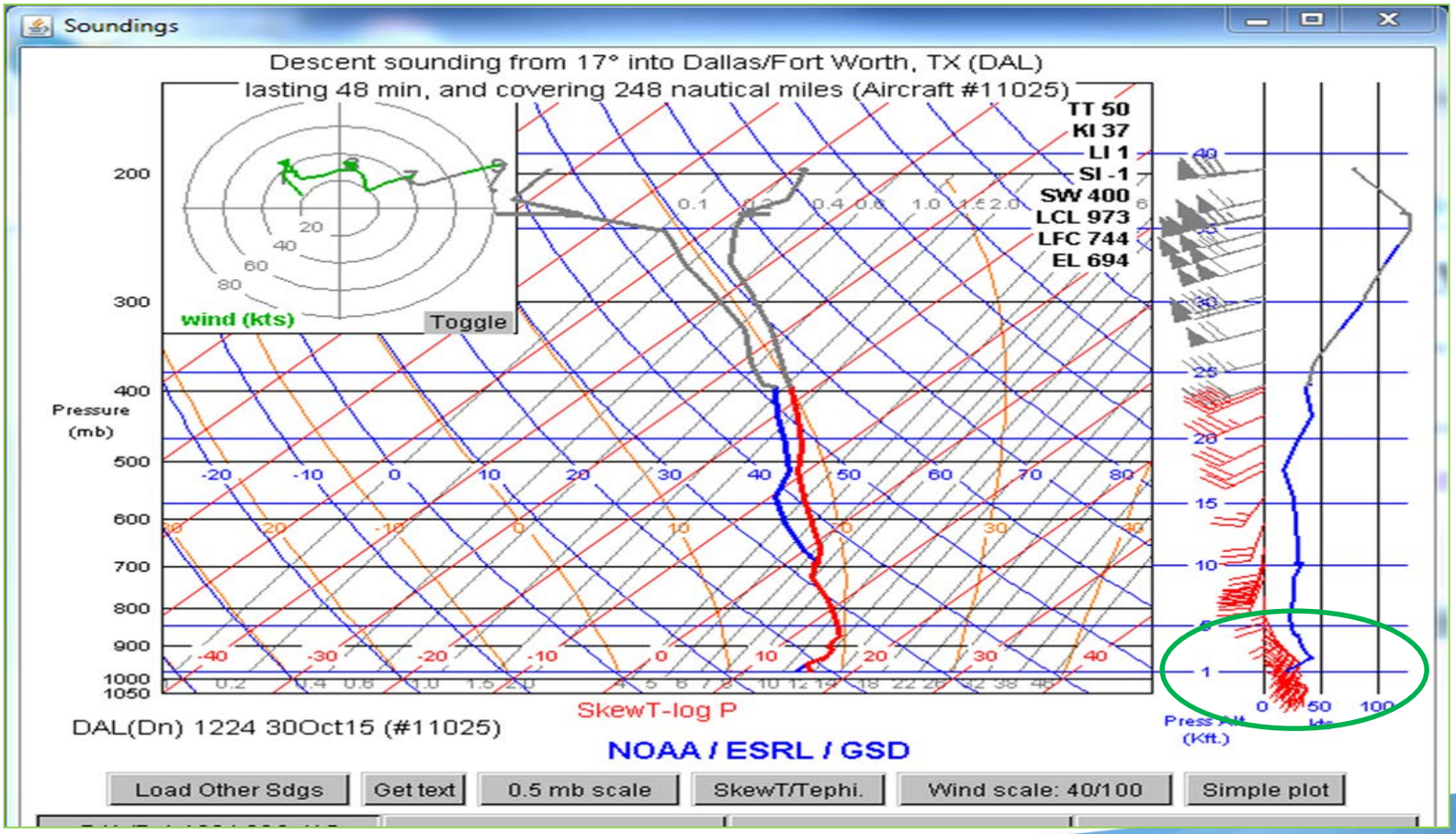
FM250200 15008KT P6SM SCT220

FM250700 20008KT P6SM FEW220

FM251400 VRB05KT P6SM SKC

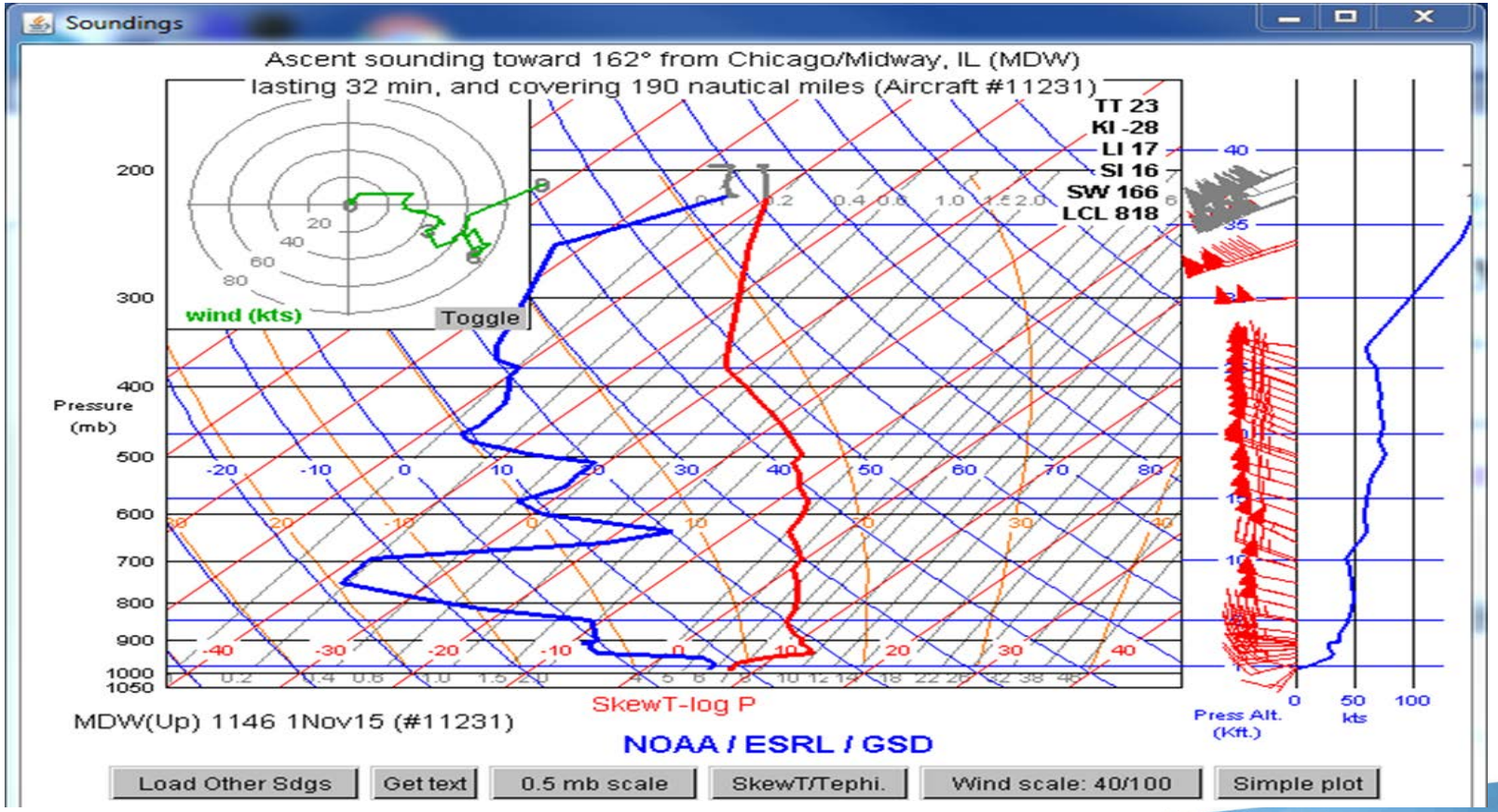
Example from Oct. 30, 2015

DAL today has pretty decent LLWS, as indicated by AMDAR:



Example from Nov. 1, 2015

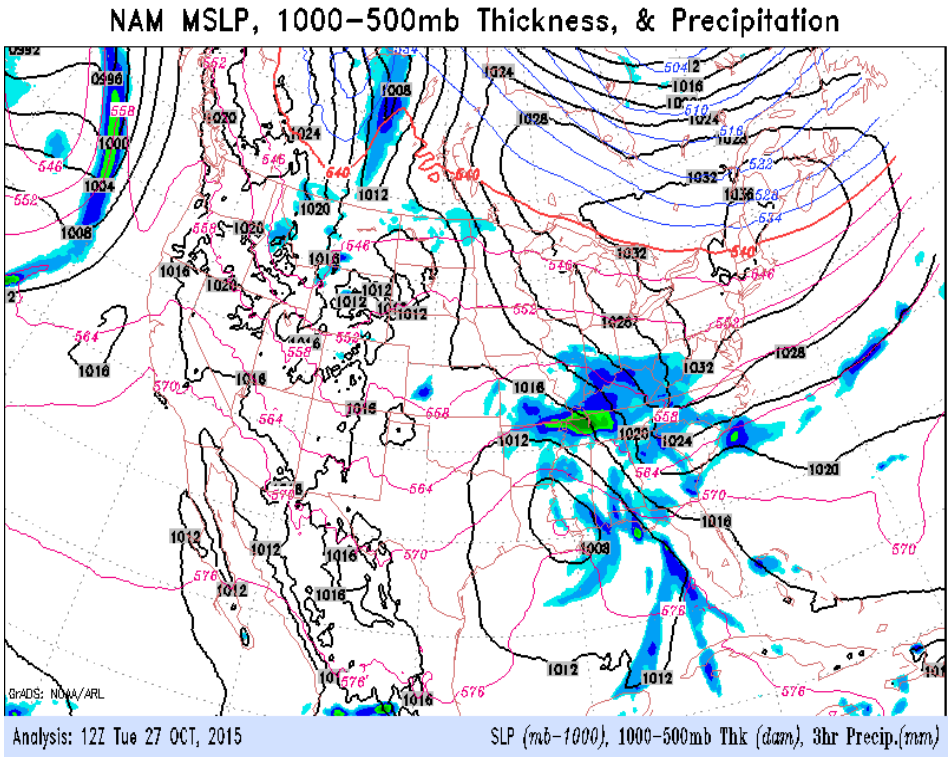
Strong LLWS around MDW once again today, supported by AMDAR. There is a SIGMET also valid for the MDW area for moderate turbulence between FL 240 and 370.



National Weather Service

- The National Weather Service appreciates the long time cooperation with the airline industry that provides an ever increasing amount of upper air data.
- AMDAR data improve the numerical weather prediction models used by the public and private sector, and are used directly by meteorologists to improve weather forecasts and warnings.

NWS Numerical Weather Prediction



- AMDAR is one of the most valuable data sources for numerical weather prediction.
- It provides upper air data from areas without weather balloon soundings, and important wind data from over the data sparse oceans.

NWS Numerical Weather Prediction

- NOAA HRRR/RAP weather model is the **backbone for most aviation hazard guidance products** for 1-18h duration, including
  - G2G-turbulence, FIP-icing
  - Upper-level (and terminal approach lower-troposphere winds
  - Ceiling/visibility, Terminal forecasts

- Skill of NOAA's regional RAP/HRRR/NAM models is strongly dependent on high-quality hourly observations over the US and North America.
  - Aircraft observations are the single most important observation source for 1-12h forecasts over the United States

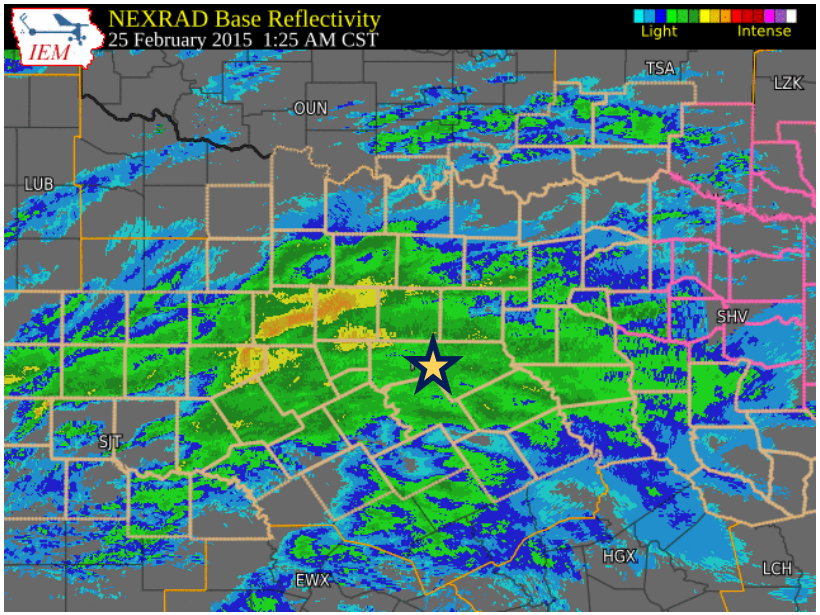
Source – Stan Benjamin Chief ESRL Modeling Branch

NWS Forecast Applications

- NWS meteorologists use AMDAR to help forecast
  - Precipitation Type
  - Convection
  - Ceiling and Visibility
  - Icing and Wind Shear
  - Marine Weather
  - Fire Weather
  - High and Low Temperatures

Rain Changing to Snow in DFW Area

An upper level disturbance produced light rain across north Texas during the early morning hours of February 25, 2015. A mild layer of air a few thousand feet above the ground would need to cool below freezing for snow to fall.

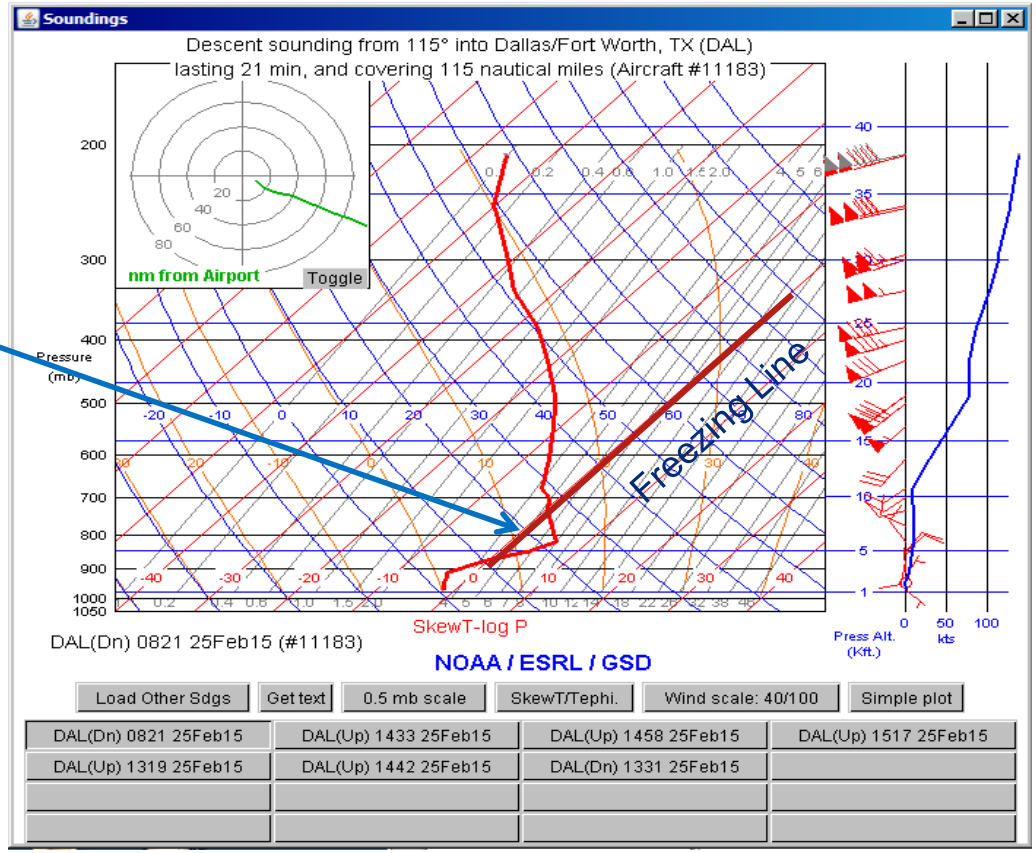


- NWS meteorologists in Fort Worth used AMDAR data to determine when the rain would change to snow.
- They mentioned it's use in several forecast discussions as the primary source of data in forecasting the change of rain to snow.

Rain Changing to Snow in DFW Area

AREA FORECAST DISCUSSION
NWS FORT WORTH TX
415 AM CST WED FEB 25 2015

A 09Z **AIRCRAFT** SOUNDING SHOWED A LAYER OF WARM AIR OF PLUS 5 DEG C AT ABOUT 5,000 FEET ABOVE GROUND LEVEL.



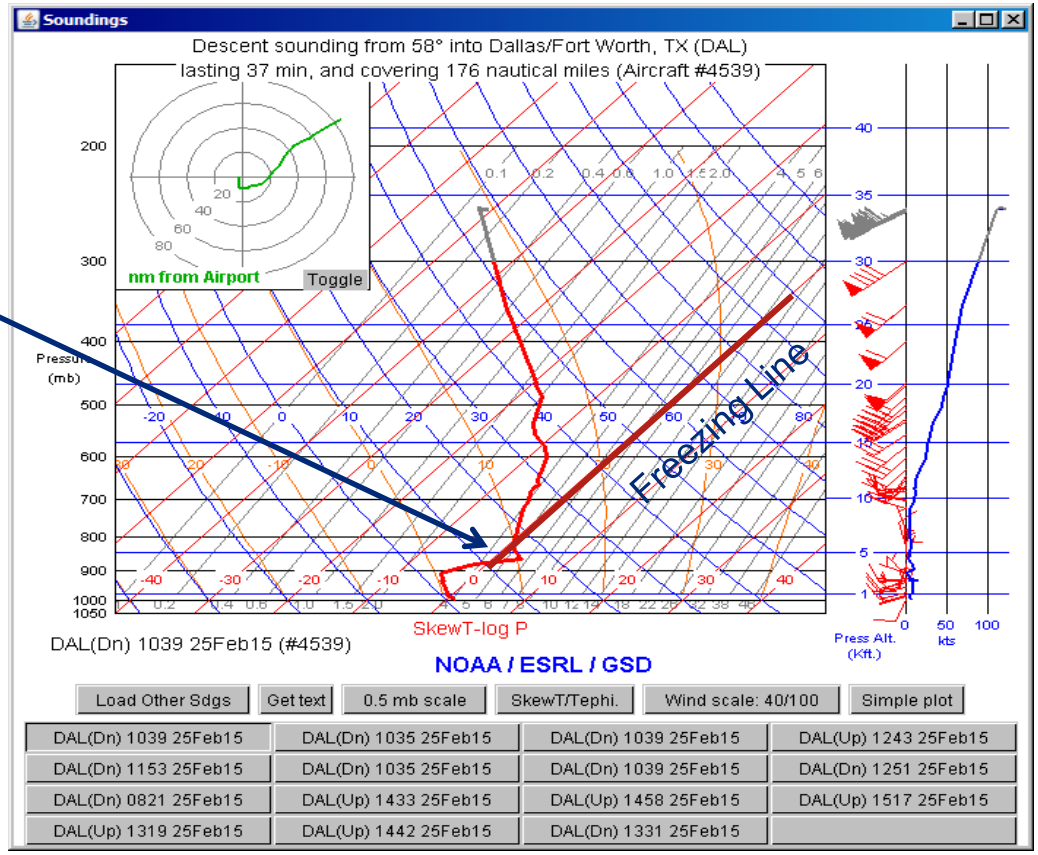
KDAL 250853Z 13005KT 2 1/2SM -RA BR SCT006 BKN012 OVC075 01/M01 A2997

Rain Changing to Snow in DFW Area

AREA FORECAST DISCUSSION
NWS FORT WORTH TX
557 AM CST WED FEB 25 2015

EARLY MORNING AIRCRAFT DATA HAVE BEEN INDICATING A COOLING OF THE WARM AIR ALOFT. IF THIS TREND CONTINUES...A TRANSITION FROM RAIN TO SNOW WOULD OCCUR OVER THE DFW AREA IN THE 6 TO 7 AM TIMEFRAME.

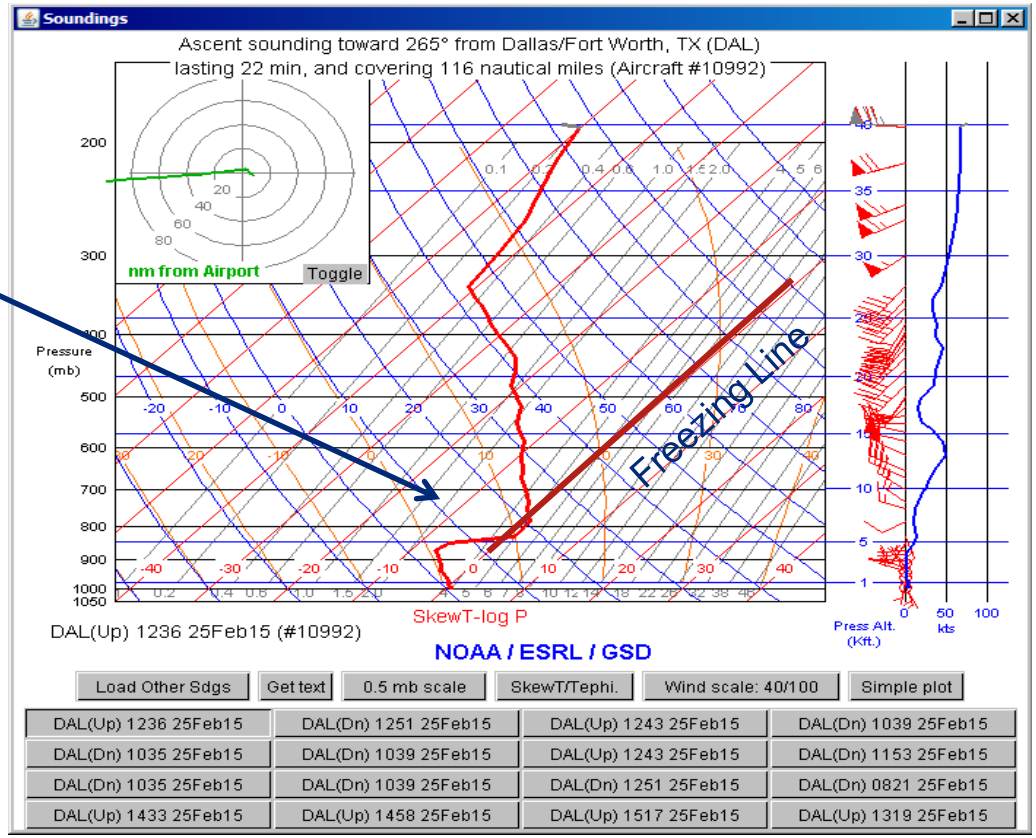
WE WILL CONTINUE TO MONITOR AIRCRAFT DATA THIS MORNING AS THIS WILL DETERMINE WHEN RAINFALL WILL CHANGE OVER TO SNOW.



KDAL 250953Z 19004KT 2SM RA BR BKN007 OVC012 01/00 A2995

Rain Changing to Snow in DFW Area

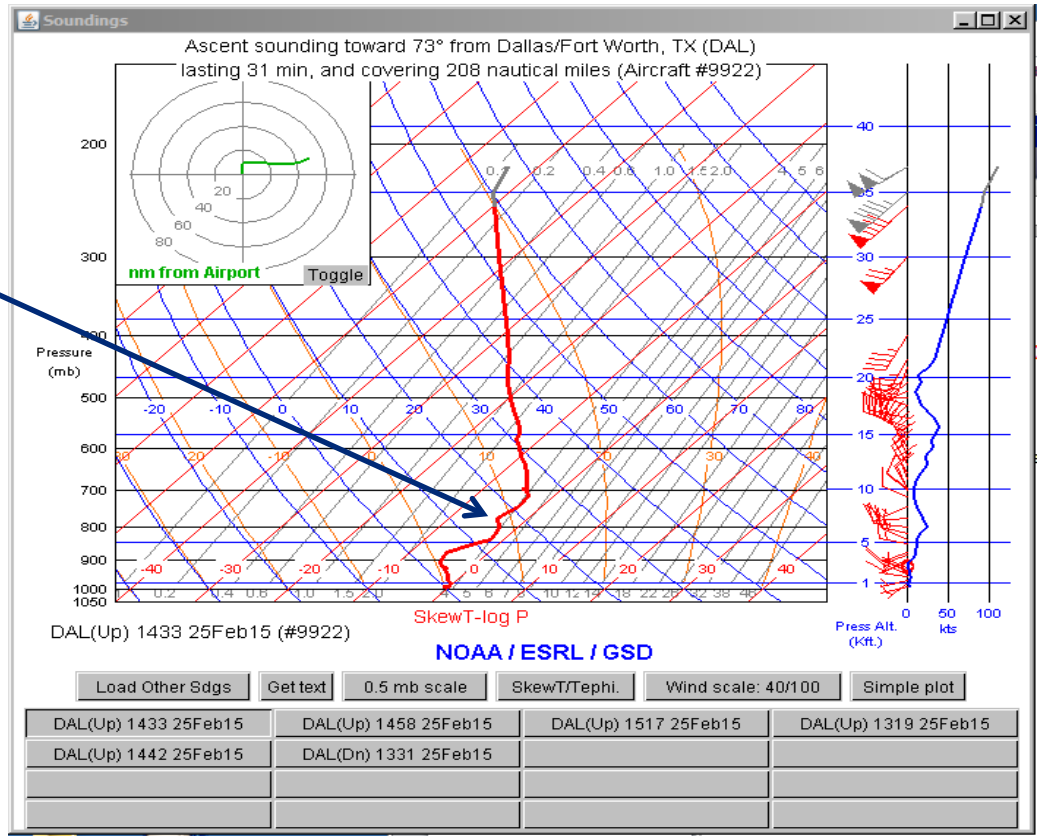
- This AMDAR sounding from 1235Z shows that the above freezing layer was nearly gone.
- The rain changed over to sleet around this time.



KDAL 251253Z 17003KT 1 3/4SM PL BR BKN007 BKN012 OVC018 01/00 A2994

Rain Changing to Snow in DFW Area

- This sounding from 1433Z shows that the atmosphere is entirely below freezing.
- Light to moderate snow was falling at this time.



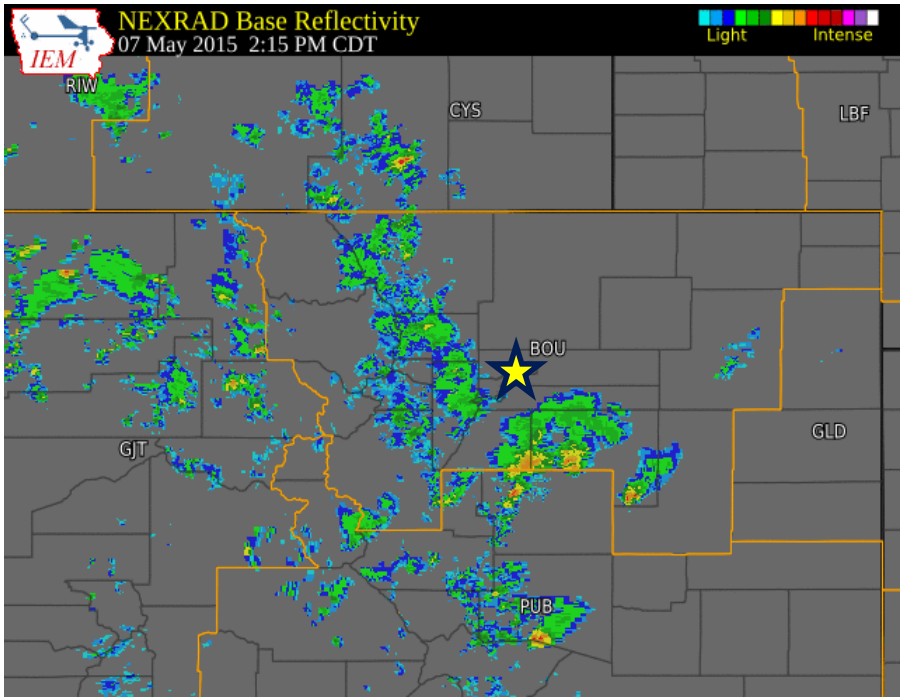
KDAL 251502Z 34003KT 1/2SM R13L/4500V5000FT SN FG OVC003 01/00 A2995

Rain Changing to Snow in DFW Area

- Airlines that provide AMDAR soundings help NWS meteorologists make better forecasts by providing important above ground data.

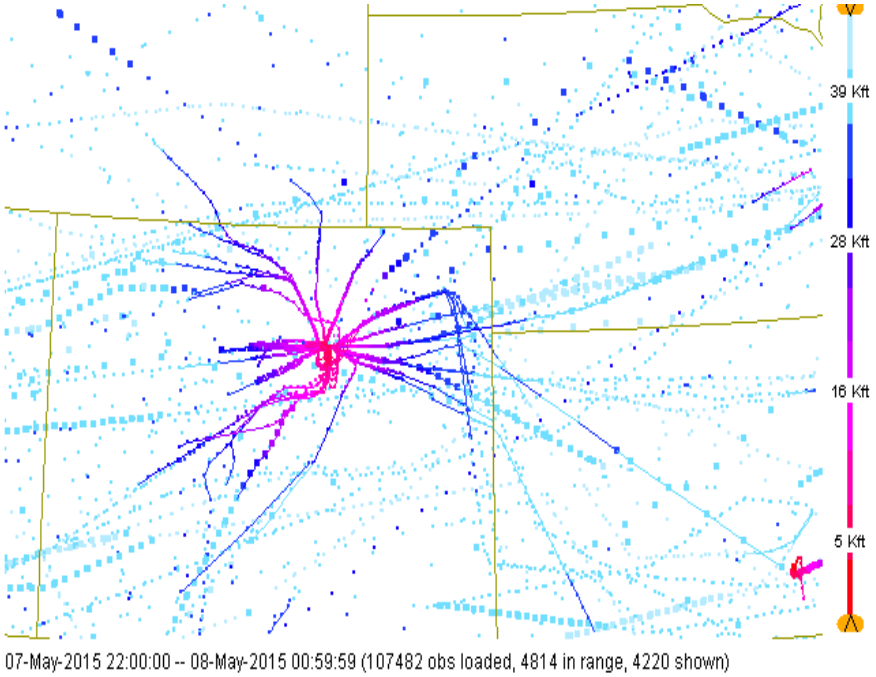
Front Range Thunderstorms

- NWS Meteorologists in Boulder were monitoring showers along the Front Range the afternoon of May 7, 2015.
- There are thunderstorms along the Palmer Divide between Denver and Colorado Springs, but will thunderstorms disrupt traffic at DIA, BJC, APA that evening?



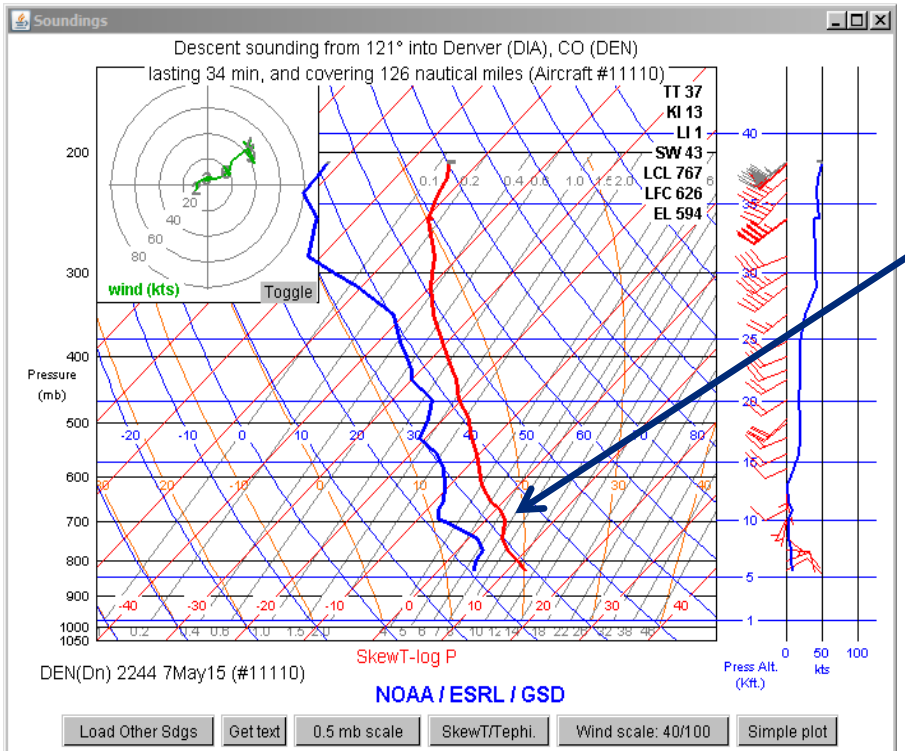
Two hour radar loop through 4pm shows showers over the foothills and Thunderstorms over the Palmer Divide.

Front Range Thunderstorms



- **Flight tracks from AMDAR web page shows abundant soundings from the Denver area during the late afternoon.**
- **These AMDAR soundings are referenced in NWS forecast discussion during the late afternoon.**

Front Range Thunderstorms



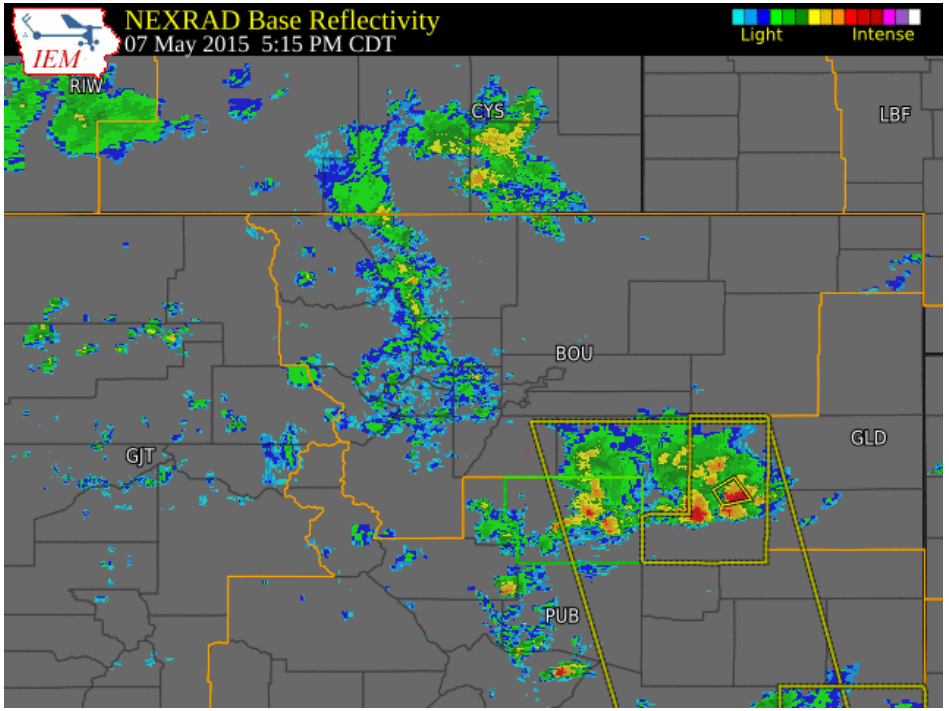
.AVIATION...(FOR THE TAFS THROUGH 00Z FRIDAY LATE AFTERNOON)
ISSUED AT 457 PM MDT THU MAY 7 2015

LATEST ACARS SOUNDINGS SHOW AIRMASS IS STILL CAPPED OVER THE TERMINALS BUT THE INVERSION HAS WEAKENED SOME OVER THE LAST 1-2 HOURS. CONTINUE TO DELAY CHANCES OF THUNDER NOW UNTIL BETWEEN 00-01Z AS STILL THINK SHOWERS WILL BEGIN TO INCREASE WITH SHALLOW UPSLOPE FLOW…

AMDAR sounding at 2244Z May 7, 2015 shows capping inversion around 10,000’ MSL inhibiting thunderstorms.

Front Range Thunderstorms

- NWS Meteorologists correctly decided to delay the chance of thunderstorms for the Denver area airports until after 01Z.
- Loop to the right shows that thunderstorms have stayed out of the Denver area through 7 PM.
- Soundings after 01z showed the capping inversion had diminished, and scattered thunderstorms did form in the Denver area.
- **AMDAR soundings provided important information needed to determine whether the atmosphere is conducive to convection**.



Two hour radar loop through 7pm shows showers over the foothills and Thunderstorms over the Palmer Divide.

Questions or Comments???

Kory Gempler
FEDEX Meteorology
kjgempler@fedex.com

Richard Mamrosh
National Weather Service
richard.mamrosh@noaa.gov