



**NTSB** National Transportation Safety Board

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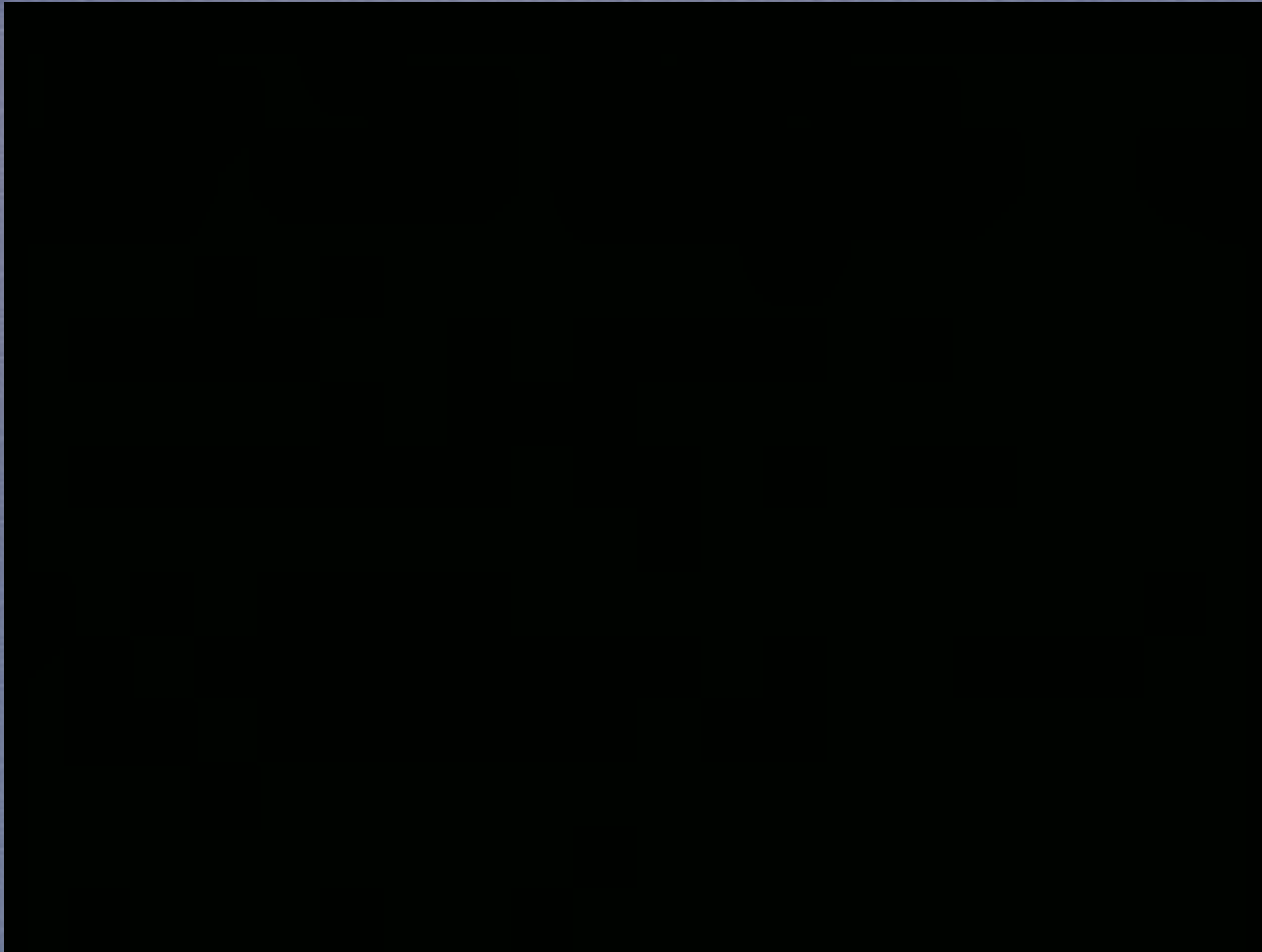
*Office of Aviation Safety*

# **Friends and Partners in Aviation Weather (FPAW)**

Donald Eick

NTSB Senior Meteorologist

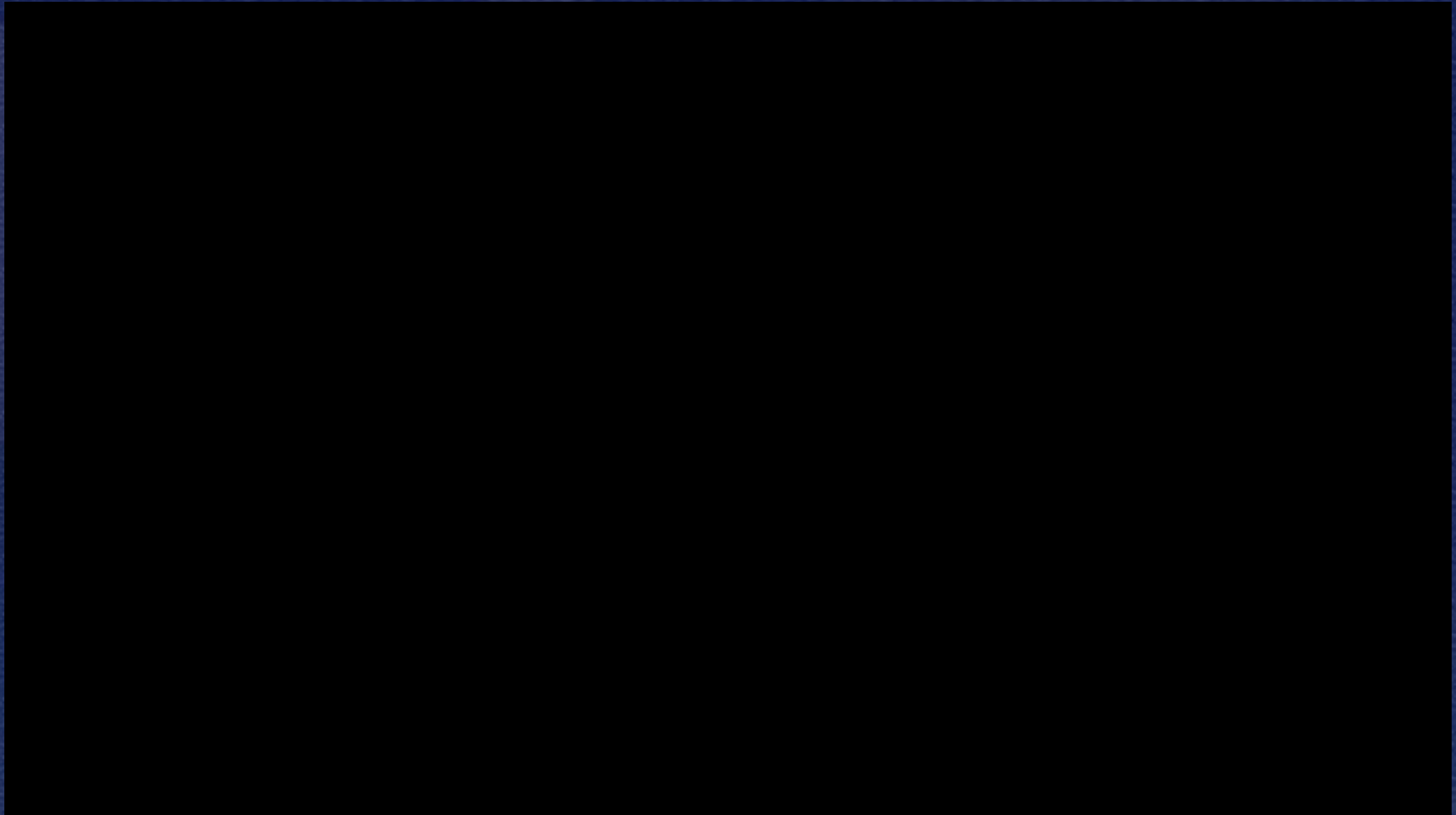
*Please silence all cell phones  
or else!*



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# NTSB Chairmen Christopher Hart





# Topics

- How are we doing?
- NTSB 2014 accident data
- Turbulence/Thunderstorms
- 2013 UPS Accident BHM Weather Recommendations
- Icing events

# NTSB 2014 - Accident Statistics

- 1,287 accidents
- 261 fatal accidents
- 439 total fatalities
- Part 121 – 16 accidents, no hull loses
- Part 91 - General Aviation accounted for 95% of all fatal accidents but only 51% flight hours
  - Accident rate 6.74 per 100,000 hours (^ 6.26)
- *Weather related events account for a high percentage of the accidents and one of the highest fatality rate!*



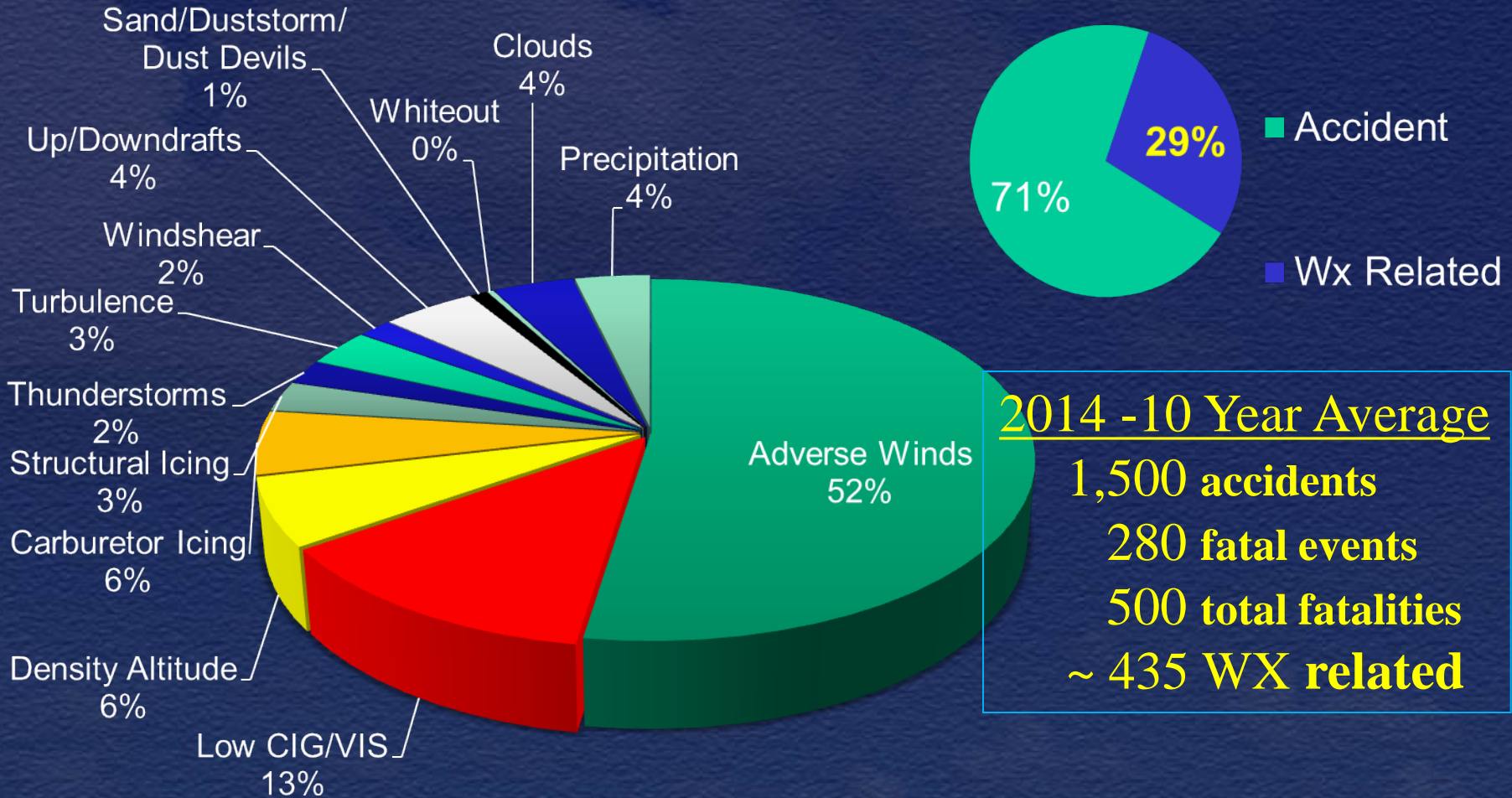
# Defining Fatal Accident Events

In 2008 NTSB began using the Commercial Aviation Safety Team (CAST) descriptions for classifying accidents:

- *Loss of Control (LOC) in flight/ground (~38% wx)*
  - *Adverse winds*
  - *Spatial Disorientation*
  - *Thunderstorms*
  - *In-flight icing*
- *System/component failure – Powerplant*
  - *Carburetor icing major contributing cause*
- *Controlled Flight Into Terrain (CFIT)*
  - *Low ceilings & visibility?*
- *Collision with terrain/object*
- *VFR encounter with IMC*
- *System/component failure – Non-Powerplant*

# Part 91 – Weather As Cause/Factor period 2000-2011

19,441 Accidents







# NTSB MOST WANTED LIST OF TRANSPORTATION SAFETY IMPROVEMENTS 2015

CRITICAL CHANGES NEEDED TO REDUCE TRANSPORTATION ACCIDENTS AND SAVE LIVES

## PREVENT LOSS OF CONTROL IN FLIGHT IN GENERAL AVIATION

The background image is a composite. The top half shows a small white aircraft flying through a dark, stormy sky with bright lightning bolts. The bottom half shows the wreckage of a small aircraft, possibly a Cessna, lying on a snowy ground in a forest of evergreen trees. The wreckage is partially buried in the snow, with the wings and tail section visible.

*“The best safety device in  
any aircraft is a well  
trained pilot”*



# CEN14LA505 – Conroe, TX

## Embraer EMB-505 “Phenom”, N322QS

### Sept. 19, 2014

- Part 91 - NetJets corporate flight
- IFR flight plan – wx briefing
- Nashville, TN – Conroe, TX
  - Lone Star Executive Airport (KCXO)
- Landing runway 1 (5000 ft x 100 ft concrete)
- ATC broke out at minimums, touched down just past 1,000 ft mark & didn't seem to decelerate
- Weather
  - *KCXO 191341Z 00000KT 2SM +RA BR FEW005 BKN080 OVC100 23/22 A2993 RMK AO2 P0021 T02280222*
- Overrun 400 ft into mud & ditch – substantial damage



# Part 121 - Air Carrier Operations Operational Control & Flight Dispatch

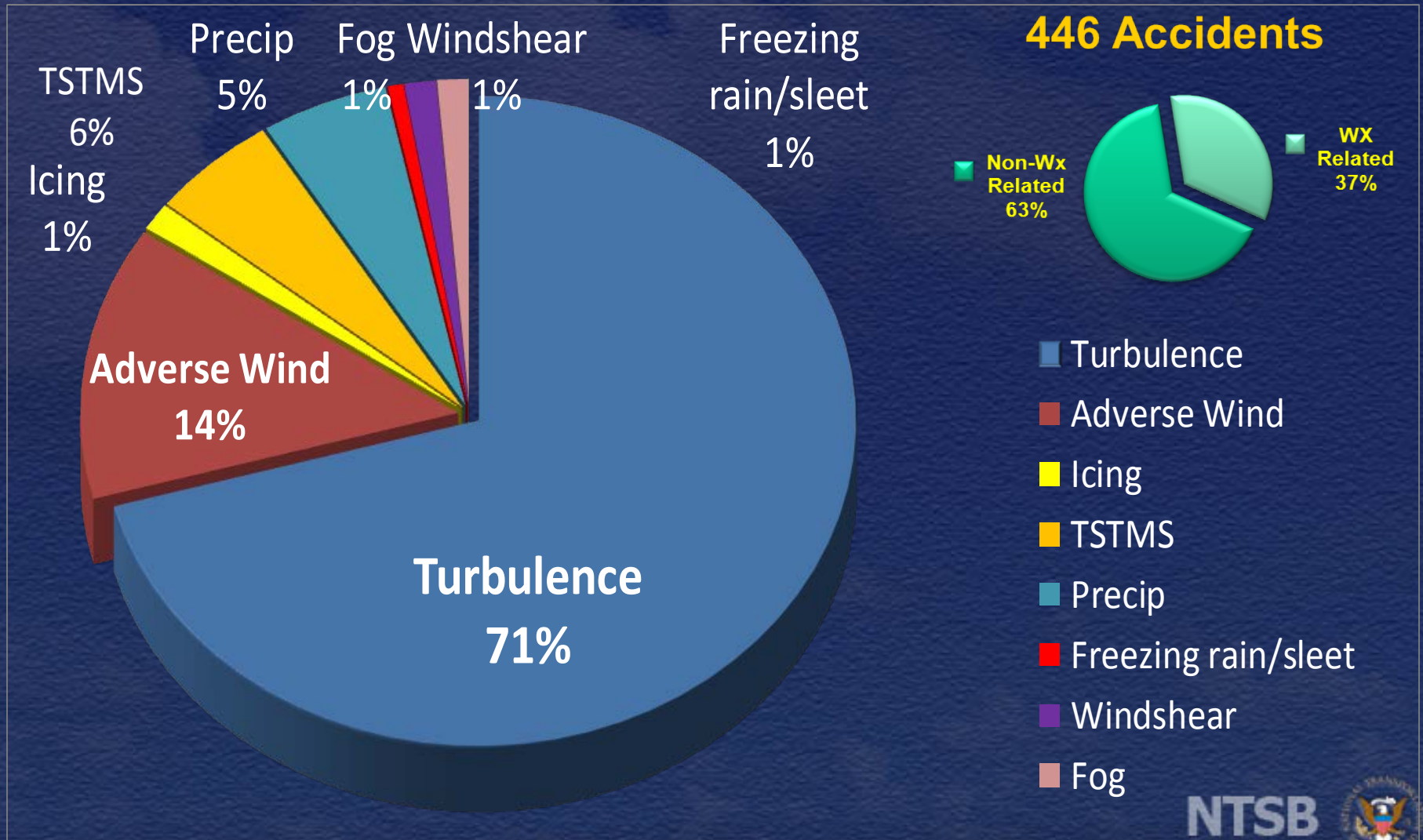




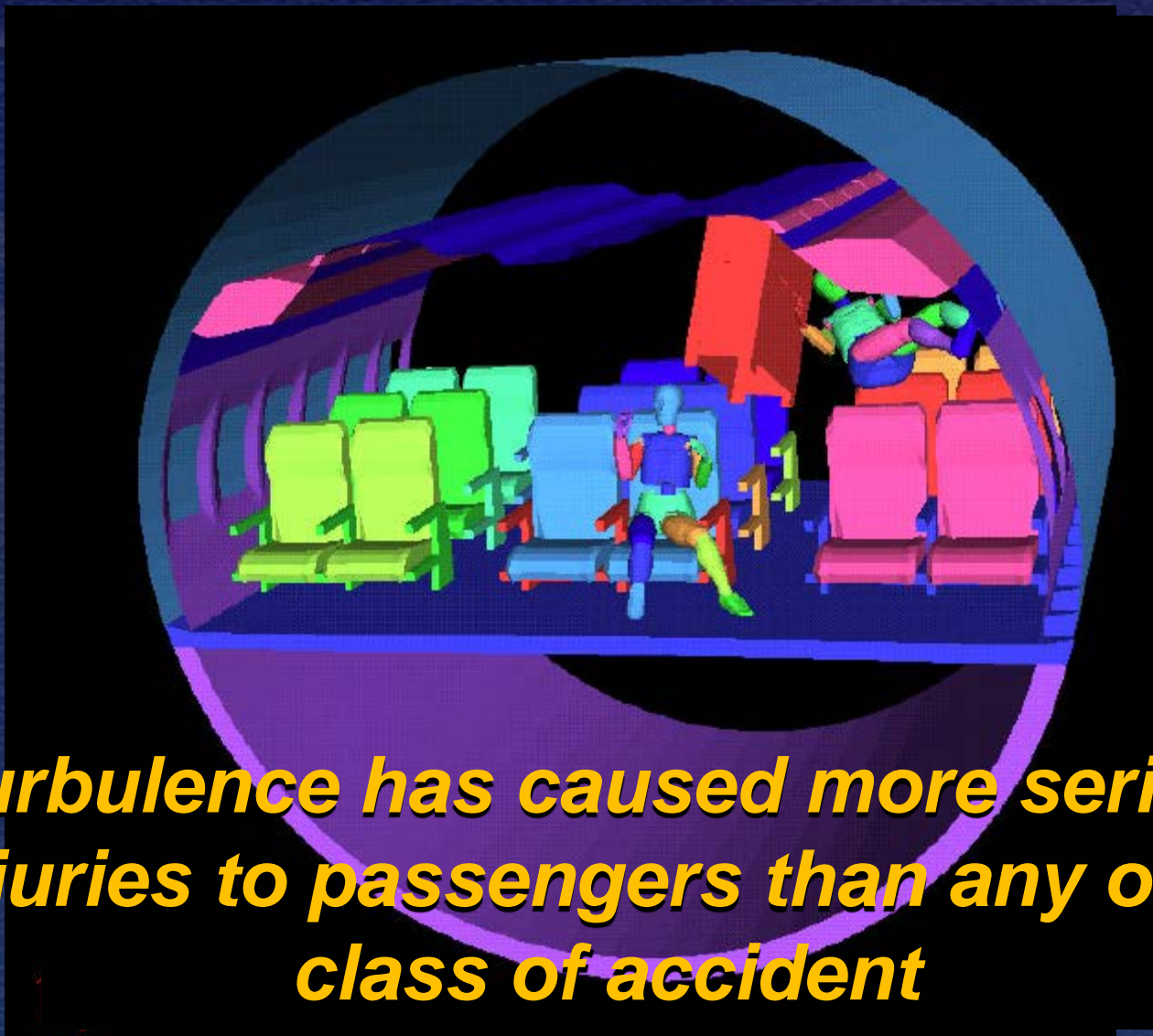
*We can control everything in the sky, except the weather!*



# Part 121 – Air carrier Weather Related Cause/Factors 2000-2011

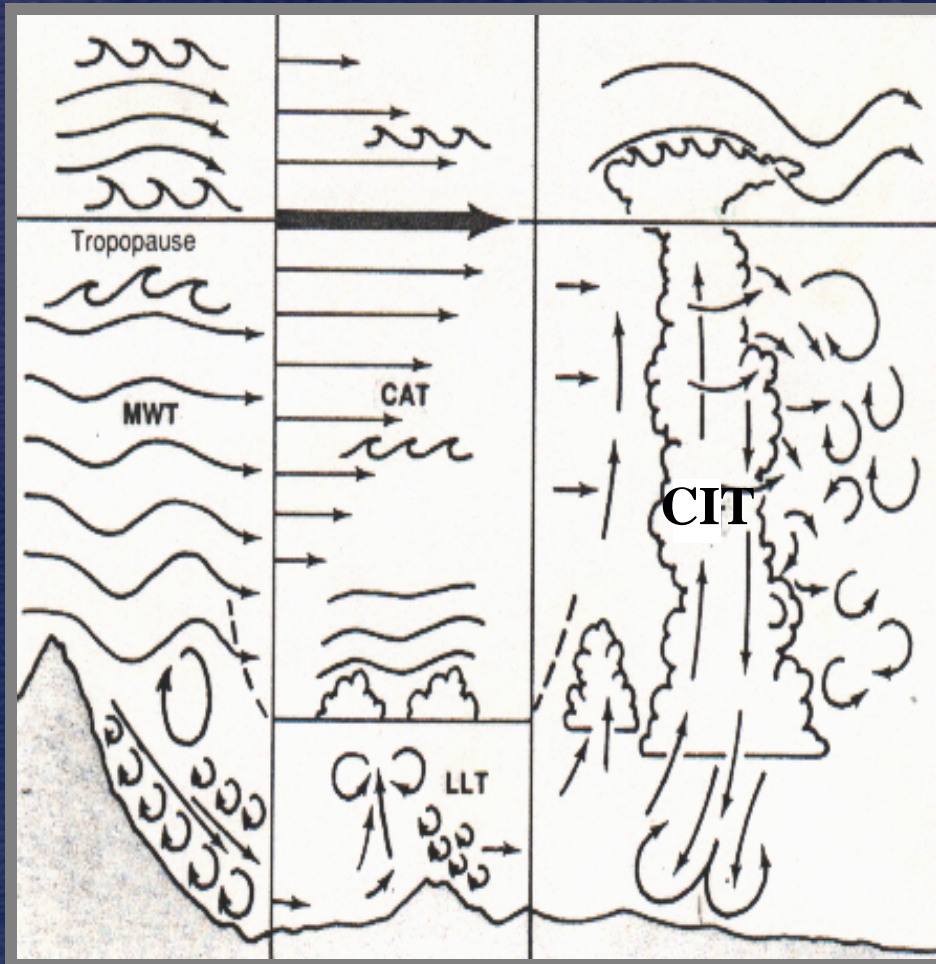






***Turbulence has caused more serious injuries to passengers than any other class of accident***

# Turbulence Classification



- Clear Air Turbulence (CAT)
- Convectively Induced Turbulence (CIT)
- Mountain Wave (MWT)
- Mechanical (LLT)
- Vortex Wake





**Convective clouds** – Convectively Induced Turbulence (**CIT**)

*All thunderstorms imply the potential for severe turbulence.  
Severe thunderstorms imply severe-to-extreme turbulence!*



# Elements of an Investigation

- Define the environment
- Relate the environmental conditions to the accident
- Evaluate weather products and services





# 2014 NTSB Part 121 – Turbulence Events

- 3 Official Part 121 accidents:
- **DCA14CA035 – Valdosta, GA** **1S/12M**
  - B767 CIT encounter, 3 FA lifted off floor, 1 fractured lumbar vertebrae, 2 others FA and 10 passengers minor incurred injuries
- **CEN14CA455 – Hemphill, IL** **1S/3M**
  - ERJ-170 encountered wake turbc, rolled, FA seriously, along with 3 passengers injured
- **DCA14LA060 – Billings, MT** **2S/9M**
  - B737 encountered MTW, all FA incapacitated 2 seriously, major head wound, diversion, 9 minor injuries & infant issue

# 2015 NTSB Part 121 – Turbulence Events

- NTSB 9 events investigated/15 others noted with injuries over 60. Numerous flight crew incapacitation events
- OPS15IA020 – Max NE A320 3M
- WPR15LA239 – Reno, NV E175 1S
- DCA15NA150 – Seattle, WA E175 1M
- DCA15NA149 – Salt Lake, NV E175 1M
- DCA15NA133 – Norfolk, VA B737 1M
- DCA15CA131 – McCook, NE CRJ 1S/6M
- DCA15CA136 – Newark, NJ B777 1S
- DCA15NA104 – Philadelphia, PA B737 1M
- DCA15LA067 – Honolulu, HI B767 1S/12M



# Data does not include International Events

## Turbulence & Hail Encounter

- Delta F159 B747-400
- June 6, 2015
- Detroit – Seoul
- FL360 @ 0630Z
- Unable to get deviations around convection
- Encounters severe turbulence & hail
- Damage – radome, leading edges, engines
- Significant damage – aircraft retired from service
- Foreign Investigation



# Hail Encounter – International Event

- American Airlines B787
- July 27, 2015
- Hail encounter after departing Beijing
- Aircraft 3-months old, 4 weeks of maintenance to return to service
- Damage radome, side window, leading edge



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**NEW DETAILS**

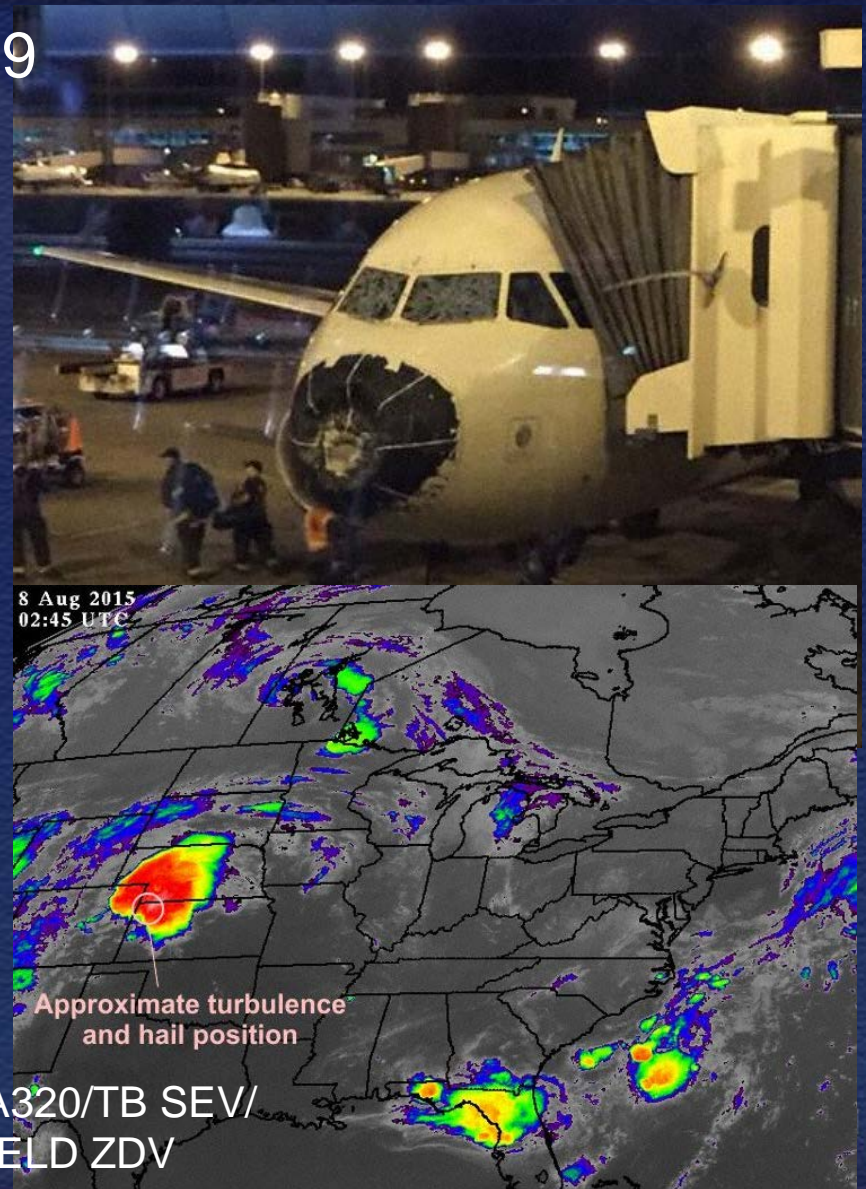
**FLIGHT POUNDED BY HAIL**  
**DO PILOTS HAVE ENOUGH WEATHER DATA?**



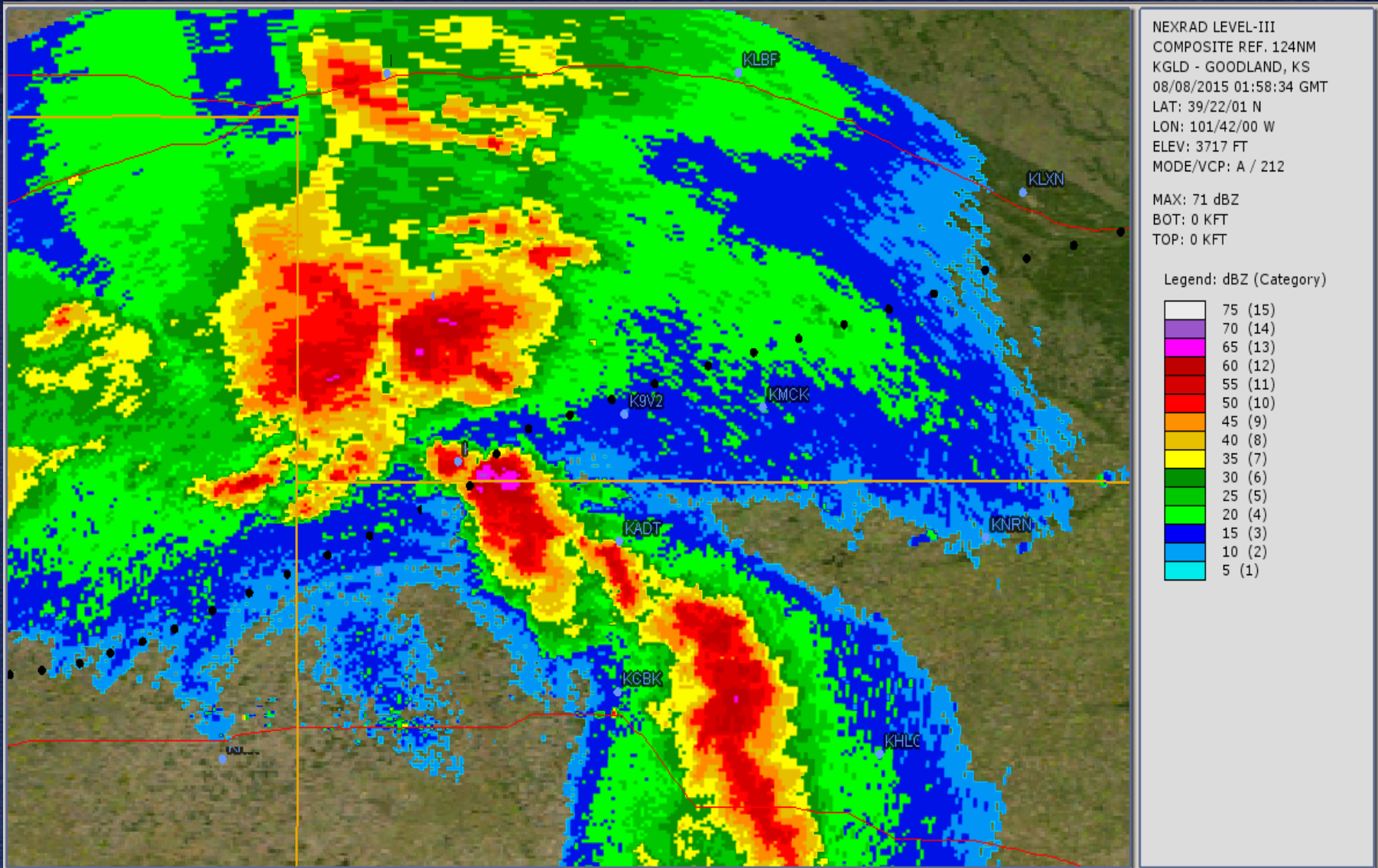
# U.S. Investigation Hail Encounters

- Delta Airlines A320 flight #1889
- KBOS-KSLC
- Aug. 8, 2015 @ 0201Z
- Aircraft encountered SVR turbulence, hail, lightning at FL340
- Crew declared emergency & diverts to KDEN
- 3 minor injuries
- Southwest B737 also encountered SVR turbulence
- **On going investigation**

GLD UUA /OV GLD04447/TM 0214/FL340/TP A320/TB SEV/  
RM SEV HAIL- CRACKED WINDSHIELD ZDV

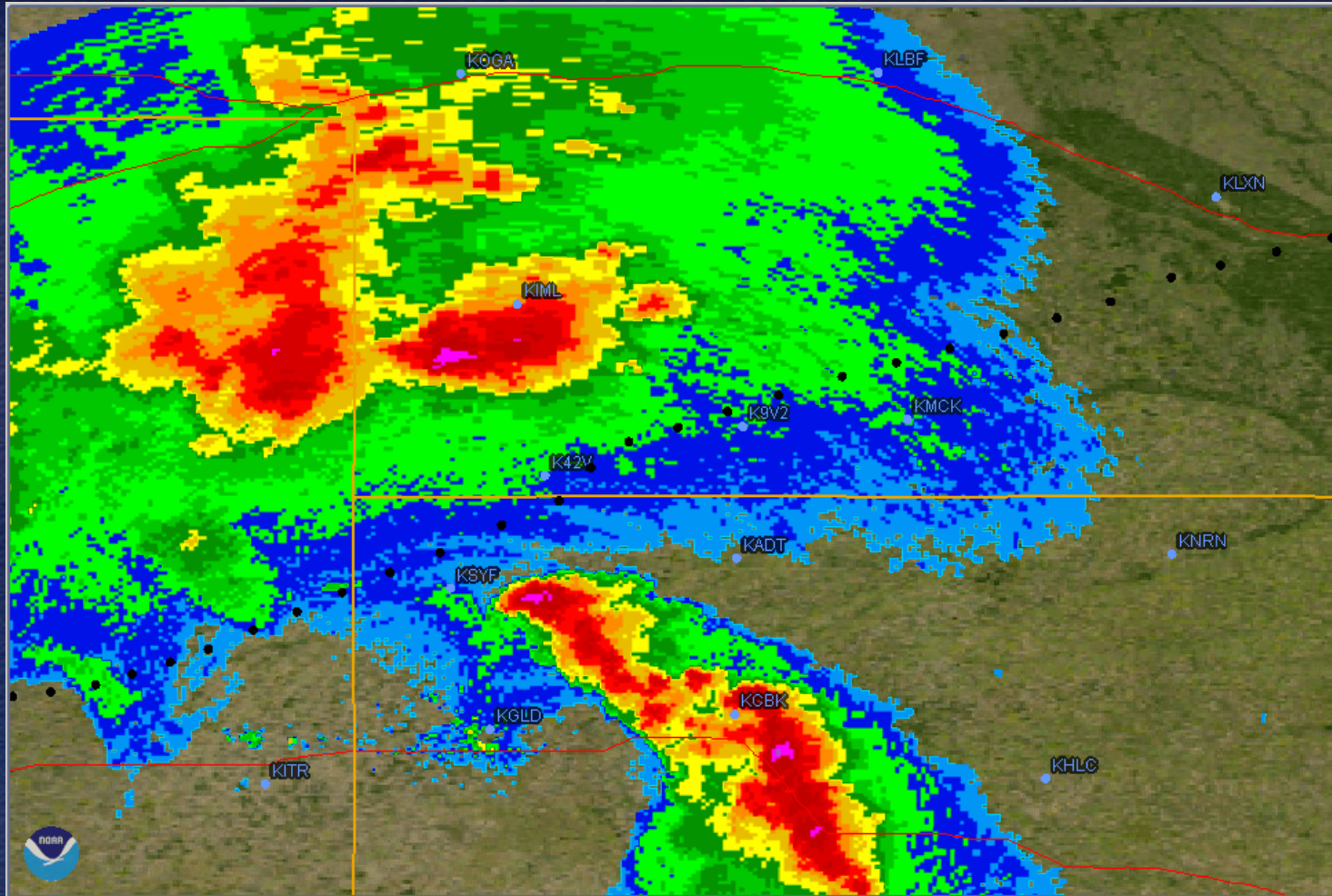






AIM & AC 00-24C – “Do avoid by at least 20 miles any thunderstorm identified as severe or giving an intense radar echo. This is especially true under the anvil of a large cumulonimbus.”

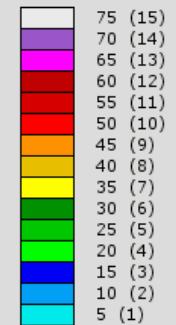
# Delta Hail Encounter



NEXRAD LEVEL-III  
COMPOSITE REF. 124NM  
KGLD - GOODLAND, KS  
08/08/2015 01:33:53 GMT  
LAT: 39/22/01 N  
LON: 101/42/00 W  
ELEV: 3717 FT  
MODE/VCP: A / 212

MAX: 71 dBZ  
BOT: 0 KFT  
TOP: 0 KFT

Legend: dBZ (Category)



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# Microbursts



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August 8, 2015 - Wet Microburst Tucson, Arizona

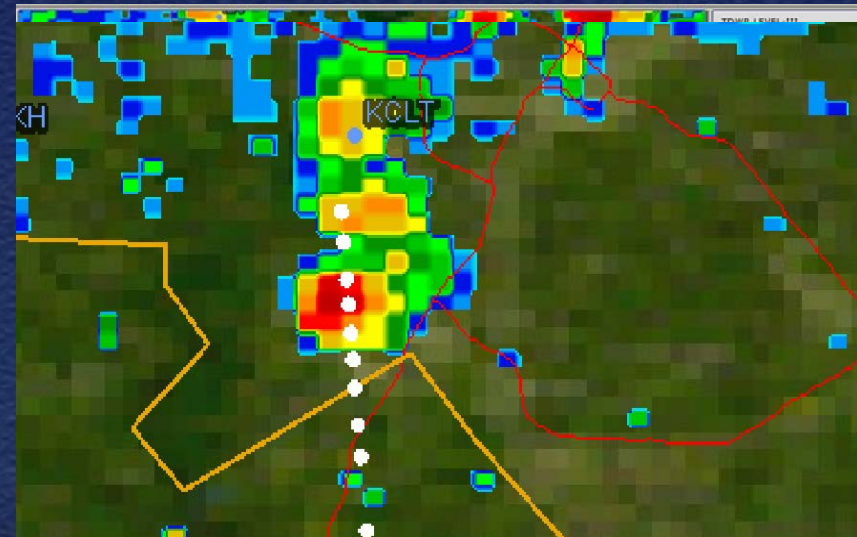


# DCA15LA173 – Charlotte, NC

## American Airlines A321

### August 15, 2015

- On going investigation
- Part 121 night flight
- ATL-CLT
- Final approach encountered LLWS
- During go-around struck approach lights and tail struck runway
- Substantial damage
- No injuries



# DCA13MA081 - Bagram, Afghanistan

## National Air Cargo, B747-400

### April 29, 2013

- Part 121- Supplemental cargo flight
- Carrying heavy Army equipment
- Crashed on takeoff
- Witnesses reported steep pitch-up, before descending into ground
- No weather issues identified
- Fatal 7





# DCA13MA133 – Birmingham, AL

## UPS Flight 1354, A300

### August 14, 2013



- Part 121 – scheduled cargo flight
- IFR flight plan SDF-BHM
- Dark nighttime conditions prevailed
- Aircraft crashed on approach at 0447 CDT
- VFR conditions existed over airport, with LIFR ceilings along approach path
- Fatal 2

# DCA13MA133 – Birmingham, AL

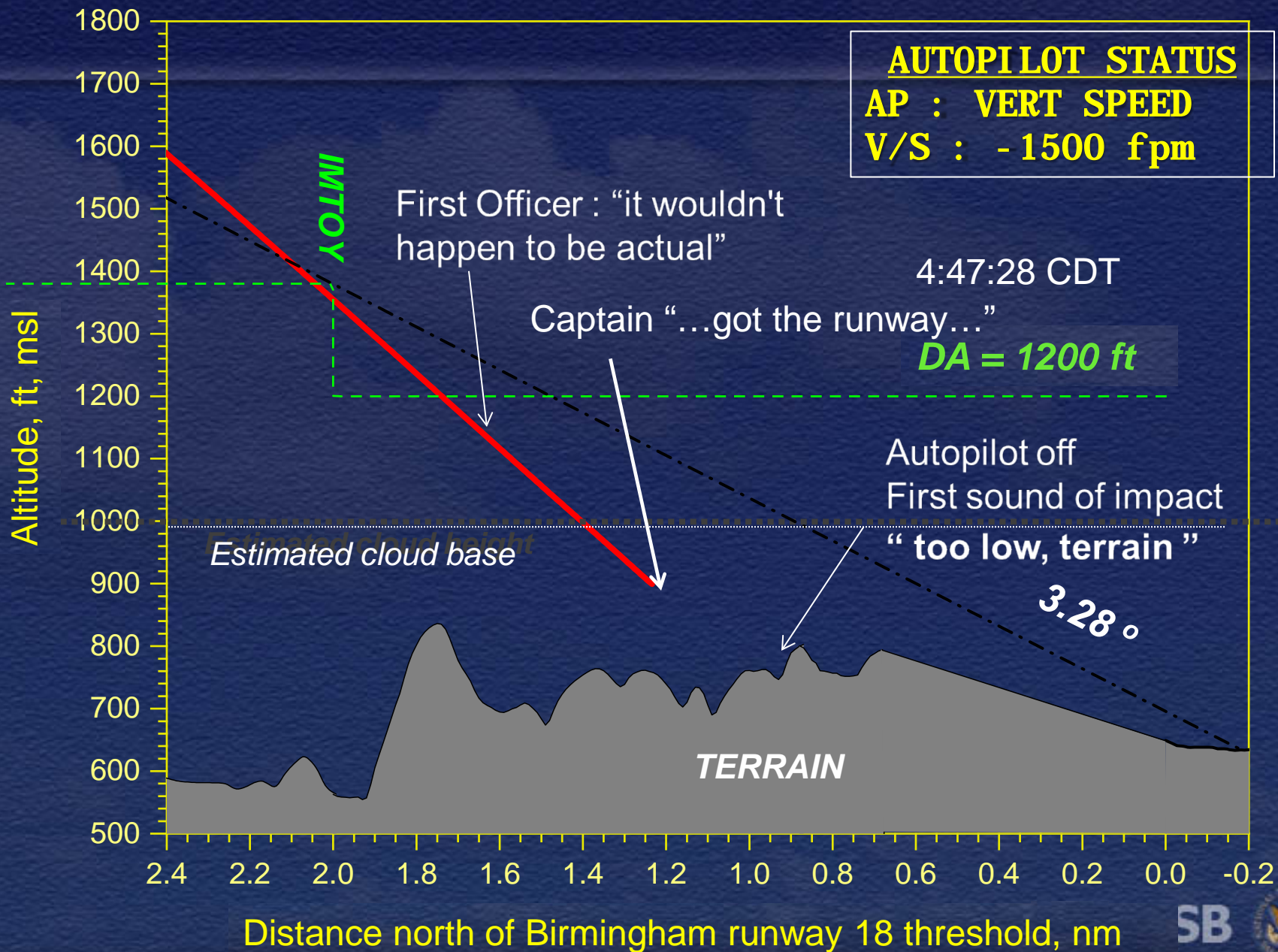
UPS Flight 1354, A300

August 14, 2013 @ 0447 CDT



- NTSB Probable Cause –
  - *Crew's continuation of an unstabilized non-precision approach & their failure to monitor the aircraft's altitude during the approach, which led to an inadvertent below the MAA and subsequent into terrain.*
  - *Contributing – flight crew's expectation that they would break out of the clouds at 1,000 ft due to incomplete weather information*





runway 18 threshold



— aft fuselage

— engines and forward fuselage

— rising terrain

— ground contact



Tree strikes











Worldwide S

Synchroniz









# UPS – Birmingham, AL

## NTSB Recommendations:

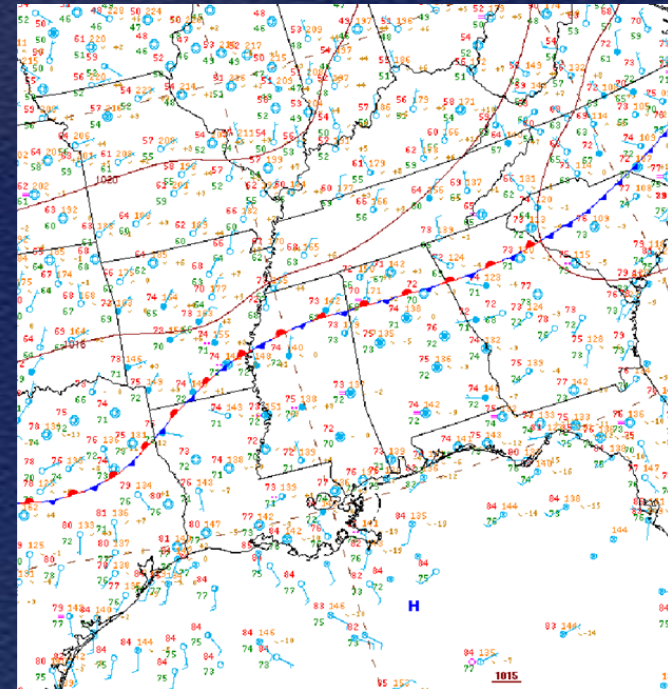
- Require annual update to Dispatch Resource Management (DRM) that includes pilot/dispatch interface
- FAA require remarks section of METAR to be provided to dispatchers & pilots
- FAA expand guidance in 7110.65 “ATC” – to further define pertinent METAR remarks

# DCA13MA133 – Birmingham, AL

## UPS Flight 1354, A300

### August 14, 2013

- Stationary front over the area producing LIFR to IFR conditions across the region – AIRMET issued
- UPS LIDO System – limitations; strips off METAR remarks, “SPECI” or “AMD”, unable to access UA, WA, CWA/MIS, AWW, other local obs
- NWS AWC site also noted stripping
- Lack of standardization s in ATC disseminate METAR remarks
- NOTAM – primary runway closed 0500 local





# UPS – Birmingham, AL



*METAR* KBHM 140753Z 0000KT 9SM OVC008 23/22 A2996

*RMK* AO2 CIG 007V011 SLP137 T02330217=

*SPECI* KBHM 140848Z 33003KT 10SM OVC010 23/22 A2997

*RMK* AO2 CIG 006V013=

*METAR* KBHM 140853Z 0000KT 10SM BKN010 OVC075 23/22 A2997

*RMK* AO2 CIG 006V013 SLP138 T02330217 52000=

*SPECI* KBHM 140904Z 0000KT 10SM SCT010 BKN075 23/22 A2996

*RMK* AO2=

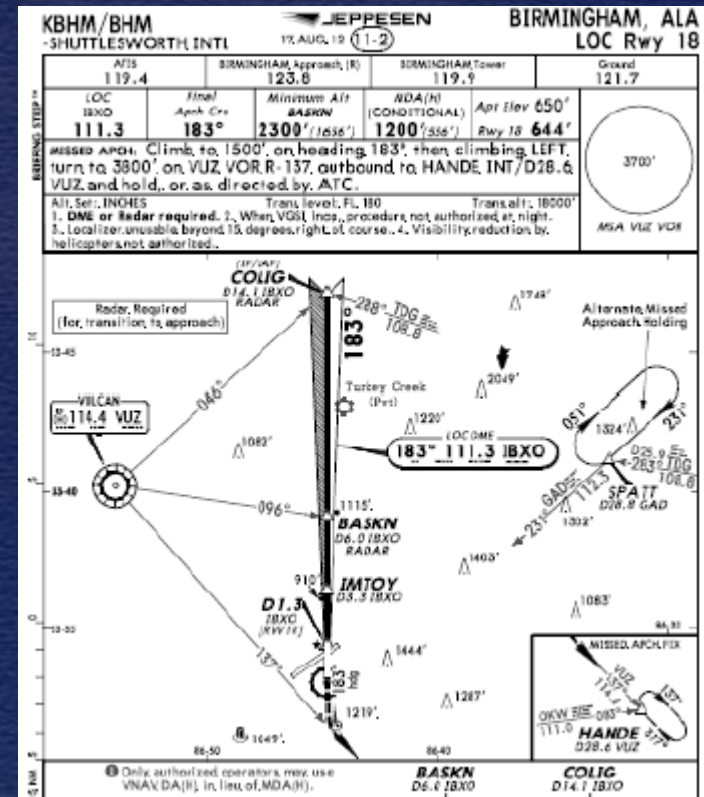
*TAF AMD* KBHM 140647Z 1407/1506 VRB03KT P6SM BKN004

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# UPS – Birmingham, AL

- Dispatcher reviewed LOC RWY 18 approach
- Chart indicated “NA” at night
- Chart error caught & FDC NOTAM had corrected “NA” error, UPS dispatcher not aware of the correction
- Primary runway closed until 0500 local (accident 0447 CDT)



TERPS	STRAIGHT-IN, LANDING, RWY 18		NIGHT
	DAY	DAY	
	MDA(H) 1200' (556') With IMTOY	MDA(H) 1380' (736') With IMTOY	NIGHT
A	1	1	
B	1	2	
C	1%	2	
D			NA



# UPS – Birmingham, AL

## Recommendations

- Lack of standardization in ATC providing “*other pertinent remarks from the weather observation*” on ATIS broadcast
- Pertinent Remarks – defined in FMH-1



ATC Specialist Vikki Cole struck by lightning while monitoring traffic Newcastal Airport, DE July 2008



# NATCA

NATIONAL AIR TRAFFIC CONTROLLERS ASSOCIATION  
WE GUIDE YOU HOME



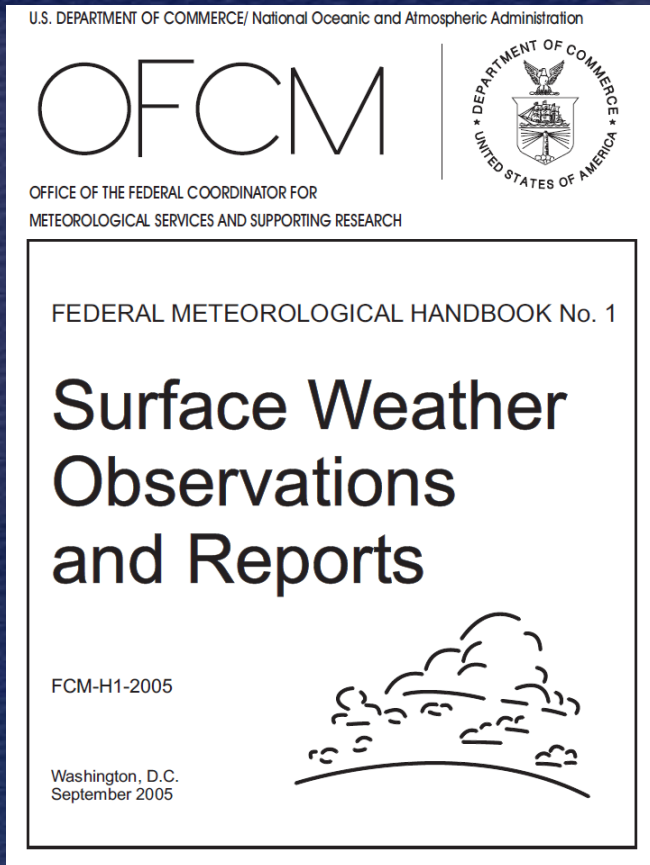
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# Federal Meteorological Handbook (FMH-1)

## 12.7 Remarks

- Clarify present Wx in main body – VC, DSNT, LTG DSNT W
- Movement clouds/Wx -“TS MOV NE”
- Volcanic Ash
- Funnel Cloud/Tornado/Waterspout
- Peak Wind
- Wind Shift/Frontal Passage – WSHFT/FROPA
- Tower/Surface visibility differences
- Variable prevailing visibility
- Sector visibility





# FMH-1 Coding of Remarks

## Remarks...

- Type/Frequency/Location of Lightning - example (*FREQ LTGICCGCC OVHD*)
- Beginning/End of precip/Thunderstorms
- TS location/movement (*TS W MOV NE*)
- Hail size (*GR*)
- Virga
- Variable ceiling/sky coverage; *CIG 4V6*
- Obscurations
- Significant Cloud Types - specifically (*TCU, CB, CBMAM, ACC, SCSL, ACSL, CCSL, ROTOR*)

# FMH-1 Coding of Remarks

## Remarks....

- Pressure Rising/Falling Rapidly (*PRESRR/PRESFR*)
- Sea Level Pressure (*SLD*)
- Aircraft Mishap
- No SPECI reports
- Snow increasing rapidly – snowfall rate/total on ground – example: *SNINCR 1/5*
- Other significant info for station (*FIRST/LAST reports of the day, runway condition, fog dispersion ops, etc.*)
- What about all those numbers?



# FMH-1 Coding of Remarks

## Additive & Automated maintenance Data

- Precip data – hourly, 3- and 6-hr, 24-hr (Prrrr)
- Snow depth (4/ssss)
  - *Note - not on runway, that's NOTAM requirement*
- Cloud types (8CCC)
- T/TD data – hourly, 6-hr max/min, 24-hr (Tstttsttt)
- Pressure tendency (5appp)
- Sensor status (*PWINO, PNO, TSNO, FZRANO*)
- Maintenance indicator (\$)
  
- *Nice to know but required to broadcast?*

# UPS – Birmingham, AL

## Weather Issues

One more thing, NTSB PIREP issues:

- Several pilots operating were interviewed regarding the Wx conditions encountered
- FedEx aircraft landed immediately after the accident on runway 06 at 0507 CDT
- Broke out of overcast layer close at minimums ~300 ft agl, never advised ATC or made any PIREP of lower than report conditions
- ASOS never reported the lower cloud layer experienced by UPS/FedEx



# RECENT ICING RELATED EVENTS UNDER INVESTIGATION

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# Icing Events

*In the 5 year period between 2010-2014 there have been 52 icing accidents with 78 fatalities.*

Part 121 – 2

EMB145 – Dayton, OH

EMB145 – Memphis, TN

Part 135 – 8

Part 91 - 42



# DEN14FA058 – Memphis, TN

## Trans State Airlines EMB-145

### Feb. 5, 2014

- Part 121 – IFR flight
- HOU-MEM
- Night IMC at MEM
- 1<sup>st</sup> approach missed, on 2<sup>nd</sup> approach 20-40 ft agl wing dropped & aircraft rolled right contacting runway
- On ramp all leading edges had significant mixed ice buildup

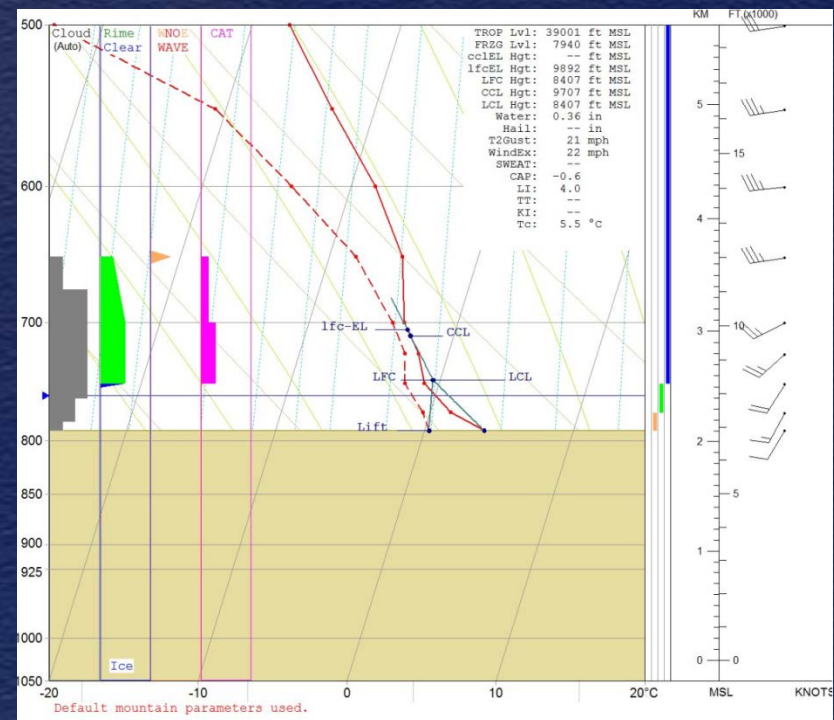


# DEN14FA058 – Memphis, TN

## Trans State Airlines EMB-145

### Feb. 5, 2014

- METAR/TAF expected LIFR BR
- TAF tempo –FZDZ
- No AIRMET/SIGMET
- CWSU closed during period, no prior advisories
- CIP expected 50-70% of LGT icing below 3,000 ft



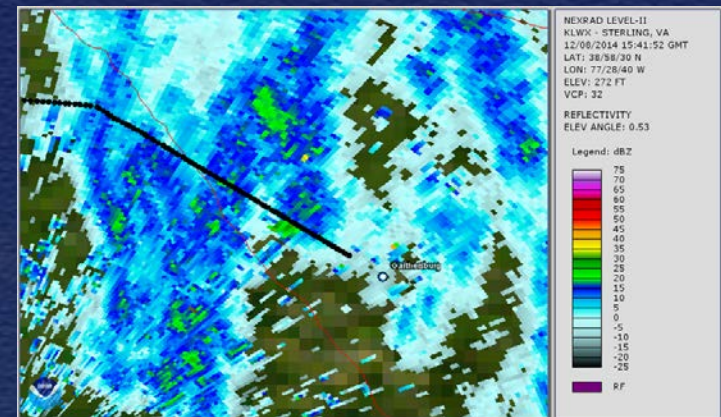


# DCA15MA027 – Gathersburg, MD

## Embraer EMB-500, N100EQ

### December 8, 2014

- Part 91 IFR business flight
- Chapel Hill, VA – Gaithersburg, MD
- Crashed on approach
- Fatal 3 aircraft, family 3 on ground
- Very light intensity echoes associated with snow squall
- Numerous reports LGT-MDT icing below 5,000 ft
- No advisories current for icing



DCA15MA085 – LaGuardia Airport, NY  
Delta Airlines flight 1086, MD-83  
March 5, 2015



***KLGA 151600Z 02009KT 1/4SM R04/3000V4500FT SN FZFG VV009  
M03/M04 A3012 RMK AO2 P0001  
3 inches new snow at time of accident  
Landing runway 13 – quartering right crosswind/slight tailwind in  
moderate snow***





***MOST WEATHER RELATED ACCIDENTS  
AND INCIDENTS ARE PREVENTABLE!***

***Questions?***



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**NTSB**