



Turbulence Detection and Avoidance Systems (TDAS)

Steve Velotas

Presentation To Airline Dispatcher Federation (ADF) Symposium

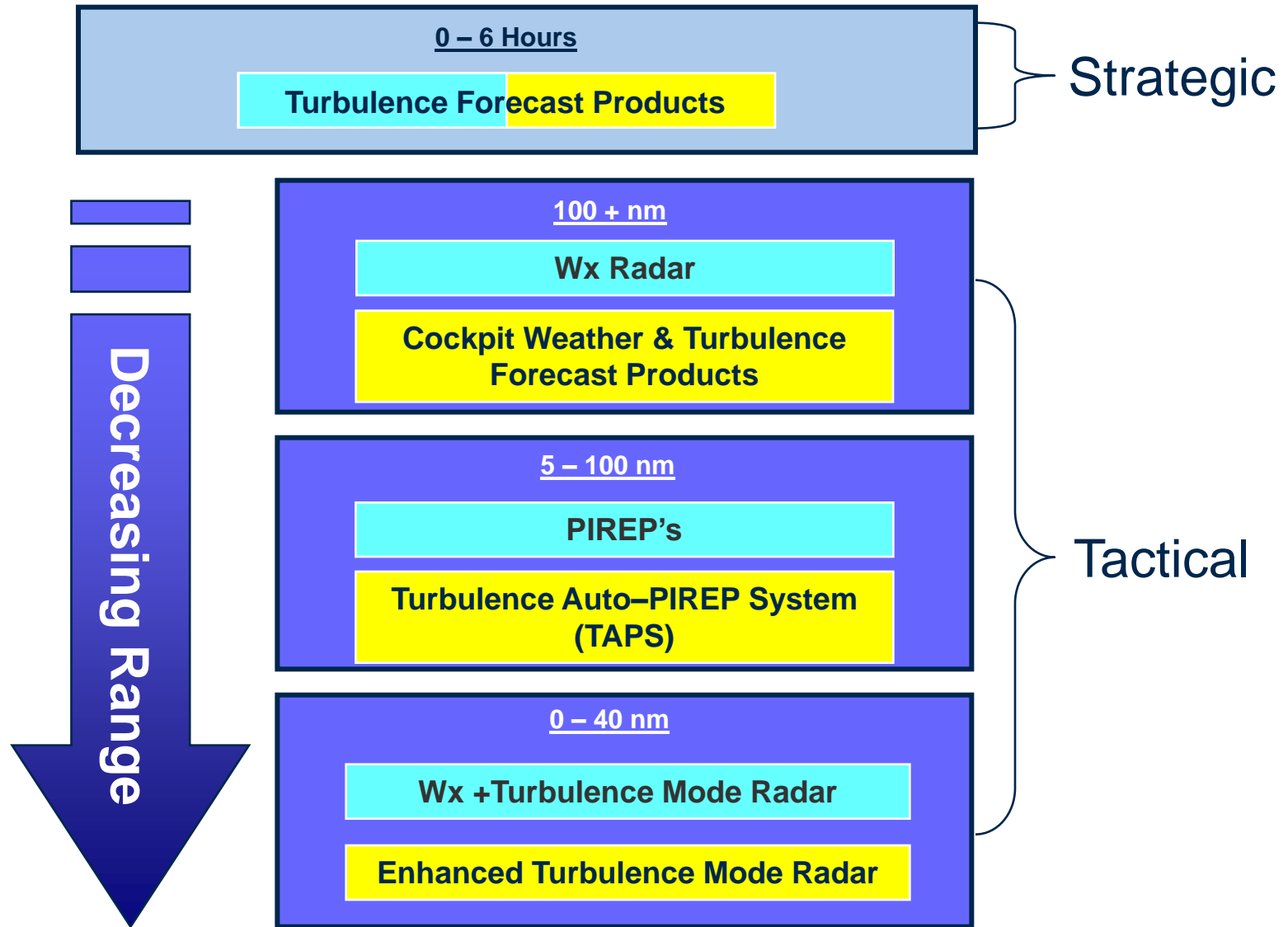
October 15, 2007

Presentation Outline

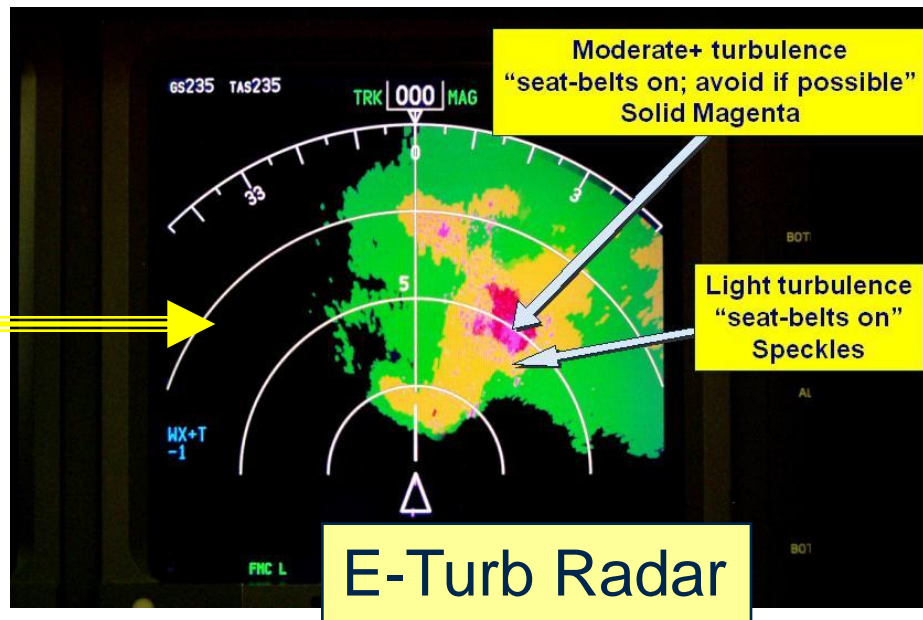
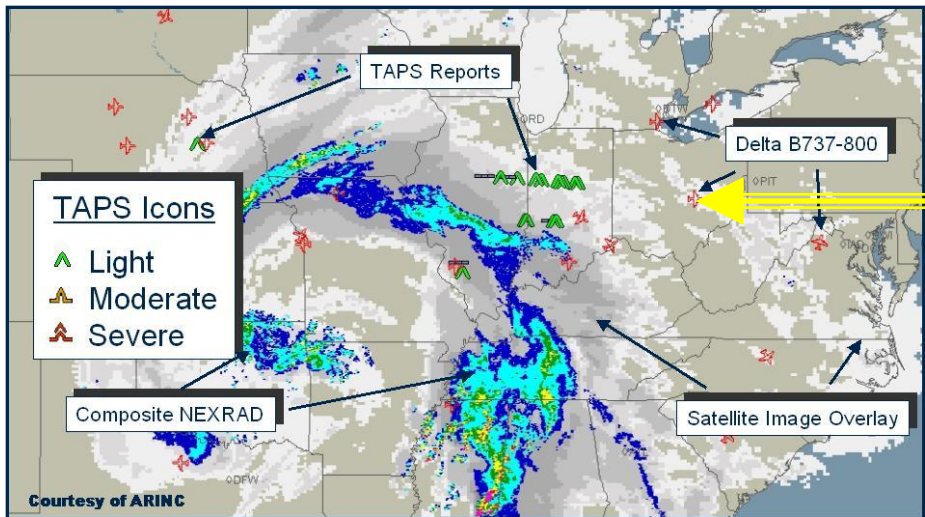
1. Turbulence Detection & Avoidance Systems (TDAS) Concept.
2. Turbulence Auto-Pirep System (TAPS).
3. Enhanced Turbulence Mode Radar (E-Turb).
4. Cockpit displays & other applications.



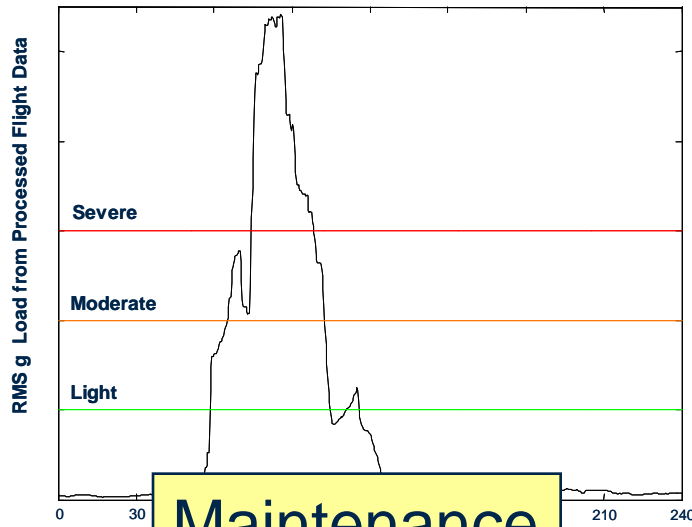
Hierarchy of Turbulence Products



Turbulence Detection & Avoidance Systems



TAPS





Turbulence Auto-PIREP System (TAPS)

The Turbulence Encounter Reporting Problem

Current turbulence encounters are GROSSLY under reported.

PIREPS that are made are:

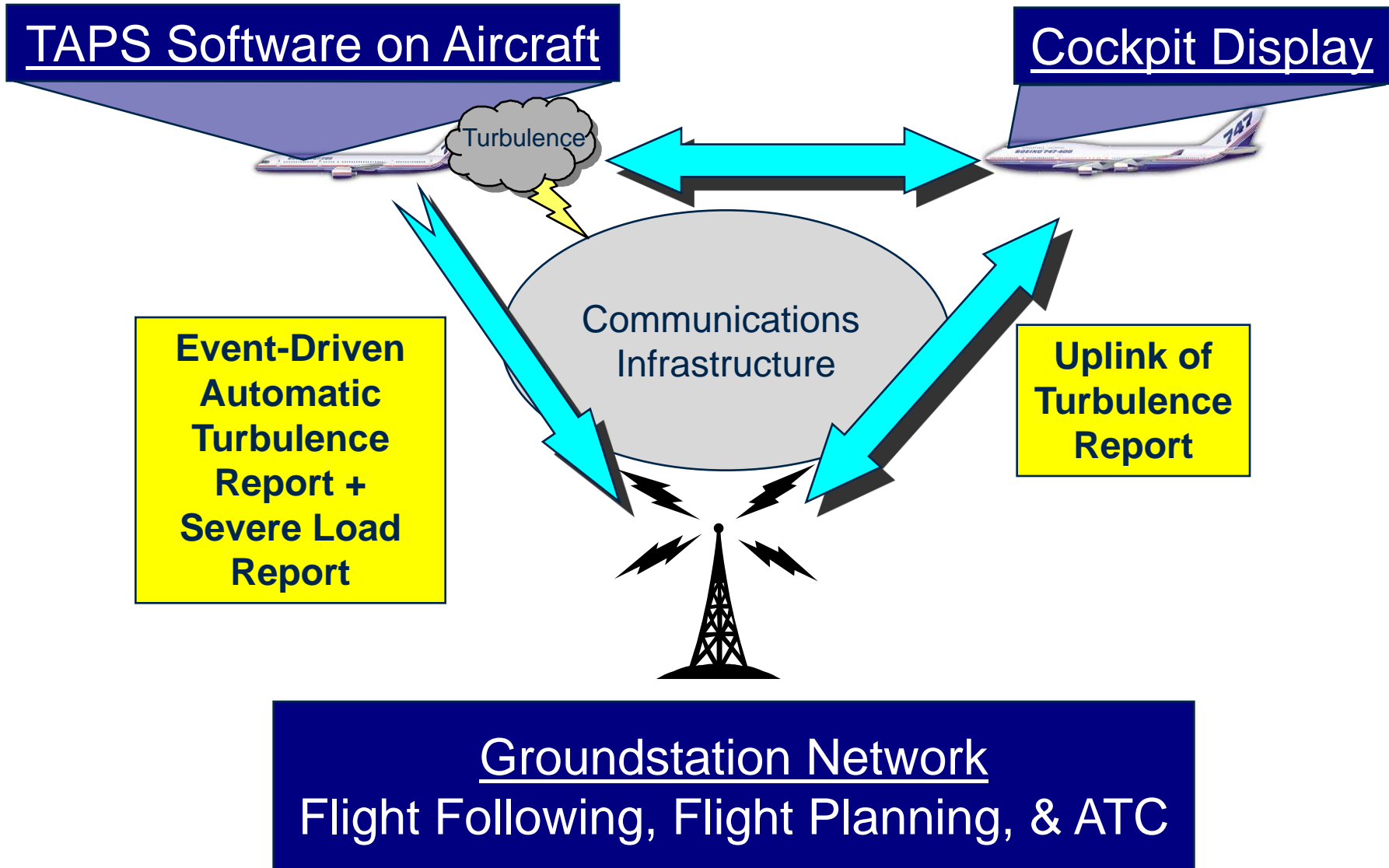
✦ **Late**

✦ **Subjective**

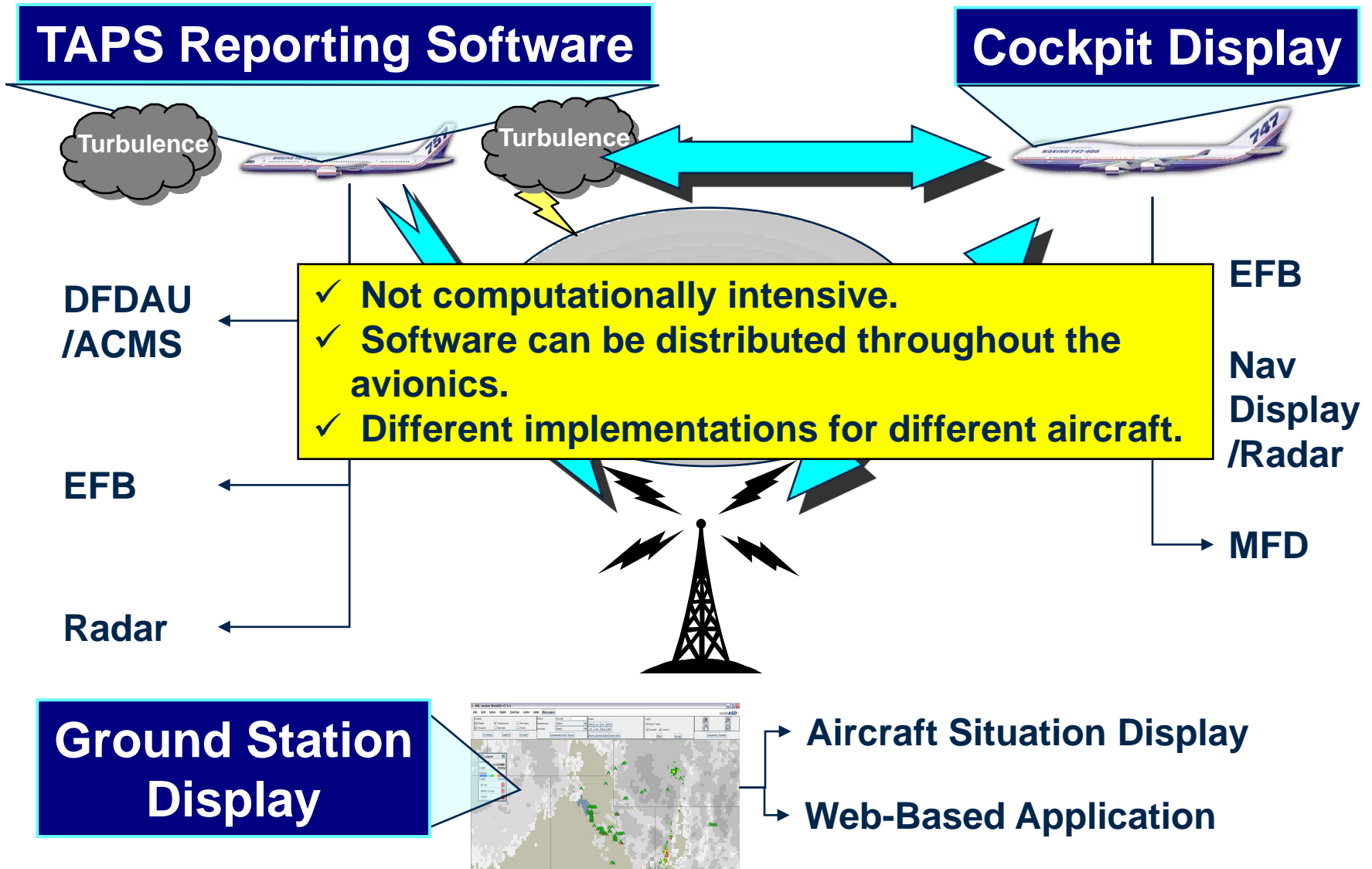
✦ **Not distributed to all users**

*The Turbulence Auto-PIREP System (**TAPS**) provides decision-makers with objective and timely information on turbulence hazards.*

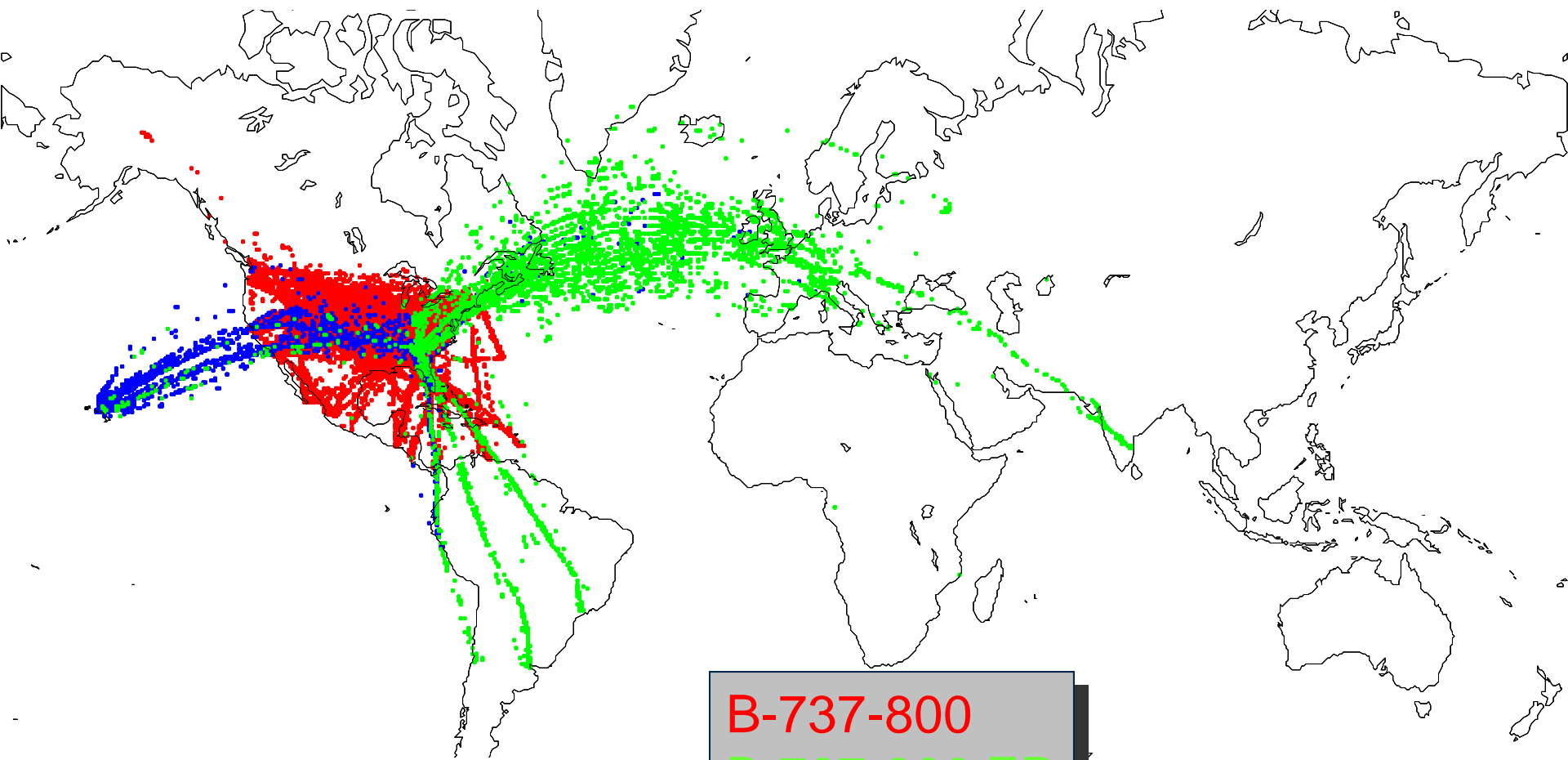
TAPS Architecture



TAPS System Integration

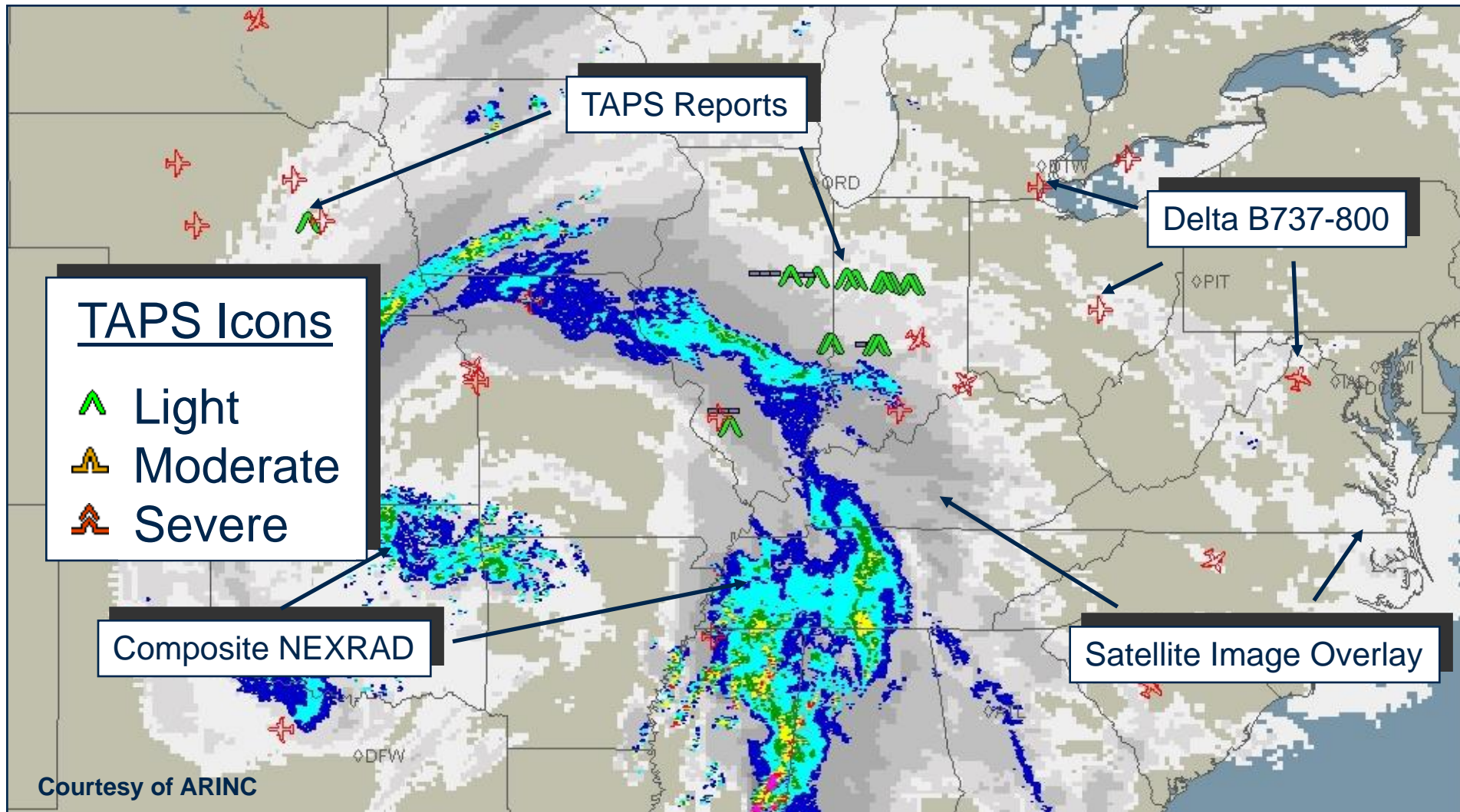


Geographic Distribution of TAPS reports

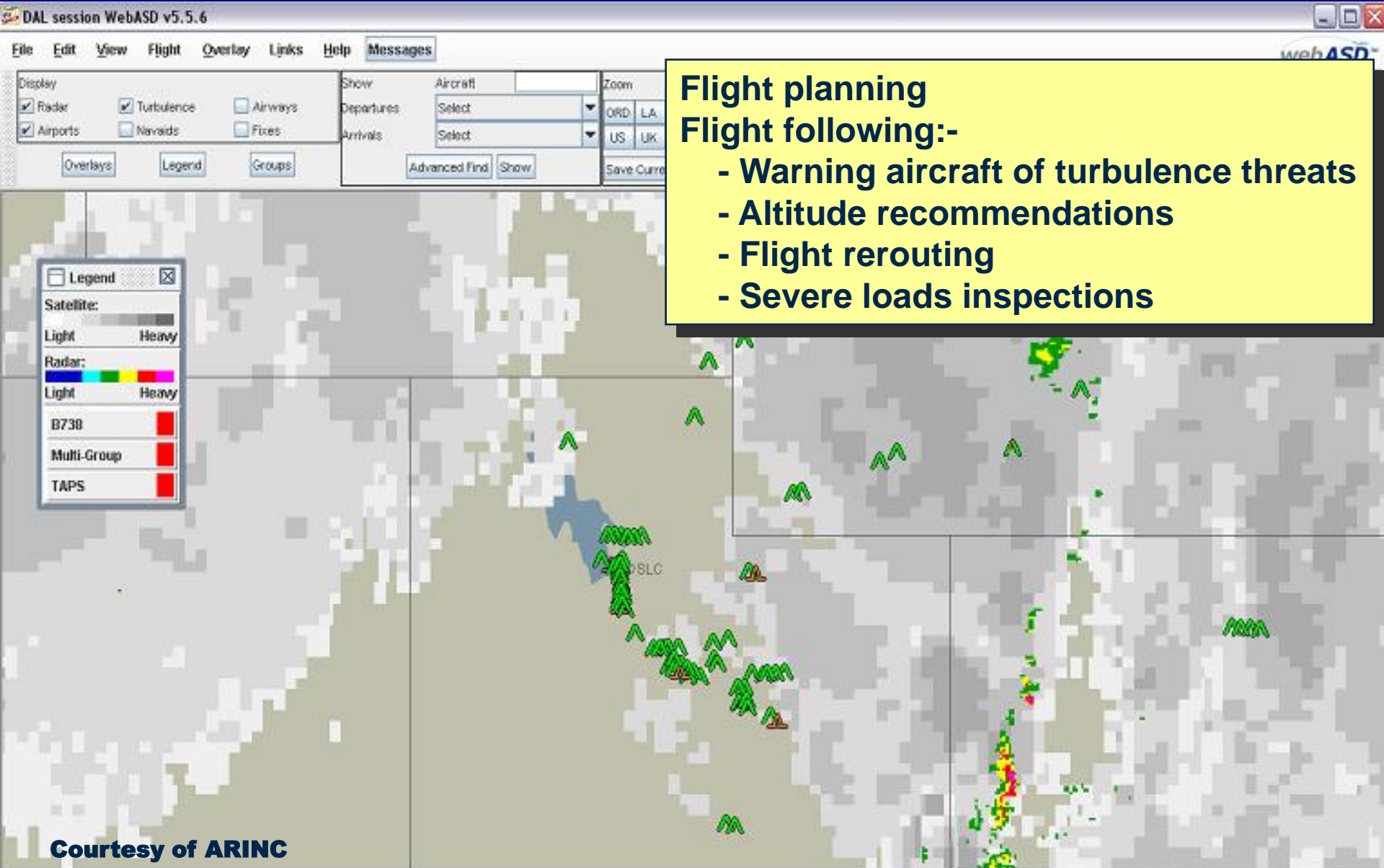


B-737-800
B-767-300 ER
B-767-400 ER

Dispatchers' TAPS WebASDSM Display



Dispatchers' TAPS WebASDSM Display

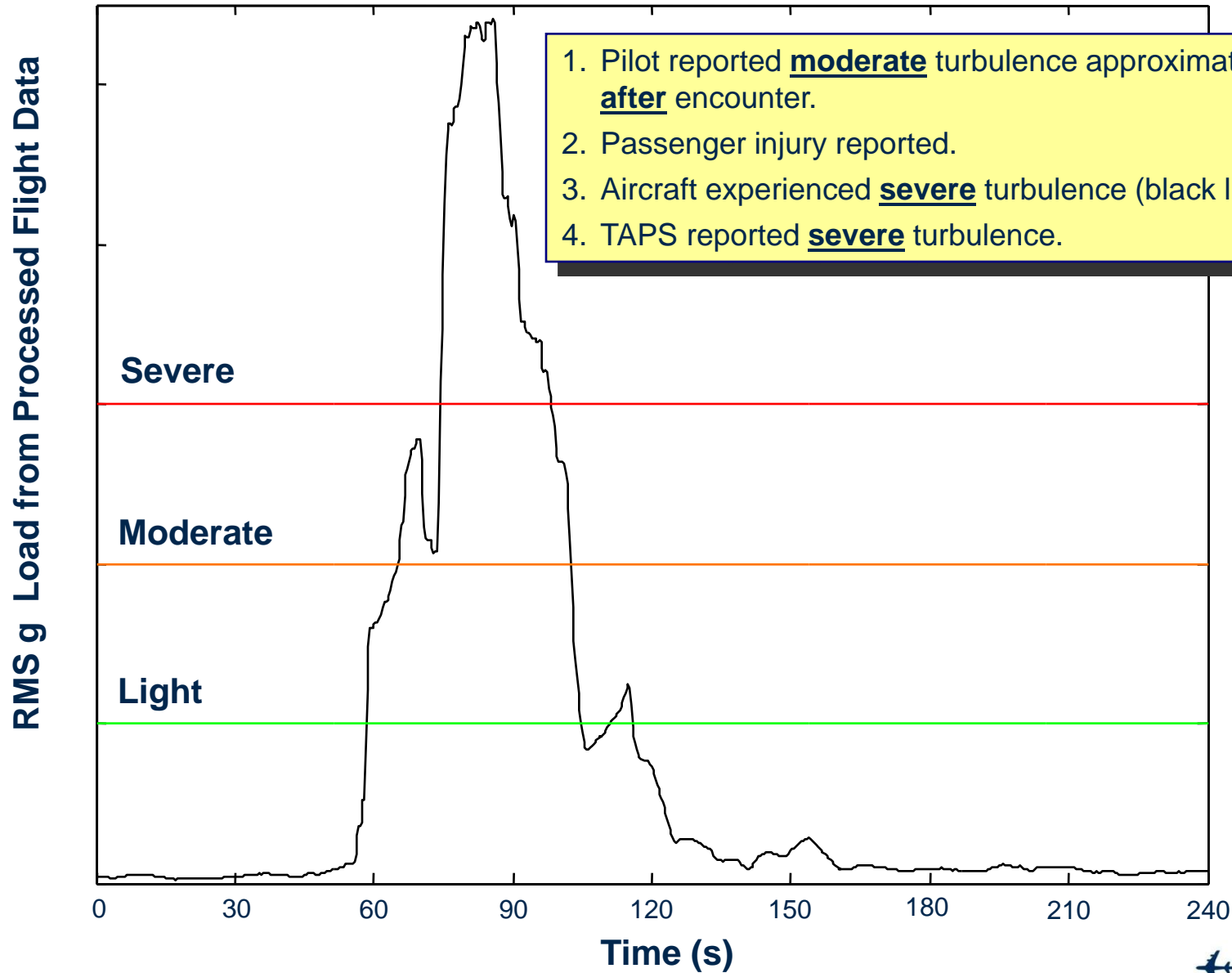


Flight planning
Flight following:-

- Warning aircraft of turbulence threats
- Altitude recommendations
- Flight rerouting
- Severe loads inspections

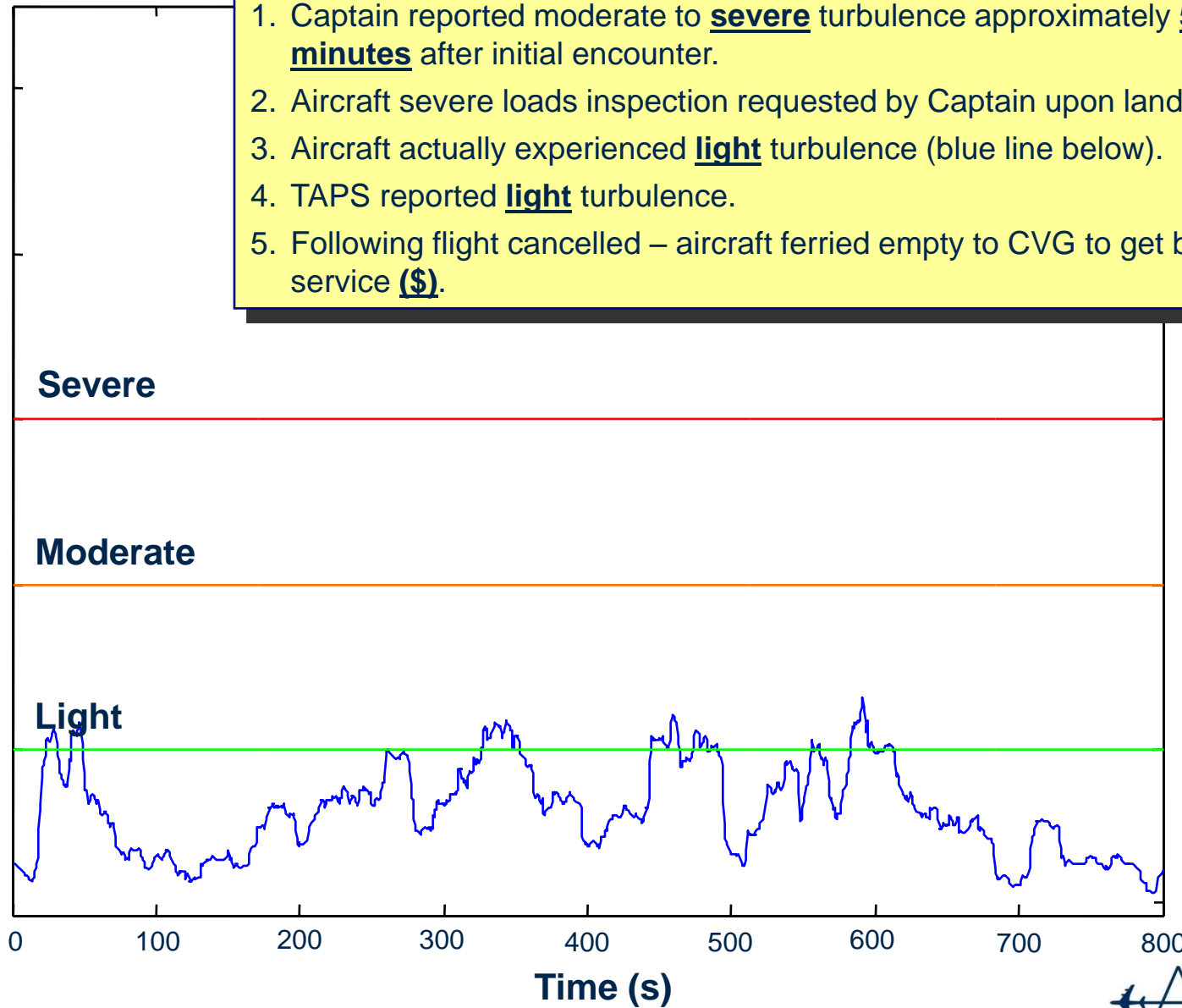
Courtesy of ARINC

PIREPs vs. TAPS: Underestimation



PIREPs vs. TAPS: Overestimation

RMS g Load from Processed Flight Data

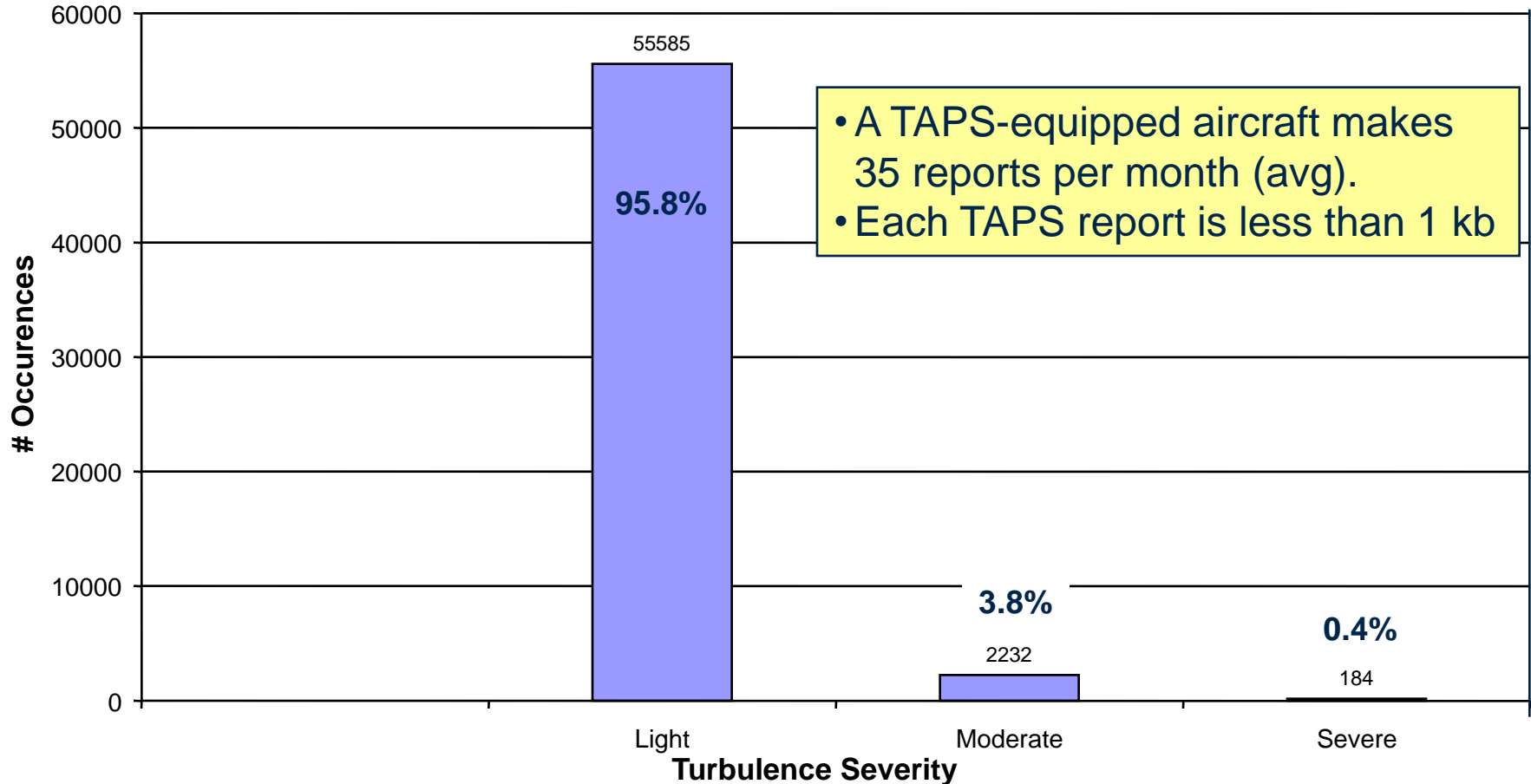


1. Captain reported moderate to **severe** turbulence approximately **5-10 minutes** after initial encounter.
2. Aircraft severe loads inspection requested by Captain upon landing (**\$**).
3. Aircraft actually experienced **light** turbulence (blue line below).
4. TAPS reported **light** turbulence.
5. Following flight cancelled – aircraft ferried empty to CVG to get back into service (**\$**).



TAPS Report Analysis – In-Service Eval

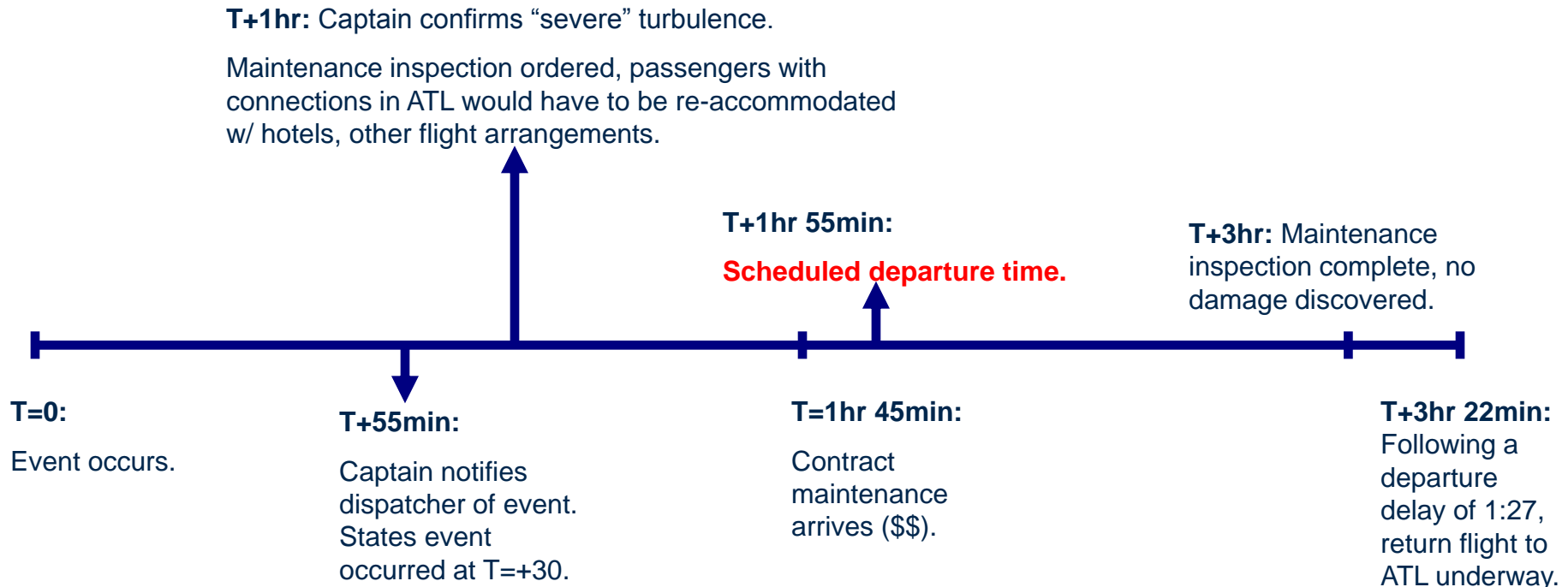
Period Covered: June 10, 2004 – August 16, 2006



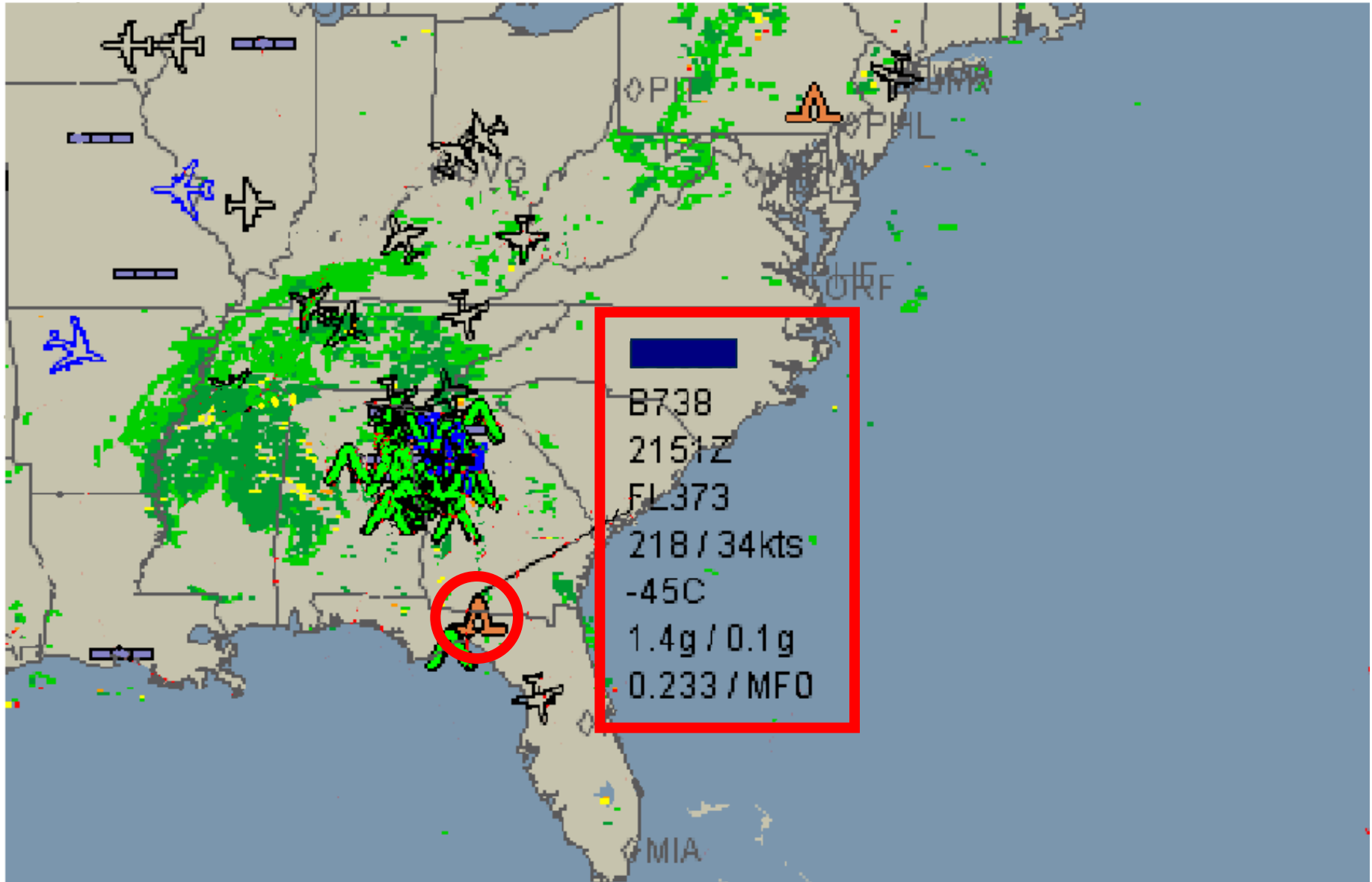
Turbulence Under-Reporting & Distribution Issues Resolved

Turbulence Impact on Operations: Today

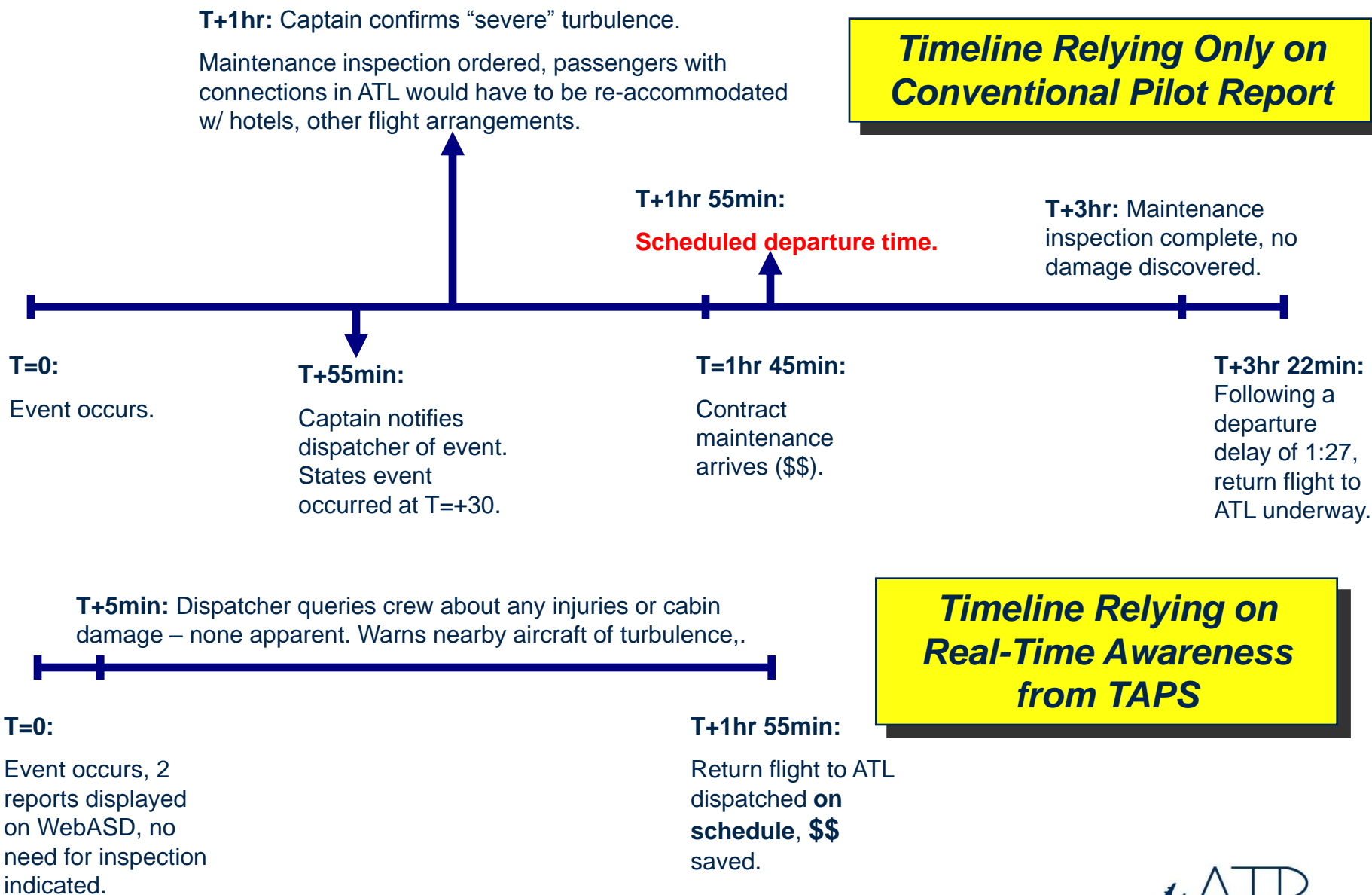
Actual event: Delta B737-800 over north Florida encounters “severe” turbulence.



Dispatcher's View of the Event



Turbulence Impact on Operations: Today +





Enhanced Turbulence Mode Radar (E-Turb)

“E-Turb” Radar Display Presentation



WX+T

005/13

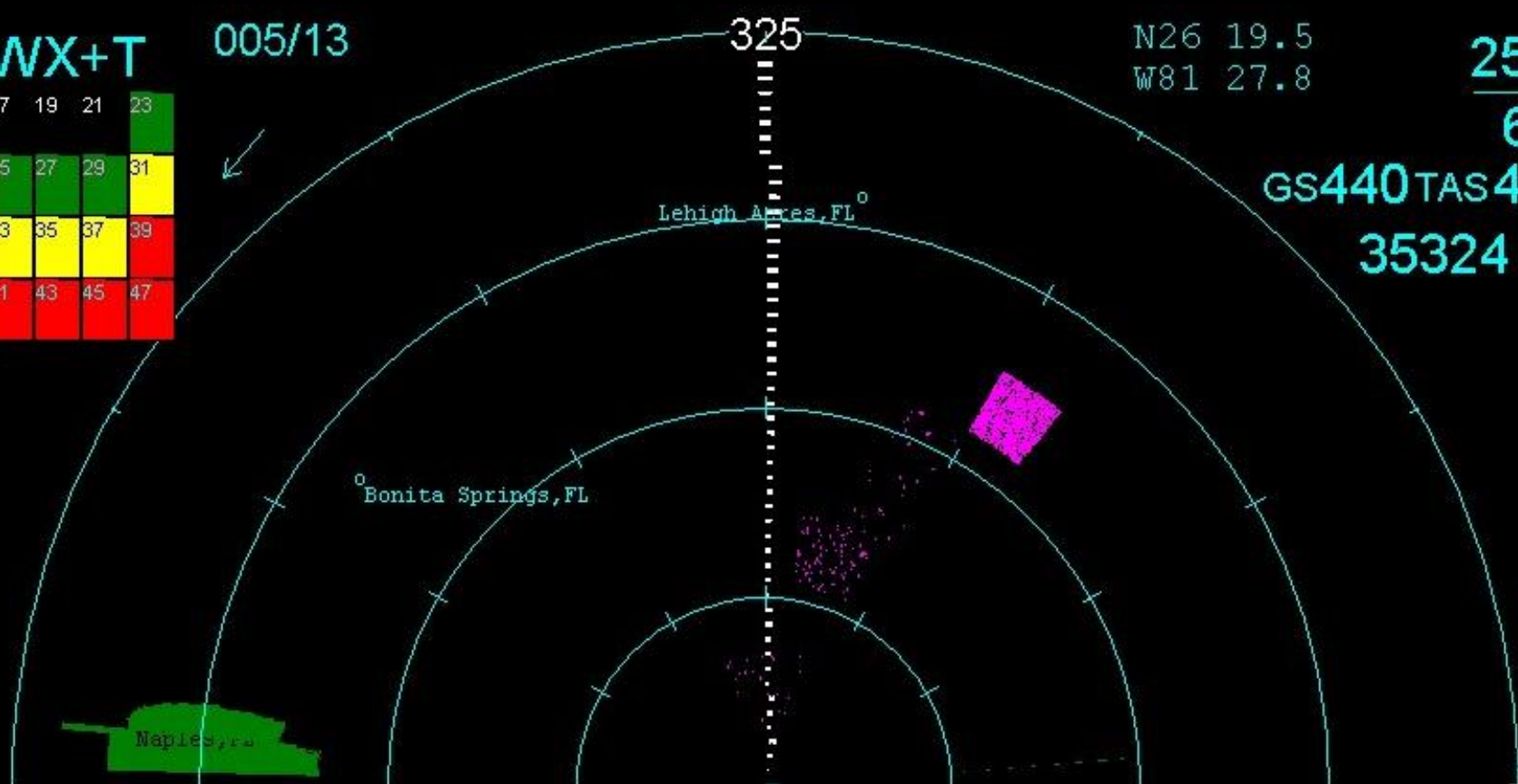
17	19	21	23
25	27	29	31
33	35	37	39
41	43	45	47

N26 19.5
W81 27.8

25
6

GS440 TAS450

35324 FT



3.00↓

MAP

WX+T

355/5

17	19	21	23
25	27	29	31
33	35	37	39
41	43	45	47

N26 32.1
W81 37.8

25
6

GS439 TAS444

35004 FT



3.00↓

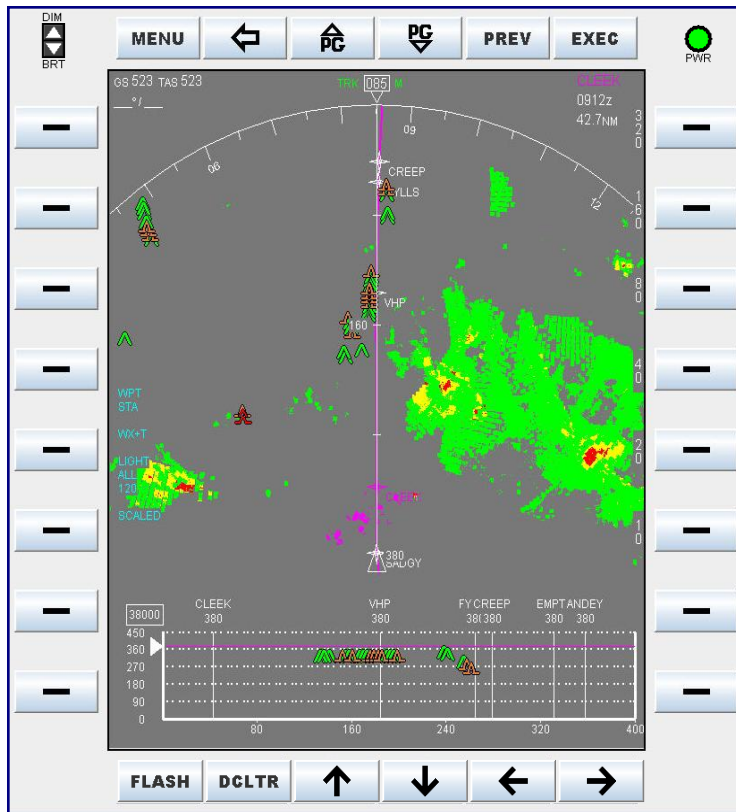
MAP



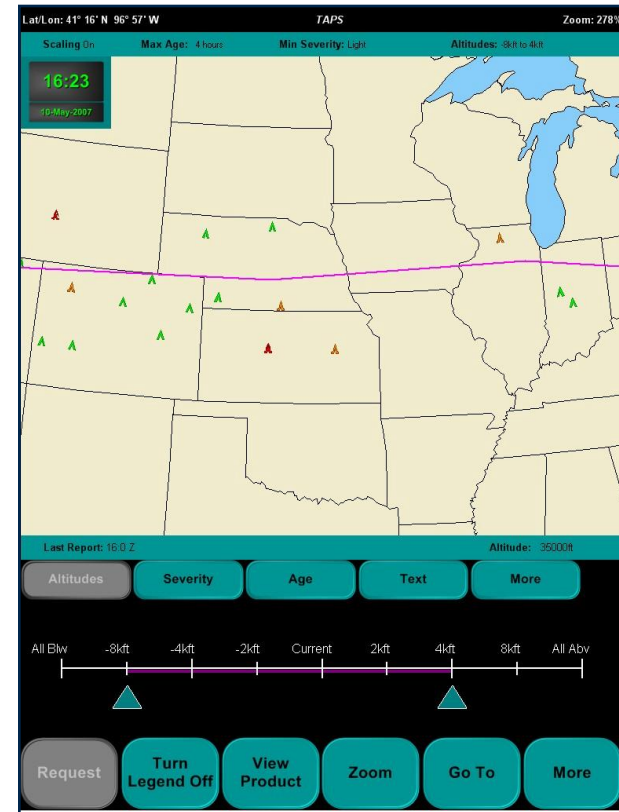
Cockpit Displays and Other Applications

Prototype Cockpit Displays

TAPS + E-Turb Sector PPI with VPD (Nav display)

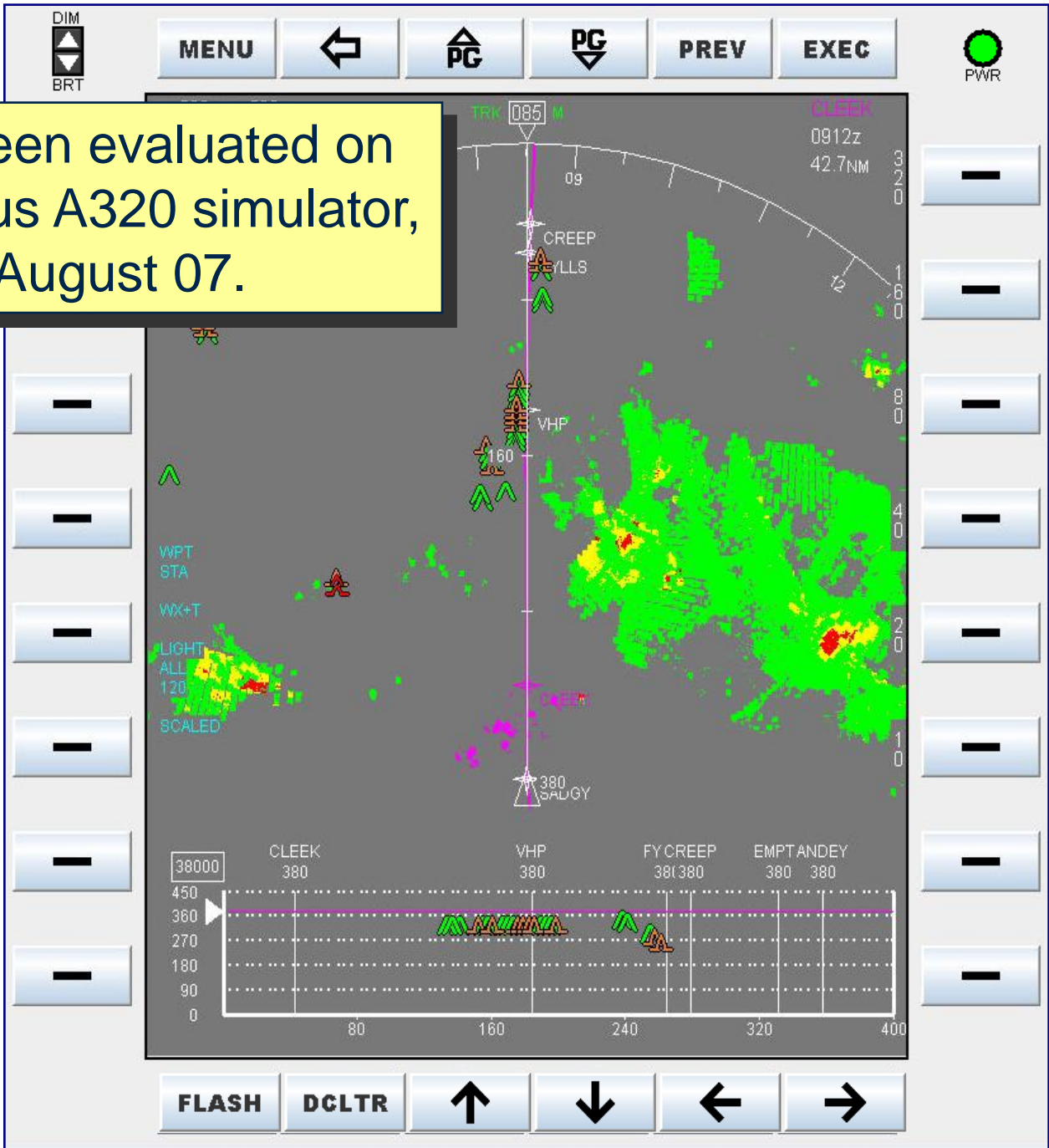


“Overhead” Map (Electronic Flight Bag)



NASA funded R&D efforts

Has been evaluated on an Airbus A320 simulator, August 07.



Lat/Lon: 41° 16' N 96° 57' W

TAPS

Zoom: 278%

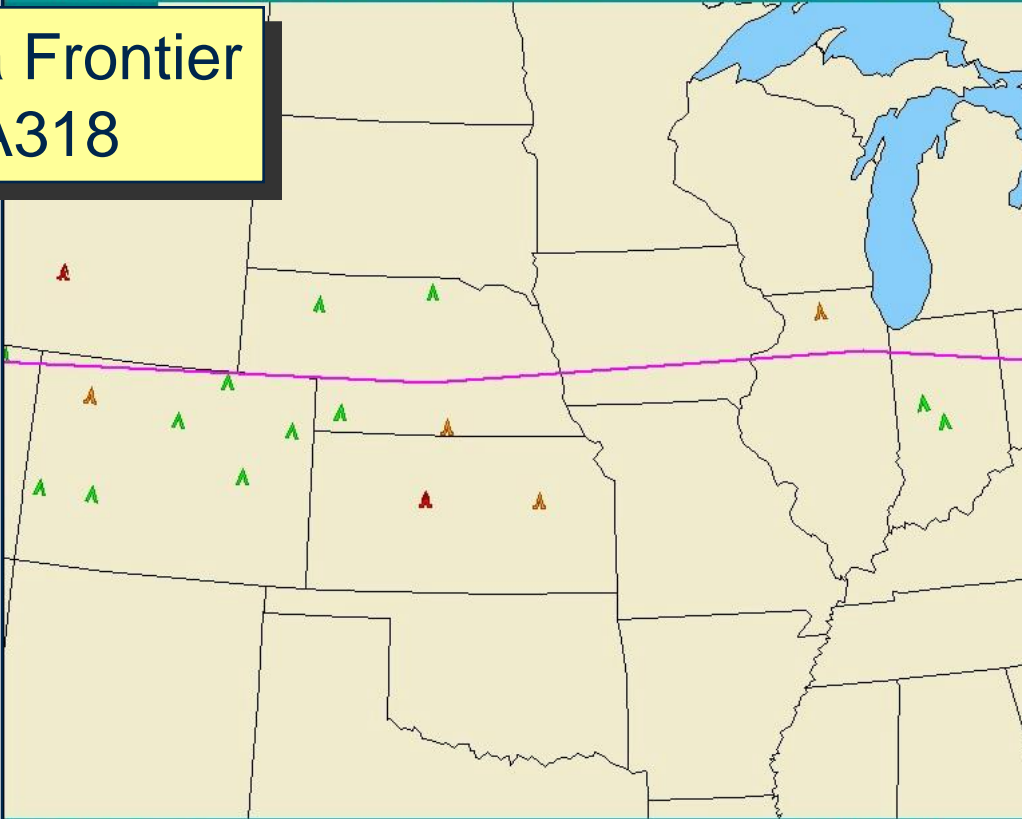
Scaling On

Max Age: 4 hours

Min Severity: Light

Altitudes: -8kft to 4kft

Installed on a Frontier Airlines A318



Last Report: 16:0 Z

Altitude: 35000ft

Altitudes

Severity

Age

Text

More

All Blw

-8kft

-4kft

-2kft

Current

2kft

4kft

8kft

All Abv

Request

Turn Legend Off

View Product

Zoom

Go To

More

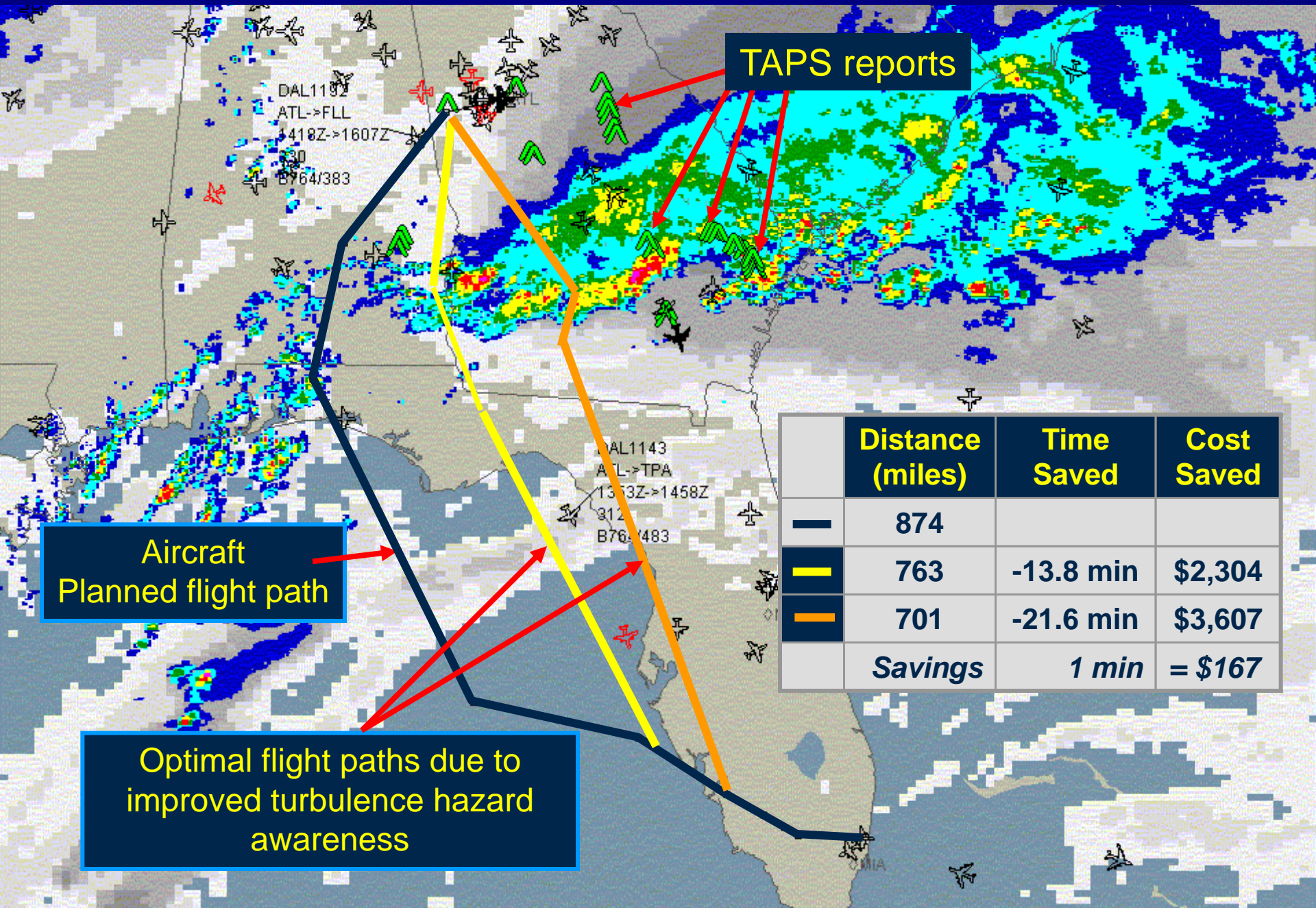


AEROTECH RESEARCH (U.S.A.), INC.



Operational Application of Turbulence Detection and Avoidance Systems

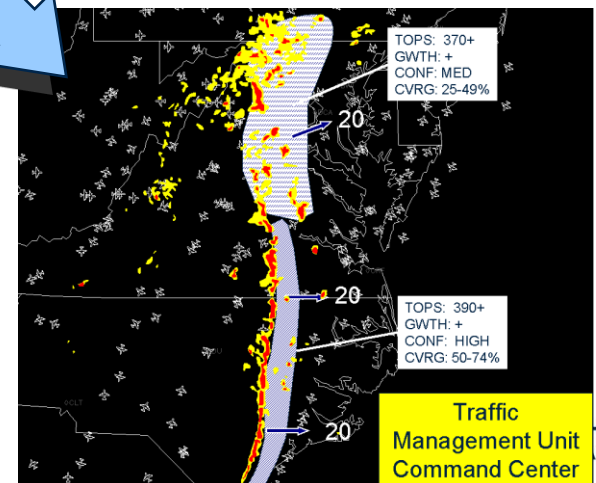
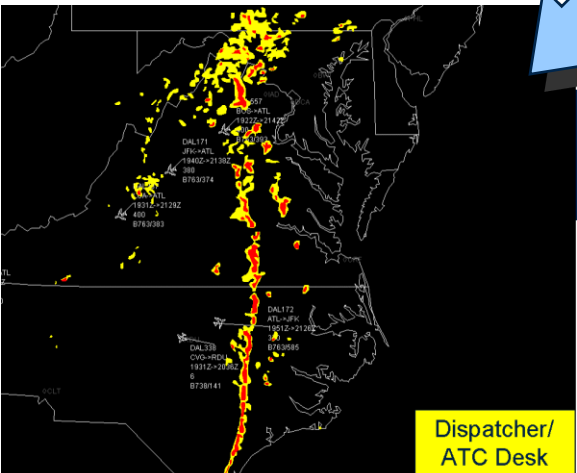
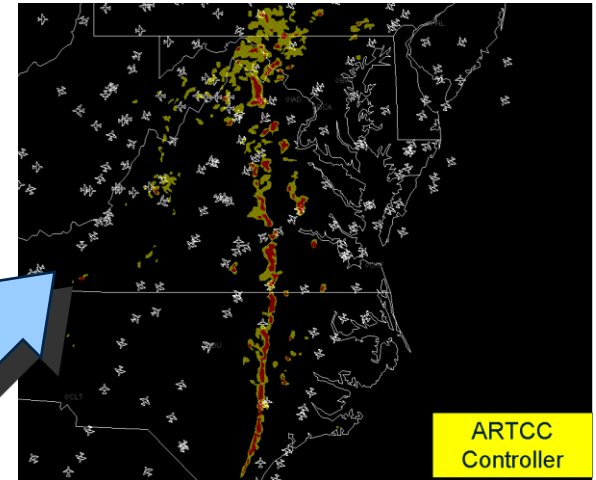
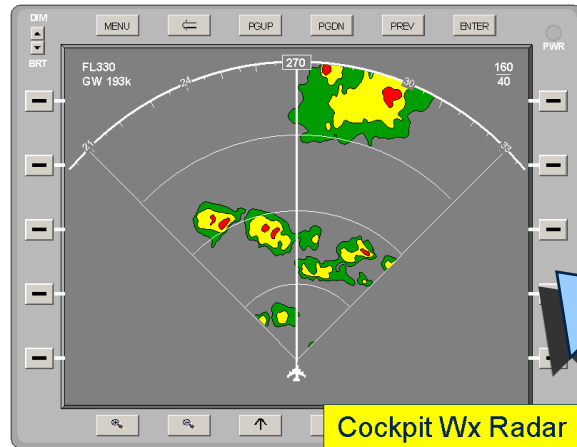
Potential Time/Distance/Cost Savings



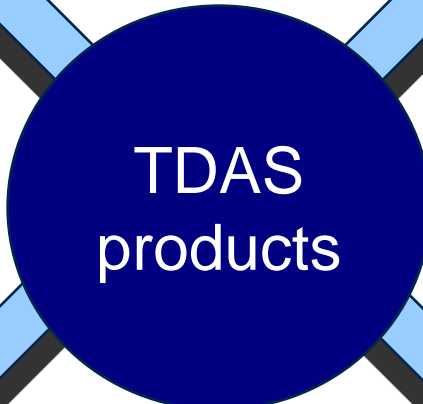
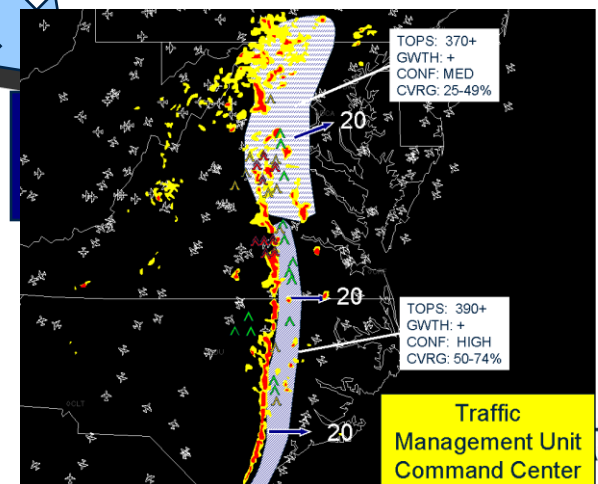
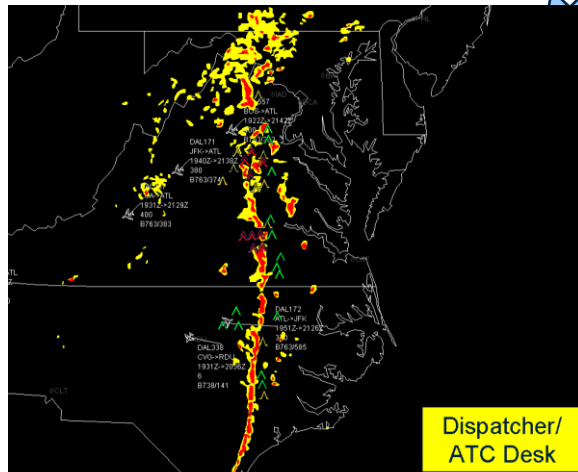
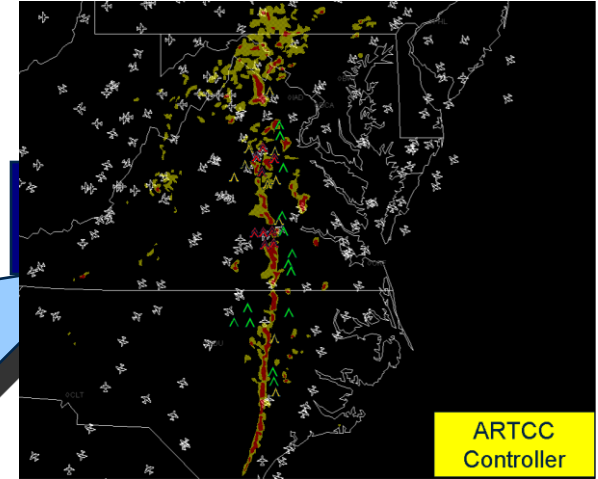
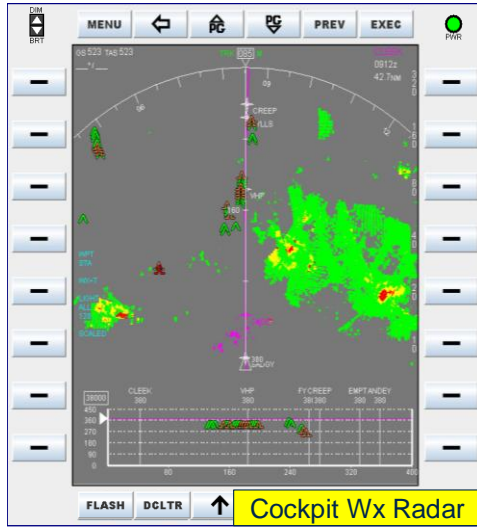
DAL1182
ATL->FLL
1418Z->1607Z
B764/383

DAL1143
ATL->TPA
1313Z->1458Z
B764/483

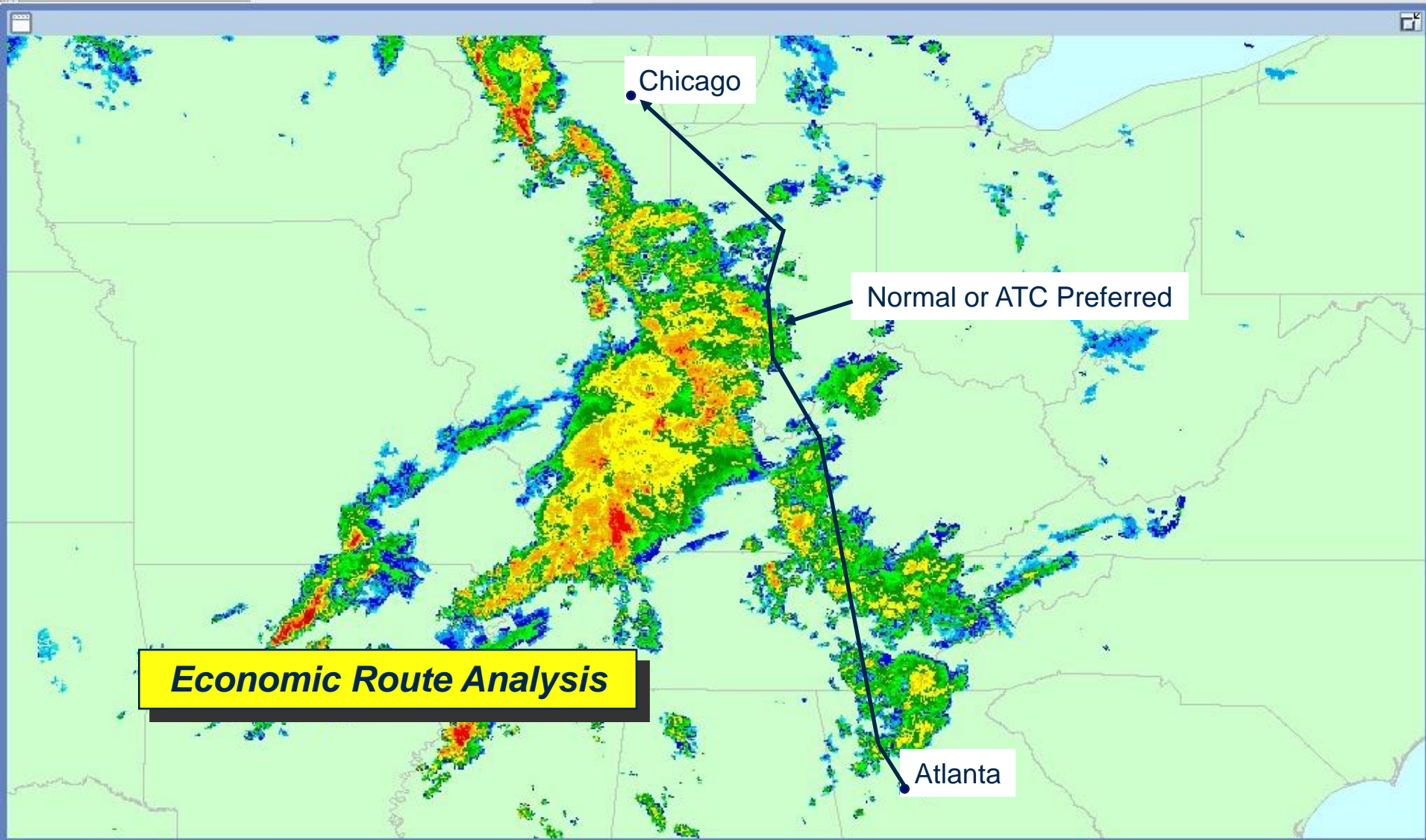
Turbulence Information Flow - Present



Turbulence Information Flow - Future



TAPS in Flight Planning



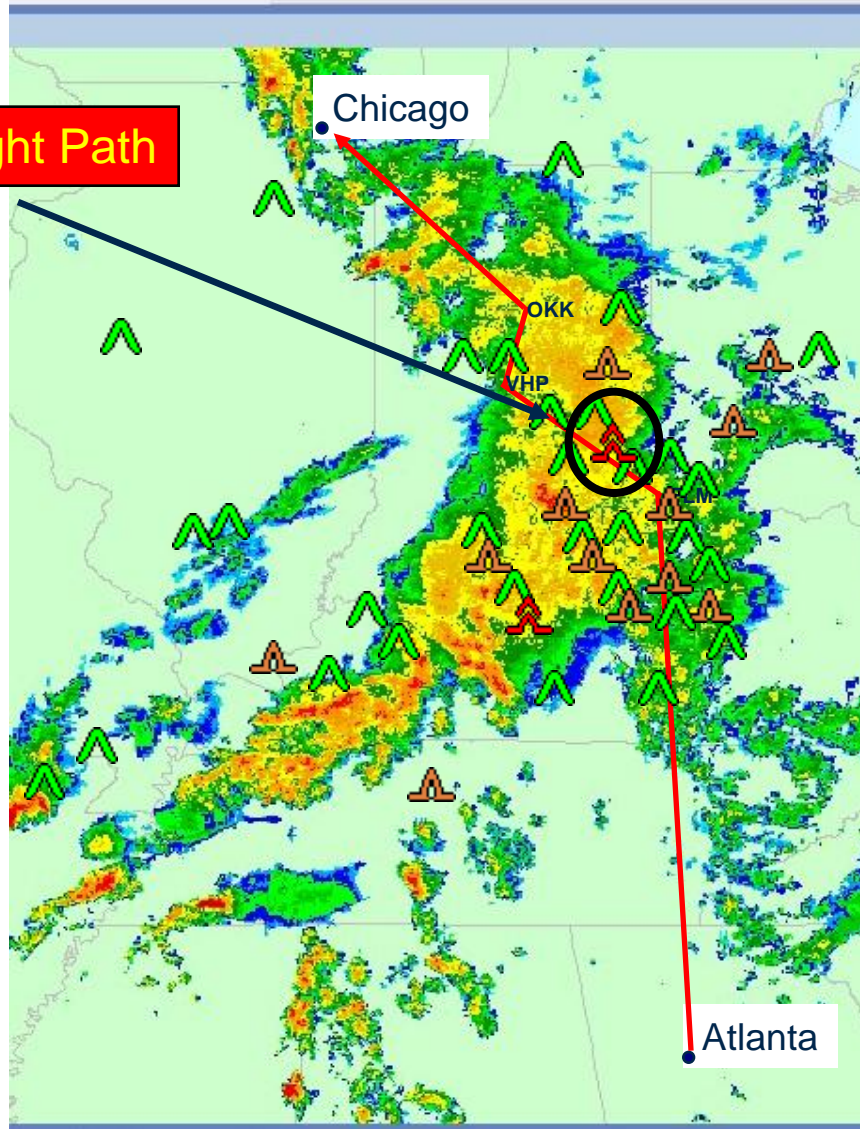
TAPS in Flight Planning



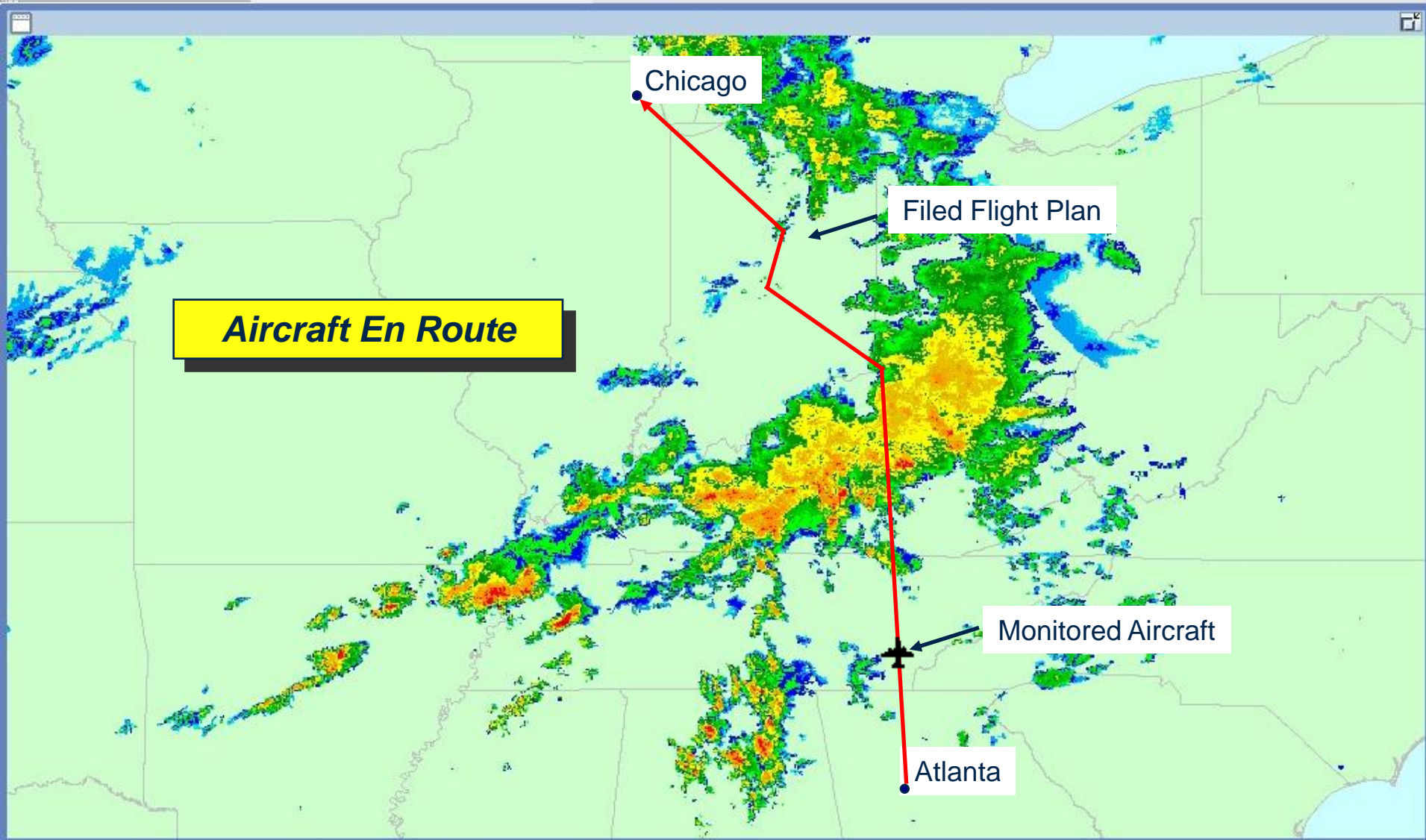
TAPS in Flight Planning

Severe Report on Flight Path

*Develop Flight Plan;
Published Re-Route from 1054z-1500z*

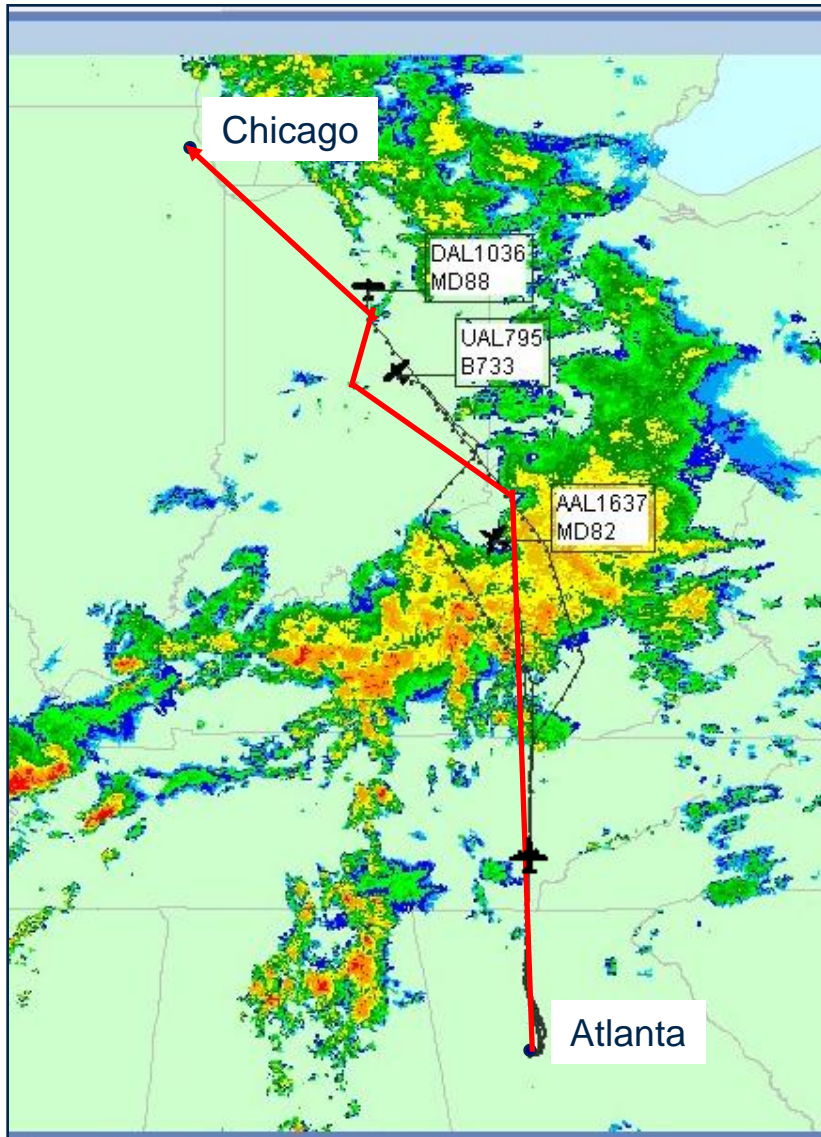


TAPS in Flight Following

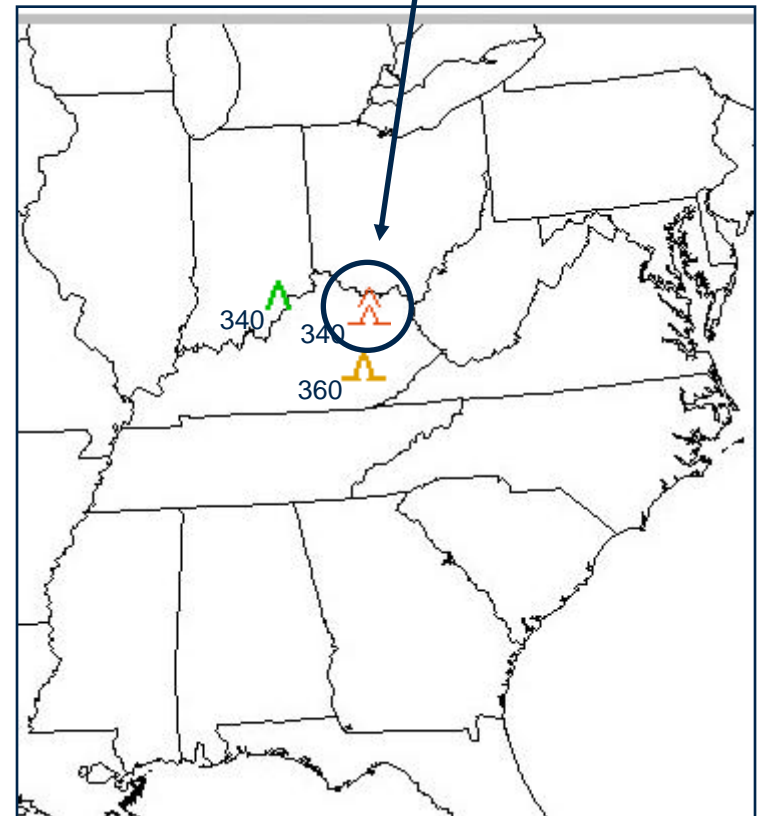


- **ATL-ORD**
- **Convective Region Along Flight Path**

TAPS in Flight Following



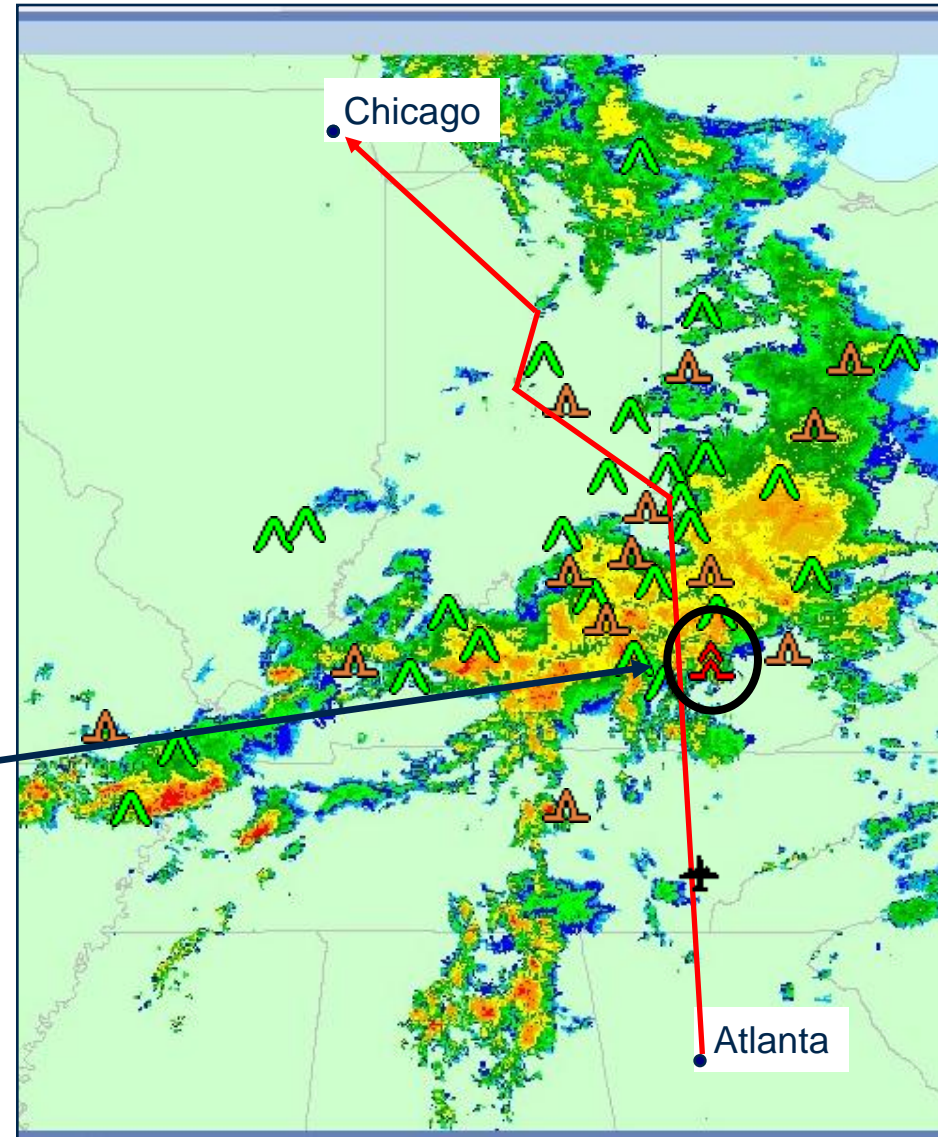
How does Severe turbulence impact operations?



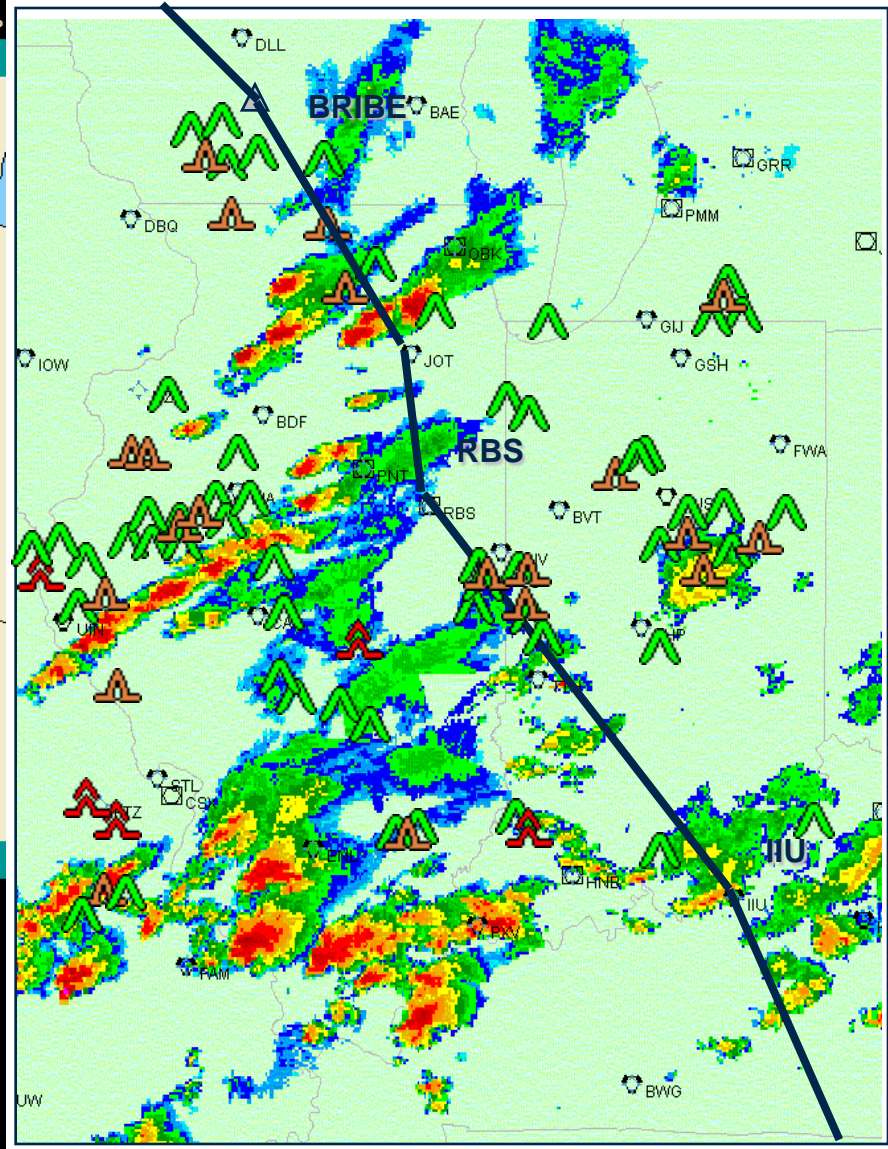
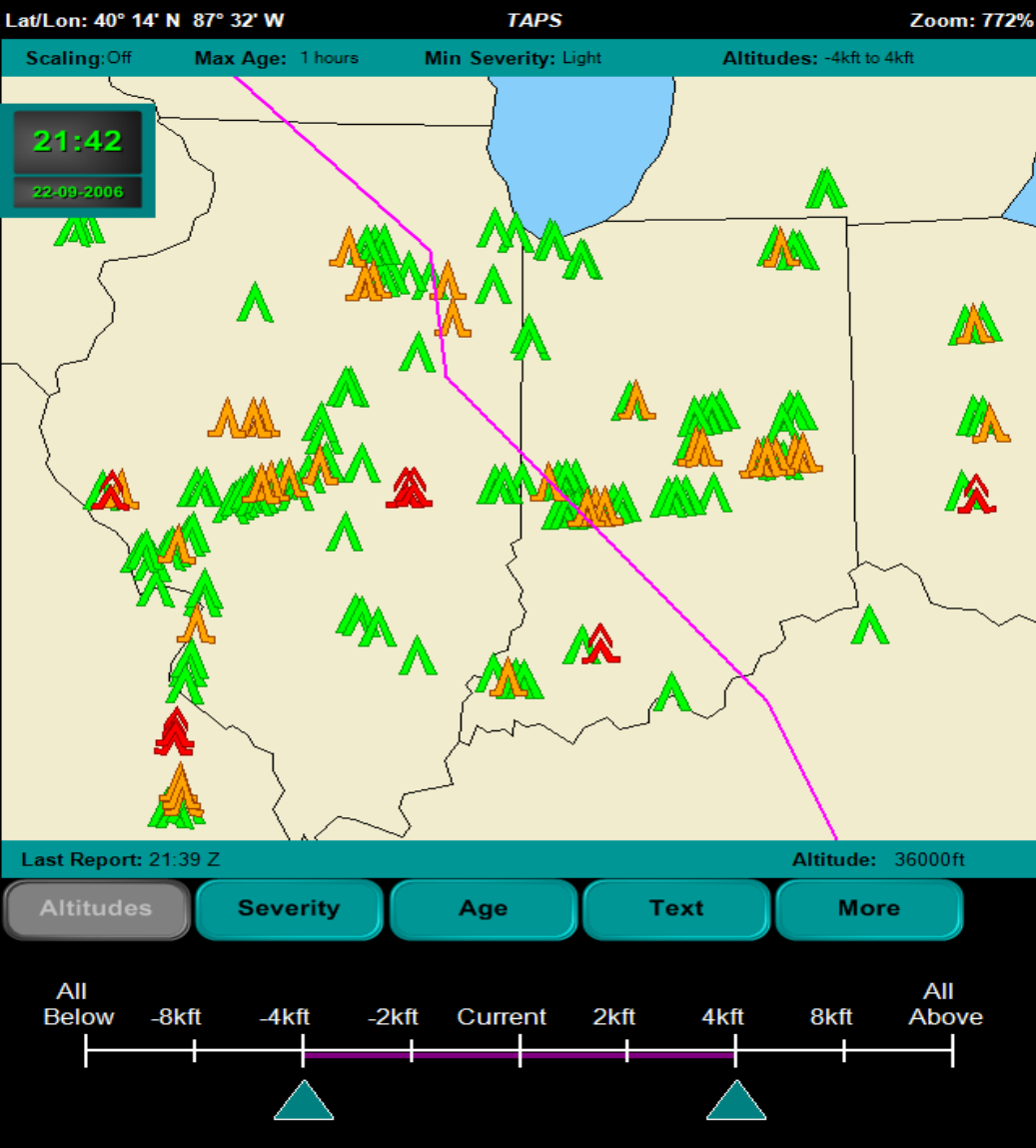
TAPS in Flight Following

Communicating Turbulence Information to the Pilot

Severe Report on Flight Path



Dispatcher-Pilot Collaboration



Contact Information

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