

# Enhanced Weather Radar and Aviation Weather Awareness & Reporting Programs

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# Motivation

- Weather is the cause or contributing factor to nearly 25% of aviation accidents and 35% of fatalities.
  - *Improved weather information for pilots may break the chain of events that lead to an accident.*
- Weather is the number one source of flight delays in the United States.
  - *Improved weather information may provide pilots with a more efficient means of navigating around hazardous weather.*

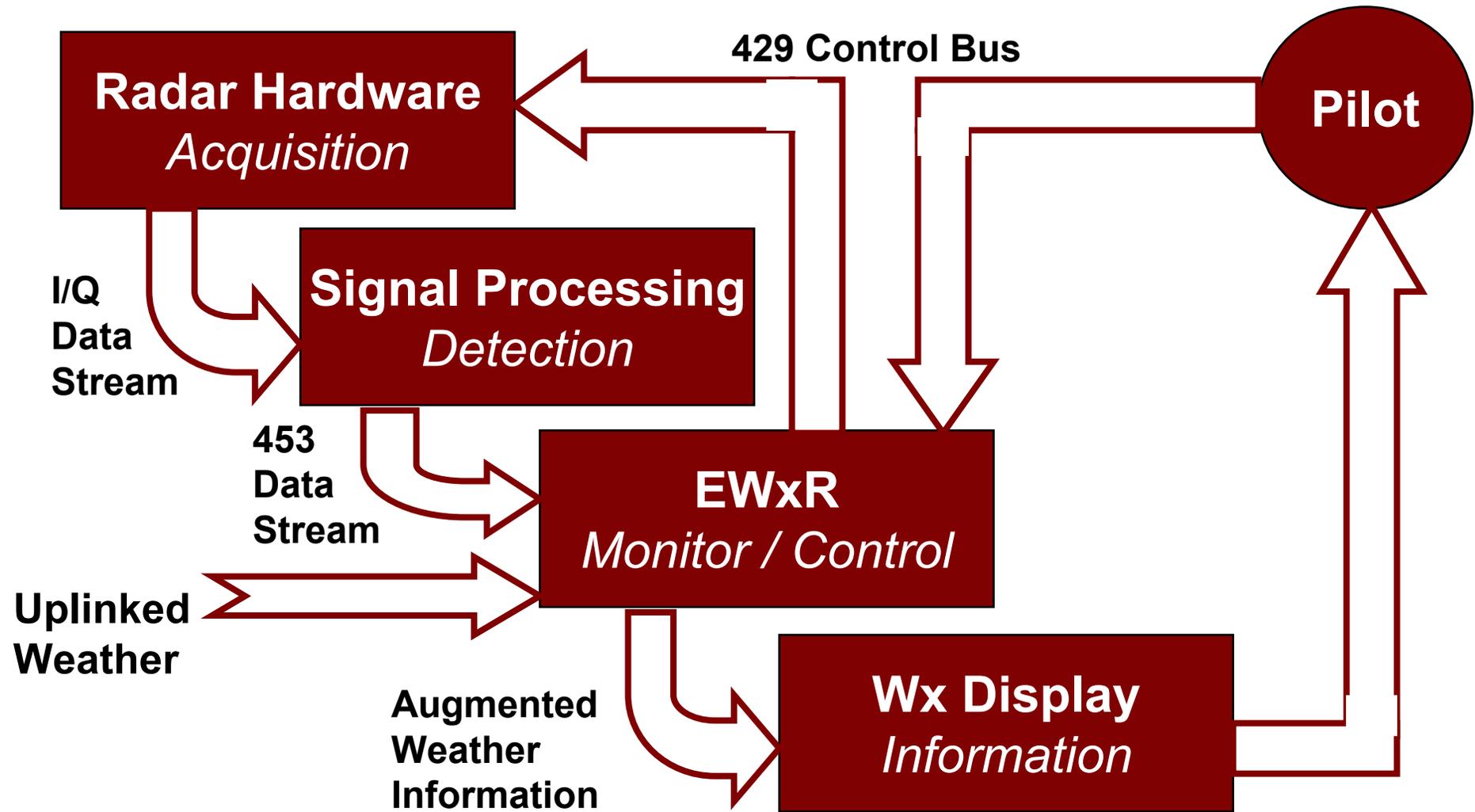
# Background

- In 1998, NASA initiated the Aviation Weather Information (AWIN) program.
  - Enhance the safety and efficiency of aircraft operations by improving the availability and quality of weather information to the flight crews.
- September 1998, NASA, Rockwell Collins, and Rockwell Science Center started two cooperative research agreements, termed Enhanced Weather Radar (EWxR), Aviation Weather Awareness and Reporting (AWARE).
- January 2001, NASA, Rockwell Collins, and Rockwell Science Center began development of the Airborne Hazard Avoidance System (AHAS).

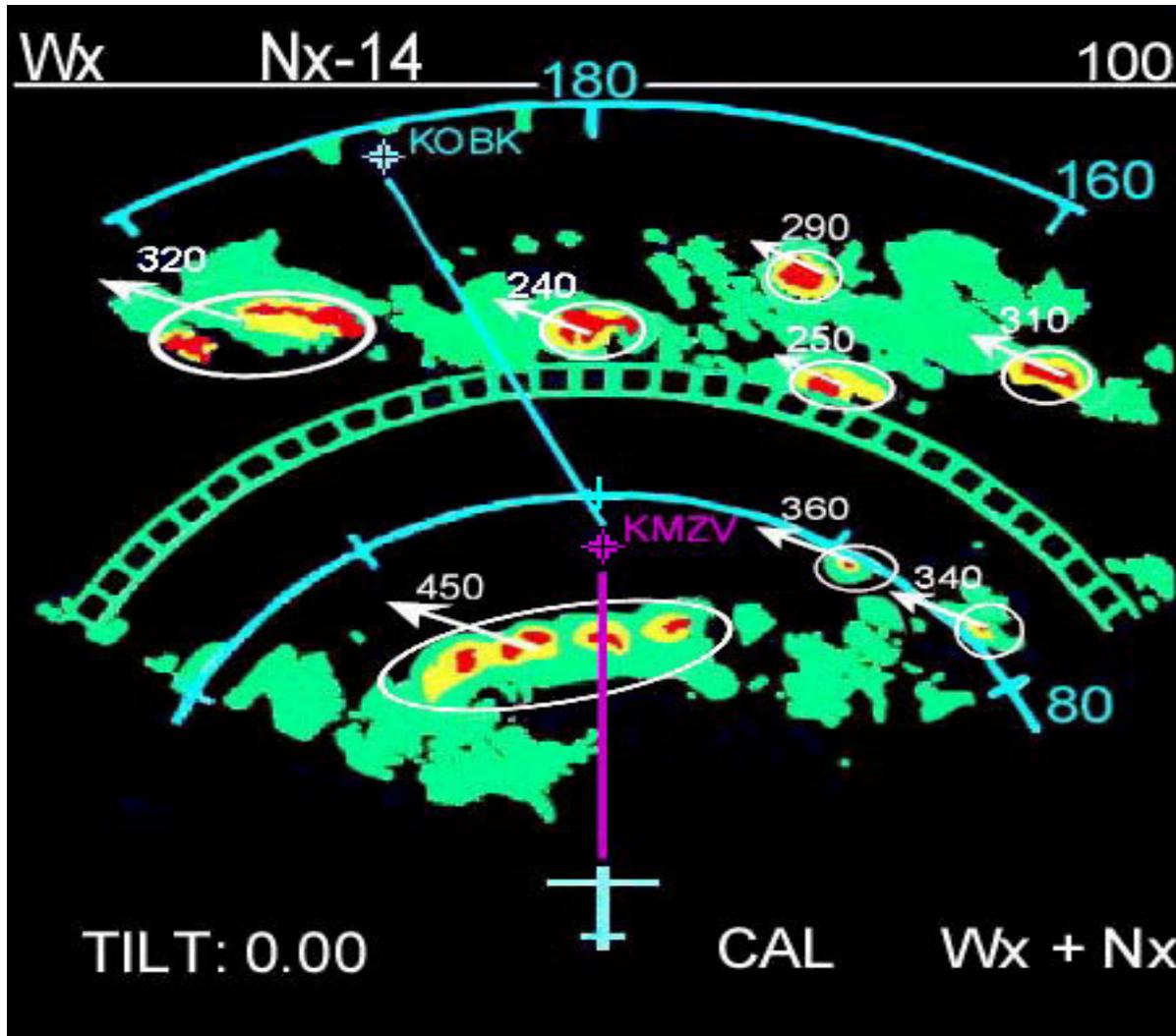
# EWxR

- 1999 Accomplishments:
  - Track storms.
  - Determination of storm dynamics, such as speed and heading.
- 2000 Accomplishments:
  - Integrate NEXRAD image data into ARINC 453 video data format and display it on a standard radar indicator, multi-function display (MFD), or xVGA monitor.
  - 9/24/00 - Successful flight test on NASA's 757.
- 2001 Accomplishment
  - Flight plan analysis

# EWxR Processing



# EWxR Display



# AWARE

- 1999 Text -> Graphics interpretation and decision analysis.
  - METARs and SIGMETs.
- 2000 Experimental NCAR products integration.
  - Icing, turbulence, convective weather products.
- 2001 IFR Summary Display Implementation.
  - Implement IFR Summary Display.
  - Incorporate Area Forecast data into Hazard Analysis model.
- 2001 PIREP Integration.
  - PIREP integration.
  - Hazard Analysis for IFR pilots.
- 2001 Demonstration on NASA 757.

# AWARE Processing

```
AIRMET ICE .WA OR CA  
FROM TVL TO FAT TO BIH TO RNO TO TVL  
LGT OCNL MOD RIME ICGG BTN 070  
AND FL200. CONDS SPRDG SLOLY  
SEWD AND CONTG BYD 09Z THRU 15Z.  
  
AIRMET TURB .WA OR CA ID MT  
FROM EHF TO SMX TO SBA TO VTU TO PMD  
TO EHF  
OCNL MOD TURB BLW 120 DUE TO MOD WLY  
FLOW. CONDS SPRDG EWD AND  
CONTG BYD 09Z THRU 15Z.
```

Parsing from text data

Weather Event  
Database

XML

Icing\_Event

- Unique\_ID:
- Spatial\_Extent: ...
- Temporal\_Extent: ...
- Type: Rime
- Severity:
- Direction:
- Velocity:
- Supercedes:

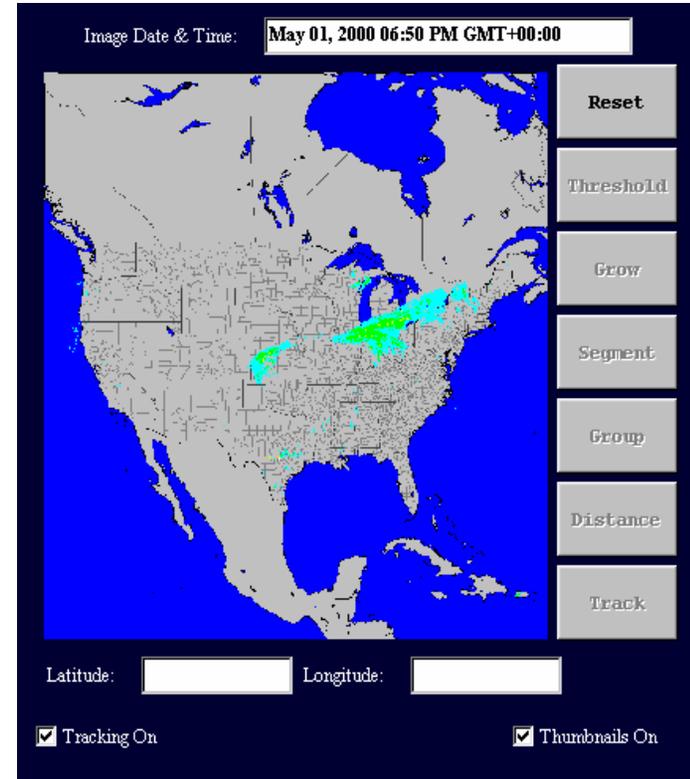
Turbulence\_Event

- Unique\_ID:
- Spatial\_Extent: ...
- Temporal\_Extent: ...
- Type: Clear air
- Severity: Moderate
- Direction:
- Velocity:
- Supercedes:

Data models



Sufficient statistics analysis &  
Information filtering for planning



Image/signal processing

Flight planning assistance &  
Decision-support analysis

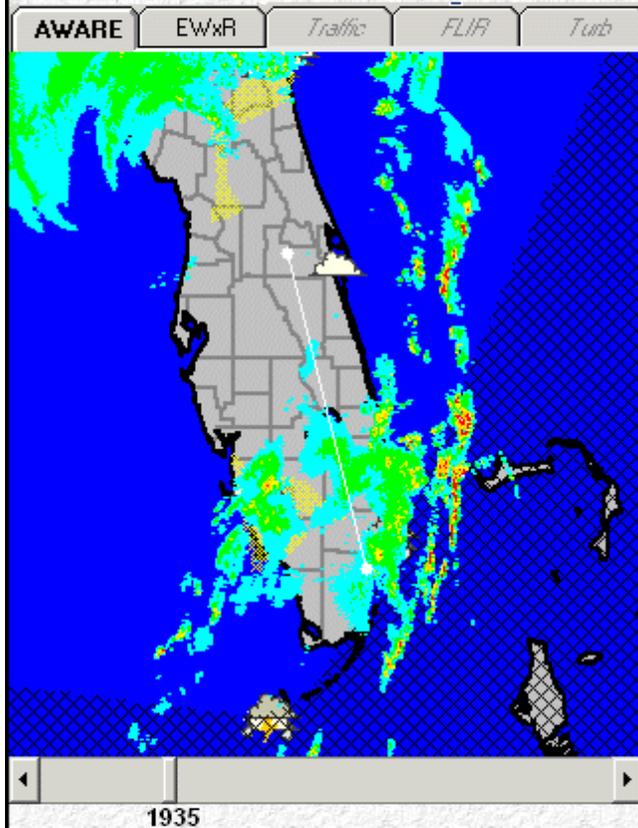
Rockwell  
Collins



Rockwell  
Science Center

# AWARE Display

Pilot: **Tim Rand** Flight Plan: **MIA - ORL** Flight Date/Time: **09/17/00 19:40** Current Date/Time: **09/21/00 13:32**



▼ <b>Mission</b>	Hazard
▼ <b>Depart/Climb</b>	Hazard
Precip	clear <a href="#">Metar</a>
▼ <b>Wind</b>	Hazard
▼ <b>Cross Winds</b>	Hazard
Reported	10 - 15 kt <a href="#">Metar</a>
Pilot Preference	10 kt <a href="#">PilotPref</a>
▷ <b>General Winds</b>	No Hazard
▼ <b>Cruise</b>	Hazard
▼ <b>Endurance</b>	Hazard
Enough Fuel	false <a href="#">Metar</a>
▷ <b>Other Overall Weather</b>	No Hazard
▶ <b>Descend/Land</b>	Potential Hazard
▼ <b>Hazard Levels (in order of probability)</b>	
Cross Winds Depart	10-15 Kt
Endurance	False
Gusting Winds Landing	+10-15 Kt

## Display Options

- |  |   |  |  |
|--|---|--|--|
| <input checked="" type="checkbox"/> Hazard Icons | <input checked="" type="checkbox"/> Flight Plan |  |  |
| <input checked="" type="checkbox"/> Summary      | <input checked="" type="checkbox"/> NEXRAD      |  |  |
| <input type="checkbox"/> OnBoard Wx Radar        | <input type="checkbox"/> Winds                  |  |  |

KMIA 180108Z 19004KT 10SM -TSRA BKN042 OVC090 23/22 A2997 RMK AO2 P0000 (SPECI)

KMIA 180109Z 19003KT 10SM -RA BKN042 BKN070 OVC090 23/22 A2997 RMK AO2 TSE09 P0000 (SPECI)

KMIA 180156Z 00000KT 10SM FEW018 BKN026 BKN070 OVC150 23/22 A2997 RMK AO2 TSE09RAE53 SLP150 P0005 T0233022

KMIA 180202Z 00000KT 10SM FEW026 SCT070 BKN150 23/22 A2998 RMK AO2= (SPECI)

# AHAS

- Develop flexible COTS-based platform with aircraft interfaces necessary for operational evaluation of:
  - AWIN systems
    - EWxR display formats, storm analysis, flight plan analysis logic
    - AWARE weather analysis and decision aids
  - Integrate new datalinked weather products from the AWC.
  - Integrate new atmospheric hazard sensors, such as the TDAM experiment.

# Further Studies

- What ranges are useful for display of NEXRAD on a weather radar indicator?
- What will be the effect of simultaneously displaying radar data taken from different angles and altitudes?
- How well does the data from from various weather data sources correlate?
- What NEXRAD update rate is necessary and how much latency is acceptable?
- Which weather product(s) will be most useful?

# Further Evaluations

- Continue experiments of EWxR, AWARE, and AHAS systems on NASA's 757 through Fall 2001.
- Fall 2001 - Participate in FAA's study of utility of ground-based weather information in the cockpit.