

# Weather Accident Prevention Project Review

May 23, 2000

Weather Hazard Information System  
Reducing General Aviation Fatal Weather Related Accidents

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ARNAV Systems, Inc

## **Weather Background**

- **Weather is a factor in 30% of aviation accidents, and is the single largest contributor to aviation delays**
- **The goal of the AWIN program is to provide improved weather information to users in the National Airspace System**
- **Weather accidents and Controlled Flight into Terrain (CFIT) is the result of loss of situational awareness**
- **In July, 1999, ARNAV and Honeywell were selected as FAA Flight Information Service (FIS) weather service providers**

## AWIN Team Members

**ARNAV Systems, Inc** - Provide certified Avionics, FAA Certification review, Wx dissemination Network, Wx Product Development

**Cessna Aircraft** - Flight test crew and aircraft, human factors response, evaluate market acceptance

**FedEx Cargo Operations** - Wiggins Air in the Northeast - Empire Air in the Northwest, evaluate human factors, provide daily use and feedback from professional pilots flying in all weather conditions

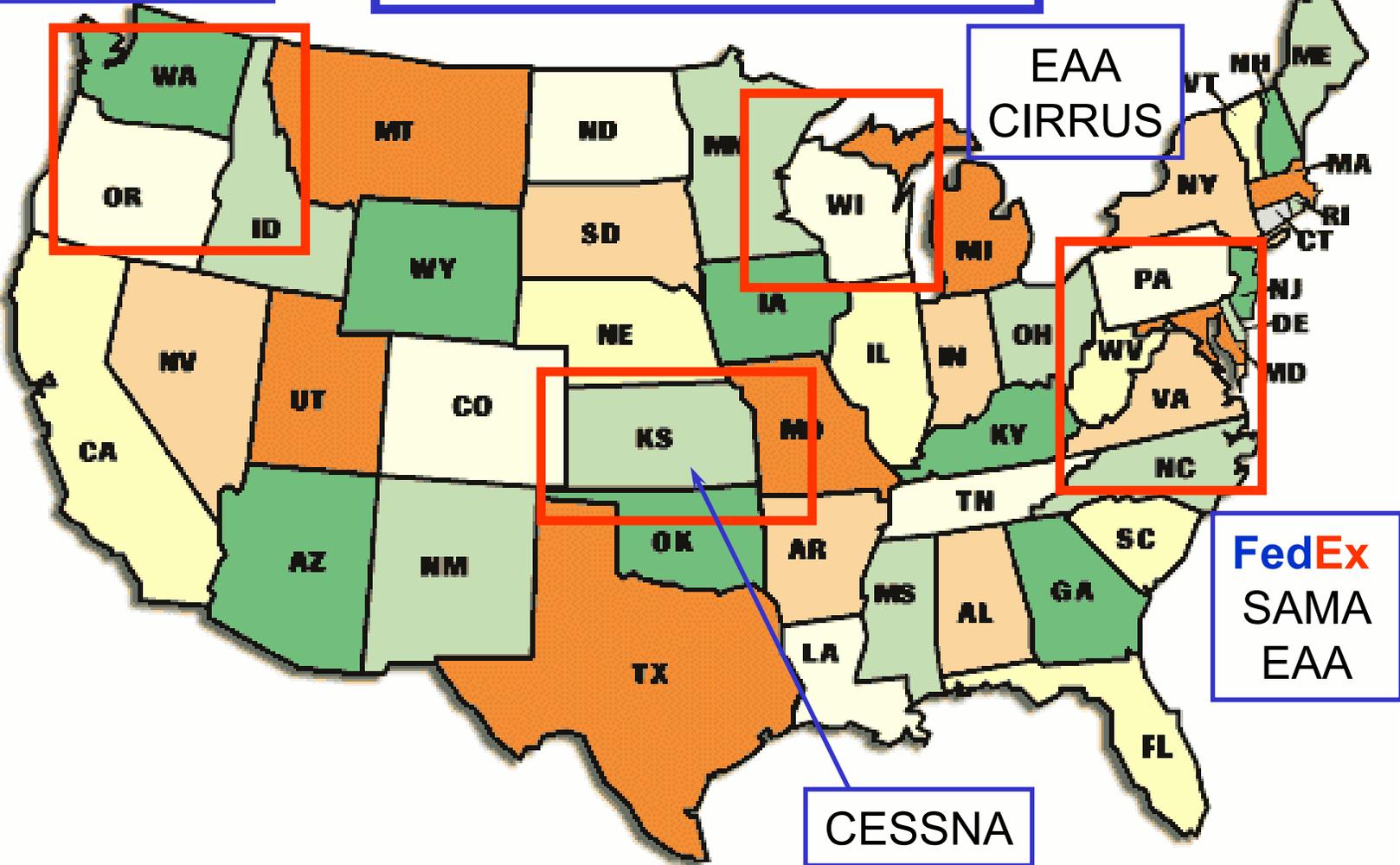
**National Center for Atmospheric Research** - Provide experimental weather products for transmission to aircraft, human factors evaluation of newly created pilot weather products

**Experimental Aircraft Association** - Evaluate market acceptance, pilot-machine interface, human factors evaluation of graphical wx products

**SAMA** - liaison to RTCA and FAA FIS programs, pilot-machine interface

**FedEx**  
ARNAV  
CAP AK / ID

**AWIN Flight Test Ranges**  
1. WA - OR      2. Kansas  
3. MN - WS      4. PA - VA



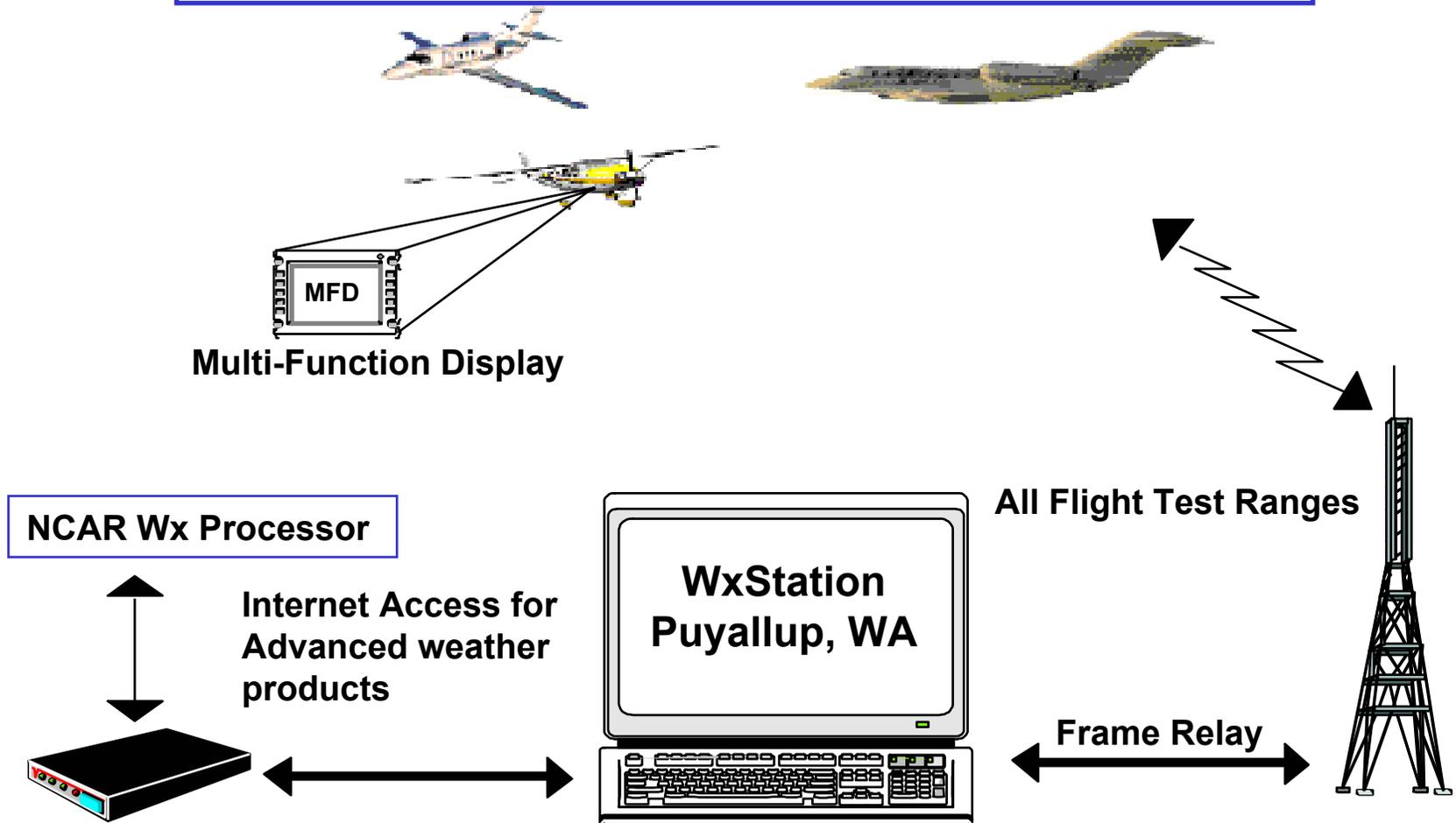
EAA  
CIRRUS

**FedEx**  
SAMA  
EAA

CESSNA

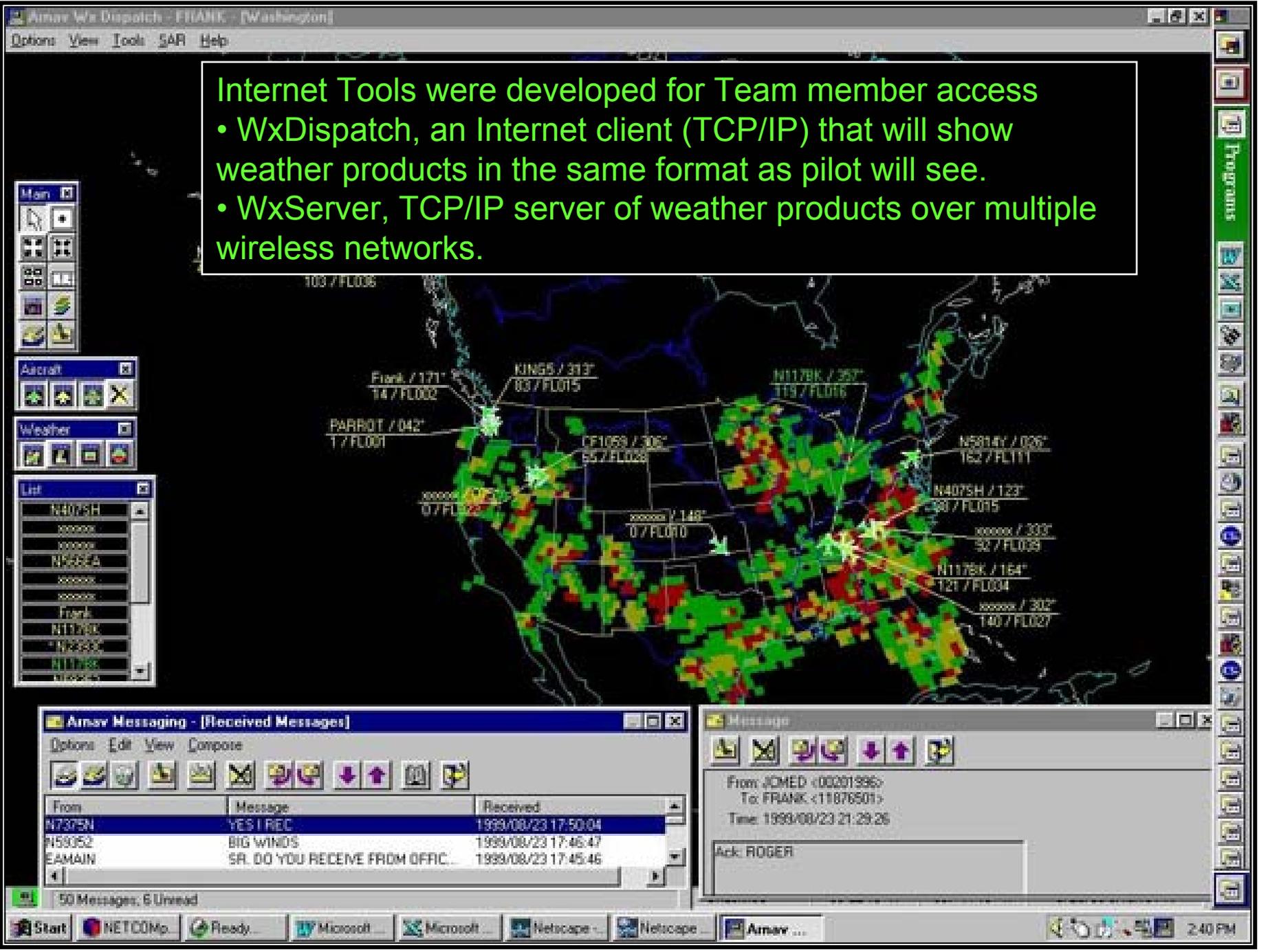
# AWIN DataLink Functions

- Broadcast of Graphical Weather Products
- Electronic Pilot reports (E-PiREPs) geo-referenced to flight following report
- Two-way Text Messages



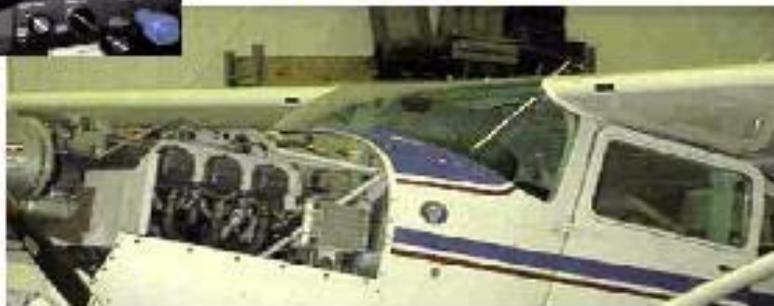
Internet Tools were developed for Team member access

- WxDispatch, an Internet client (TCP/IP) that will show weather products in the same format as pilot will see.
- WxServer, TCP/IP server of weather products over multiple wireless networks.





**Cessna 182**



**Cessna T-47**

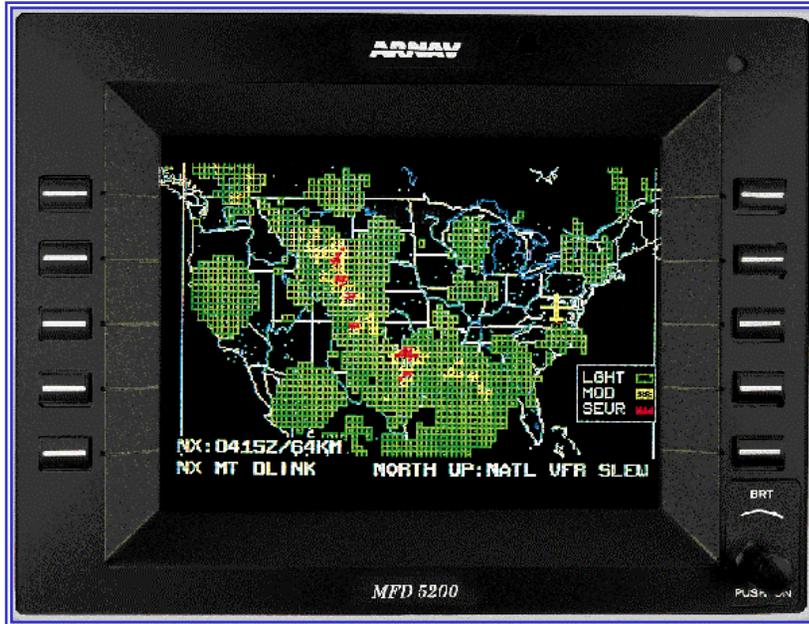
**Cessna 210**



**As of April 2000 - Flight Testing in 44 aircraft**

- 3 Cessna owned Aircraft
- 4 **FedEx** C-208B Caravans in Cargo Operations (e-PiREPs)
- 4 Virginia DOT aircraft
- 1 EAA GlaStar at FAA Tech Center
- 1 SAMA Aircraft in MD (e-PiREPs)
- 10 ARNAV Aircraft (4 e-PiREPs)
- 21 Civil Air Patrol aircraft (AK & ID)

# Avionics Equipment



**Multi-Function Display**

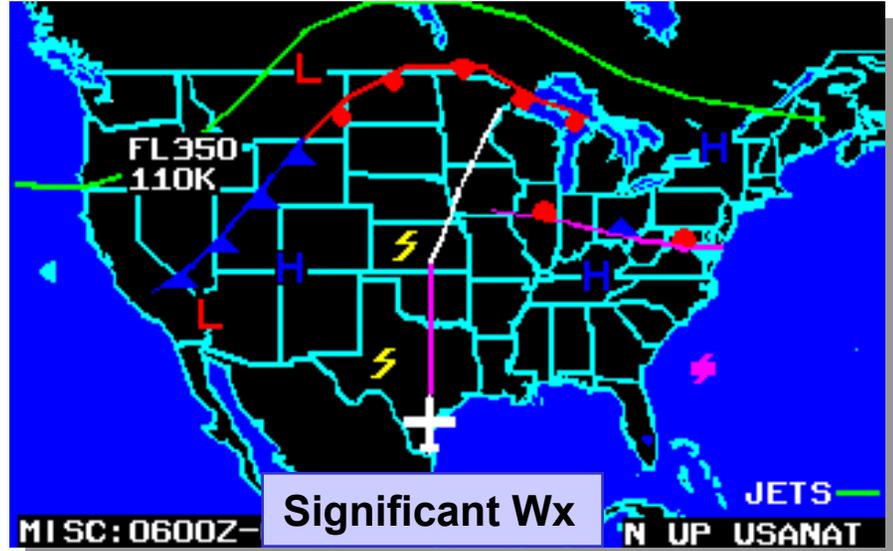
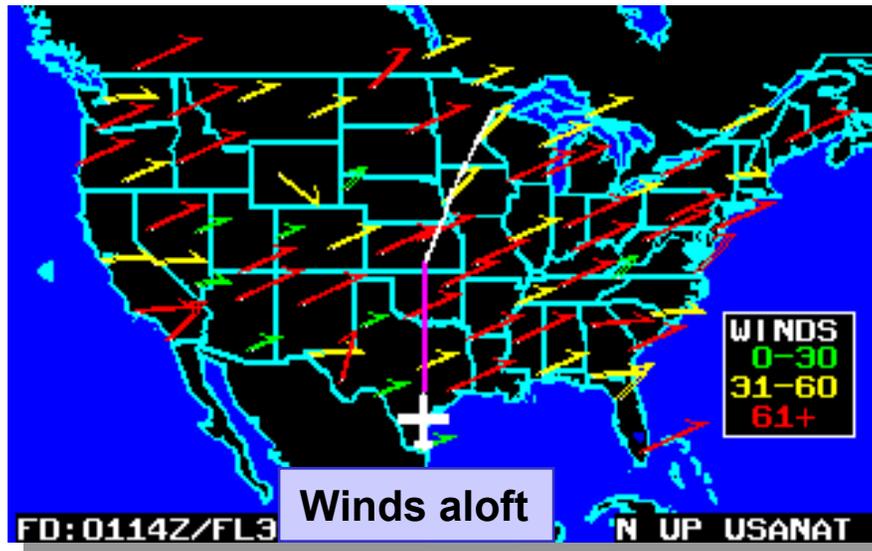
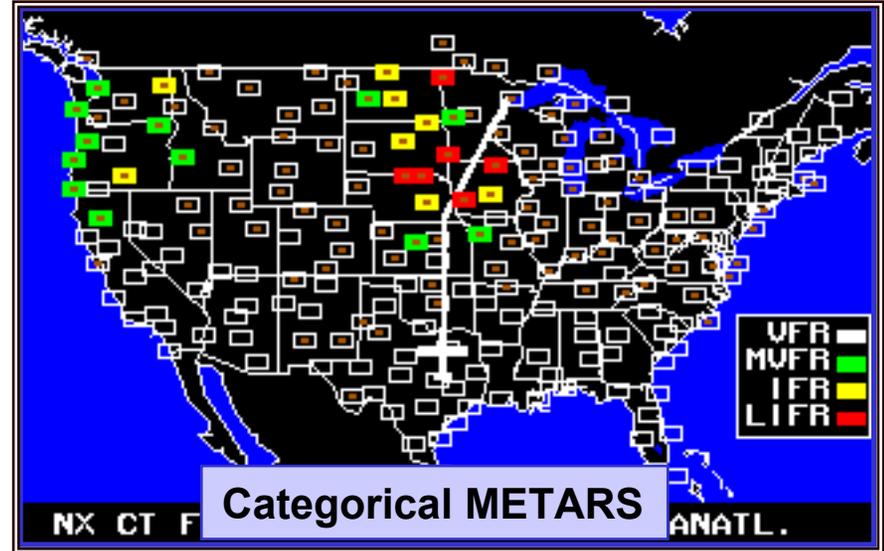
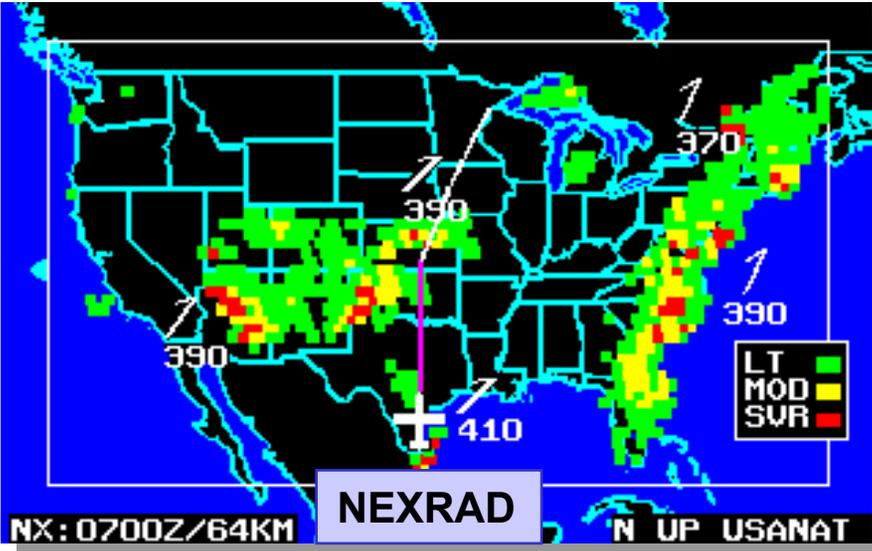


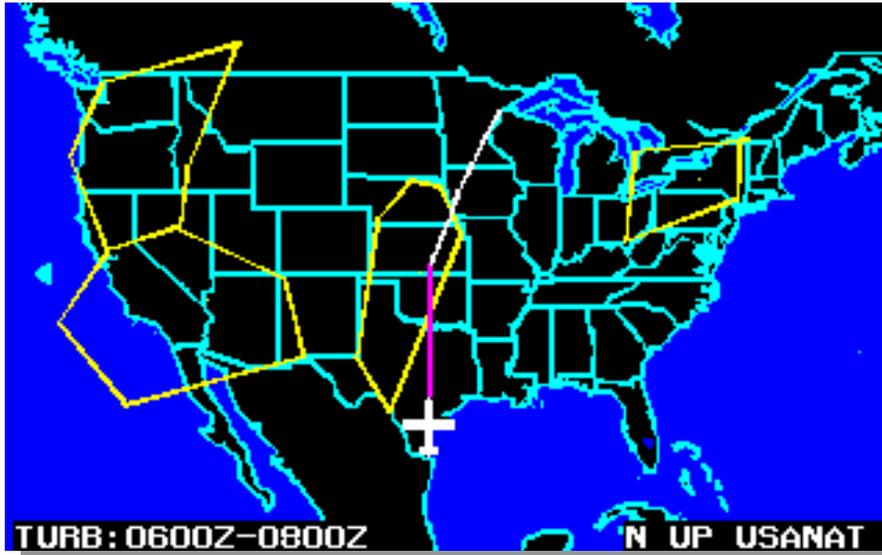
**Datalink / GPS / E-Pireps**

## **E-Pirep Sensors Approved on Cessna Caravan**

- Humidity Sensor 3% accuracy, 1% stability per year
- Temperature Sensor +/- .6 degree C, range -40C to +60C
- Icing level switch selected by pilot - Rime - Clear - Mixed

# Weather Products

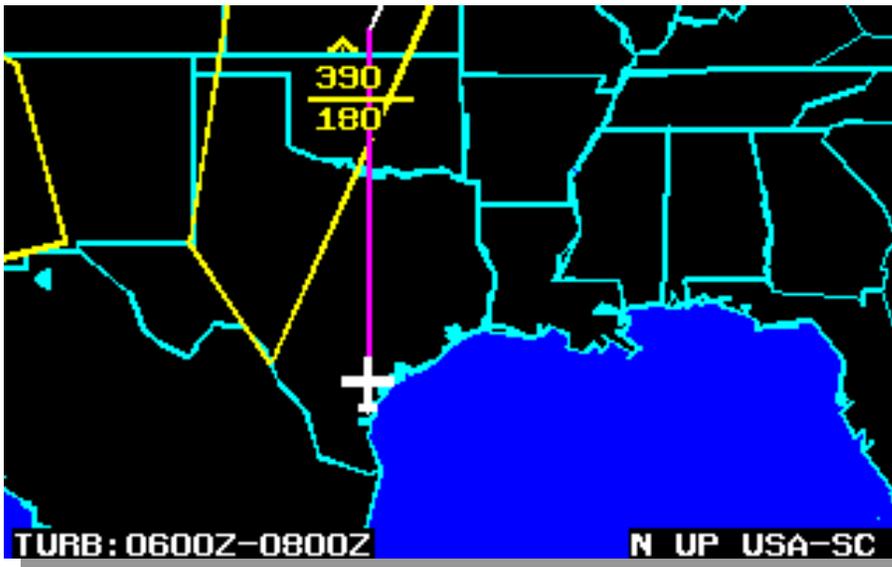




Turbulence

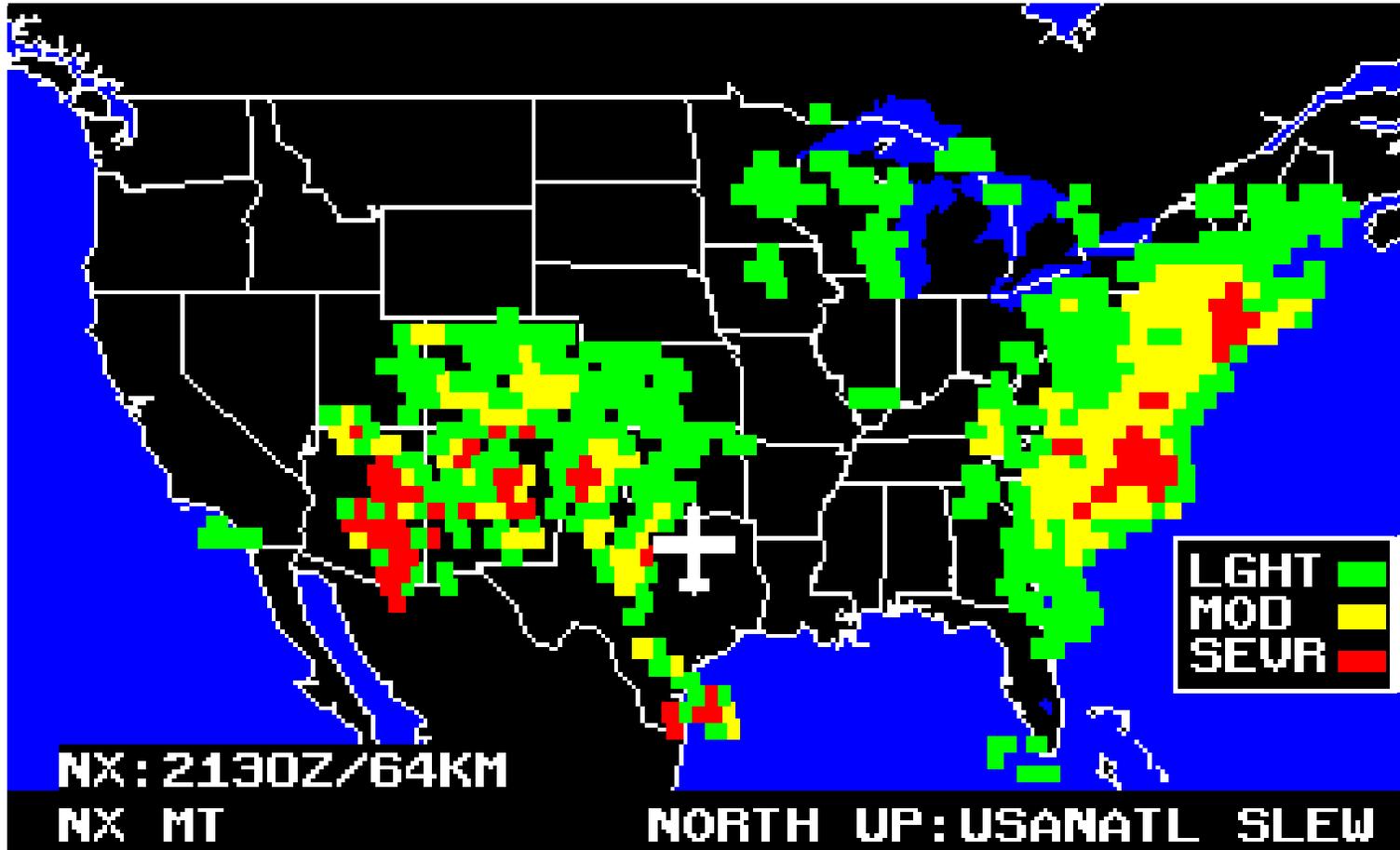


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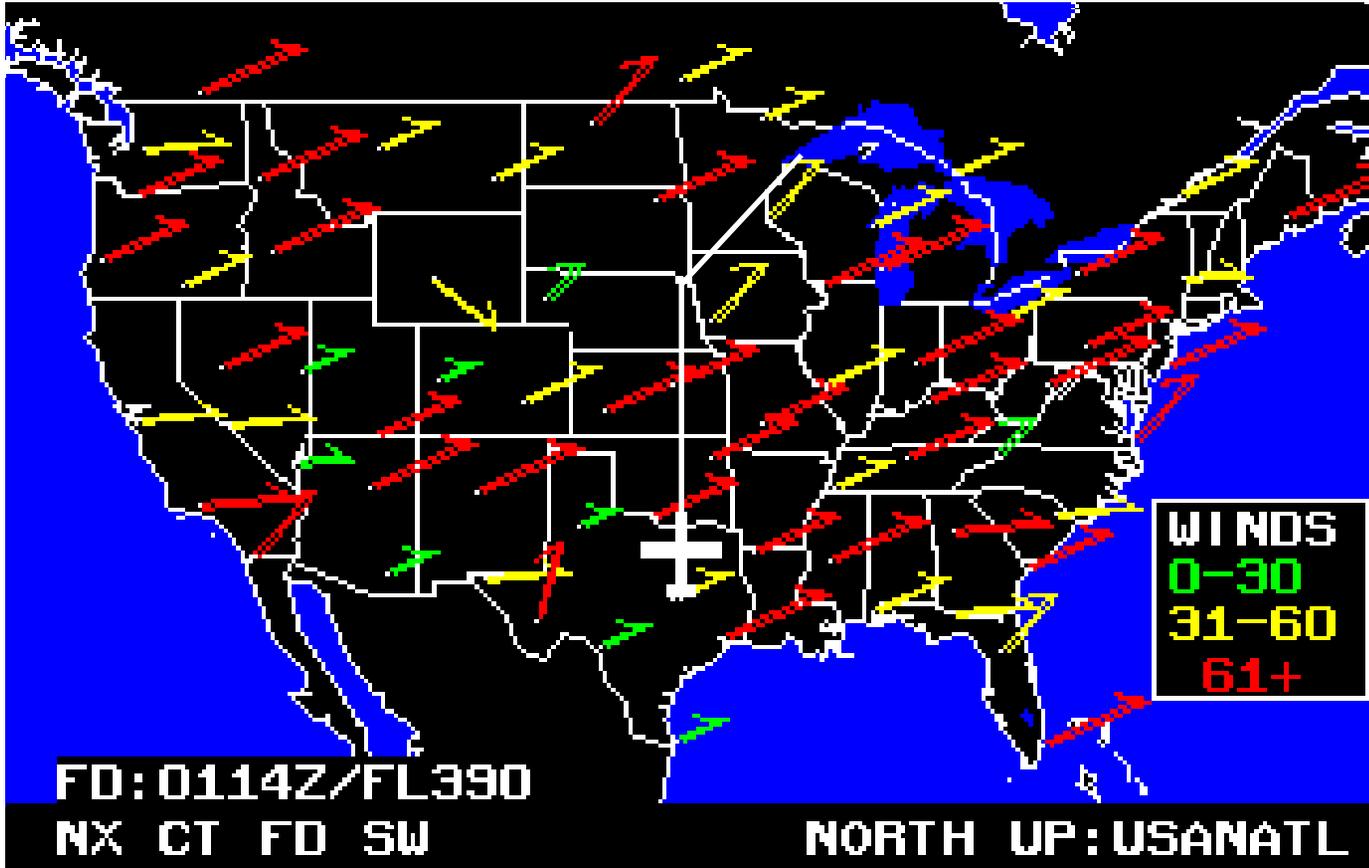


**Significant Weather**  
 includes worldwide jet stream,  
 surface fronts, volcanic ash,  
 pressure centers, hurricane,  
 tornadoes, and other significant  
 weather phenomena.

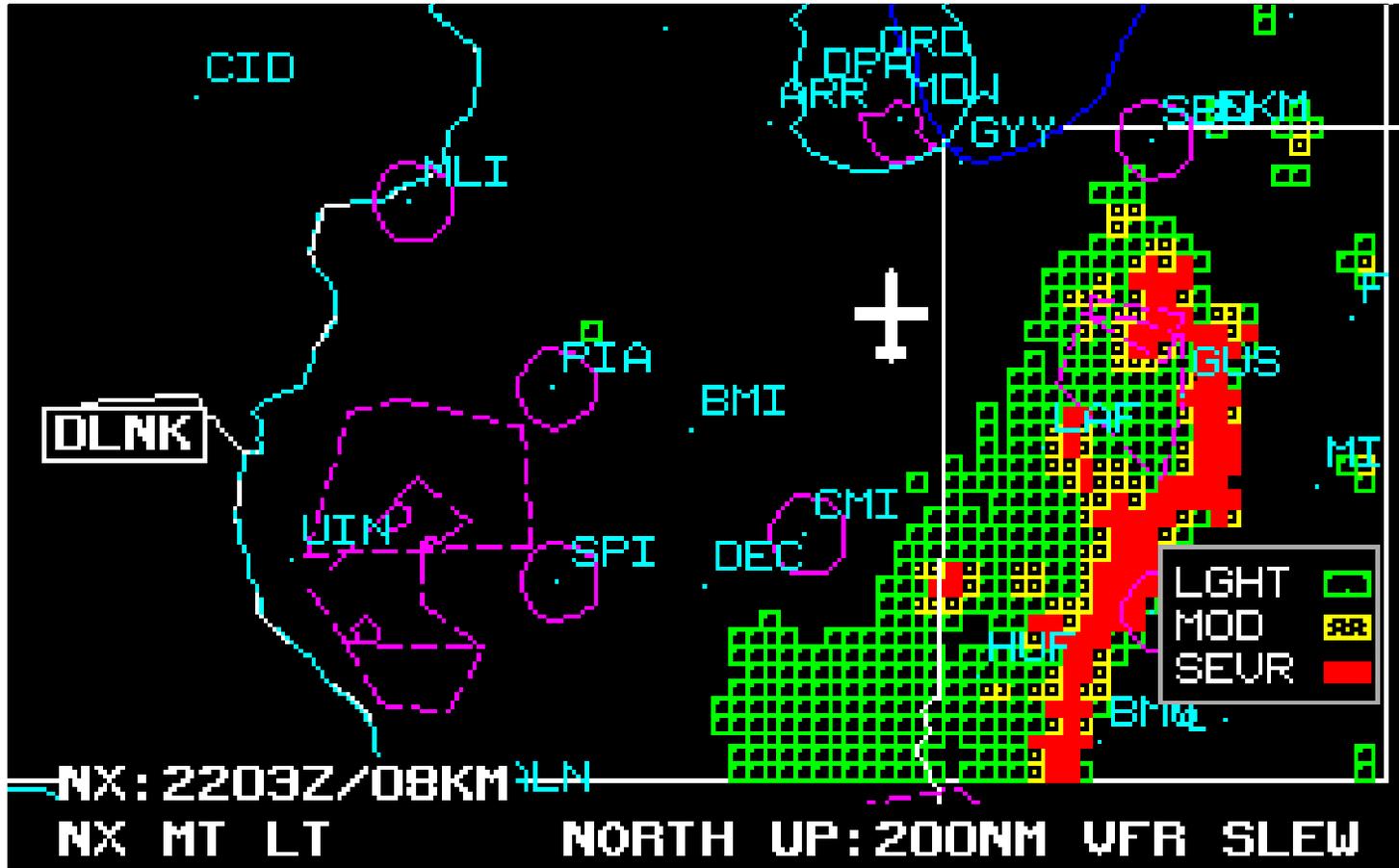
# Hurricane Floyd with animation



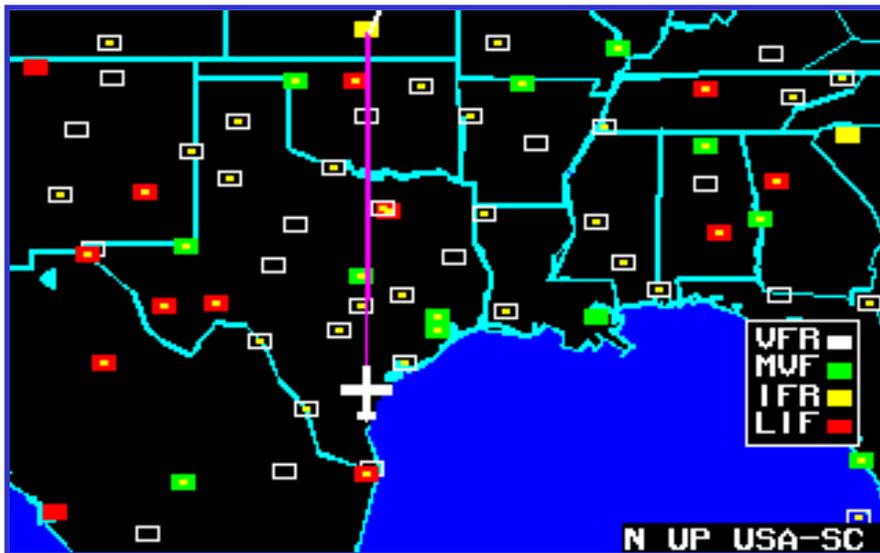
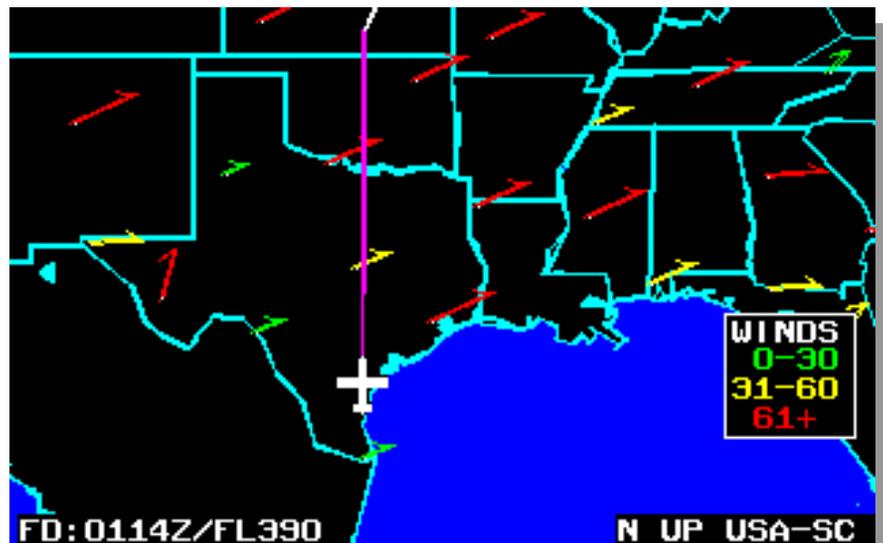
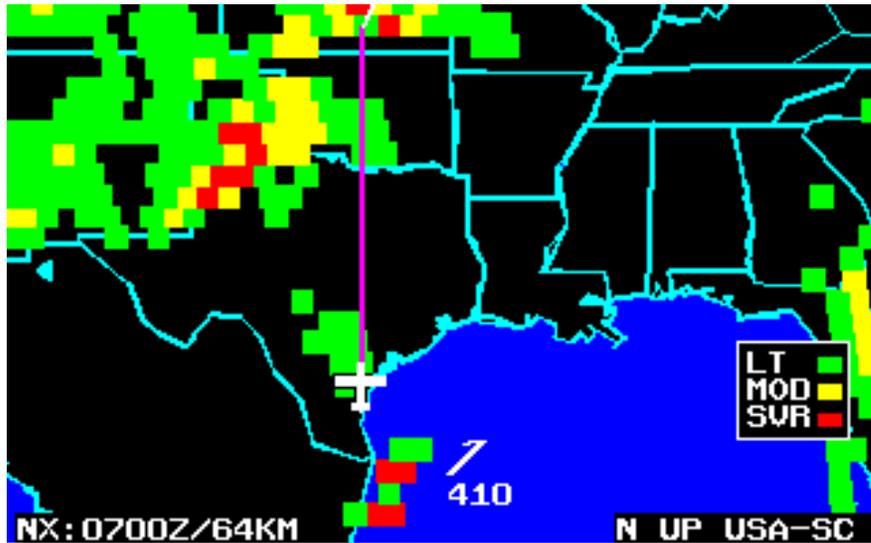
# Winds Aloft Animated



# 8 kilometer NEXRAD Base Reflectivity



# Regional Weather Products



PIE ST PETERSBURG- INTL  
N 27°54.47 BLOCK DAY: 30  
W 082°41.06 BLOCK TIME: 23:44

WINDS: SW 15 - 20 KTS

CEILING: LIFR

VISIBILITY: IFR

FREEZING DANGER: LOW

TEMP/DEW SPREAD: LESS THAN 4C

PRESS ANY BUTTON



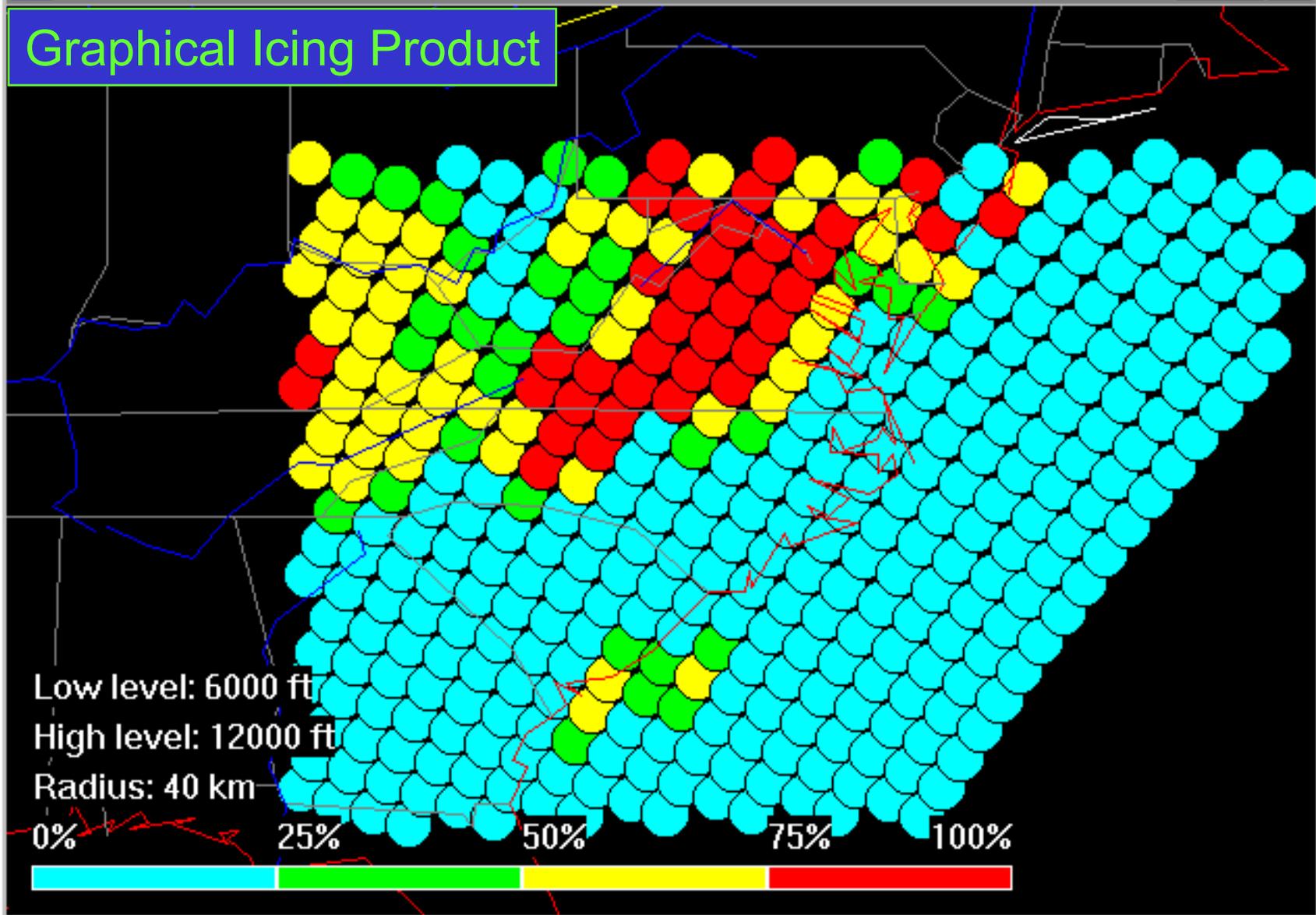
Graphical METARS



Text METARS

Ceiling	Visibility	Meaning	Color
>=3000	> 5 nm	VFR	clear
<3000, >=1000	< 5 nm, > 3nm	MVFR	green
<1000, >=500	<3nm, > 1nm	IFR	yellow
<500 ceiling	< 1nm	LIFR	red

# Graphical Icing Product



## Controlled Flight into Terrain - CFIT

- Controlled Flight into Terrain (CFIT) is the result of loss of spatial awareness, many times a result of deviation from flightplan due to weather.
- CFIT is often the result of VMC into IMC conditions, dark hole night approaches, or other obscuration to visibility.
- For general aviation, weather and CFIT accidents should be considered the same mode of failure.
- Once you have equipped with GPS and MFD, the terrain database and algorithms are easy add-on's

## **TOPS (Terrain / Obstruction Proximity System)**

- Terrain data based on digital elevation model (DEM)
- Elevations spaced at 30-arc seconds (1 kilometer).
- Airports, navigation aids (VOR's, NDB's), Maximum Elevation Figures (MEF's - 30 minute quadrangle data supplied by FAA), summits database supplied by the USGS, and man-made obstacles supplied by the FAA are used to enhance obstruction awareness.
- Compression of data allows worldwide coverage for less than 50 megabytes of storage.



## **AWIN Phase I Accomplishments**

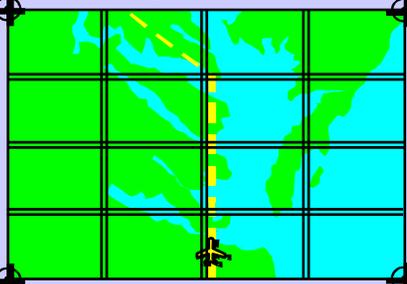
- **Developed new weather products geared specifically for transmission to General Aviation aircraft.**
- **Developed TCP/IP software tools for distribution of the same weather products for pre-flight use.**
- **Obtained FAA certification of initial set of weather products.**
- **Obtained FAA certification for low-cost E-PIREPS Sensor (<\$200).**
- **Performed Human Factors evaluation for Pilot use of weather products and terrain obstruction proximity system, with thousands of simulator and flight hours logged.**
- **Established requirements for certification of weather products through FAA FIS Team and RTCA SC195.**

## **AWIN Phase II Effort**

- 1. Equip additional aircraft with E-Pireps sensors. ARNAV will distribute E-Pireps data to weather researchers via TCP/IP.**
- 2. Devise compression techniques for aviation gridded database (AGD) elements. The work from Phase I icing layers will serve as starting point to develop appropriate layer thickness.**
- 3. Develop new datalink message formats to broadcast aviation gridded data to cockpit, which allow for various latency & transmission modes. The data will be transmitted via ARNAV Aeronautical Network, FAA FIS Network, ACARS and SITA VHF Network, and LEO satellite providers.**
- 5. Create pilot interface to allow mix of ride control & AGD.**
- 6. Certify enhanced hazard awareness (weather & terrain) with expanded terrain database.**

# AWIN Phase II AGD development

Experimental Gridded Forecast Graphic Display



Map with proposed route

0	0	1	0
0	1	3	1
0	0	3	1
0	1	0	0

Layer 2: Icing (0-3)

0	0	1	0
0	0	1	0
0	0	1	0
0	1	0	0

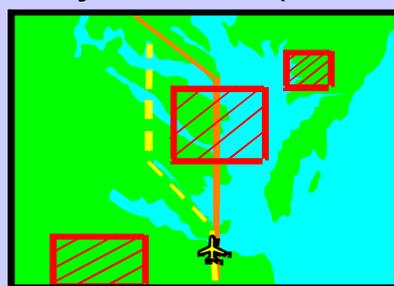
Layer 4: Lightning (0-1)

0	1	1	0
0	1	3	0
0	1	3	1
1	2	0	0

Layer 1: Turbulence

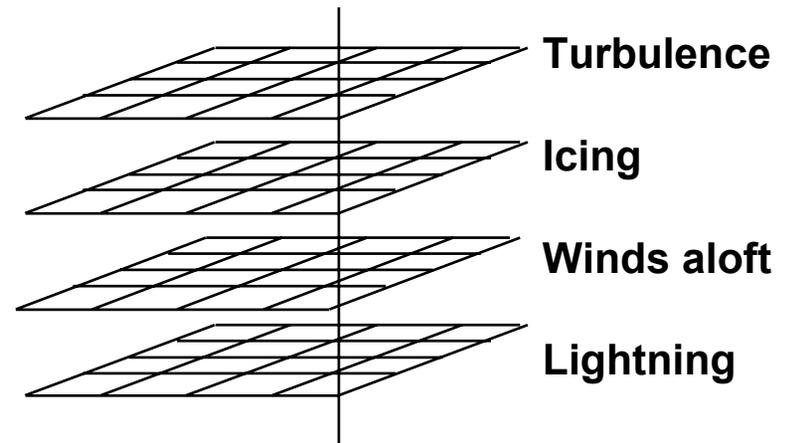
-2	-1	1	0
0	1	2	0
-1	1	2	0
1	1	0	0

Layer 3: Winds (-3 to +3)



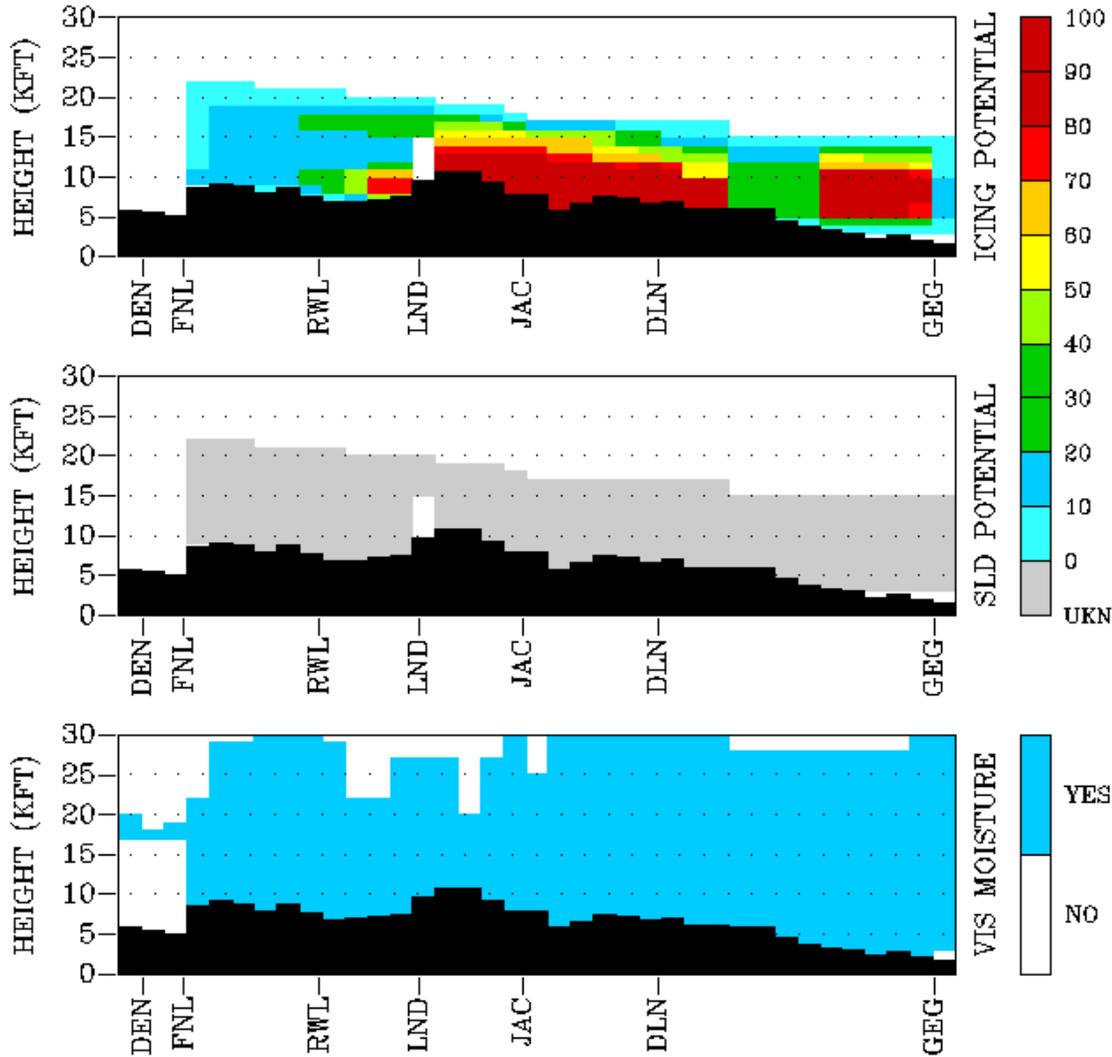
weather hazard zone

Each two dimensional weather variable layer is summed vertically with the Pilot ride control to create weather hazard zones.



# Side view Weather and Terrain

EXPERIMENTAL ICING PRODUCT  
981124 - 18Z



**More information regarding transmitting  
weather sites, as well as a  
downloadable version of WxDispatch.exe  
is available at  
[www.arnav.com](http://www.arnav.com)**