



NCAR



Weather Integration into Tomorrow's Airspace *System*

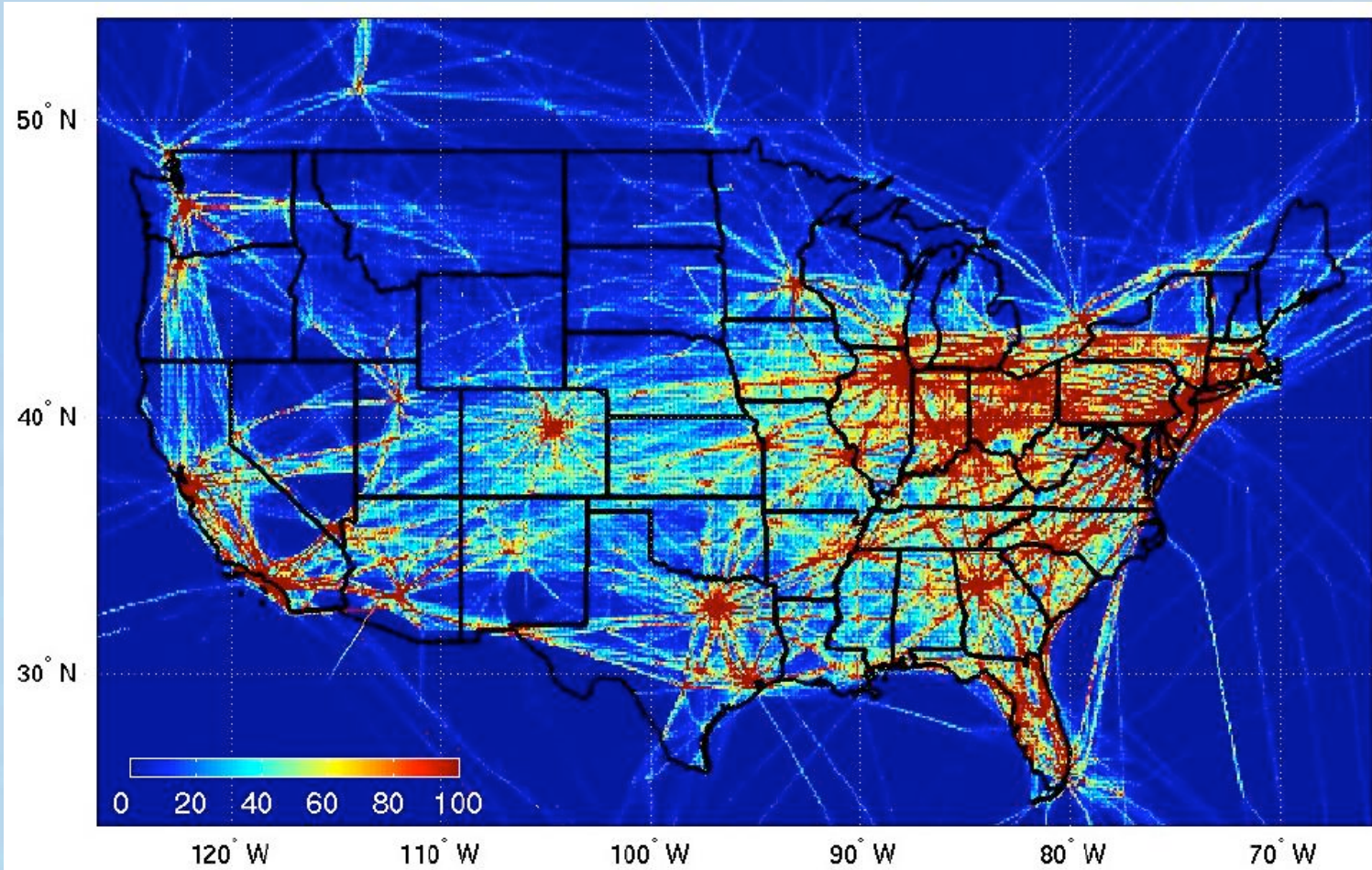
Tenny Lindholm
ADF 2008 Safety Symposium
19-21 October 2008

National Center for Atmospheric Research

Who Benefits?

- The NAS
 - Considers curb-to-curb
- The “triad” functions
 - Dispatch
 - Air Traffic Control/Management
 - All legacy airborne users—Parts 91, 121, 135, DoD
- Emerging VLJ and UAS operations
 - Low, mid, and high altitude
 - Potentially large numbers

A Snapshot of the Problem



Motivation to Integrate

The System is maxed out, in some cases broken. Witness:

- There were over **500,000 flight delays in 2006**, costing the airlines **\$6B** and passengers **\$10B** (FAA)
- **In June 2007, flight cancellations topped 100,000** (FAA, largely due to severe weather events in the NYC area and their ripple effects throughout the system)
- Now for weather: **70-75%** of delays are weather related
 - Convection and storms have the greatest impact
 - **60% of these delays are avoidable** (JPDO studies)

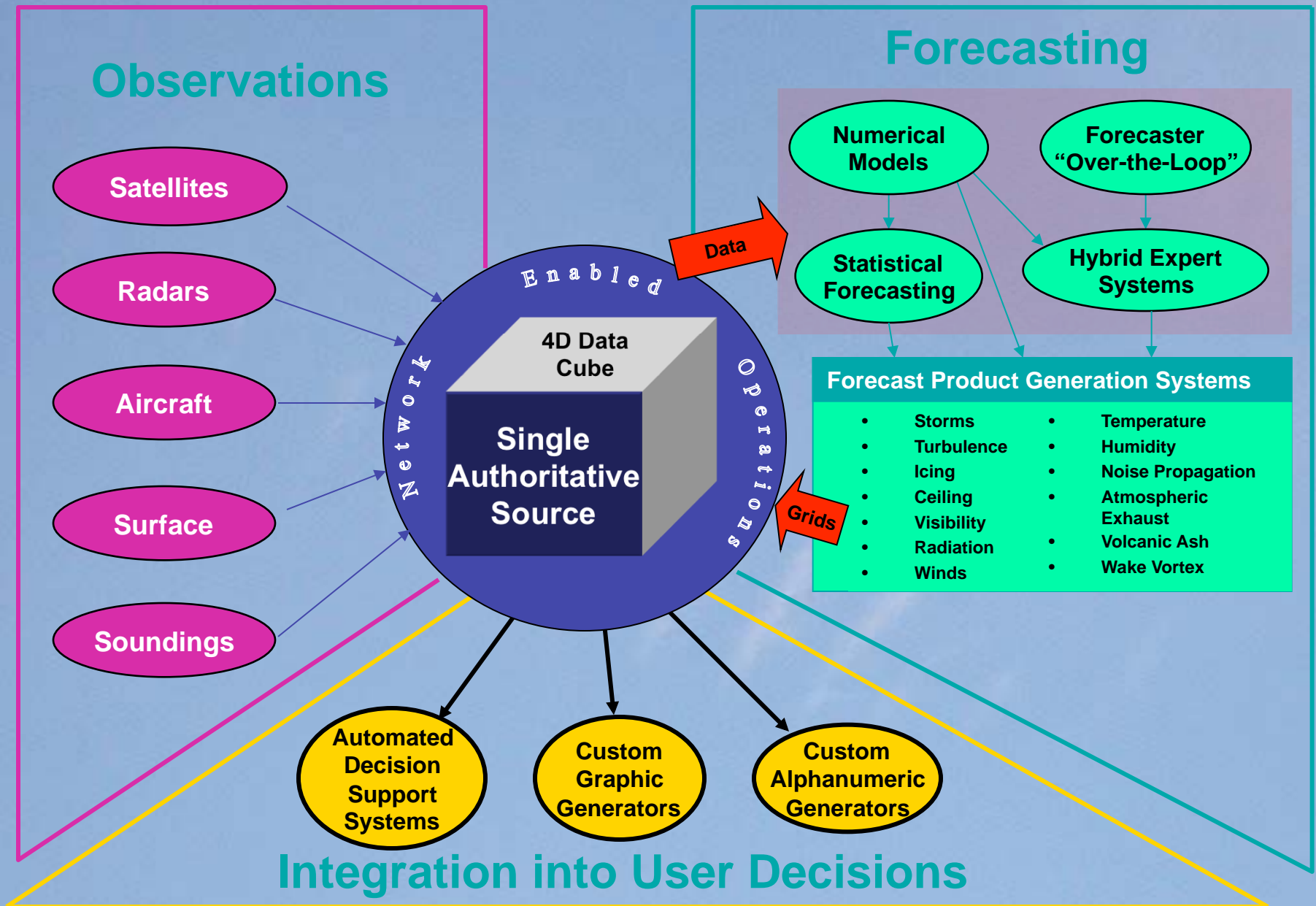


The fact is...

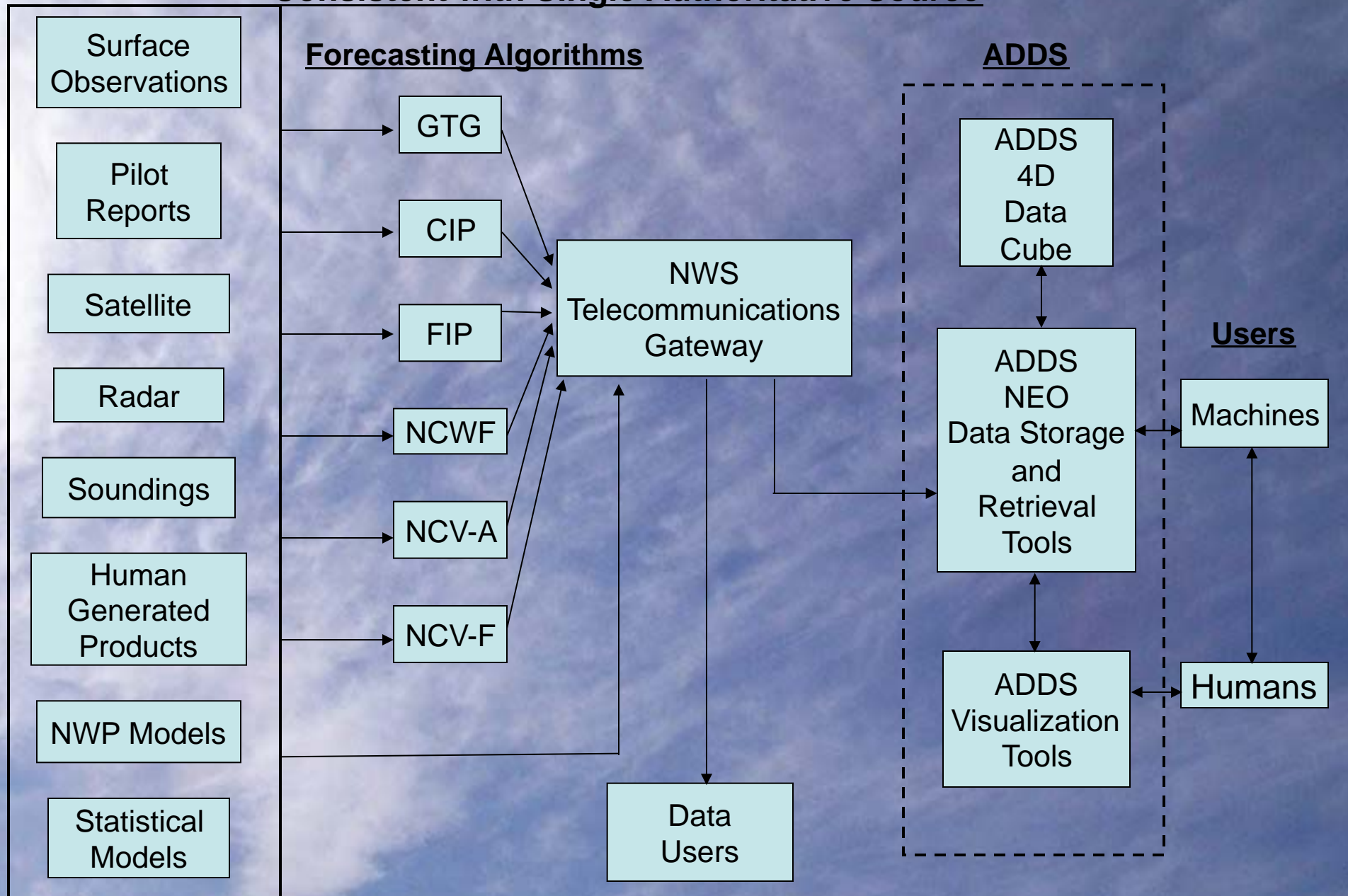
...a majority of weather situations can be mitigated by *intelligent use* of *better forecast information*. Intelligent use includes specialized applications for *decision support tools for both planning and execution*. Better weather information includes elements like convection, icing (ground and in-flight), turbulence, low ceilings and visibility, [oceanic, wake vortex, space weather], as well as their associated uncertainties. Plus, significant improvements are extremely unlikely without a *common environmental awareness* for all users in the NAS.

JPDO

NextGen Net-enabled Weather (NNEW) Toward Common Environmental Awareness



Current Forecasting Tools and ADDS Architecture are Consistent with Single Authoritative Source



Guiding Principles

Weather Information Depiction and Decision Support

- Weather is a constraint on the system—hence, weather information is essential for effective ATM decision support
- All users require a common weather picture, or awareness of the state of the environment
- High “glance value” and information content, not data
- Weather forecasting is uncertain, will never be exact -> risk management vs. risk avoidance
- Decision support rules differ by user, type of decision
- Human in the loop still needed
- En route weather DSS must include terminal constraints
- Concept of operations needed for “now” and graceful transition to the “future”—NextGen

ADDs Homepage



ADDs - Aviation Digital Data Service - Mozilla Firefox

File Edit View History Bookmarks Tools Help

RAL | RAL home F&A Application Portal dispatcher.org - dispatcher.org RAL | Aviation Applications Program ADDs - Aviation Digital Data Ser...

NOAA's National Weather Service
Aviation Weather Center
Aviation Digital Data Service (ADDs)

weather.gov

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Local forecast by "City, St" or Zip Code
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Turbulence
Icing
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Home News Organization
Turbulence Icing Convection Winds/Temps Prog Charts Java Tools
METARs TAFs PIREPs AIR/SIGMETs Satellite Radar

Top News ...

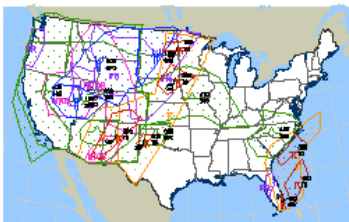
- 01 October 2008: Experimental [Graphical Airman's Meteorological Advisory \(G-AIRMET\)](#) is now available for all en-route aviation weather hazards supplementing the AIRMET. See [G-AIRMET Help Page](#) for details.
- 04 September 2008: On November 5, 2008 The AWC will eliminate the use of Above Ground Level (AGL) in Dallas and Chicago area forecasts See [Technical Implementation Notice 08-70](#) for details.
- 22 April 2008: On November 5, 2008 the Terminal Aerodrome Forecast (TAF) format will change to incorporate the new 30-hour TAF. See [Service Change Notice 08-15](#) and [Supplement](#) for details.

The **Aviation Digital Data Service (ADDs)** makes available to the aviation community text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables. ADDs is a joint effort of NCAR Research Applications Program ([RAP](#)), Global Systems Division ([GSD](#)) of NOAA's Earth System Research Laboratory ([ESRL](#)), and the National Centers for Environmental Prediction ([NCEP](#)) Aviation Weather Center ([AWC](#)).

The **National Weather Service** operationally supports this site as well as the following operational products:

<ul style="list-style-type: none">• METARs• TAFs• PIREPS• AIR/SIGMETs• Satellite• Radar	<ul style="list-style-type: none">• Analysis & Prognostic Charts• Graphical wind & temperature charts• National Convective Weather Forecast• Current & Forecast Icing Potential• Graphical Turbulence Guidance
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Current AIR/SIGMETs:



The **Federal Aviation Administration** funds and directs the continuing development of ADDs as well as other experimental products being developed by the **FAA Aviation Weather Research Program (AWRP)**.

The results of the latest ADDs development efforts along with new experimental AWRP algorithm results can be viewed on the [experimental ADDs site](#).

Turbulence

Injures Cabin Crew and Frightens Passengers

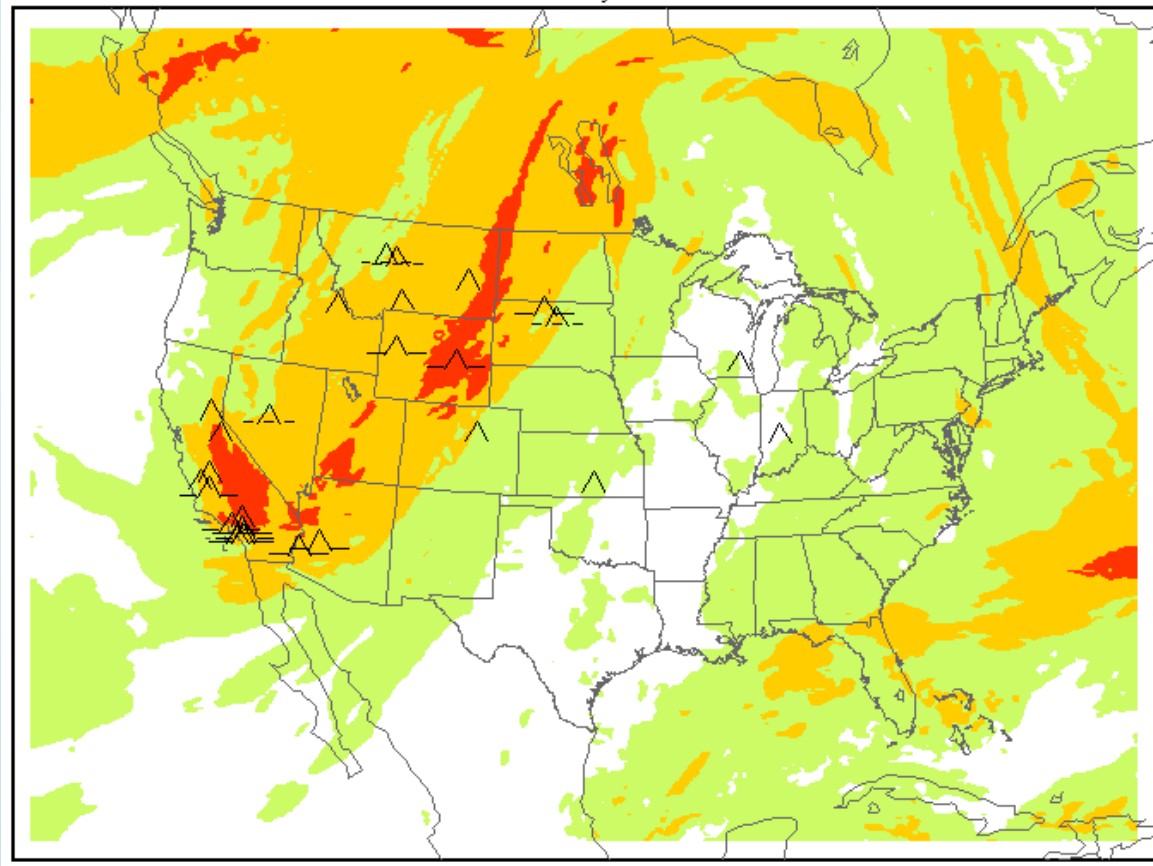


Turbulence (GTG)

↓ ↑ MAX 1600 UTC Mon 13 Oct 2008 < >

Maximum turbulence potential (FL200-FL450)

Analysis valid 1600 UTC Mon 13 Oct 2008



None LGT MOD SEV Extreme

The GTG is an automatically-generated turbulence forecast product that supplements AIRMETs and SIGMET by identifying areas of turbulence. The GTG is not a substitute for turbulence information contained AIRMET and SIGMETs. It is authorized for operational use by meteorologists and dispatchers.

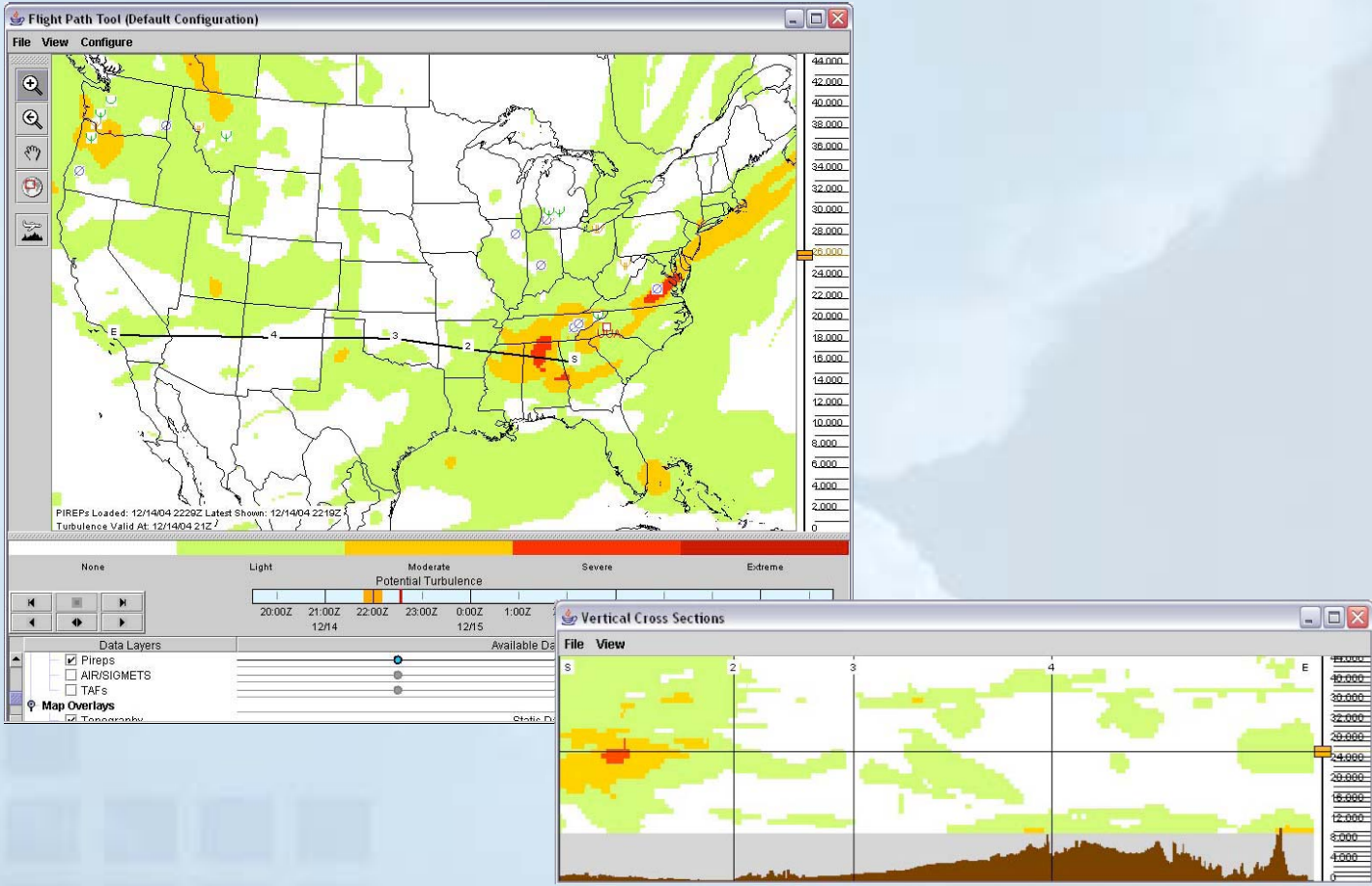
Graphical Turbulence Guidance (GTG)



- Model based, currently clear air turbulence
- Assimilates up to 30 diagnostics and algorithms for CAT
- Other modes (mountain wave, convective-induced) will be integrated as they are developed
- Operational with restrictions (meteorologists and dispatchers only)
- 4-D grid with probability
- Includes in situ downlink data, NEXRAD (NTDA)
- 10,000 feet to FL450

Flight Path Tool Application

(Functions Apply With Any 4-D Gridded Data)



Winter Weather

Affects Aircraft In-flight and on the Ground



SLD Icing Accretion on the NASA Twin Otter

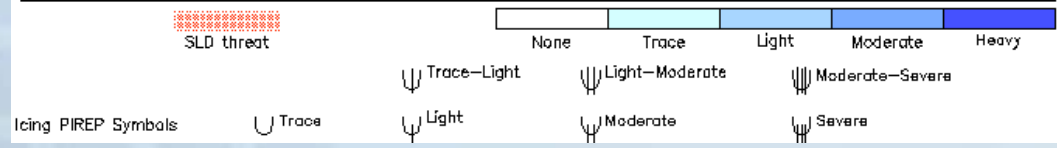
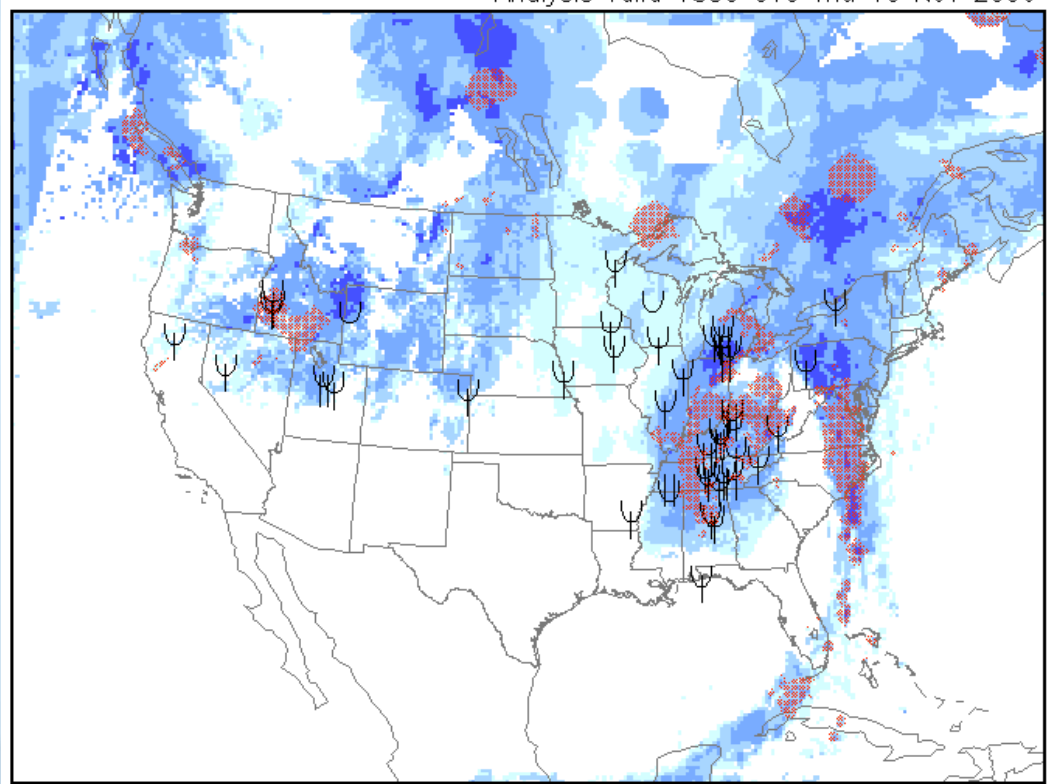


Current Icing Product (CIP) with SLD

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

Maximum icing severity (1000 ft. MSL to FL300)

Analysis valid 1800 UTC Thu 16 Nov 2006

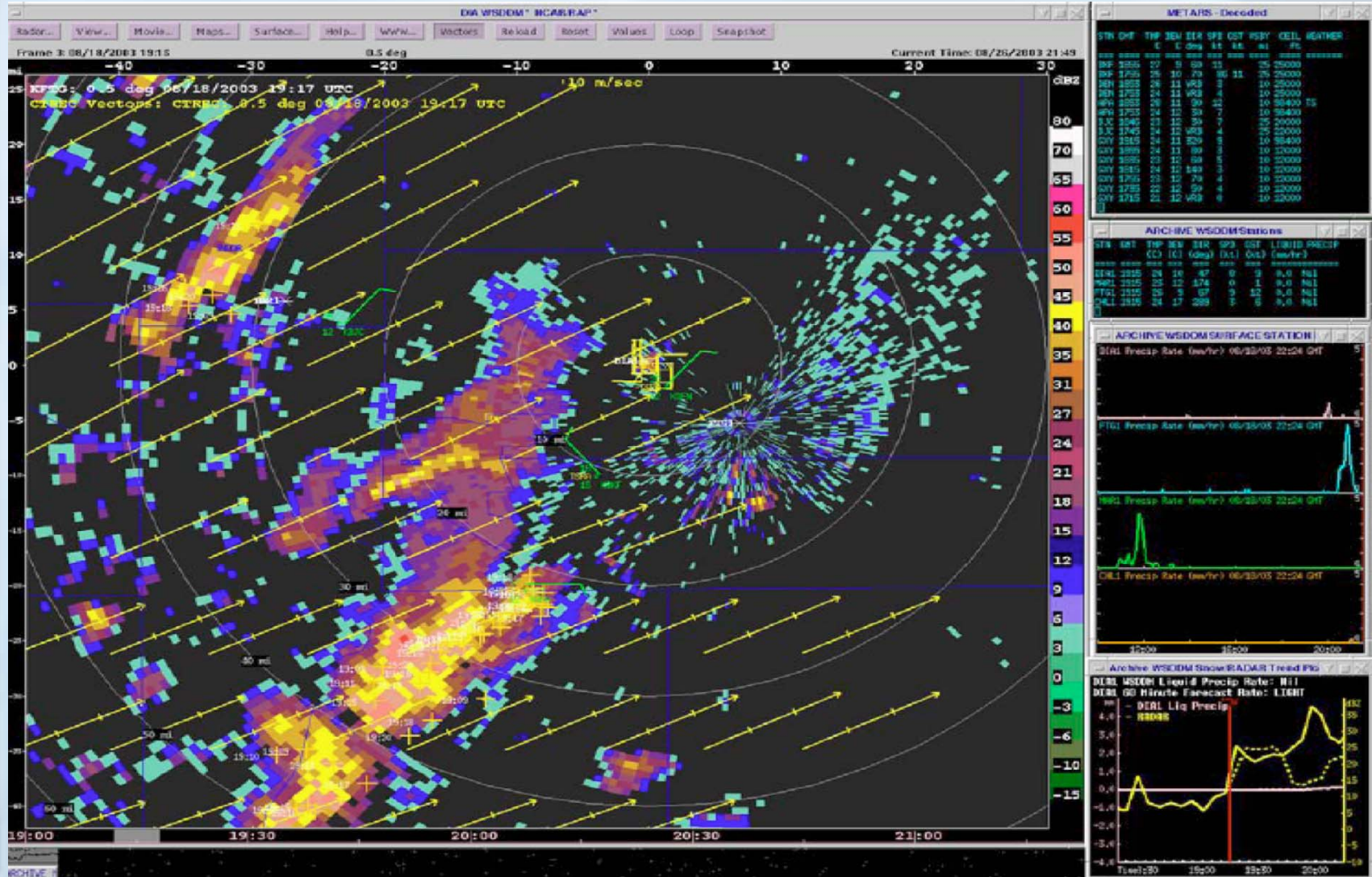




Current and Forecast Icing (CIP/FIP)

- Current icing with severity, probability, and super-cooled large droplet (SLD) volume
- Forecast icing potential
- 4-D grid
- Assimilates data from satellite, ground sensors, NEXRAD, numerical models, diagnostics
- Operational. Status: “By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as AIRMET or SIGMET (ref AIM).”
- 1000 feet to FL300

Weather Support to Decision Making (WSDM)



WSDDM Check-time



Ceiling and Visibility

**Contributes to General Aviation
Accidents and Air Carrier Delays**

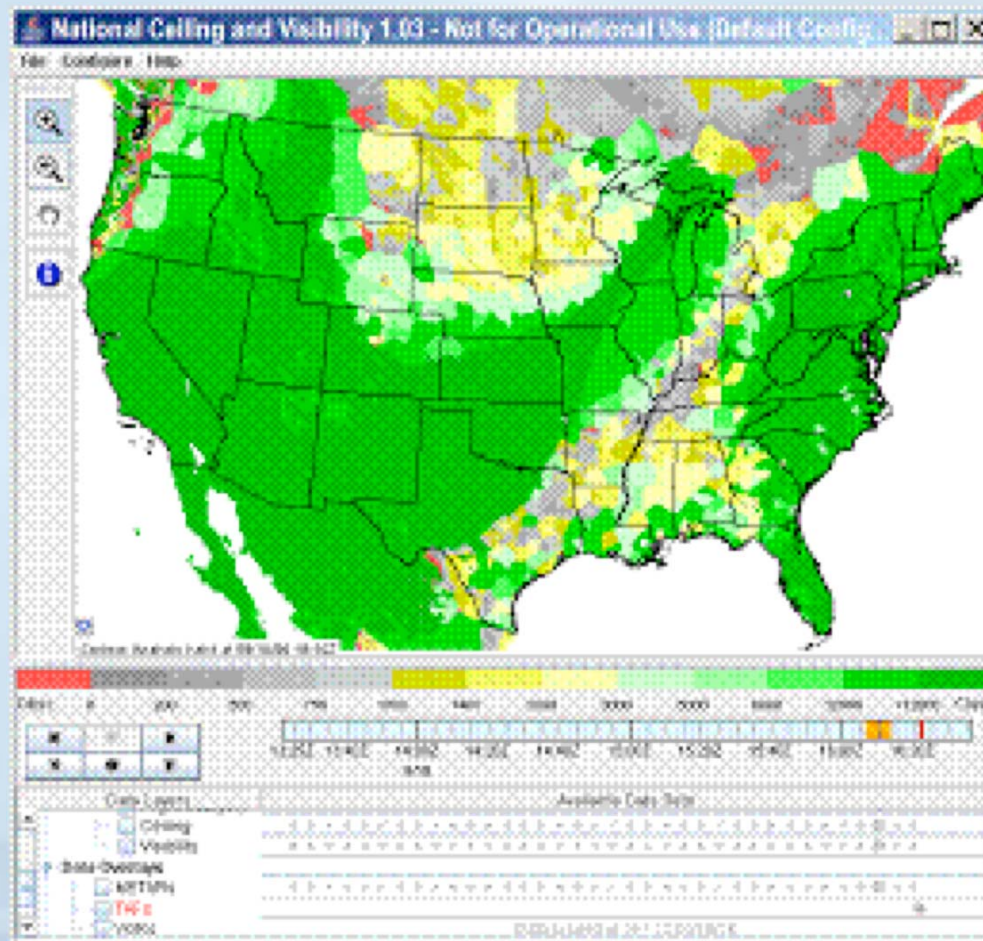


SFO Impact



top

Ceiling and Visibility (National)



Thunderstorms

Cause Accidents and Delays



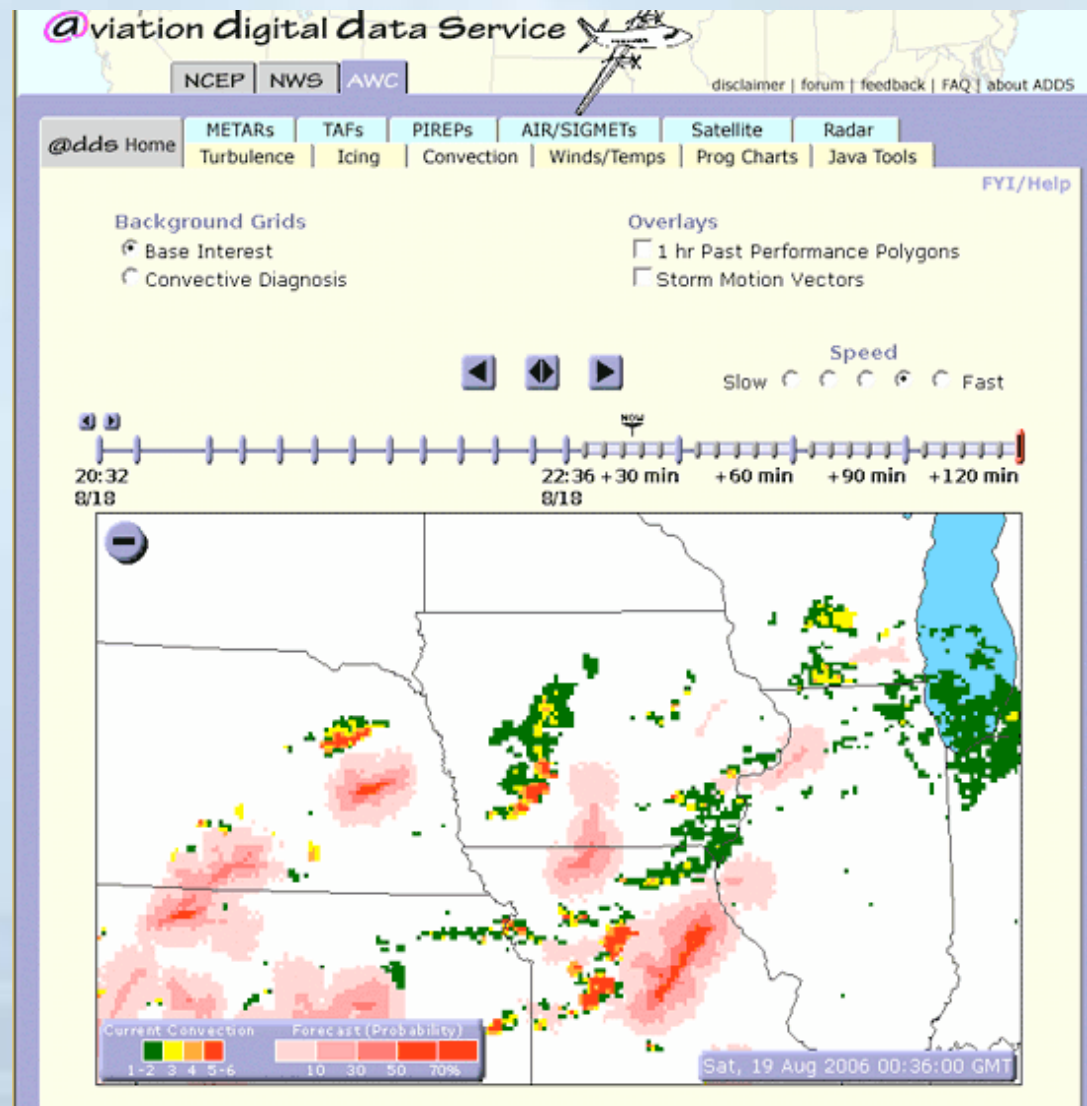
Storms



National Convective Weather Forecast (NCWF)

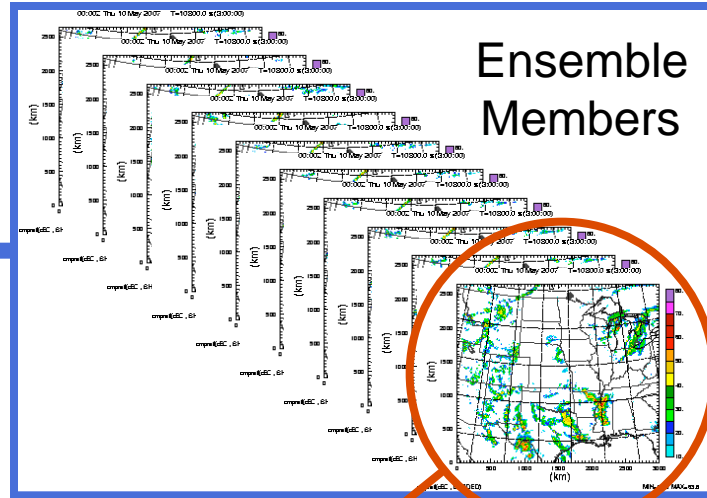
- NCWF. “The NCWF is an automatically generated depiction of: (1) current convection and (2) extrapolated significant current convection. It is a supplement to, but does not substitute for, the report and forecast information contained in convective SIGMETs.”
- NCWF-2 and probability
- Consolidated Storm Prediction for Aviation—next step for the NAS
 - Will include summer and winter storm prediction

NCWF-2

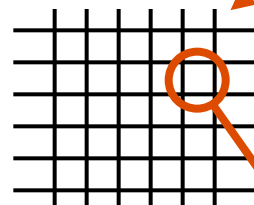


deterministic realizations of potential weather outcome

Forecast System

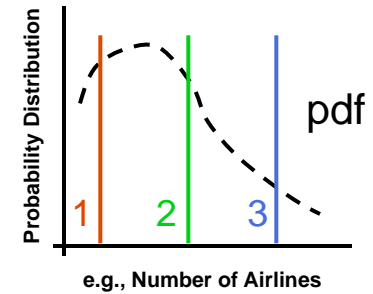


Probabilistic Weather Forecast (gridded)



for each member (overlay grid)

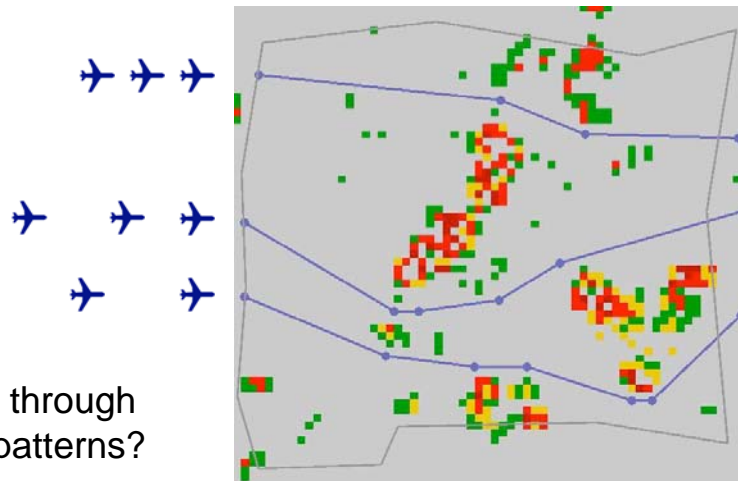
for each airspace (gridbox)



for each airspace based on all ensemble members

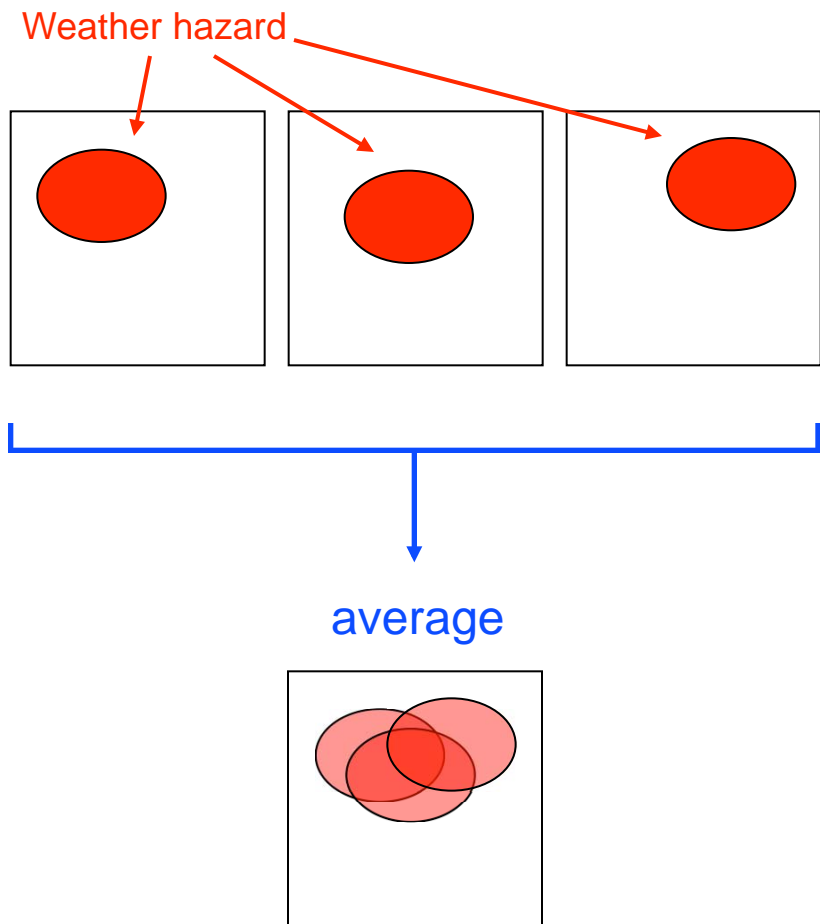
Weather Pattern Analysis from an Aviation Perspective

permeability, MinCuts, etc.



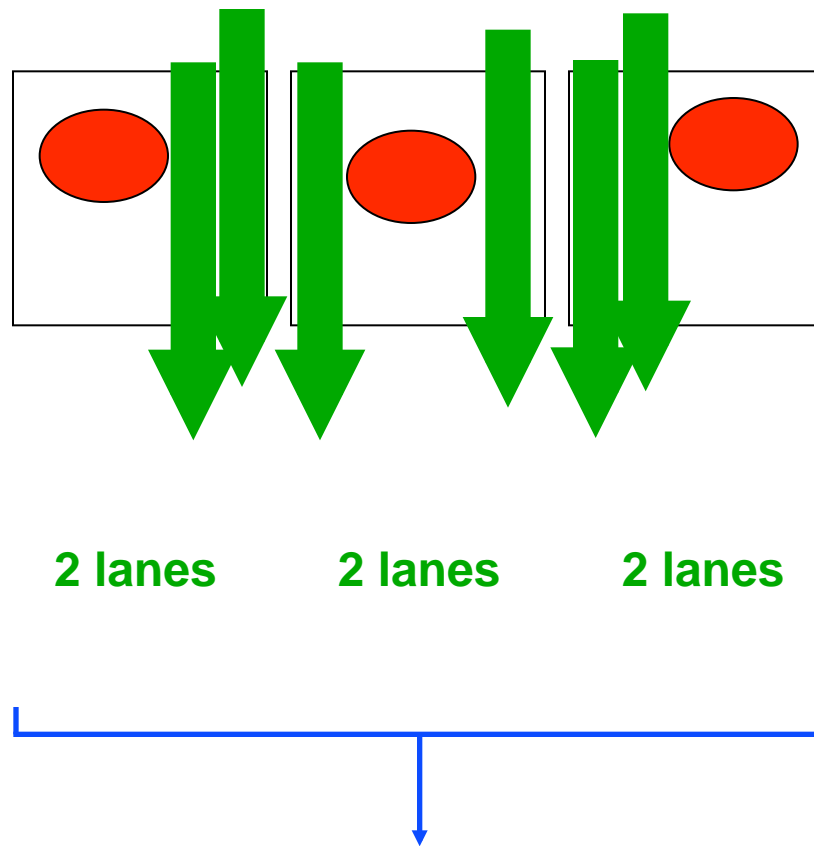
How many air lanes fit through evolving precipitation patterns?

Old way ...



How many air lanes?

New way ...



Most likely 2 air lanes ...

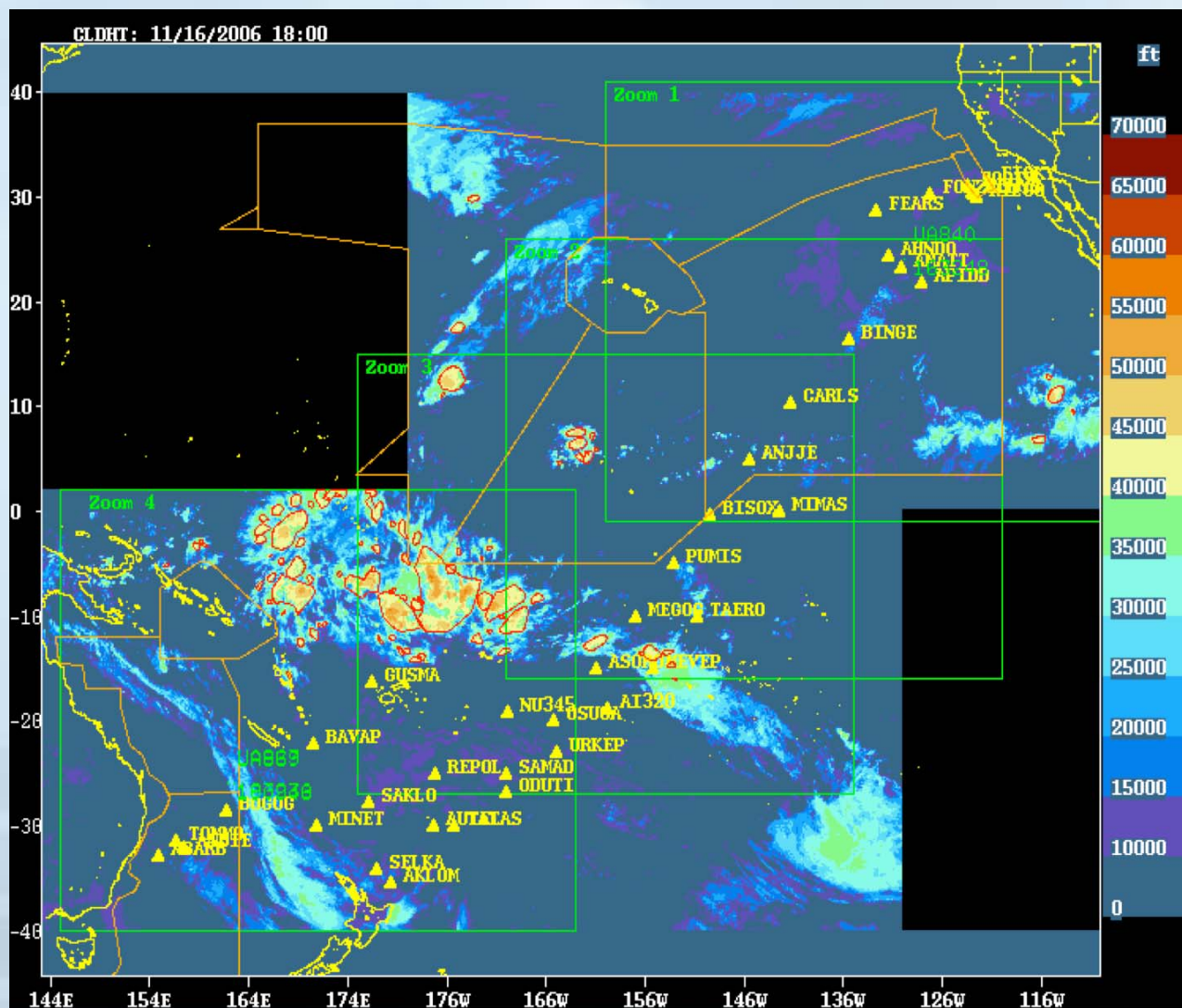
Information Dissemination

**Is Key to Improved Weather
Decision Making**





Oceanic/Remote

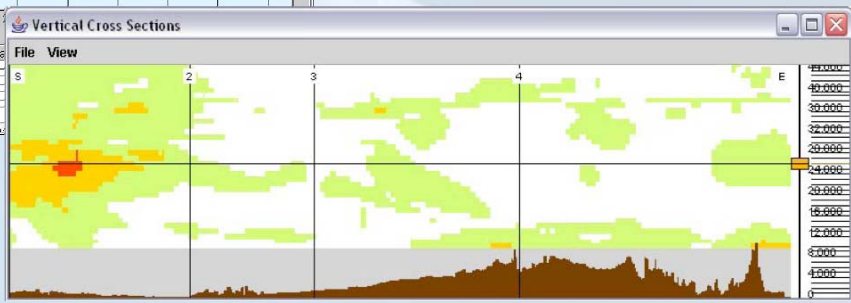
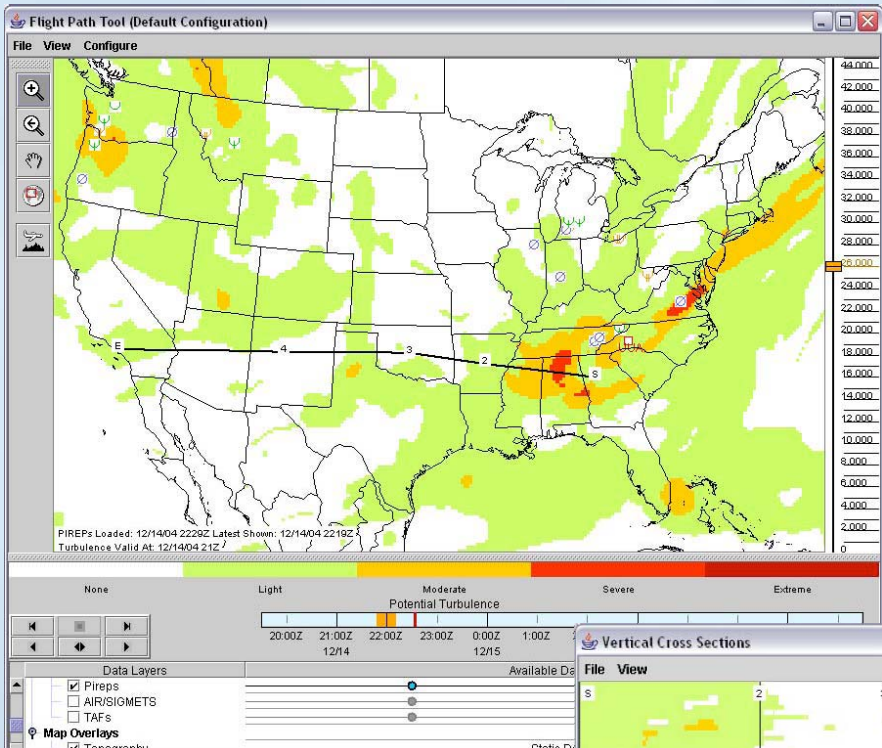


*** Caching may need to be turned off for images to update ***

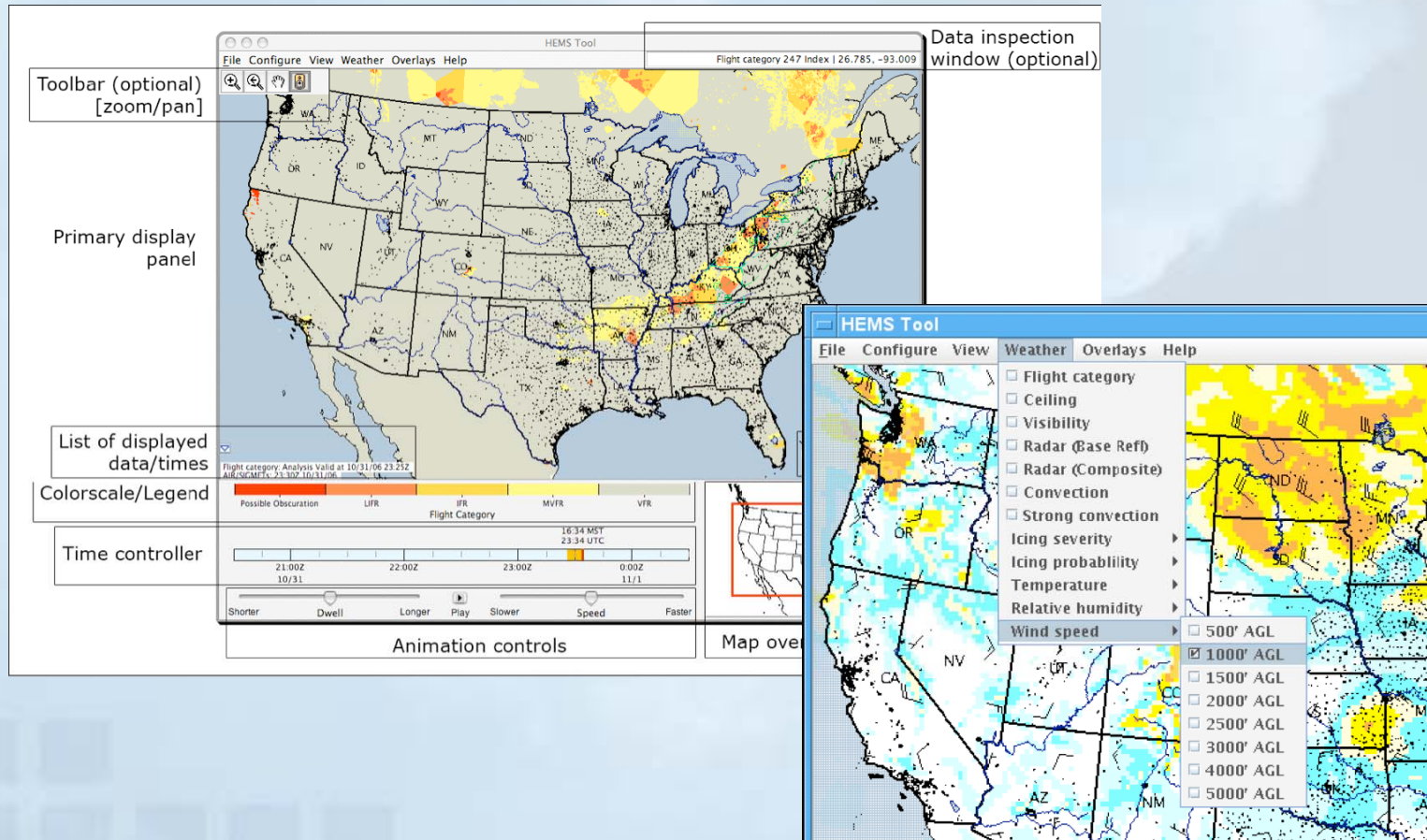
• [Click here to see the current character-based cockpit tactical displays.](#)

Flight Path Tool Application

(Functions Apply With Any 4-D Gridded Data)



HEMS (Helicopter Operations)





Questions

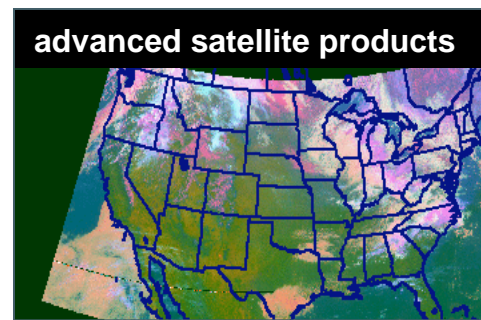
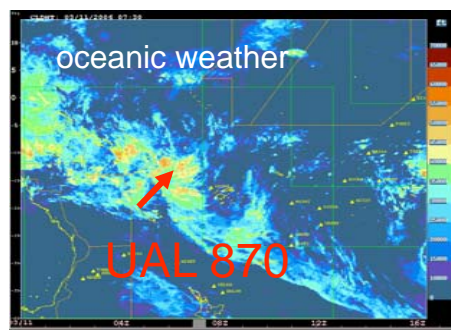
Tenny Lindholm, lindholm@ucar.edu
<http://ral.ucar.edu/>

European/North America Harmonization

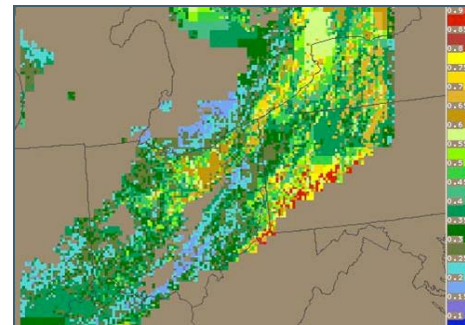
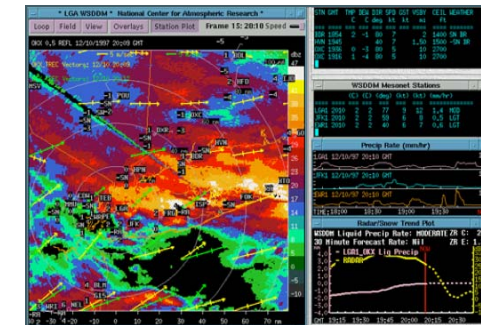
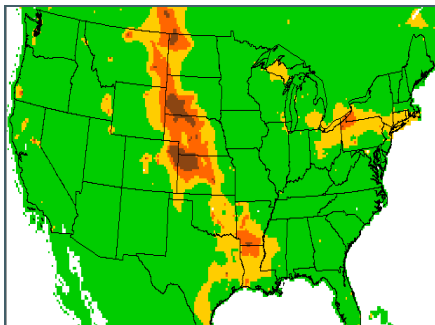
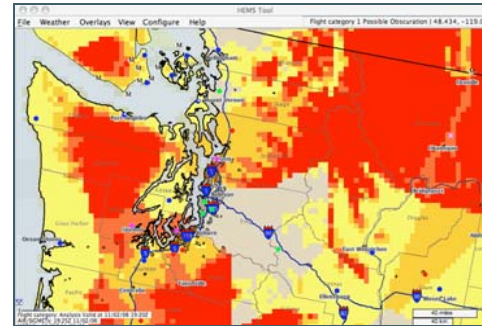
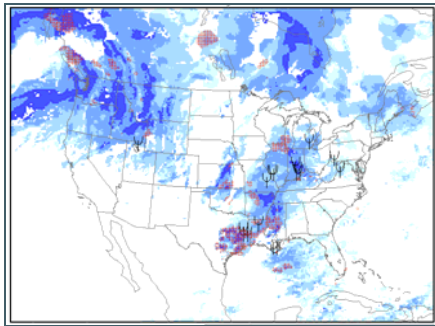
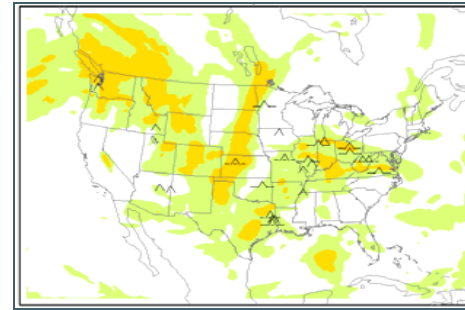
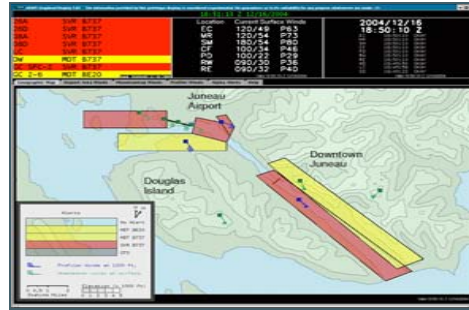


- SESAR (single European sky initiatives) and NGATS harmonization
- FIS-B, format and weather content harmonization; extension to ICAO member states
- Efforts are underway—FAA, EUROCONTROL; RTCA, EUROCAE
 - Operational Services and Environment Description (OSED, operational concept) and Final Review and Comment (FRAC) process

Aviation Applications Program



Aviation Applications Program





NCAR



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