

October 8<sup>th</sup> 2009 - NWS Technology Day

Environmental & Energy Solutions



**HARRIS**

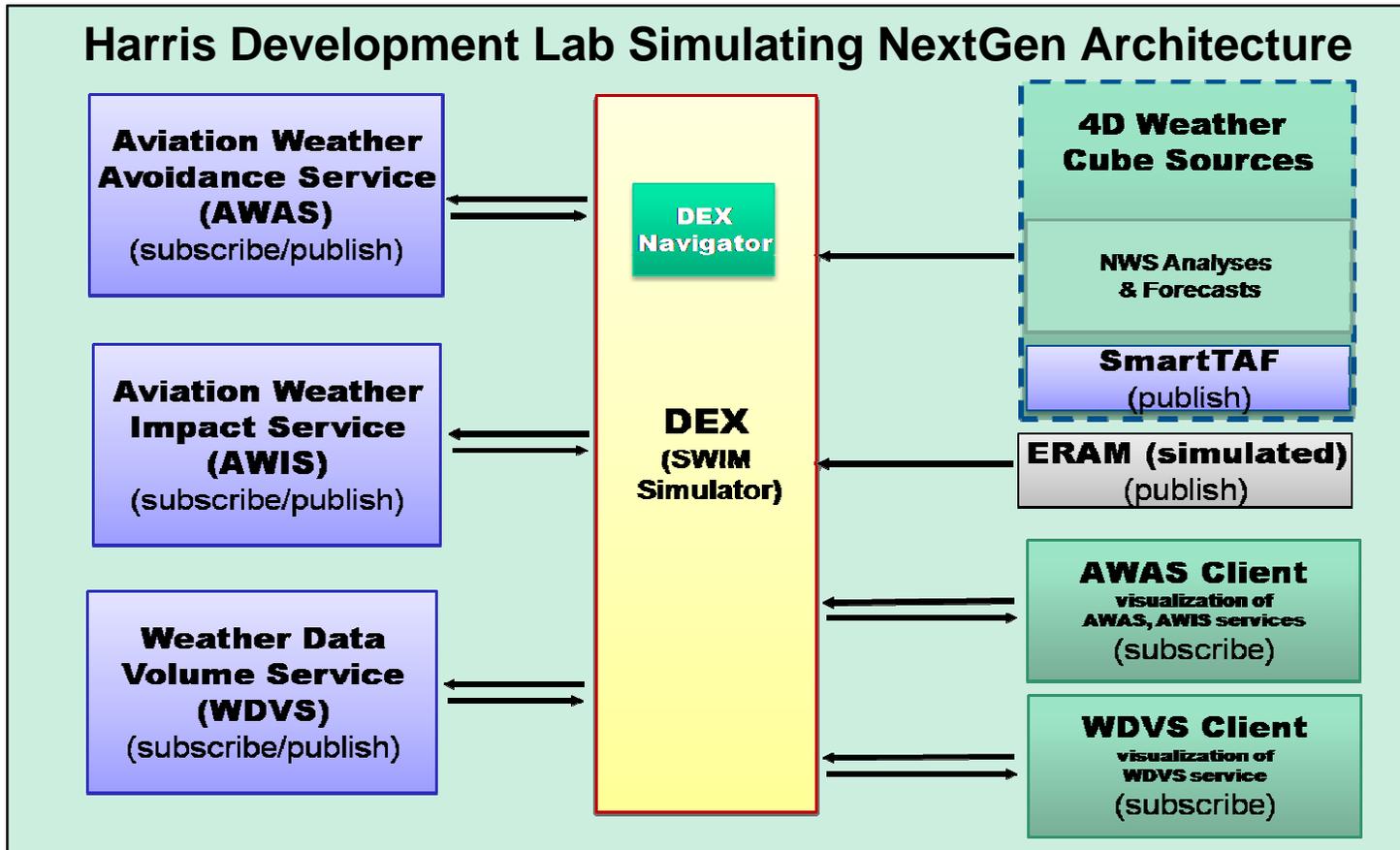
15-Oct-09

*Decision Support Technologies  
for  
Next Generation Aviation Weather*

**Tom Hicks  
Principal Investigator  
Next Generation Aviation Weather IR&D  
Harris Corporation  
Melbourne, FL**

- Harris Corporation is proud of our **45 year** heritage providing weather solutions for the Government and Commercial marketplace.
- We are especially proud NOAA selected us as the provider of the **Ground Segment for GOES-R**.
- For nearly 20 years we have provided weather systems in support of aviation decision support in a mission critical setting-
  - ARTCC Meteorologist Weather Processor (MWP)
  - ARTCC Weather and Radar Processor (WARP)
  - FAA FSS OASIS

- Harris has developed and is integrating four weather related decision support capabilities into a Service Oriented Architecture similar to the one planned for the Next Generation Air Traffic Control System
  - **Aviation Weather Avoidance Service** (AWAS)
  - **Aviation Weather Impact Service** (AWIS)
  - **Weather Data Volume Service** (WDVS)
  - **SmartTAF** (Automated Terminal Forecast Service)



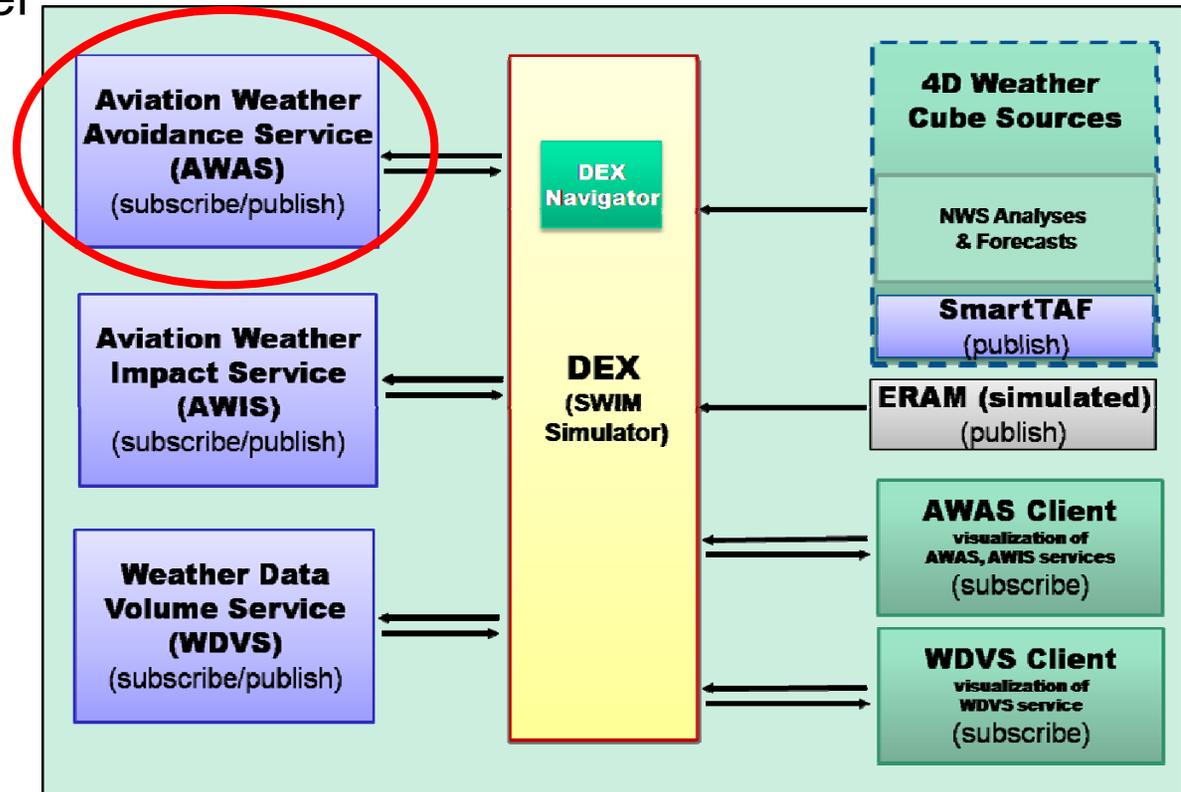
- DEX - At the heart of the Harris Lab is a Service Oriented Architecture (SOA) framework called DEX (Data Exchange) that simulates FAA's future System Wide Information Management.
- Harris' four decision support capabilities - AWAS, AWIS, WDVS & SmartTAF – highlighted in blue.
- ERAM – Enroute Automated Modernization, source of flight data for controllers.
- AWAS, WDVS – Harris developed end-user visualization tools.

*Aviation Weather Avoidance Service  
(AWAS)*

# AWAS Overview



- Evaluates 4D weather impacts on 4D flight trajectories (4DT)
  - Thunderstorms
  - Turbulence
  - Icing
  - IFR
- Provides alternative trajectories
  - If impacted by weather
- Subscriber/publisher to DEX

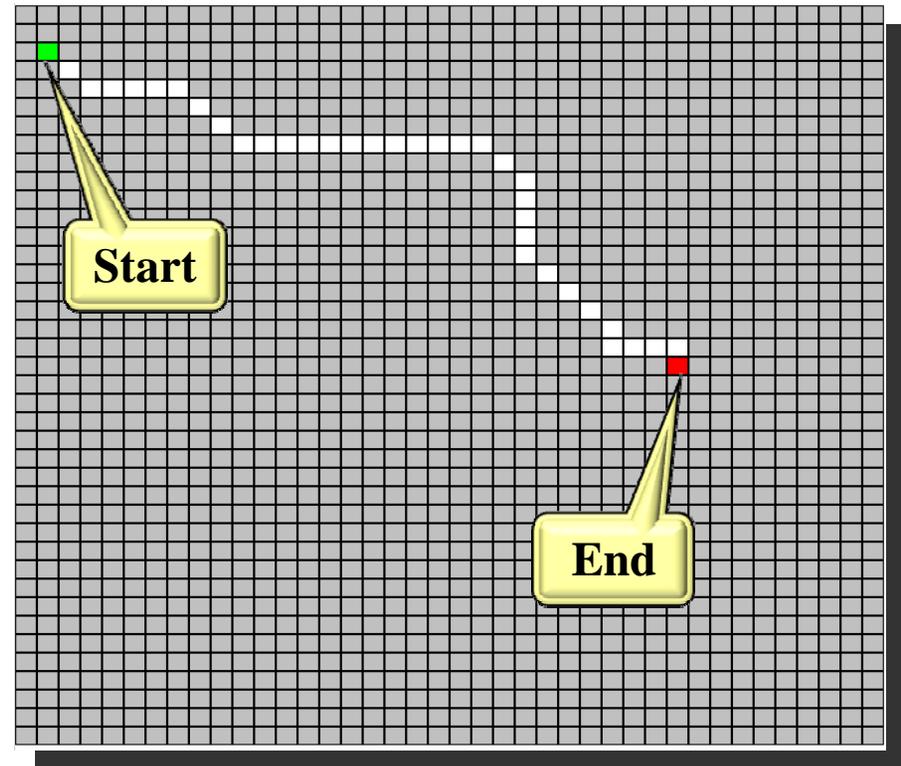


- Evaluates each planned or active trajectory with respect to:
  - Each projected aircraft position in space and time
  - Current or forecast weather from the 4D Weather Cube
  - Weather rules specific to that 4DT regarding allowable exposure to aviation hazards.
  
- Results of this evaluation are:
  - Weather impact
    - Favorable, marginal, unfavorable
  - Alternative trajectory, if impact is marginal or unfavorable
  
- AWAS is designed to process thousands of flight trajectories that may be active or planned at a given time
  - Operates on high-availability, high-performance grid of up to 40 servers
  - Uses gaming technologies to avoid adverse weather impacts

# AWAS Under the Hood



- Evaluates each potential aircraft position in 3D grid
- Evaluates impact of 4D weather
  - Matches time of aircraft position to valid time of forecast weather
- Selects optimal route
  - that meets weather rules
  - that results in lowest cost in distance and weather impact
  - Original route is preferred



AWAS 2D View  
Planned Route







# AWAS Screen Shot



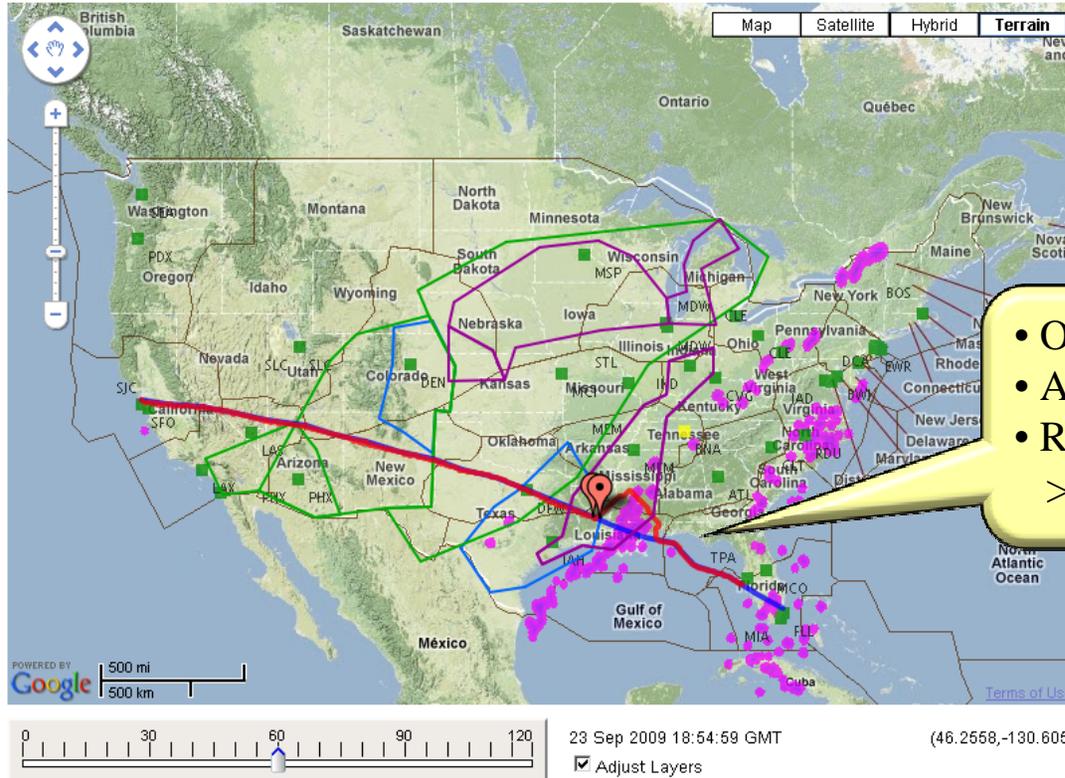
- Forecast
- Hub
- SmartTAF



**Layers**

- World
- States
- Rivers
- Cities
- ARTCC Boundaries
- NCWD 23/1755z
- NCWF2 30 Minute 23/1755z
- NCWF2 60 Minute 23/1755z
- NCWF2 90 Minute 23/1755z
- NCWF2 120 Minute 23/1750z
- Jet Routes
- SID 20/1912z
- STAR 20/1912z
- SmartTAF 23/1805z
- Hub 23/1805z

**Advisories**



Aircraft ID	Departure	Destination	Begin Window Date	Time	End Window Date	Time	Check Which Time? Is Impacted	Search
	FLL	SFO	September 23, 2009	00:00	September 24, 2009	00:00	Departure Time <input checked="" type="checkbox"/>	Clear Map

Route	Alternate	#	Aircraft ID	Departure	Destination	Off-Block Time	Arrival Time	Flight Rule
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1	DAL_123E7E9531E	FLL	SFO	2009-09-23 17:18:30.0	2009-09-23 22:19:01.0	DAL



- **Plan Flight**
  - Flight operator submits proposed trajectory and AWAS provides weather impact and alternative trajectory if necessary
- **Manage impacted trajectories**
  - A flight management decision-support service publishes trajectory data and subscribes to AWAS for weather impacts and alternate trajectories
- **Monitor Active Flight Query**
  - 4DT identifier submitted to AWAS, and while flight and query remain active, updated weather impacts and alternative trajectories are provided
  - Could be provided to in-flight operators via data stream from weather service provider
- **Impacted Flight Query**
- **Impacted Fix Query**
- **Impacted Sector Query**

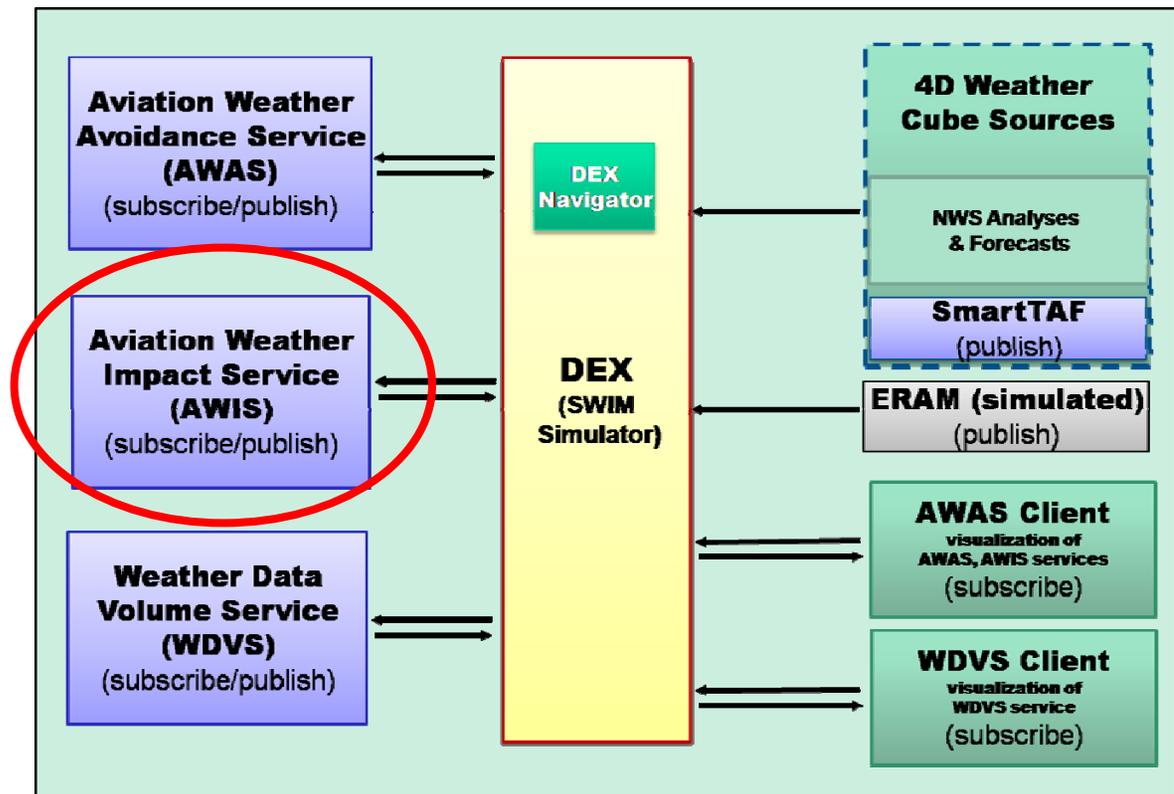
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*Aviation Weather Impact Service  
(AWIS)*

# AWIS Overview



- Evaluates 4D Weather impacts on complex geospatial objects (a core functional weather requirement for NextGen)
  - Points
  - Polygons
  - Volumes
  - Trajectories
- Publish weather impacts



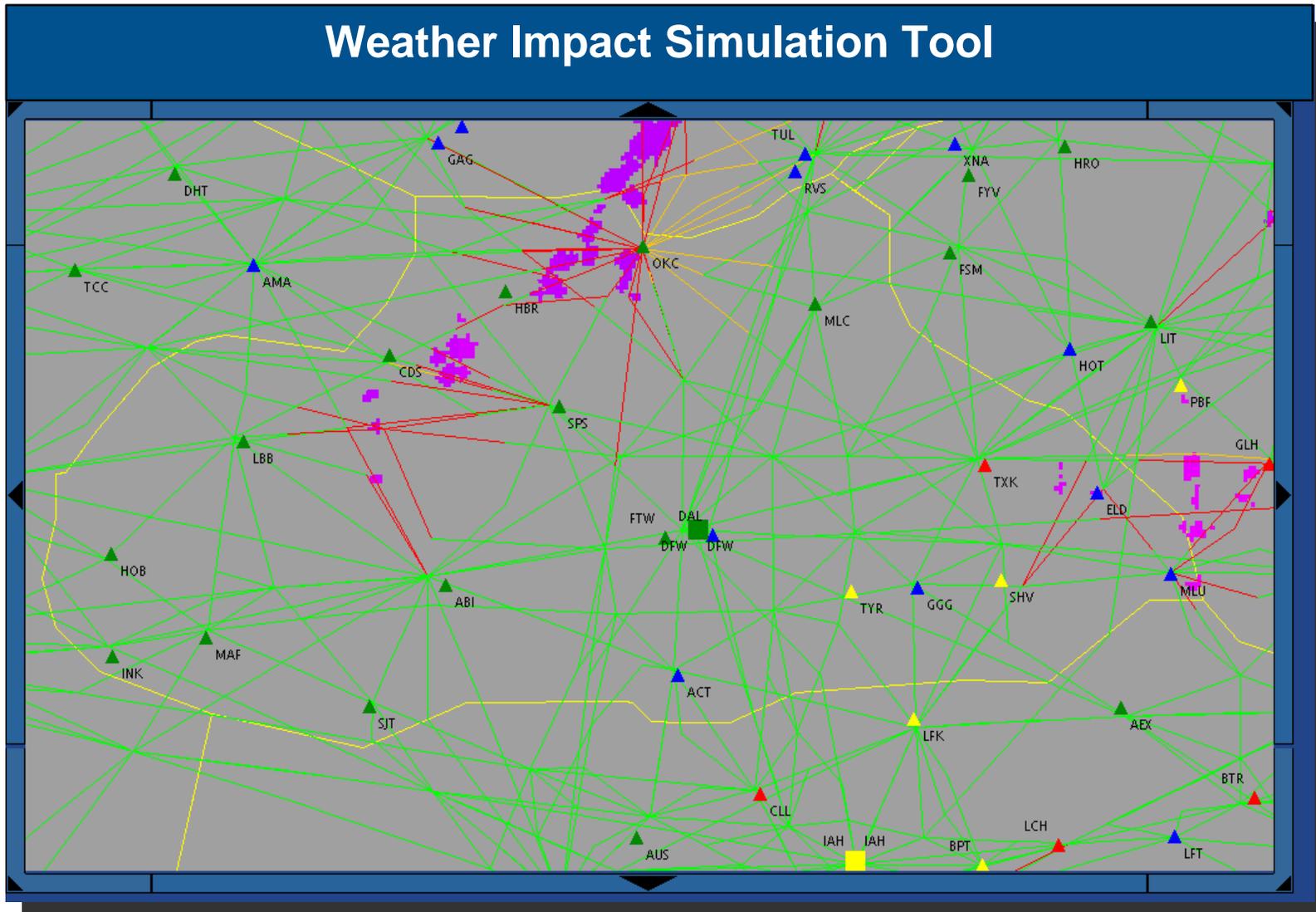
# AWIS Under the Hood



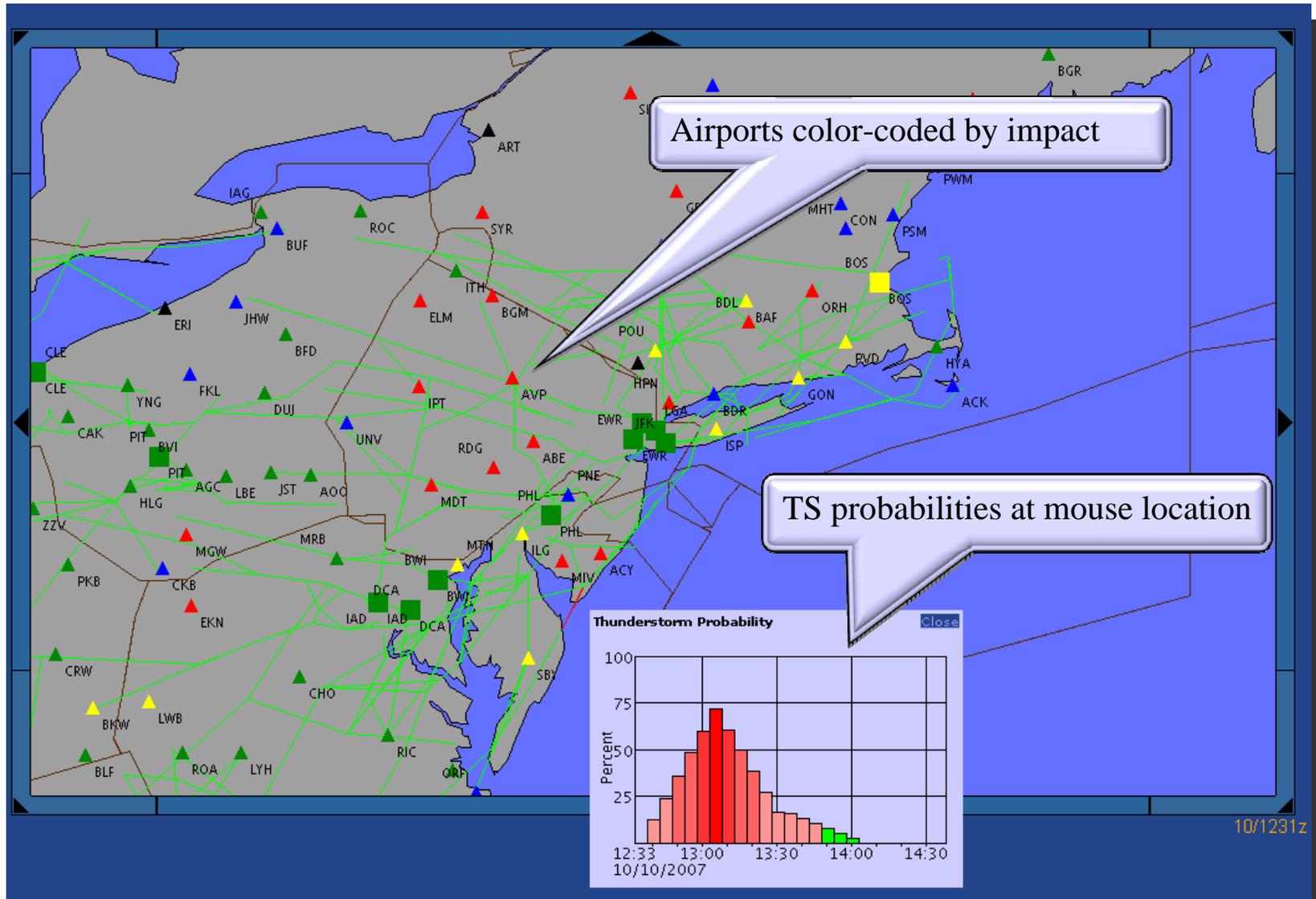
- Functionality is essentially a subset of AWAS
- Subscribes to simulated 4D Weather Cube
  - FBWTG (FAA Bulk Weather Telecommunications Gateway)
  - HWDS (Harris Weather Data Service)
  - NCWD, NCWF2 (National Convective Weather Diagnostic, Forecast)
  - SmartTAF (automated aviation terminal forecasts)
- Subscriber provides [geometry, rules, time](#)
- AWIS publishes impacts to network



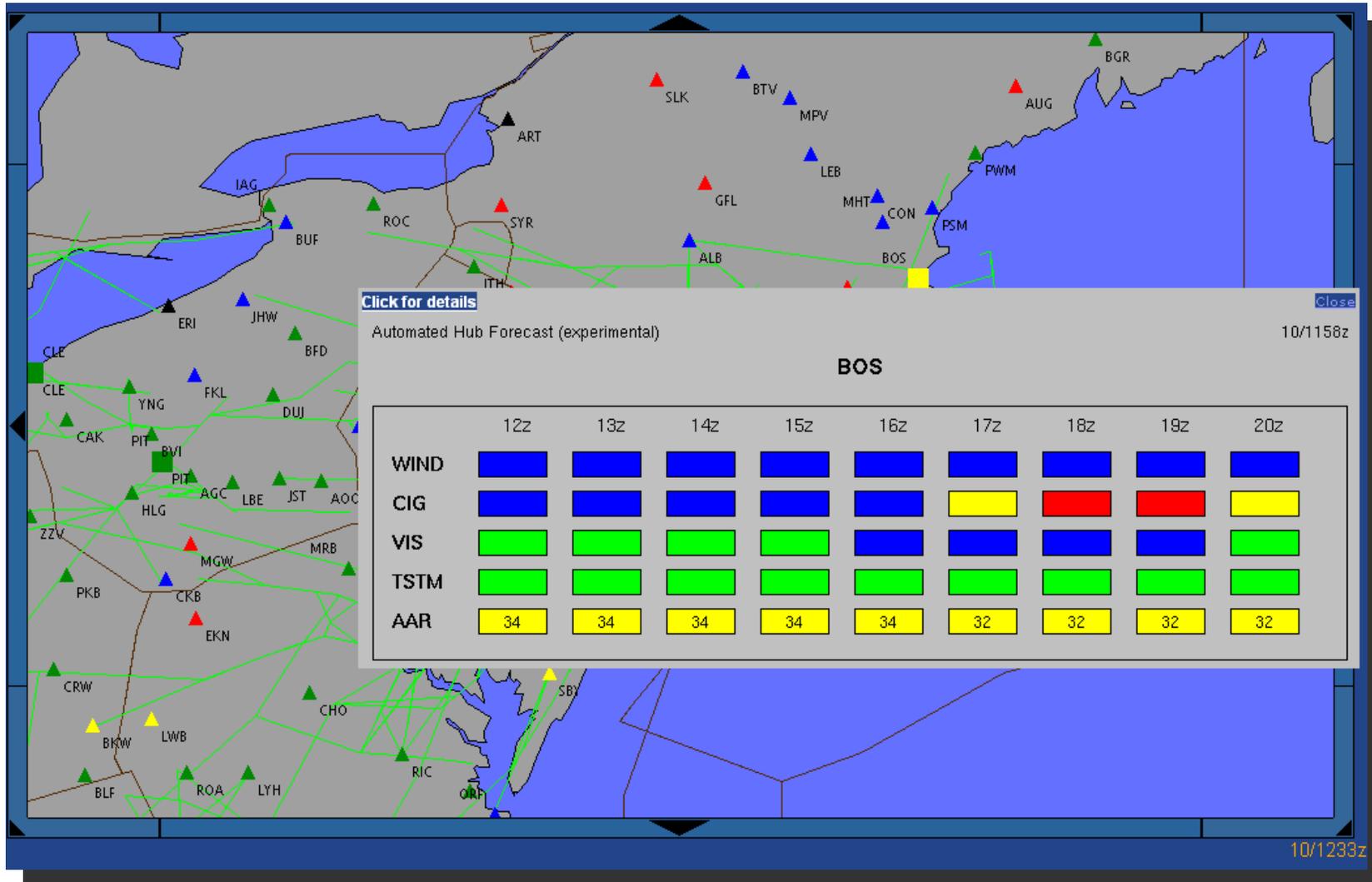
# AWIS Screen Shot (Jet routes, TS)



# AWIS Screen Shot (Airports)



# AWIS Screen Shot (Hub Airports)

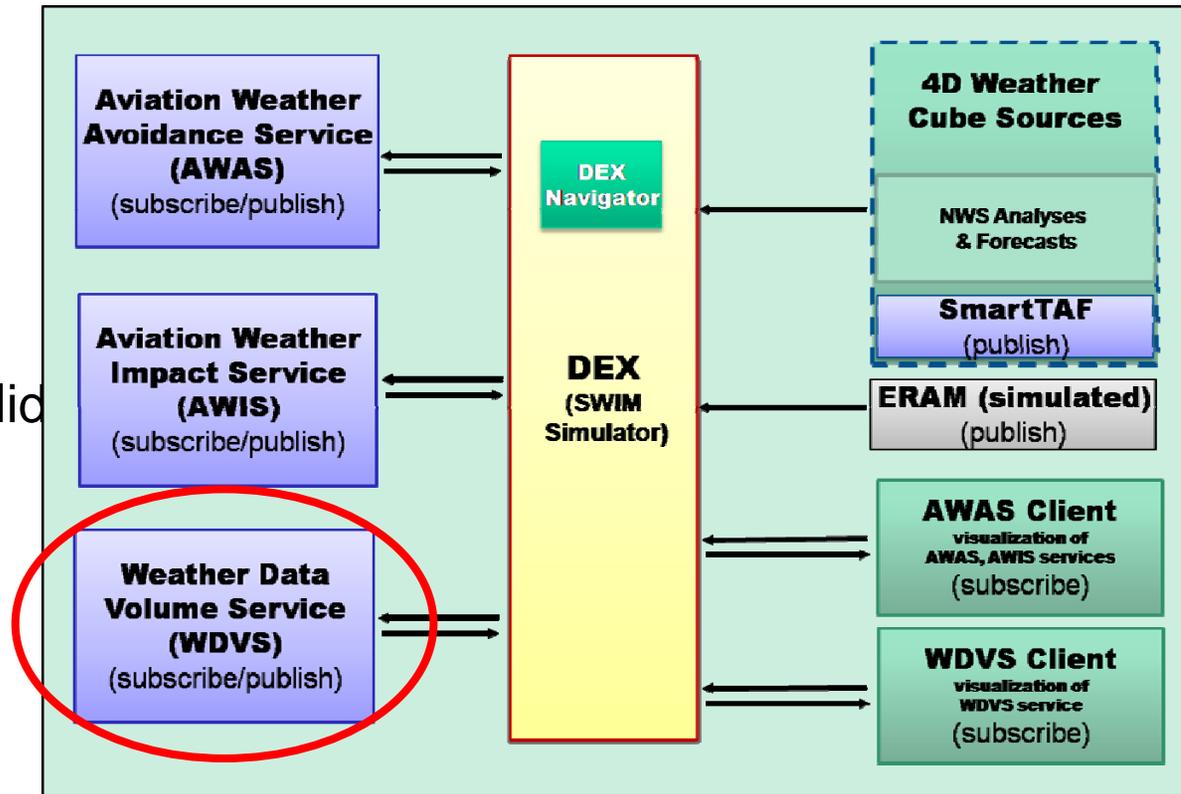


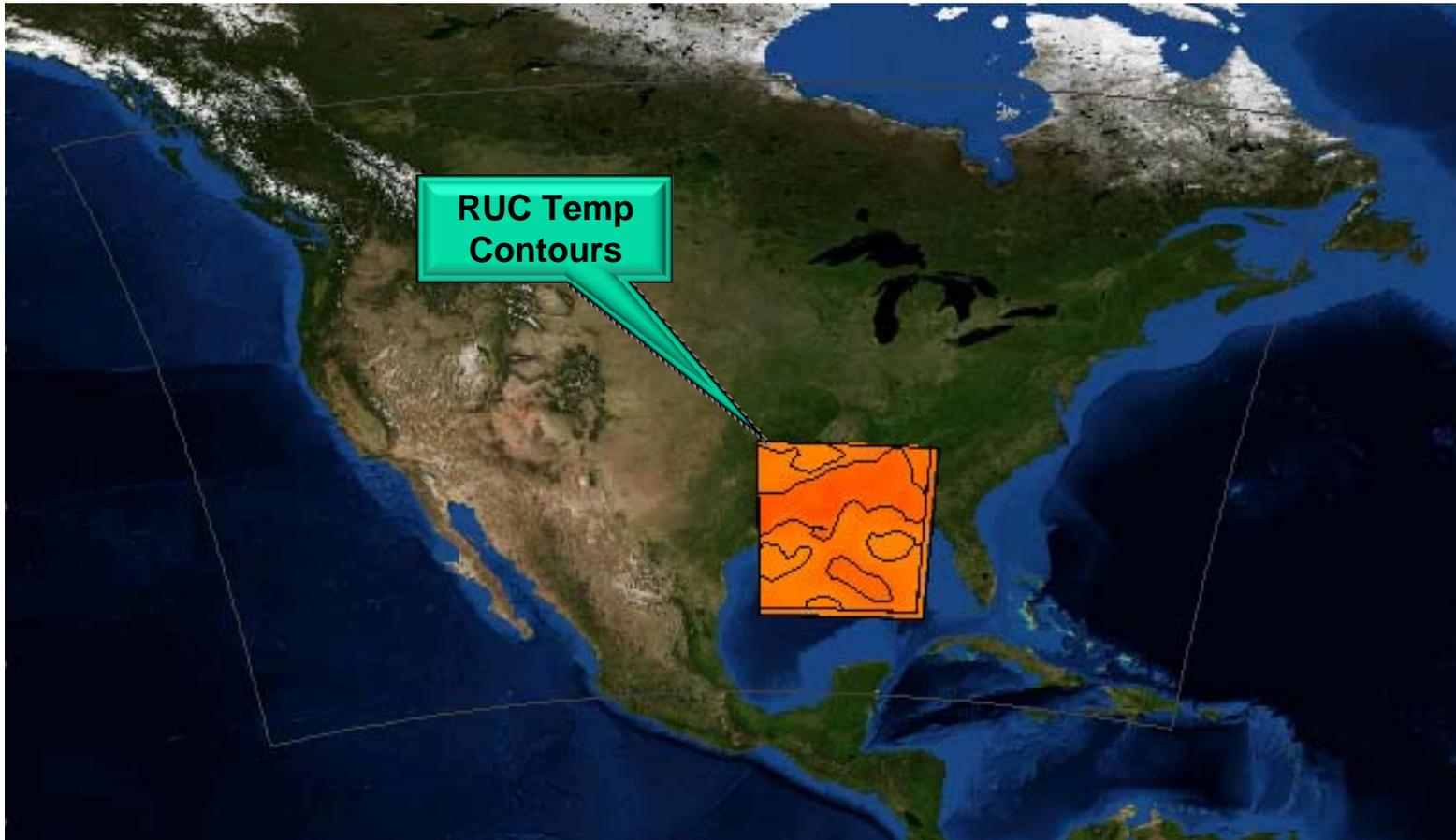
*Weather Data Volume Service  
(WDVS)*

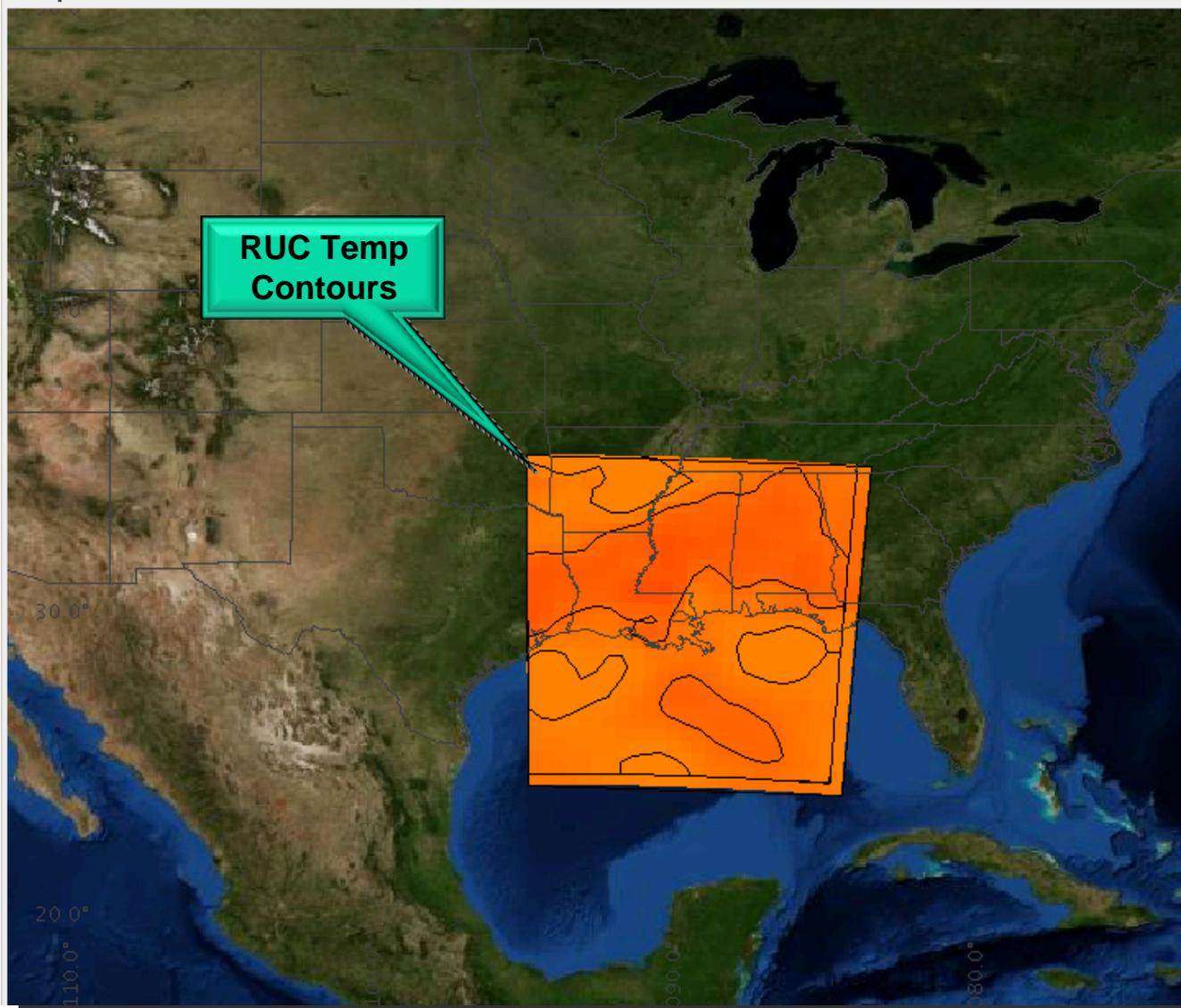
# WDVS Overview



- Extracts a subset of NWP model data for user-specified geospatial object
- Subscriber provides model, geometry, valid time
- Publishes output to network







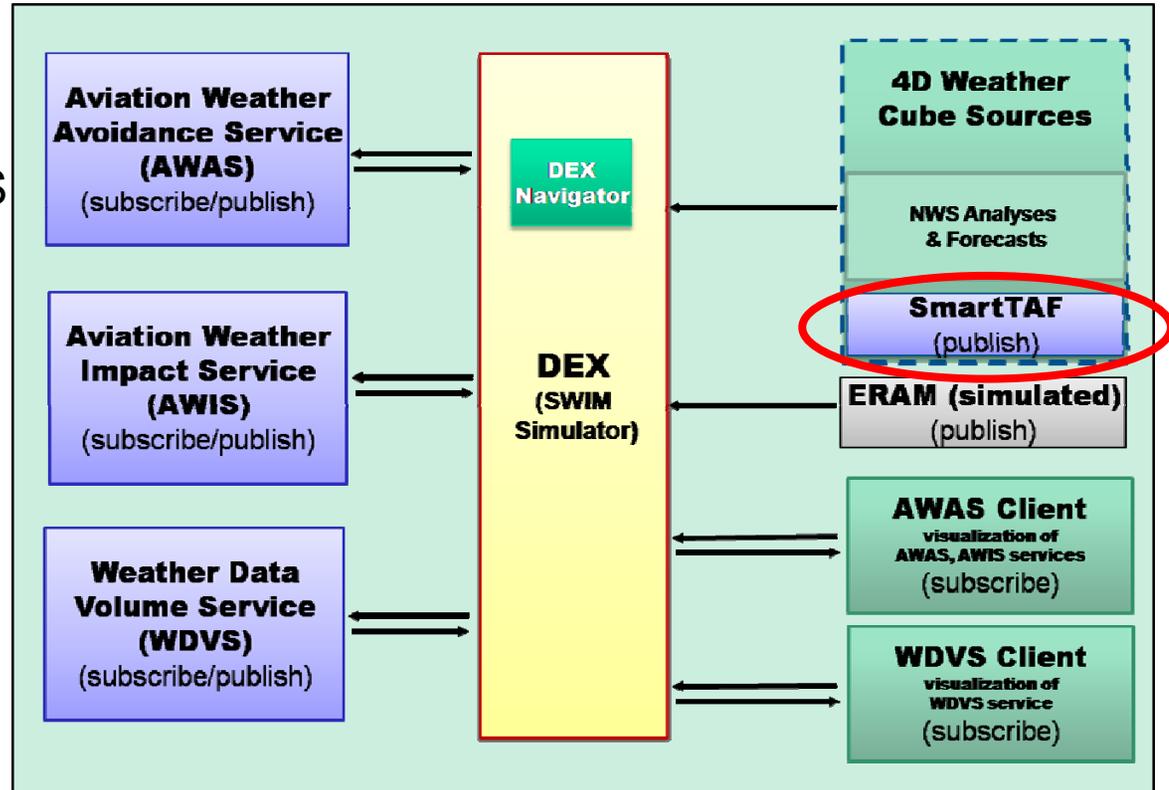
# *SmartTAF*

*Automated Aviation Forecast Service*

# SmartTAF Overview



- Generates automated “first guess” TAF-like forecasts
- Forecasts for All CONUS TAF locations
  - Based on fuzzy systems utilizing
    - latest METAR
    - GFS MOS, LAMP
    - RUC model
    - National Convective Weather Forecast (NCWF-2)
  - Generated upon arrival of new METAR
- Currently used by a Harris partner to support a major U.S. air carrier
  - Well suited for ‘forecaster over-the-loop’ operations

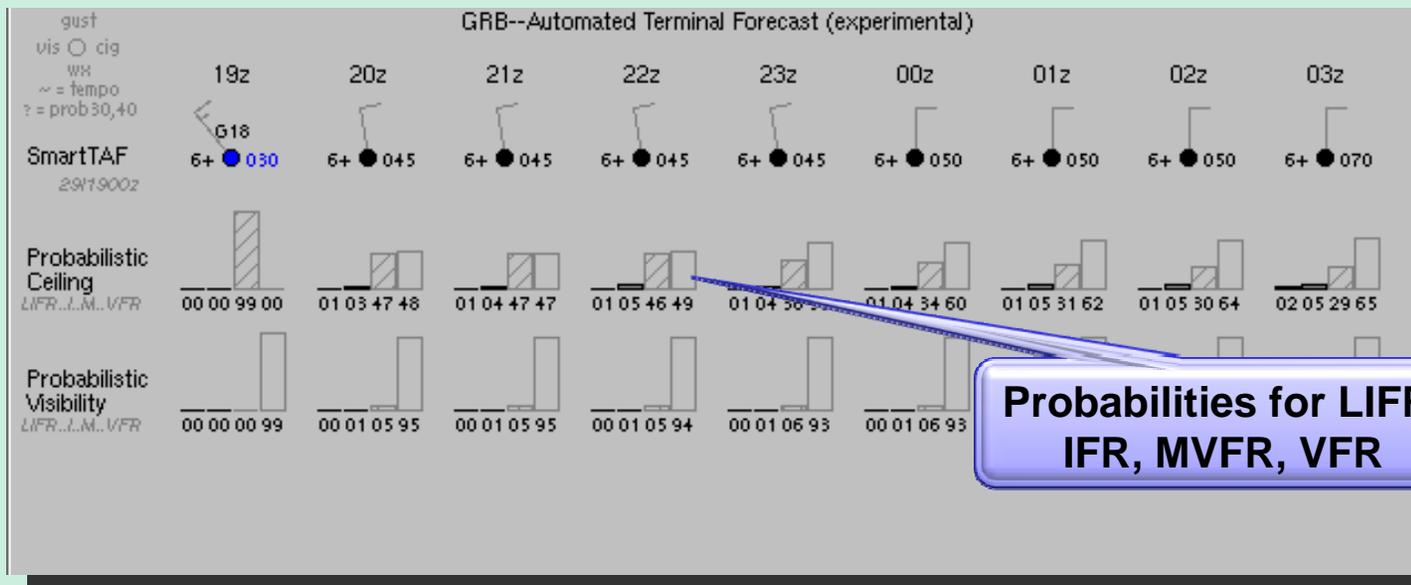


# SmartTAF Screen Shots



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FZZGRB      (experimental)
KGRB 291900Z 2919/3018 32013G18KT P6SM OVC030
FM292000 35012KT P6SM OVC045
FM292100 35012KT P6SM OVC045
FM300000 36010KT P6SM OVC050
FM300300 36009KT P6SM OVC070
FM300600 36006KT P6SM OVC250=
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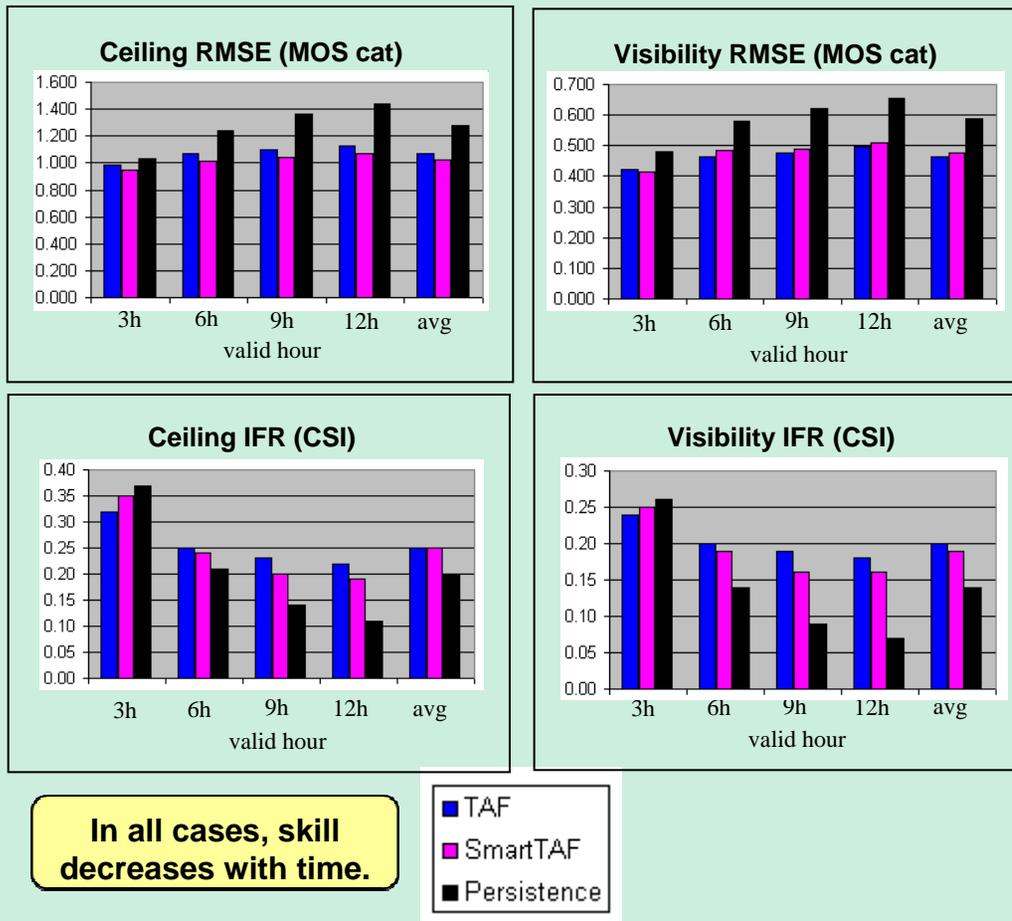


**Probabilities for LIFR, IFR, MVFR, VFR**



## Verification--TAF & SmartTAF Jan 2004 – Apr 2008

7,715,163 forecasts



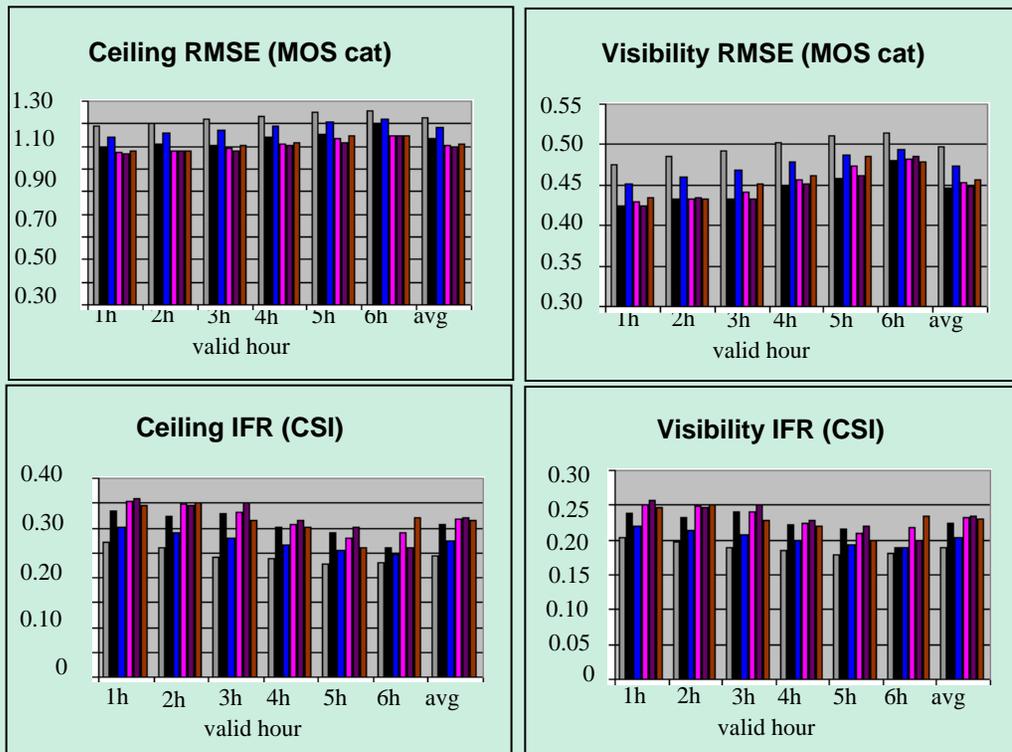
- Typical comparative forecast verification...
  - Forecasts issued at same time and valid at same time
- SmartTAF compares well with TAF proving that “first guess” automated forecasts can be useful.
- **Important to note...**
  - TAFs are issued every 6 hours, excluding amendments, and may be up to 6 hours old
  - SmartTAFs are issued upon METAR arrival and are therefore at most 1 hour old

# SmartTAF Verification for 'Next 6 Hours'



## Verification--TAF & SmartTAF Jan 2004 – Apr 2008

7,715,163 forecasts



- For possible hours 00z – 23z
  - TAFs are 0-6 hours old
  - SmartTAFs are 0-1 hour old
- This difference in forecast age makes a difference in the very important next 6 hours...
  - SmartTAFs with average age 0-1 hour verified more favorably than TAFs with average age 0-6 hours, for each valid hour 1-6
- Automation and forecaster-over-the-loop operations can handle more forecast locations with existing resources



- Harris has developed an IR&D environment leveraging over 20 years of aviation weather experience to focus on the application of weather in the Next Generation national airspace system.
- Weather plays a critical role in the NAS and Harris has technologies waiting to be exploited to make it more useful to all NAS users including the flying public.
- These are just a few of the types of services that need to be employed to assist in the design, development and deployment of the NAS weather infrastructure.

*Thank you.*

For more information or questions concerning  
this presentation,  
please visit the Harris booth  
in the Exhibit Hall.