



**Federal Aviation
Administration**

The Federal Aviation Administration's Advanced Weather Radar Techniques Program

Presented to: Sixth Conference on Transition
of Research to Operations

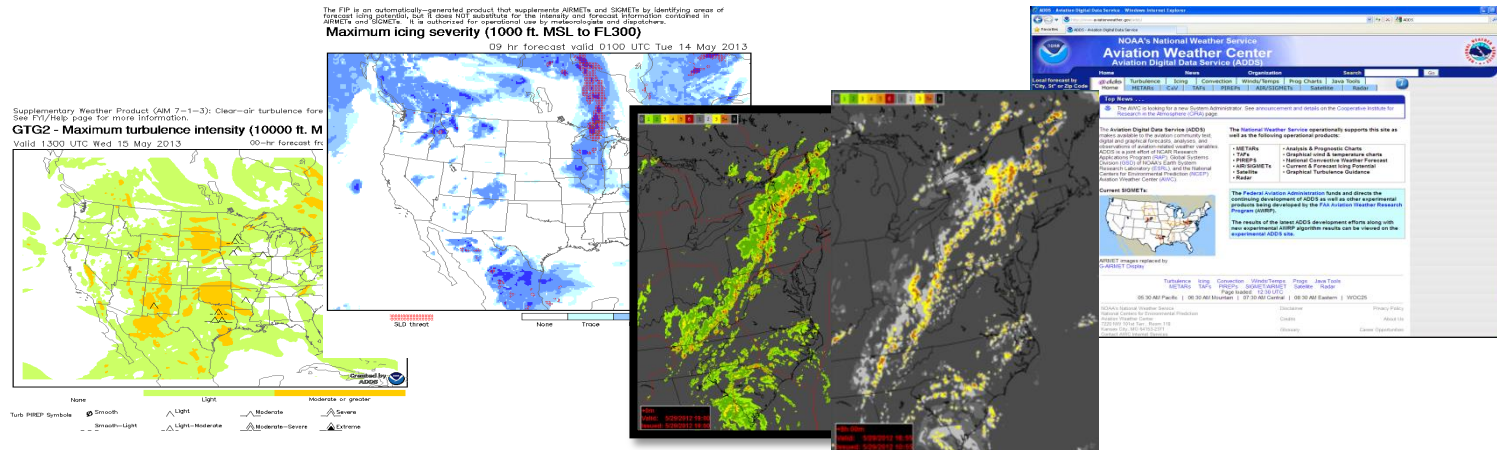
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With significant contributions from
Courtney Maciejewski (FAA)



Aviation Weather Research Program (AWRP)

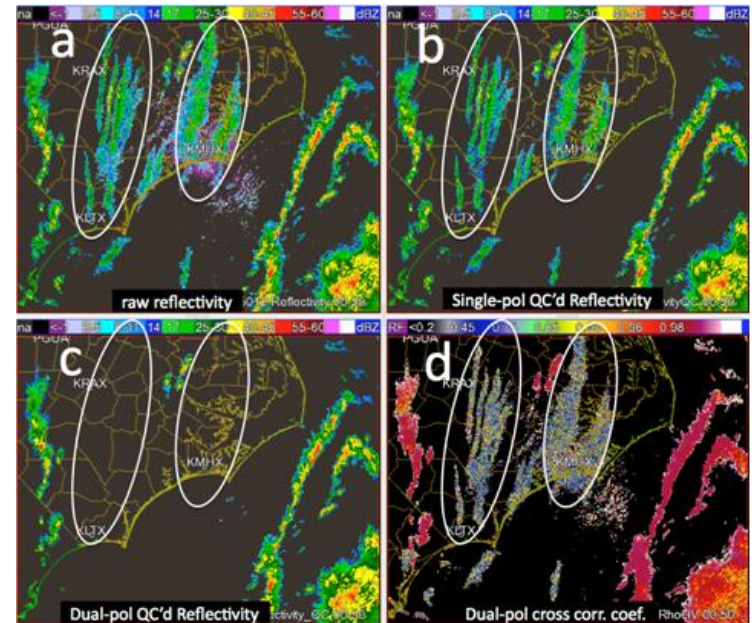


- Applied research to minimize the impact of weather on the National Airspace System (NAS) by:
 - Meeting specific NextGen Operational Improvements in NextGen Implementation Plans
 - Mitigating weather related safety and/or efficiency issues with a line of sight to operations
 - Evolving weather information required today in legacy capabilities to meet emerging NextGen needs often in collaboration with the National Weather Service (NWS)

Advanced Weather Radar Techniques

Project History & Overview:

- The Advanced Weather Radar Techniques (AWRT) Product Development Team (PDT) was established by the AWRP for the research and development (R&D) of advanced radar technologies for aviation weather applications
- AWRT explores quality control techniques to mitigate effects of any conditions which may result in false weather radar presentations
- The work involves applications using the newly-fielded dual polarization capabilities and the integration of multiple radar assets (WSR-88D, Terminal Doppler Weather Radar (TDWR), Canrad). The mosaic applications reside in the Multi-Radar Multi-Sensor (MRMS) system



Advanced Weather Radar Techniques

➤ **Mission:**

- Improve and increase radar detection and forecast of aviation-impacting weather conditions, and enhance the delivery of aviation weather services by the FAA and the NWS

➤ **Goals:**

- Research and develop quality assurance schemes for MRMS data, and develop new products based on requirements from the operational aviation community
- Provide evaluation of existing weather radar sensors and processor networks
- Support roadmap investment decisions and initial concepts of weather radar sensing and data processing

Advanced Weather Radar Techniques

- The FAA's William J Hughes Technical Center (WJHTC) operates a MRMS R&D system for testing and development of aviation-weather related capabilities
- This test bed is compatible with the R&D MRMS system at National Severe Storms Lab (NSSL) and the operational MRMS system at the National Center for Environmental Prediction (NCEP)
- Available with a 30 second product update cycle supporting the FAA's Common Support System – Weather (CSS-Wx) capability evaluations
- Actively utilized in data assimilation, product development, and as a verification tool for new FAA and NWS algorithms and products such as icing and turbulence detection
- Internal FAA MRMS website with user defined archives for significant weather cases
- New operational products available for use by FAA, airlines, aviation meteorologists and other users



Multi-Radar Multi-Sensor (MRMS)

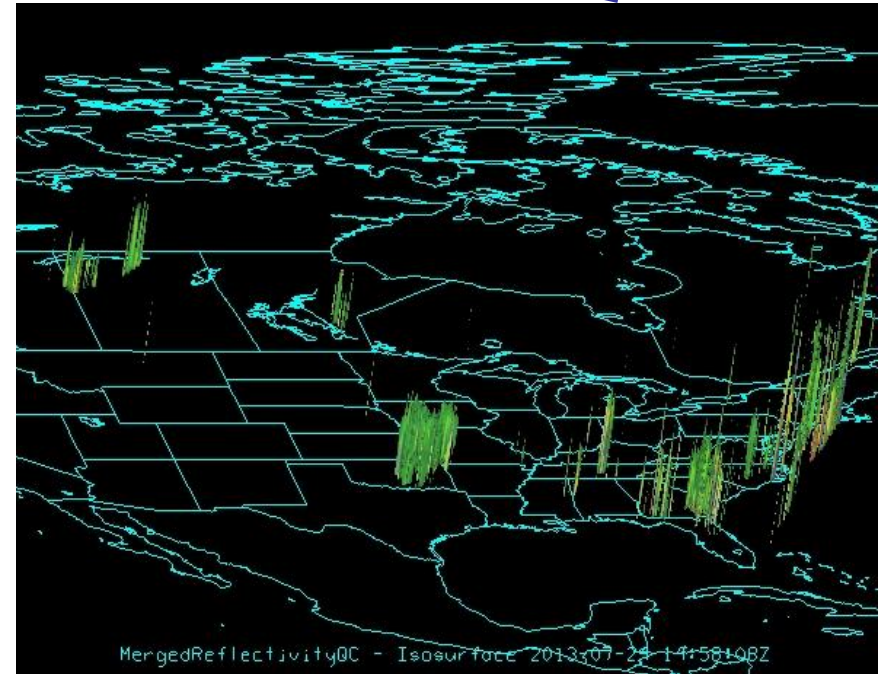
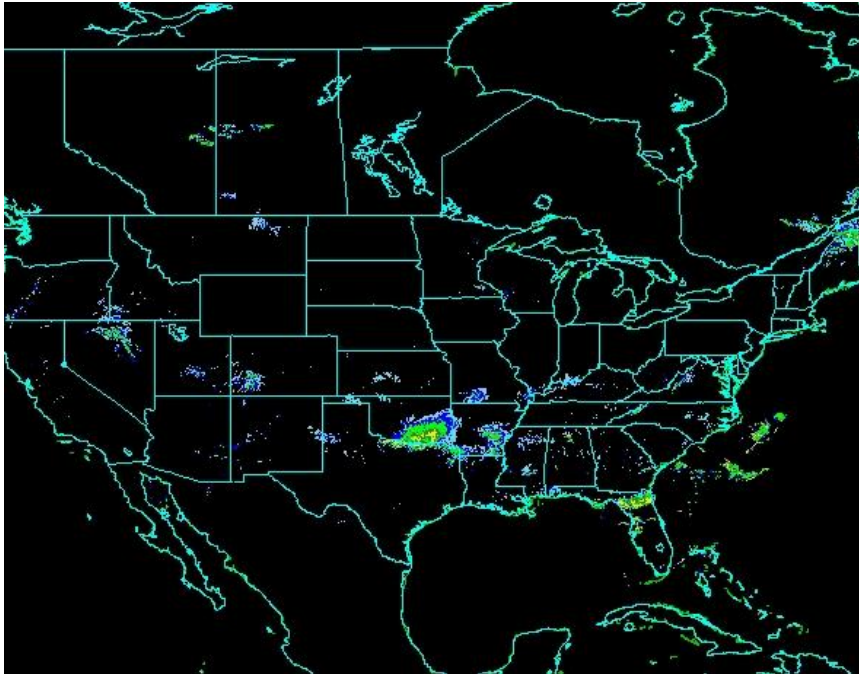
“A Powerful 3D Weather Radar Capability”

Decision
Support Tool
Validation

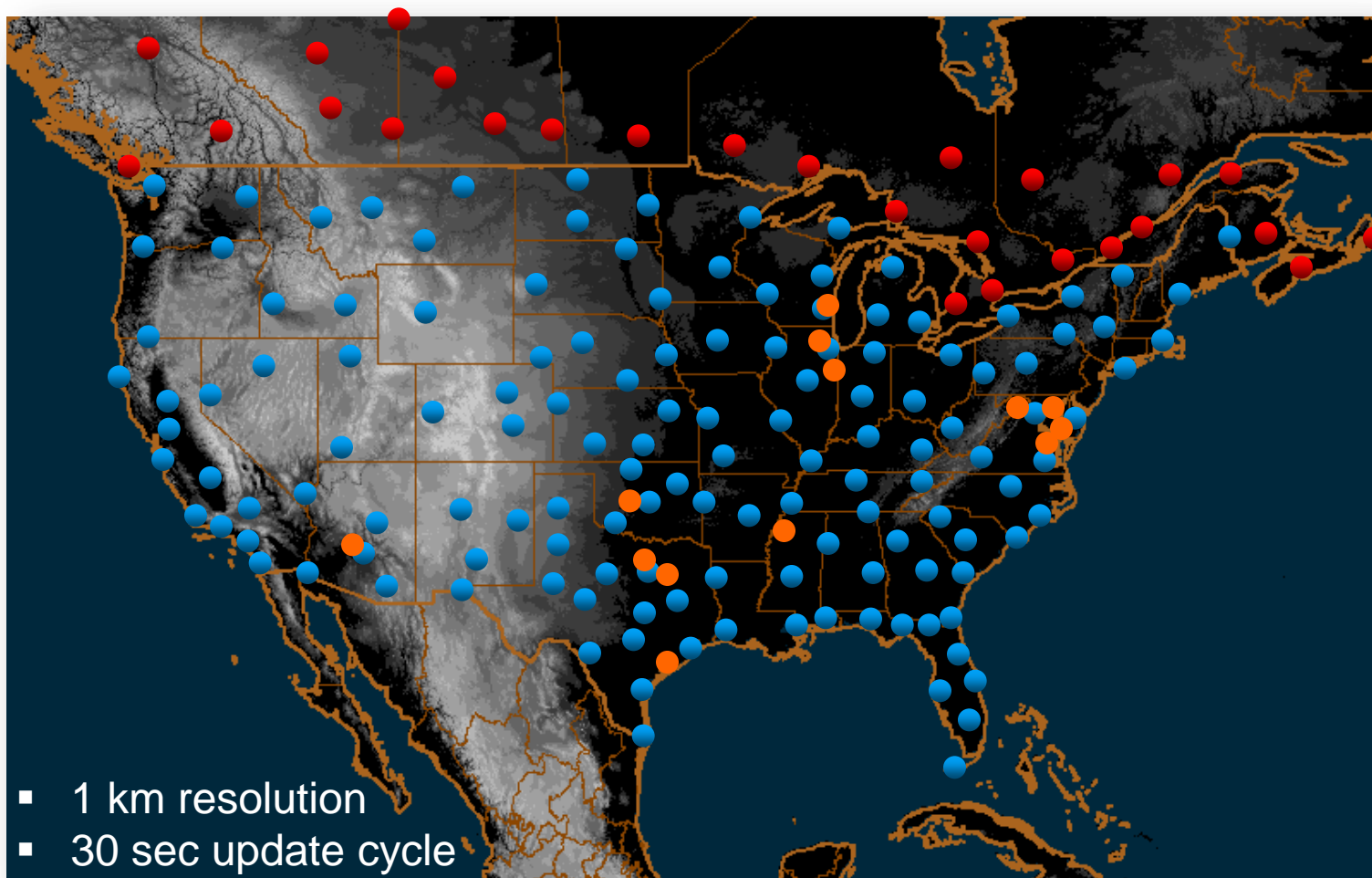
Requirements
Identification

Modeling &
Simulation

Concept
Validation



MRMS Domain

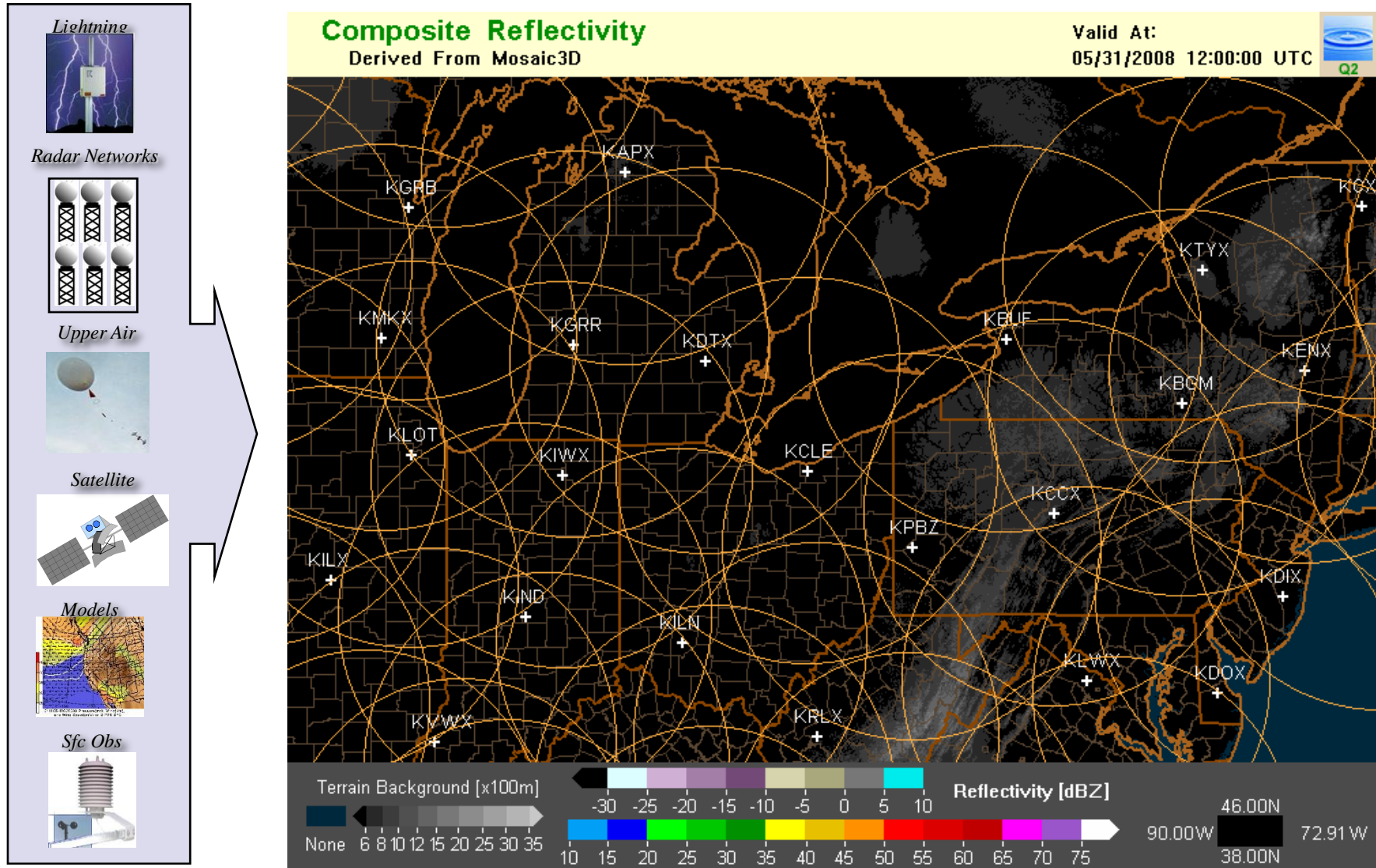


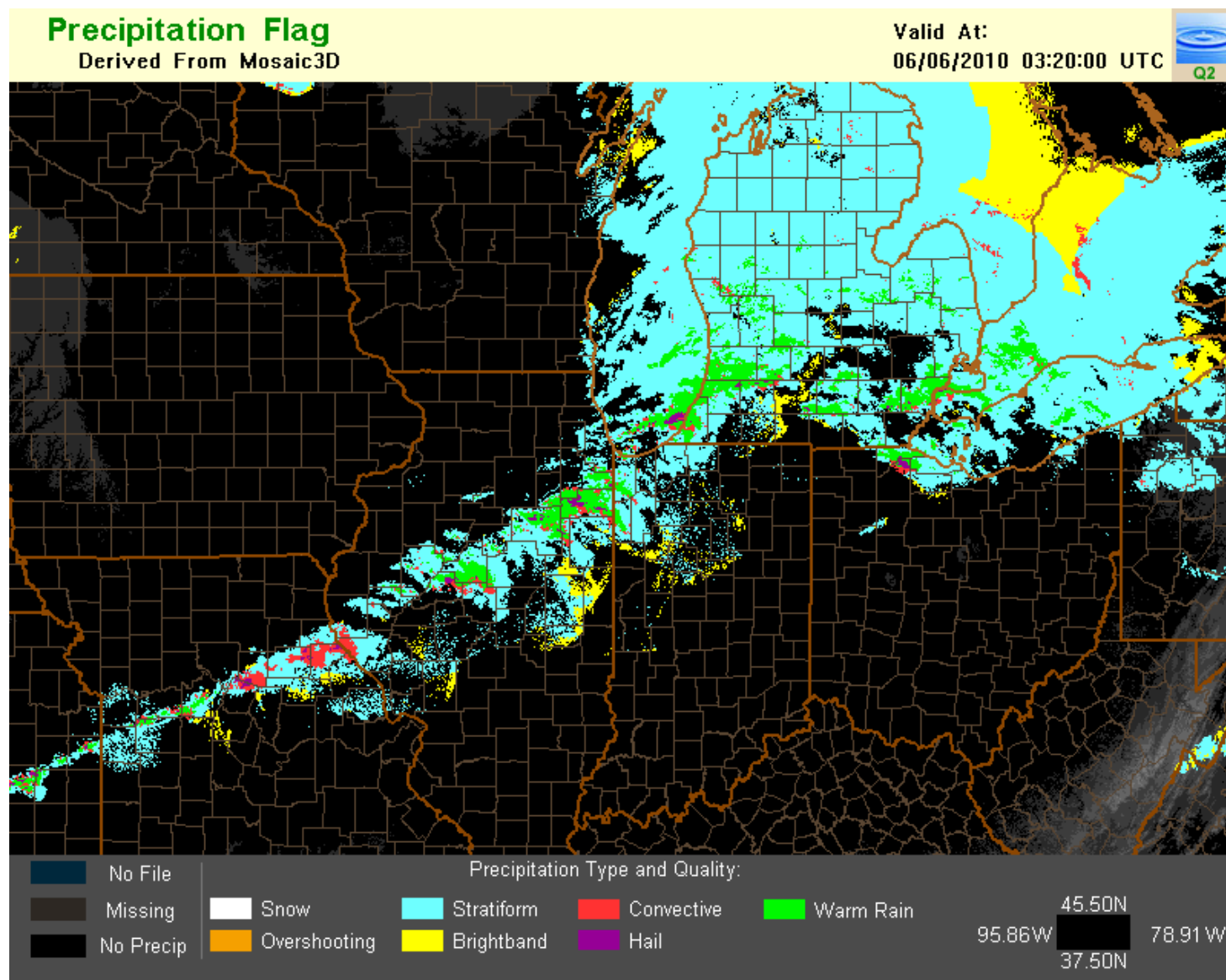
● WSR-88D

● Canadian

● TDWR

Integrated multiple sensor approach to high resolution rendering of storms and weather



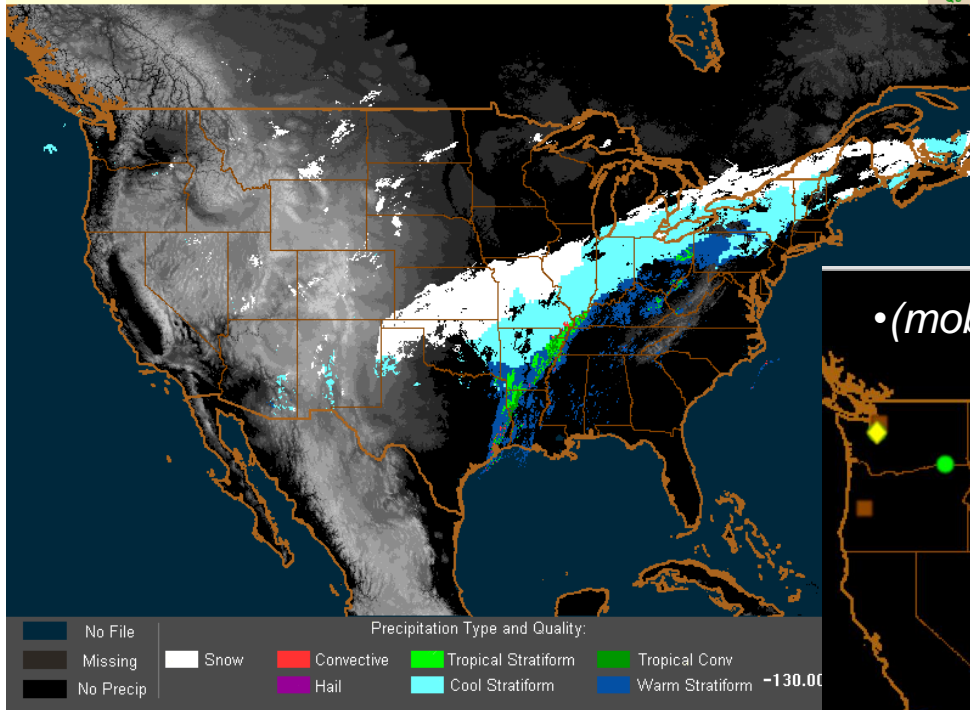


Surface Precip Classification Validation

Surface Precipitation Type

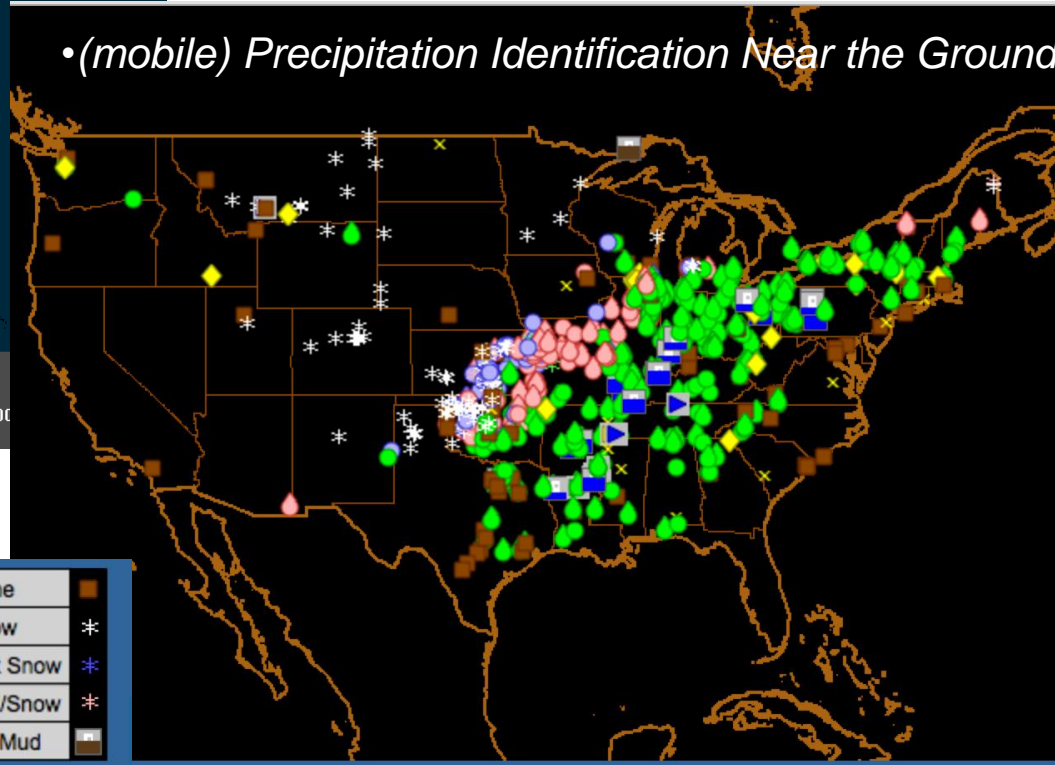
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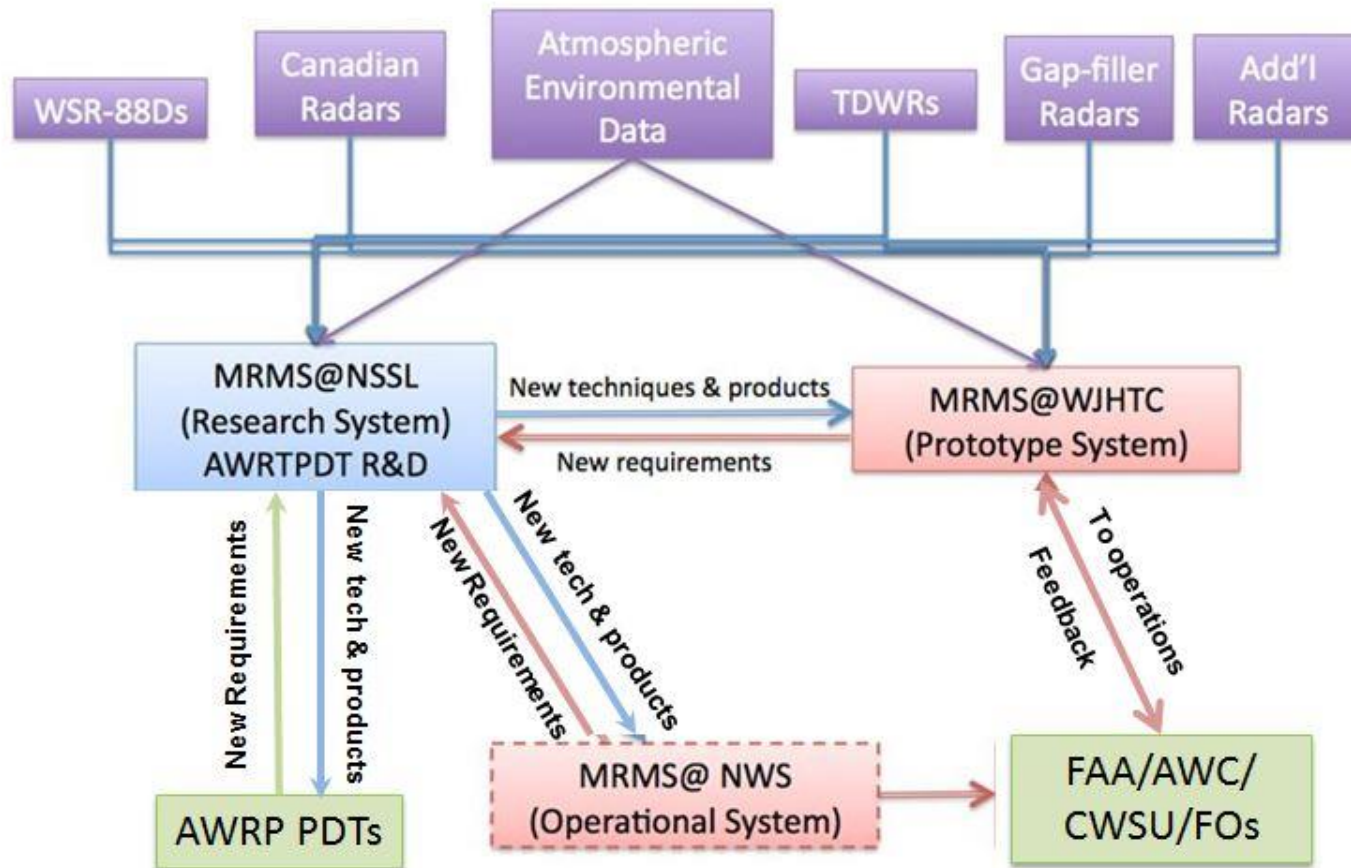
mPING.nssl.noaa.gov

•(mobile) Precipitation Identification Near the Ground



MRMS Science-2-Operations Transfer

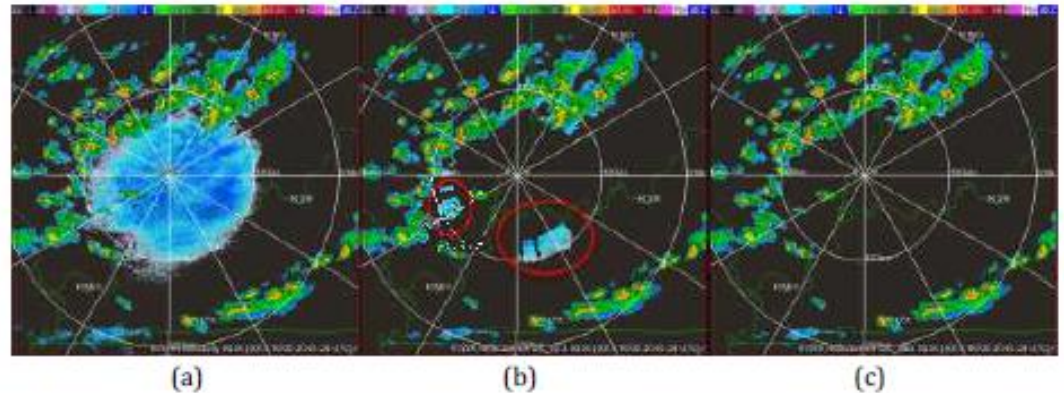
The NextGen research and development work flow



Recent Accomplishments

- Development, testing and verification at WJHTC was instrumental in transitioning MRMS to operational status at NCEP in September 2014
- Implemented a new 2-D melting layer delineation scheme in the MRMS testbed - minimizes erroneous removal of precipitation pixels in the bright band area, improves icing detection
- Completed implementation of Canadian radar quality control algorithms into MRMS

(a) Original base reflectivity
(b) Previous QC method
(c) ML delineation QC method



Current and Planned Projects

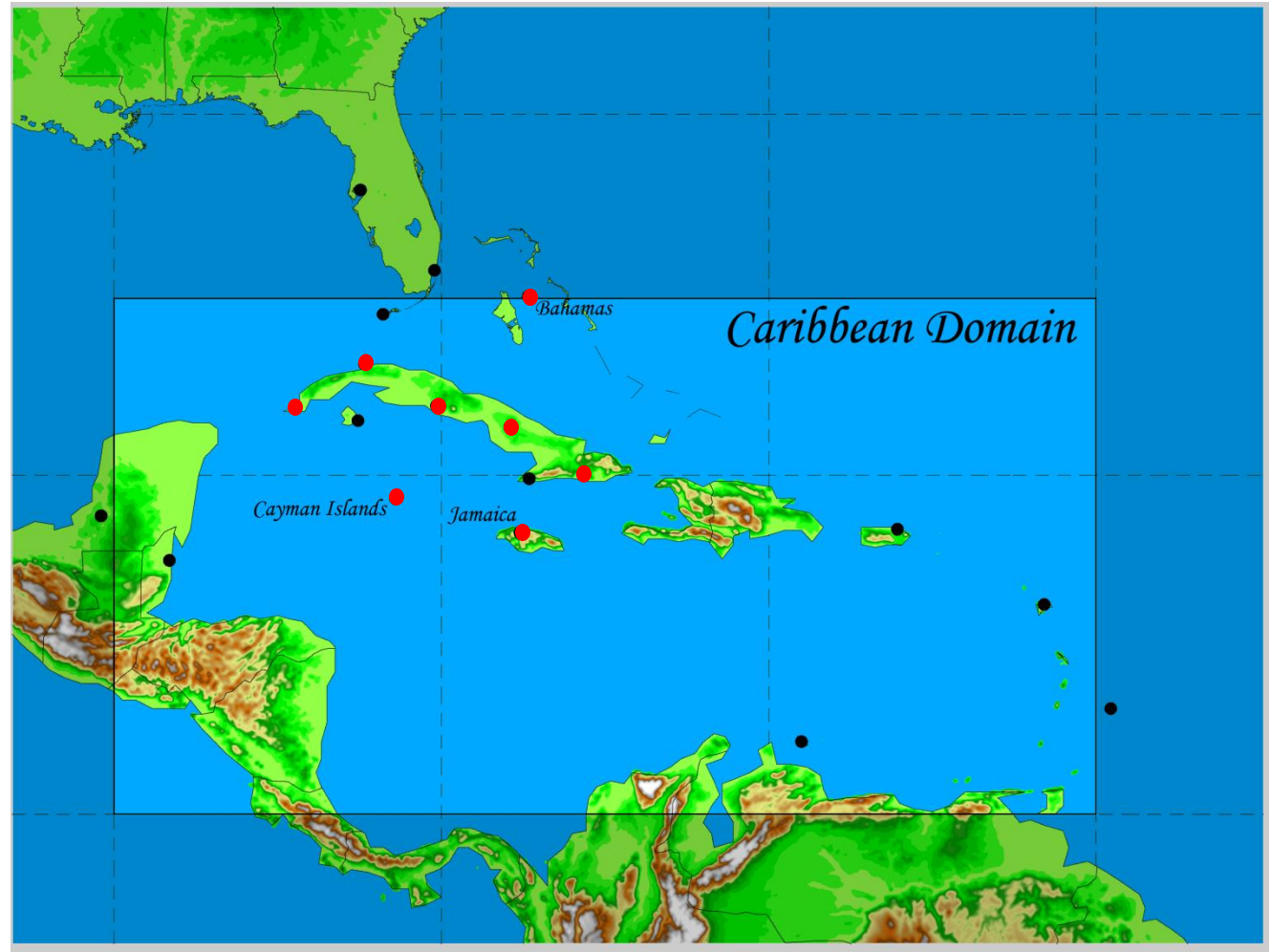
Tasks and expected accomplishments this coming year:

- Baseline the MRMS systems running at WJHTC, NSSL, and NCEP
 - Allows for a common operating system between the three locations
- Integrate Caribbean radar data
 - Improves the spatial coverage of MRMS to offshore areas in the Caribbean
 - Sets the process for additional MRMS suites for the Pacific to aid in aviation weather support
- Develop and integrate a Quasi-Vertical Profiles (QVPs) algorithm in MRMS
 - More precise identification of layers in the atmosphere where threats such as icing, high-ice water content hydrometeors, and dust exist
- Create and integrate icing and hydrometeor classification algorithms into MRMS
 - Improves diagnosis and depiction of icing conditions of interest to aircraft operations
- Complete a feasibility study for the potential implementation of NCAR's Turbulence Detection Algorithm (NTDA) and the Diagnosis of Convectively-Induced Turbulence (DCIT) algorithm into the MRMS system
 - Risk reduction task to identify benefits and risks (including operational considerations), path to operations, and steps required to bring these capabilities into operation
- Develop a 5 year plan for aviation-weather related algorithm development and potential integration of MRMS system and/or products into FAA operations

New Radar Additions

- FY16 work to configure and implement new MRMS domains (in red)

- Cuba
- Bahamas
- Jamaica
- Cayman Islands



Summary

- AWRT manages R&D of advanced radar technologies for aviation weather applications and explores quality control techniques to mitigate effects of conditions which may result in false weather radar presentations
- The FAA operates a MRMS R&D system for testing and development of aviation-weather related capabilities
- Actively utilized in data assimilation, product development, and as a verification tool
- Test bed is compatible with the R&D MRMS system at NSSL and the operational MRMS system at NCEP
- Established, working process for transition of MRMS algorithms from research to operations
- Good collaborative working relationship with NSSL, the National Center for Atmospheric Research and others for improving MRMS capabilities

Questions?

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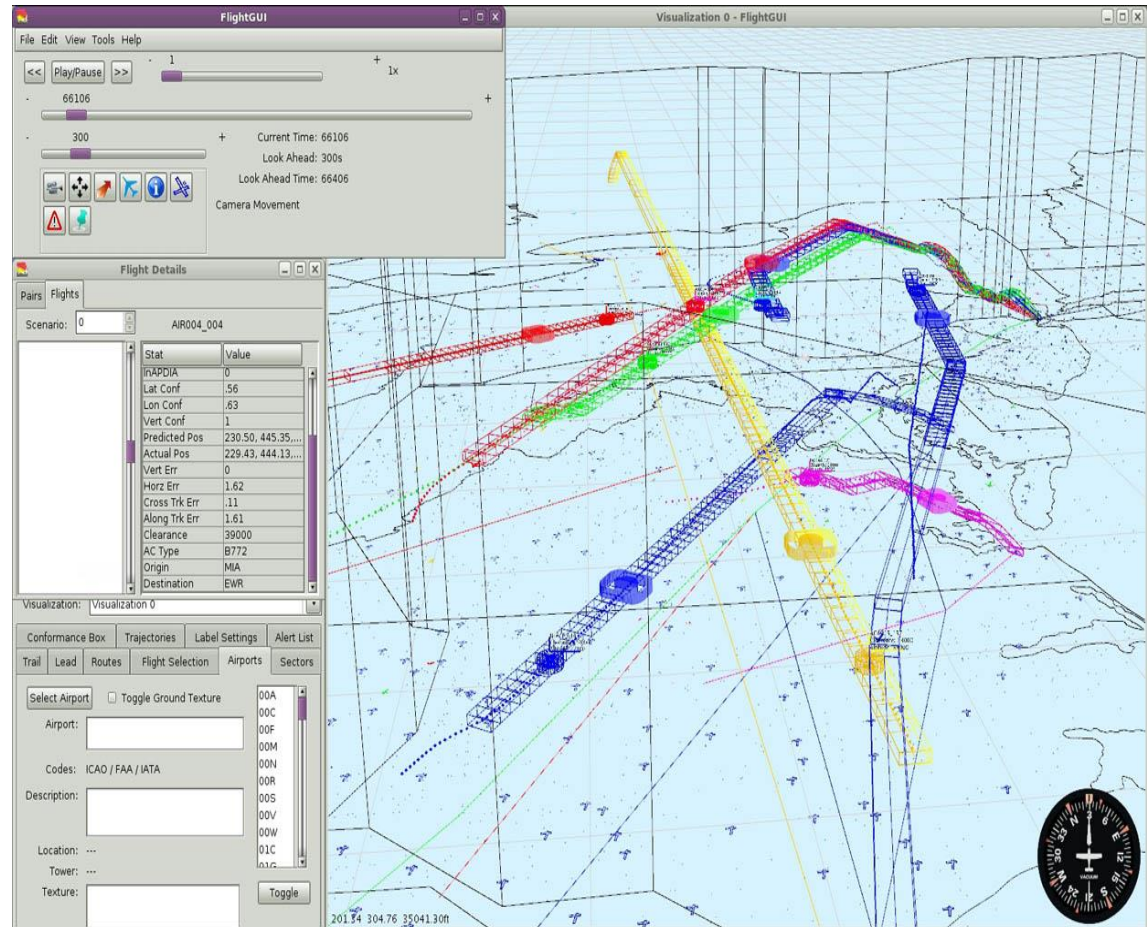


Back Up



Convective Weather in FliteViz 4D Visualization Tool

- The FAA Concept Analysis Branch developed an interactive four-dimensional (4D) visualization tool for analysis of practically any aviation concept
- This tool overlays 3D MRMS products with real aviation traffic to examine flight deviations while encountering weather events



MRMS Transition into NCEP Operations

- MRMS has been installed on the NWS Integrated Dissemination Program (IDP) Phase II processing farm at NCEP in College Park, MD
- Initial MRMS configuration product suite operational in Sept 2014
- Major MRMS product updates Sept 2015 and July 2016
- MRMS full backup system located on the NWS IDP processing farm in Boulder, CO (March 2015)

