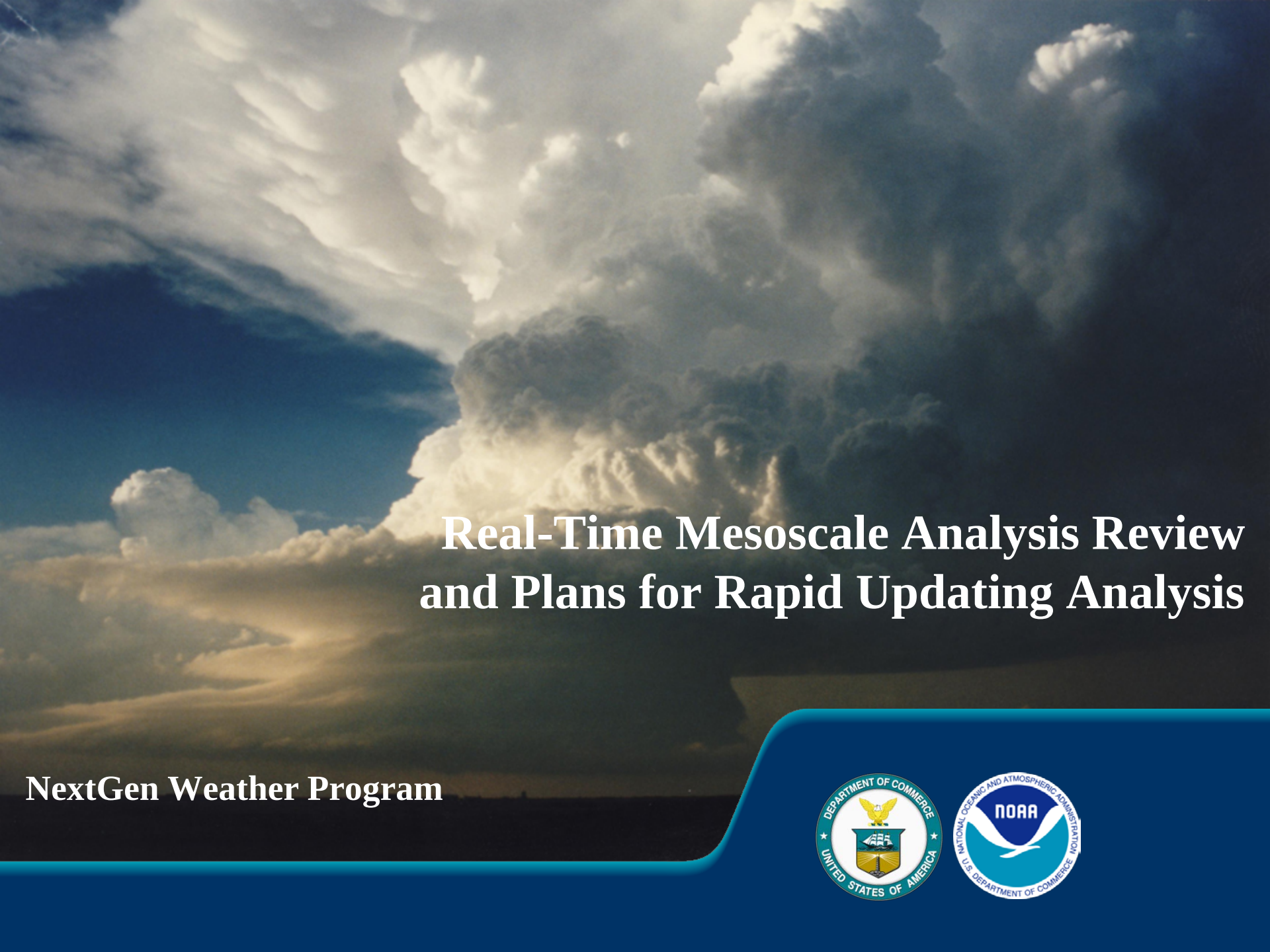


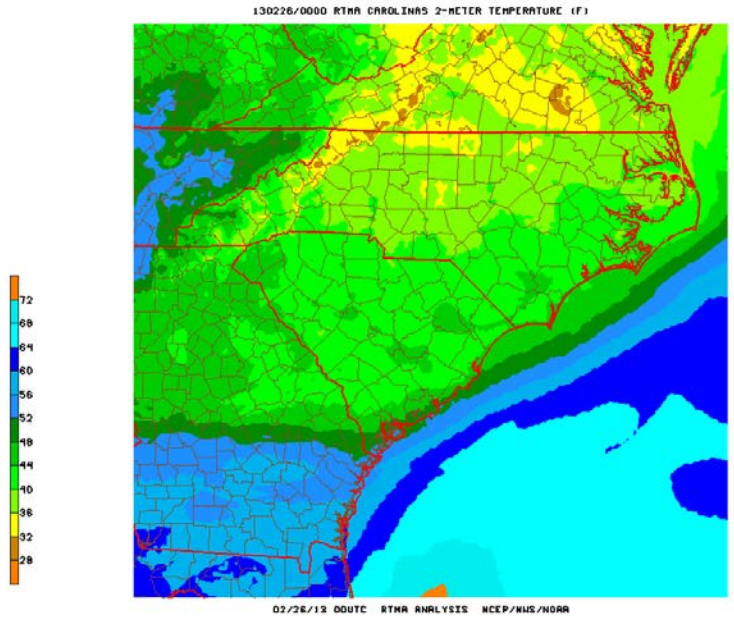
Real-Time Mesoscale Analysis Review and Plans for Rapid Updating Analysis

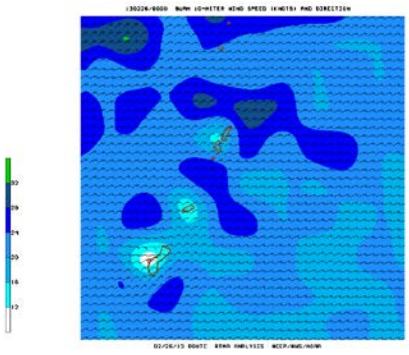
NextGen Weather Program

What is RTMA?

RTMA: Real-Time Mesoscale Analysis

- A 5 km to 2.5 km hourly CONUS gridded weather analysis
- Provides gridded initial conditions for local forecasts for NWS field offices
- Also used as the “Analysis of Record” (AOR) for forecast verification and case studies





RTMA Details

Analyses:

- Wind Speed and Direction
- Temperature
- Dew Point Temperature
- Surface Pressure
- Effective Cloud Amount
- Accumulated precipitation

Analysis Uncertainty:

- Temperature
- Dew Point Temperature
- Wind Speed
- Wind Direction

Model Terrain:

- Fixed field

Hourly Domains:

- CONUS (5 and 2.5 km)
- Hawaii (2.5 km)
- Alaska (6 km)
- Puerto Rico (2.5km)

3 hourly Domain:

- Guam (2.5km)

2013 RTMA Enhancements

3 km Analysis upgrade for Alaska

1.5 KM Analysis domain for Juneau

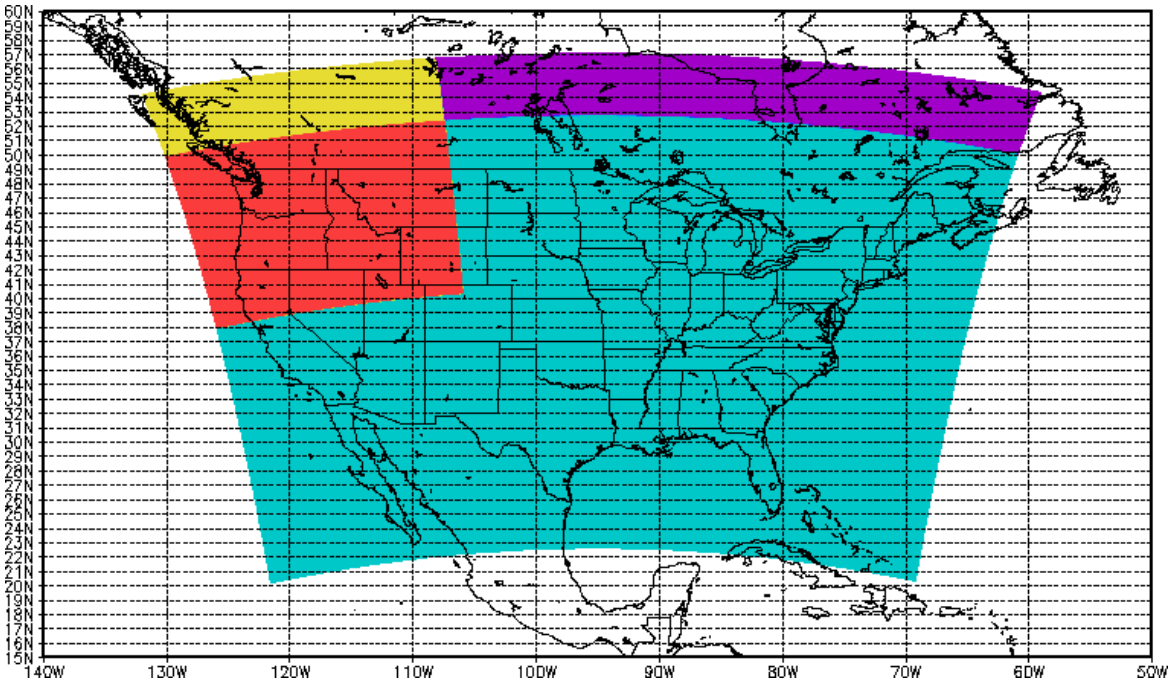
2.5 km Analyses for Northwest RFC domain

Science and quality control technique improvements:

- Improved handling of snowpack in RAP
- Winds from Hurricane WRF added to improve analyses of tropical cyclones

New analysis variables:

- Wind gusts
- Visibility



Next Steps for RTMA Development

Explore potential for additional Aviation impact analysis variables:

- Total cloud cover
- Cloud base heights
- Mean sea level pressure

Continue to enhance quality control of observations:

- Real-time monitoring system
- Real-time data mining
- Add metadata into GSI
- Improved Land sea mask

Unrestricted Mesoscale Analysis:

Run 4 hours after RTMA

Collects more complete set of observations

Improved product verification

RTMA will continue to be available

Enables transition to Analysis of Record capability

Transition to Rapid Updating Analysis

- Benefits:
  - Enhance forecaster and user situational awareness
  - Enable issuance of warnings and forecasts with greater lead time and accuracy
  - Provide a more accurate data set for model and forecast initialization and verification
- Concepts:
  - Updated every five minutes
  - 1km horizontal resolution
  - Expands coverage to 3D atmosphere
  - Uses satellite, radar and soundings (aircraft, etc.)
  - **Multiple-Radar-Multiple-Sensor (MRMS) system serves as the initial backbone**
    - VIL
    - Vertical wind shear
    - Precipitating species (hail)
    - Lightning
    - Reflectivity and radar quality
  - Products will execute on NCEP mainframe
- At full capability, will generate the most state-of-the-art analyses of the atmosphere currently possible, with the best scientific techniques
- RUA data will serve as both a real-time analysis and eventually as initialization for high resolution models

Multi Radar Multi Sensor
NextGen Weather Program

Presentation materials sourced from:

Ken Howard

HydroMet Research Group

NSSL Warning R&D Division

What is MRMS…

- Multiple Radar Multi Sensor System (MRMS) is the world's most advanced weather 'research soon to be operational' radar processing system.

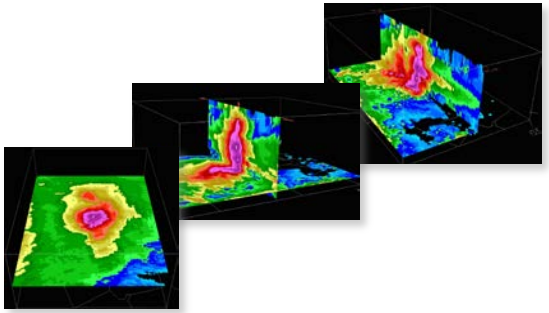
- The MRMS system (formally known in the AWRP project plans as NMQ) exists today as a result of FAA and NOAA R&D investments leveraged over the last decade.

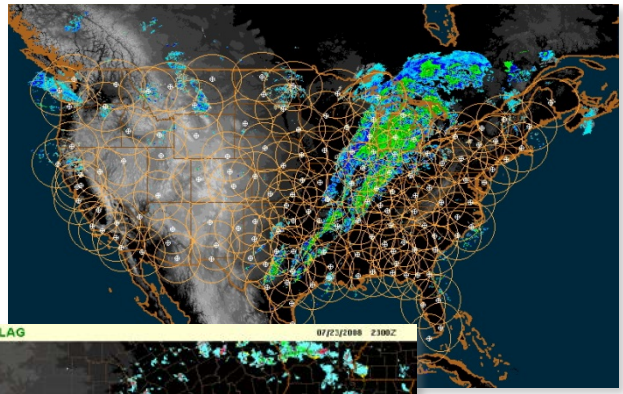
What is MRMS....

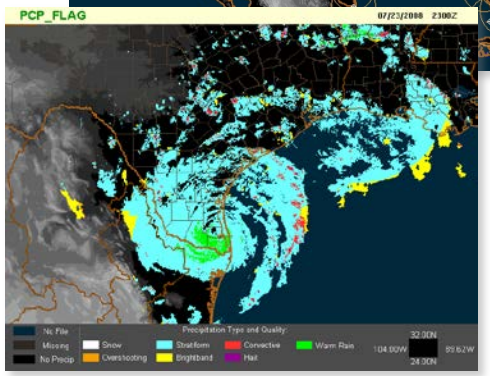
MRMS - Multiple-Radar / Multiple-Sensor

Multiple-Radar: Exploits the overlapping coverage of the WSR-88D, TDWR, Canadian networks and the base level real-time data feeds to build a seamless rapidly-updating high-resolution three-dimensional cube of radar data (moments).

Multiple-Sensor: Objectively blends data from the multiple-radar 3D sources with surface, upper air, lightning, satellite, rain gauges, and NWP environmental data, to produce highly-robust decision support products.



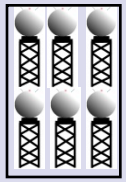




Integrated multiple sensor approach to high resolution rendering of storms and weather

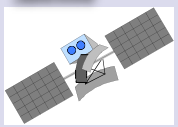
Lightning

Radar Networks

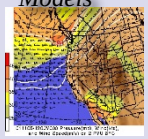


Upper Air

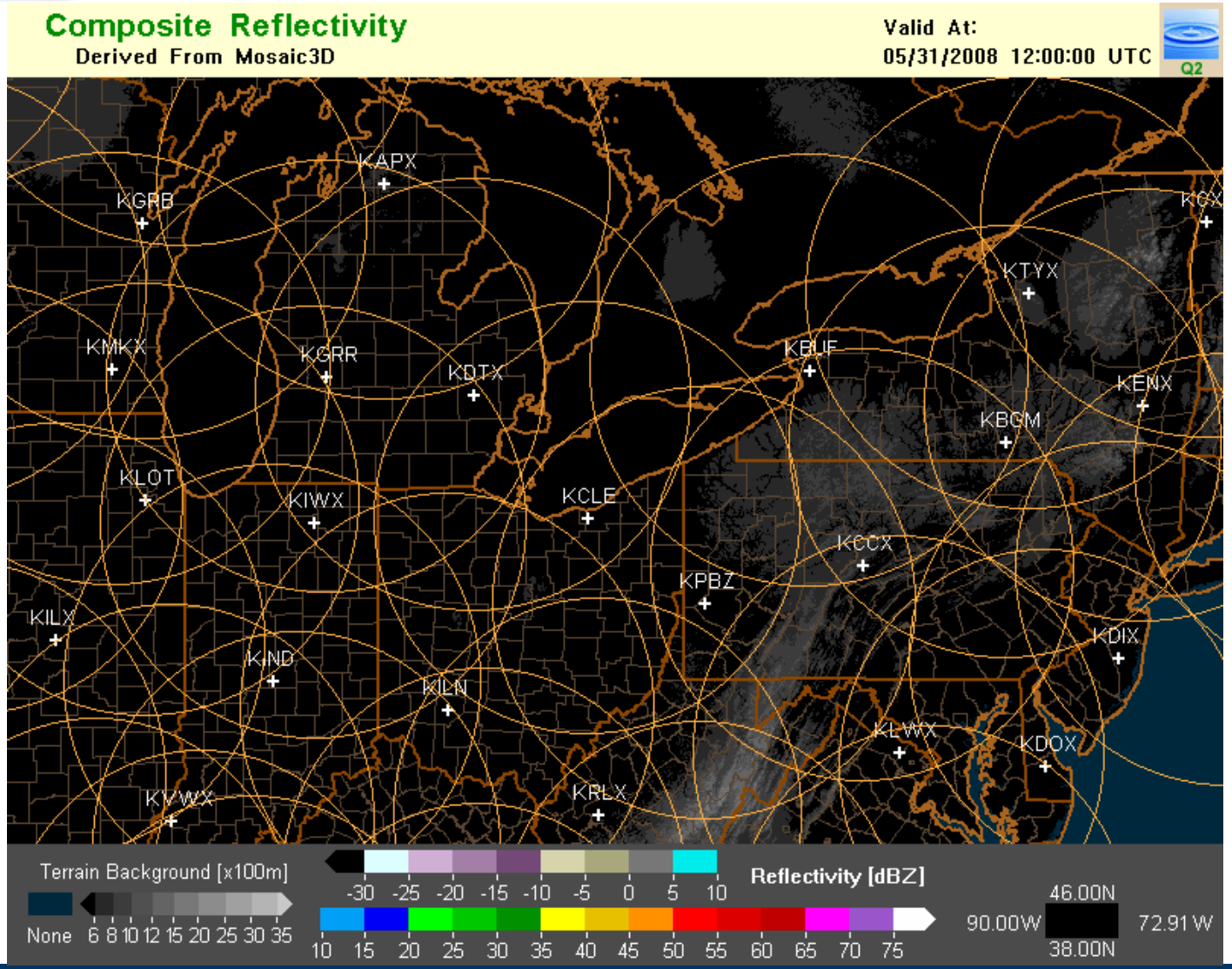
Satellite



Models



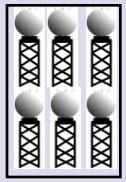
Sfc Obs



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

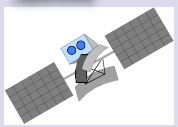
Lightning

Radar Networks

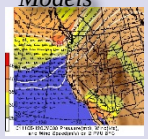


Upper Air

Satellite



Models



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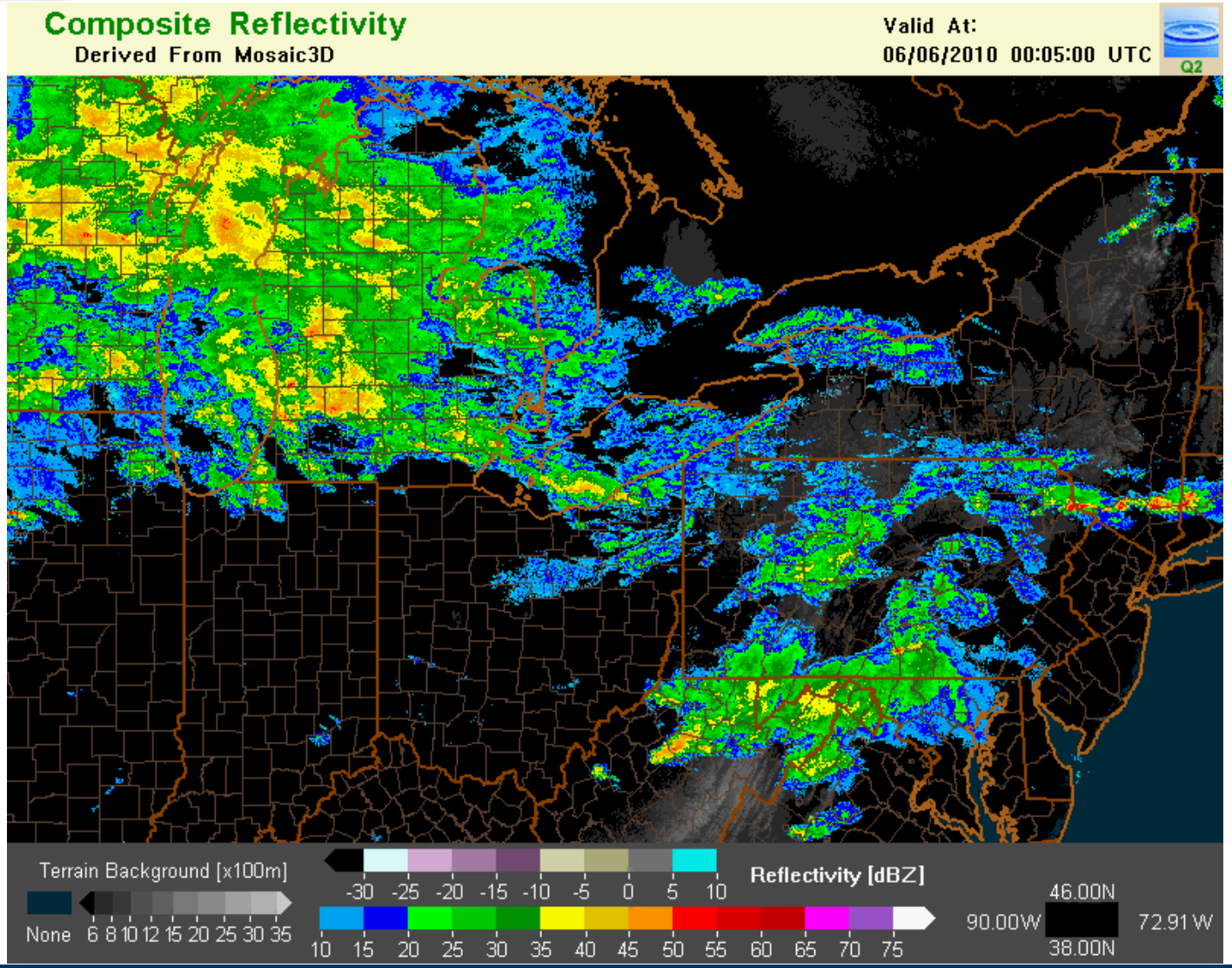
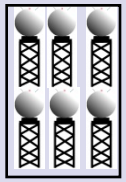


Integrated multiple sensor approach to high resolution rendering of storms and weather

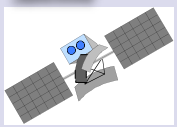
Lightning

Radar Networks

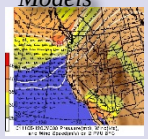


Upper Air

Satellite



Models



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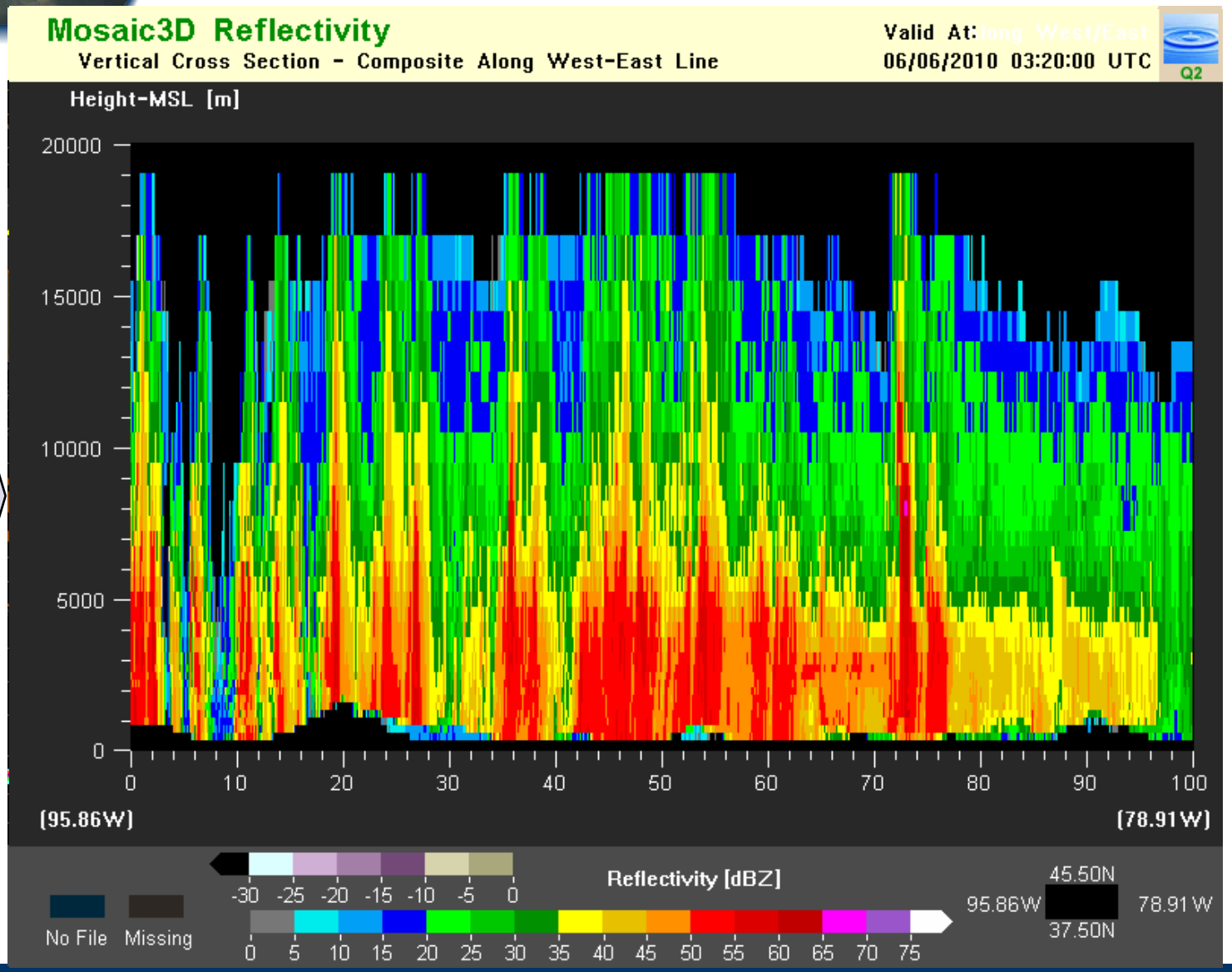
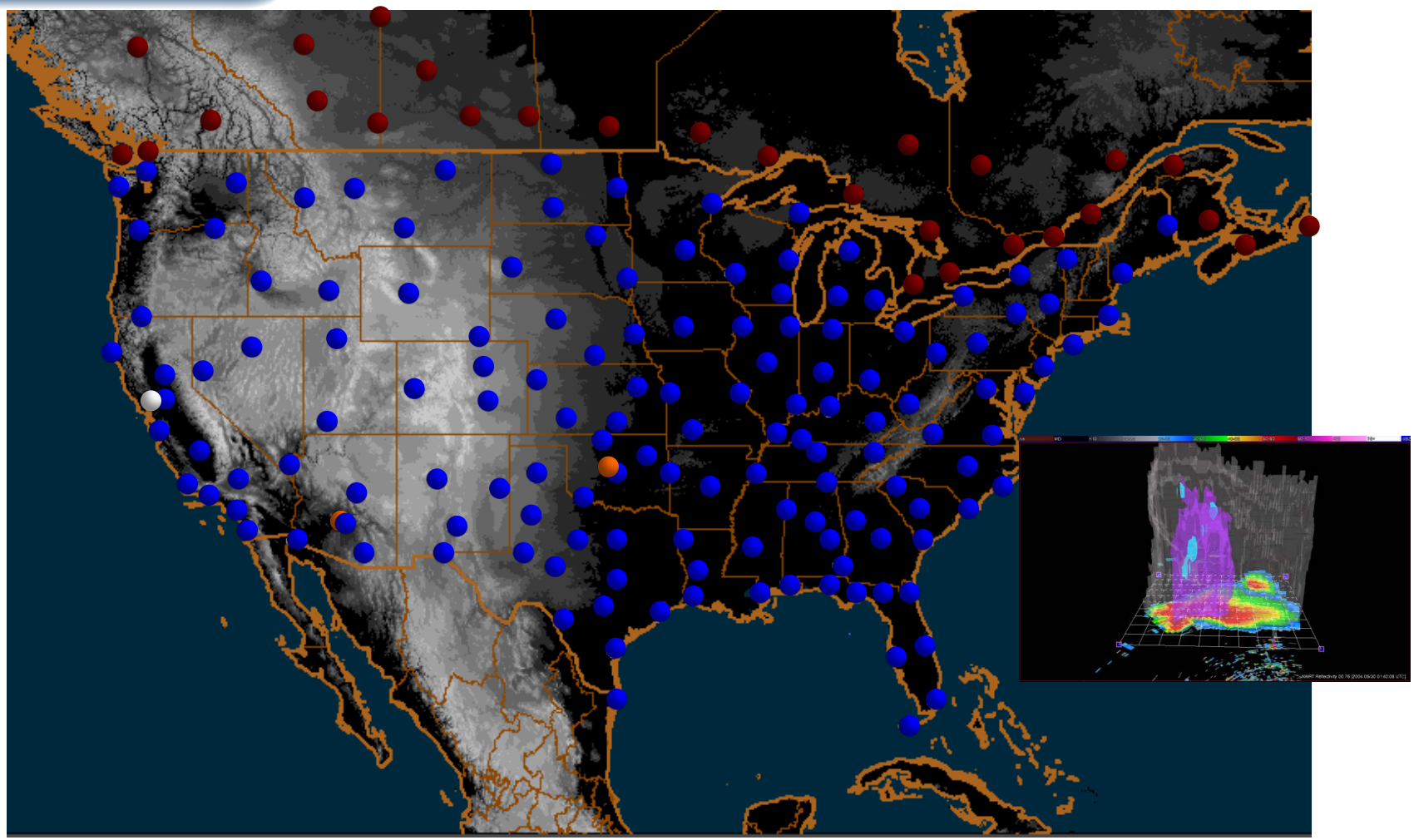


MRMS Domain



● ~140 WSR-88D ● 31 Canadian ● 15 TDWR ○ 1 TV station radar

MRMS Usage

The weather and climate enterprise has been utilizing MRMS products, in some form, **for well over decade**.

NCEP uses the radar mosaics at the Storm Prediction Center, the Aviation Weather Center, and the Weather Prediction Center for **real-time** hazardous weather forecasting and post-event data analysis.

MRMS 3D products are used to **initialize and verify** high-resolution storm-scale models such as the RR and HRRR.

The MRMS system is a component of a larger, multi-agency effort to create a new, state-of-the-art 3D storm-scale analysis capability.

NATIONAL MOSAIC AND MULTI-SENSOR QPE (NMQ) SYSTEM

Description, Results, and Future Plans

BY JIAN ZHANG, KENNETH HOWARD, CARRIE LANGSTON, STEVE VASILOFF, BRIAN KANEY, AMI ARTHUR, SUZANNE VAN COOTEN, KEVIN KELLEHER, DAVID KITZMILLER, FENG DING, DONG-JUN SEO, ERNIE WELLS, AND CHUCK DEMPSEY

A research system integrates radar, rain gauge, satellite, and numerical weather prediction data and generates automated, seamless national 3D radar mosaic and multisensor quantitative precipitation estimates at high temporal and spatial resolution.

The deployment of the U.S. Weather Surveillance Radar-1988 Doppler (WSR-88D) network (Crum and Alberty 1993; www.roc.noaa.gov/) has provided meteorologists with critical information toward the issuance of warnings for tornadoes, severe storms, and flash floods. In the early years, the users were able to access only two-dimensional (2D) imagery products from single radar or multiradar mosaic instead of the full 3D base-level data in real time because of limited bandwidth for transmitting data. The advent of Internet-2 and effective compression techniques made it possible to transmit base-level radar data from the WSR-88D network economically and in real time, as demonstrated by the Collaborative Radar Acquisition Field Test (CRAFT) Project (Droegemeier et al. 2002; Kelleher et al. 2007). In 2003, the U.S. National Weather Service (NWS) implemented the communication infrastructure that facilitated the central collection and distribution of base-level data in real time from more than 140 WSR-88D sites to several centralized hubs (Crum et al. 2003a,b; www.roc.noaa.gov/NWS_Level_2/AMS.asp). Now the real-time data are available to users from government agencies, universities, and private industries. The success of the project opened many new opportunities for multiradar and multisensor applications in meteorology, aviation, and hydrology. For instance, free access to the volume scan base-level data allows users to build 3D and 4D multiradar mosaics on a regional to national scale (e.g., Zhang et al. 2005; Lakshmanan et al. 2006; Langston et al. 2007), providing more complete depictions and rendering of storm structure than previous 2D products. Further, the radar mosaic grid is easily combined with information from other data sources such as satellite, gridded model analyses,

AFFILIATIONS: ZHANG, HOWARD, VASILOFF, VAN COOTEN, AND KELLEHER—NOAA/OAR/NSSL, Norman, Oklahoma; LANGSTON, KANEY, AND ARTHUR—CIMMS/University of Oklahoma, Norman, Oklahoma; KITZMILLER, DING, AND SEO—NOAA/NWS/OHD, Silver Spring, Maryland; WELLS—NOAA/NWS/OCWWS, Silver Spring, Maryland; DEMPSEY—Salt River Project, Tempe, Arizona
CORRESPONDING AUTHOR: Jian Zhang, NOAA/National Severe Storms Laboratory, 120 David L. Boren Blvd., Norman, OK 73072
E-mail: jian.zhang@noaa.gov

The abstract for this article can be found in this issue, following the table of contents.
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In final form 23 May 2011

MRMS Transition to NWS Operations

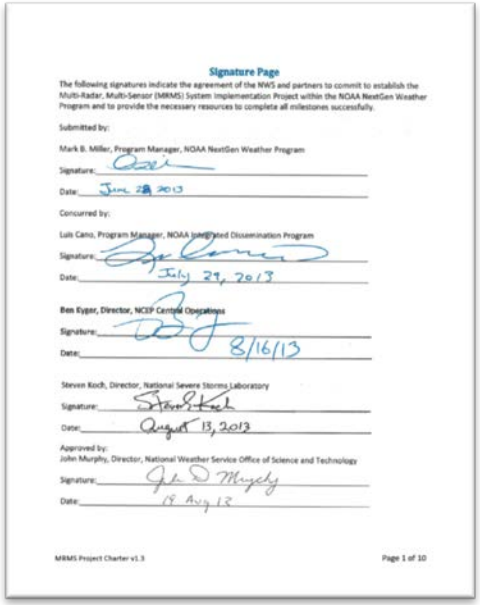
- Approval of the MRMS as an official NOAA Line Office Transition Project (December 2010)
- Transition managed by NextGen Weather Program office (May 2013)
- MRMS transition charter signed (August 2013)

U.S DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

MULTI-RADAR MULTI-SENSOR SYSTEM
IMPLEMENTATION PROJECT

PROJECT CHARTER

August 13, 2013
Version 1.3



Signature Page

The following signatures indicate the agreement of the NWS and partners to commit to establish the Multi-Radar, Multi-Sensor (MRMS) System Implementation Project within the NOAA NextGen Weather Program and to provide the necessary resources to complete all milestones successfully.

Submitted by:

Mark B. Miller, Program Manager, NOAA NextGen Weather Program

Signature:

Date: Jun. 28 2013

Concurred by:

Luis Cano, Program Manager, NOAA Integrated Dissemination Program

Signature:

Date: July 29, 2013

Ben Eyger, Director, NCEP Central Operations

Signature:

Date: 8/16/13

Steven Koch, Director, National Severe Storms Laboratory

Signature:

Date: August 13, 2013

Approved by:
John Murphy, Director, National Weather Service Office of Science and Technology

Signature:

Date: 19 Aug 13

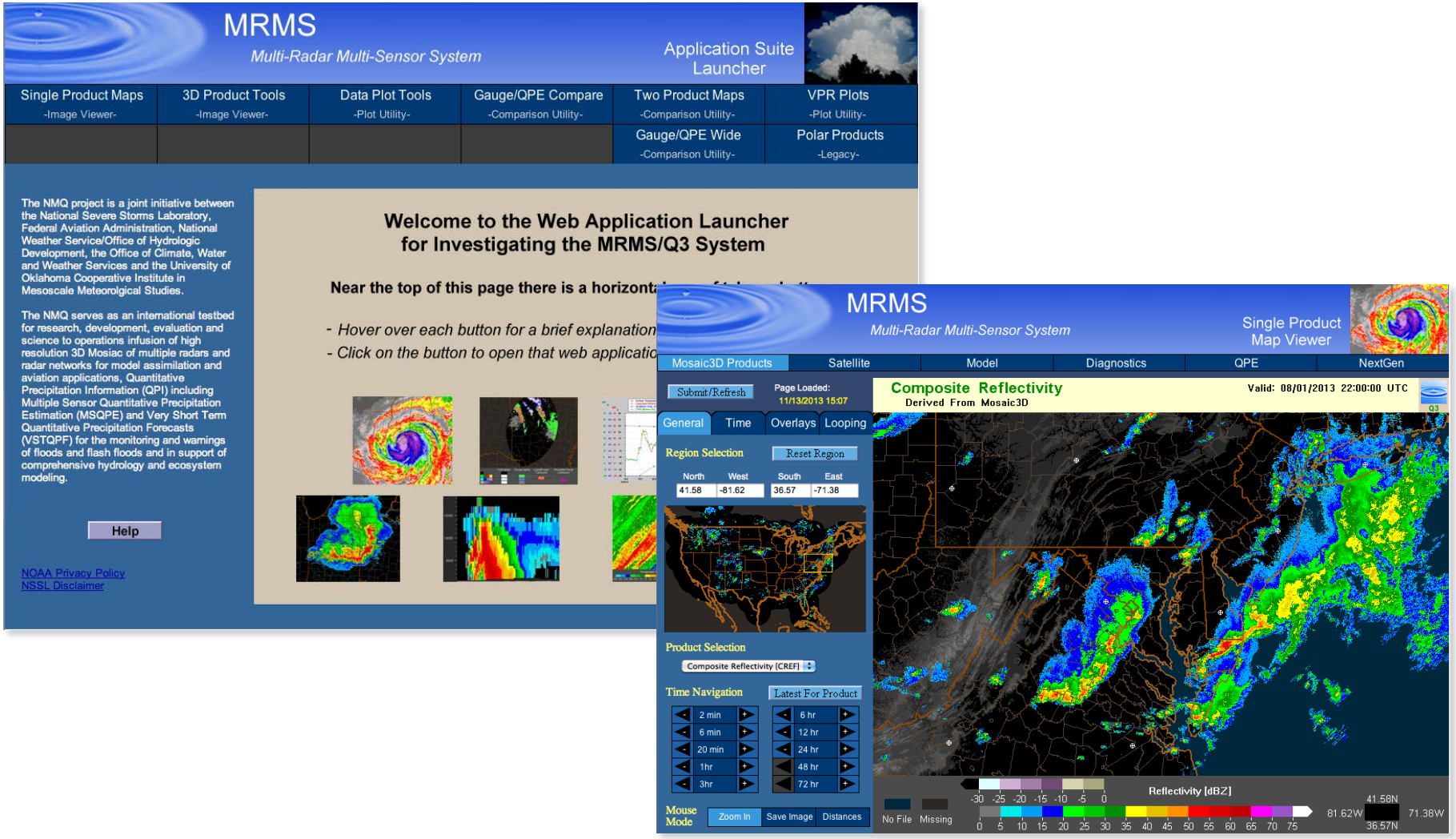
MRMS Project Charter v1.3 Page 1 of 10

MRMS Operational Transition Milestones

Program Phase/Milestone End

- Finalize plan for MRMS product dissemination 06/2014
- Establish Subversion MRMS source code repository at NCEP 01/2014
- Test MRMS on primary NCEP compute farm 01/2014
- Install and test MRMS IOC products on WJHTC MRMS System 03/2014
- Install and test MRMS IOC system on primary NCEP compute center 07/2014
- Verify MRMS test products are received at remote test sites 08/2014
- MRMS IOC at College Park with products available operationally 09/2014
- Refine performance and make adjustments to product creation/dissemination 11/2014
- MRMS FOC - Entails installing software on backup compute center (Boulder) 04/2015

MRMS Web Page (nmq.ou.edu)



MRMS Summary

- **Provides**, seamless, high resolution data sphere of integrated radar and sensor data for multiple agencies
- Improves depictions of convective initiation, structure, and evolution for warnings, forecasts, air traffic routing
- **Provides** framework for research and development for aviation related products via WJHTC MRMS system
- Will provide an analysis of record to more robustly understand severe weather and precipitation climatologies nationwide
- Will strengthen existing and establish new partnerships with multiple development and operational agencies
- Will save lives, property, aviation delays/accidents

Questions

Back-up

Current MRMS R&D

- **QC study of the Canadian radar and other candidate radar networks.** Data quality issues associated with non-WSR-88D radar networks require continued research and development for optimum quality assurance for the data to be fully integrated into the seamless 3D mosaic and derivative products. This effort benefits those forecast capabilities that rely on high fidelity radar imagery as an input (HRRR, CIP, GTG, CoSPA).
- **Utilize polarimetric radar techniques to further improve radar data quality control.** The polarimetric radar variables have shown to provide more accurate identification of anomalous propagation, sea clutter, biological scatterers, and chaff echoes than using single-polarized radar variables. Better identification and removal of non-weather echoes will increase airspace capacity. DELIVERED
- **Integrate polarimetric radar variables with atmospheric environmental data and develop robust algorithms to identify different cloud and precipitation types** (e.g., liquid vs. frozen, supercooled water vs. ice crystals, etc.). Accurate delineation of different hydrometeor regions could be beneficial to the TAIWIS and In Flight Icing PDTs.

Current MRMS R&D

- **Evaluating performances of the polarimetric radar hydrometeor classification algorithm (HCA) for different seasons and different geographical areas, and develop strategies for seamless mosaicing of the HCA products for the CONUS domain**. A high-resolution 3D national mosaic of cloud hydrometeor types (e.g., rain droplets, hail, ice crystal, etc) will be very useful for en route air traffic controllers. Further, the 3D HCA mosaic will be helpful for validation and improvements of various microphysical schemes used in numerical weather prediction models.
- **Continue supporting the MRMS system at the WJHTC and develop new techniques and products based on requirements from the aviation community.** Continue to provide MRMS products to other AWRP PDTs and develop new techniques and products based on requirements from other AWRP PDTs.