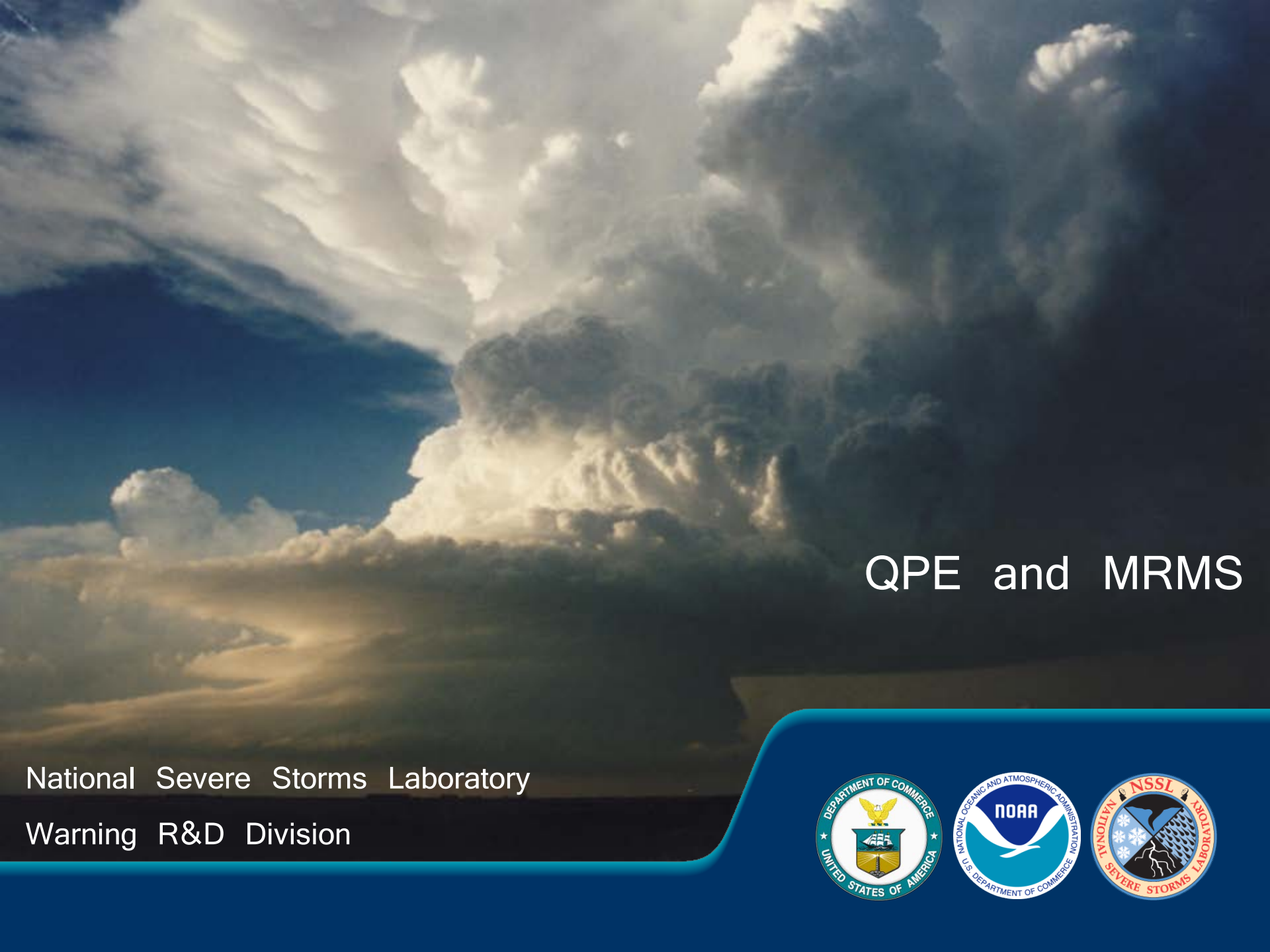


QPE and MRMS

National Severe Storms Laboratory

Warning R&D Division

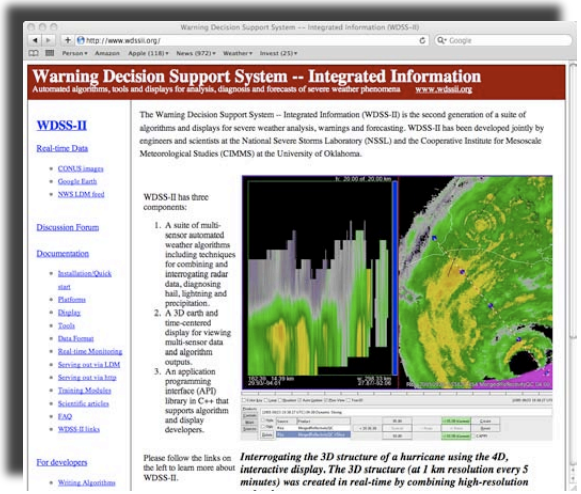
The Challenge

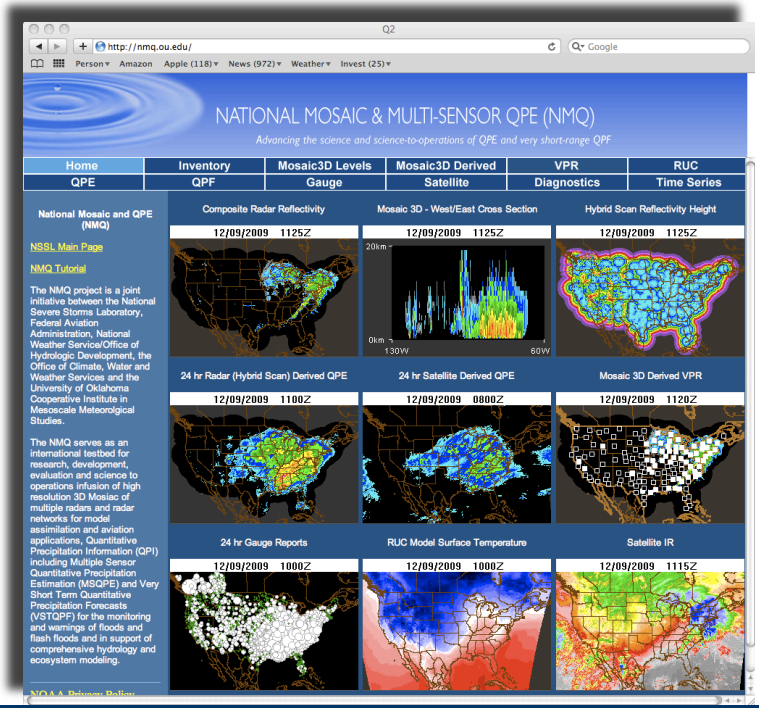
NSSL's MRMS Approach

http://nmq.ou.edu http://wdssii.nssl.noaa.gov

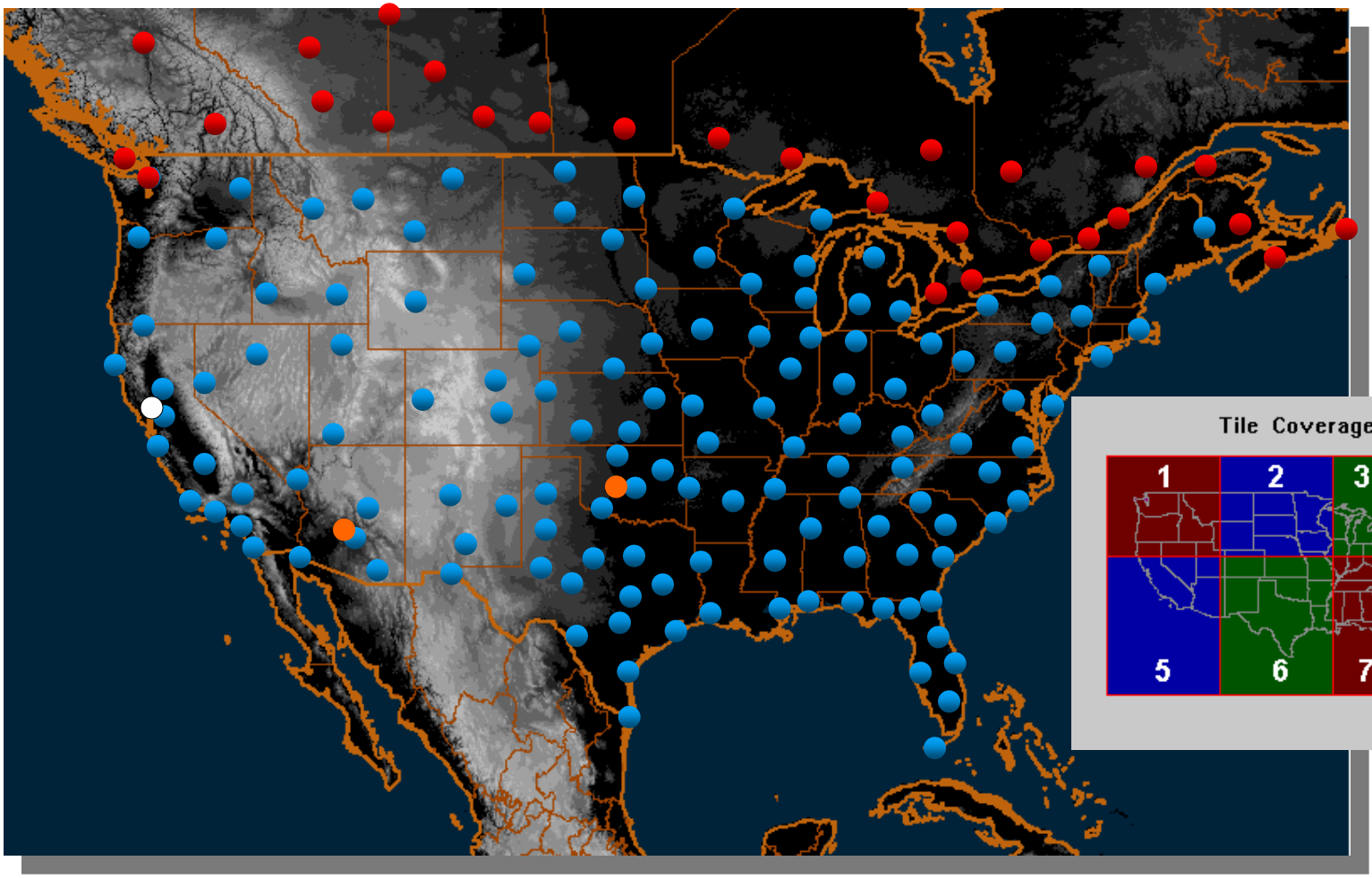
Provide a flexible 'real time' framework for seamless aggregation of multi radars, multi sensors observations into seamless solutions.

Scalable by resolution (time and space) as well as by radar systems and networks





MRMS Domain

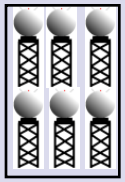


142 WSR-88D 31 Canadian 2 TDWR 1 TV station radar

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

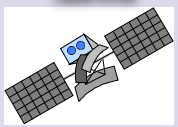
Lightnina

Radar Networks

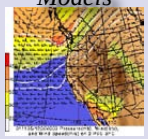


Upper Air

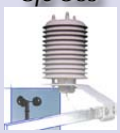
Satellite

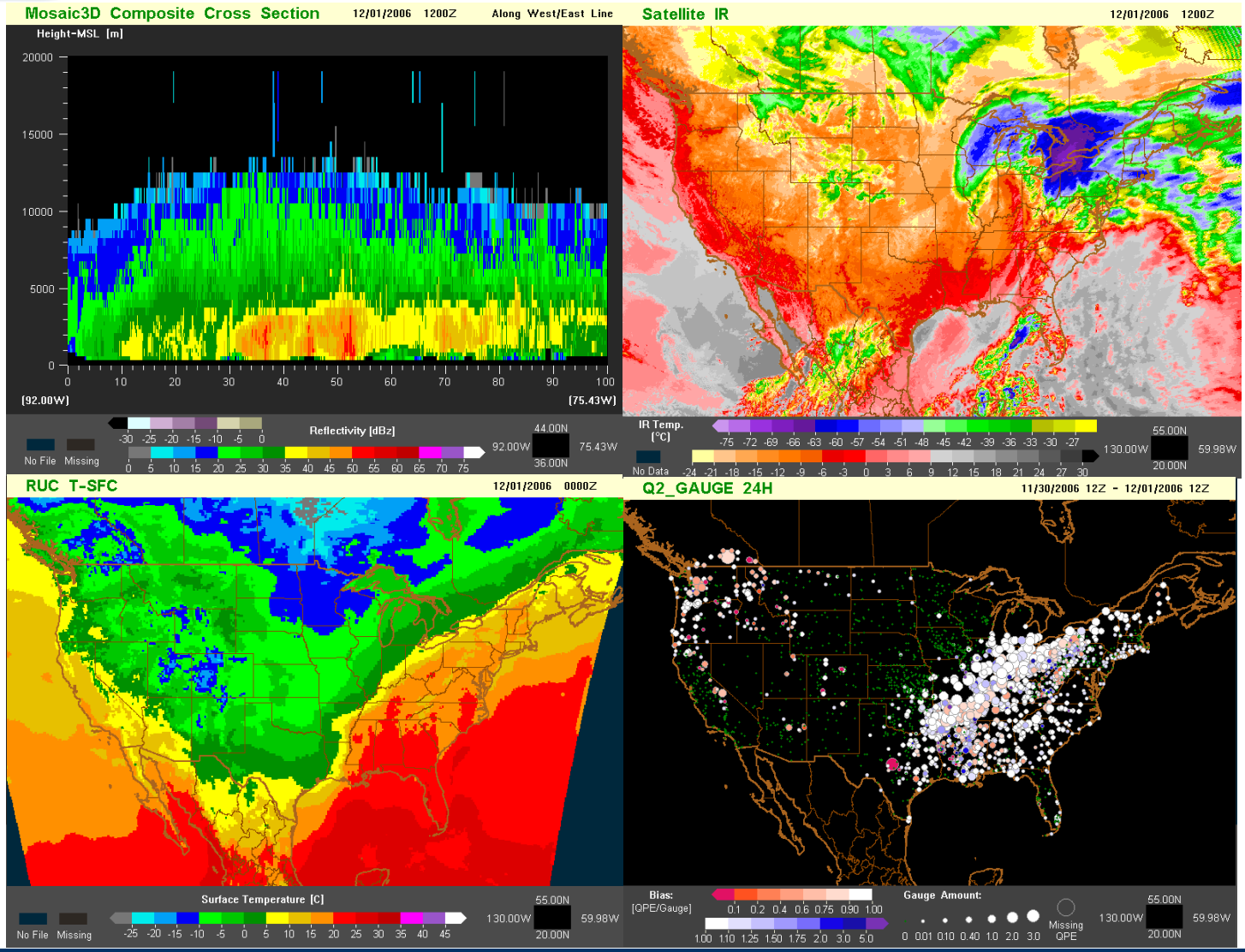


Models

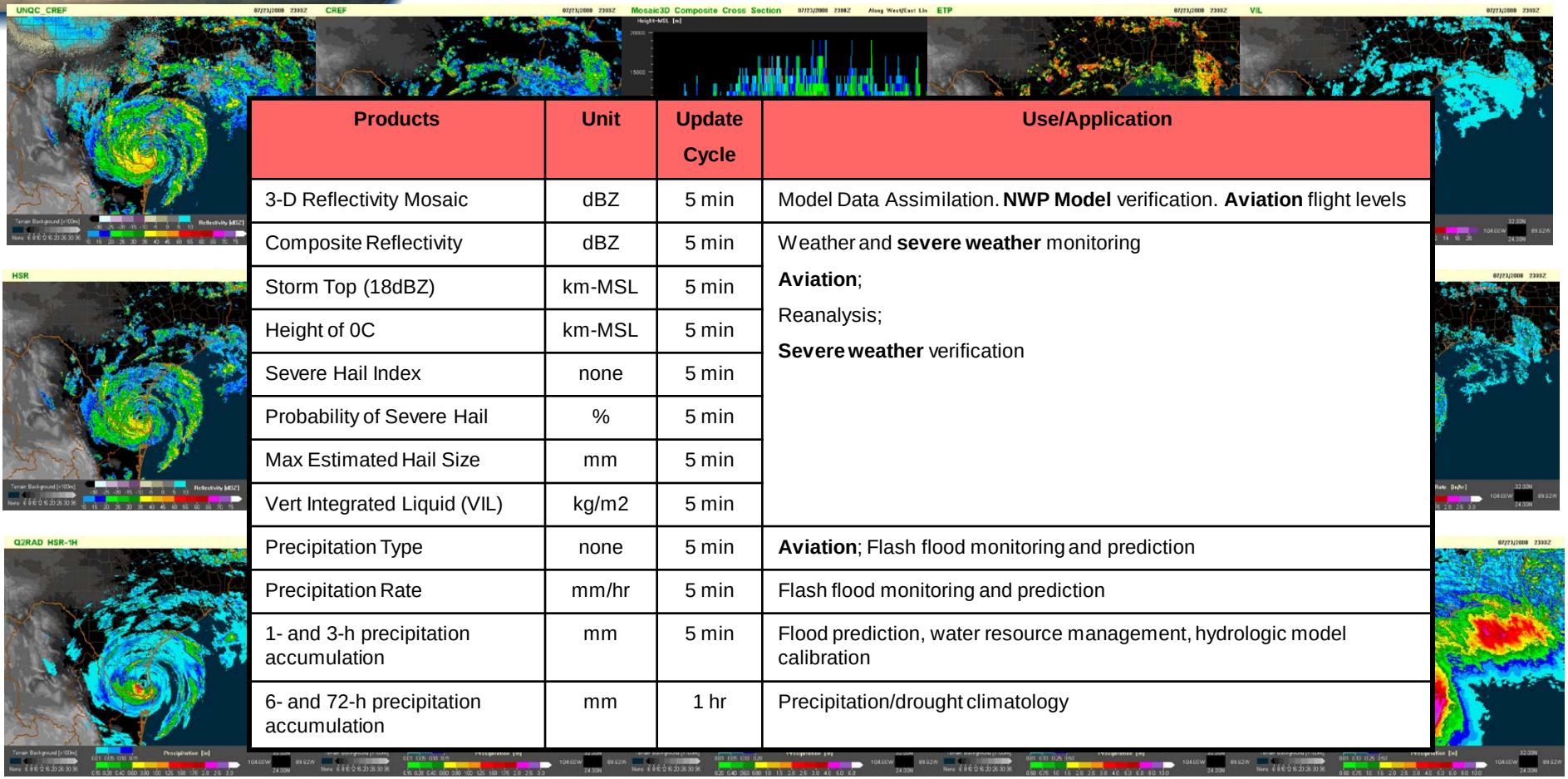


Sfc Obs





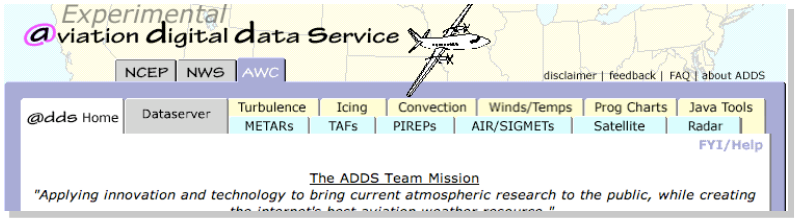
Current MRMS NextGen Product Generation



Products	Unit	Update Cycle	Use/Application
3-D Reflectivity Mosaic	dBZ	5 min	Model Data Assimilation. **NWP Model** verification. **Aviation** flight levels
Composite Reflectivity	dBZ	5 min	Weather and **severe weather** monitoring **Aviation**; Reanalysis; **Severe weather** verification
Storm Top (18dBZ)	km-MSL	5 min	
Height of 0C	km-MSL	5 min	
Severe Hail Index	none	5 min	
Probability of Severe Hail	%	5 min	
Max Estimated Hail Size	mm	5 min	
Vert Integrated Liquid (VIL)	kg/m2	5 min	
Precipitation Type	none	5 min	**Aviation**; Flash flood monitoring and prediction
Precipitation Rate	mm/hr	5 min	Flash flood monitoring and prediction
1- and 3-h precipitation accumulation	mm	5 min	Flood prediction, water resource management, hydrologic model calibration
6- and 72-h precipitation accumulation	mm	1 hr	Precipitation/drought climatology

NSSL produces and disseminates a suite of approx 83 high resolution NextGen 'solutions' per 5-minutes (600+ per hour) over North America **(FY10 1-km, 2-minute update cycle)**

MRMS Collaborators and Product Distribution



Environment Canada Environnement Canada

unidata

NCAR

UCAR

NASA

USGS
science for a changing world

NMQ/WDSSII

Aviation,

Severe weather

Precipitation

Products

And Diagnostics

Sea Grant

NOAA's National Weather Service
Radar Operations Center
NEXRAD WSR-88D

National Weather Service
National Operational Hydrologic Remote Sensing Center

NOAA's National Weather Service
Advanced Hydrologic Prediction Service

NOAA's National Weather Service
Office of Hydrologic Development

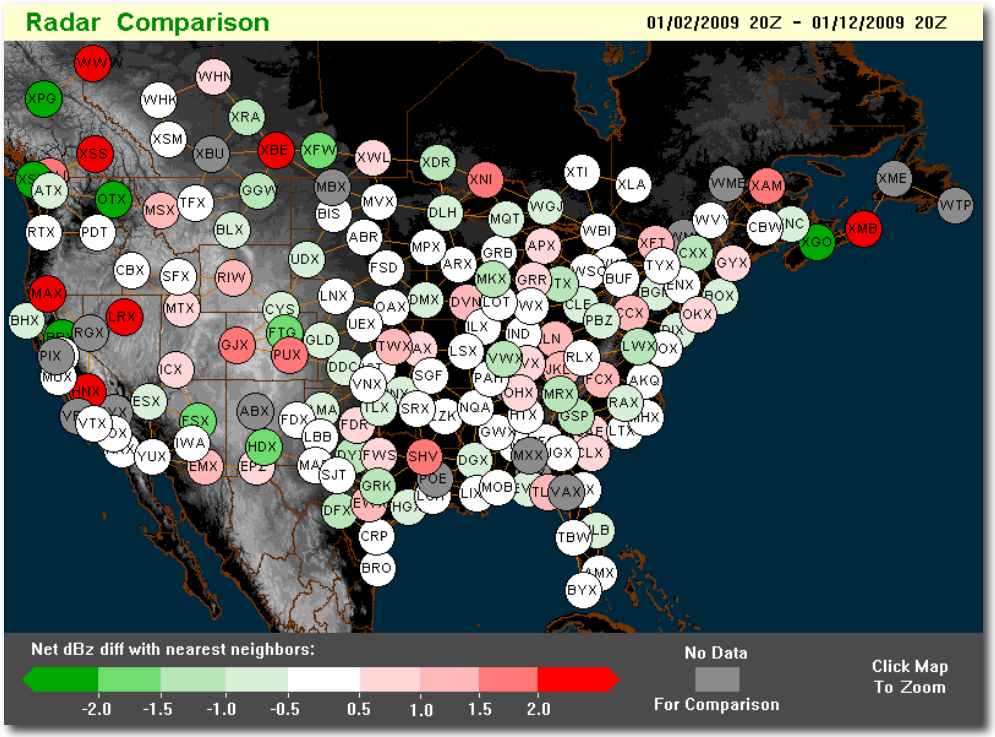
NOAA's National Weather Service
Office of Climate, Water, and Weather Services

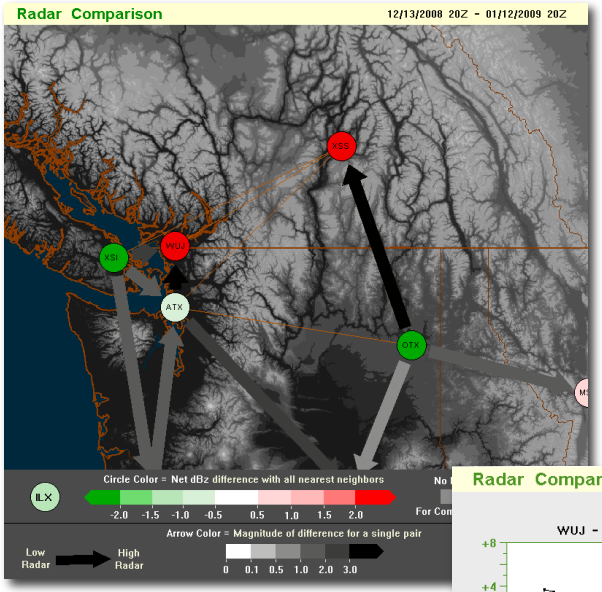
Earth System Research Laboratory
Serving Society through Science

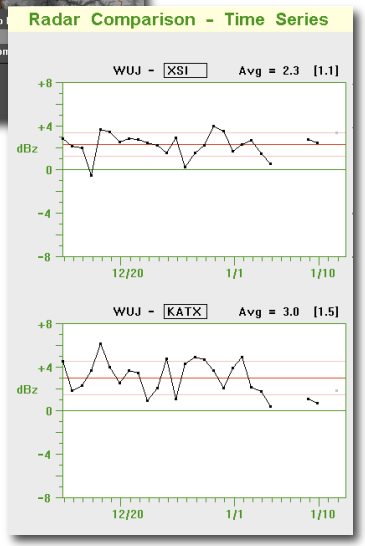
National Oceanic and Atmospheric Administration
Great Lakes Environmental Research Laboratory

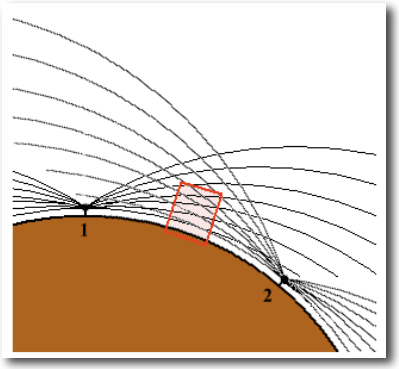
National Oceanic and Atmospheric Administration
Hydrometeorology Testbed Program

Radar Reflectivity Comparison Tool (RRCT)









Objective: A real time system to monitor potential calibration offsets and transmitter drift.

NOAA's National Weather Service
Radar Operations Center
NEXRAD WSR-88D

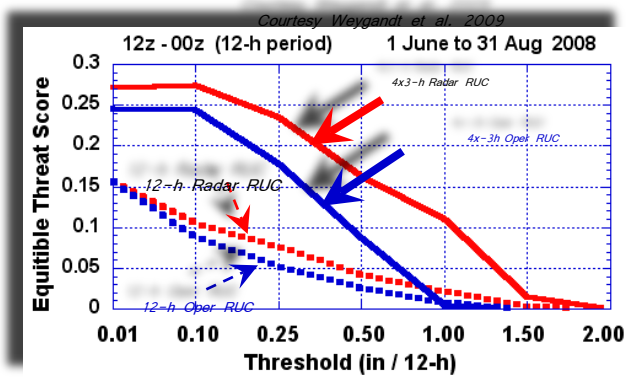
MRMS
Operational Transition

Completed implementation of 3D base (level 2) reflectivity components to support the RUC Rapid refresh in 2006 (Fortran IBM SC).

At Gate 3 of the NWS HOSIP process (Business case OHD Q2 to NCEP).

In process of testing software and scripts using NCEP specified Dell server architecture and networking configuration.

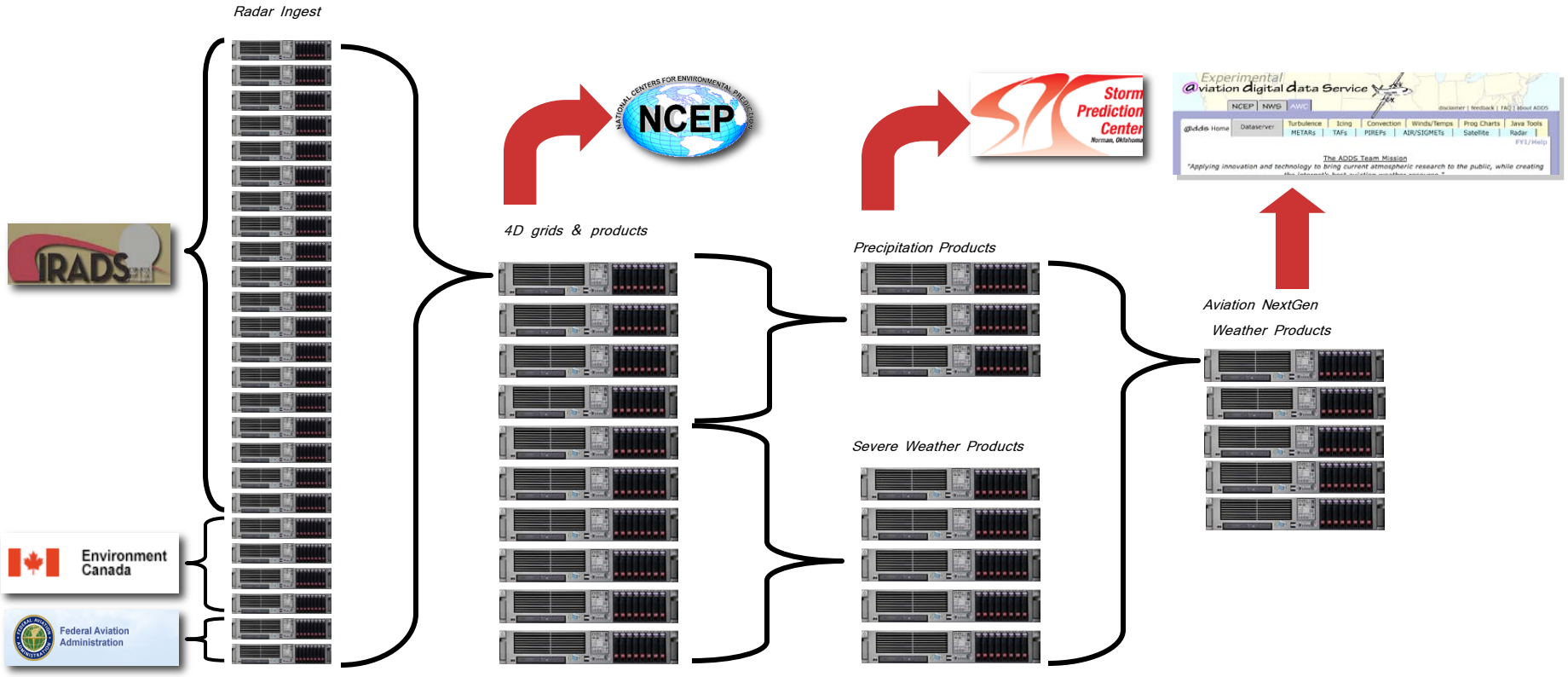
Once testing is completed will deliver final hardware specs for procurement.



FY10-11 Initial MRMS operational solutions generation

Will continue to maintain NSSL's MRMS system for real time research and prototyping in support of FAA AWRP.

MRMS Mosaic and Product Creation



Products are disseminated in NetCDF, binary, AWIPS, NetCDF, GIS, and HRAP formats using a LDM protocol.

MRMS

NextGen Product Generation

Current to 2012

2012 to 2016

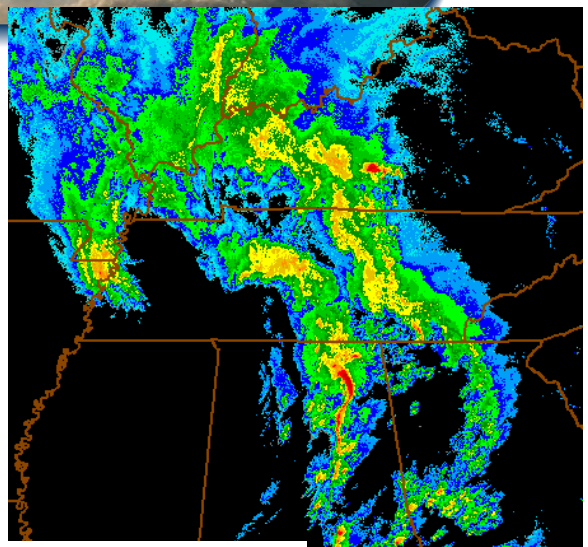
1.1.1.1.1 Determine Liquid Precipitation Type	^ #	
1.1.1.1.1.1 Determine Location of Drizzle	^ #	
1.1.1.1.1.1.1 Determine[2] Horizontal Extent of Drizzle	^ # *	
1.1.1.1.1.1.2 Determine Vertical Extent of Drizzle	^ #	
1.1.1.1.1.2 Determine Location of Rain	^ #	
1.1.1.1.1.2.1 Determine Horizontal Extent of Rain	^ # *	
1.1.1.1.1.3 Determine Location of Rain Shower(s)	^ #	
1.1.1.1.1.4 Measure[3] Accumulation of Liquid Precipitation	^ #	
1.1.1.1.1.5 Determine Movement Direction of Liquid Precipitation	^ #	
1.1.1.1.1.6 Determine Movement Speed of Liquid Precipitation	^ #	
1.1.1.1.1.7 Calculate Rain Fall Intensity	^ #	
1.1.1.1.1.7.1 Calculate Rain Fall Rate (inches/hour)	^ # *	
1.1.1.1.1.7.1.1 Determine Beginning Time of Liquid Precipitation	^ #	
1.1.1.1.1.7.1.2 Determine Ending Time of Liquid Precipitation	^ #	
1.1.1.2 Observe Surface Solid Precipitation +		
1.1.1.2.1 Determine Solid Precipitation Type	^ #	
1.1.1.2.1.1 Determine Location of Hail	^ #	%
1.1.1.2.1.1.1 Determine Horizontal Extent of Hail	^ # *	%
1.1.1.2.1.1.2 Estimate Size of Largest Hailstone (inches)	^ #	
1.1.1.2.1.1.3 Determine Location of Hail Shower	^ #	
1.1.1.2.1.2 Determine Location of Snow	^ #	
1.1.1.2.1.2.1 Determine Horizontal Extent of Snow	^ # *	%
1.1.1.2.1.2.2 Measure Snowfall Accumulation	^ # *	%
1.1.1.2.1.2.3 Determine Location of Snow Showers	^ # *	
1.1.1.2.1.2.4 Measure Snowfall Rate (inches/hour)	^ # *	%
1.1.1.2.1.2.4.1 Determine Snowfall Beginning Time	^ # *	%
1.1.1.2.1.2.4.2 Determine Snowfall Ending Time	^ # *	%
1.1.1.2.1.2.5 Calculate Liquid Water Equivalent of Snowfall (inches/hour)	^ #	%
1.1.1.2.1.3 Observe Ice Crystals +	^ #	
1.1.1.2.1.3.1 Determine Location of Ice Crystals	^ #	
1.1.1.2.1.4 Determine Location of Ice Pellets	^ #	
1.1.1.2.1.4.1 Determine Location of Ice Pellets	^ #	
1.1.1.2.1.4.2 Determine Horizontal Extent of Ice Pellet Showers	^ #	
1.1.1.2.1.4.3 Measure Ice Pellet Intensity	^ #	
1.1.1.2.1.4.4 Determine Beginning Time of Ice Pellets	^ # *	
1.1.1.2.1.4.5 Determine Ending Time of Ice Pellets	^ # *	
1.1.1.2.1.5 Determine Location of Snow Grains	^ #	
1.1.1.2.1.6 Determine Location of Blowing Snow	^ #	

[2] Determine = To establish or ascertain definitely, as after consideration, investigation, or calculation.
[3] Measure = To ascertain the extent, dimensions, quantity, capacity, and so on, by comparison with a standard.

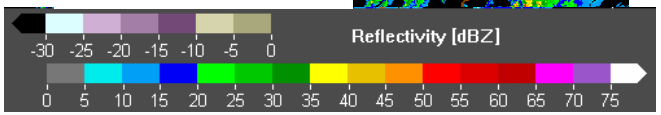
1.1.1.2.1.6.1 Determine Where Snow Is Blowing Over Runways[4]	^ # * ~ %	
1.1.1.2.1.7 Determine Location of Low Drifting Snow	^ # * ~ %	
1.1.1.2.1.8 Determine Location of Small Hail	^ #	
1.1.1.2.1.9 Determine Location of Snow Pellets	^ #	
1.1.1.2.1.9.1 Determine Beginning Time of Snow Pellets	^ #	
1.1.1.2.1.9.2 Determine Ending Time of Snow Pellets	^ #	
1.1.1.3 Observe Surface Freezing Precipitation +	^ # * ~	
1.1.1.3.1 Determine Location of Freezing Rain	^ # * ~ %	
1.1.1.3.1.1 Determine Horizontal Extent of Freezing Rain	^ # * ~ %	
1.1.1.3.2 Determine Location of Freezing Drizzle	^ # * ~ %	
1.1.1.3.2.1 Determine Horizontal Extent of Freezing Drizzle	^ # * ~ %	
1.1.1.3.3 Determine Existence of Surface Icing Conditions	^ # * ~ %	
1.1.1.3.3.1 Determine Time When Surface Icing Accretion Began	^ # * ~ %	
1.1.1.3.3.2 Measure Intensity of Freezing Precipitation	^ # ~ %	
1.1.1.3.3.3 Determine Surface Icing Accretion Rate (inches/hour)	^ # * ~ %	
1.1.1.3.3.3.1 Determine Beginning Time of Freezing Precipitation	^ # * ~ %	
1.1.1.3.3.3.2 Determine Ending Time of Freezing Precipitation	^ # * ~ %	
1.1.1.4 Observe Surface Obscurations (to Visibility)	^ # *	
1.1.1.4.1 Determine Location of Haze	^ # *	
1.1.1.4.2 Determine Location of Smoke	^ # *	
1.1.1.4.3 Determine Location of Mist	^ # *	
1.1.1.4.4 Determine Location of Fog	^ # * ~	
1.1.1.4.4.1 Determine Location of Shallow Fog	^ # *	
1.1.1.4.4.2 Determine Location of Partial Fog	^ # *	
1.1.1.4.4.3 Determine Location of Fog Patches	^ # *	
1.1.1.4.4.4 Determine Location of Freezing Fog	^ # *	
1.1.1.4.5 Determine Location of Blowing Spray	^ #	
1.1.1.4.6 Determine Location of Blowing Sand	^ # * ~ %	
1.1.1.4.6.1 Determine Location of Low Drifting Sand	^ # ~ %	
1.1.1.4.7 Determine Location of Blowing Snow	^ # *	
1.1.1.4.8 Determine Location of Widespread Dust	^ # *	
1.1.1.4.9 Observe Volcanic Ash	^ # * ~	
1.1.1.4.9.1 Determine Horizontal Extent of Volcanic Ash	^ # * ~ %	
1.1.1.5 Observe Other Surface Weather +		
1.1.1.5.1 Observe Thunderstorms	^ # * ~	
1.1.1.5.1.1 Measure Direction of Thunderstorm Movement	^ # * ~	
1.1.1.5.1.2 Measure Speed of Thunderstorm Movement	^ # *	
1.1.1.5.1.3 Determine Thunderstorm Intensity	^ # * ~	
1.1.1.5.1.4 Determine Horizontal Extent of Thunderstorm	^ # * ~	

[4] But not snowing at point of observation.

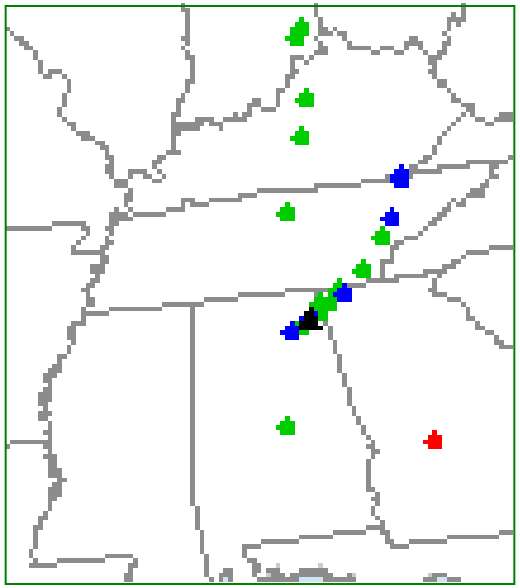
Q2 Precipitation Classification

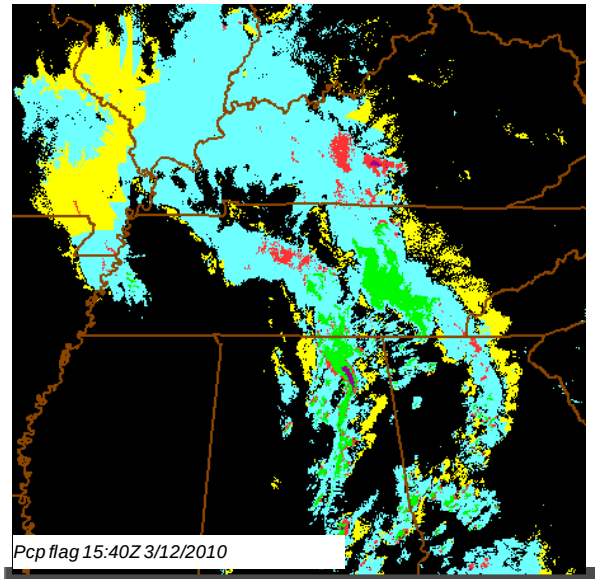


CREF15:40Z 3/12/2010

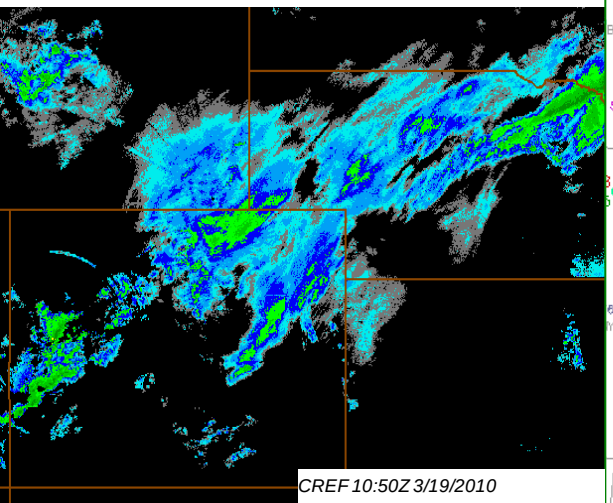


SPC storm report
12-19Z 3/12/2010

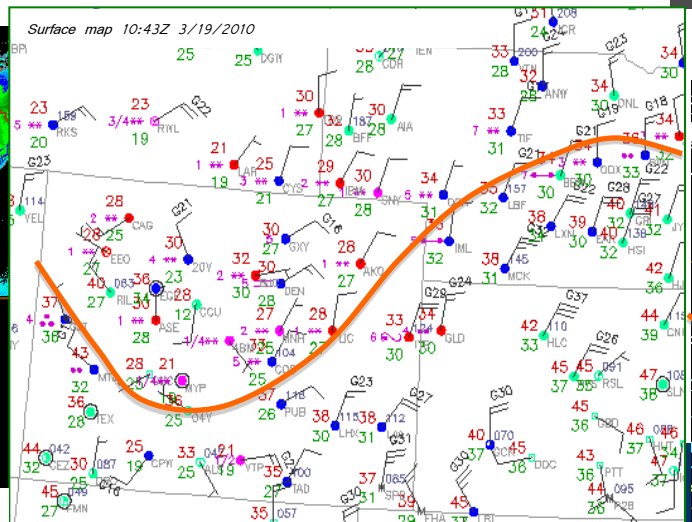


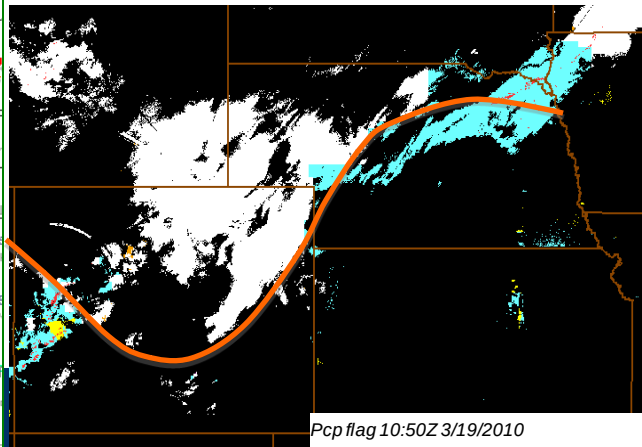


Pcp flag 15:40Z 3/12/2010



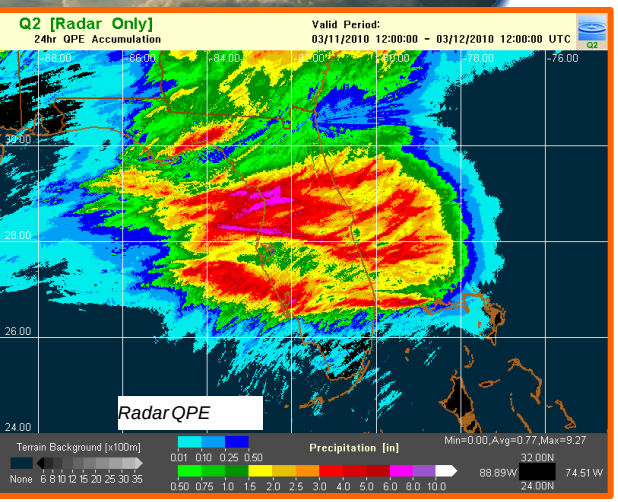
CREF 10:50Z 3/19/2010

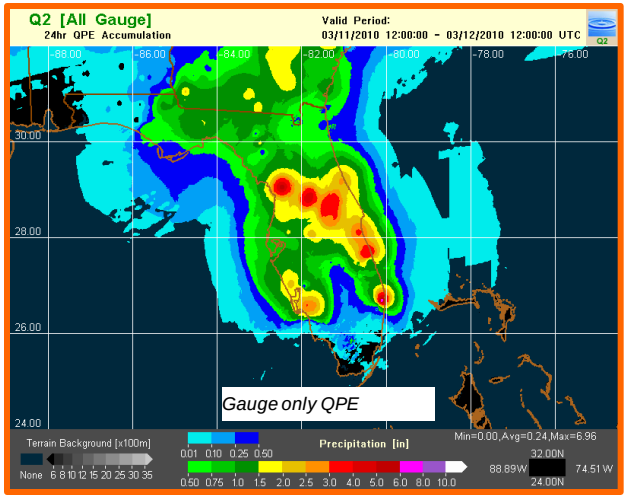


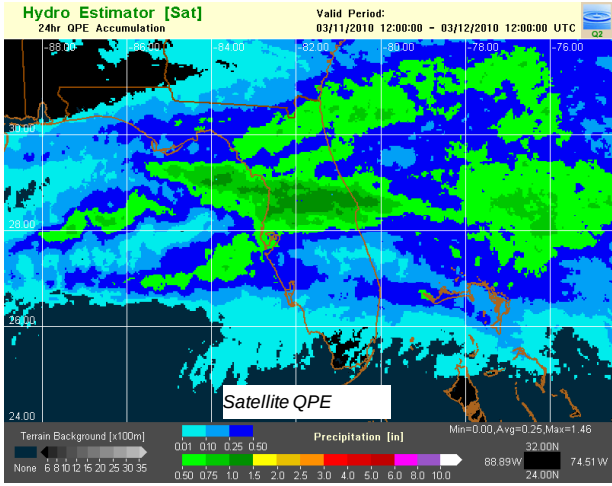


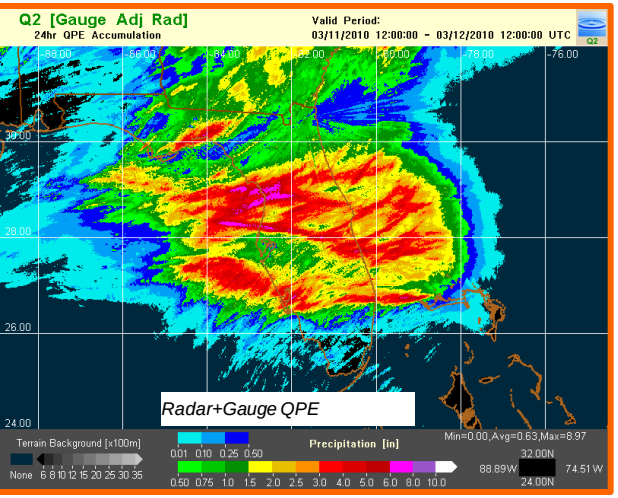
Pcp flag 10:50Z 3/19/2010

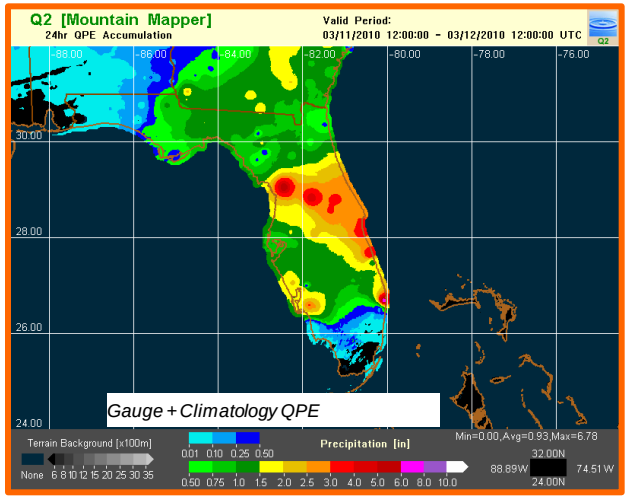
Multi-sensor Precipitation Products

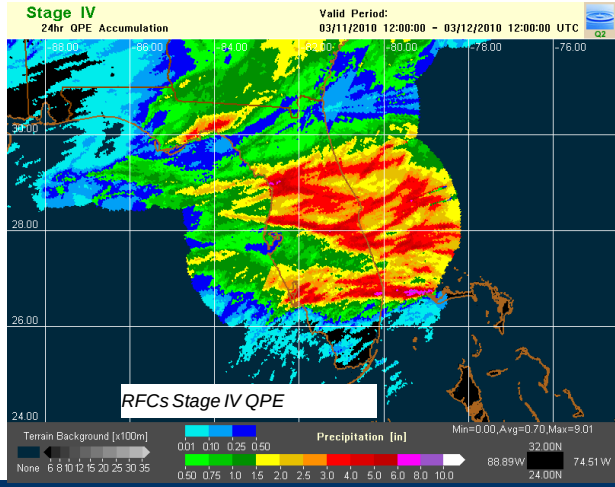




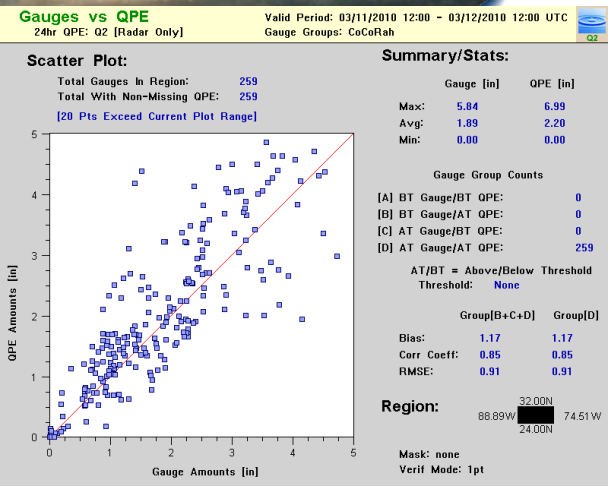




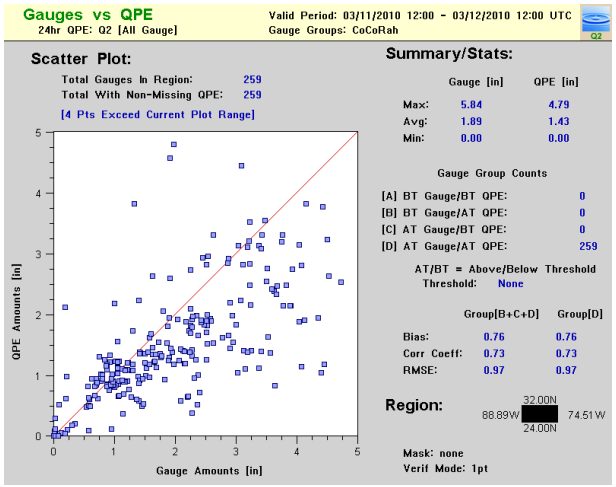




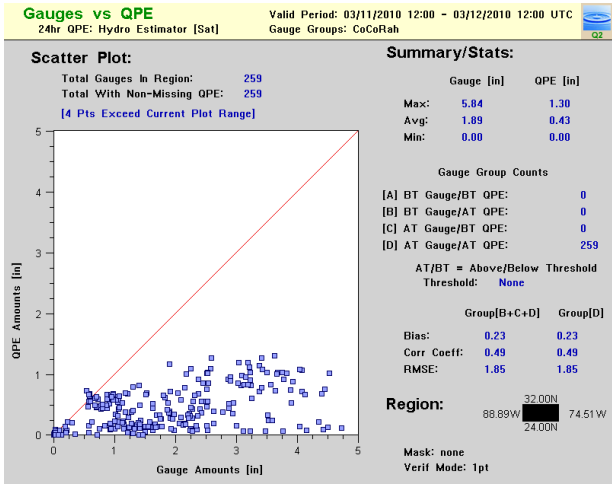
MRMS Real-time Verification System



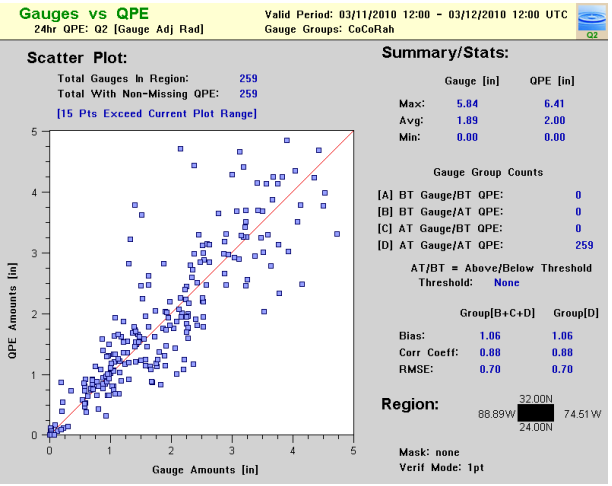
Radar QPE



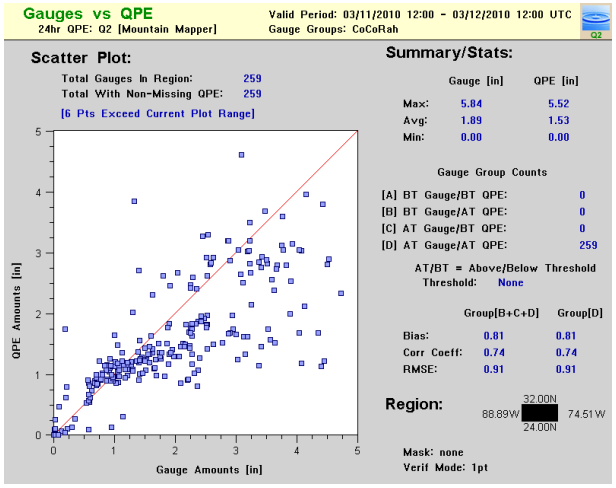
Gauge only QPE



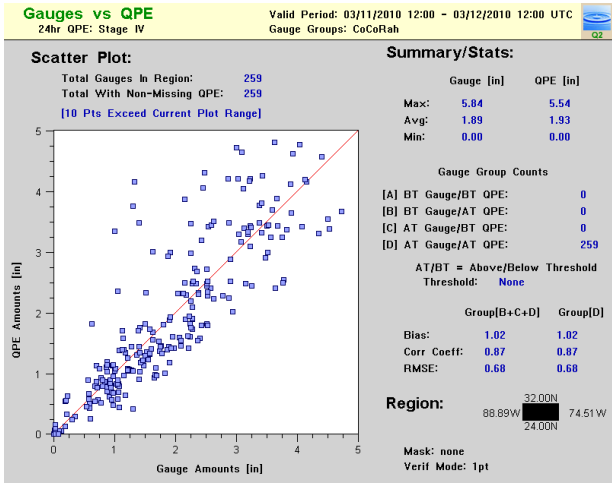
Satellite QPE



Radar+Gauge QPE

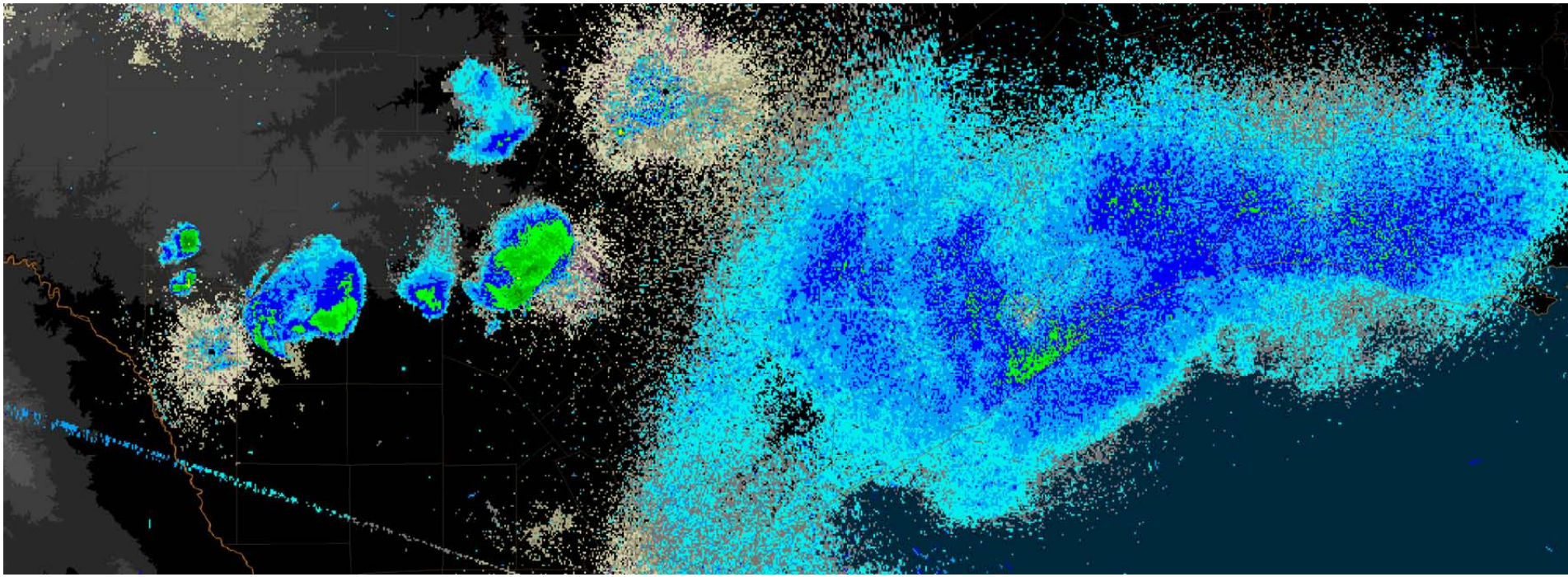


Gauge + Climatology QPE



RFCs Stage IV QPE

MRMS Biota Maps



Birds, bugs and bats,

MRMS Development Pathway

FY10 **NCEP Implementation of advanced CONUS 4D reflectivity mosaic and products**

Severe weather and aviation related products per NextGen requirements

Resolution of 1-km x 2-min update cycle with 3D reflectivity mosaic 31 levels

Ingest includes commercial, Canadian radars and TDWRS

Q2 precipitation type and rate products

FY11 **Operational .5 km CONUS 4D reflectivity mosaics and products**

Improved automated quality control methods for TDWR, Canadian and commercial radars

Initial 3D Mosaics for Hawaii / Alaska regions

Evaluating and advancing dual-pol algorithms specific to NextGen requirements

FY12 **Dual Polarization 4D CONUS Mosaics prototype at NSSL**

Initial 4D Dual Pole Hydrometeor CONUS mosaic for model data assimilation

Advanced Dual polarizing quality control and hydrometer classification

FY13 **Operational Dual Polarization 4D CONUS Mosaics at NCEP**

Initial connections to Mexican & Caribbean radars

Summary

•NSSL continues to facilitate the seamless, scientificly sound, high resolution integration of radar systems and networks into a 4D frame as the possible NOAA NextGen radar source

•The NSSL's experimental system serves as the foundation for other aviation research and product development

•Completed the initial operational infusion of NSSL's MRMS at NCEP for model data assimilation and CONUS, high resolution multi sensor radar based products.

•In FY10 NSSL will work with NCEP, OHD and FAA to establish NSSL's MRMS as the prototype and operational system to facilitate radar derived products to meet FAA NextGen requirements and NOAA operational needs.