Multi-Radar, Multi-Sensor: A Successful Case of Research-To-Operations

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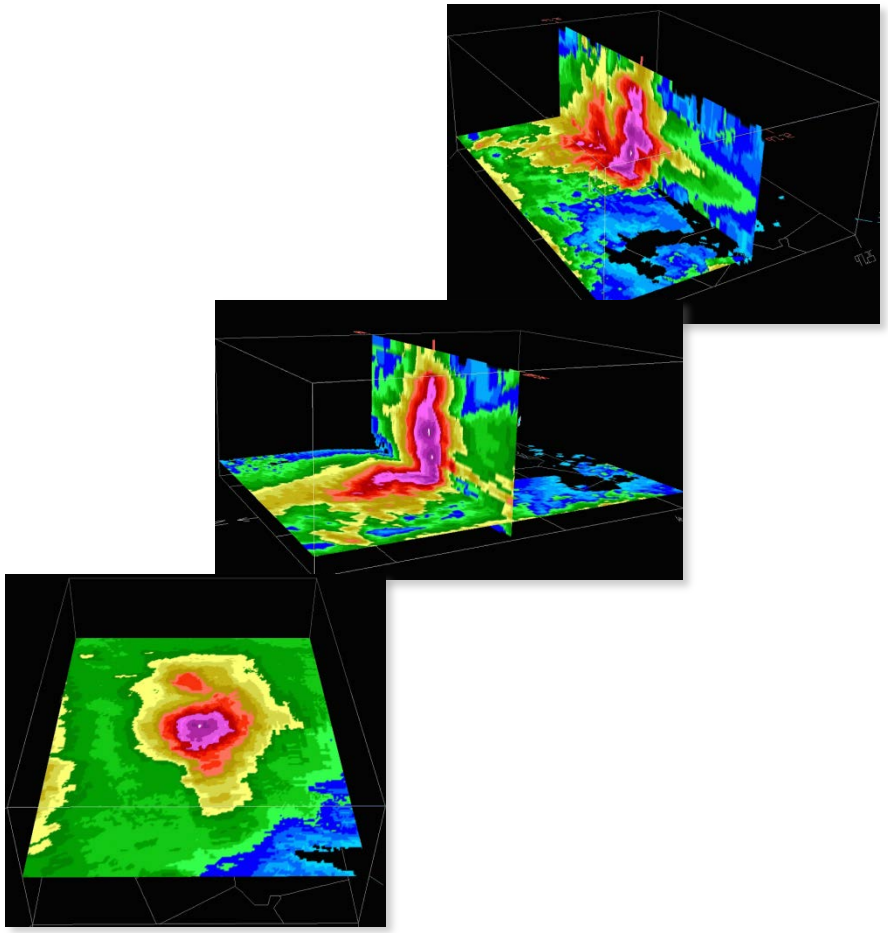
Outline

- MRMS Background
- Current Products & Activities
- MRMS Implementation
- Research to Operations Success
- Challenges/Lessons Learned
- Summary

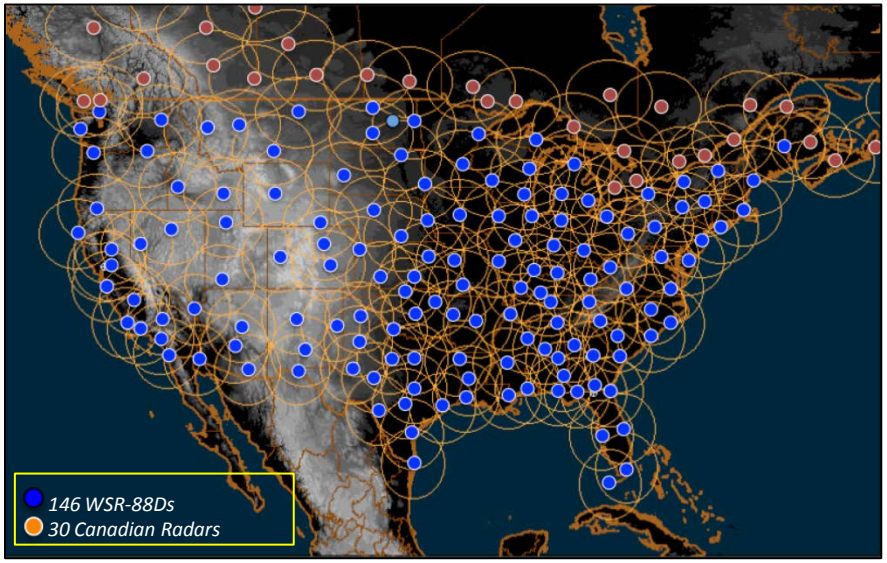
MRMS Background

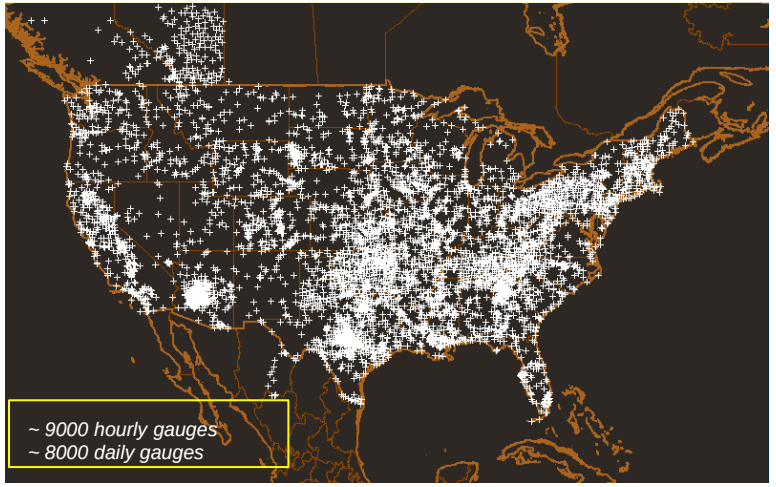
Multiple Radar Multi Sensor System (MRMS) is an advanced radar processing system that integrates radar, surface observations, satellite, and numerical weather prediction grids and generates automated, seamless national 3D radar mosaic, storm attributes and multi sensor quantitative precipitation estimates at high temporal and spatial resolution.



MRMS Background

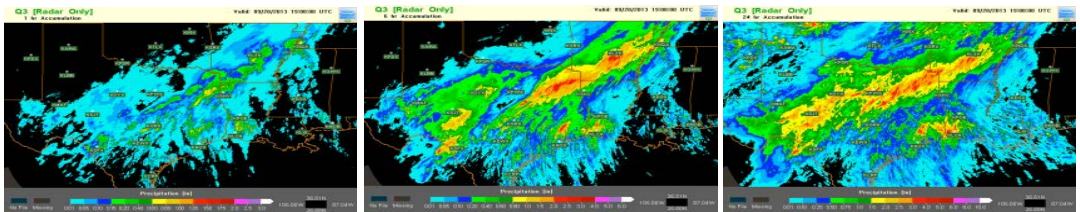
- Current Domain: CONUS
  - Next update will include Alaska, Hawaii, Guam, Puerto Rico/Caribbean
- Resolution
  - 0.01°lat x 0.01°long
  - 2 min update cycle
- Data Sources
  - ~180 radars every 4-5min
  - ~9000 rain gauges every hour
  - Model hourly 3D analyses
  - Satellite and lightning: optional
- System Locations
  - National Severe Storms Lab (Norman, OK); 2006
  - William J. Hughes Technical Center (Atlantic City, NJ); 2010
  - NCEP Central Operations (NCO); Sep 2014





Current Products

- Severe and Aviation Weather Products
  - Composite Reflectivity
  - 3D Reflectivity Mosaic
  - Echo Top Heights
  - CG Lightning Density
  - Max Expected Hail Size
  - Storm Rotation Tracks
- Quantitative Precipitation Estimates (QPE) and Flash Flood
  - Surface Precip Type & Rate
  - Radar QPE (1, 6, 24, 48, 72h, 10-day acc)
  - QPE/gauge comparison

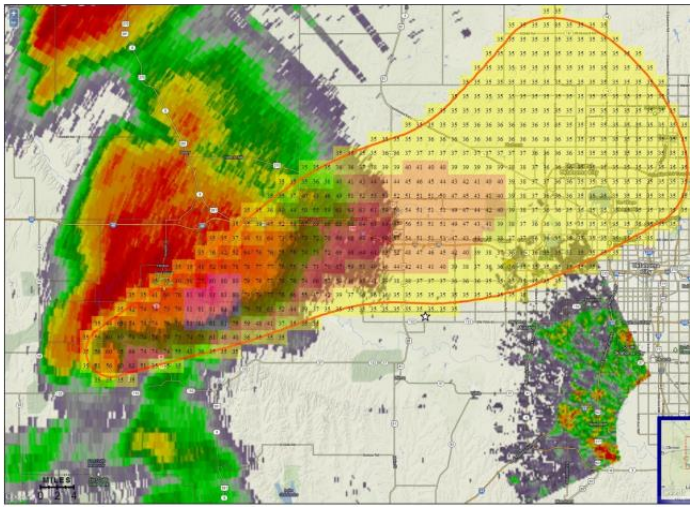


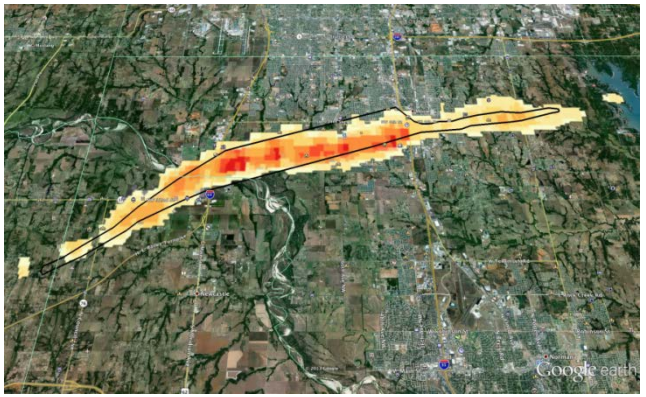
MRMS in Operations

- NWS uses the radar mosaics at the Storm Prediction Center (SPC), the Aviation Weather Center(AWC), and the Weather Prediction Center (WPC) for real-time hazardous weather forecasting and post-event data analysis.
- AWC forecasters use MRMS as THE mosaic radar display
  - Used as the default radar mosaic at www.aviationweather.gov
- MRMS 3D products are used to initialize and verify operational high-resolution storm-scale models

Final Operating Capability

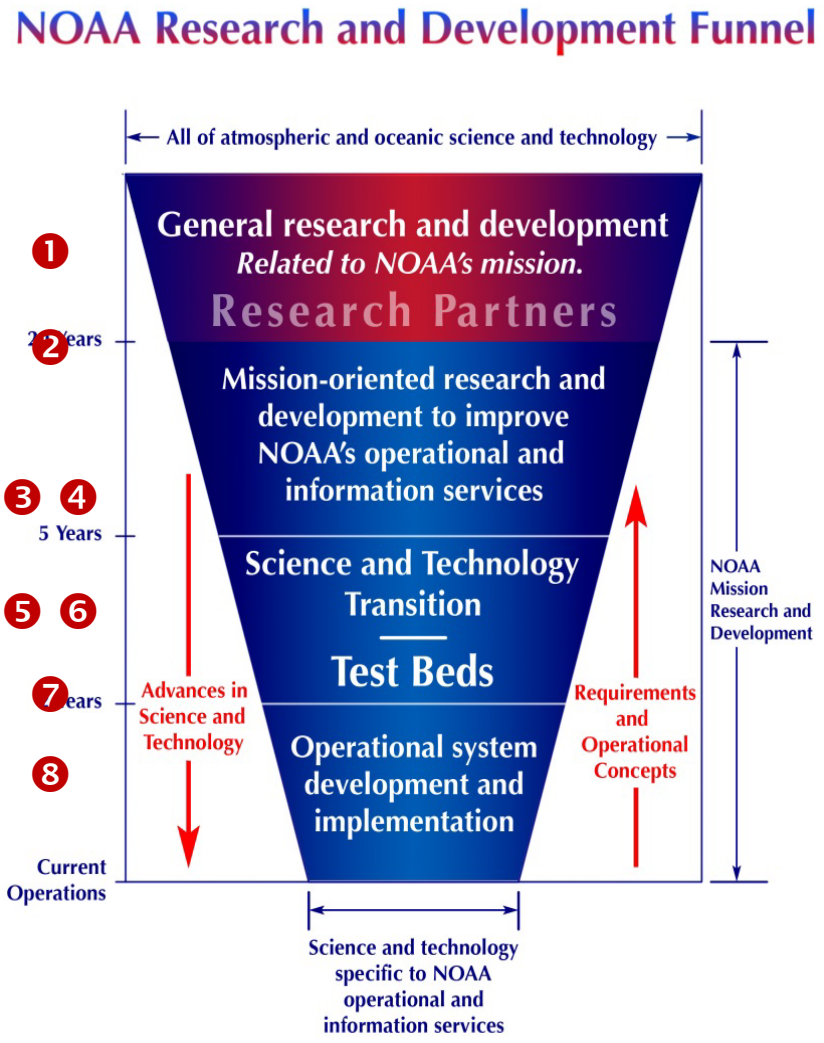
- The final, major operating upgrade to MRMS will occur in Q3FY16
  - Expansion to full suite of MRMS products including
    - Convective forecasts out to 2 hours
    - Additional severe weather products
- Fully redundant backup system in Boulder, CO
- Full Optimization across all components of MRMS system
- Flooded Locations and Simulated Hydrographs (FLASH)





Road to MRMS Implementation

1	Pre-08	General R&D on decision support and quantitative precip estimates using radar
2	Oct 08	MRMS enters NWS transition process
3	Nov 10	MRMS running at FAA Tech Center
4	Dec 10	MRMS approved as an official NOAA Line Office Transition Project
5	May 13	Funding for MRMS transition
6	Aug 13	MRMS Implementation Project charter signed
7	Aug 13 – Sep 14	MRMS enters final development and testing at NCEP
8	Sep 14	MRMS operational at NCEP



MRMS R2O Success

- NSSL team worked directly with NCEP staff on the operational implementation including on site training and interactions

- NSSL built and maintains a real time MRMS system processing environment nearly identical to the NCEP system
  - Provides a straight forward research-to-operations integration platform

- Developed realistic transition/implementation plan
  - Schedule detailed tasks and who does each
  - Documentation
  - Follow the schedule with rigor
  - Communication!
  - User and stakeholder awareness and buy-in

Challenges/Lessons Learned

- Difference in perspectives
  - Research (NSSL) versus Operations (NWS/NCEP)
  - Performance requirements and metrics
  - Level of documentation

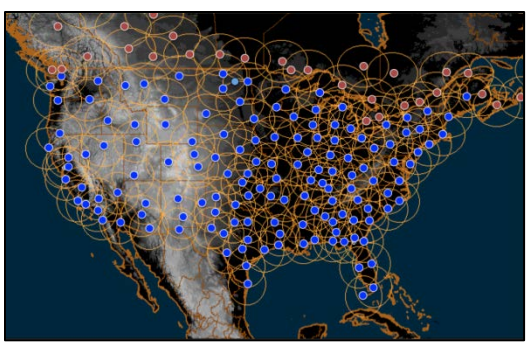
- Evolving operational onboarding process
  - MRMS was first project to be implemented on NCEP system
  - Alleviated by high level of interaction and communication between agencies

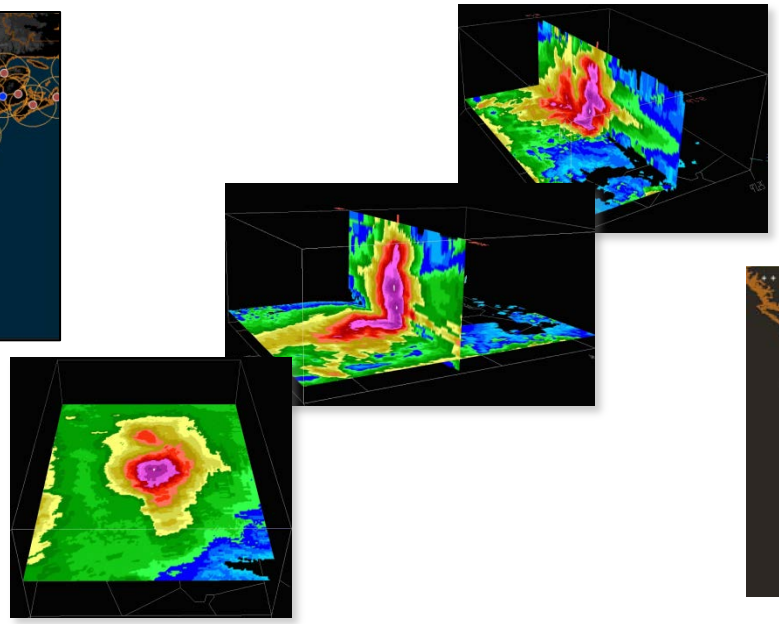
Summary

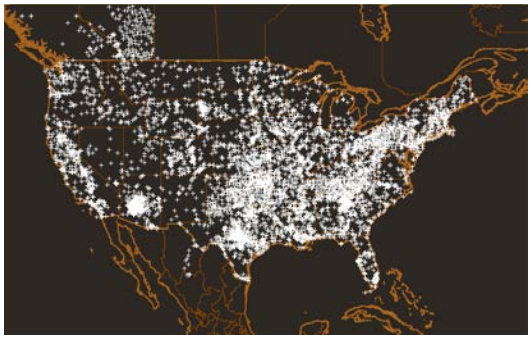
- MRMS provides seamless, high resolution data sphere of integrated radar and sensor data for multiple agencies
- Strengthens existing and establish new partnerships with multiple development and operational agencies
- MRMS Implementation Project provides an example of good practices to transition R&D as well as lessons learned for future transition projects.

Questions?

MRMS Background







Multi-Radar: Exploits the overlapping coverage of the WSR-88D network and the Level-II real-time data feeds to build a seamless rapidly-updating high-resolution three-dimensional cube of radar data CONUS.

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

Products over SBN*

Composite Reflectivity	Base Reflectivity
Composite Reflectivity Height	Low-Level Rotation Tracks (60 & 1440 min. accum.)
Composite Reflectivity [0-4 km]	Mid-Level Rotation Tracks (60 & 1440 min. accum.)
Radar Quality Index	Maximum Estimated Size of Hail (MESH)
Seamless Hybrid Scan Reflectivity	MESH Tracks (60 & 1440 min. accum.)
Cloud-to-Ground Lightning Density (1, 5, 15, & 30 min.)	Vertically Integrated Liquid (VIL)
Cloud-to-Ground Lightning Probability (0-30 min.)	Vertically Integrated Ice (VII)
Probability of Warm Rain (POWR)	18, 30, 50, & 60 dBZ Echo Top (ET)
Surface Precipitation Type	Height of 50dBZ Echo Above -20°C
Instantaneous Radar Precipitation Rate	Height of 50dBZ Echo Above 0°C
Radar 1H, 3H, 6H, 12H, 24H, 48H, 72H QPE	Height of 60dBZ Echo Above 0°C
Local Gauge Bias Corrected 1H, 3H, 6H, 12H, 24H, 48H, & 72H QPE	Reflectivity at 0°C, -10°C, -20°C
Mountain Mapper 1H, 3H, 6H, 12H, 24H, 48H, 72H QPE	Reflectivity At Lowest Altitude (RALA)

** Subset of currently produced products*