Multi-Radar/Multi-Sensor – Transition to Operations

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National Weather Center

Norman, Oklahoma

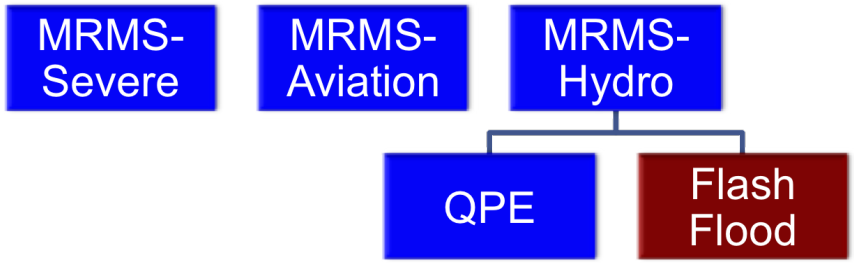
What is Multi-Radar/Multi-Sensor (MRMS)

a research and operational system for the integration and assimilation of multiple sensor observations and numerical analysis/prediction fields for the identification and short term prediction of hazardous weather.

Approaching 500,000 lines of code and scripts

Generates 1,600 CONUS product grids and data sets per day

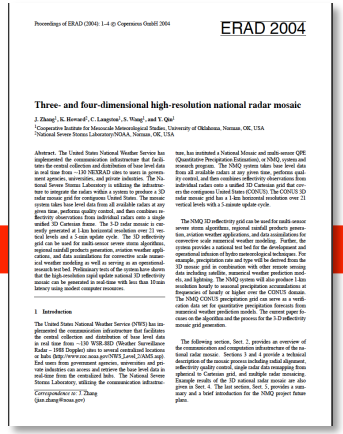
80% of the MRMS products have never been operationally available



Why MRMS?

2000

2002



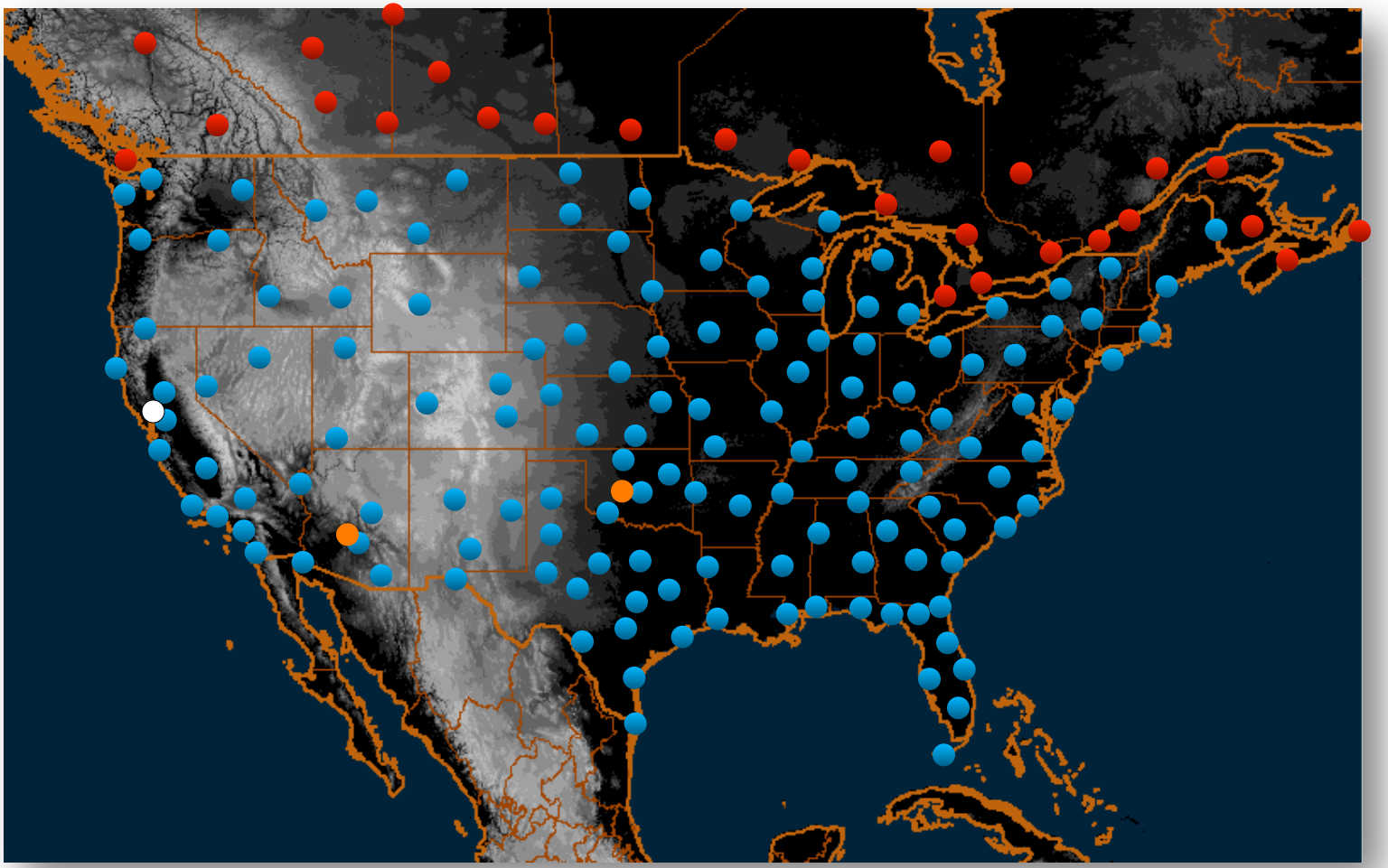
2004

2007

2011

The MRMS system was specifically conceived and designed to address the objectives of and to support Weather Ready Nation, NextGen Weather, and Integrated Water Resource Services (IWRS) initiatives.

MRMS Domain

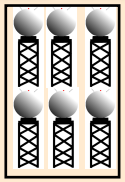


● ~140 WSR-88D ● 31 Canadian ● 19 TDWR ○ 1 TV station radar

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

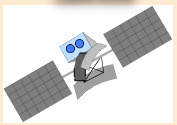
Lightning

Radar Networks

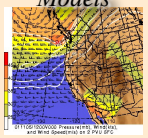


Upper Air

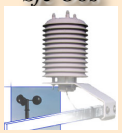
Satellite

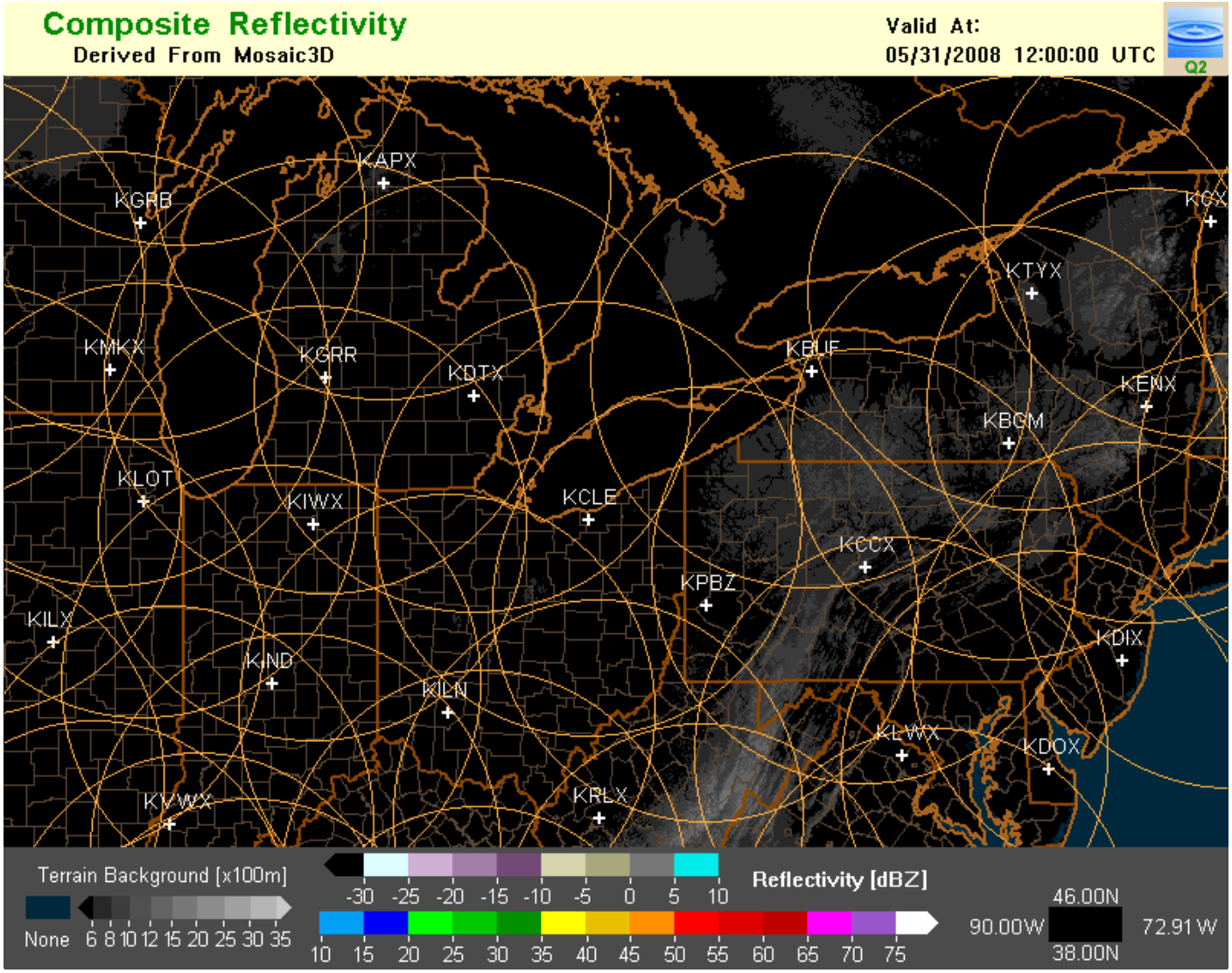


Models



Sfc Obs





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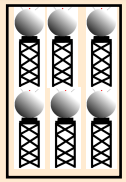

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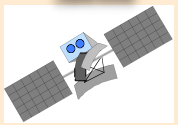

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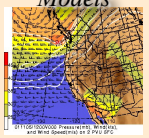

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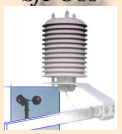

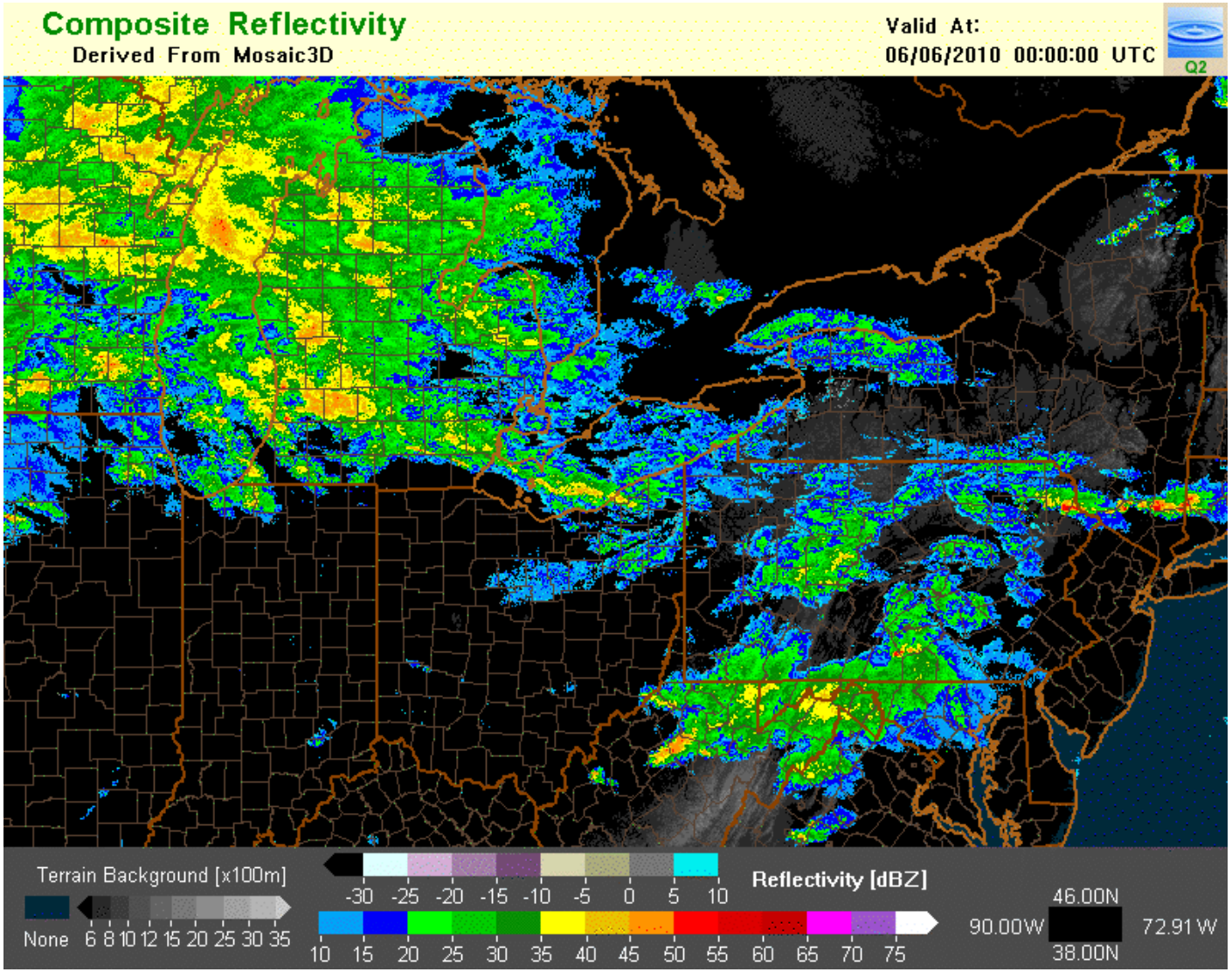

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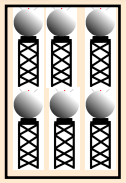

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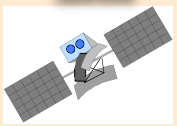

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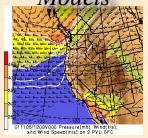

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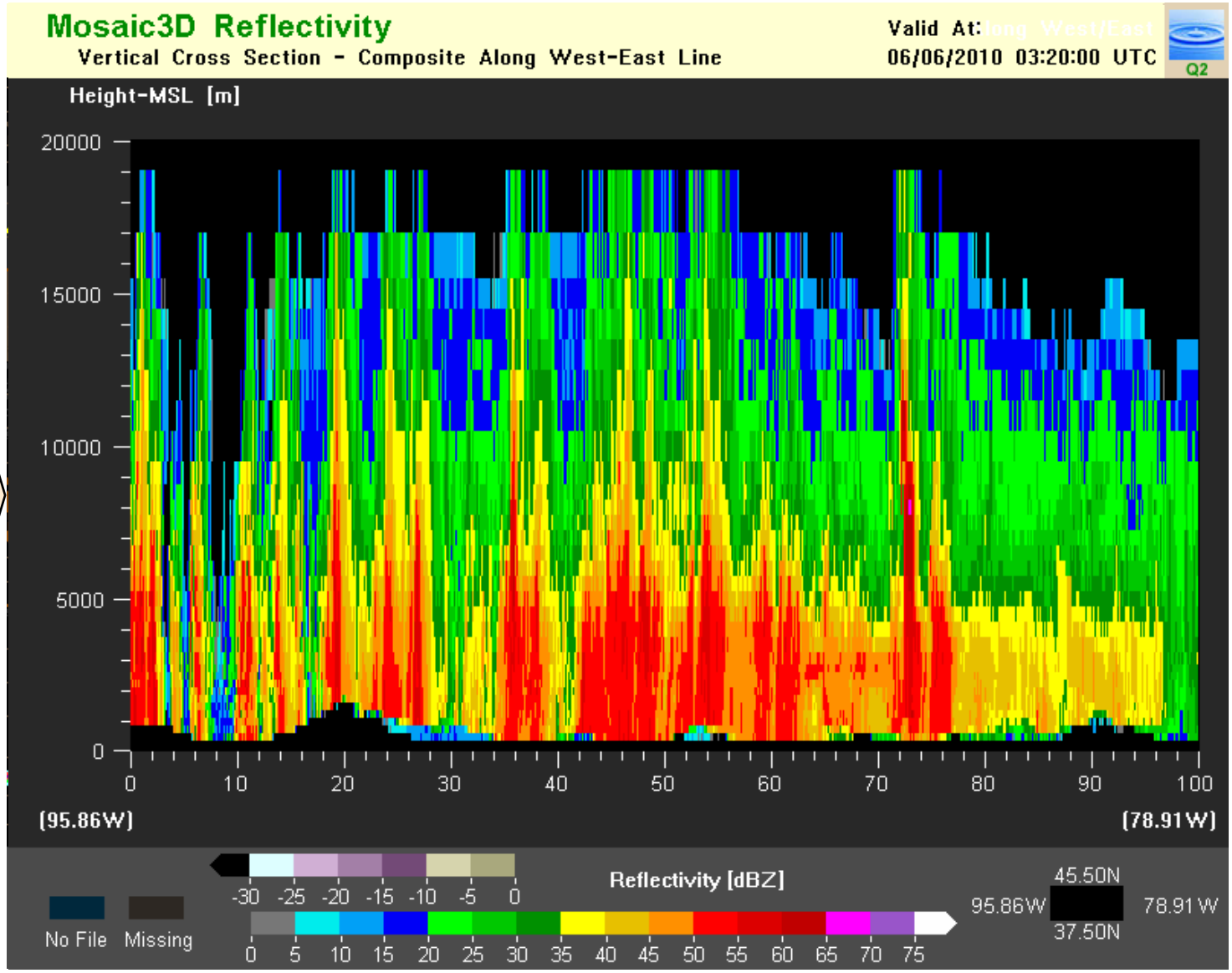
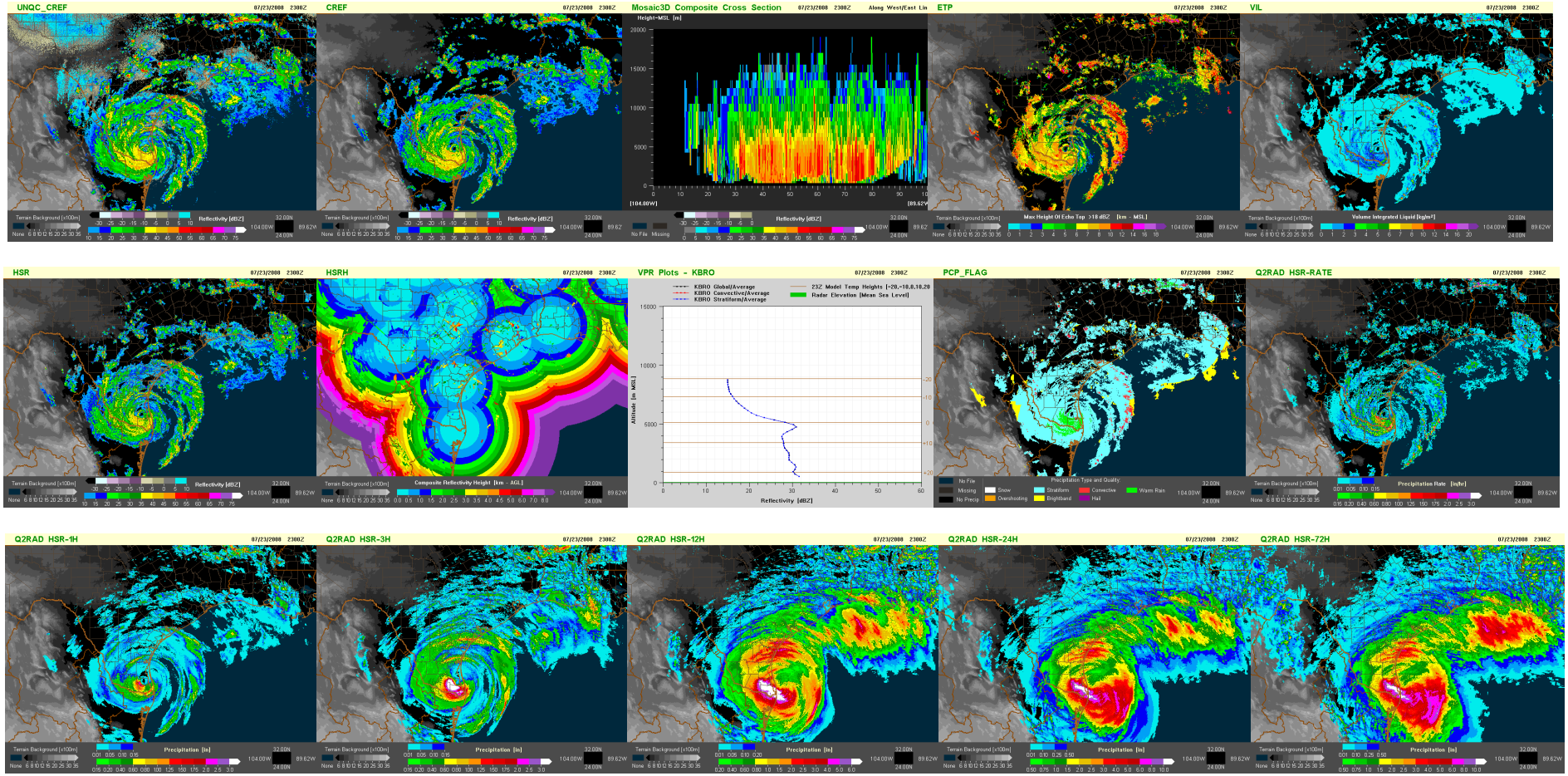
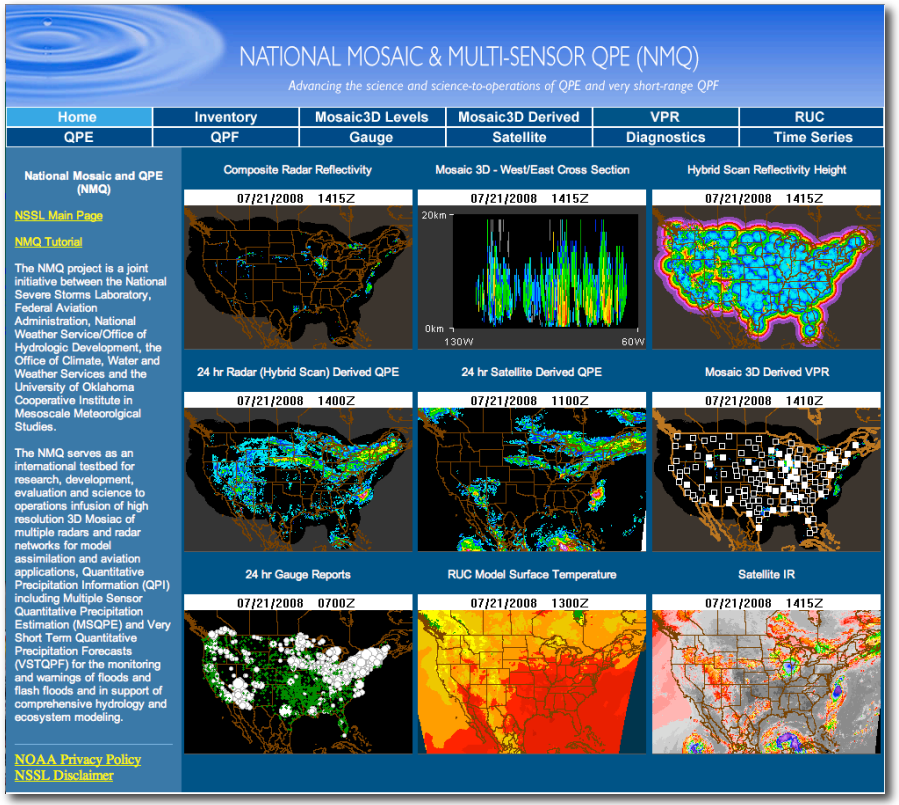


MRMS Reflectivity, Precipitation & Diagnostic Grids

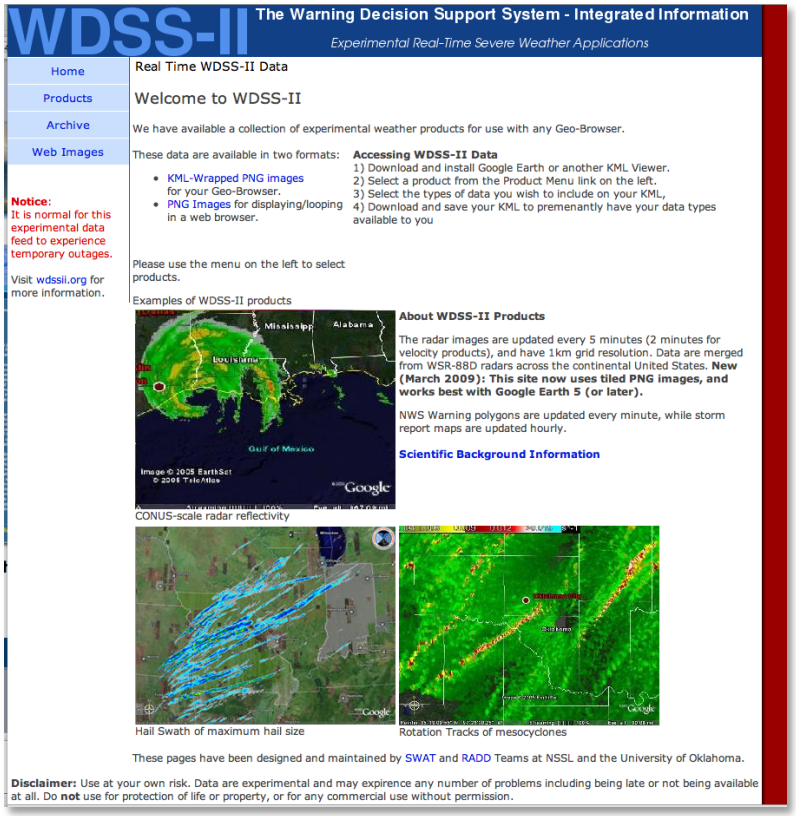


MRMS produces and disseminates a suite of **100+** high resolution product grids over North America **(1-km, 2 to 5 minutes)** for use in model data assimilation, severe weather, aviation and hydrometeorology (flooding and water resource management).

Transparency - MRMS Web Portals



mrms.ou.edu



wdssii.nssl.noaa.gov

MRMS Collaborators and Product Distribution

NCEP

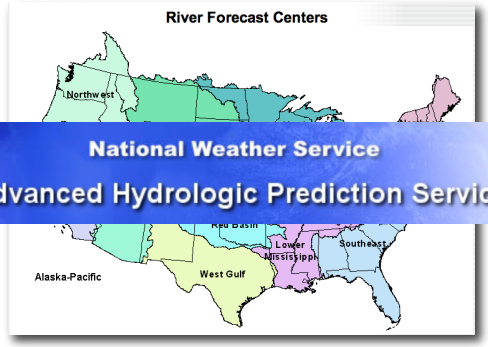
NOAA's National Weather Service
Radar Operations Center
NEXRAD WSR-88D

Storm Prediction Center
Norman, Oklahoma

NOAA's National Weather Service
Aviation Weather Center

National Weather Service
Hydrometeorological Prediction Center

Earth System Research Laboratory
Global Systems Division



National Weather Service
Advanced Hydrologic Prediction Service

UCAR

NCAR

Center for Analysis and Prediction of Storms
University of Oklahoma
CAPS

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

NASA

unidata

Environment Canada

Environnement Canada

MRMS System Expansion

Seamless Integration of Radar Advances, Systems, and Networks

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	

Canada Network

Commercial Radars

WSR88D High Res

WSR88D DoD L2

TDWR Network

Hawaii WSR88Ds

88D Dual Polarization

Alaska WSR88Ds

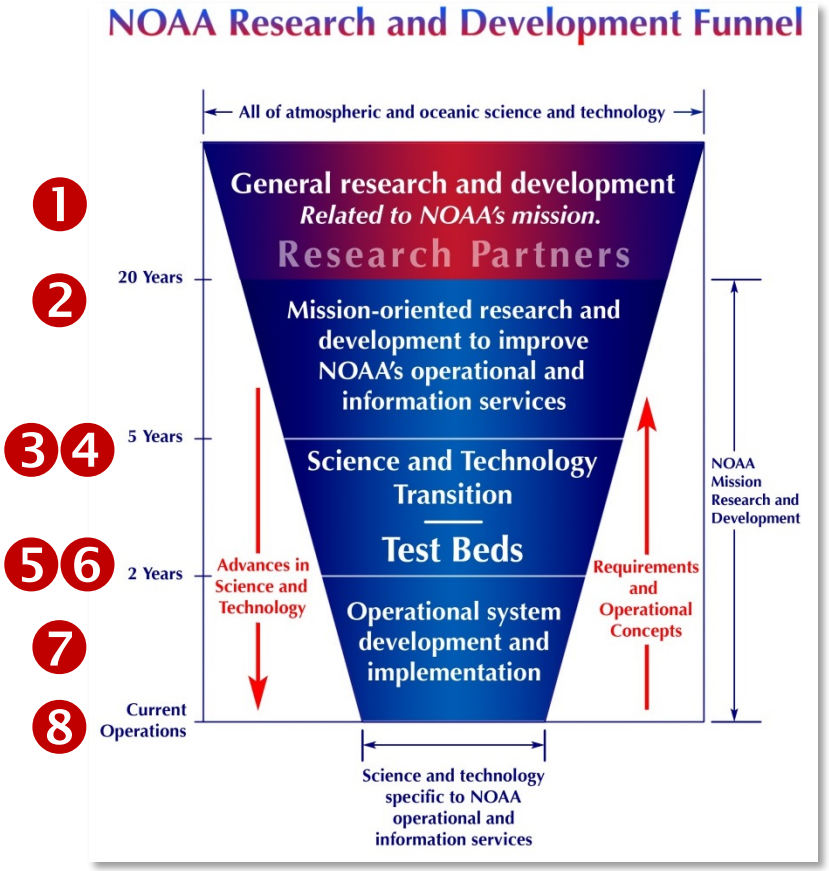
Caribbean Network

1km/5min → 1km/2.5min → 1km/2min ⟶ 500m/2min → 250m/1min

North America Resolution and Refresh Rate

Road to MRMS Implementation

1	Pre-06	General R&D on decision support and quantitative precip estimates using radar
2	Oct 06	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 went operational at NCEP



MRMS R2O Success

- Having The Right People who know The Right Stuff

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

- A R&D Environment that functions Operationally

  NSSL built and maintains a real time MRMS system processing environment nearly identical to NCEP in content and data flow to test and evaluate new science and technologies for operational implementation (R2O).

Seamless Transition

MRMS Benefits Hydrology

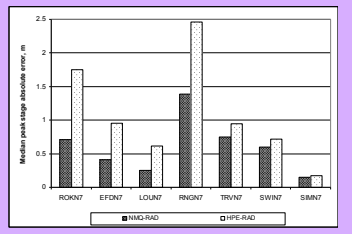
Precipitation Estimation
(WFOs, RFCs, EMC, HPC)

"MRMS/Q2 provides precipitation estimates from portions of southwest Texas, western New Mexico, south central Colorado and Mexico where few if any other sources of precipitation data exist. This area has now experienced major flooding in two of the past four years due to dissipating tropical systems. The loss of Q2 would, in short, mean the loss of what we have seen to be our most accurate radar-based QPE."
– Greg Story (West Gulf RFC).

- **Increases effective precipitation estimation coverage in "radar hostile" regions (terrain, bright-band, hail) by up to 35%**
- Provides measured improvements in data QC removing false precipitation echoes, which improves the RTMA, and reduces inaccurate precipitation estimates and unnecessary flash flood warnings.
- Greatly benefits the Western U.S., where there is a combination of major flooding vulnerability and radar coverage gaps.

Integrates lightning sensor data to apply advanced precipitation segregation (convective, stratiform) for more accurate rainfall rates

The **river stage forecast errors** in some basins are **reduced by up to 1 meter** using MRMS/Q2. This improved accuracy will **lead to major savings in flood mitigation efforts** (e.g., sandbagging, evacuations).



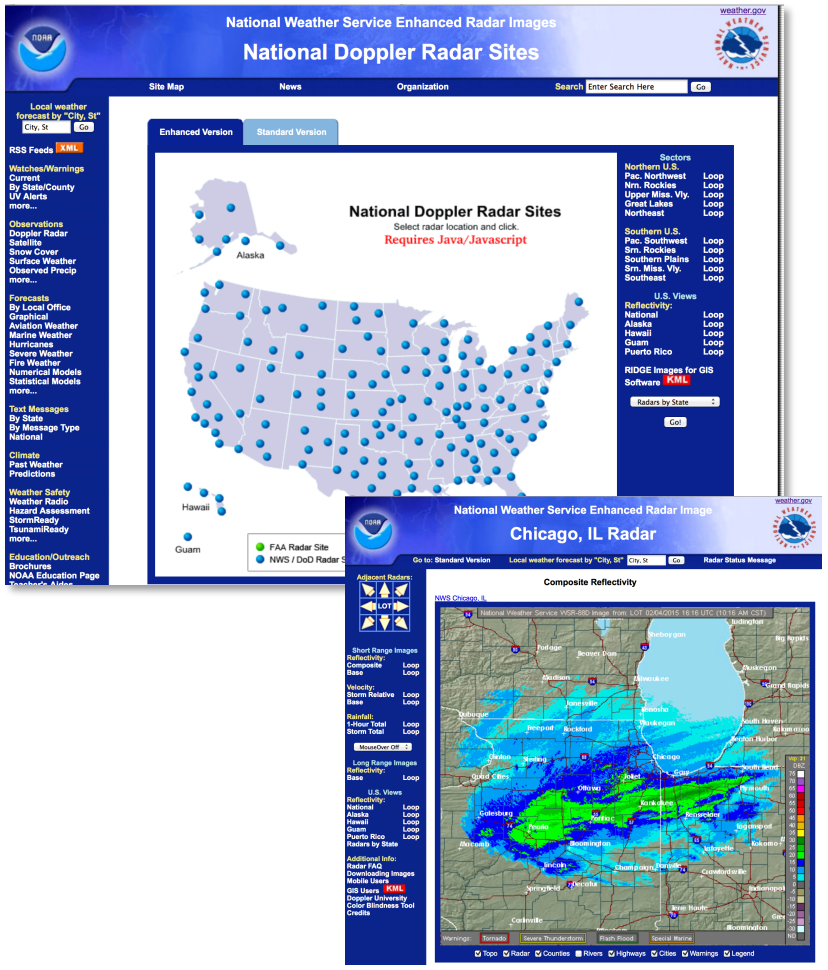
MRMS Transition into NCEP Operations

MRMS has been installed on the National Weather Service' (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 (to be completed in March 2015)

MRMS activities 2015-2016

- MRMS will provide back-end processing for NWS radar mosaic and single radar products for public website (FY15) - **MRMS will become a single authoritative source CONUS wide mosaics**
- Recast portions of MRMS into Gridpoint Statistical Interpolation (GSI) framework at EMC for improved data assimilation
- Expand MRMS domain to Alaska, Hawaii, PR, Guam, and western Pacific
- 3 month update cycle for new products and applications



Summary

~~MRMS Implementation Project provides a example of good practices to transition R&D as well as lessons learned for future transition projects.~~

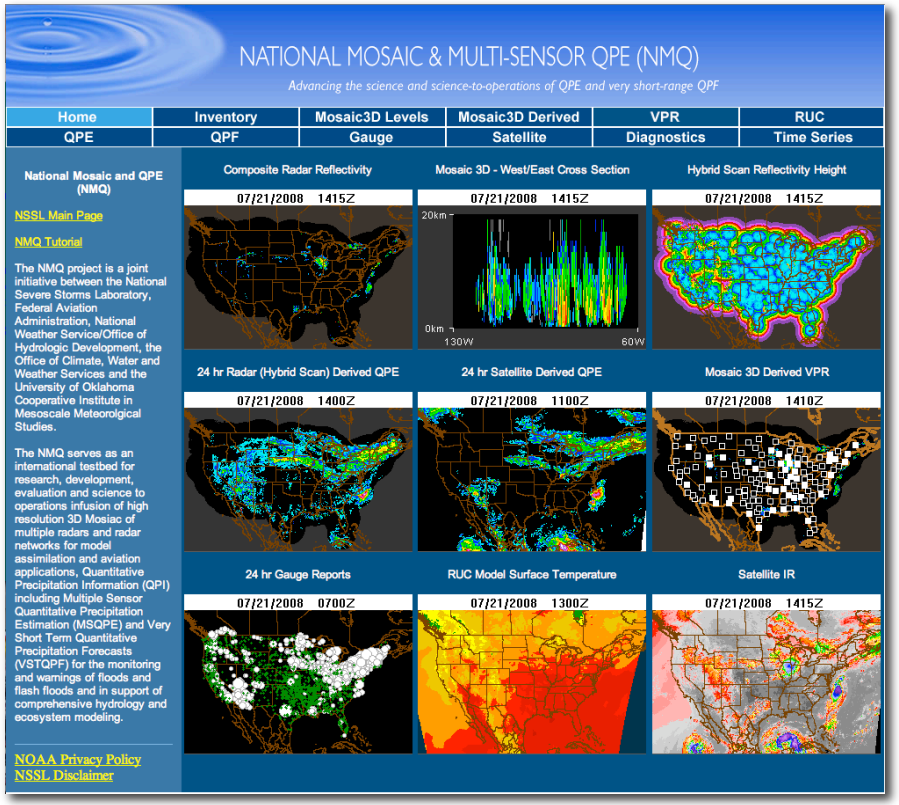
It took the very best of NSSL to implement a world class system to address some of meteorology's most difficult operational challenges.

And we are not done…

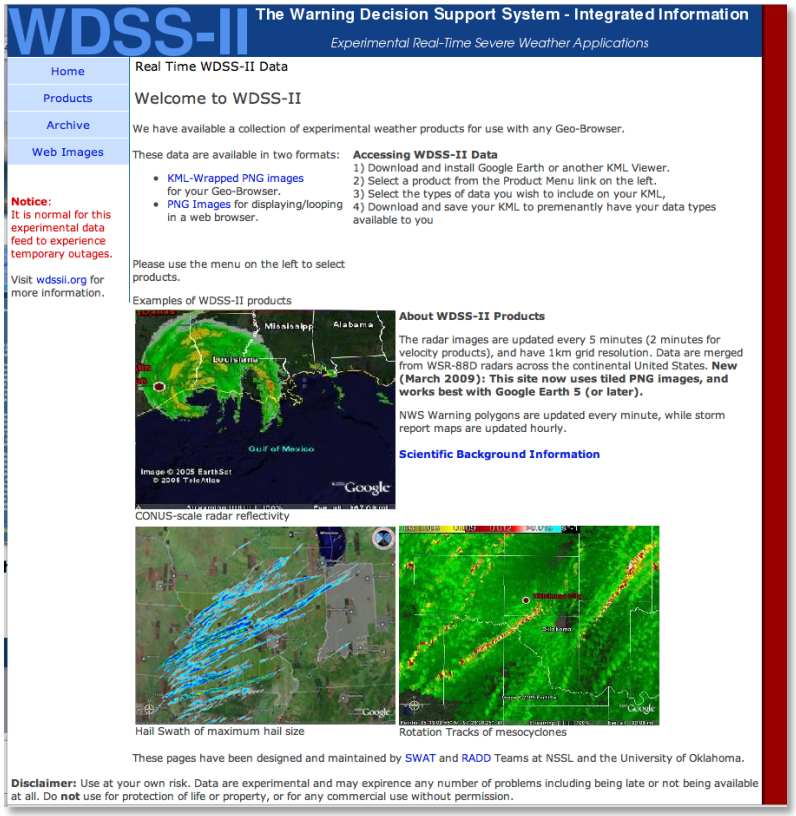
"Most unsuccessful programs fail at the beginning."

Steven R. Meier, *"Best Project Management and Systems Engineering Practices,"* Project Management Journal, Vol 8, Issue 1, March 2008

MRMS Web Portals - Transparency



http://nmq.ou.edu/



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