National Mosaic and Quantitative Precipitation Estimation Project (NMQ)

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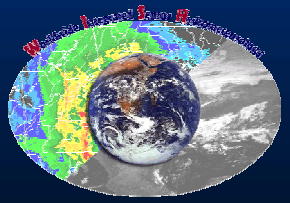
Dr. DJ Seo and David Kitzmiller

National Weather Service, OHD

QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.



Relevance of NMQ?

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are needed to see this picture.

- Monitoring and prediction of water underpins the nation's health, economy, security, and ecology.
- However there exists no seamless high resolution systematic monitoring of fresh water resources in North America
- The scientific and political challenges are significant requiring a community based and multi-faceted approach for fresh water monitoring and prediction.

What is NMQ?

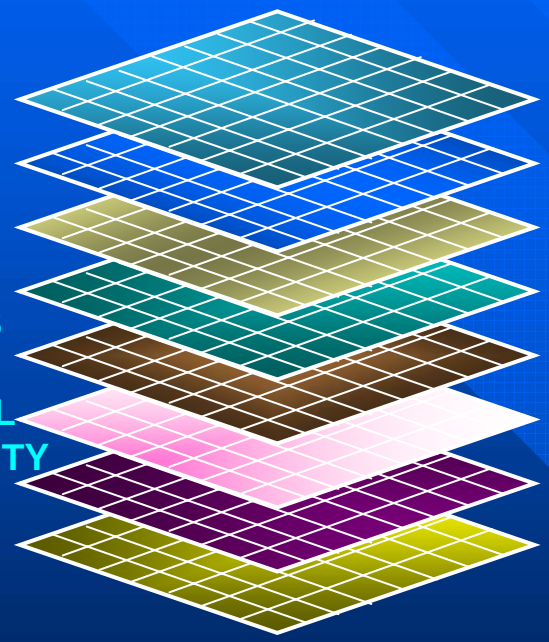
- The National Mosaic and QPE (NMQ) project is a joint initiative between NSSL, FAA, NCEP and the NWS/Office of Hydrologic Development (OHD) and the Office of Climate, Water, and Weather Services (OCWWS) to address (among others) the pressing need for
  - high-resolution national 3-D radar mosaics for atmospheric data assimilation and severe weather identification and prediction
  - multi sensor QPE and short term QPF for all seasons, regions, and terrains in support of operational hydrometeorological products and distributed hydrologic modeling
  - Research to operations infusion pathway

Objectives of NMQ

- Create a national system for community-wide research and development (R&D) of hydrometeorological applications in support of monitoring and prediction of freshwater resources in the U.S. across a wide range of space and time scales
- Facilitate community-wide collaborative R&D and research-to-operations (RTO) of new applications, techniques and approaches to precipitation estimation (QPE), short-range precipitation forecasting (QPF), and severe weather
- Create a scientifically sound real-time system to develop and test techniques and methodologies for physically realistic high-resolution rendering of hydrometeorological and meteorological processes using current and near future observational systems

NWS Water Science Vision: Integrated Products and Services

a) NWS-NDFD High-Resolution Gridded Water Resources Product Suite (WRPS)



U.S. FOCUS

GLOBAL CAPABILITY

- Precipitation
- Snowpack
- Soil Moisture, Runoff
- Evaporation
- Groundwater
- River flow
- Surface Storage
- Water Quality
- Others

Applications

Drought

Flood Management

Flash Flood Prediction

Water Supply

Transportation

Emergency Management

Agriculture

Debris Flows

Ecosystems Management

Research

Customers

NWS

NOAA

Federal Agencies

Tribal Agencies

State Agencies

Local Agencies

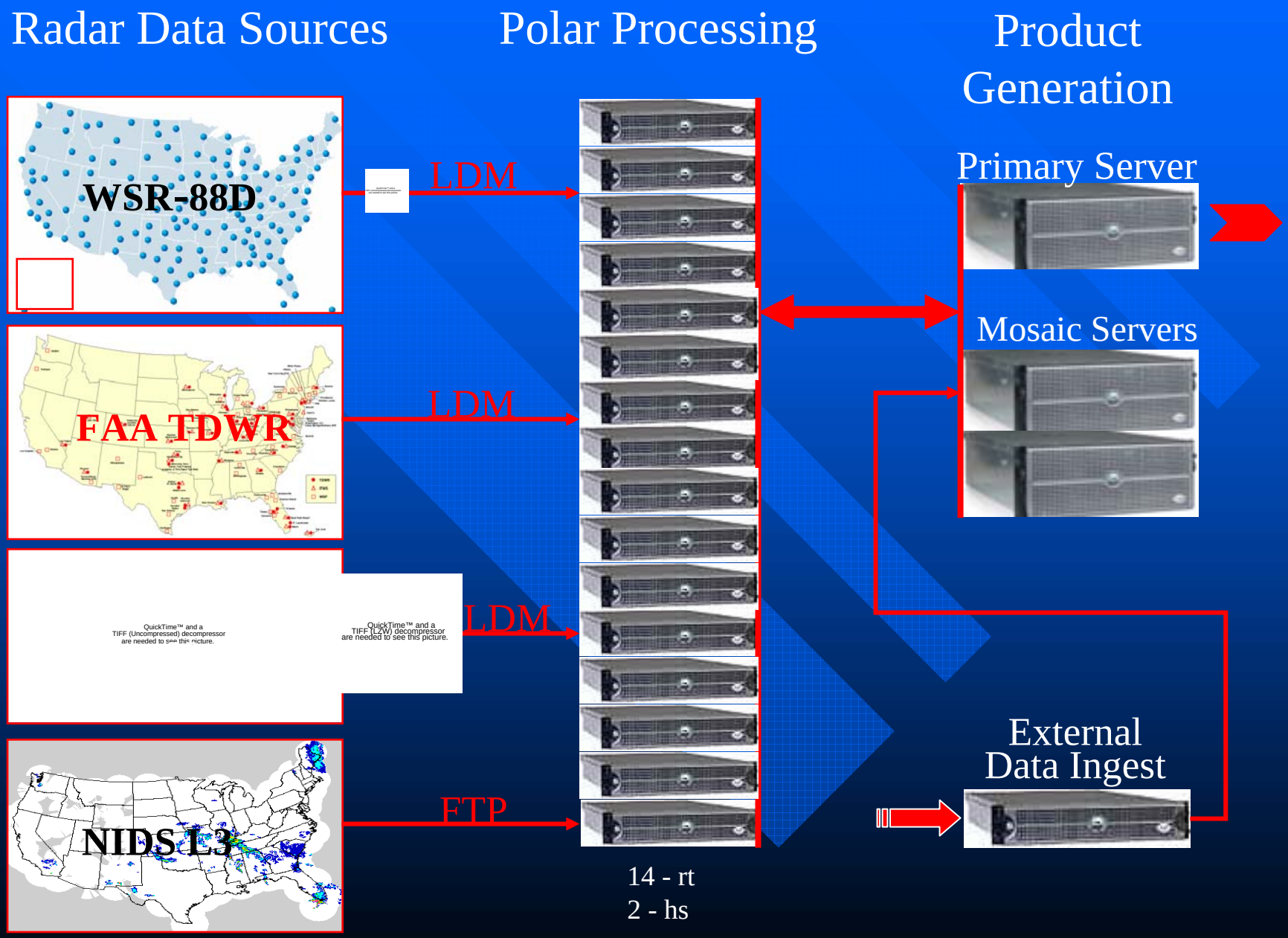
Private Sector

Academia

The WRPS includes a comprehensive suite of high-resolution (1-10 km) gridded hydrologic state variable and flux datasets and derived products to support a wide range of future applications and services. Temporal characteristics of WRPS range from current-hour analyses to forecasts of several months. Datasets include rainfall, snowfall, snow water equivalent, snowpack temperature, snowmelt, soil moisture, soil temperature, evaporation, sublimation, streamflow, and surface storage. Other hydrologic variables such as groundwater, fuel moisture, soil stability (e.g. debris flows potential), water quality, etc. are also possible in this framework.

From NWS Integrated Water Science Plan (2004)

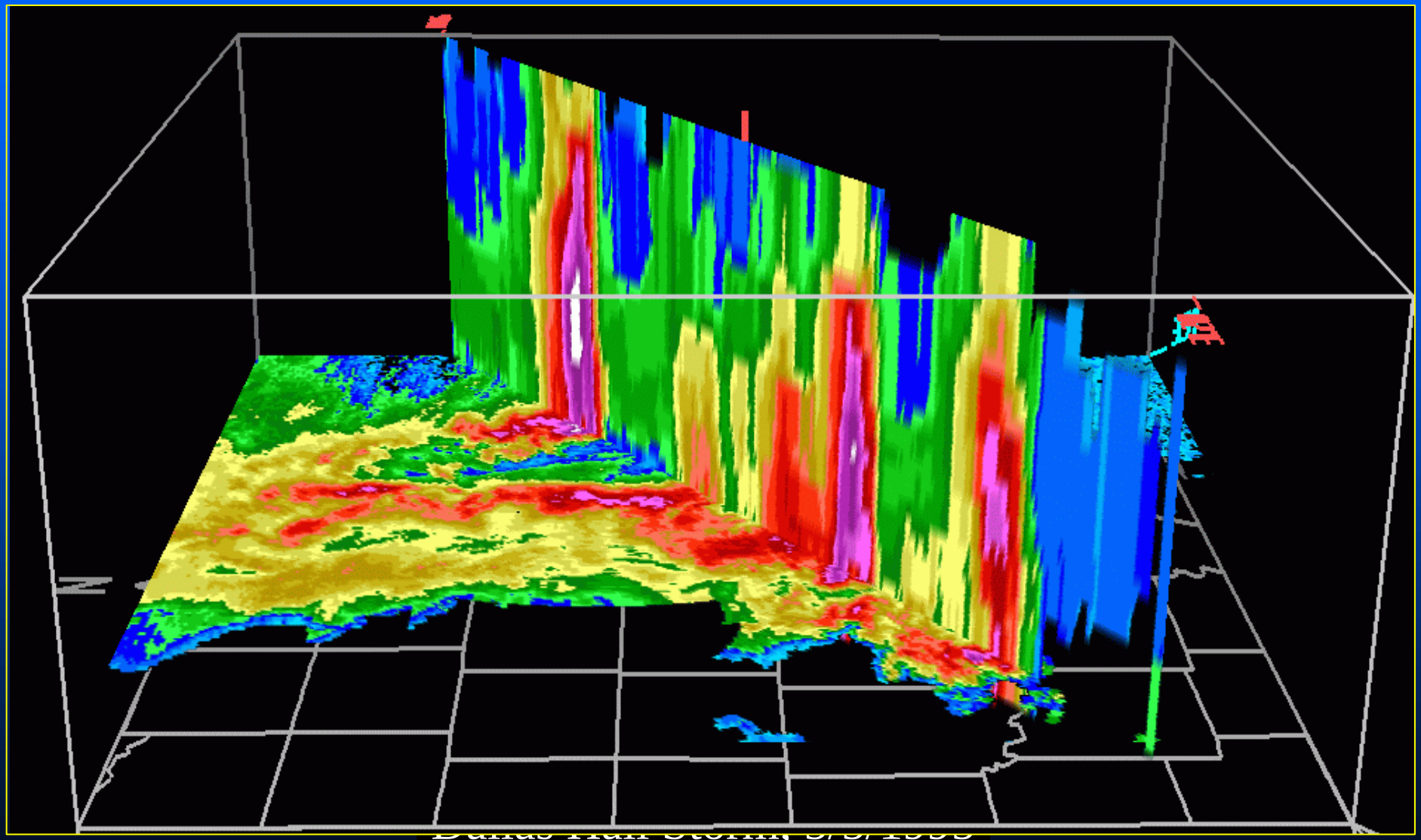
NMQ_xrt Polar Ingest (1 km to 250 meter)



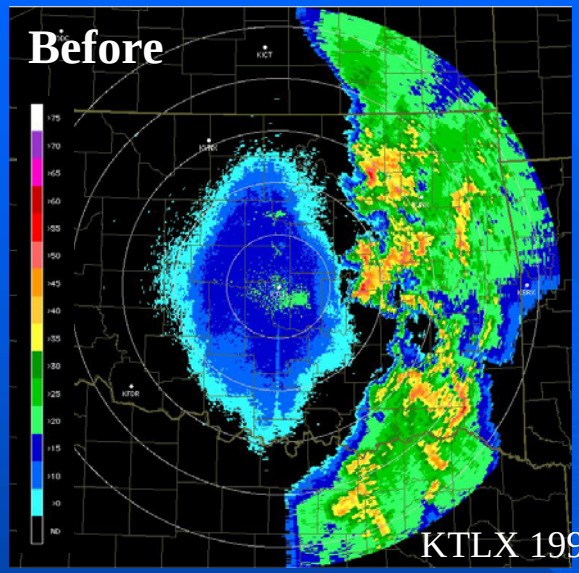
NMQ ‘Real Time’ CONUS

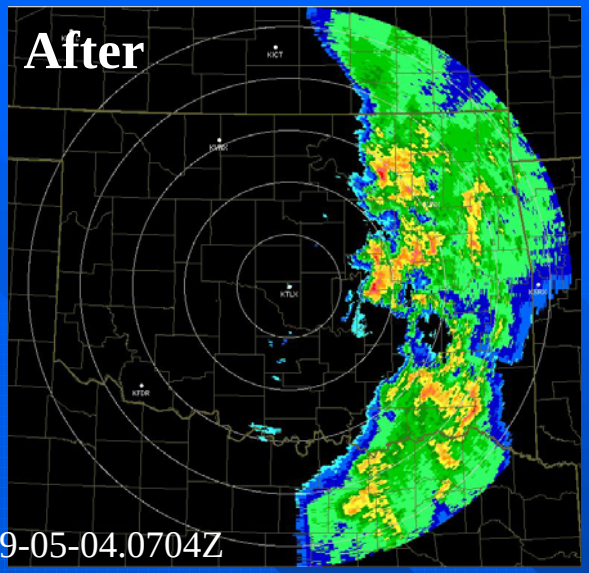
QuickTime™ and a
Video decompressor
are needed to see this picture.

Cross Sections from 3-D Mosaic



Reflectivity QC

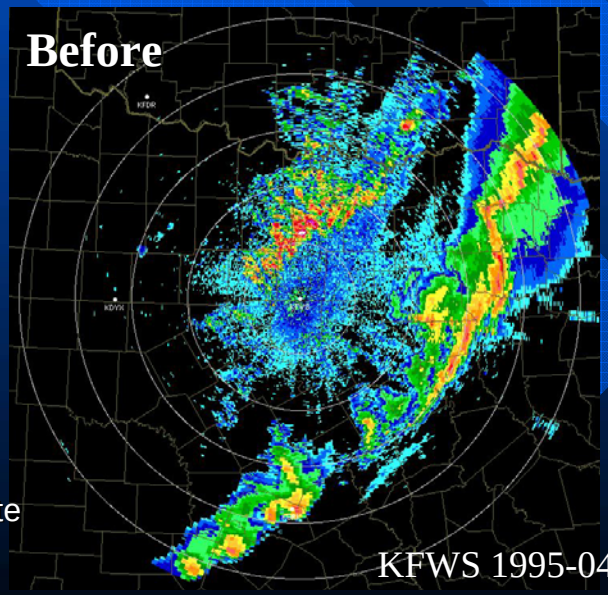


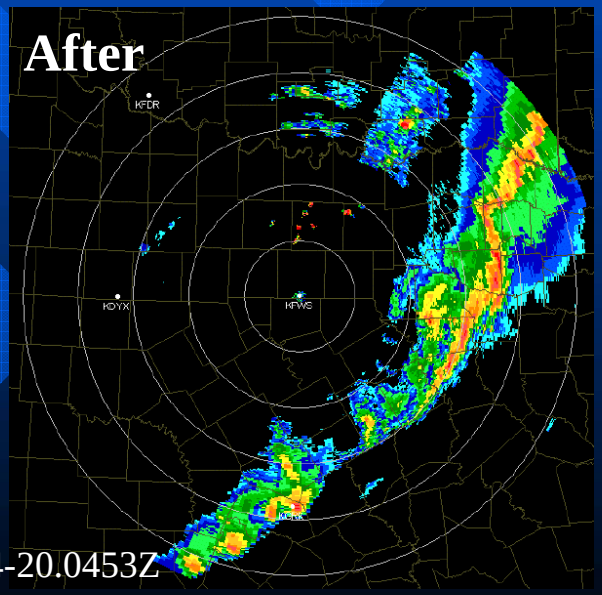


KTLX 1999-05-04.0704Z

Clear Air Echoes

- Low intensity
- Shallow depth
  - May not be segregated from very shallow stratiform precip/snow using refl structure only
  - Require velocity info

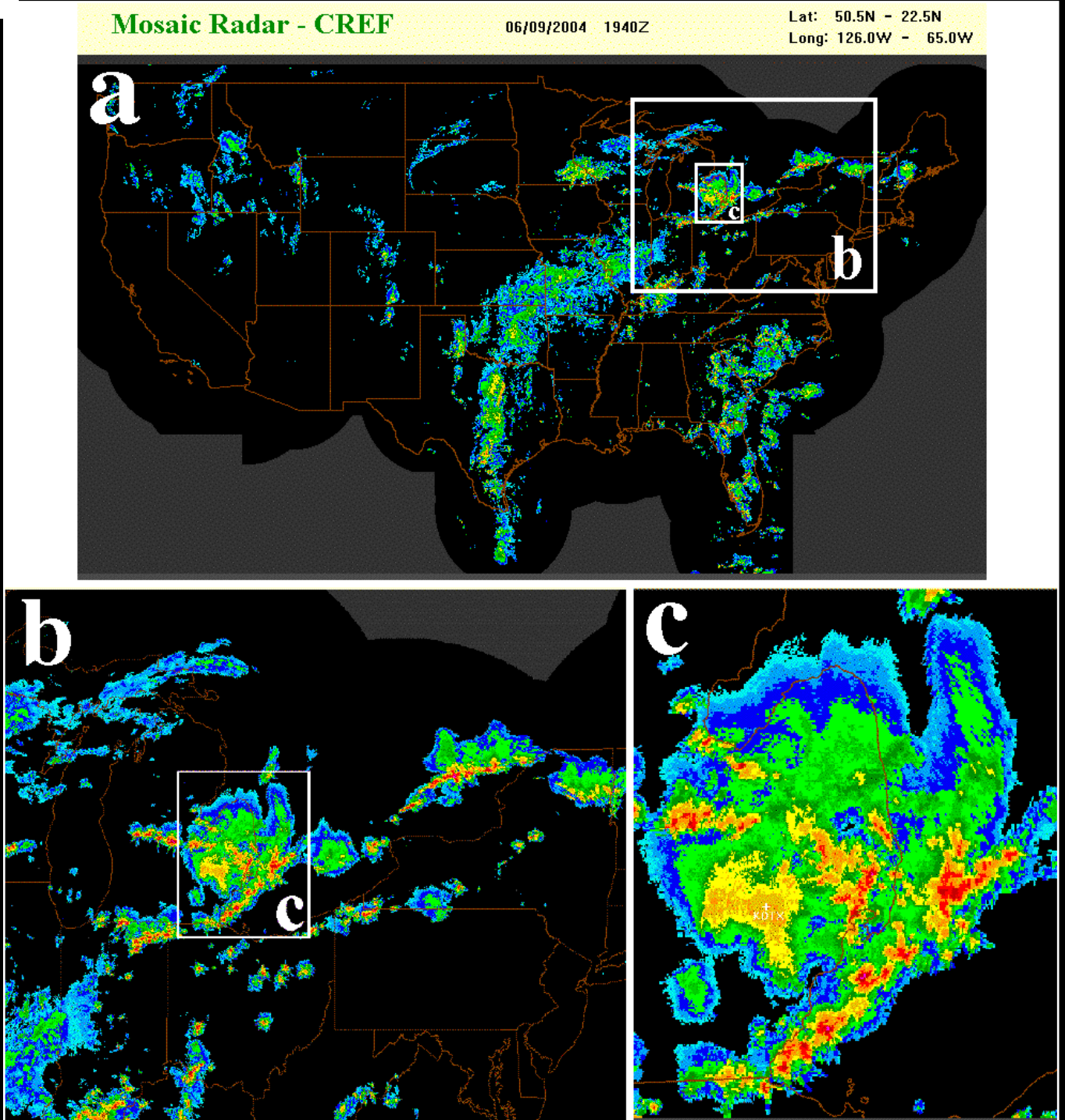




KFWS 1995-04-20.0453Z

AP Echoes

- Lack of vertical continuity
- Rough texture
  - AP at far ranges can not be segregated from shallow precip by using refl structure only
  - Need additional info such as satellite



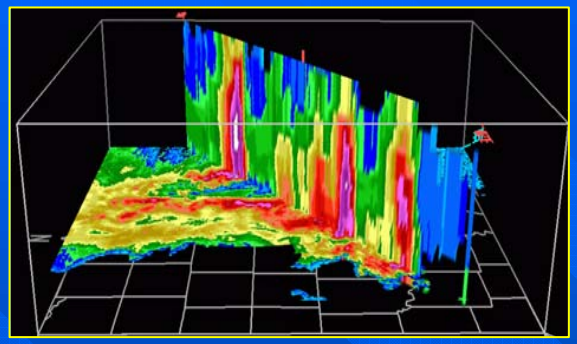
NMQ_xrt
Real-time
CONUS
3-D Mosaic

FY06
124+ Radars
1 km x 1 km x 500m
21 vertical levels
5 min updates cycle

FY07
180+ Radars
250 m x 250 m
30 vertical levels
<5 min update cycle

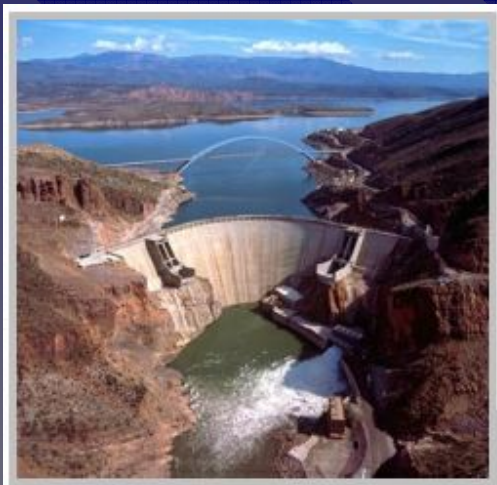
NMQ Applications and Products Based upon the 3D Mosaic

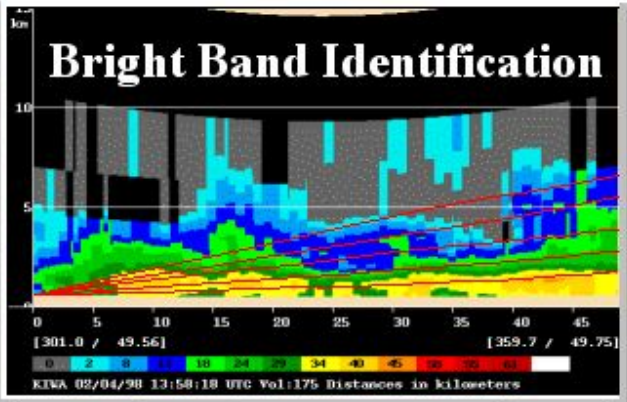
- 2D and 3D products and Multi-sensor Severe Storm Attributes
  - Composite Refl., Height of Comp. Refl.
  - Hybrid Scan Refl, Height of Hyb scan refl.
  - Refl on constant T-levels
  - Gridded VIL
  - Gridded Hail products
  - Echo top

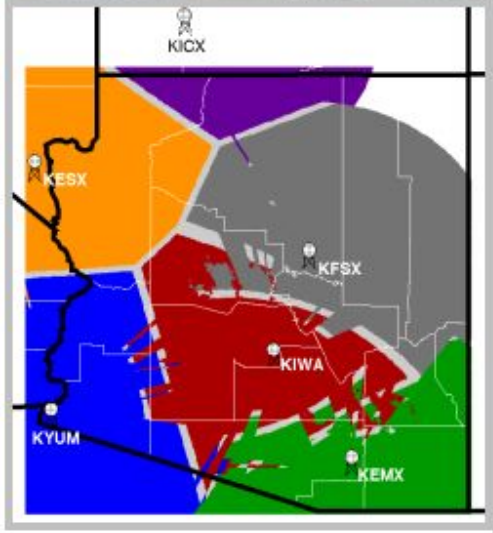


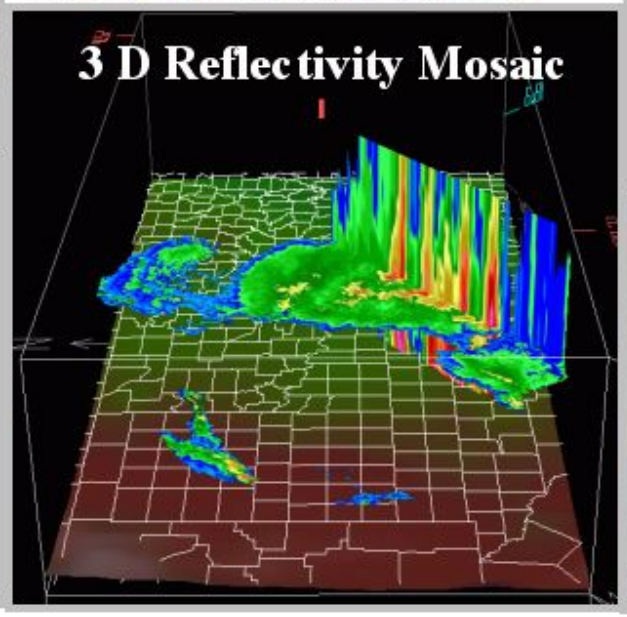
- Multi-sensor Quantitative Precipitation Estimation (in collaboration with OHD/NWS)
  - High-resolution, rapid update precipitation accumulations (QPE)
  - Short term QPF
  - Flash-flood detection and warning
- Data Assimilation for Convective-scale Numerical Weather Prediction (in collaboration with NCAR, FSL, CWB and NCEP)
  - 3-D diabatic initialization
  - Reduce spin-up time and improve convective-scale QPF

Quantitative Precipitation Estimation and Segregation Using Multiple Sensors

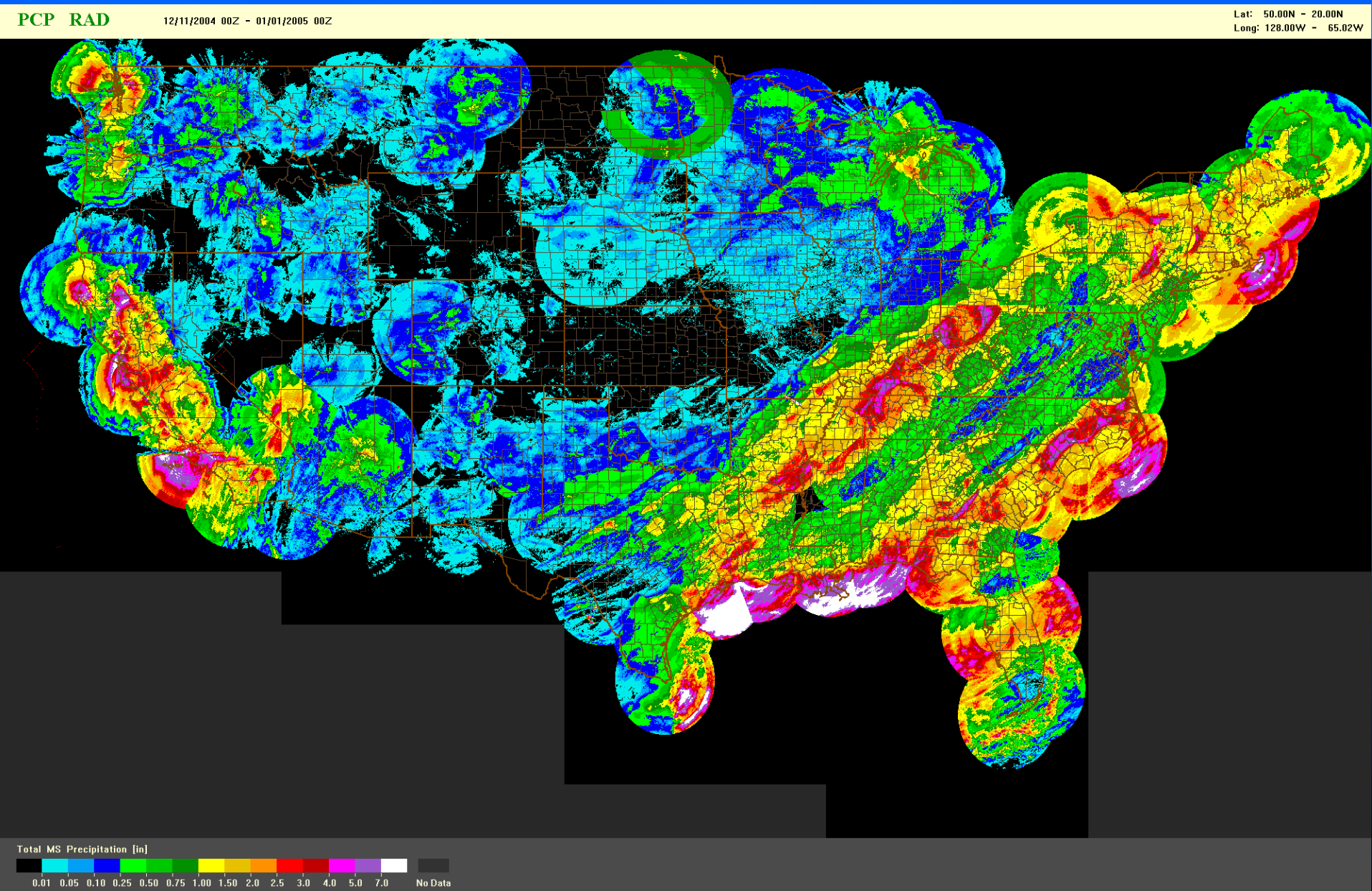




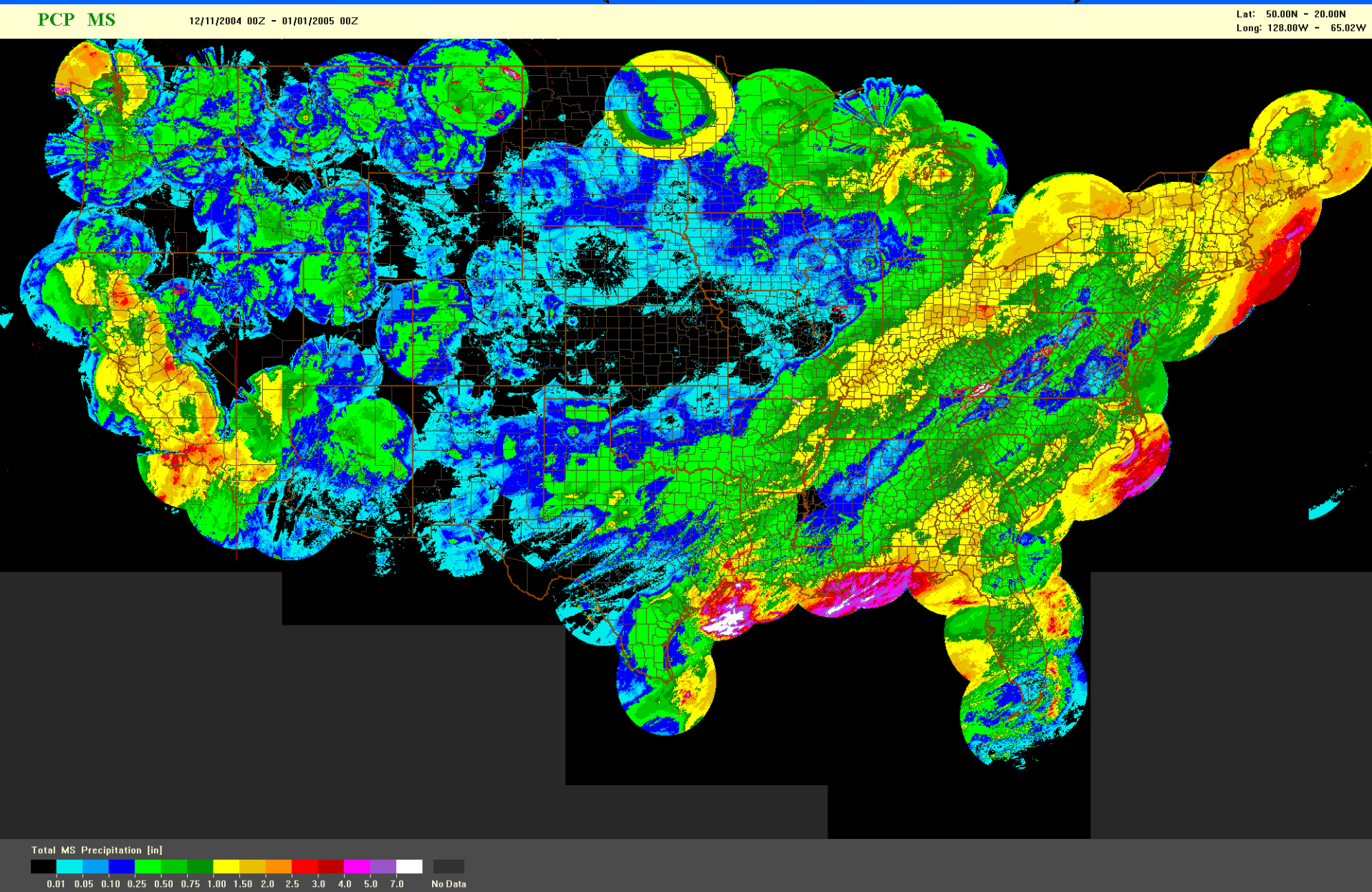




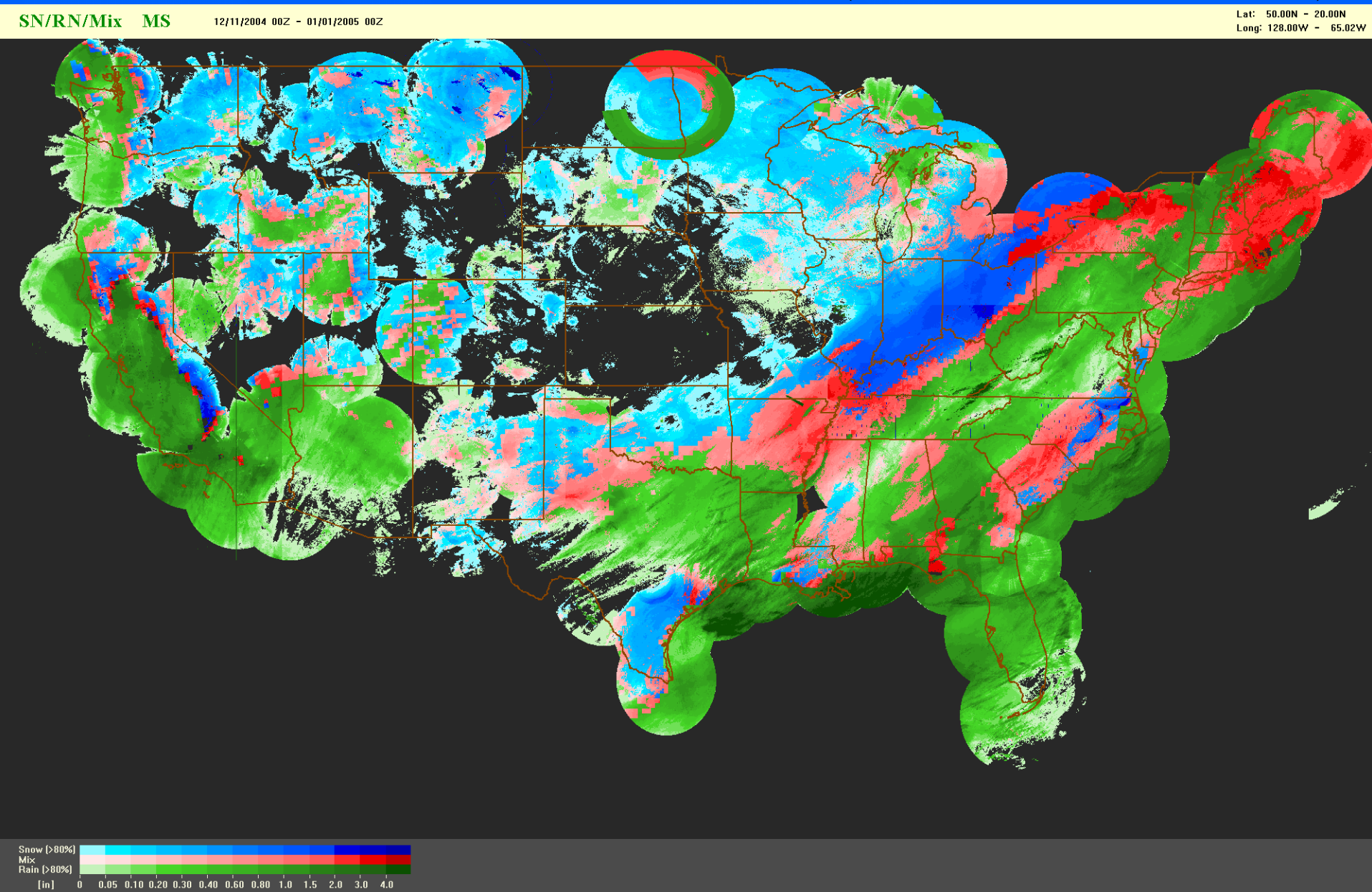
Radar Only PCP (Dec. 11- Jan. 1)



MS PCP (Dec. 11- Jan. 1)



Snow/Rain Mix MS PCP (Dec. 11- Jan. 1)



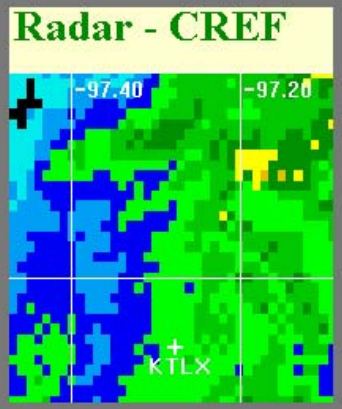
NMQ Verification

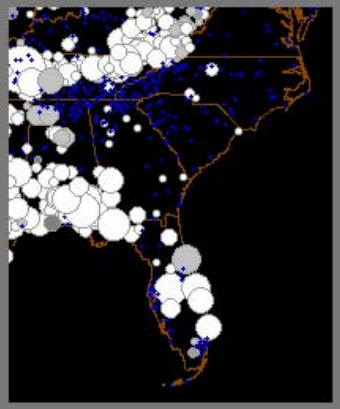
http://172.16.20.180/~qpeverif/Internal/

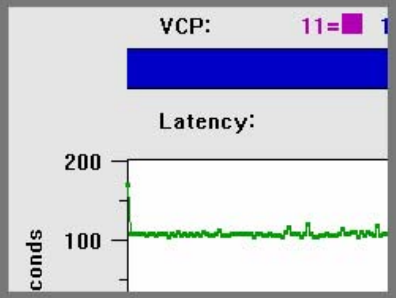
NMQTest EmpExp Gmail Amazon News ▾ NPR NMQQPE NMQ Typhoons Weather NexRadMos NexSat Refd Phoenix NSSL Modis Apple NLocate

NMQ Verification Page

Meteorological Data | System Monitoring | Radar Comparison | Data Inventory | Events/Analysis | Data Retrieval







NMQ Verification

http://nmqserver.protect.nssl/~qpeverif/

Amazon News NPR NMQ Typhoons Weather DuPage NexSat Refd Phoenix NSSL Modis Apple

NMQ Verification Page

Meteorological Data System Monitoring Radar Comparison

Time Period

24 hr beginning 0Z

On Date

Month: 10

Day: 18

Year: 2004

-1 dy +1 dy

Options

Region: CONUS

- tile + tile

Select/Refresh

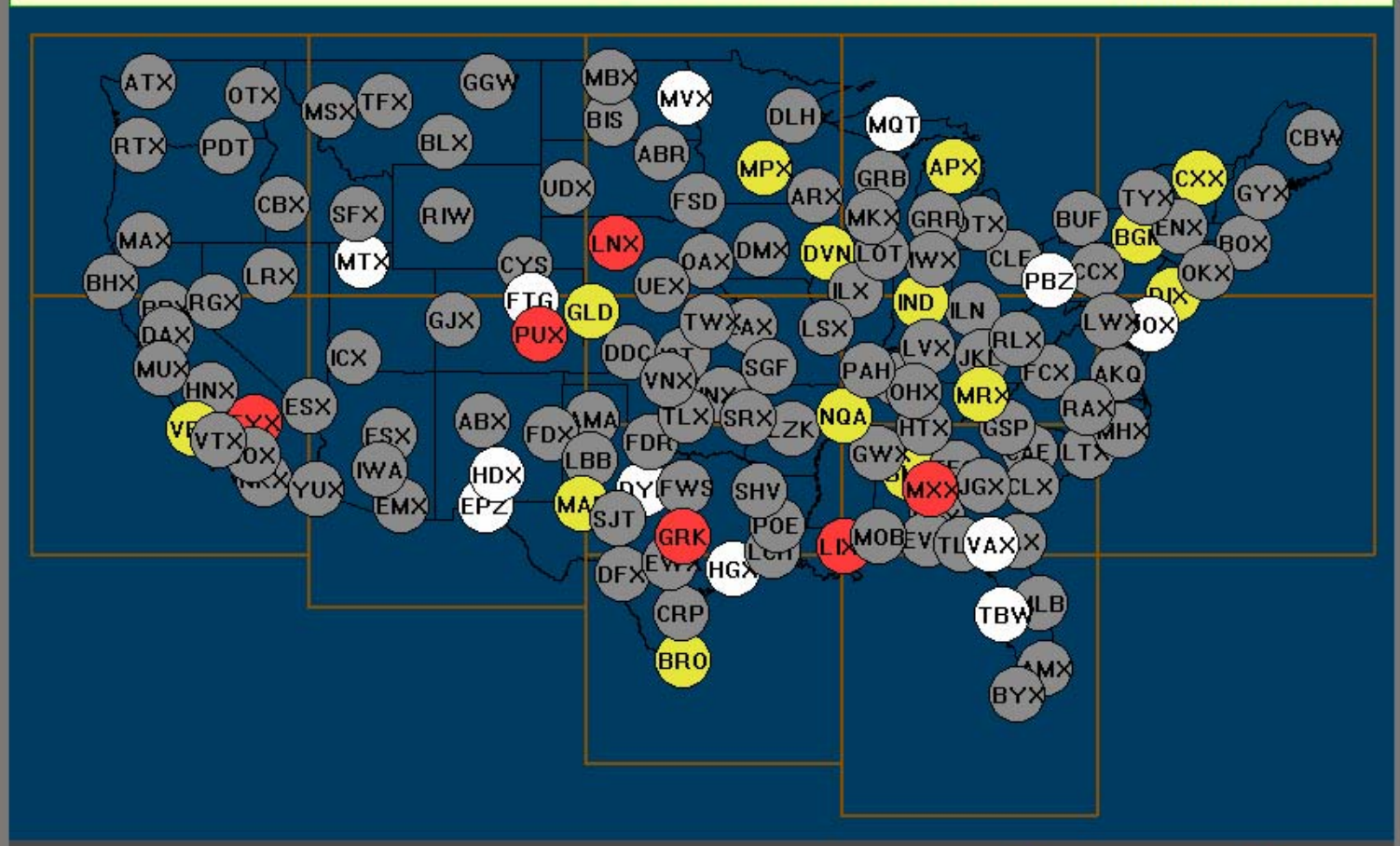
Mosaic File Generation Monitoring

Polar File/Radar Ingest Monitoring

National Radar Status

10/18/2004 00Z - 10/19/2004 00Z
Image Generated: 10/18/2004 21:34Z

Lat: 19N - 51N
Long: 129W - 64W



Longest Data Gap : < 20 min SHV 20 min - 1 hr BUF 1 hr - 6 hr GRK > 6hr VAX

NMQ Verification

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NMQ Verification Page

Meteorological Data System Monitoring Radar Comparison

Time Period

- 1 month ending 1st/12Z
- 24 hr ending 12Z
- 1 hr ending: 12 Z

On Date

Month: 10

Day: 18

Year: 2004

-1 dy +1 dy

Options

Units: English

Select/Refresh

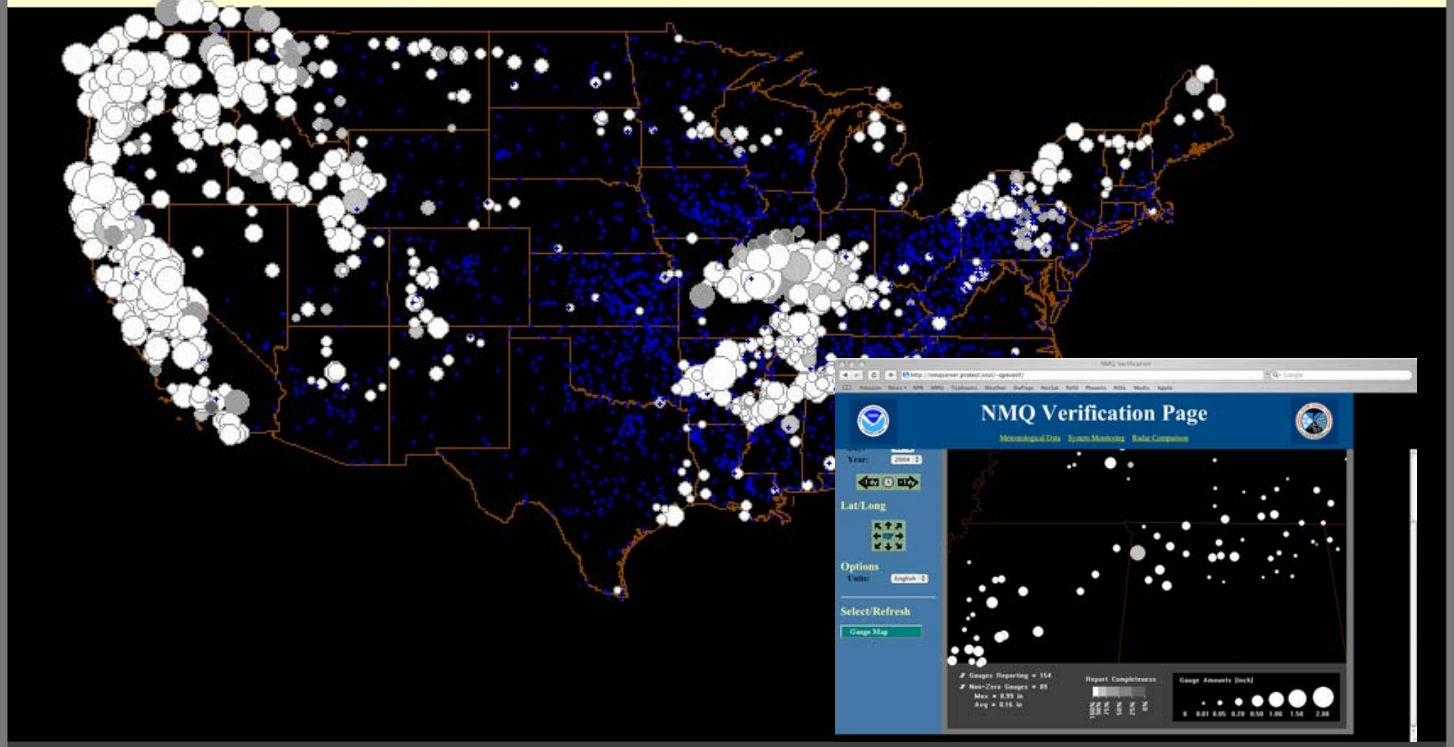
Gauge Map

Daily NCEP Gauges

10/17/2004 12Z - 10/18/2004 12Z

Lat: 50.00N - 20.00N

Long: 128.00W - 56.28W



Gauges Reporting = 2831

Non-Zero Gauges = 828

Max = 3.35 in

Avg = 0.27 in

Report Completeness

100% 90% 75% 50% 25% 0%

Gauge Amounts (inch)

0 0.01 0.05 0.20 0.50 1.00 1.50 2.00

Next Generation QPE ‘Q2’

- An optimum blend of multisensor techniques using existing applications and developments (PPS, MPE, QPESUMS, HydroEst, etc) for high resolution QPE (250 meter and >5 minute)
- Depart from radar centric precipitation typing to a true multi sensor approach focused on 2-D, 3-D mosaic grids of radar, satellite, model and surface observations
- Improve logic for QC and precipitation identification and typing
- Implementation of robust gap filling and VPR adjustments
- Robust synchronization of satellite imagery with radar for physically representative regressions
- Identification and precipitation rate adjustments for Orographic forced processes
- Optimization and mitigation of gage biasing latency through parallel QPE processing.

Q2 Timetable

- Initial version of Q2 CONUS by June 2005
- NSSL/OHD Q2 workshop June 20, 2005
- Phase out of NMQ QPESUMS by December 2006
- Q2 v 2.0 full implementation January 2006
- Q2 short term QPF CONUS June 2006
- NMQ resolution 250x 250 meter CONUS Fall of 2007

NMQ and HMT

- NMQ serves as national baseline for (in real time and retrospective analysis) performance assessment of QPE and QPF applications across all time and time and space scales
- NMQ system serve for testing HMT derived techniques and applications on both a HMT and national scale
  - ability to quantitatively evaluate the impact of gap filling radars on stream flow forecasts.
- NMQ system serve as archival system for HMT data collection and dissemination
- Community verification

In Closing

- The NMQ project addresses high-resolution multisensor quantitative precipitation estimation (QPE) for all seasons, regions and terrains in support of hydrometeorological and hydrologic data assimilation and distributed hydrologic modeling.
- The NMQ system is being developed as a community system for R&D and RTO of QPE, short-range QPF and severe weather science and applications. It consists of the Research and Development Subsystem (RDS) and the Product Generation Subsystem (PGS).
- To enable joint development, testing and evaluation in an open and flexible environment, the Joint Applications Development Environment (JADE) is being developed. The JADE configuration on the NMQ system is expected to become functional in the fall of 2005.
- The many issues and complexities of quantitative estimation and short-range prediction of precipitation require a community-based approach and effort. Toward building an open and flexible community testbed for QPE and other hydrometeorological applications, we invite comments, suggestions, input, and participation of the community.

Thank you!

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Video decompressor
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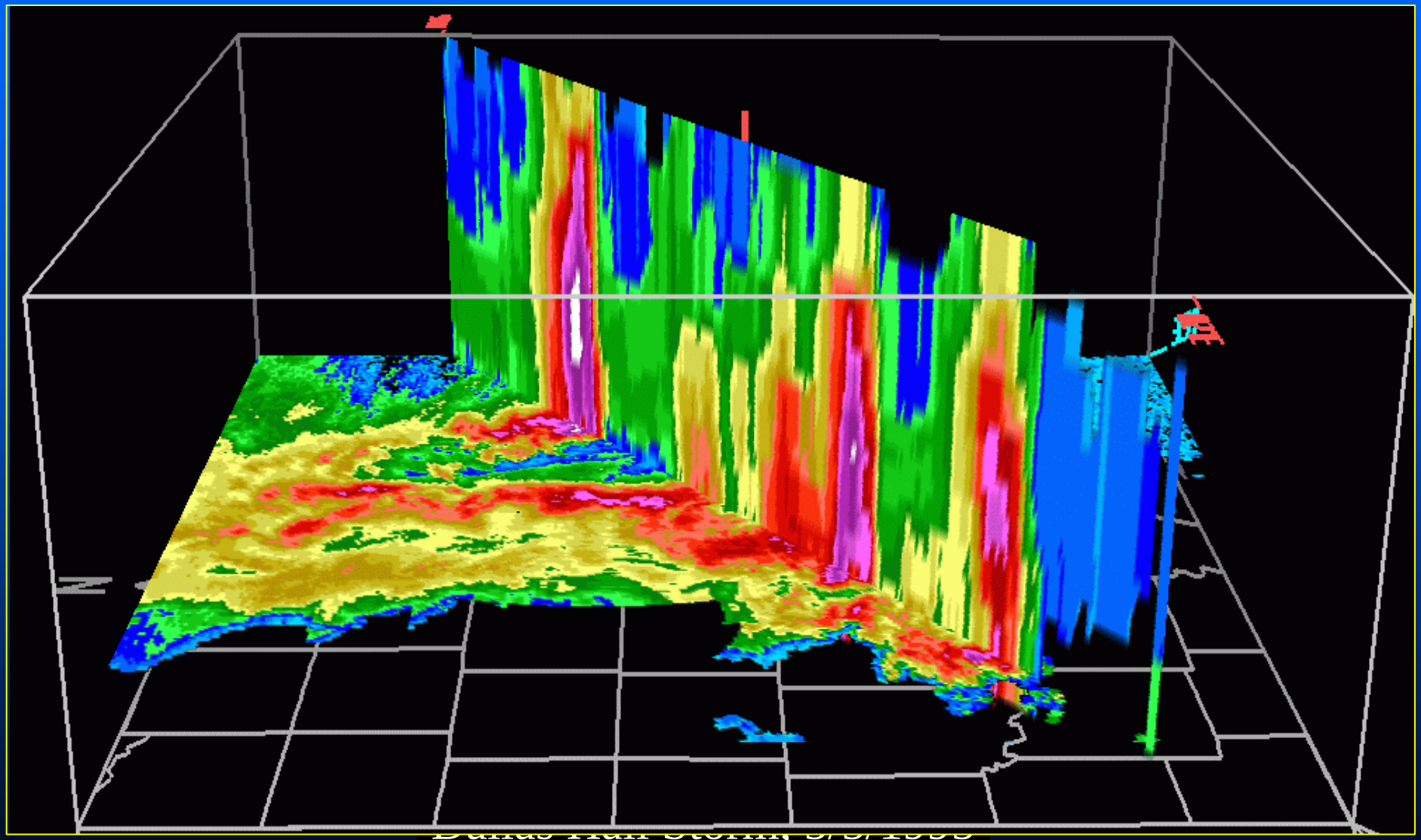
Cross Sections from 3-D Mosaic