Evaluation of Quantitative Precipitation Estimation in Complex Terrain

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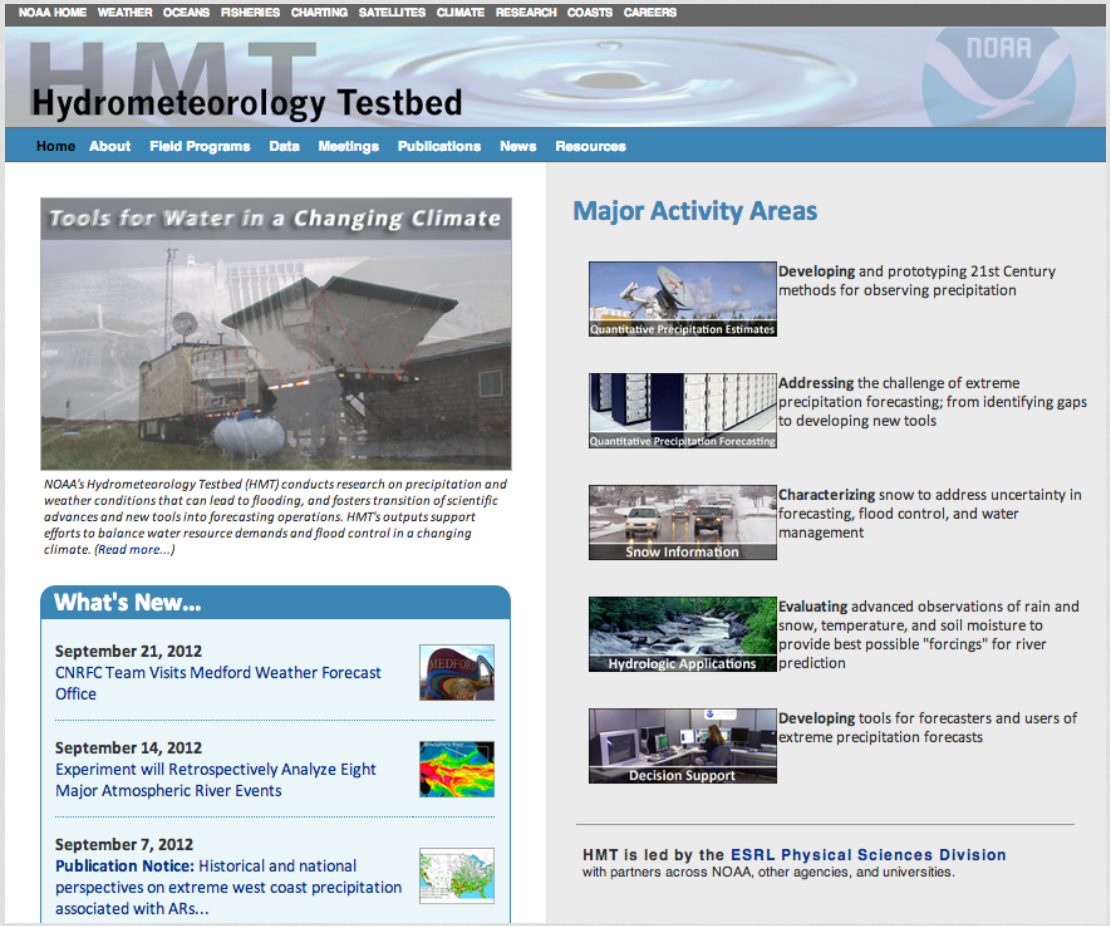
OVERVIEW

- Background and Motivation
  - QPE as a major activity of HMT
  - Difficulty of QPE in mountainous areas
- Methodology
  - Retrospective case study analyses
  - MPE and MRMS precipitation mapping systems
- Results
  - MRMS and MPE
    - Radar vs gauge results
- Next Steps
  - Input into hydrologic models

HYDROMETEOROLOGY TESTBED (HMT)



- HMT conducts research on precipitation and weather conditions that can lead to flooding, and fosters transition of scientific advances and new tools into forecasting operations
- 5 major activity areas
  - **QPE**
  - QPF
  - Snow Information
  - HASP
  - DST
- hmt.noaa.gov

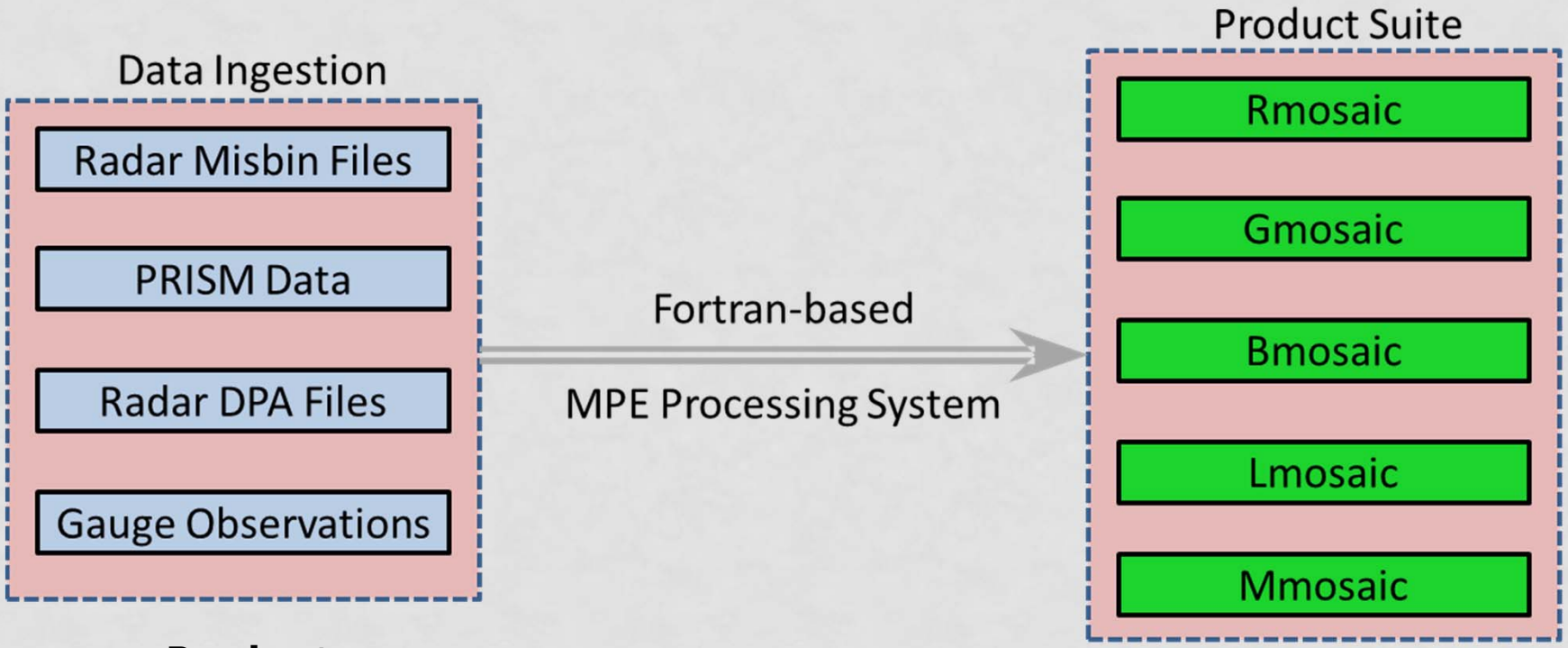
MOTIVATION

- QPE is used for a variety of applications ranging from flash flood monitoring to weather forecast model verification
- Determining the “best” QPE in any give region at any given time is complicated by precipitation processes, terrain influences, gauge/radar network density
- Russian and Napa Rivers are prone to flash flooding
- NEXRAD coverage and gauge observations in this region are lacking
- What is the value of using commercial radar to improve QPE in this region?

METHODOLOGY (1)

- Multi-sensor Precipitation Estimator (MPE)
  - Developed by National Weather Service (NWS) and used by many NWS River Forecast Centers
  - Interactive algorithm producing 1hour rainfall accumulation ending at top of the hour
    - Gridded, ~ 4.2 km resolution
  - Can use rain gauges to reduce existing biases in NEXRAD rainfall estimates and produce a suite of radar-gauge rainfall products
    - Radar-only, gauge-only, merged radar-gauge
  - Has the ability to produce regional mosaics from any desired number of NEXRAD sites, or other radar sites (KPIX commercial TV radar)
  - Can serve as input to various hydrologic models

MPE ARCHITECTURE



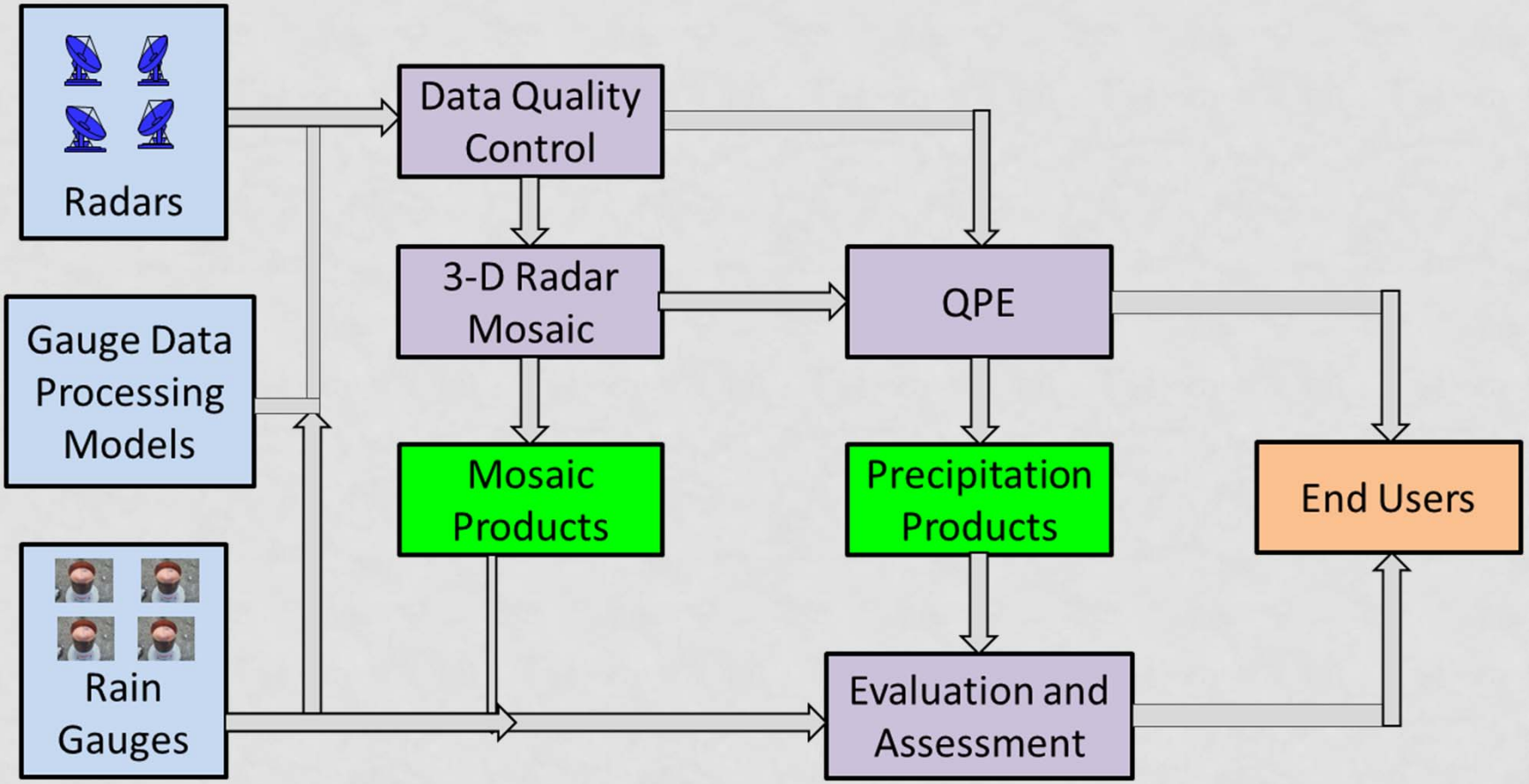
Products

- **Rmosaic**: radar-only rainfall mosaic
- **Gmosaic**: gauge-only rainfall mosaic
- Bmosaic: mean field bias adjusted radar mosaic using gauges
- Lmosaic: local bias adjusted radar mosaic using gauges
- **Mmosaic:** Multi-sensor merged rainfall mosaic

METHODOLOGY (2)

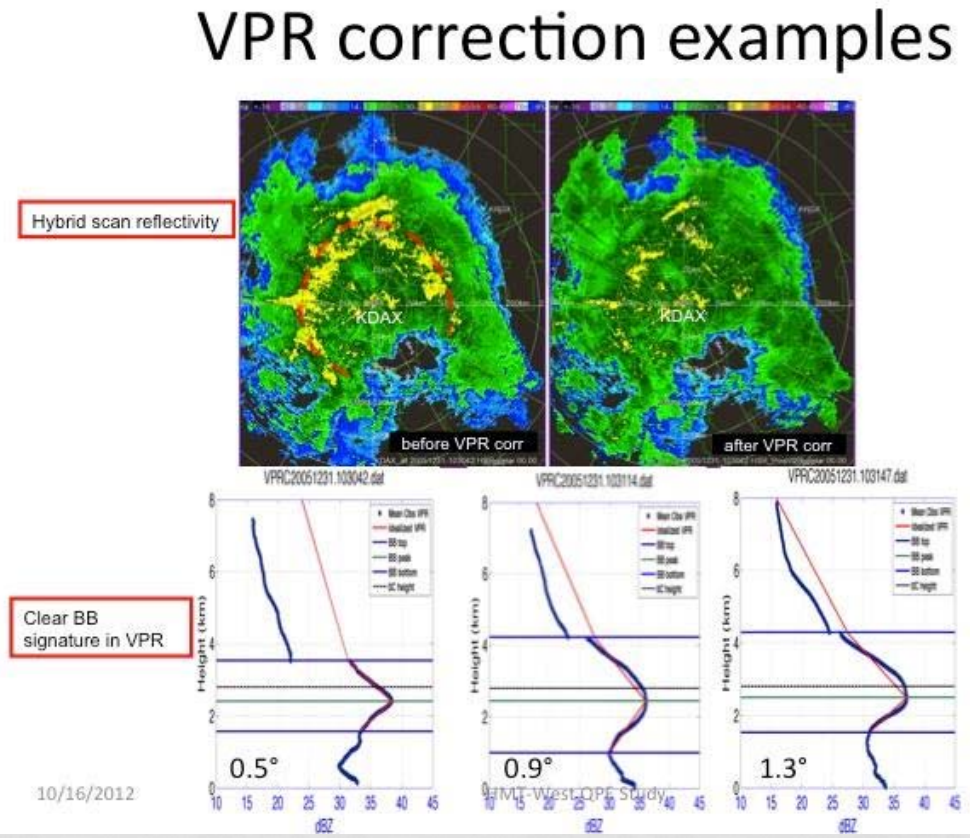
- Multi-radar Multi-sensor Precipitation System(MRMS)
  - Developed by the National Severe Storms Laboratory (NSSL) and also used by NWS
  - Automated system producing gridded, precipitation accumulation ranging from 5-minute to 72-hours
    - 1 km grid resolution
  - Ability to ingest data from different radars, rain gauges, satellites, and atmospheric models
  - “Smarter” radar mosaicing and correction for precipitation processes
  - Produces similar product suite to MPE
    - Radar-only, gauge-only, bias adjusted radar
  - Real-time verification system (nmq.ou.edu)
  - Similar to MPE, can serve as forcing for hydrologic model

MRMS ARCHITECTURE



MRMS precipitation and mosaic products include the gauge-only based rainfall estimates and mosaiced rainfall estimates.

MELTING LAYER IMPACTS



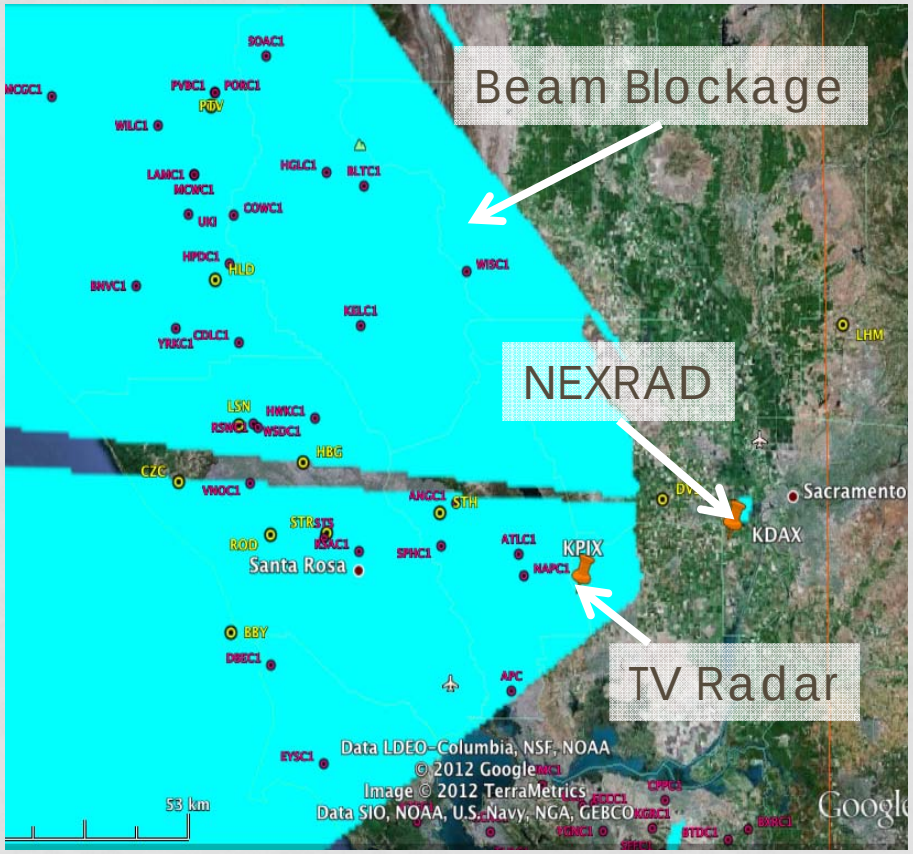
- VPR correction available in MRMS
- VPR correction not available in MPE

METHODOLOGY (CONTINUED)

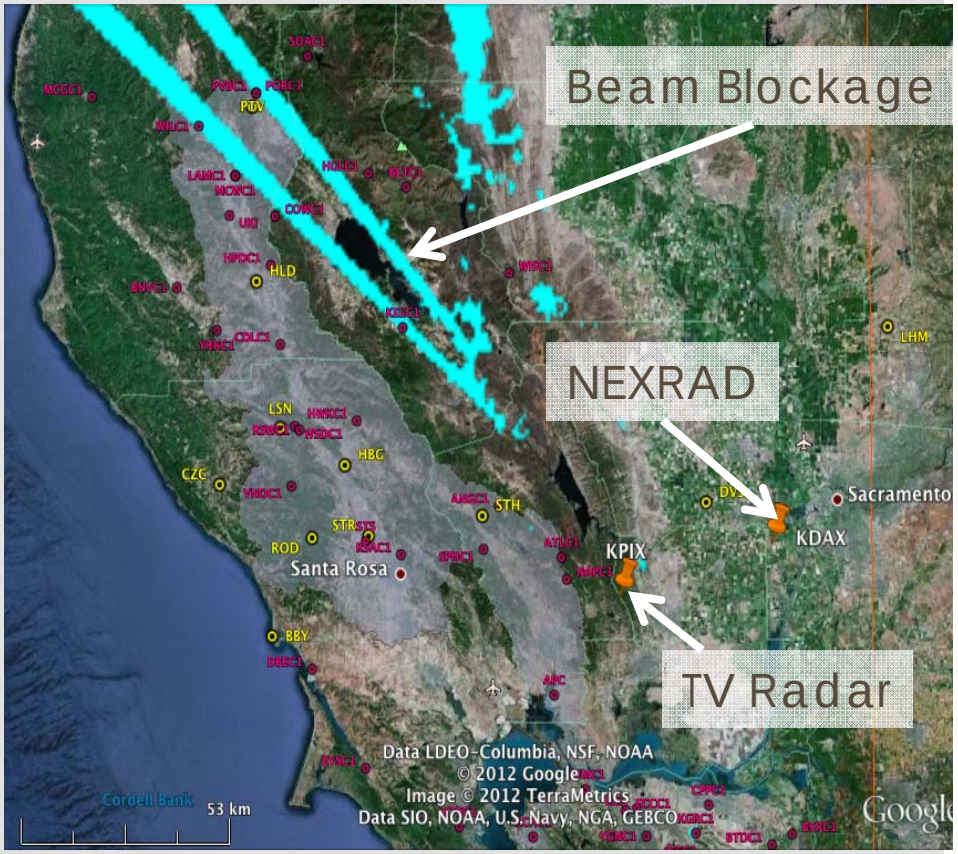
- The retrospective version of MPE and MRMS were installed at the NOAA Earth System Research Laboratory. They are slightly modified for the analysis in the Russian River Basin.
- A common gauge list is used for both MPE and NMQ for better comparison.
- An event from March 2012 is used to illustrate the methodology

RADAR COVERAGE IN SONOMA-NAPA COUNTY REGION

NEXRAD (KDAX) 0.9° Beam Blockage



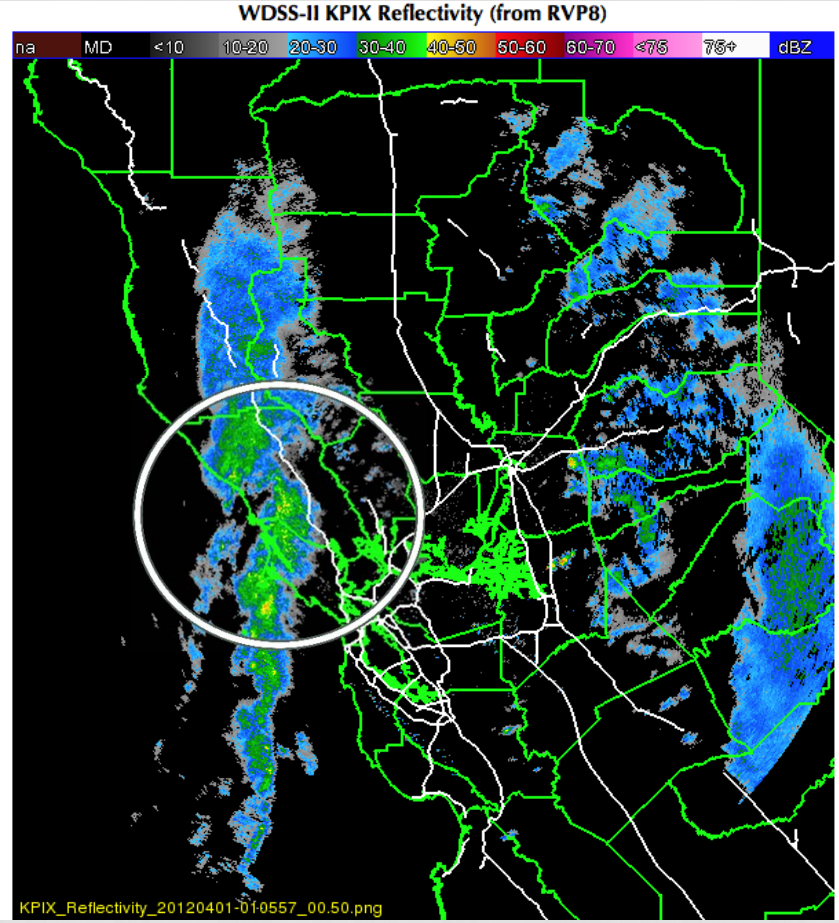
TV Radar (KPIX) 0.0° Beam Blockage



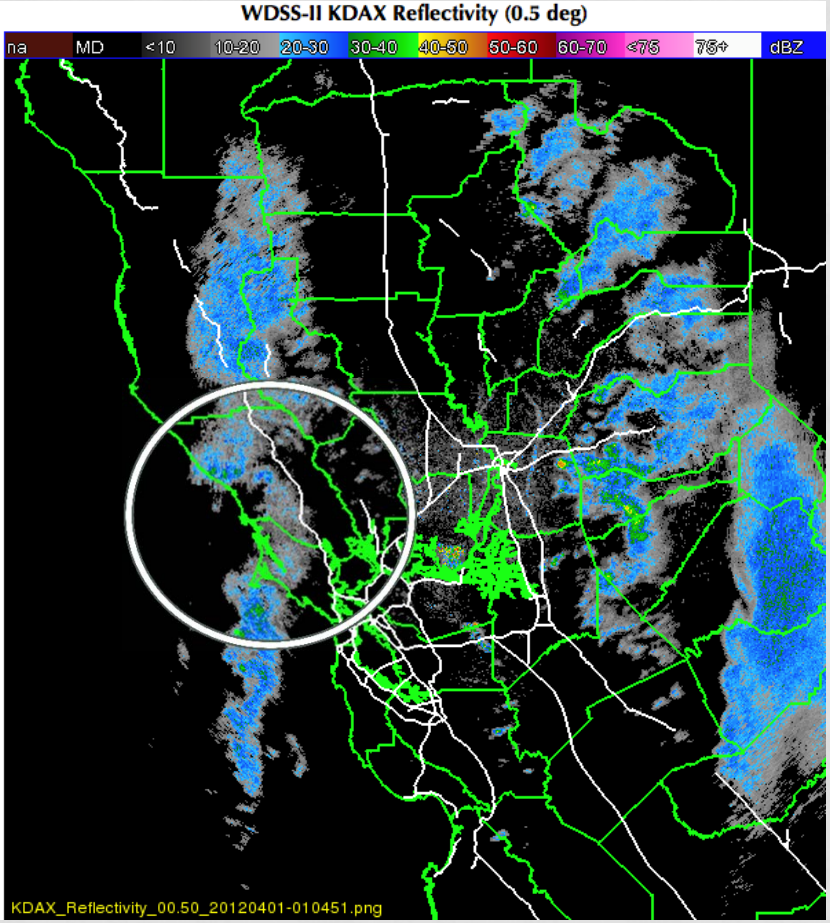
- Red – gauges used in NMQ/MPE analysis
- Yellow – independent gauges

COMPARISON OF KPIX AND KDAX

KPIX Radar Reflectivity

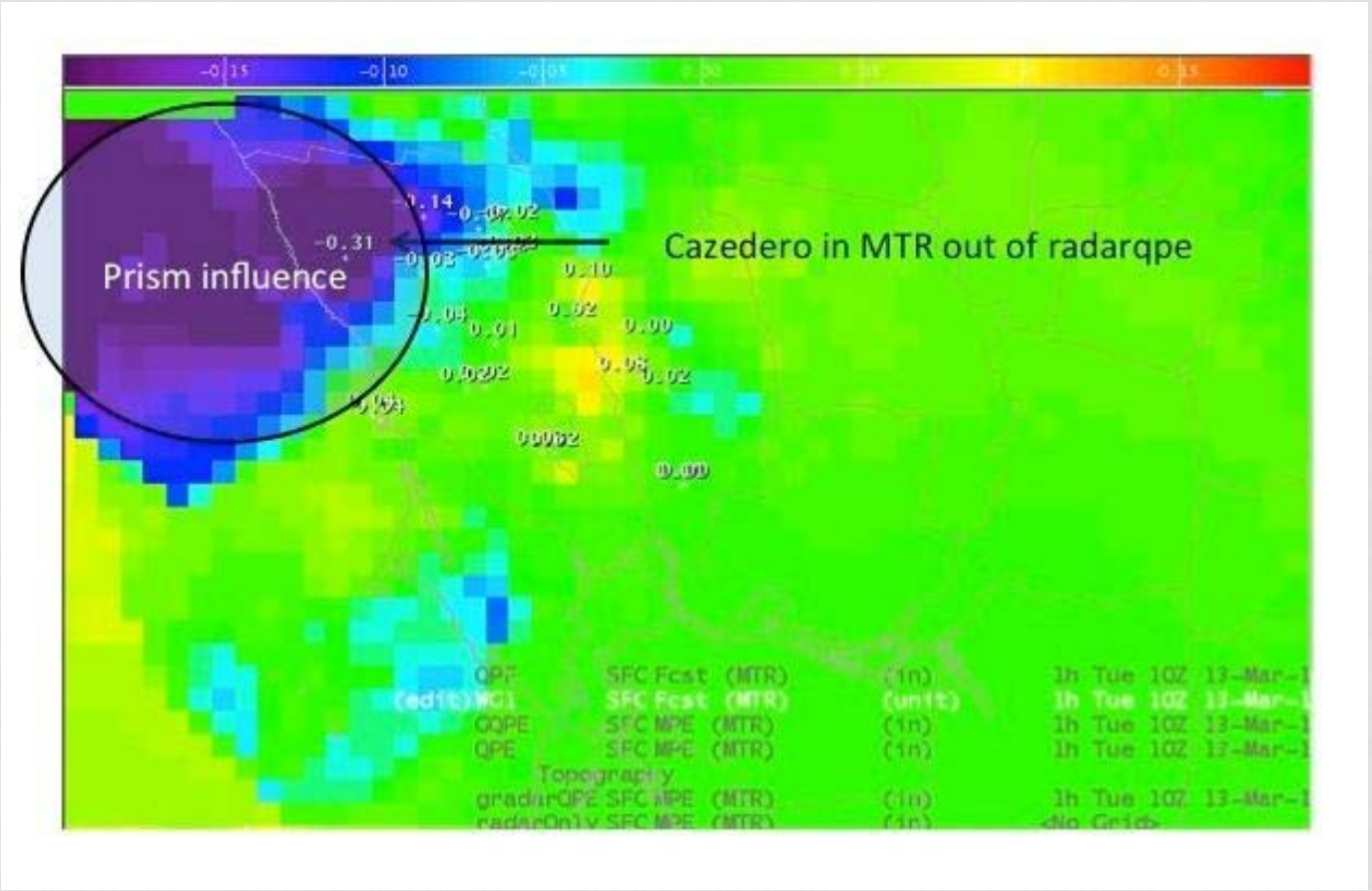


KDAX Radar Reflectivity



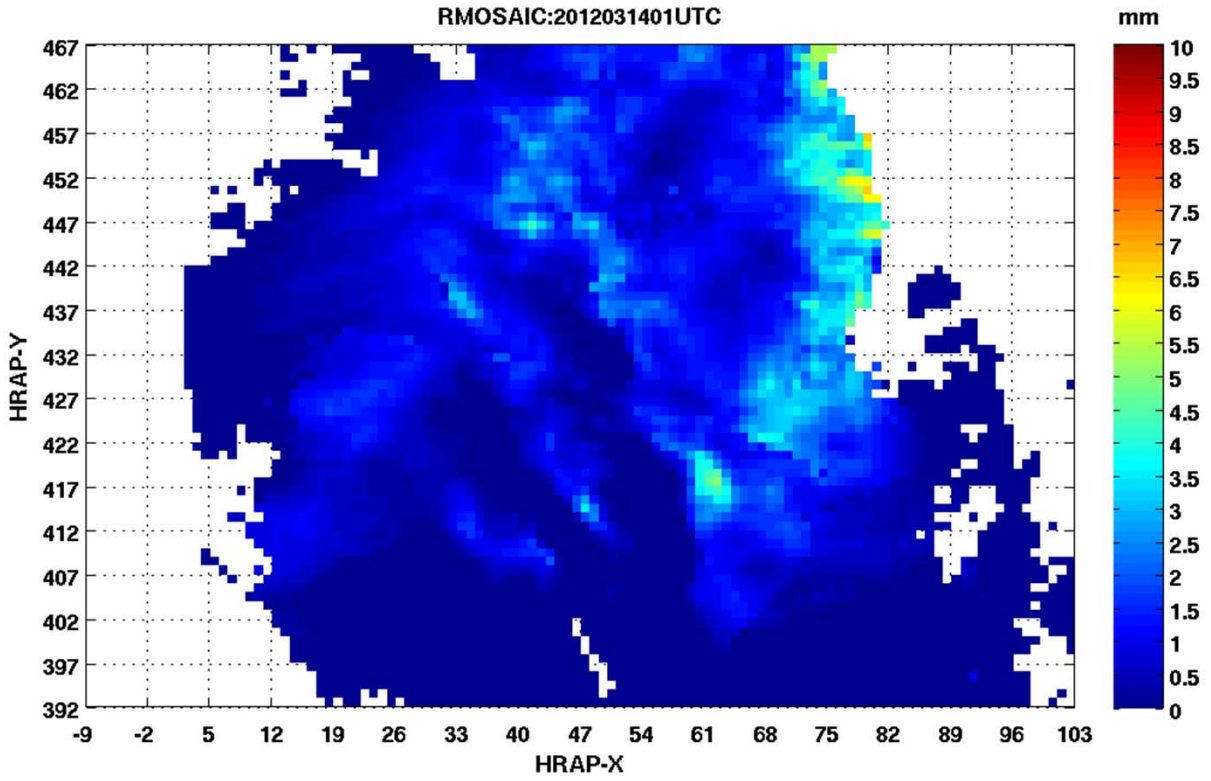
MPE COMPARISON WITH DIFFERENT GAUGE INPUT

Difference in Gauge-Only Hourly Precipitation Accumulation (in)

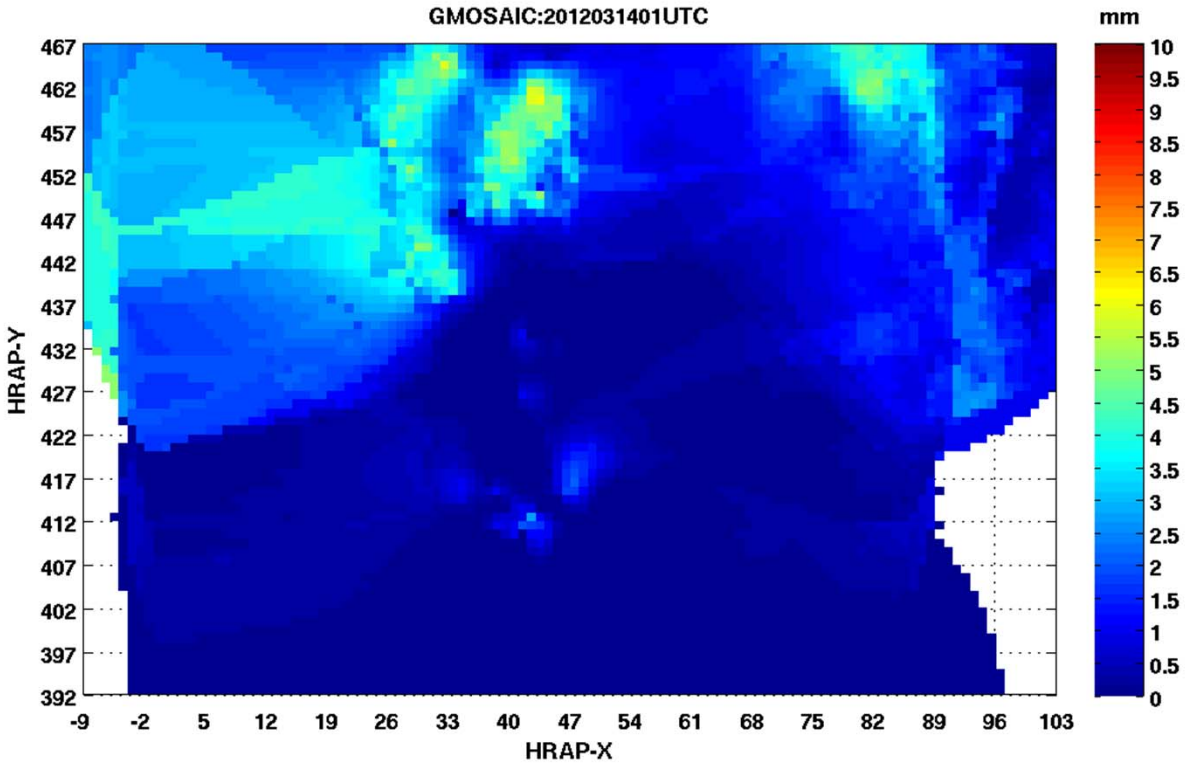


Analyses can be significantly impacted by gauge selection

RADAR MOSAIC RAINFALL MAPS FROM MPE SYSTEM FOR MARCH 14, 2012 CASE

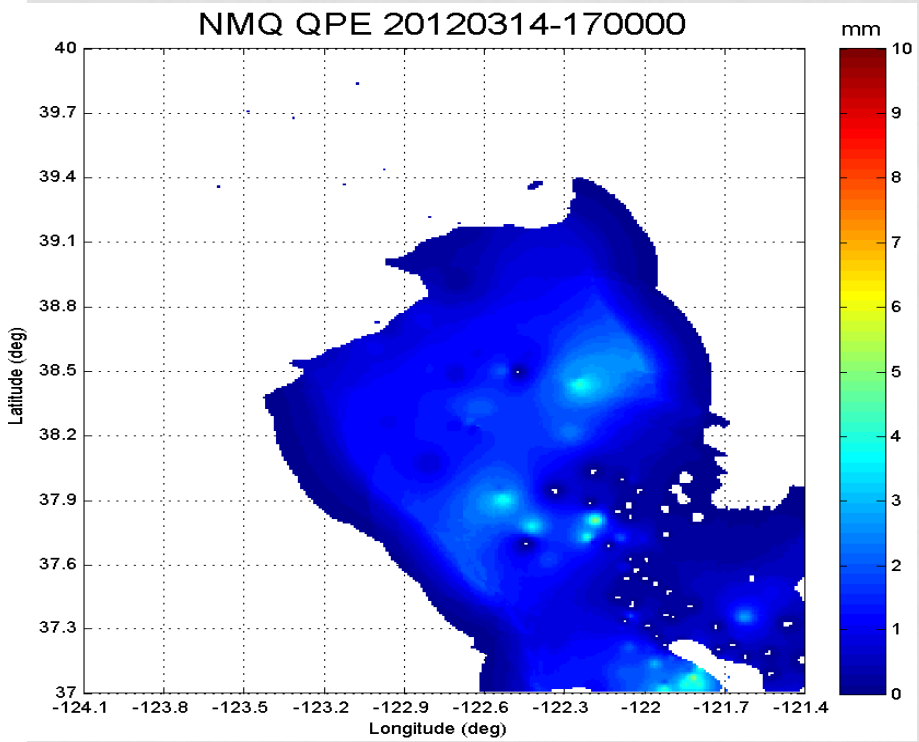


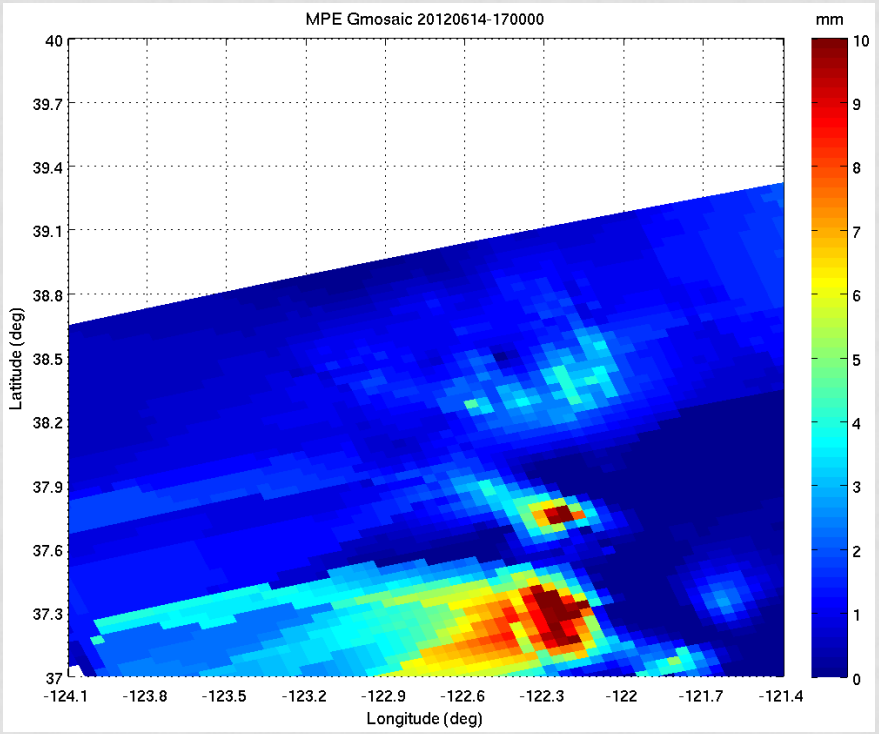
GAUGE MOSAIC RAINFALL MAPS FROM MPE SYSTEM FOR MARCH 14, 2012 CASE



- Bulls-eye pattern resulting from limited gauge density
- PRISM influence in higher terrain regions

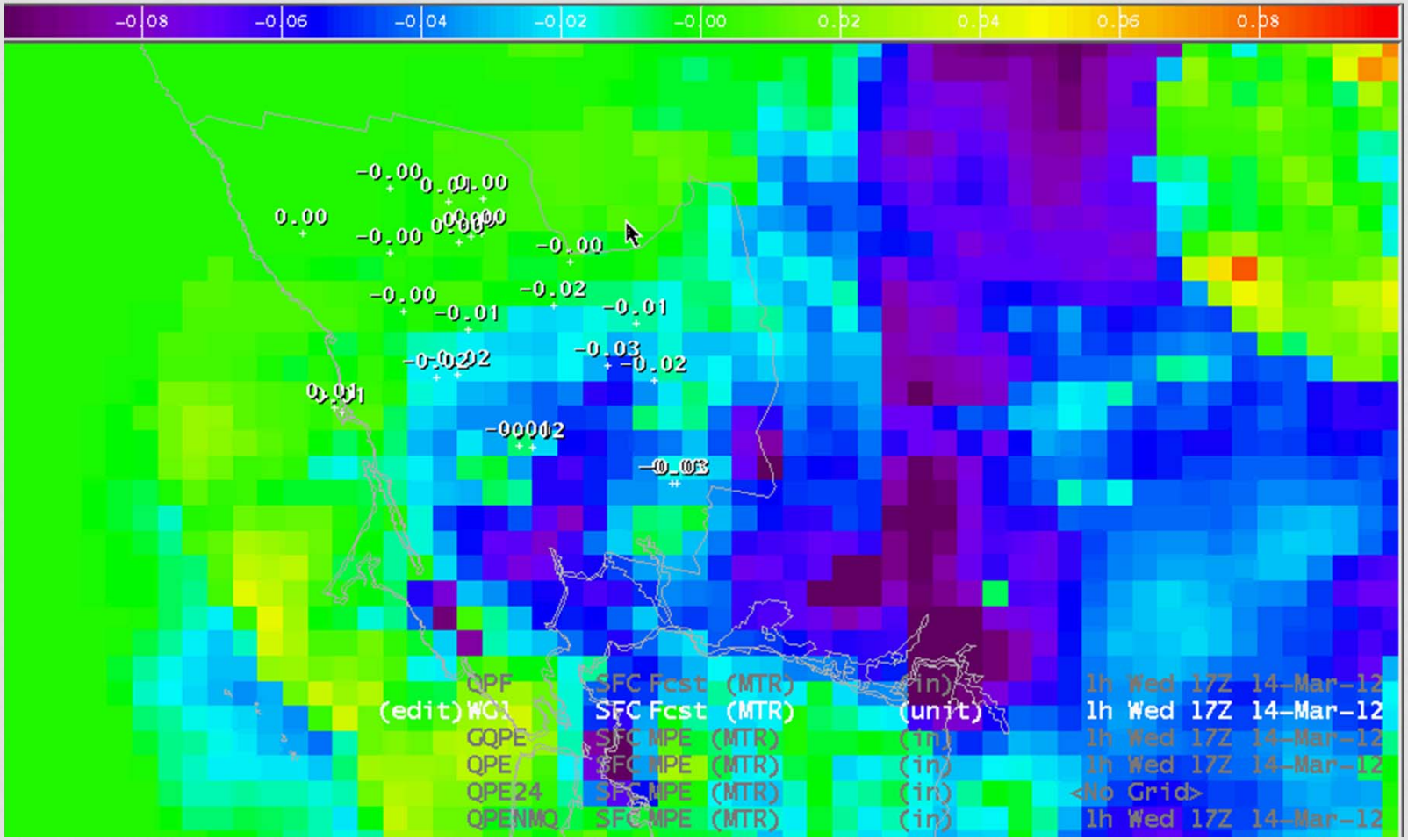
MRMS AND MPE GMOSAIC MARCH 14, 17Z, 2012





- MRMS uses inverse distance weighting
- MPE uses a combination of inverse distance weighting and PRISM

MPE MMOSAIC MINUS MRMS BIAS ADJUSTED RADAR QPE MARCH 14, 16-18Z, 2012



Differences due to VPR and Z-R selection

NEXT STEPS

- Use independent gauges to assess which QPE product performs best
  - MRMS or MPE
  - Radar-only, gauge-only, combined
  - Impact of KPIX on QPE
- Assess QPE performance using spatial verification techniques
- Assess QPE performance with hydrologic model