# Development of a high-resolution multisensor rainfall product for flash flood detection in radar sparse regions of the U.S.

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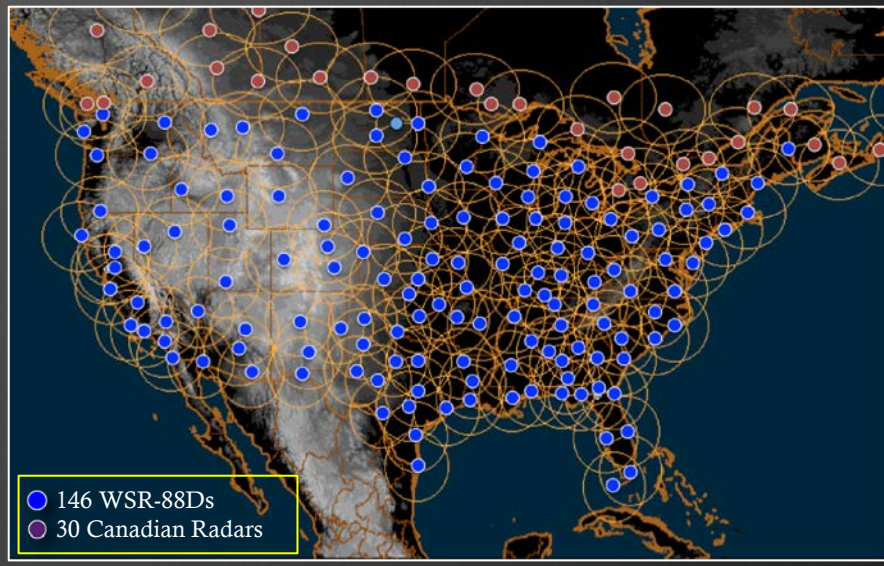
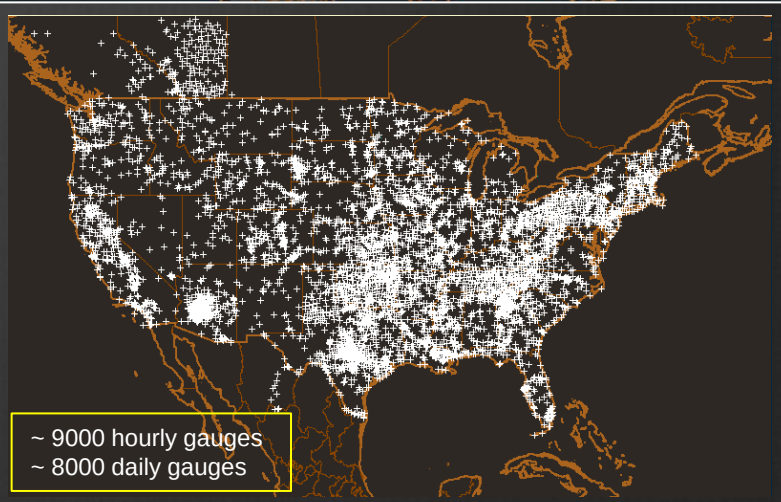
# The Multi-Radar/Multi-Sensor System (MRMS)

- Domain: 20-55°N, 130-60°W
- Resolution
  - 0.01°lat x 0.01°long
  - 2 min update cycle
- Data Sources
  - ~180 radars every 4-5min
  - ~9000 gauges every hour
  - RAP model hourly 3D analyses
  - Satellite and lightning: optional
- QPE Products
  - Instantaneous Precip Type/Rate
  - Radar QPE (1 hr – 10-day accums)
  - Gauge QPE
  - Local gauge-adjusted radar QPE
  - Gauge + orographic pcp climatology QPE
- Operational at NCEP: 10/2014



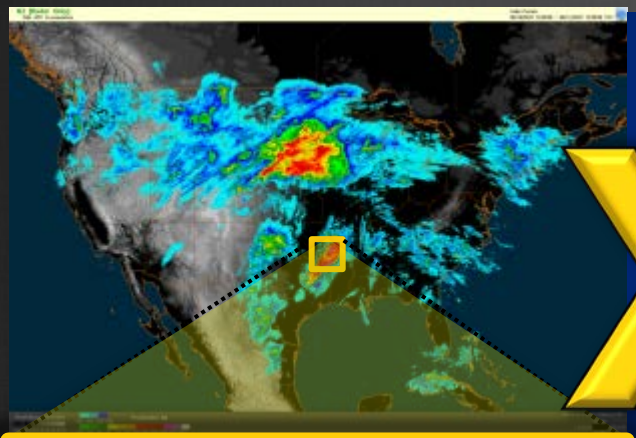
# Flooded Locations And Simulated Hydrographs (FLASH)

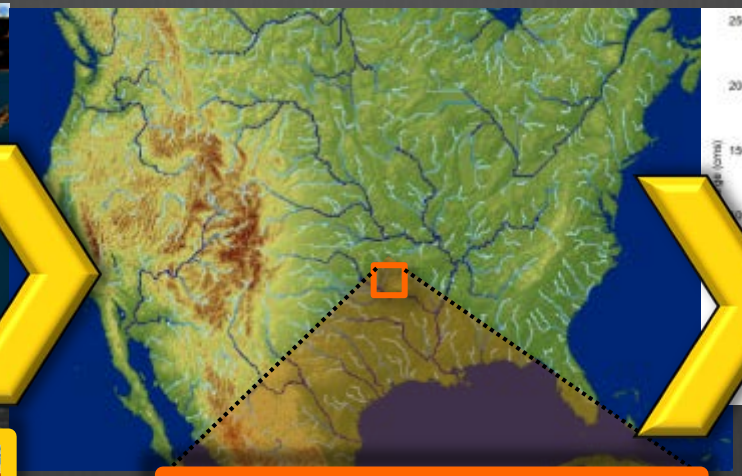
## A CONUS-wide flash-flood forecasting system – Operational at NCEP 10/2014

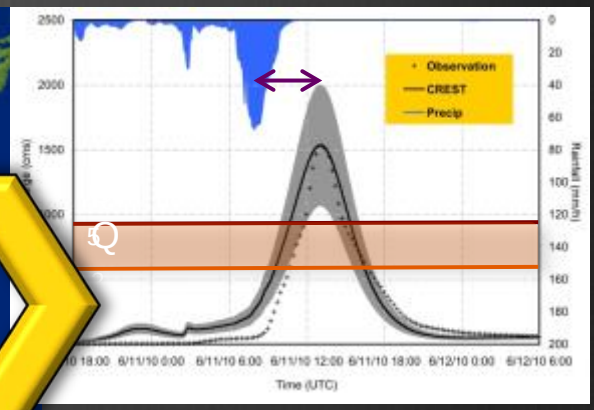
Stormscale Rainfall Observations (MRMS)

Stormscale Distributed Hydrologic Models

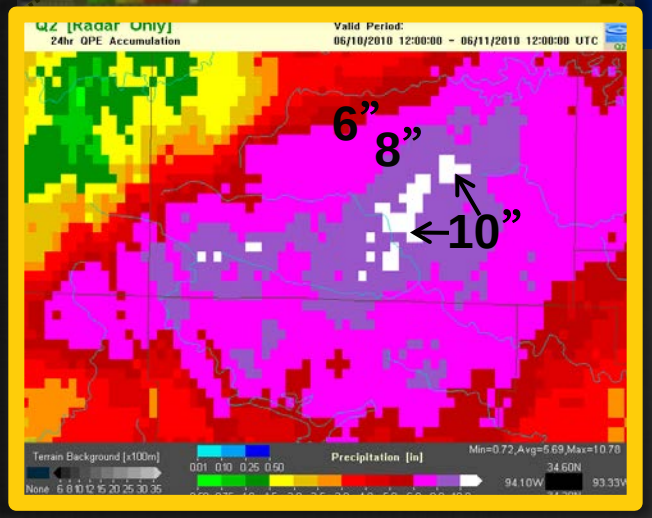
Probabilistic Forecast Return Periods and Estimated Impacts







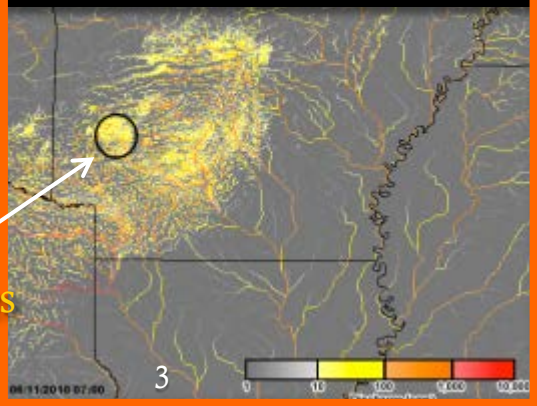

Hydrograph of Simulated and Observed Discharge

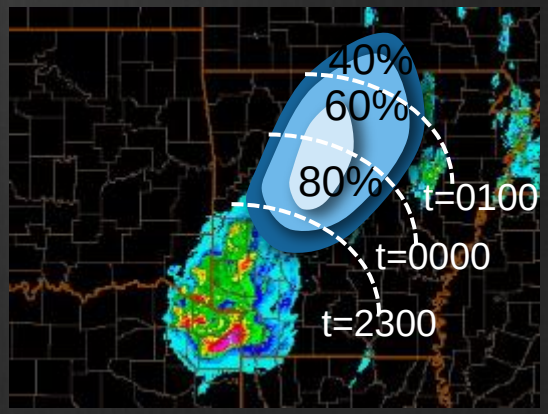



10-11 June 2010, Albert Pike Rec Area, Arkansas

20 fatalities

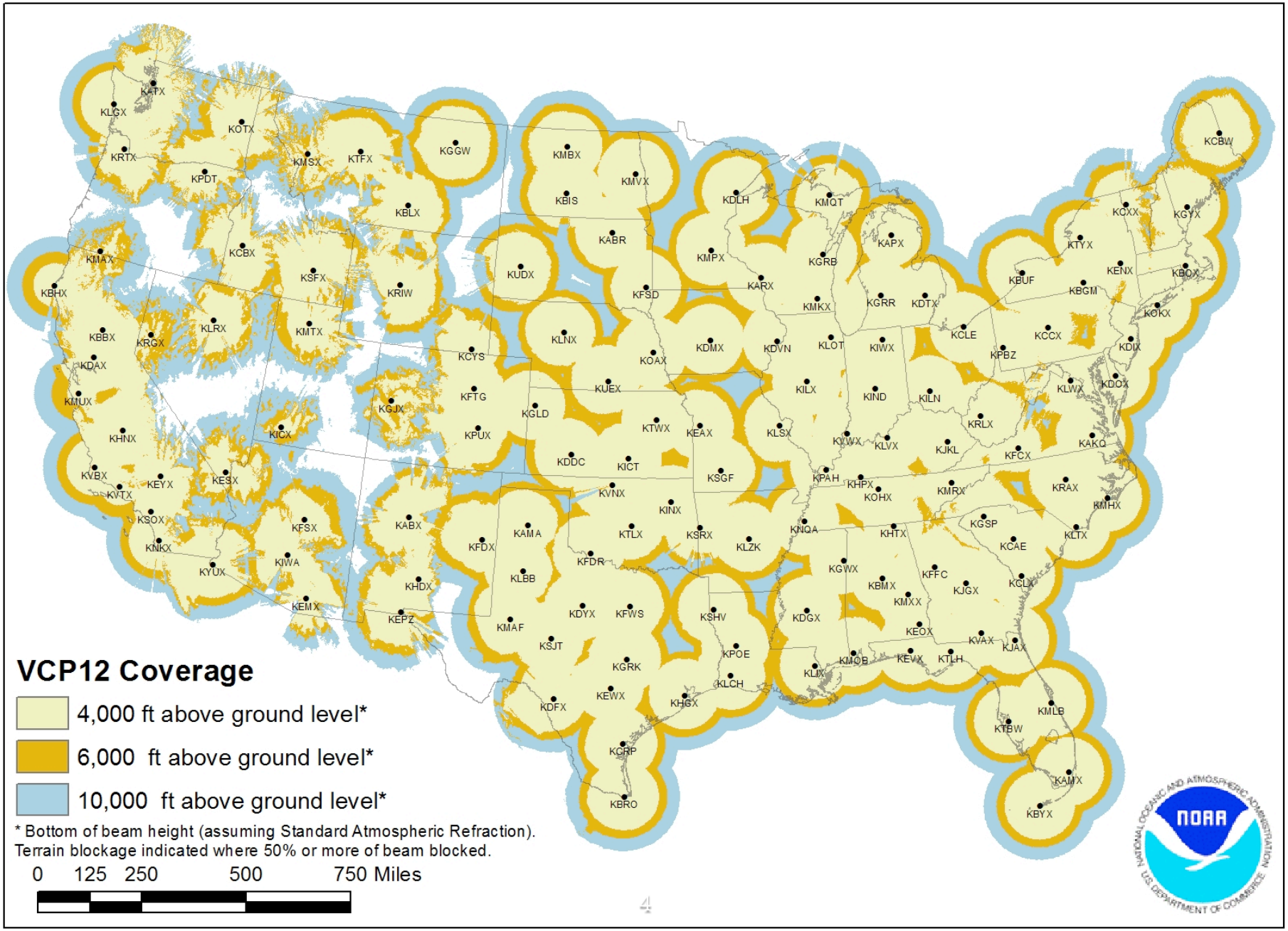
Simulated surface water flow






Probability of *life-threatening* flash flood

# NEXRAD Coverage Below 10,000 Feet AGL

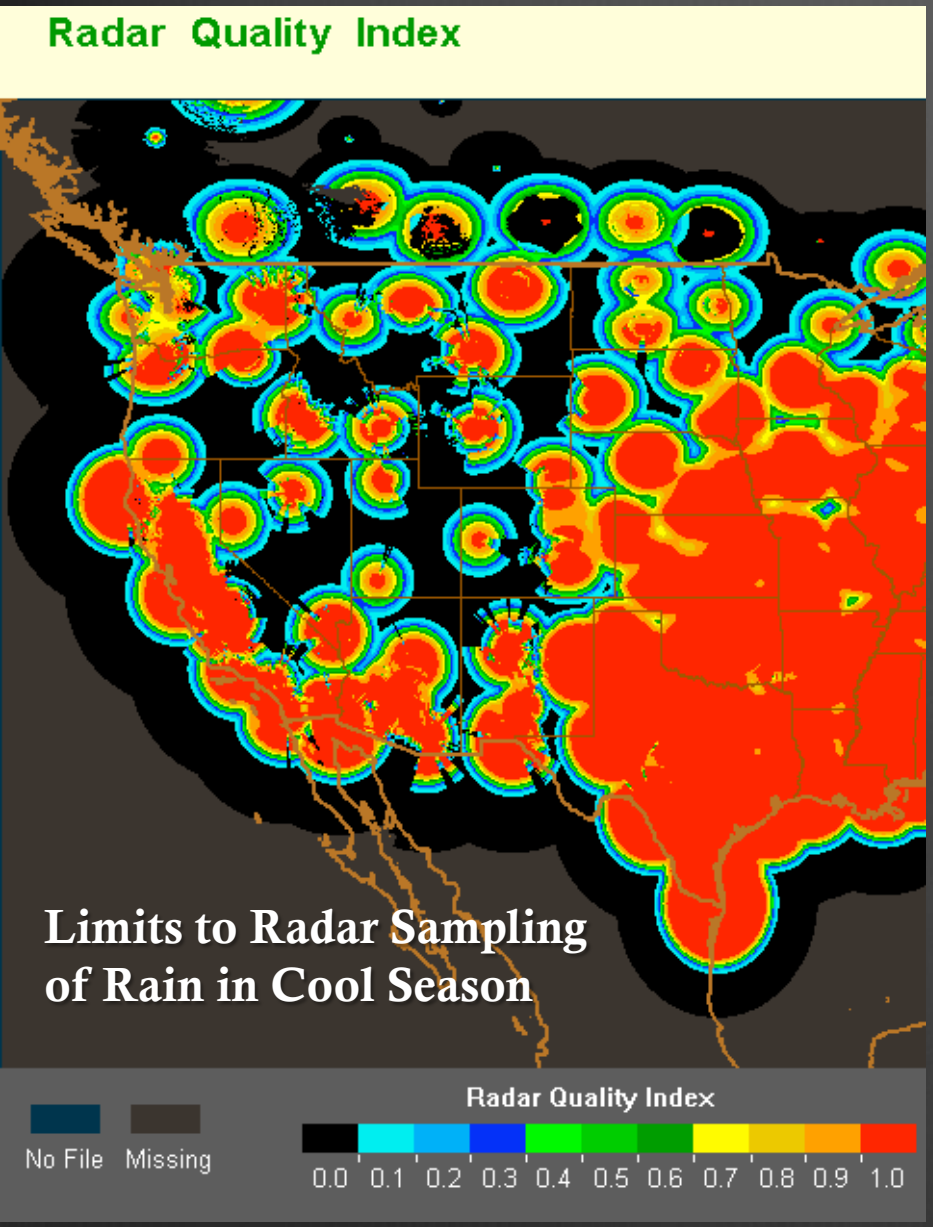


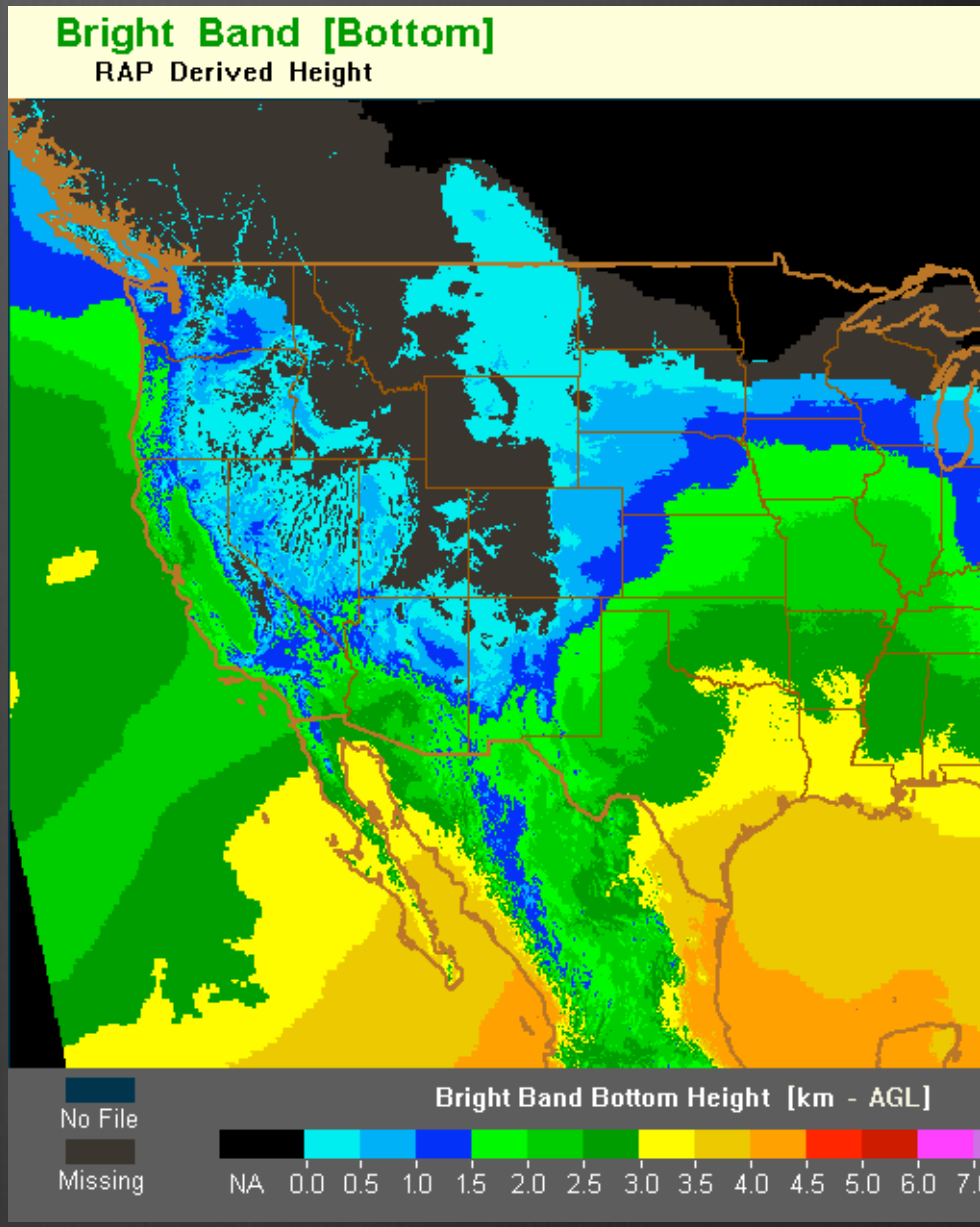

## VCP12 Coverage

- 4,000 ft above ground level*
- 6,000 ft above ground level*
- 10,000 ft above ground level*

* Bottom of beam height (assuming Standard Atmospheric Refraction).
Terrain blockage indicated where 50% or more of beam blocked.

0 125 250 500 750 Miles


Radar Quality Index
Limits to Radar Sampling of Rain in Cool Season
No File
Missing
Radar Quality Index
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0


Bright Band [Bottom]
RAP Derived Height
No File
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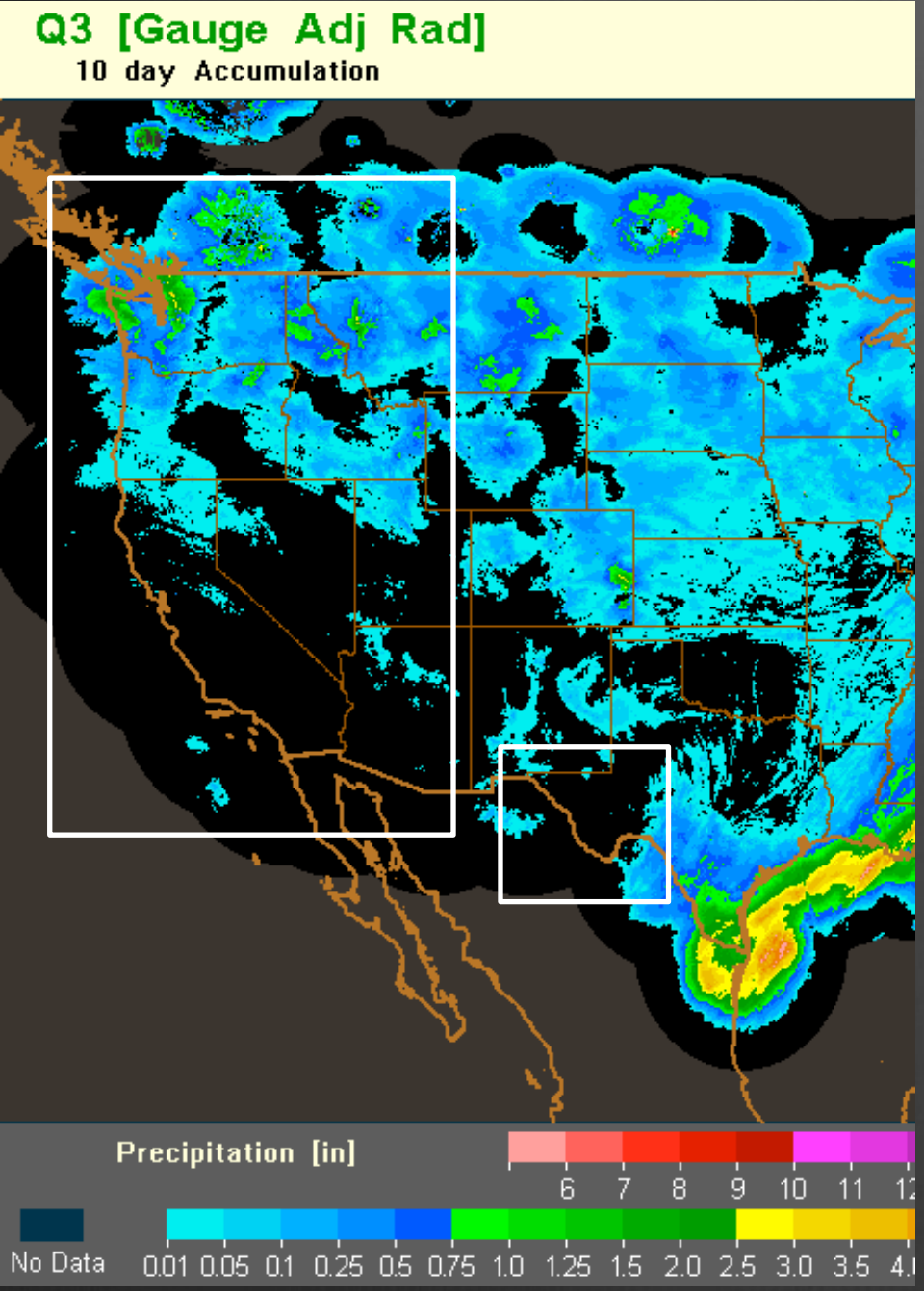
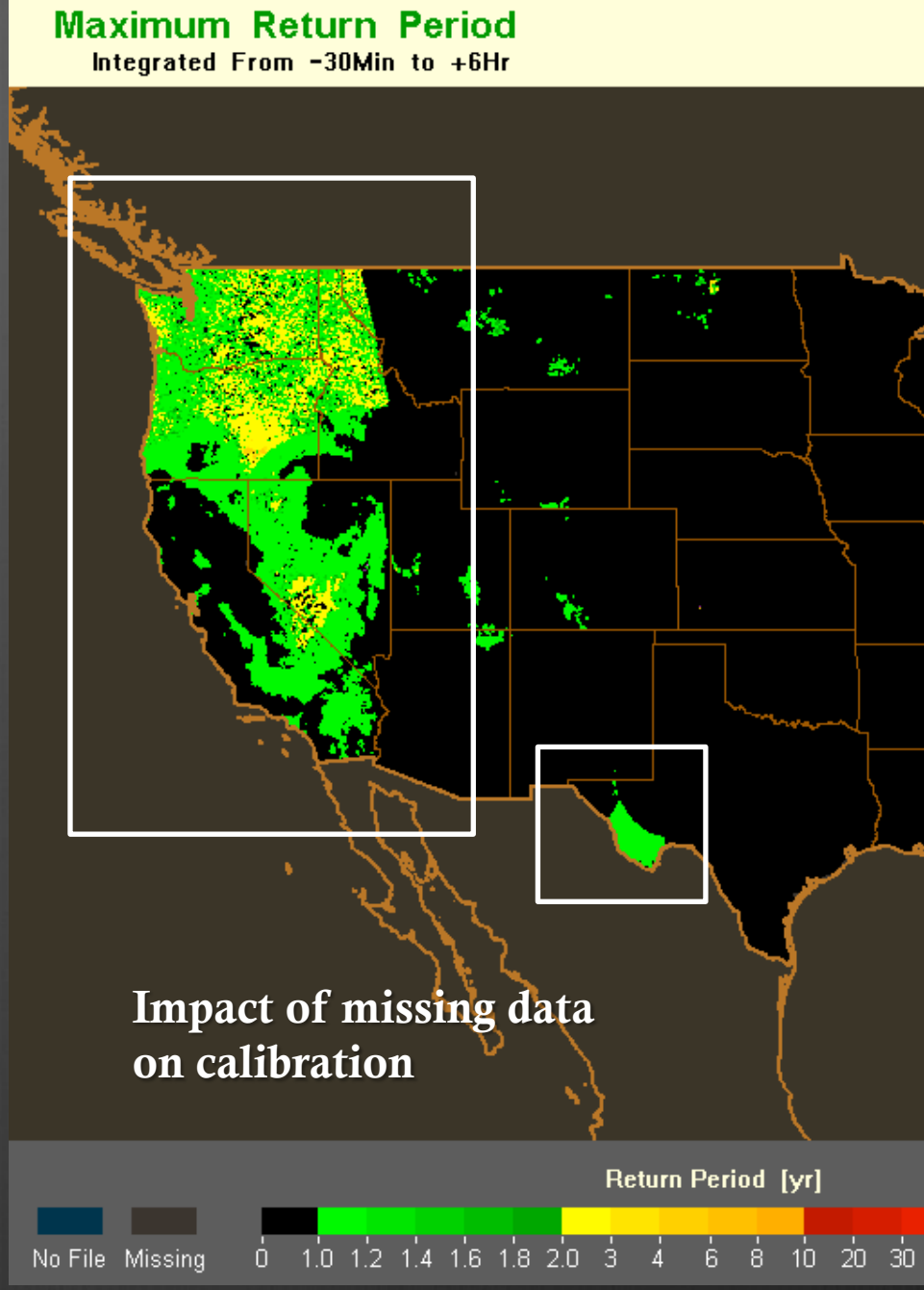
Bright Band Bottom Height [km - AGL]
NA 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 6.0




Impact of missing data on calibration

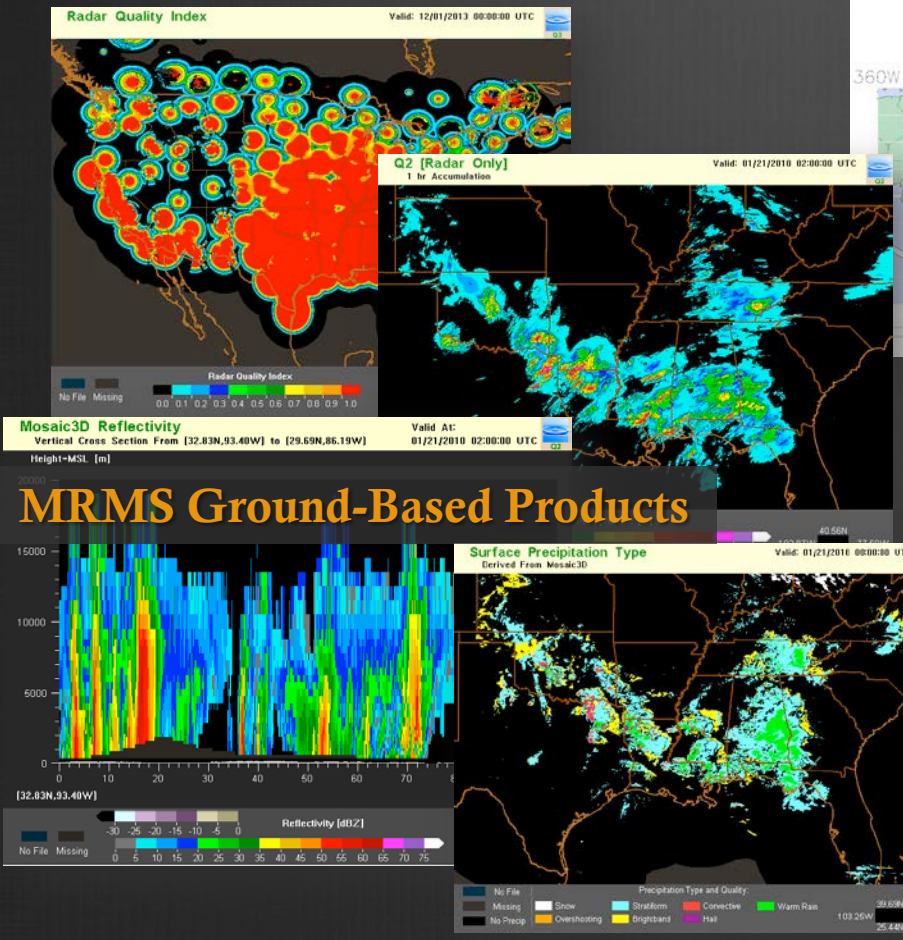
# Filling Gaps with Satellite QPE?

- Renewed Opportunity with GOES-R
  - Spatiotemporal resolution improvements for flash flood scale
    - 15 min → 5 min over CONUS
    - 4 km → 2 km for ABI-derived products

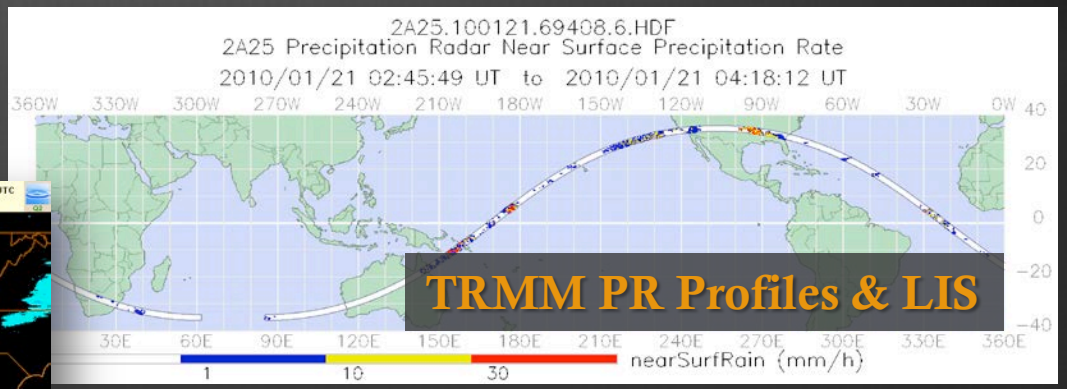
    } ~ MRMS scale
  - Geostationary Lightning Mapper
    - Convective/Stratiform Precip Type Segregation in data-sparse areas
  - Expanded list of cloud properties from ABI:
    - Cloud top height, temperature, phase, pressure; emissivity, effective radius, optical depth, etc.

# MRMS Calibrated GOES-R/TRMM Rainfall

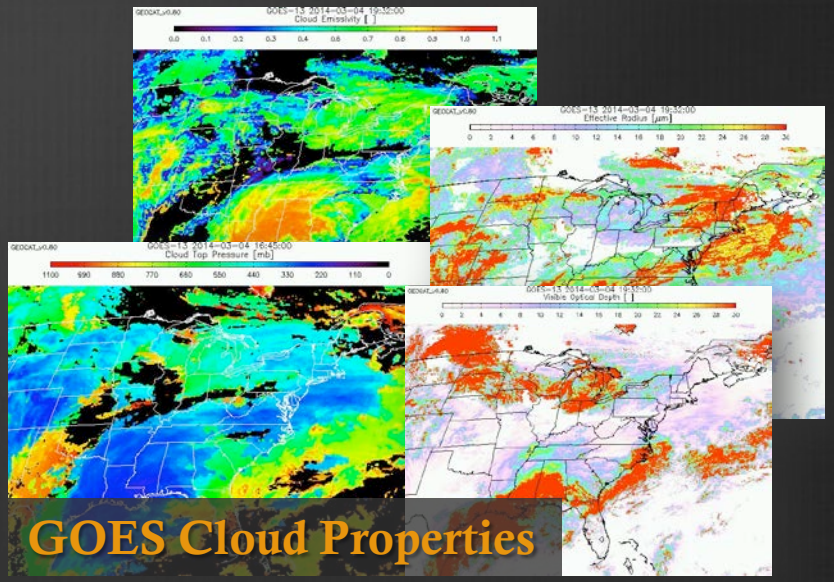
1. Build Training Database (2009 – Present)




MRMS Ground-Based Products



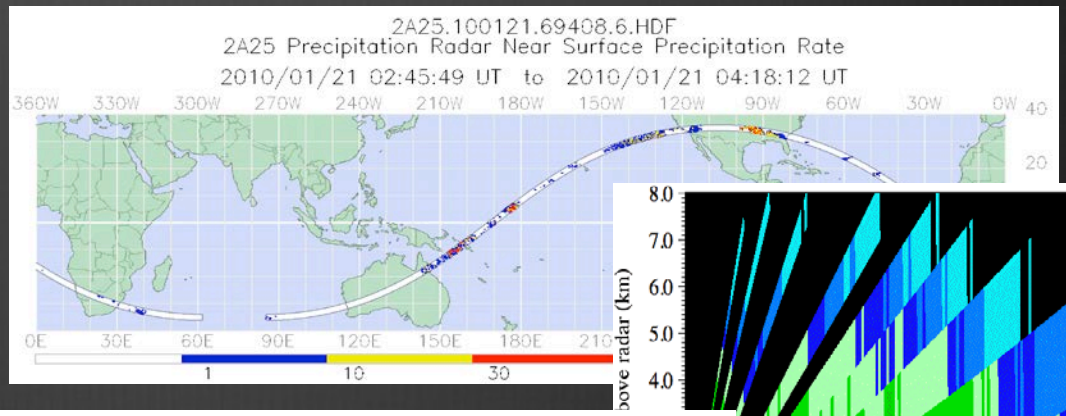

TRMM PR Profiles & LIS



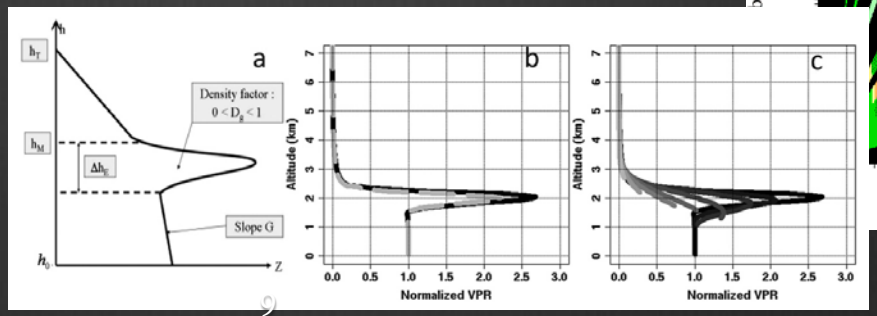

GOES Cloud Properties

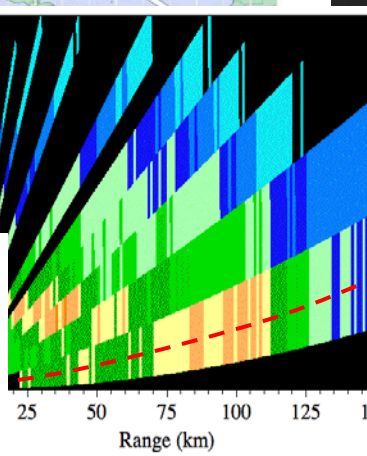
# MRMS Calibrated GOES-R/TRMM Rainfall

2. Preprocessing of Datasets
   a. Remap all inputs to GOES-R resolution (2 km/5 minutes)
   b. Derive S-band vertical profiles of reflectivity from Ku-band TRMM PR
   c. Filter by precip type and NEXRAD coverage quality




3. Develop Rainfall Model
   a. Two versions: TRMM and no-TRMM
   b. Joint-PDF matching approach



# Current Status and Future Plans

## Year 1: Current work (June 2014)

a. Build training archive and aggregate to common grid
b. Two databases: TRMM-available and full dataset

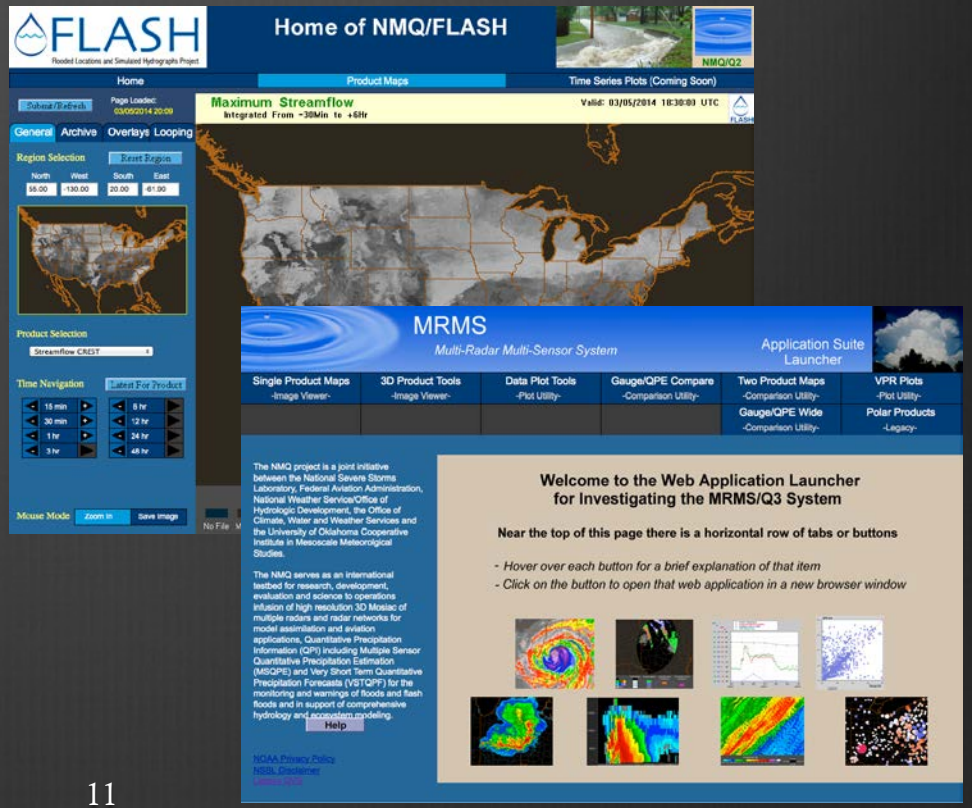
## Year 2: Product development and MRMS integration

a. Dec 2014: Prototype CONUS precip rates and types
b. Feb 2015: Merge satellite-based rainfall products with MRMS ground-based QPE (RQI-based weighting scheme)

## Year 3: Validation and FLASH integration

a. Evaluate model performance (both with TRMM/GPM and without)
b. Test blended MRMS QPE+satellite QPE as input to FLASH in real-time
c. After GOES-R launch, adjust model to use real-time GOES-R input (ABI and GLM)

# Thank you!

- Contact: Heather Grams (heather.moser@noaa.gov)

- For more info:
  - http://mrms.ou.edu
  - http://flash.ou.edu