



Multi-Radar Multi-Sensor (MRMS) — Flooded Locations and Simulated Hydrographs (FLASH)

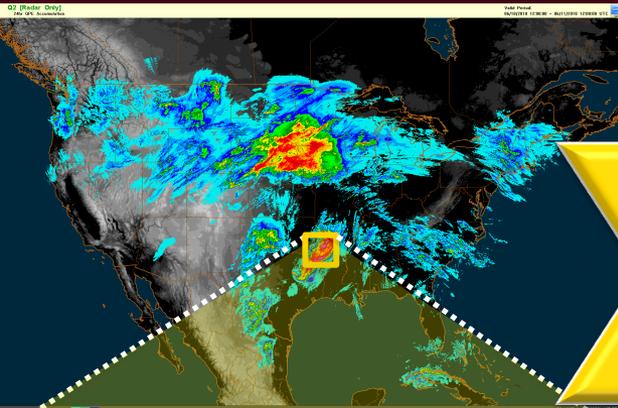
Jonathan J. Gourley
February 25–27, 2015
National Weather Center
Norman, Oklahoma



Multi-Radar Multi-Sensor QPE (MRMS) Flooded Locations And Simulated Hydrographs (FLASH)

- An NWS CONUS-wide flash-flood forecasting system

MRMS/Q3 Rainfall
Observations
-1km²/2 min

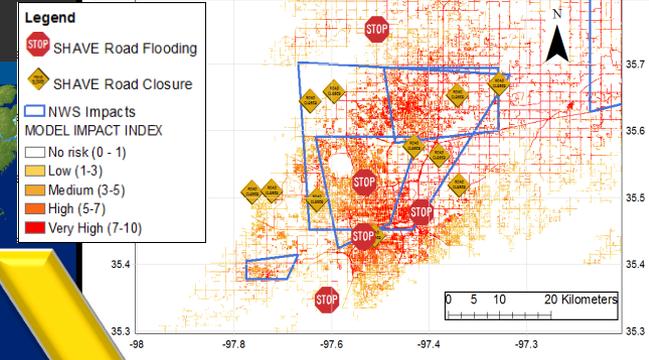


Stormscale Distributed
Hydrologic Model Ensemble
-1km²/10 min

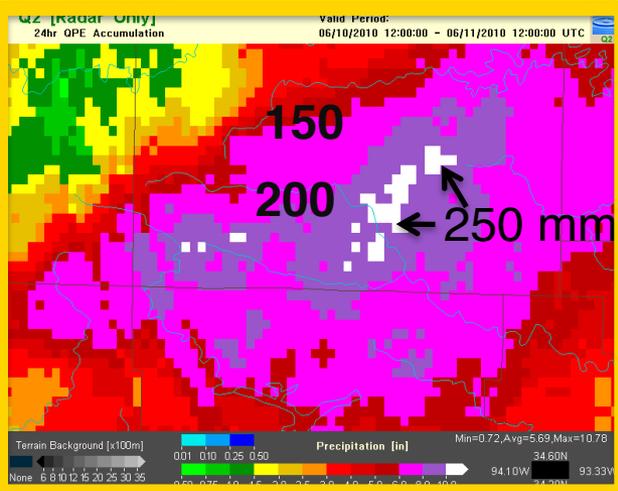


Hydro-FACETS

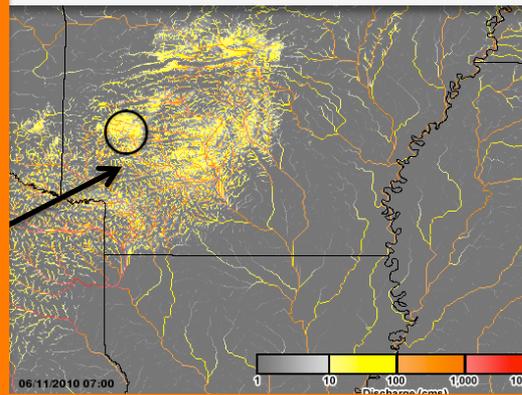
OKC 2010 FF EVENT: Road Flooding model & Observed Impacts



Probabilistic Forecast
Products on the Flash Flood
Impacts and Magnitudes (70%
chance of hazardous road
flooding)



Simulated surface water
flows and return period



20
fatalities

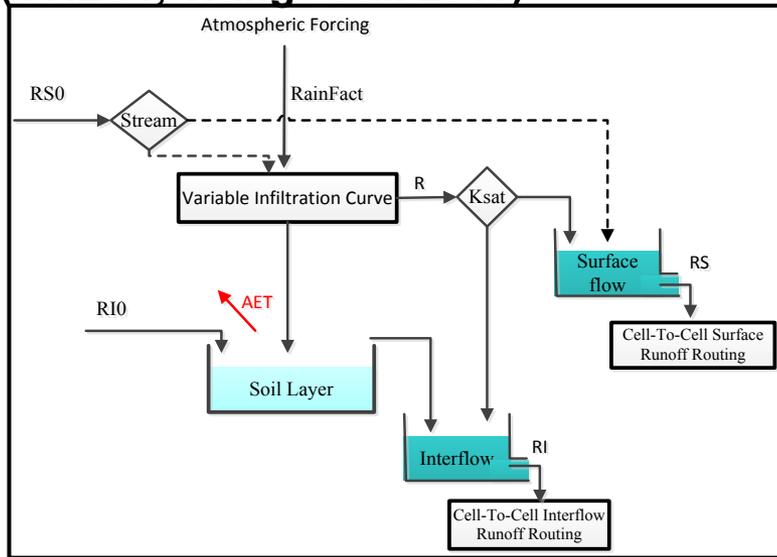
Indicator of Relevance
NSSL's Grand Scientific
Challenge #3:
*Reliably predict flash
flooding for both urban
and complex landscapes
out to several hours*

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

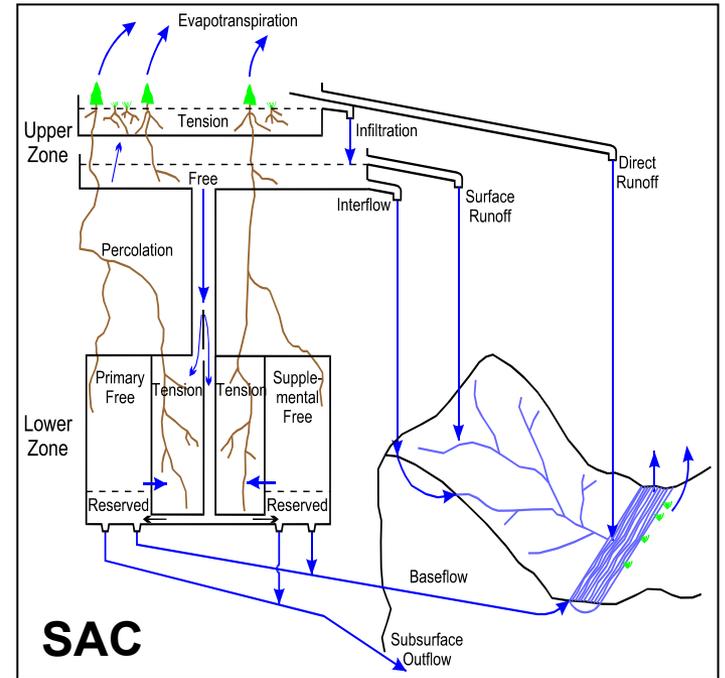


Ensemble Framework for Flash Flood Forecasting

Coupled Routing and Excess Storage (CREST; Wang et al. 2011)



All Parameters from Basin Properties

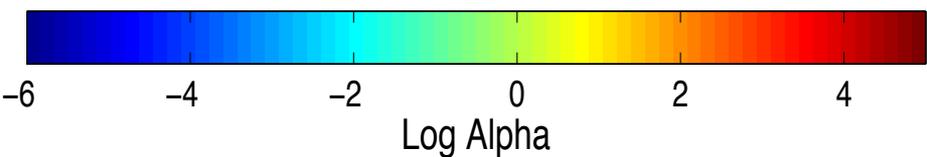
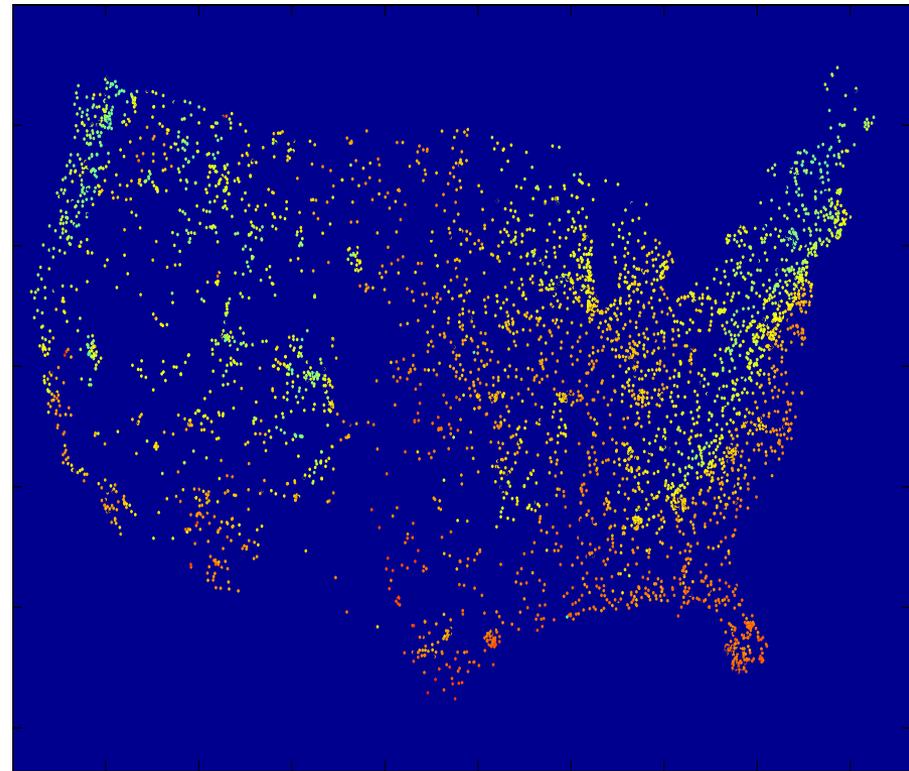
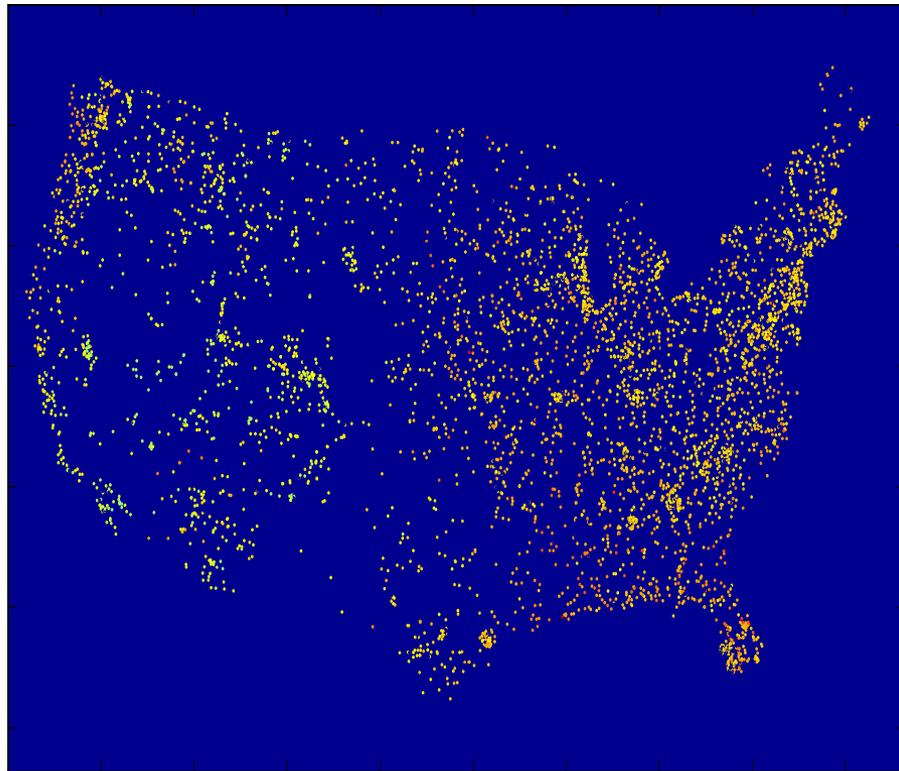


Kinematic Wave Routing

Figure adapted from UC-Irvine



Estimates (via regression) at gauged locations



Channel routing parameters at USGS stream gauges

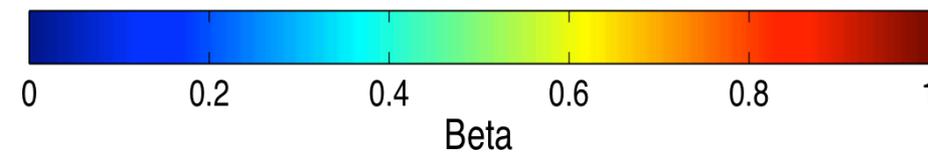
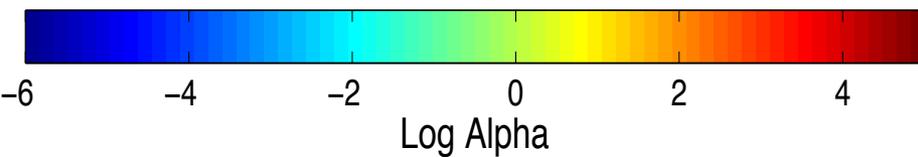
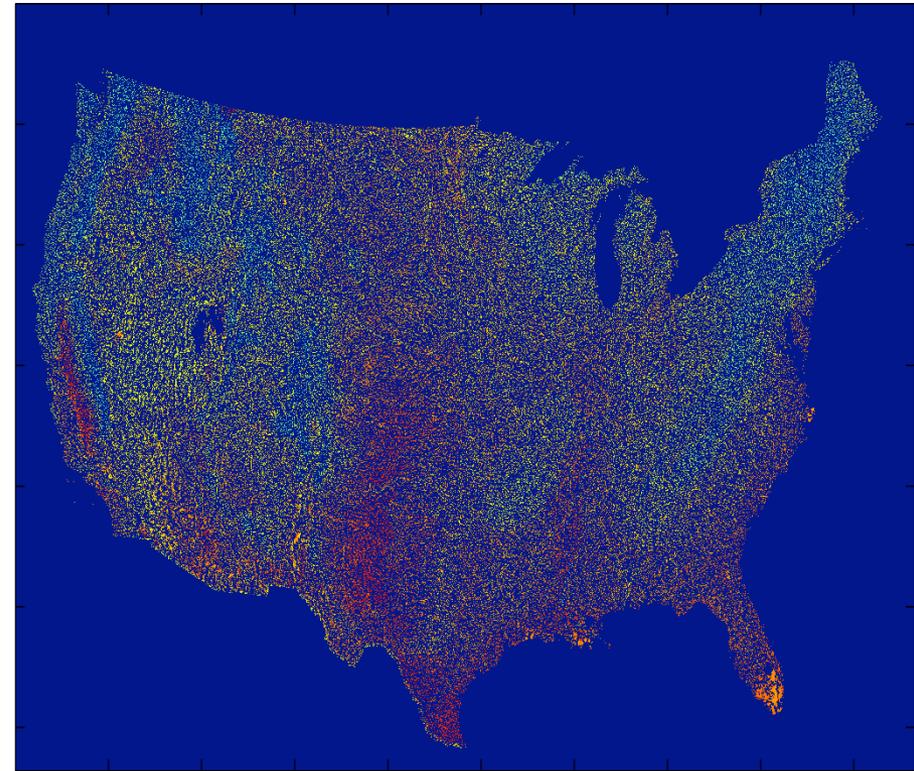
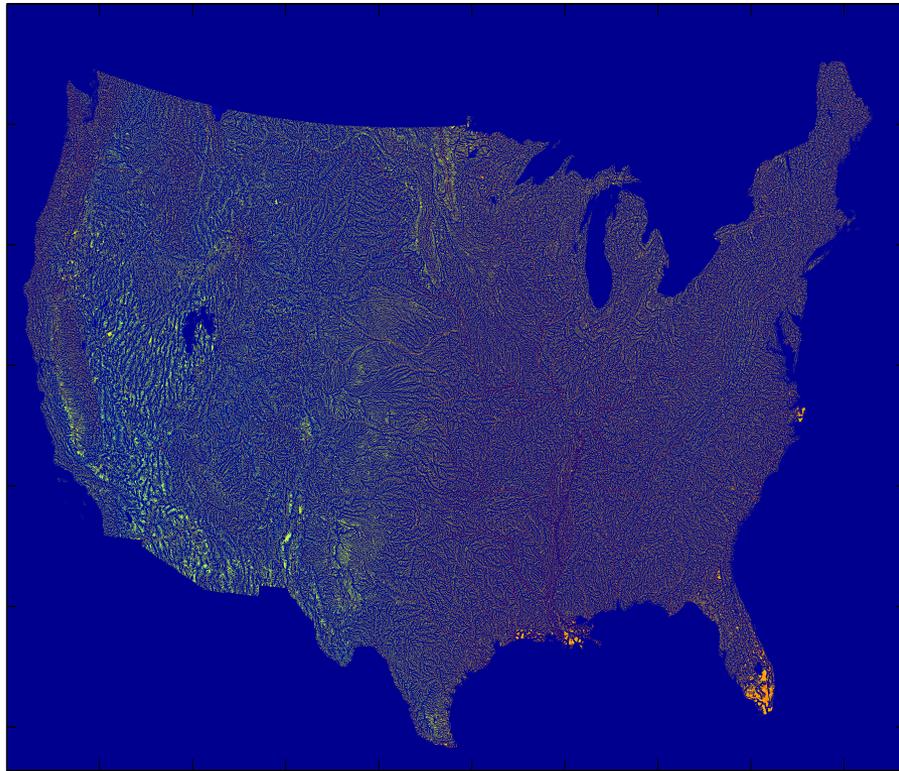
Kinematic wave parameters α β Lateral Inflow β

$$\frac{\partial Q}{\partial x} + \alpha \beta Q^{\beta-1} \frac{\partial Q}{\partial t} = q$$





Extended to all grid points using statistical model (Rigby and Stasinopoulos, 2005)



Significant explanatory variables: 1. **Annual Precip, Mean Temp, Relief Ratio, Basin Area**



Real-time, direct simulation of flash floods a reality (flash.ou.edu)

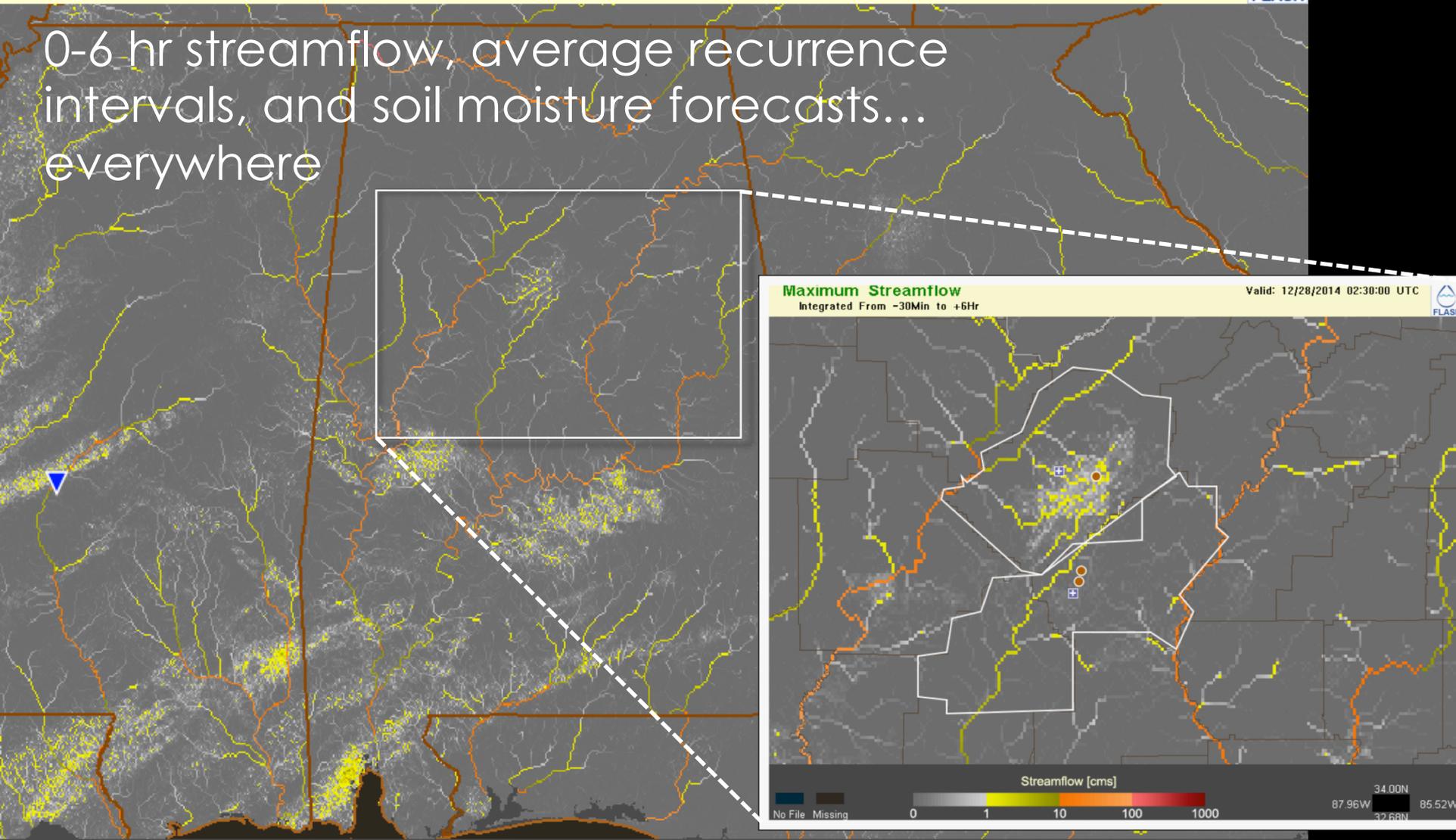
Maximum Streamflow

Integrated From -30Min to +6Hr

Valid: 12/28/2014 00:00:00 UTC



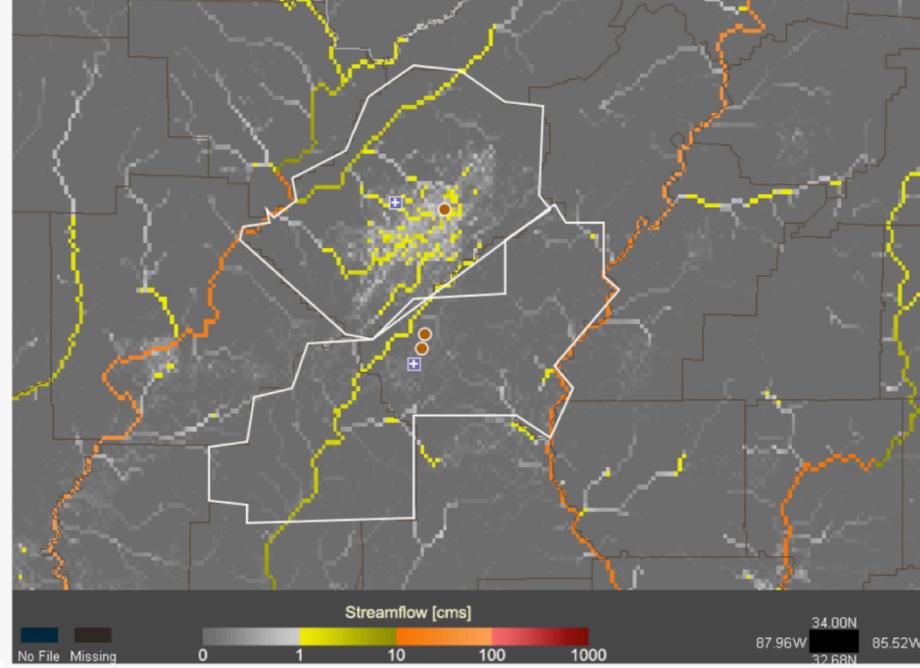
0-6 hr streamflow, average recurrence intervals, and soil moisture forecasts... everywhere



Maximum Streamflow

Integrated From -30Min to +6Hr

Valid: 12/28/2014 02:30:00 UTC



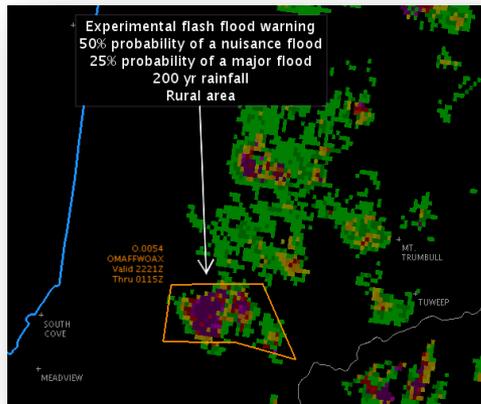
Streamflow [cms]



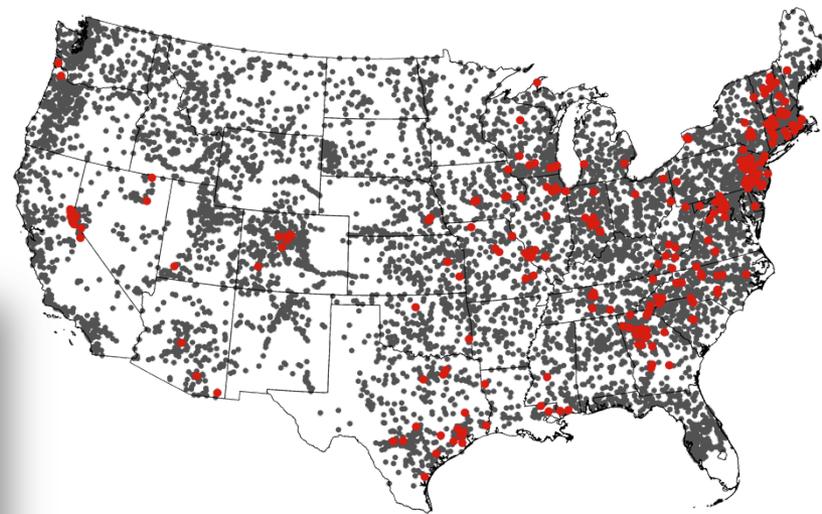
35.12N
90.50W 81.62W
30.28N

Subjective and Quantitative Evaluations

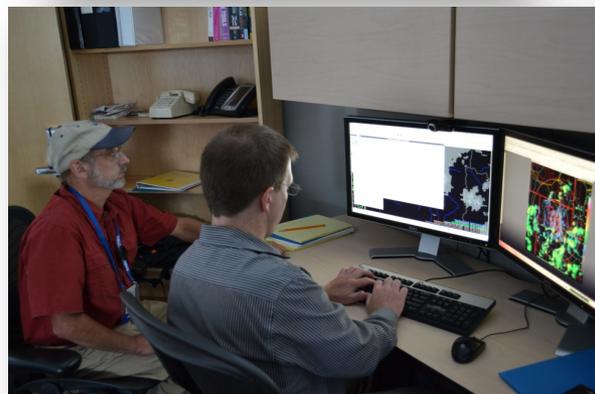
1. HWT-Hydro Testbed Experiment



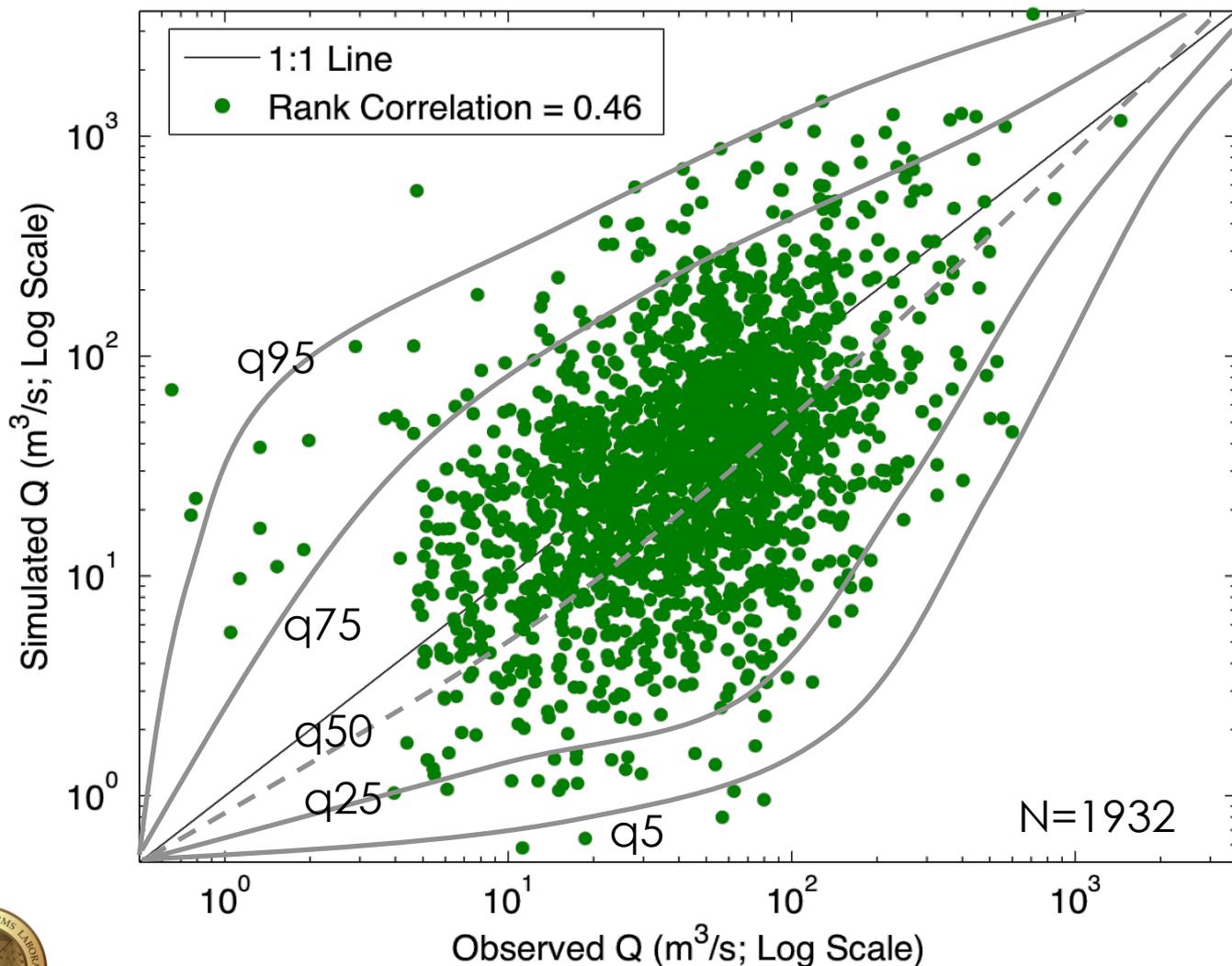
2. US Flash flood observation data base (Gourley et al., 2013, BAMS)



- 2002-2011 using MRMS precip reanalysis (1 km/5min)
- CREST model (uncalibrated)
- 256 gauged basins
- Evaluate simulation of event peakflow



Event-Based Evaluation (Peakflow)



Quantiles describing observed vs. simulated peakflows using error model (Rigby and Stasinopoulos, 2005)

Future work will extend/regionalize error model to specific hydroclimatic, geomorphologic regimes



MRMS-
SevereMRMS-
AviationMRMS-
Hydro

QPE

Flash
Flood

Multi-radar Multi-sensor (MRMS) Operational Implementation Schedule to NWS/NCEP

07/15	10/15	04/16	04/17
QPE-to-Flash Flood Guidance (FFG) Ratio	CREST# (Streamflow, ARI, Soil Moisture)	Sacramento (Streamflow, ARI, Soil Moisture)	QPF inputs to FFG, ARI, hydro models
QPE Average Recurrence Interval (ARI*)		Probabilistic QPE ⁺	Probability of Flash Flood
			Probability of Debris Flow
			Impact-Specific Products

#CREST = **C**oupled **R**outing and
Excess **S**torage model (Wang et al.,
2011)

*Rainfall ARIs computed by comparing
real-time MRMS QPE to NOAA Atlas 14
precipitation frequency estimates

+PRORATE=**P**robabilistic QPE using
Radar **O**bservations of **R**ate **A**nd
Typology **E**stimates (Kirstetter et al., 2015)

Summary

- 53 peer-reviewed articles on remote sensing of precipitation and flood forecasting in past 5 years
- \$1.4 million of project funding brought in from NOAA, NASA, and NSF (weighted by SRI%) in past 5 years
- Guest editor for *J. Hydrol.* special issue on Flash floods, hydro-geomorphic response and risk management, 2014-present
- AMS *J. Hydrometeor.* Editor's Award, 2013
- NASA Goddard Space Flight Center Robert H. Goddard Award (Team) for the category of Exceptional Achievement in Science, 2015
- Dept. of Commerce Bronze Medal Award, 2012
- Member of NASA's Precipitation Measurement Mission Science Team, 2013-present
- Member of AGU's Precipitation Technical Committee, 2010-present

