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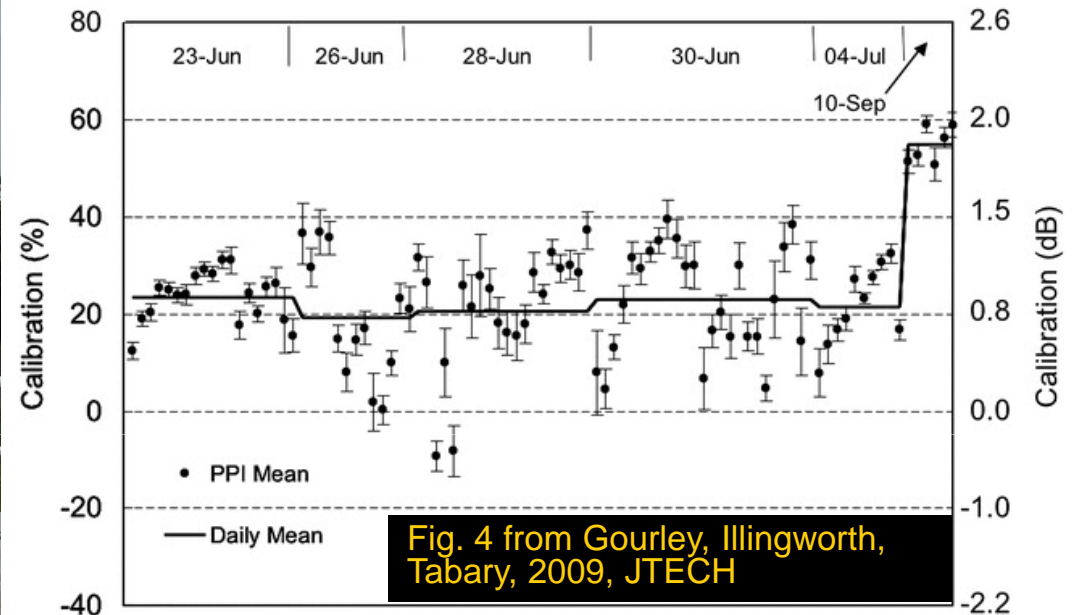
Zachary Flamig, OU/NSSL
Yang Hong, OU
Kenneth Howard, NSSL



**A contemporary demonstration
system for flash flood forecasting
in the US**



A little history first...

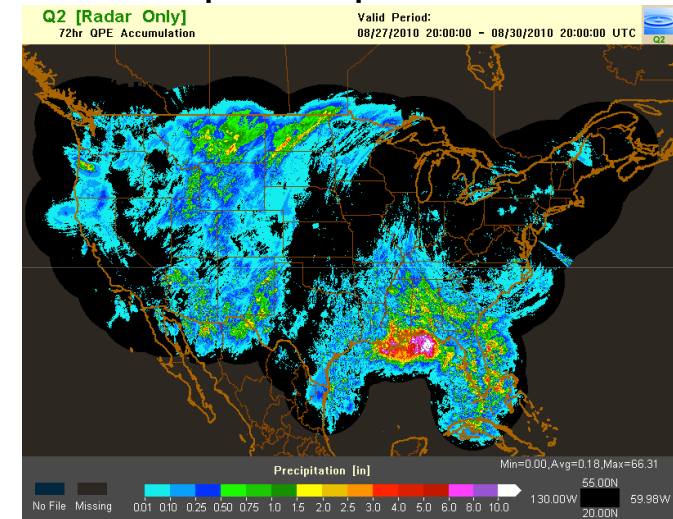


- Tower painted on 27 Jul 2005
- Waveguide replaced shortly thereafter
- Excellent opportunity to check radar calibration method using self consistency !

Project Goals

- Expand use of radar-based rainfall estimates
 - Reasonable accuracy
 - Long-term archives, represents climatology (?)
 - High-resolution, appropriate for flash flood scale
- Produce flash flood forecasts in radar-covered regions **without the requirement of in-situ stream gauges**
- Improve upon current tools used for operational flash flood forecasting (**inverse flash flood guidance** method)
- Consider **social dimension** of flash flood impacts
- Develop a demonstration system to serve as a centerpiece for research and development

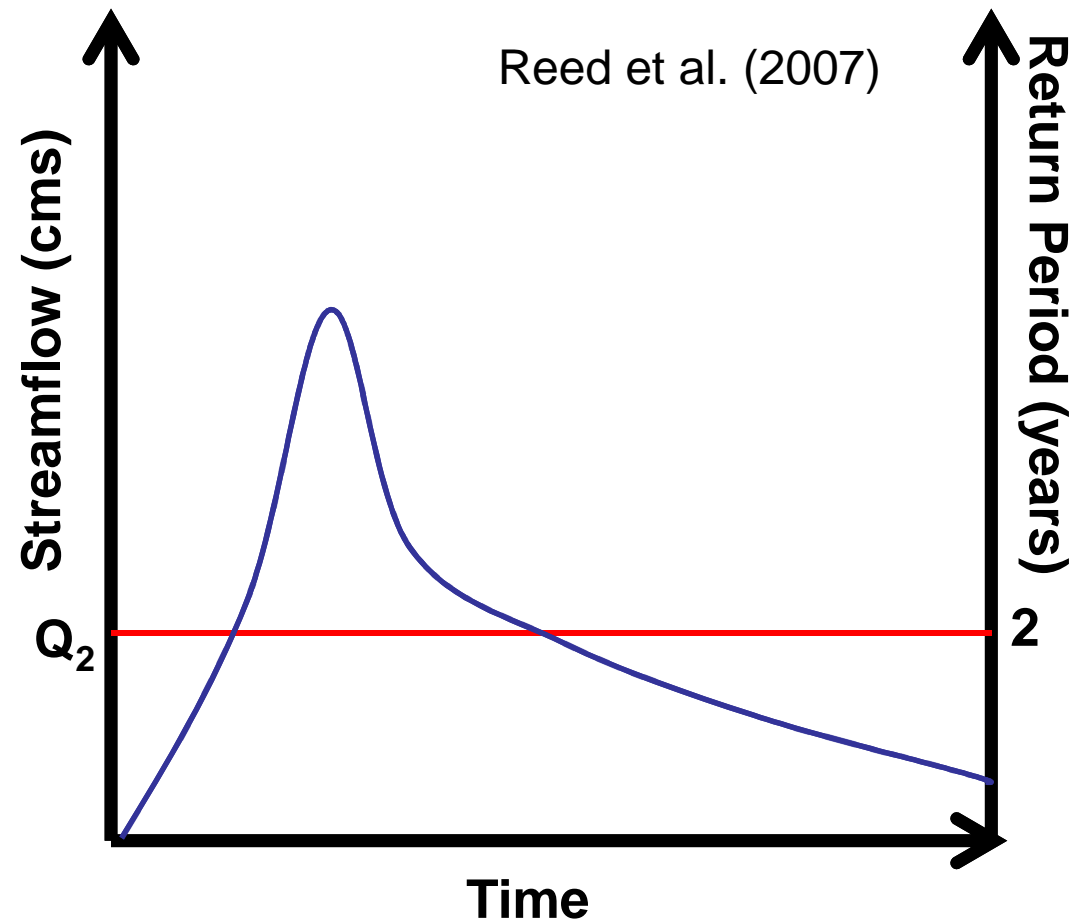
<http://nmq.ou.edu>



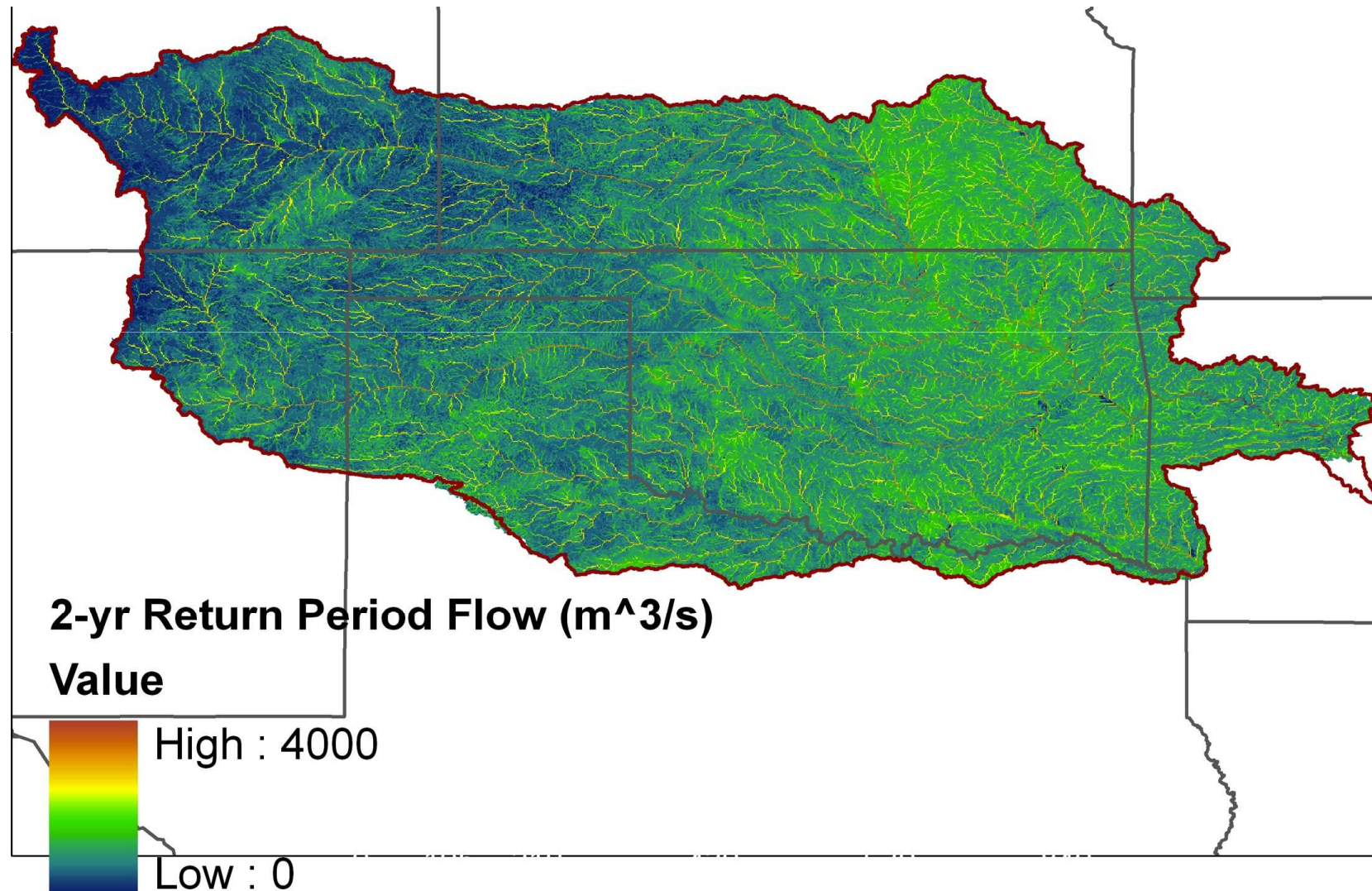
Threshold frequency method for flash flood prediction

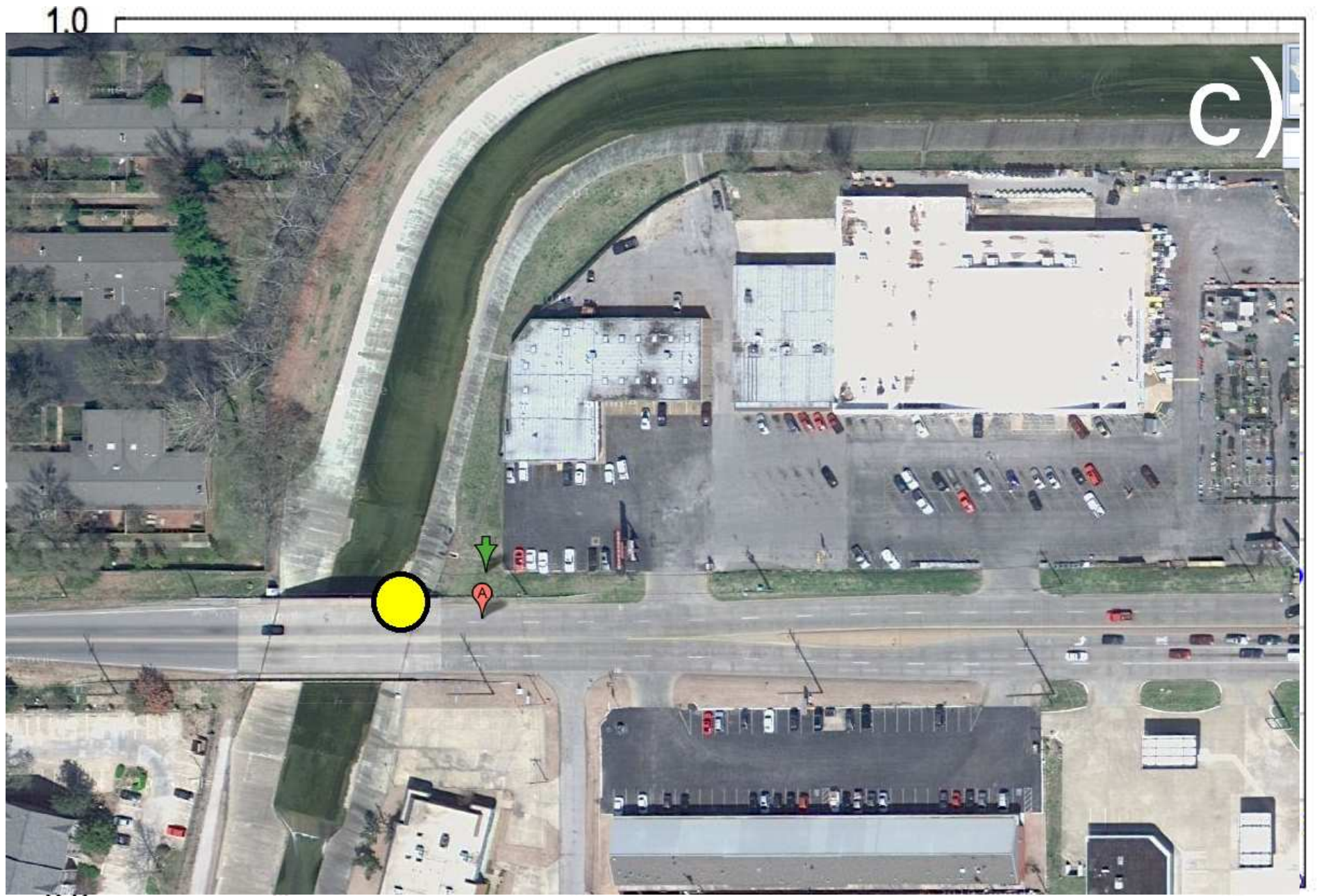
1. Take longest available gridded rainfall record (1996-present)
2. Simulate flow with hydrologic model for period of rainfall recording annual maximum flows @ each grid cell
3. Compute Log-Pearson III distribution from annual maximum **simulated** flows (gives mean, standard deviation and skew parameters)
4. From this distribution we can estimate return period for any discharge value at every grid point

Inherent bias correction for inputs+model



Return period flows from NEXRAD archive (1996-present)





Gourley et al. (2012) *Hydro. Sci. J.*

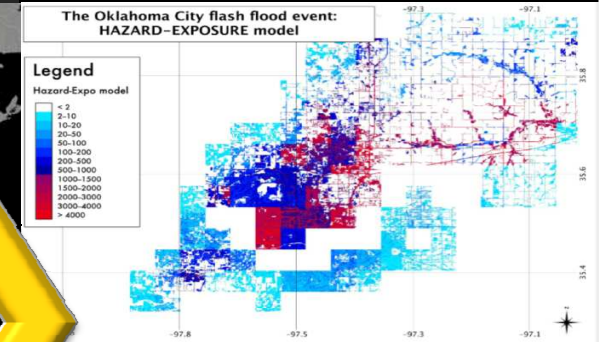
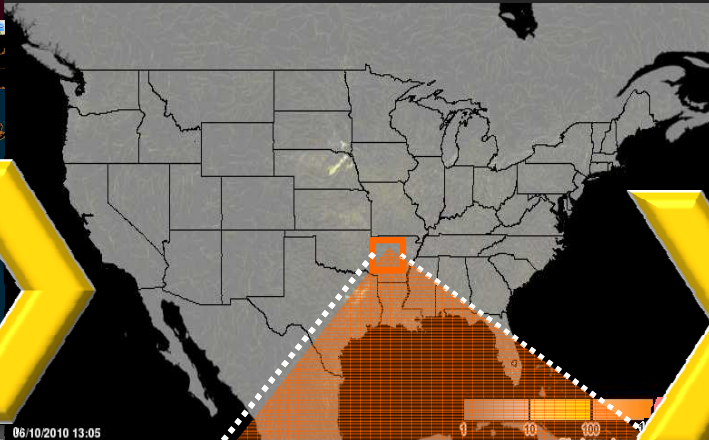
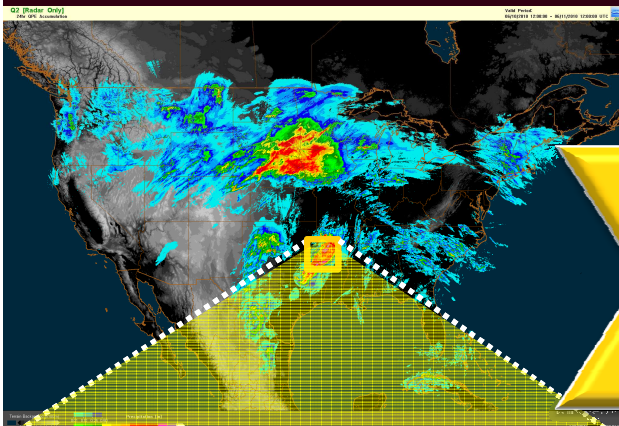
National Mosaic and Multi-Sensor QPE (NMQ/Q2) Flooded Locations And Simulated Hydrographs (FLASH)

- A CONUS-wide flash-flood forecasting demonstration system

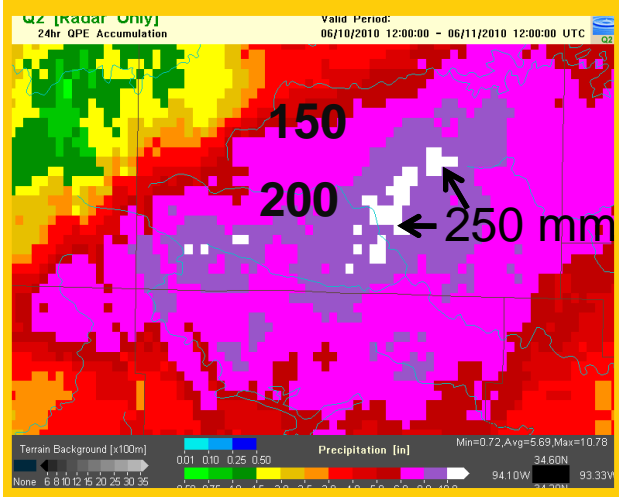
NMQ/Q2 Rainfall Observations
- 1km²/5 min
Stormscale Ensemble Forecasts

CREST Stormscale Distributed
Hydrologic Model
- 1km²/5 min

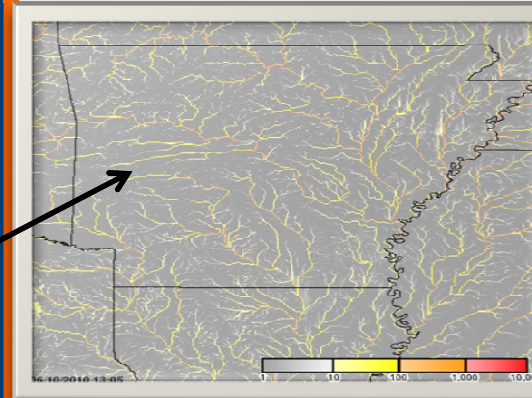
Forecast Products on the
Flash Flood Impacts



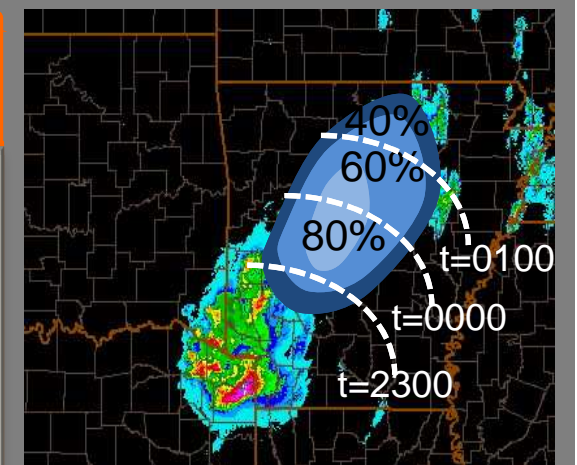
Hazard-Exposure Model =
DHM-TF * Drainage area * Land cover * Road network



Simulated surface water
flows and return period



20
fatalities



Probability of life-threatening
flash flood

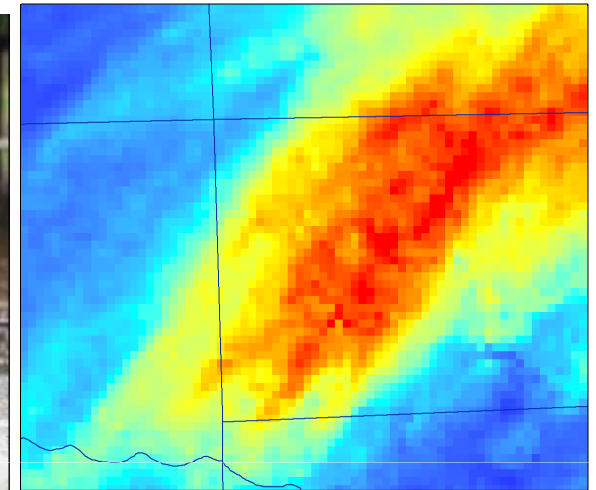
10-11 June 2010, Albert Pike Rec
Area, Arkansas

Oklahoma City Flash Flood

Morning of June 14th, 2010

~250mm of rain in < 6 hours!

Lots of flooding & property damage,
thankfully no loss of life



0 Accumulation (mm) 325



Gauges vs QPE

24hr QPE: Q2 [Radar Only]

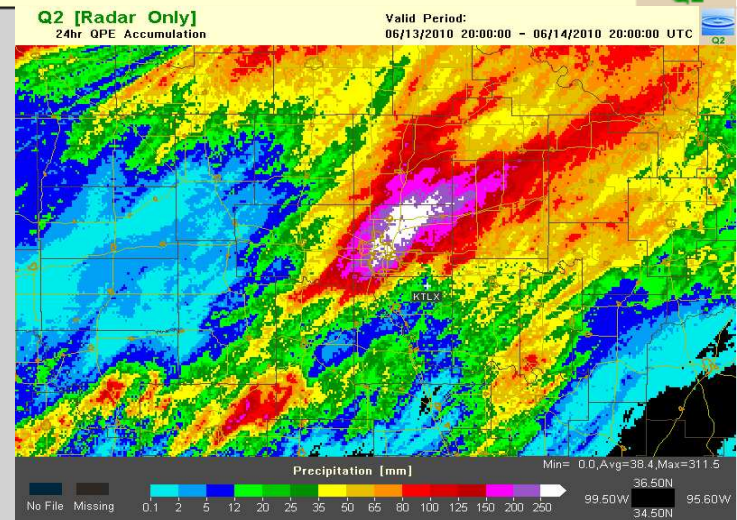
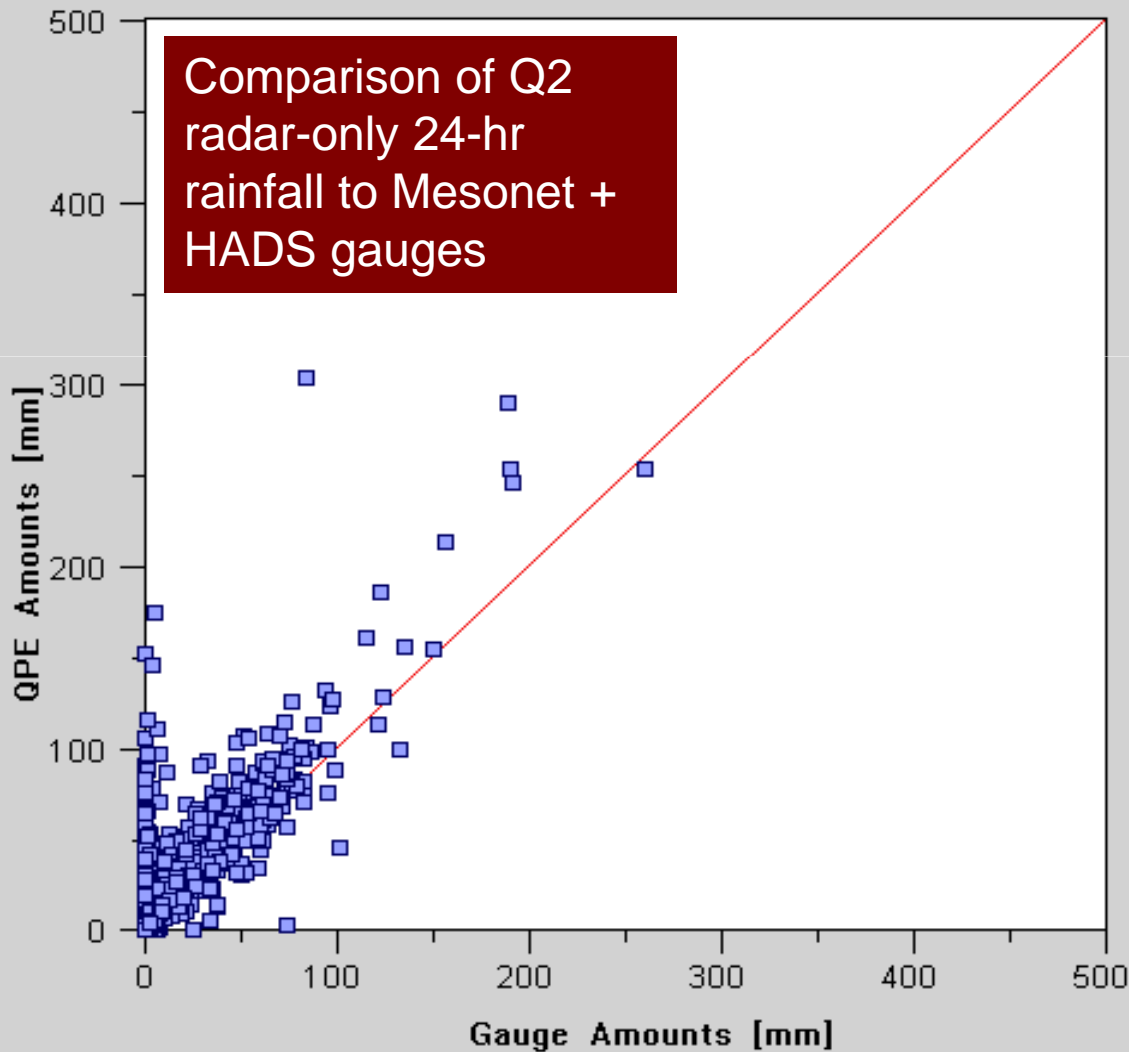
Valid Period: 06/13/2010 20:00 - 06/14/2010 20:00 UTC

Gauge Groups: HADS,OCS



Scatter Plot:

Gauges In Region:	1206	Max:	259.59	302.10
Total With QPE:	1206	Avg:	12.16	19.36
		Min:	0.00	0.00



	N	Y	
Yes/No Threshold:	0	1206	Y
	0	0	N
	Actual		

Stats:	[Y/Y]	[Y/Y+Y/N+N/Y]
Total Bias:	1.59	1.59
Corr Coeff:	0.85	0.85
RMSE [mm]:	19.51	19.51

Region:	40.00N		
	106.00W		90.31W
		32.00N	

Mask: none
 Verif Mode: 1pt
 Accum >= 0%

Gauges vs QPE

24hr QPE: Q2 [Radar Only]

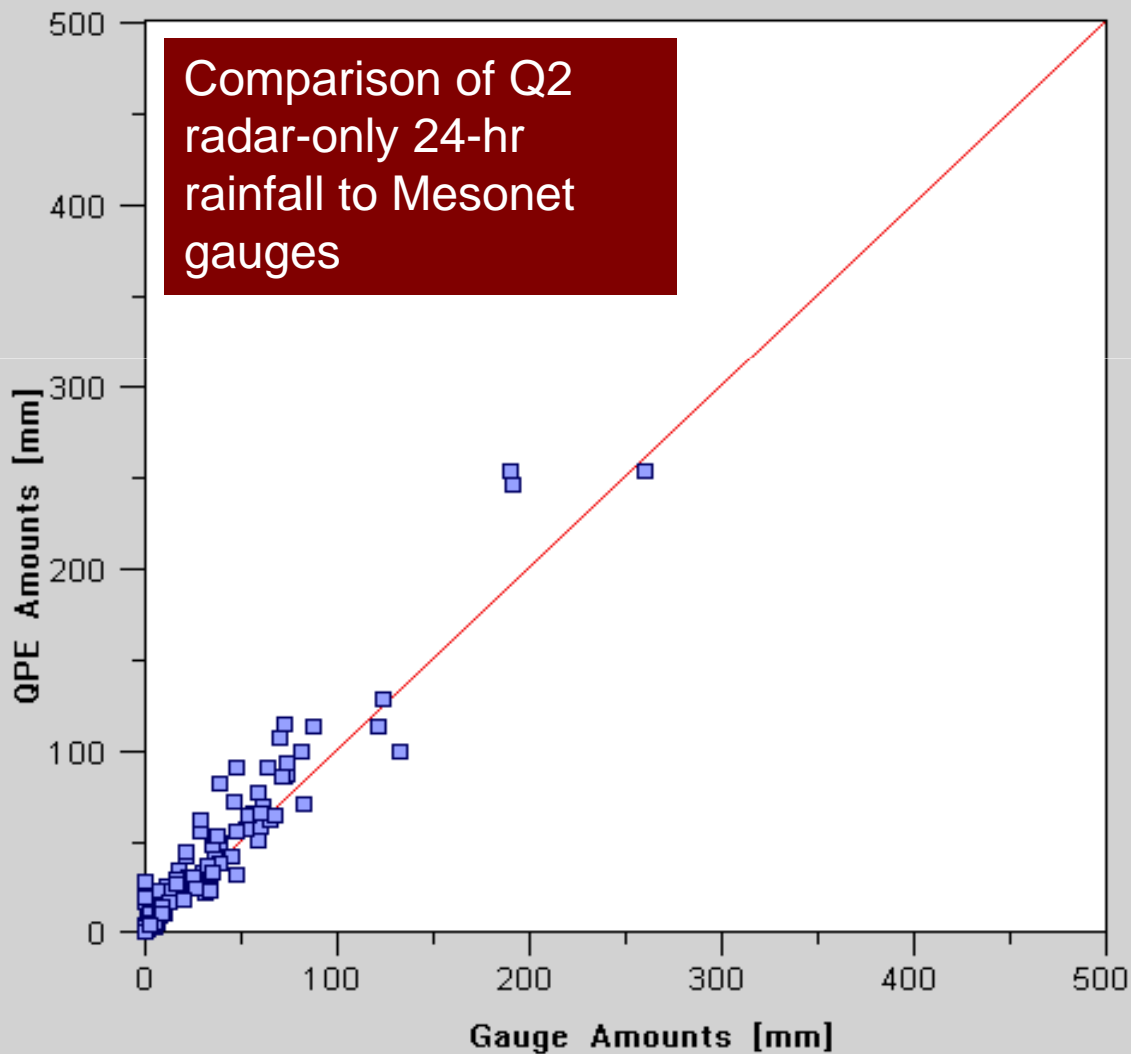
Valid Period: 06/13/2010 20:00 - 06/14/2010 20:00 UTC

Gauge Groups: OCS

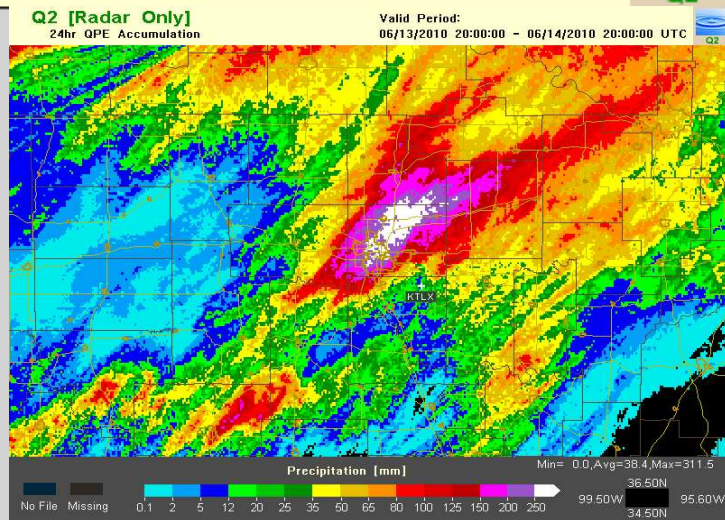


Scatter Plot:

	Gauge	QPE [mm]
Gauges In Region:	116	Max: 259.59 252.30
Total With QPE:	116	Avg: 30.12 36.51
		Min: 0.00 0.00



Comparison of Q2 radar-only 24-hr rainfall to Mesonet gauges



	N	Y	
Yes/No Threshold:	0	116	Y
	0	0	N
		Actual	

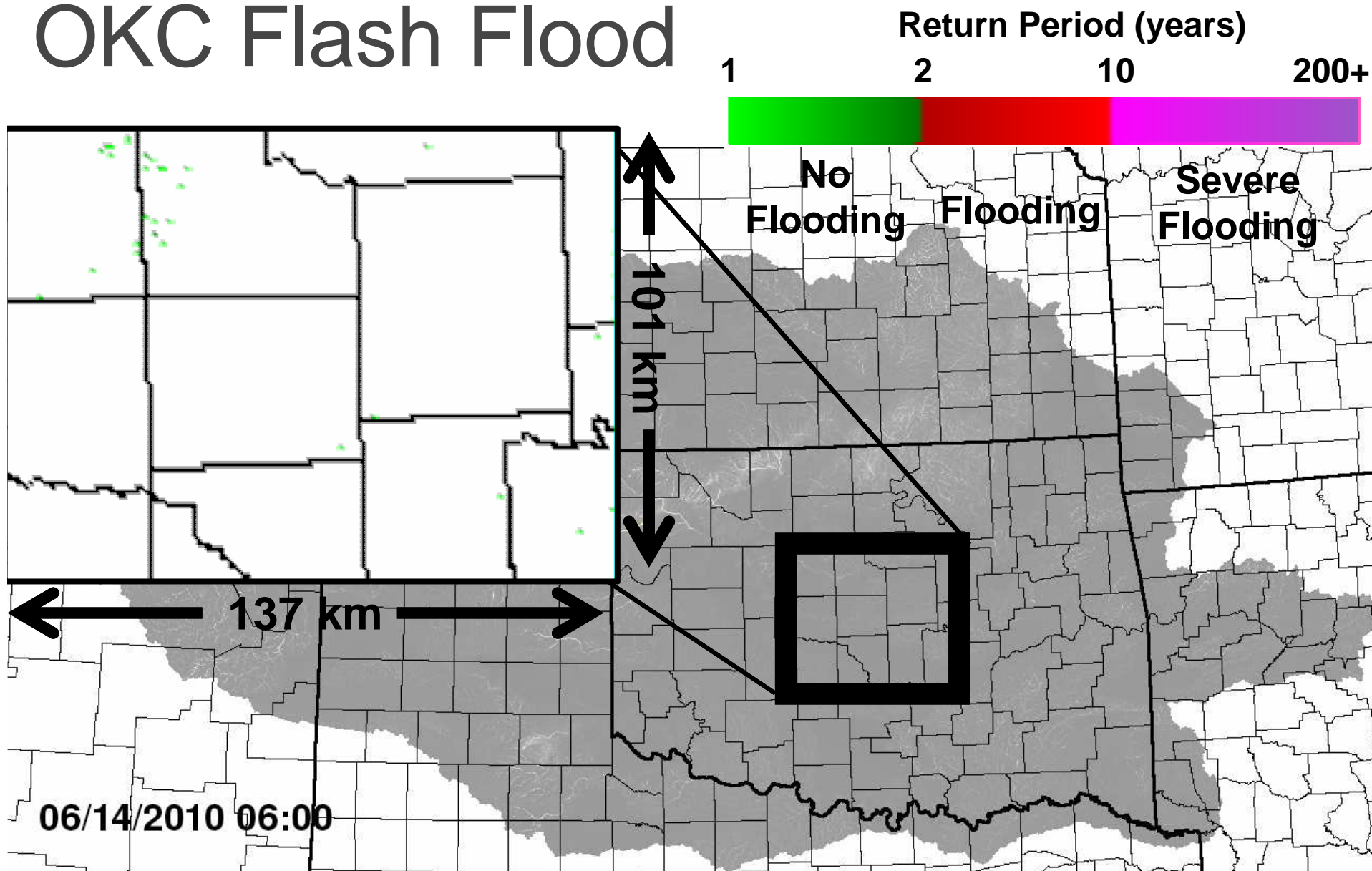
Stats:

	[Y/Y]	[Y/Y+Y/N+N/Y]
Total Bias:	1.21	1.21
Corr Coeff:	0.96	0.96
RMSE [mm]:	14.80	14.80

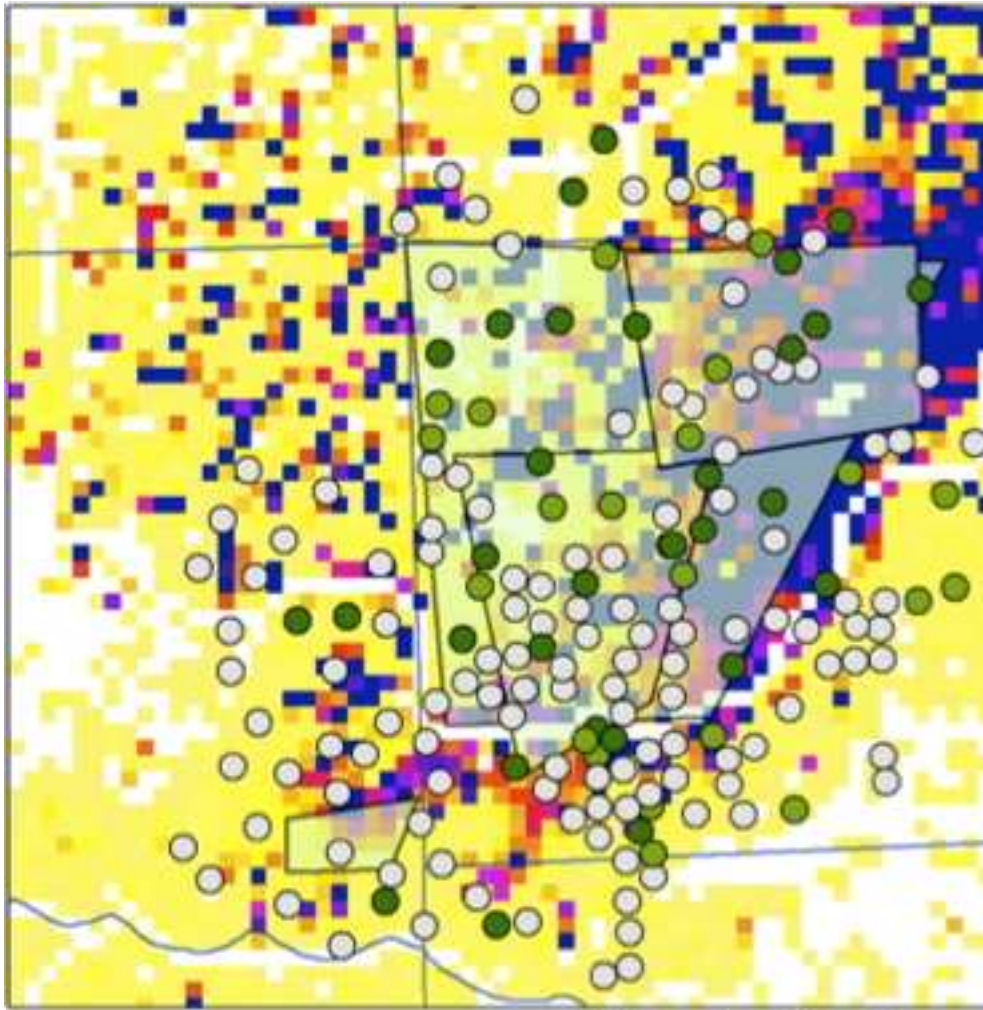
Region: 106.00W 40.00N 90.31W 32.00N

Mask: none
 Verif Mode: 1pt
 Accum >= 0%

OKC Flash Flood



Evaluation of Flash Flood Simulations



Severe Hazards Analysis and Verification Experiment
Ortega et al., *BAMS* (2009) ; Gourley et al., *J. Hydrol.* (2010)

Flash flood database freely available here:
ftp://ftp.nssl.noaa.gov/users/gourley/ff_database/2012_v1

Probabilistic Flash Flood Forecasting using Stormscale Ensemble Precipitation Forecasts



Jill Hardy
Gina Hodges

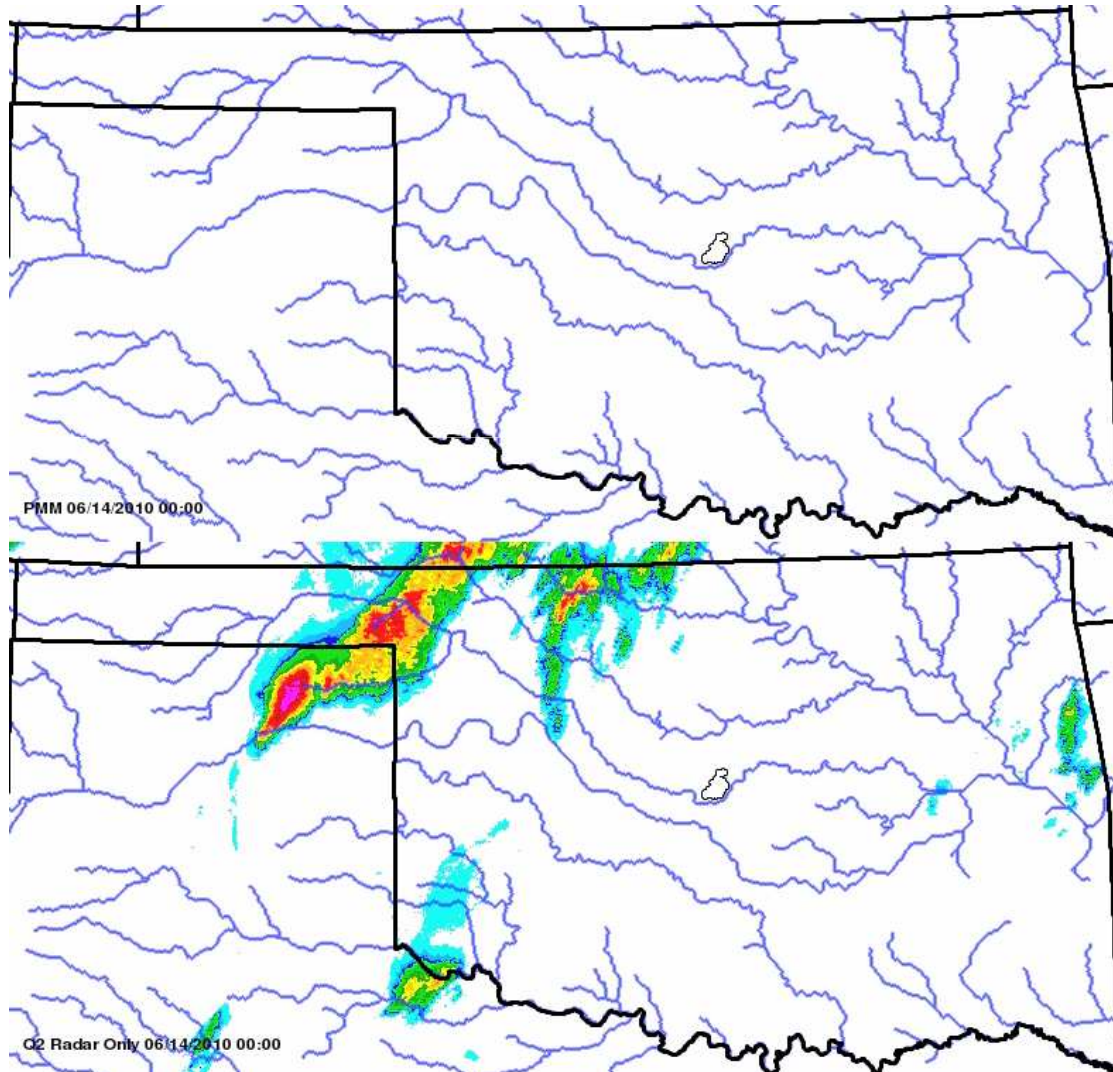


NSF Graduate Research Fellowship





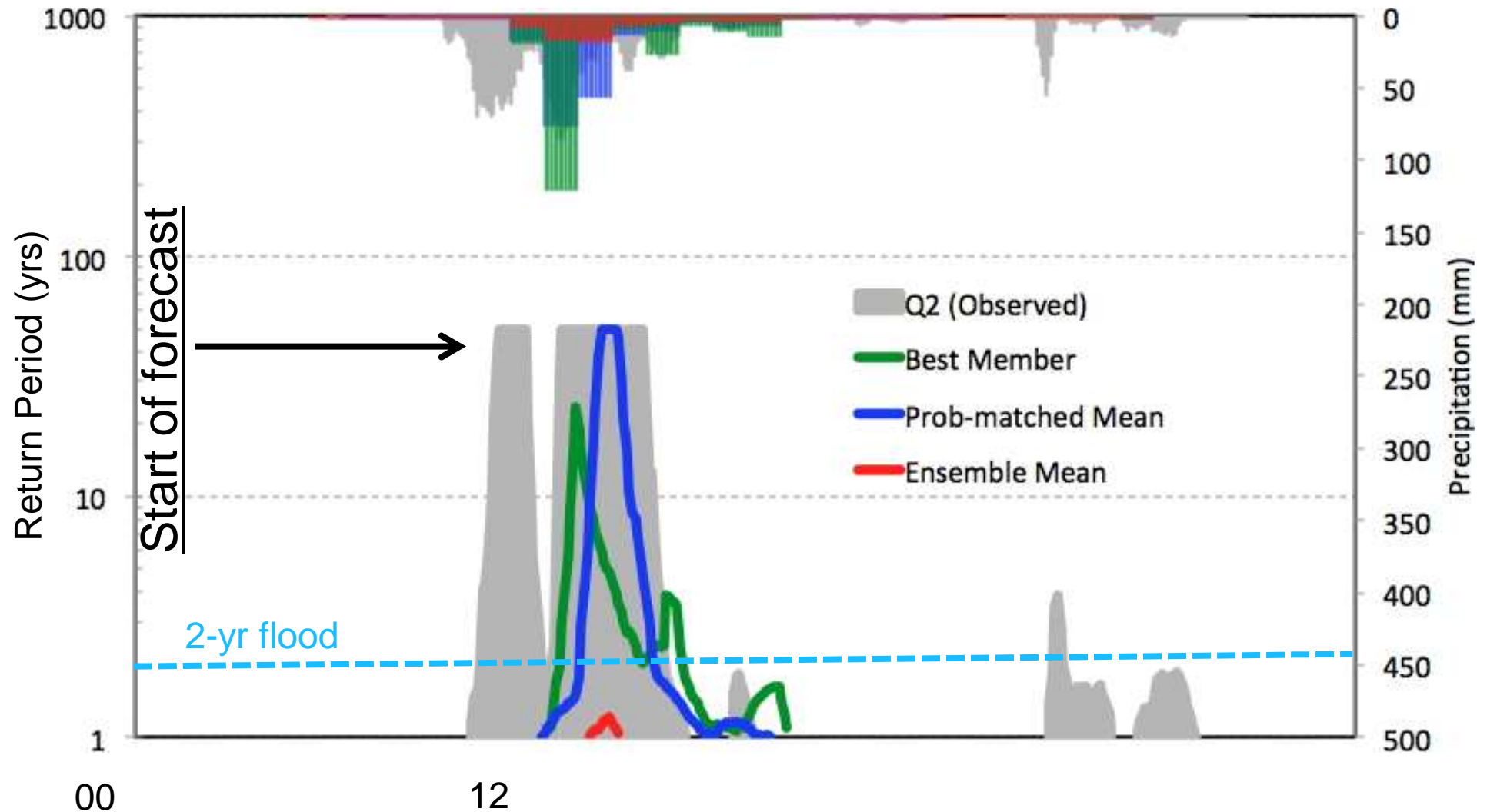
Rainfall Forecasts from Univ. Oklahoma CAPS Ensembles



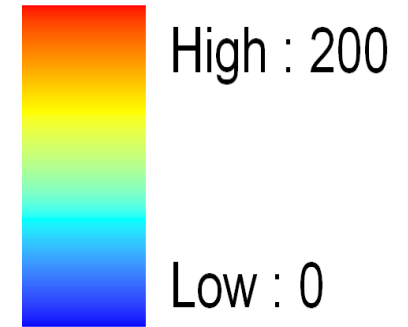
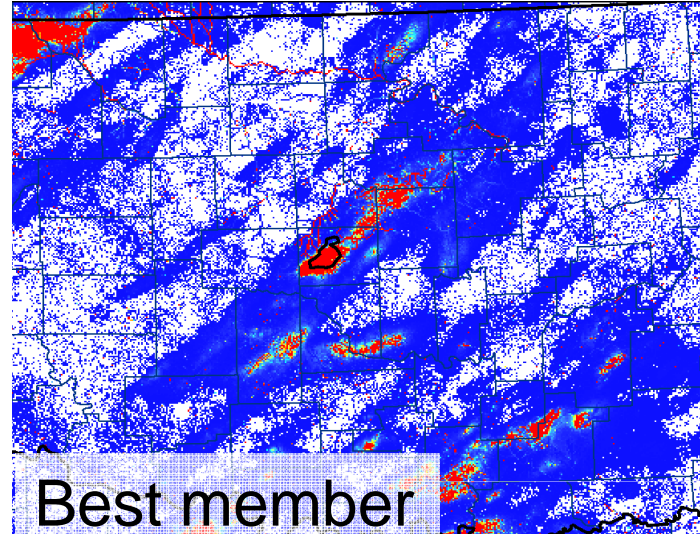
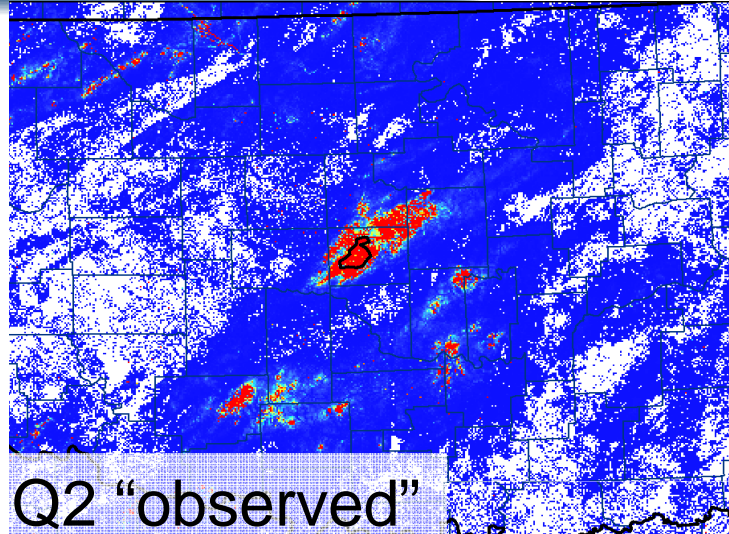
Probability
matched
mean
(forecast)

Q2 Rainfall
(observed)

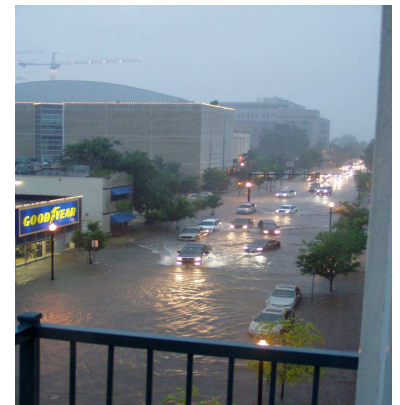
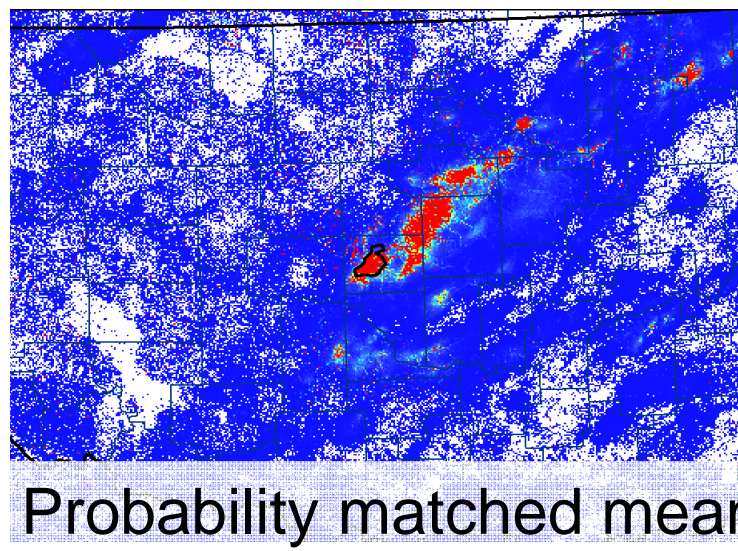
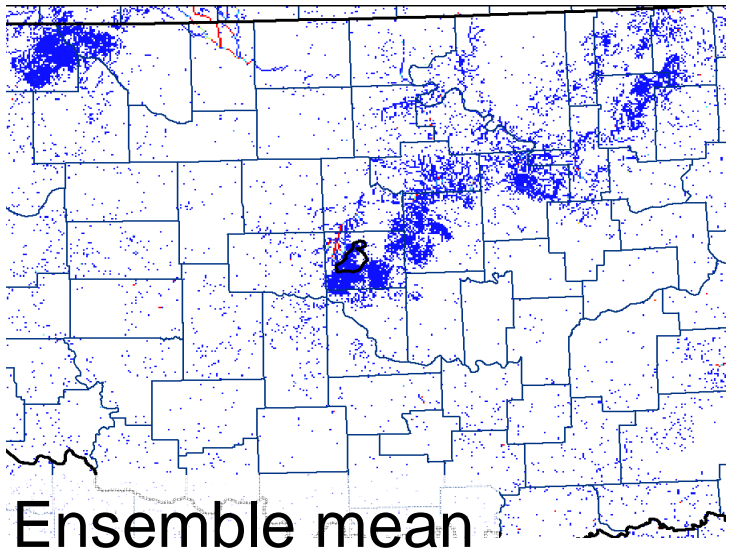
Basin-Specific Hydrologic Simulations



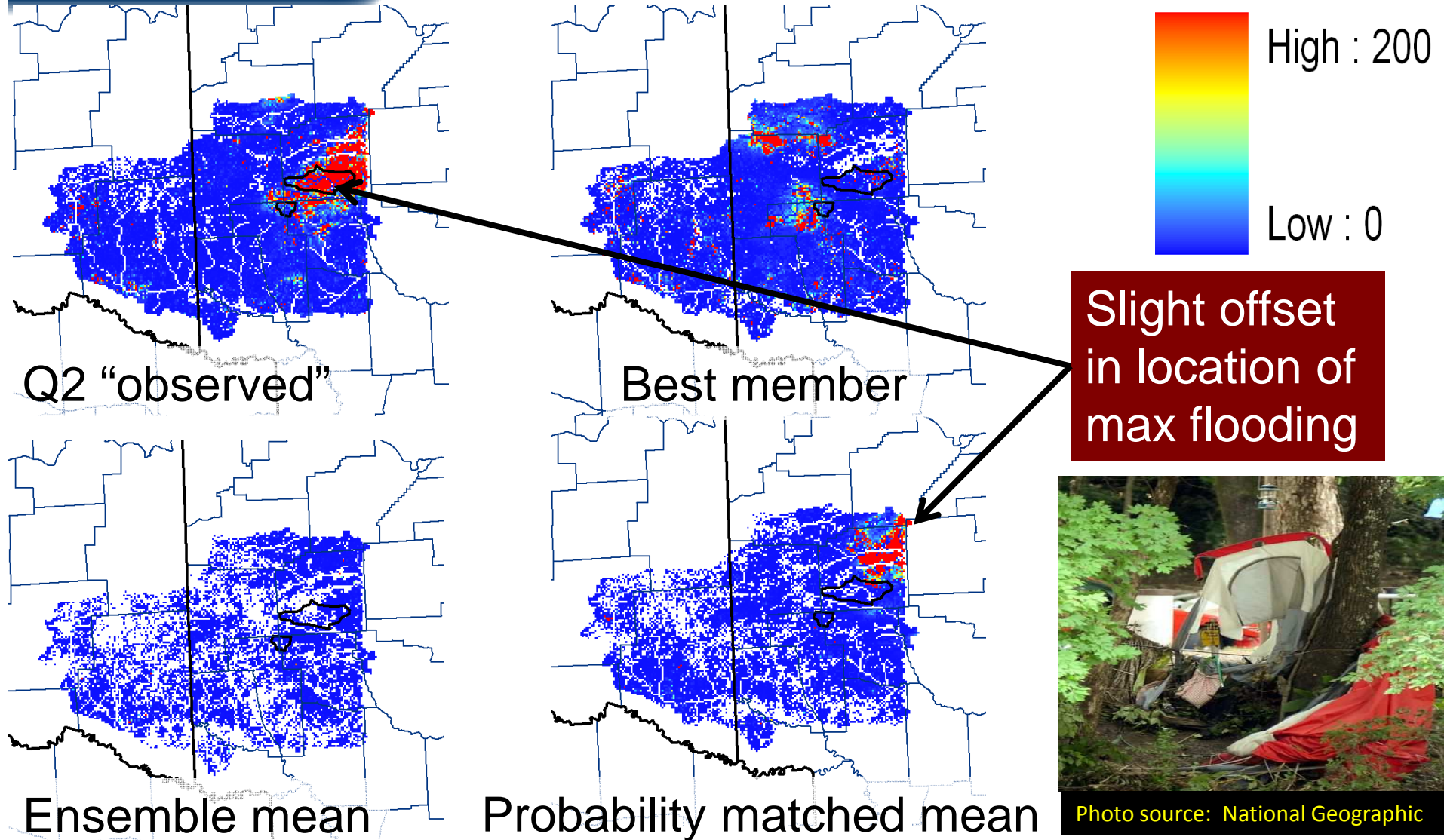
Maximum Return Periods – OKC Flash Flood



Promising performance from a 12-hr forecast !



Maximum Return Periods – AR Campground Flash Flood



Status

- Hardware up and running
- Testing took 2.5 min for 6-hr flash flood forecast over CONUS
- Single deterministic forecasts running in real-time over south-central US
- 8-yr CONUS-wide retrospective simulation underway
- CONUS flash flood forecasts by end of summer

