Development and Evaluation of Probabilistic Forecasts of Flash Flood Impacts

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Intense Precipitation as an Integrating Theme

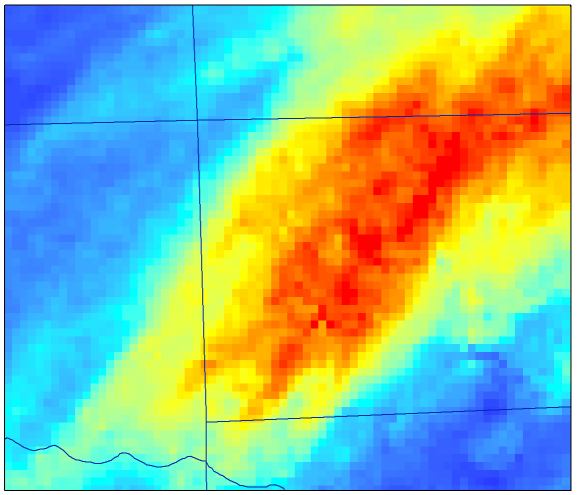
- QPF focus was an added component to the Spring Experiment of the Hazardous Weather Testbed (HWT) – more on this from Faye
- Expand the NOAA Hydrometeorology Testbed at the Hydrometeorological Prediction Center (HMT-HPC)
- Underlying goal is to evaluate stormscale ensemble QPFs 1) using tools from Developmental Testbed Center (DTC) and 2) as inputs to contemporary flash flood prediction system
  - Presents paradigm shift from current method of FFG generation at River Forecast Centers and operational use at Local Forecast Offices
  - New and improved probabilistic flash flood products, with focus on specific impacts, will inevitably follow from forecaster interaction

Oklahoma City Flash Flood

Morning of June 14th, 2010

325 mm of rain in < 6 hours**!**

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



Gauges vs QPE

24hr QPE: Q2 [Radar Only]

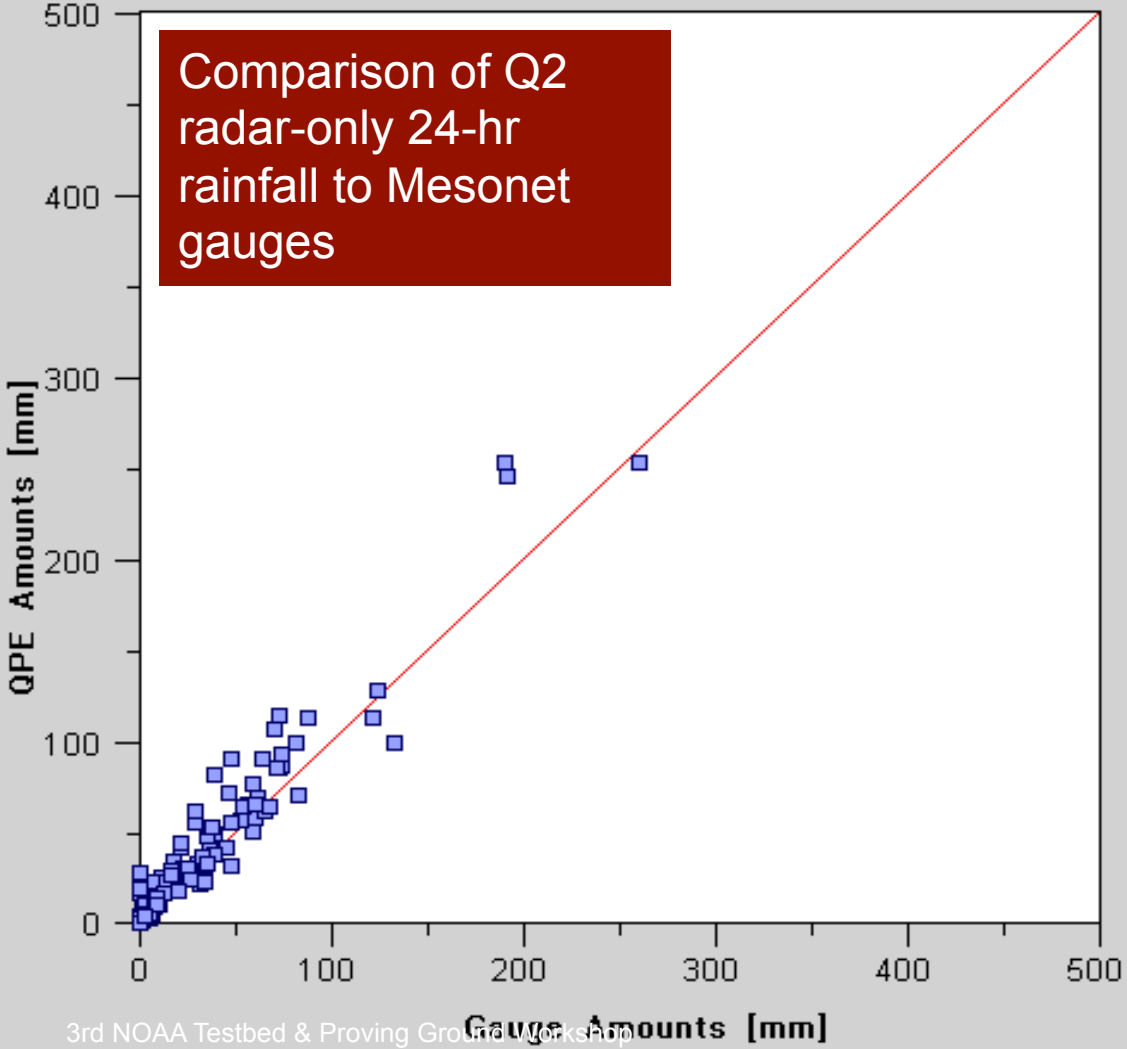
Valid Period: 06/13/2010 20:00 - 06/14/2010 20:00 UTC

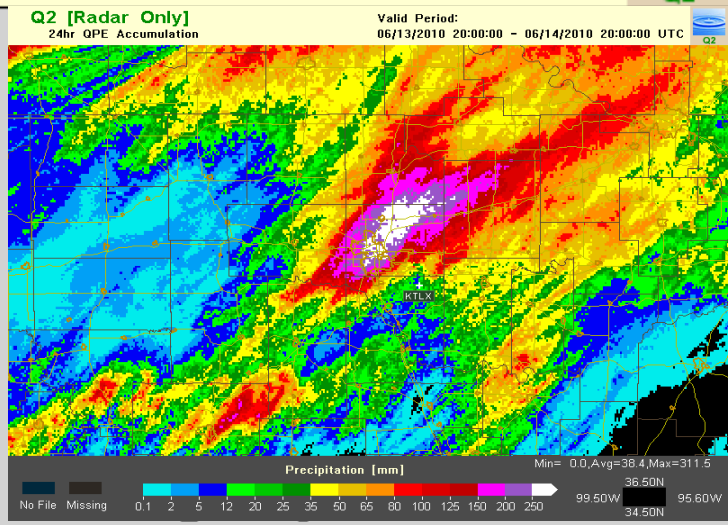
Gauge Groups: OCS

Q2

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





Yes/No Threshold: None

Predicted \ Actual	N	Y
Y	0	116
N	0	0

Stats:

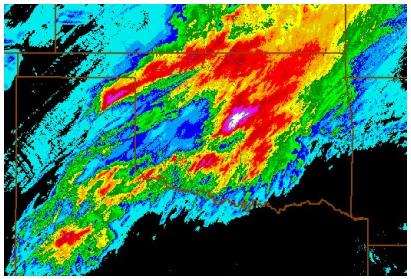
	[Y/Y]	[Y/Y+Y/N+N/Y]
Total Bias:	1.21	1.21
Corr Coeff:	0.96	0.96
RMSE [mm]:	14.80	14.80

Region:

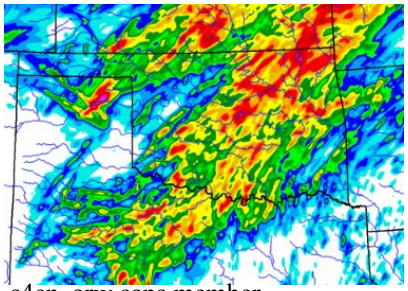
40.00N
106.00W 90.31W
32.00N

Mask: none

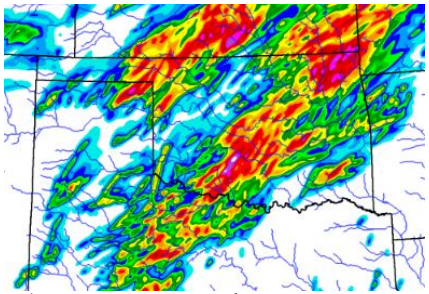
Verif Mode: 1pt Accum>=0%



Q2



s4cn_arw caps member



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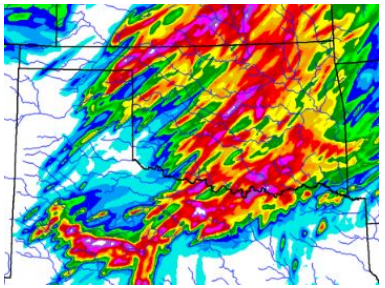

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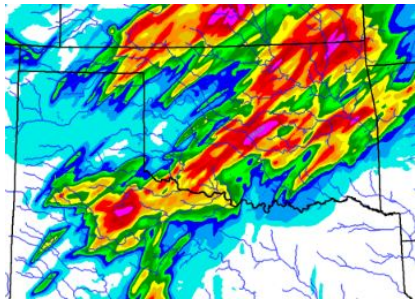

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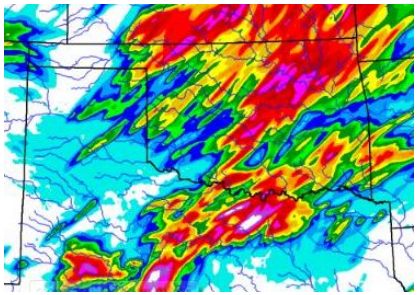

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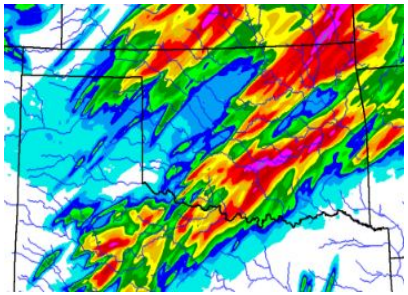

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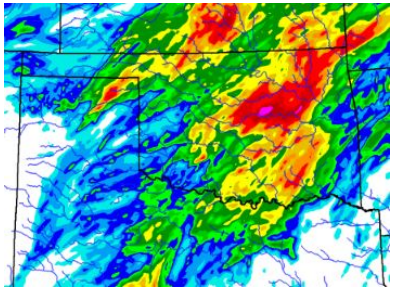

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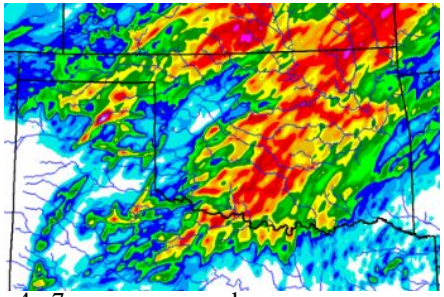

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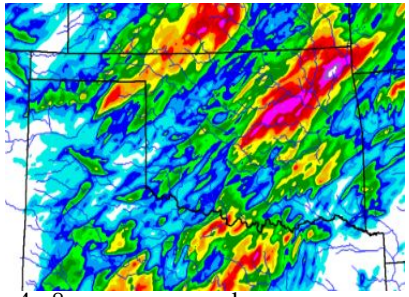

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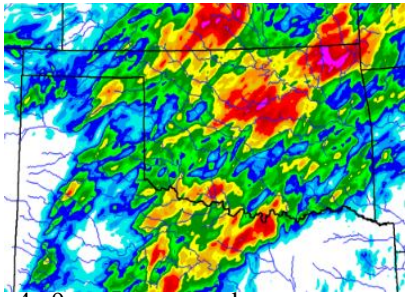

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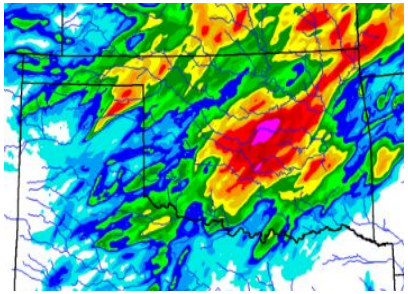

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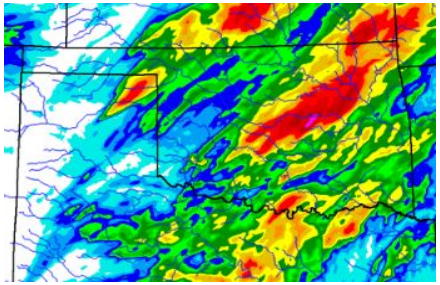

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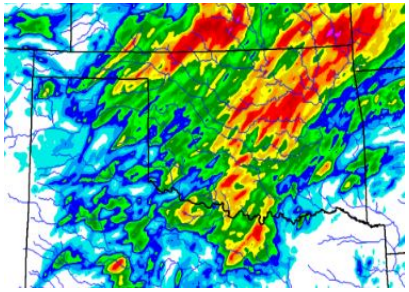

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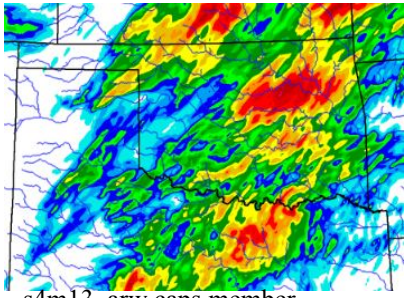

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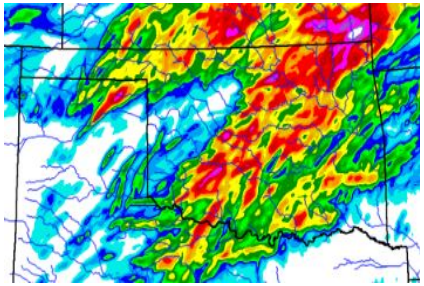

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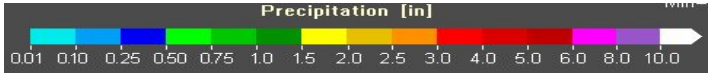
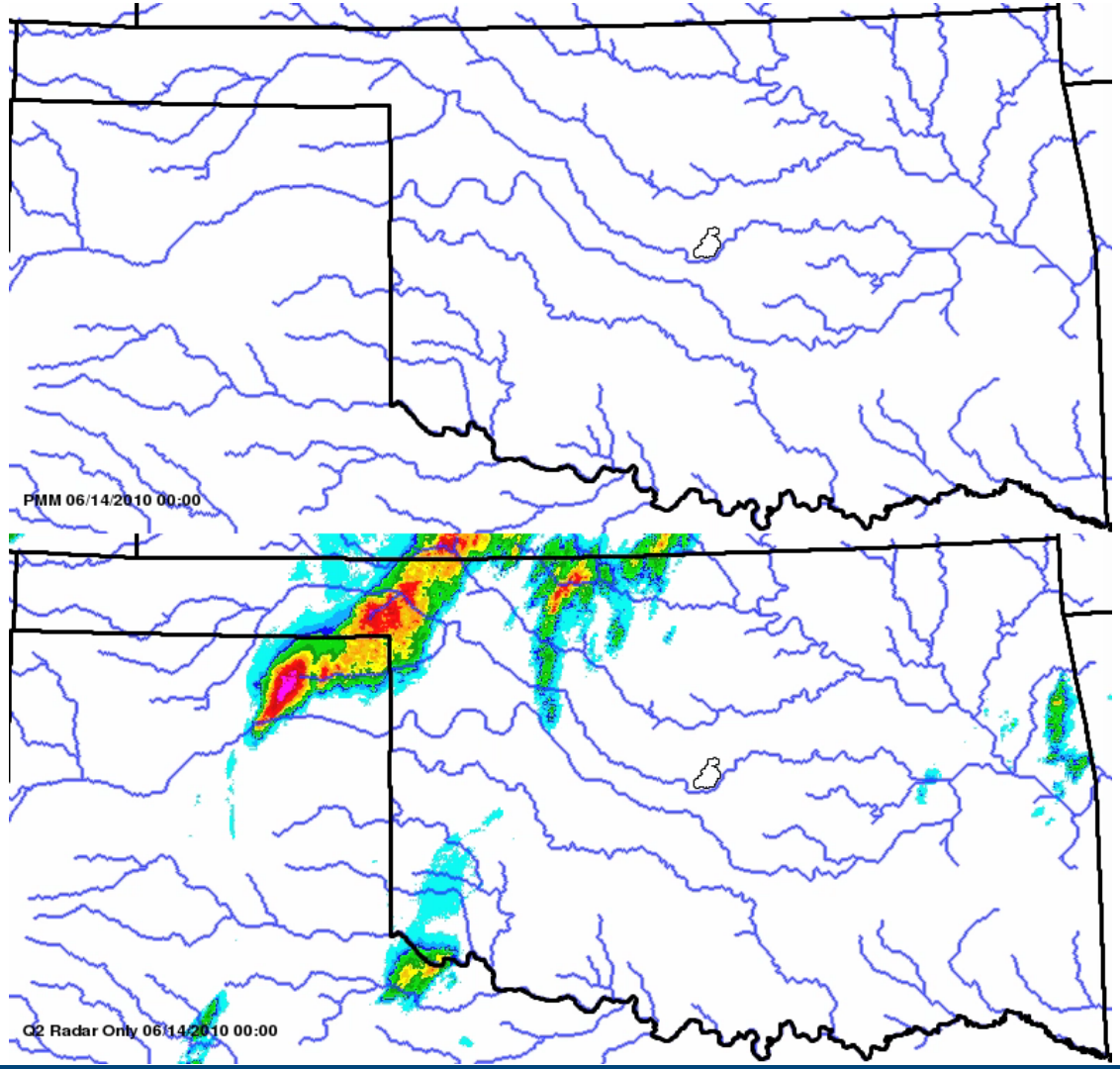


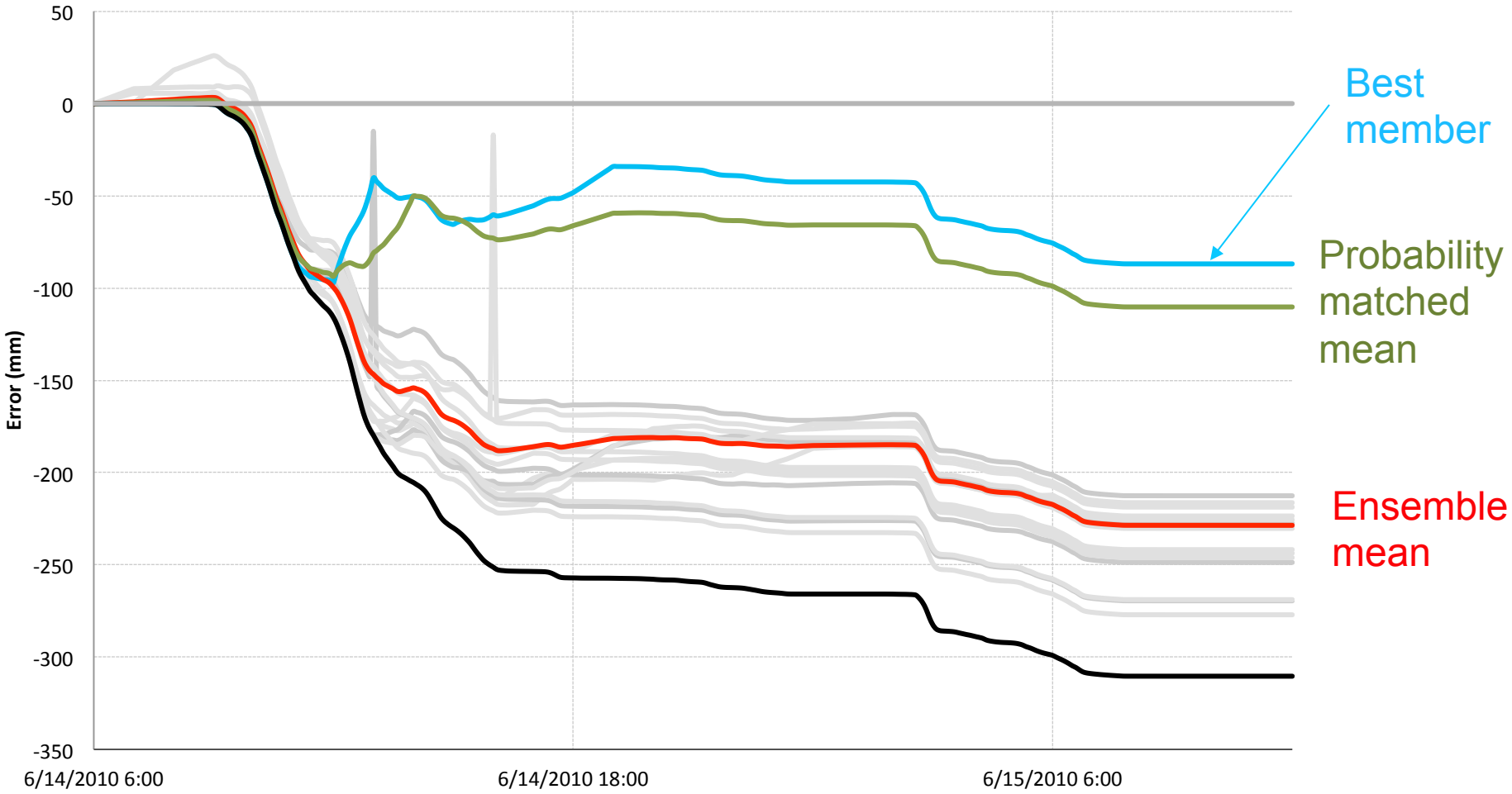
Rainfall Forecasts from CAPS Ensembles



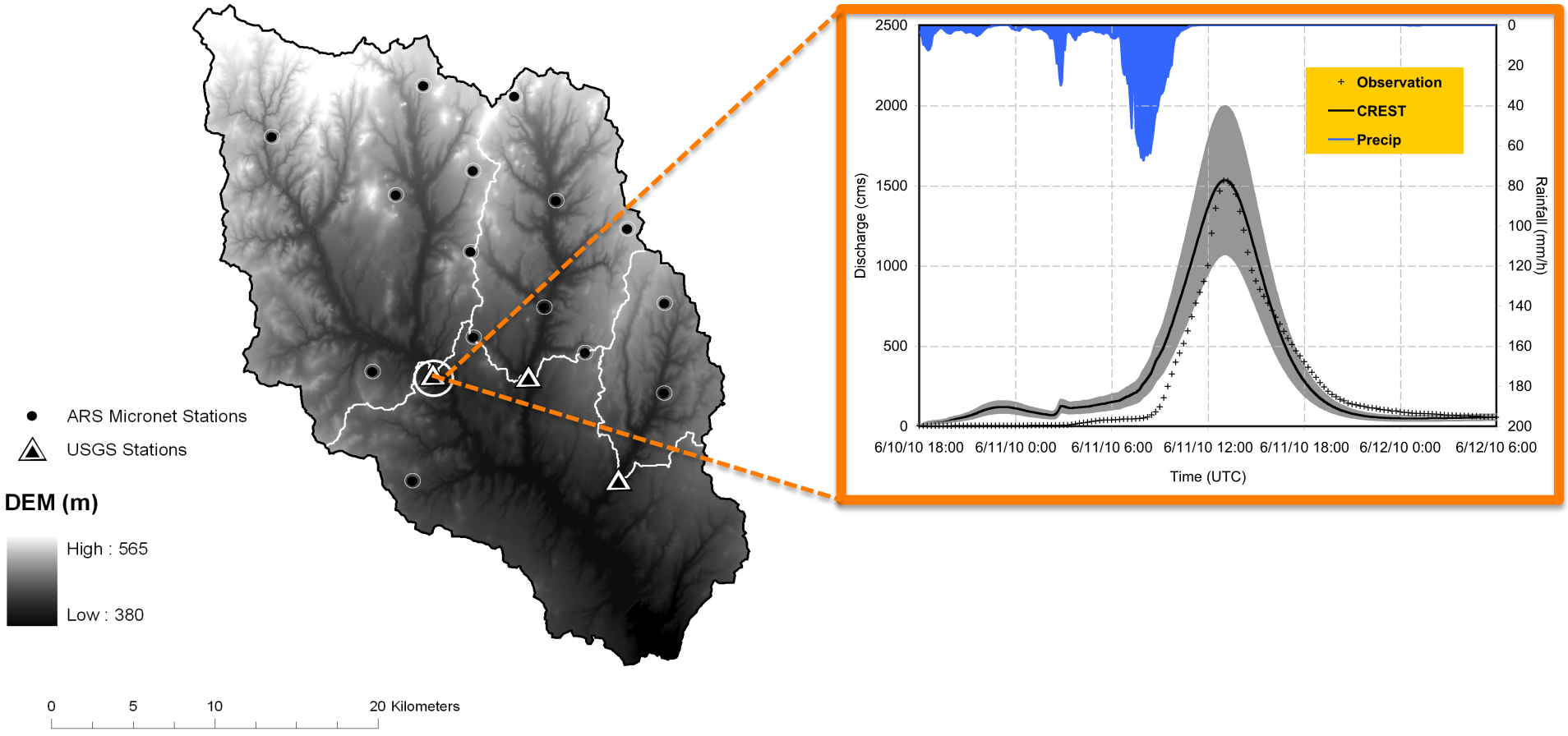
Probability matched mean (forecast)

Q2 Rainfall (observed)

Basin-Specific Rainfall Error



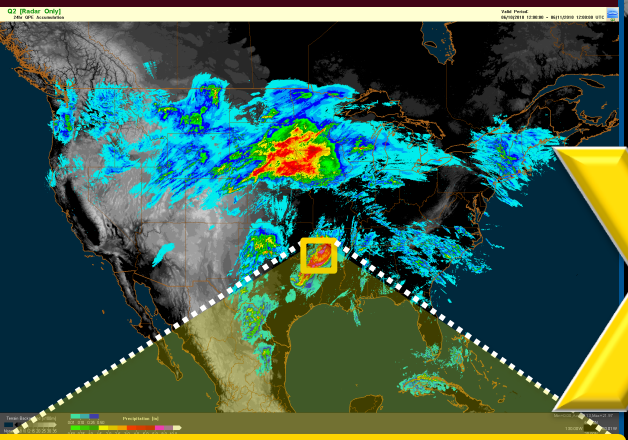
The 1D (traditional) way of doing hydrology

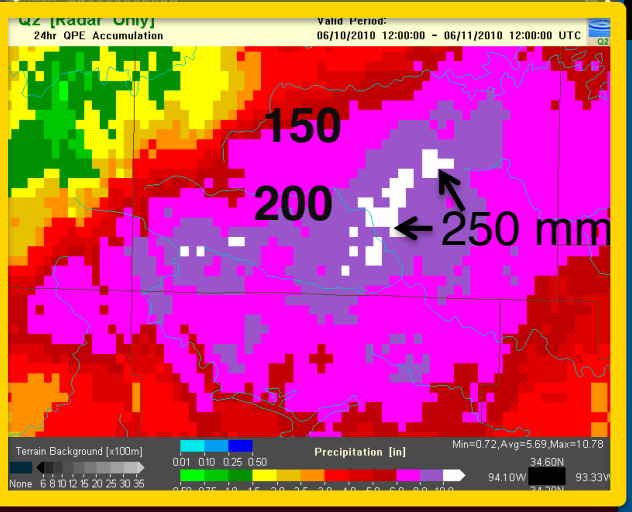


National Mosaic and Multi-Sensor QPE (NMQ-) Flooded Locations And Simulated Hydrographs (FLASH)

A CONUS-wide flash-flood forecasting demonstration system

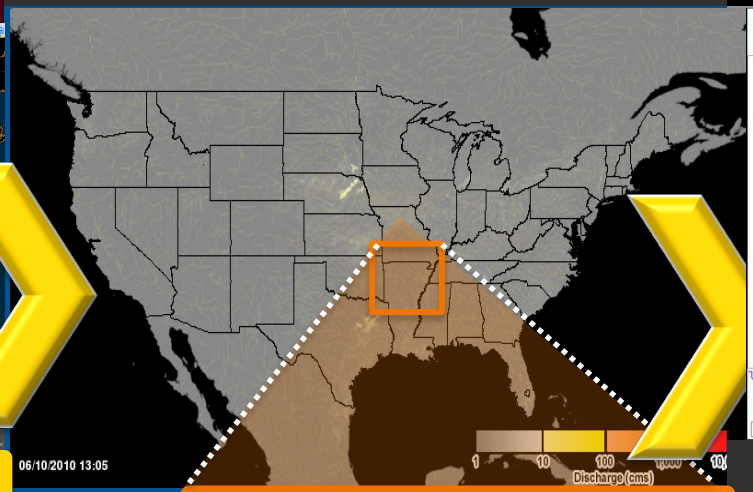
NMQ/Q2 Rainfall Observations -1km²/5 min Stormscale Rainfall Forecasts



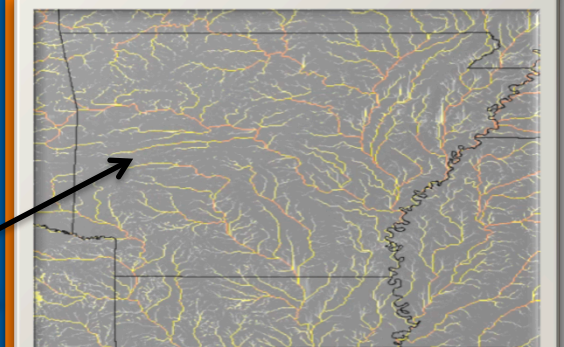


10-11 June 2010, Albert Pike Rec Area, Arkansas

CREST Stormscale Distributed Hydrologic Model -1km²/5 min

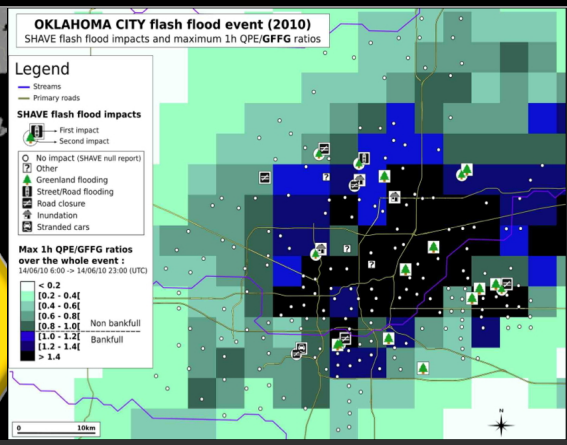


Simulated surface water flows and return period

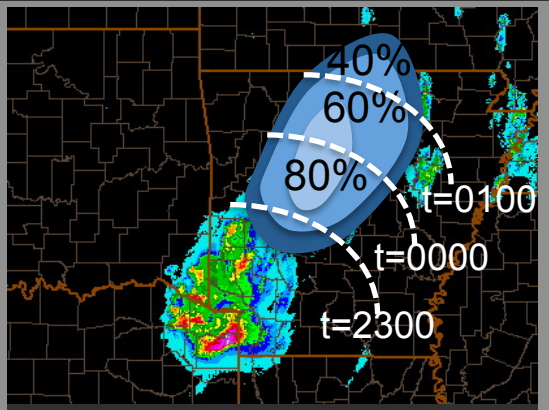


20 fatalities

Probabilistic Forecast Products on the Flash Flood Impacts



Type of flash flood impact according to SHAVE database

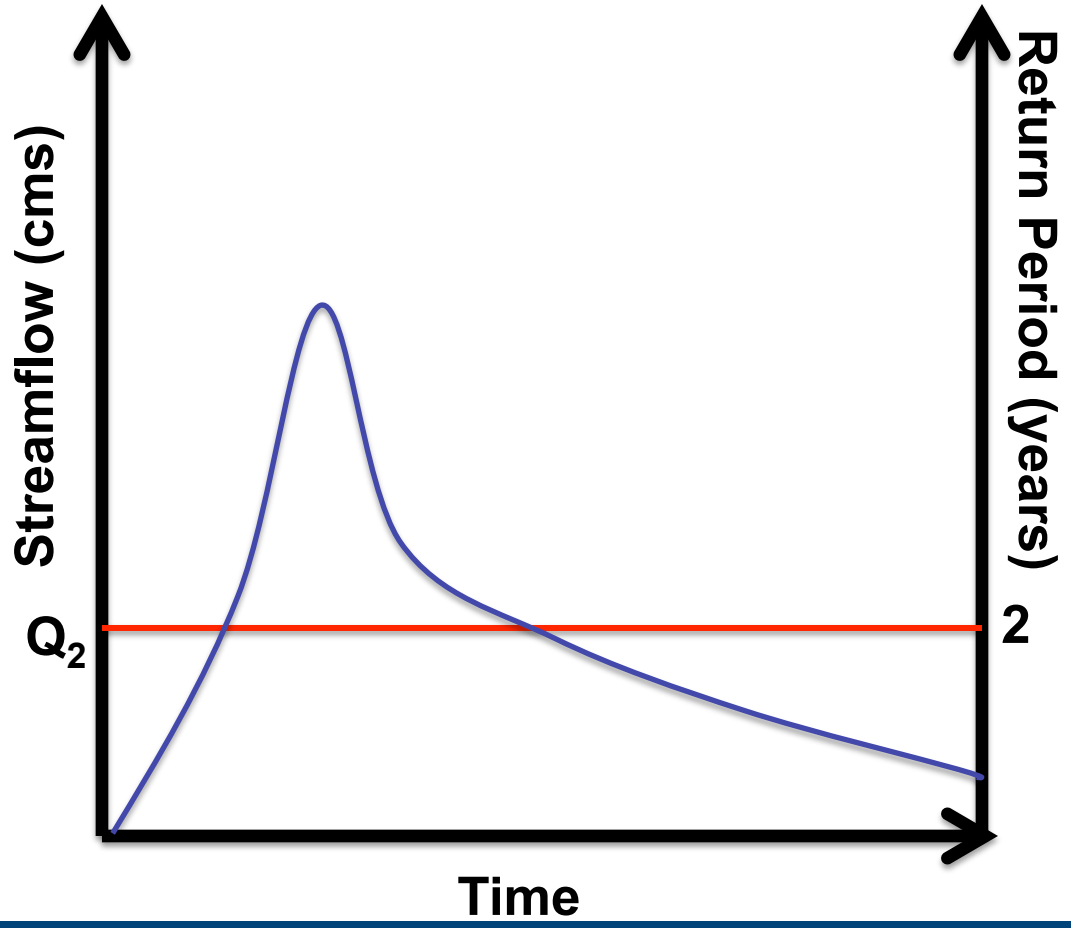


Probability of *life-threatening* flash flood

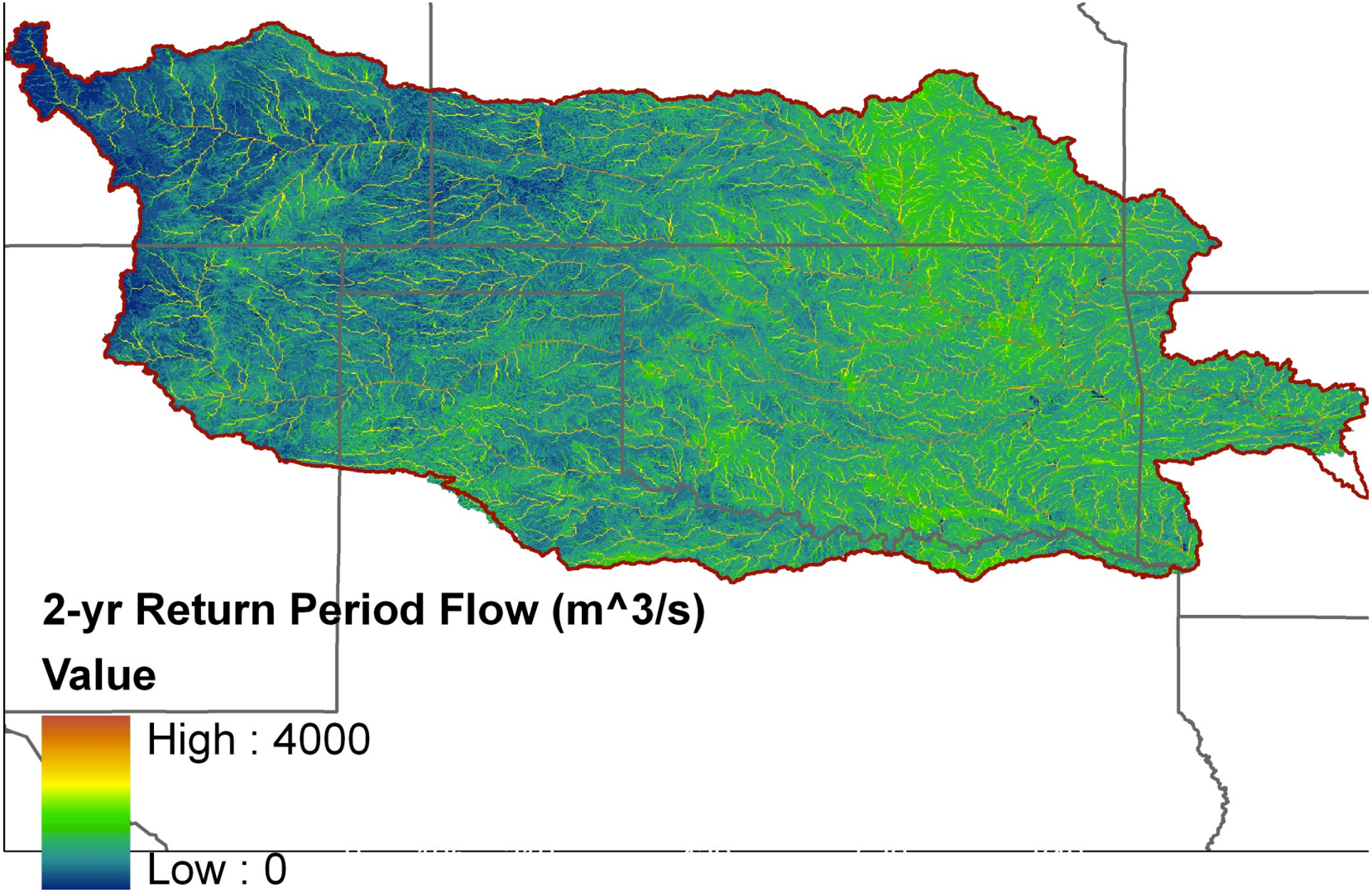
Threshold frequency method for flash flood prediction

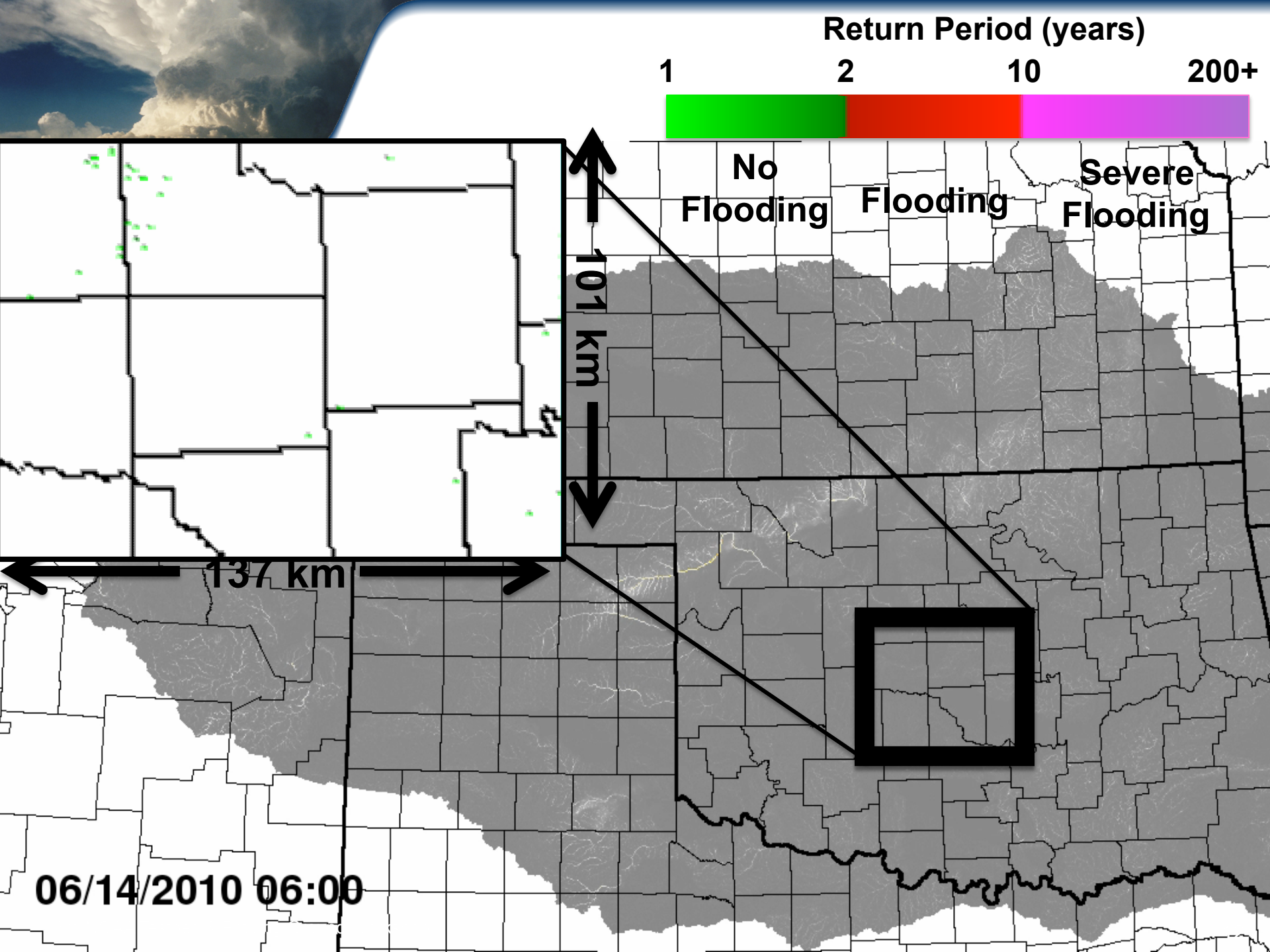
1. Take longest available gridded rainfall record
2. Simulate flow with hydrologic model for period of rainfall recording annual maximum flows @ each grid cell
3. Compute Log-Pearson III distribution from annual maximum sim flows (gives mean, standard deviation and skew parameters)
4. From this distribution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

Inherent bias correction for inputs+model

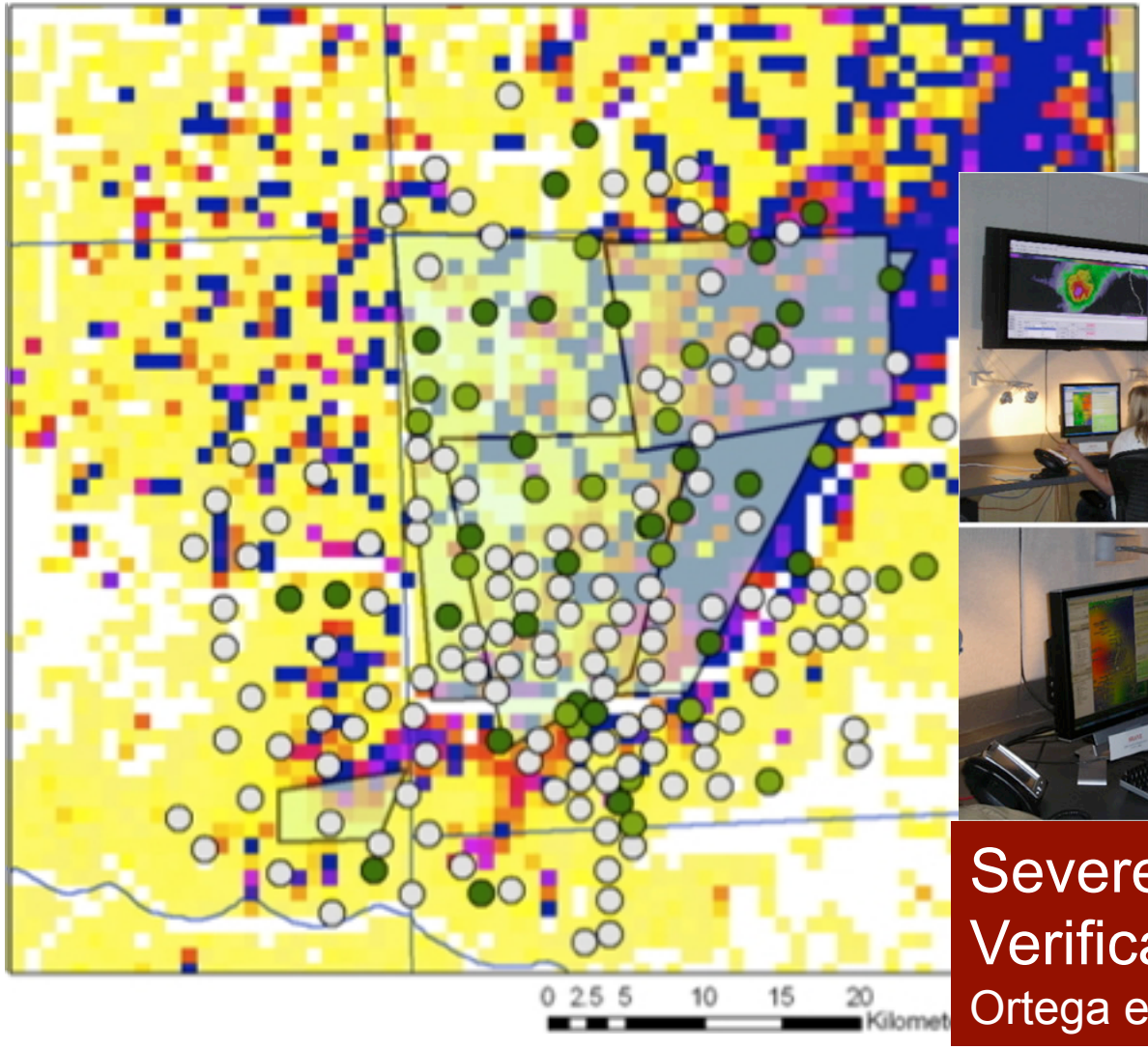


Return period flows from Stage IV archive (1996-present)




Return Period (years)
1
2
10
200+
No Flooding
Flooding
Severe Flooding
101 km
137 km
06/14/2010 06:00

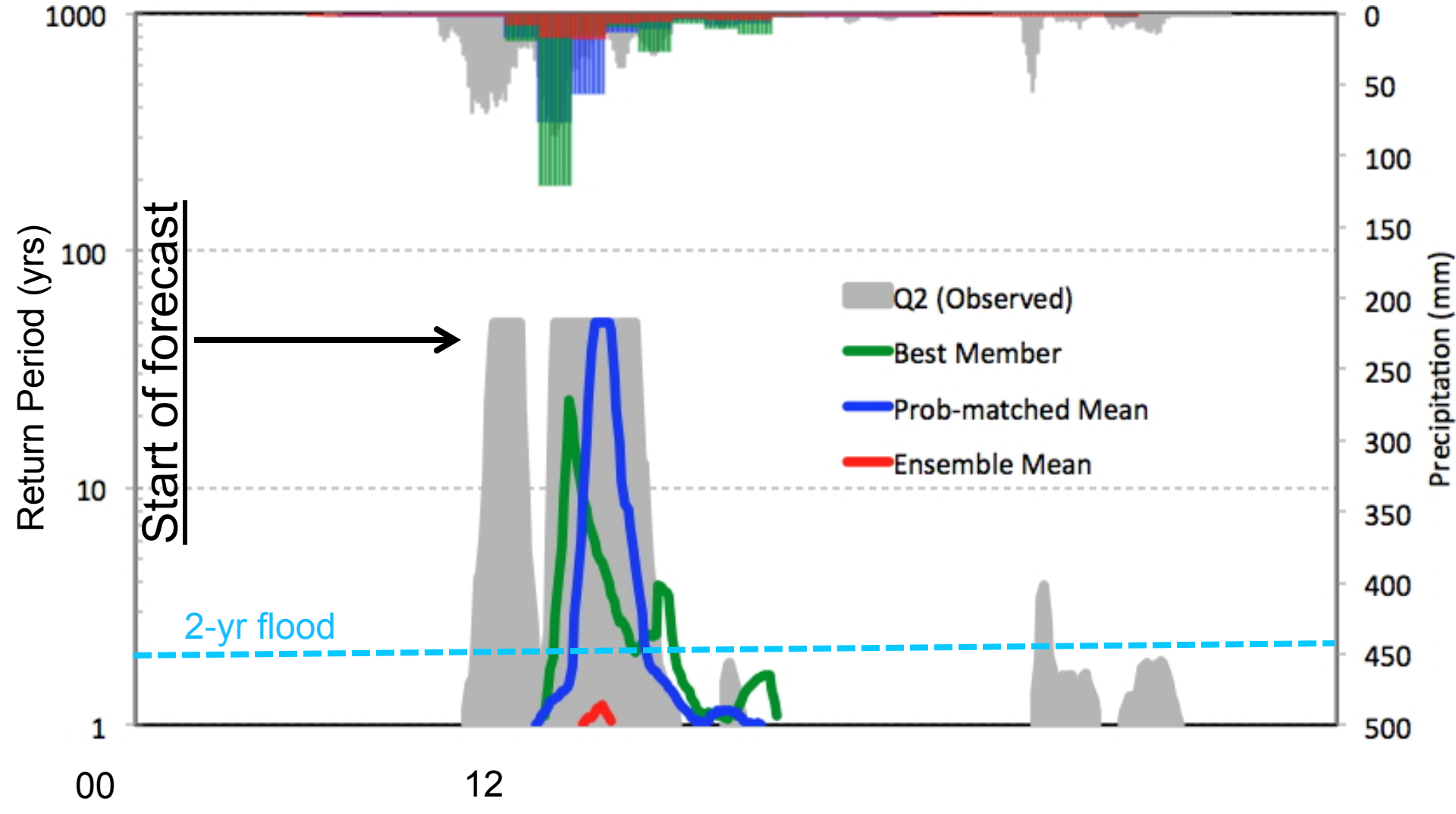
Evaluation of Flash Flood Simulations



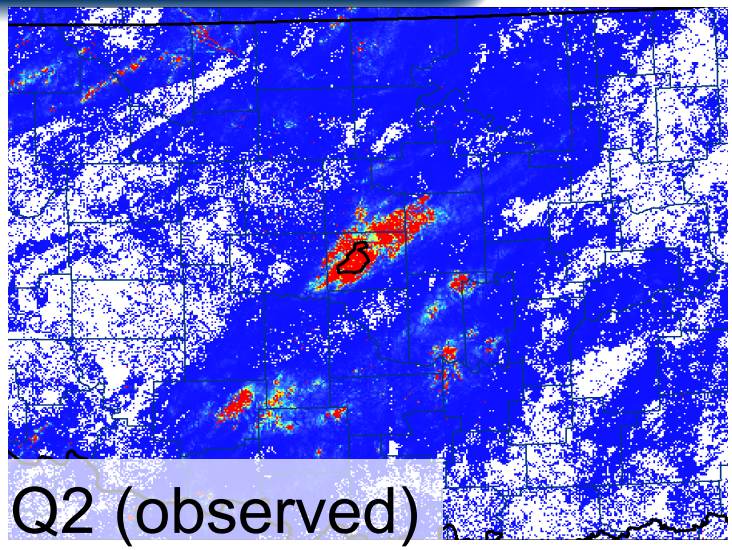
Severe Hazards Analysis and Verification Experiment

Ortega et al., BAMS (2009)

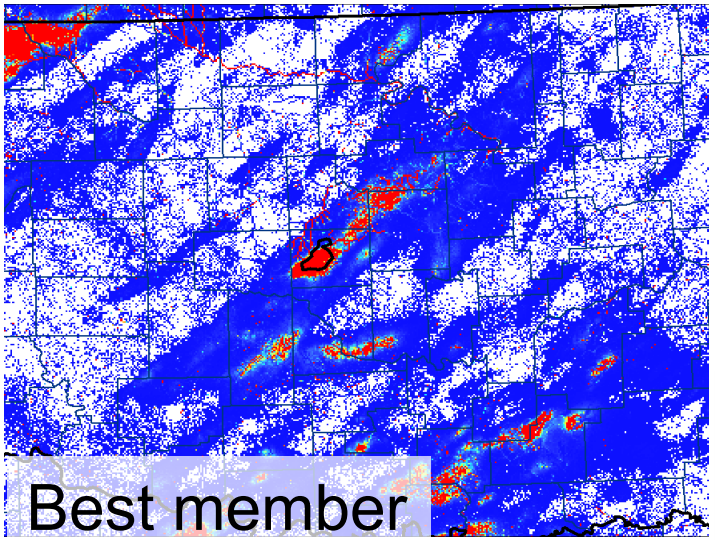
Basin-Specific Hydrologic Simulations



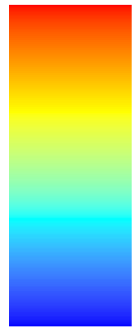
Maximum Return Periods – OKC Flash Flood



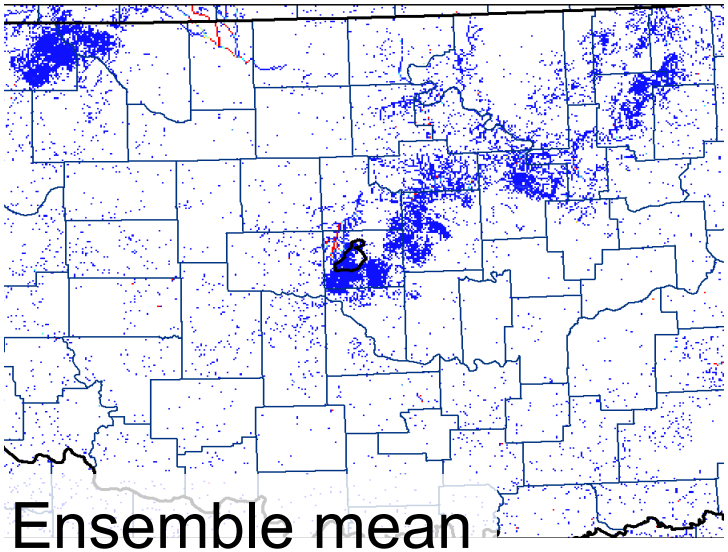
Q2 (observed)



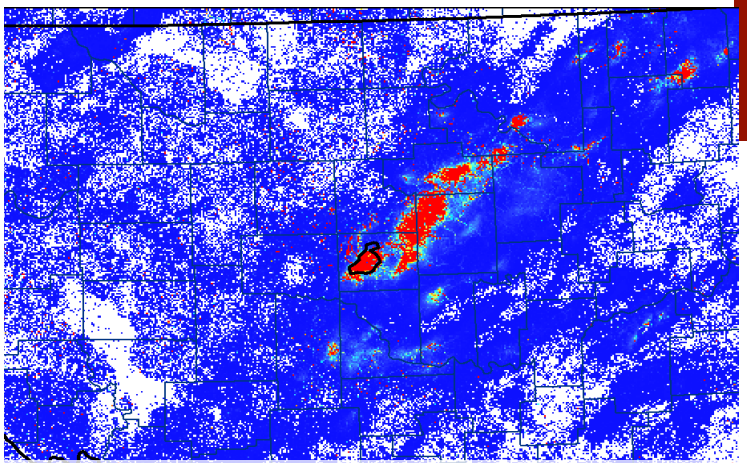
Best member



Promising performance from a 12-hr forecast !

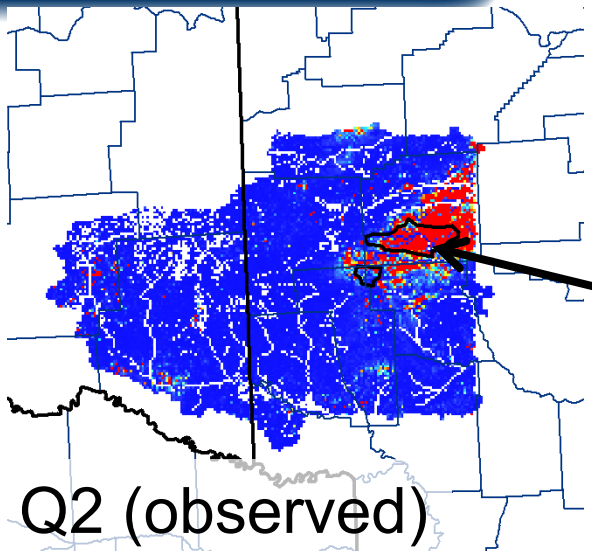


Ensemble mean

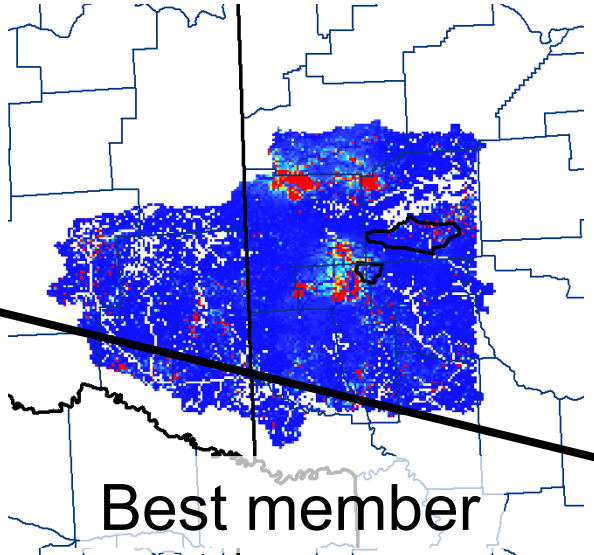


Probability matched mean

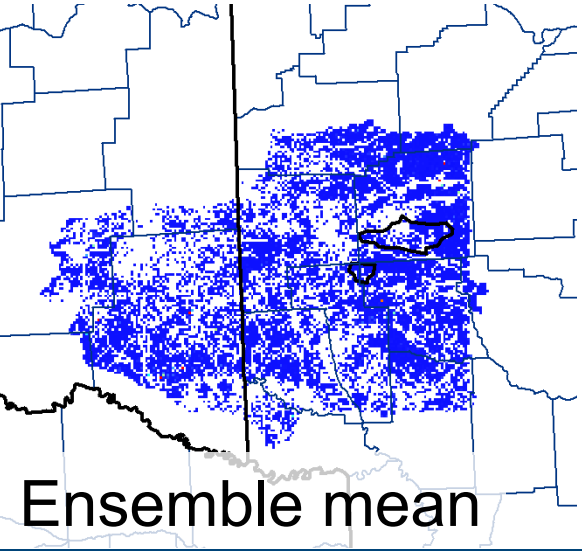
Maximum Return Periods – AR Campground Flash Flood



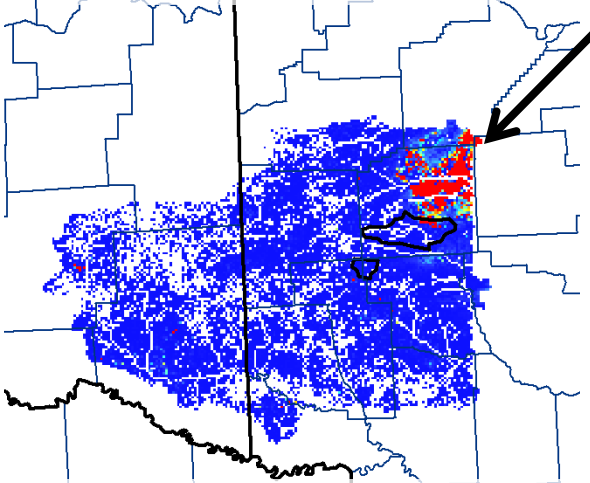
Q2 (observed)



Best member



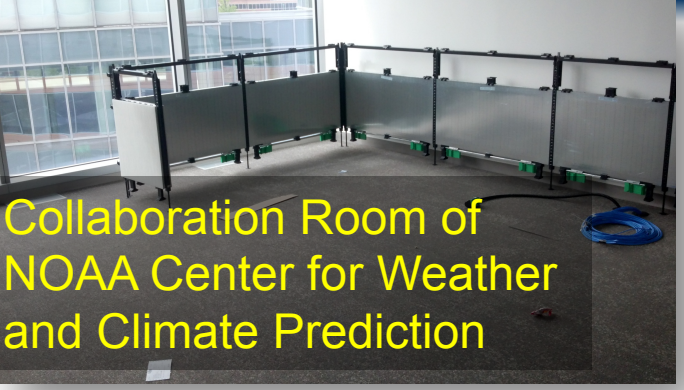
Ensemble mean



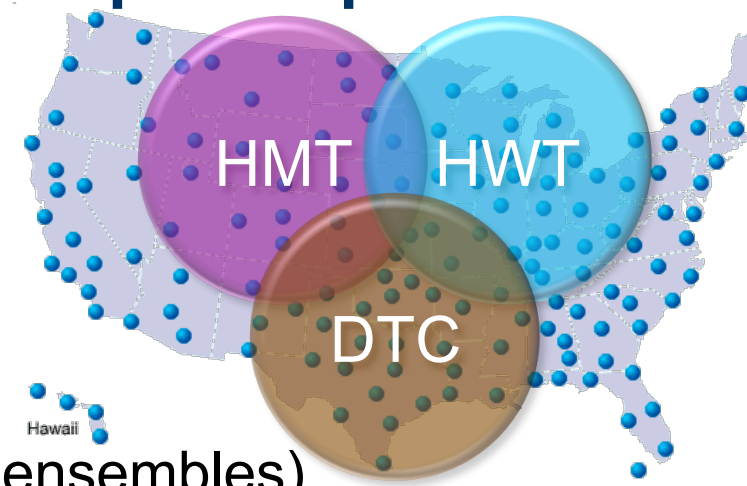
Probability matched mean

Slight offset in location of max flooding

Photo source: National Geographic



A testbed concept on intense precipitation

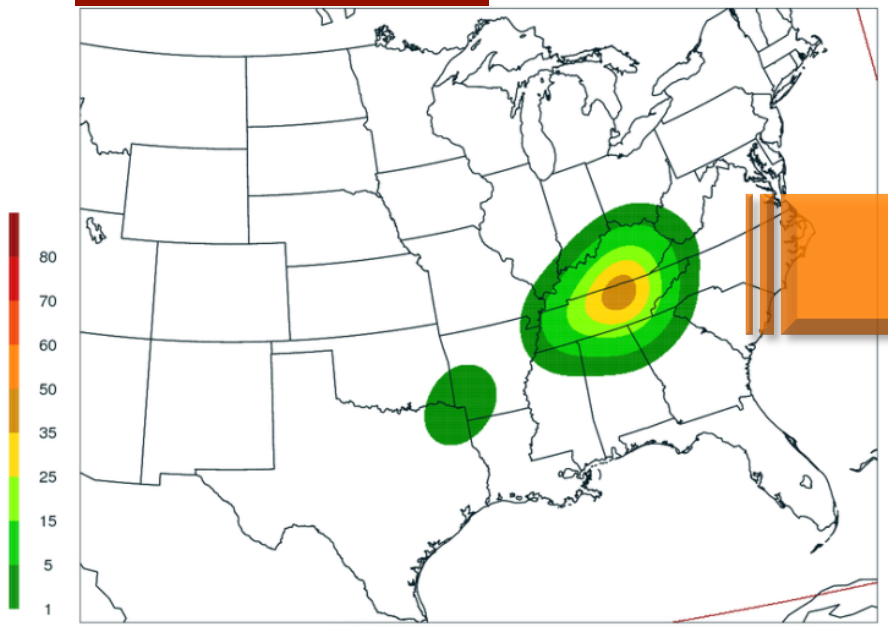


Intense Precipitation/Flash Flooding (IPFF)

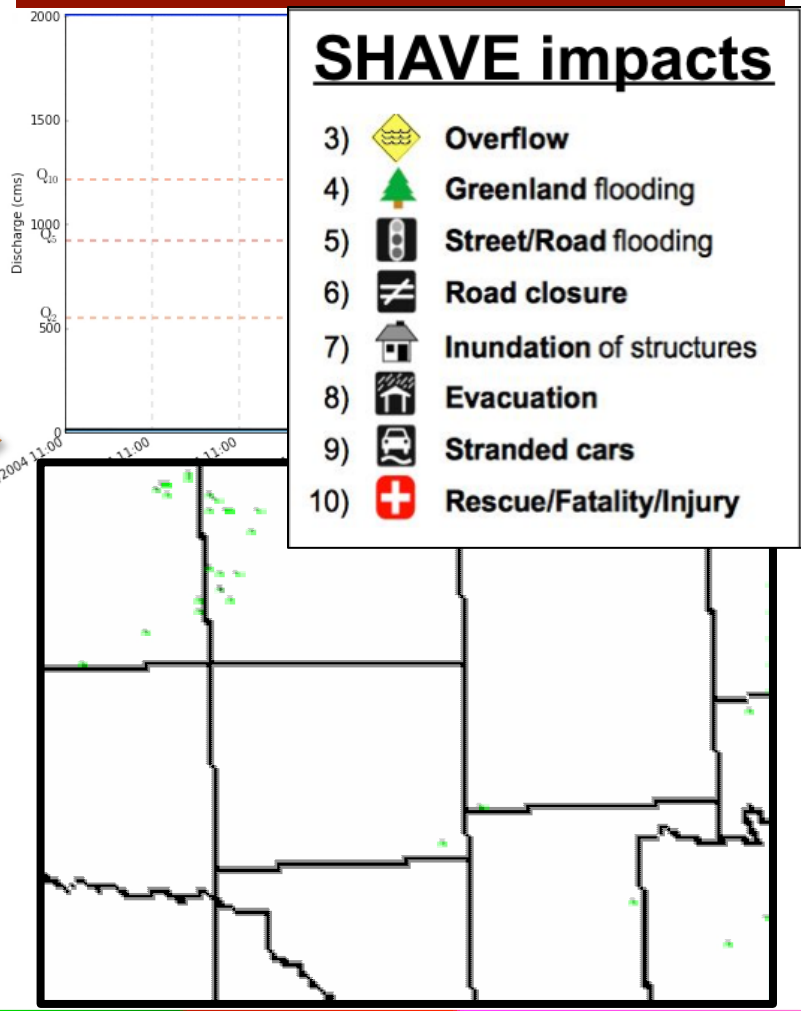
- Take place during warm season months
- Utilizes research (e.g. CAPS stormscale ensembles) and operational QPF products over the CONUS
- Incorporates QPF evaluation tools developed at DTC
- Will be transitioned close to operations, at the HPC
- Develops and evaluates new products such as *probability of flash flooding*, rather than probability of QPF > threshold rainfall (FFG)

From probability of heavy rainfall to probability of flash flooding

Probabilistic QPF



Probabilistic Flash Flood Forecast



FLASH
Flooded Locations and Simulated Hydrographs Project

www.nssl.noaa.gov/projects/flash