Using Crowd-Sourced Data to Improve Analysis of Flash Flood Events

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Lower Mississippi
River Forecast Center

NOAA

Overview

- Flash flooding near the top for "short-fuse" weather fatalities and damages

- Flash flood warnings typically lacking when compared to other "short-fuse" warnings

- Current methods of collecting flash flood reports inadequate for verifying new models/techniques under development

Overview

- Data-mining of social media, news media, and other web sources is one potential way to complement NWS LSRs

Why care about flash flooding?

- Detailed weather fatality/injury/damage statistics available over shorter 19 year period (1994-2013)

- Among short-fuse weather events, *flash* flooding is just shy of #1* in:
  - Number of fatalities
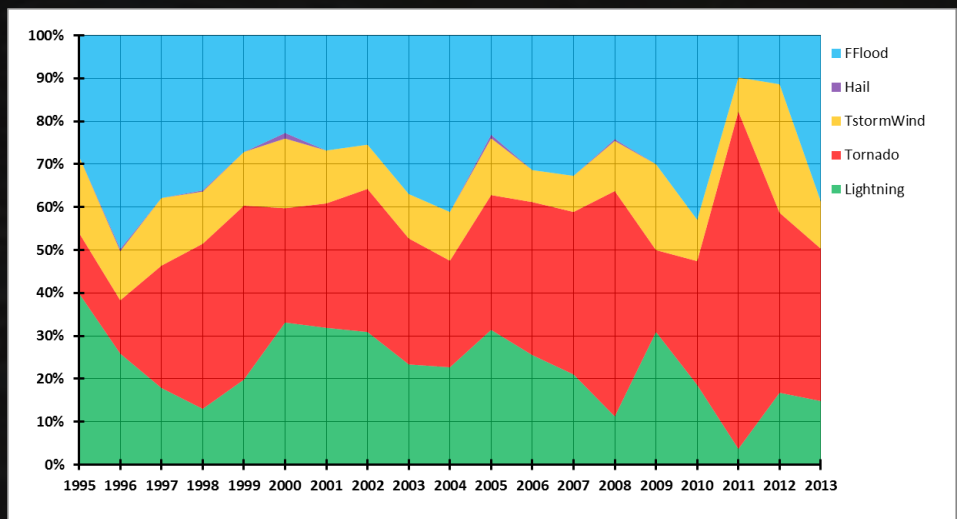 - Crop/property damage

NOTE: Ignoring the big tornado year of 2011, flash flooding would be approximately the same as tornadoes.

Flash Flooding Statistics

U.S. Weather Fatalities:
All
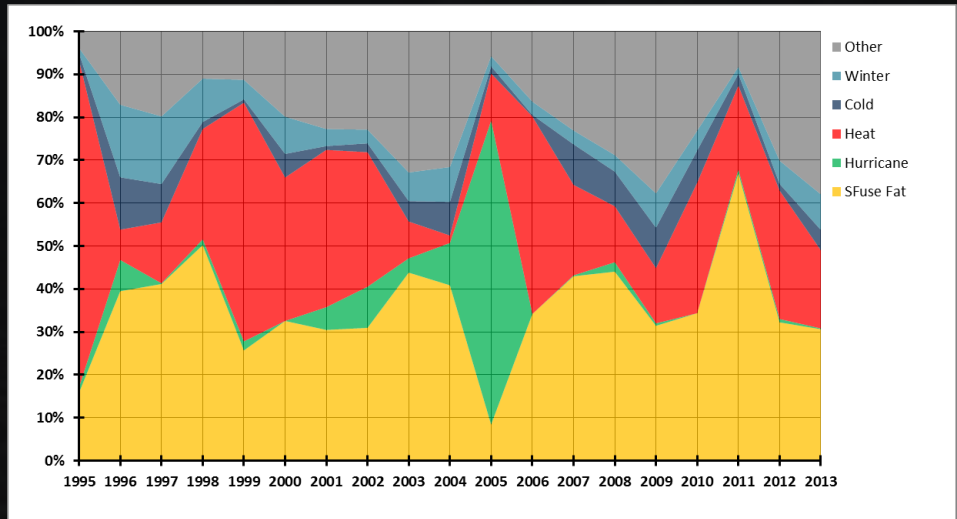
U.S. Weather Fatalities:
Short-fuse events

Source: National Weather Service Office of Climate, Water, & Weather Services

Why improve flash flood warnings?

- Tornado/Severe warnings:
    - Scientific reasoning
    - Specific location of threat
    - Threat severity information
    - Predicted movement and evolution

- Flash Flood warnings:
    - Frequently cover large areas
    - Frequently lack severity information

Current nowcasting tools

- Gridded Flash Flood Guidance (GFFG) utilized by Flash Flood Monitoring and Prediction (FFMP). Nation-wide coverage.

- Site-Specific Headwater Predictor (SSHP) used for very few, specific locations

GFFG and FFMP

- Gridded product that provides flood/no-flood rainfall value over set durations

- Based upon land cover, slope, and soil type

- Shows where runoff is generated, not where accumulating (no routing)
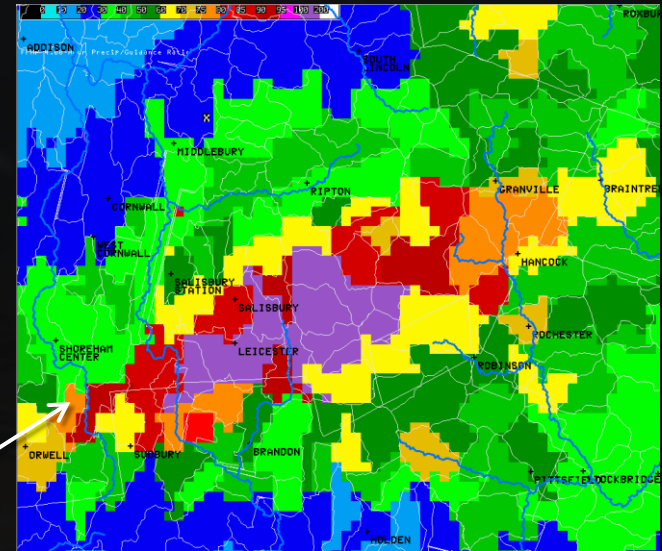
*Realtime rainfall...
ratio of GFFG in FFMP*
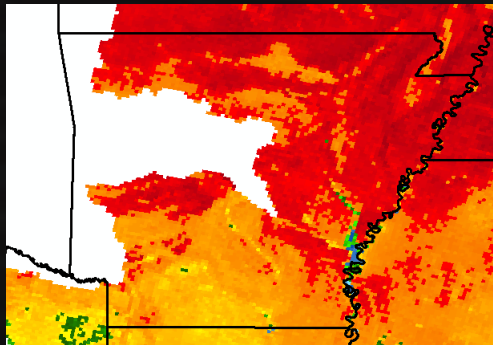
Adjusted for soil moisture 4x daily

GFFG and FFMP

- Gridded product that provides flood/no-flood rainfall value over set durations

- Based upon land cover, slope, and soil type

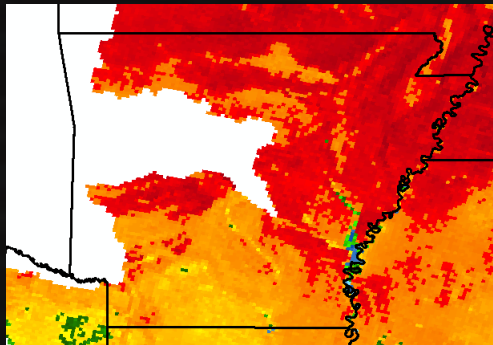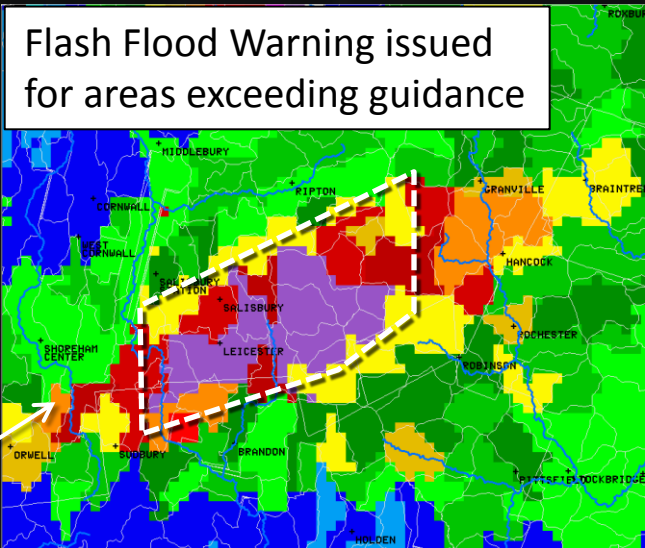- Shows where runoff is generated, not where accumulating (no routing)

Flash Flood Warning issued for areas exceeding guidance
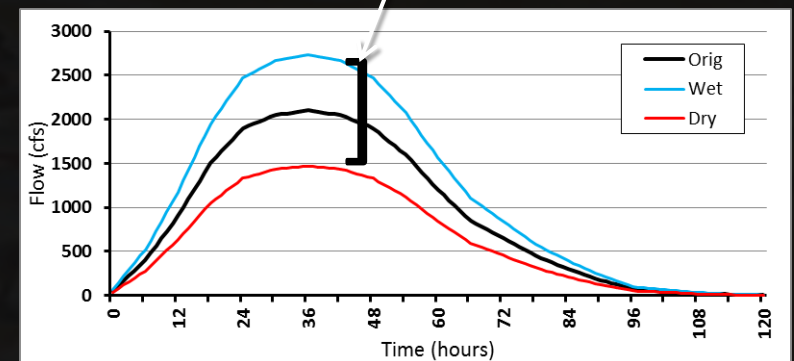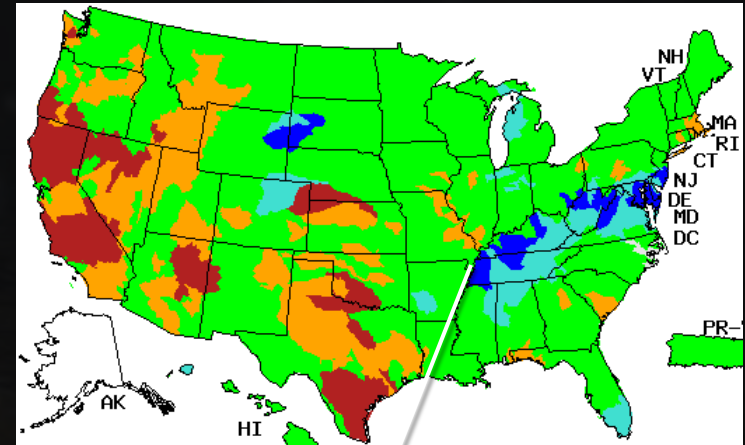
Realtime rainfall… ratio of GFFG in FFMP

Adjusted for soil moisture 4x daily

SSHP

- Substantial period of record required
- Calibrated to observations
- Specific locations only

Soil moisture adjustment
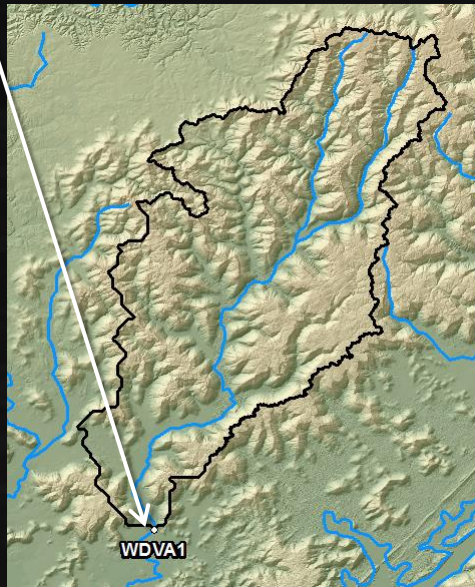
How to improve flash flood warnings?

- New models and techniques that…
  - provide estimates of event magnitude
  - show where runoff accumulates, rather than where it is generated
  - project the evolution of the flash flood event

How to improve flash flood warnings?

- Techniques need to be verified and/or calibrated against actual flash flooding

- Current reports of flash flooding come from NWS Local Storm Reports (LSRs)
  - Data is inconsistent by event and by office
  - Data lacks areas of "no flooding"
  - Data isn't used to verify warnings *spatially*

How to improve flash flood warnings?

- What do we do?

    - <u>Search for as much data as possible for real events and quantify the severity</u>

Severe weather post-event surveys

- For tornadoes/straight-line winds NWS surveys damaged areas after event to determine scope and cause

- Damage for high-end wind events typically evident even in lower population areas

Severe weather post-event surveys

Jenna Beall

- Where's the evidence of high-end flash flood event?

Severe weather post-event surveys

Jenna Beall

- Where's the evidence of high-end flash flood event?

Severe weather post-event surveys

- With quick onset of flooding and quick drainage, sometimes there is no debris nor obvious mud/dirt marks in vegetation within just a few days

Occupants escaped through attic

Jenna Beall

Water reported as reaching top of fence

Jenna Beall

Sources for additional reports

- ## Social media
  - Facebook pages for TV, radio, newspaper
  - Twitter posts using tags Pensacola and Flood
  - Youtube videos
- ## News media
  - TV, radio, newspaper websites
- ## Other web sources
  - Blogs
  - Google Traffic

Sources for additional reports

- Data from social media... community TV facebook

Neda Burtman, posted to social media
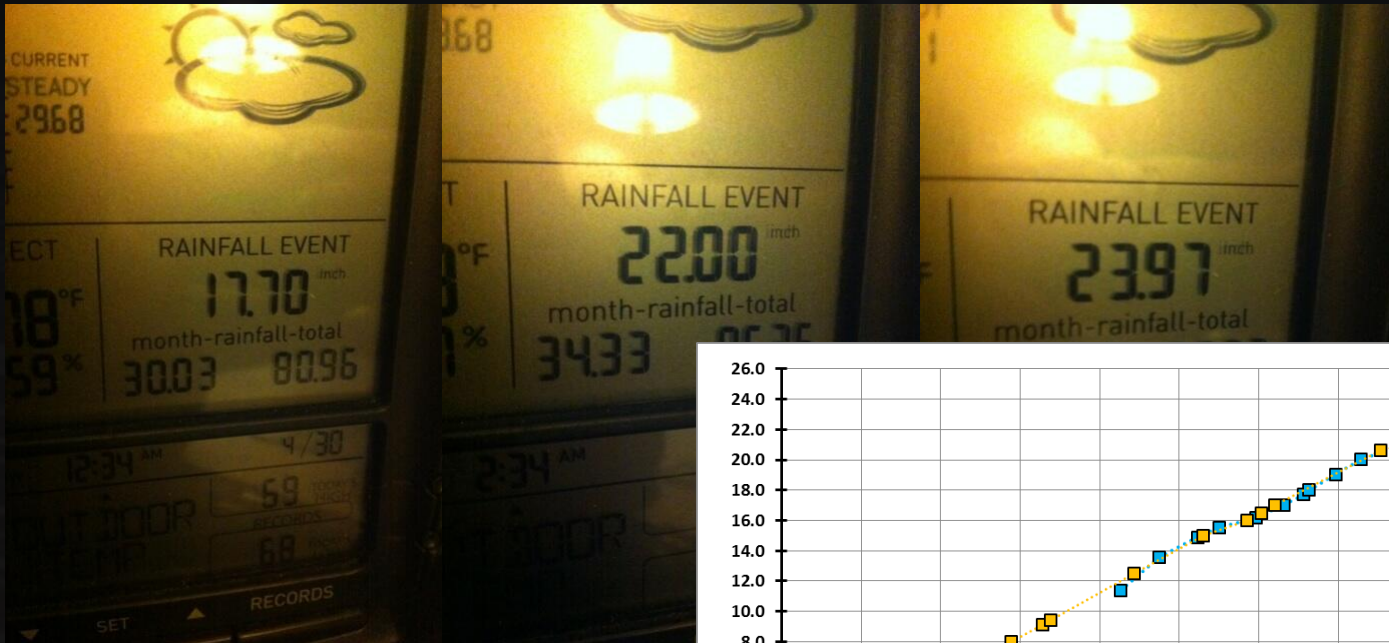
Power lines

Boathouse

Grandview Pond

Google Maps

Sources for additional reports

- Data from social media... public posting pictures

Andrew Soileau Jr. ▶ WEAR ABC 3 News, Pensacola
Follow · 14 hrs

Damage roads & empty lakes at Adara Gulf Course at Shoal River Dr. & Grandview Lakes in Crestview, FL

Like · Comment · Share

Jennifer Raulerson likes this.

W Scott Lincoln Andrew: Do you have any other pictures of this dam failure along Shoal River Dr? This one is definitely one of the best I've seen so far.
Like · Reply · 14 hours ago

Write a comment...

Interacting with commenter for more information

Andrew Soileau Jr., posted to social media

Sources for additional reports

- Data from social media… Twitter

32 tweets
over 9 hours!

Rob McGahen, posted to social media
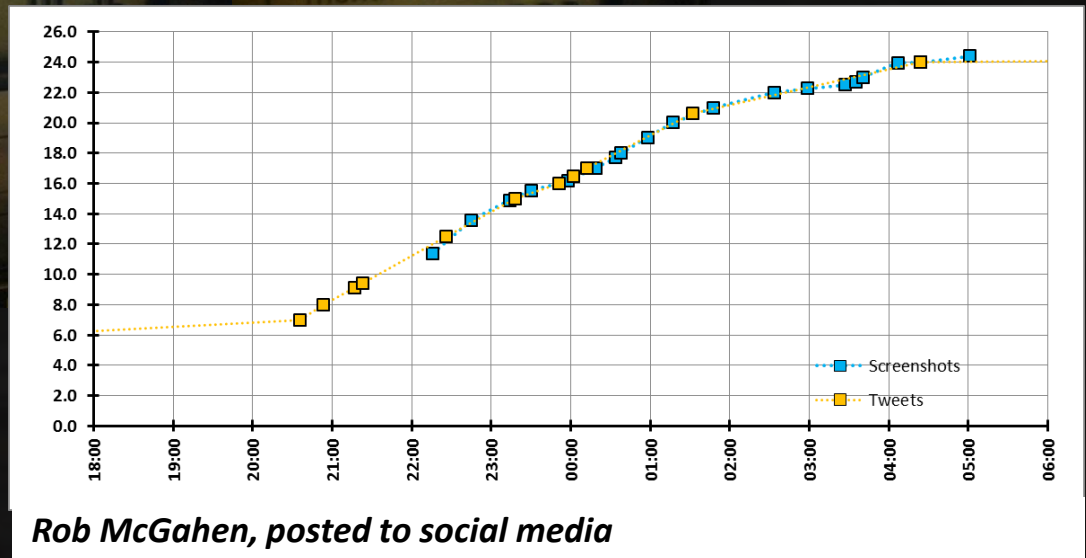
Sources for additional reports

- Google Traffic

Gap in traffic data coincident with waterway

Gap in traffic data with standstill traffic

Data recreation
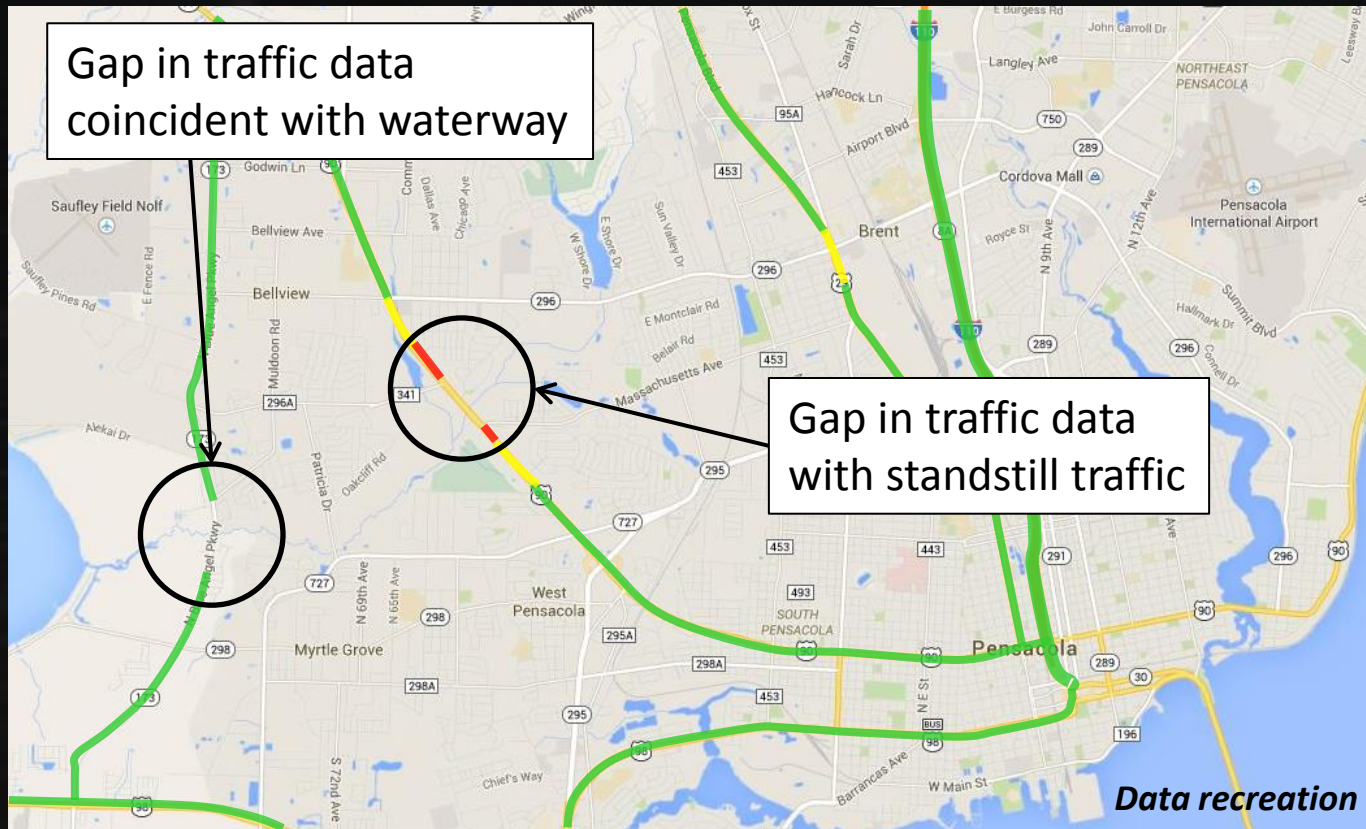
Sources for additional reports

- Youtube

Vehicle washed off road

Youtube: Mike Locke

Youtube: Mike Locke

Sources for additional reports

- Blog posts

Corroboration of other reports

04-30-2014, 04:49 PM   #125

wld1985
Senior Member
Blue Marlin

Join Date: Oct 2007
Location: Pensacola
Posts: 4,498

Quote:

Originally Posted by **Realtor** ⬛
Just got through to one of my tenants over on Crescent lake they told me the dam gave way and the lake will be empty in another hour. There was a vehicle in the trees from when the dam let go, it washed the car off Massachusetts ave. into the trees. such a shame.

Im in Gulf South Manor, and when i let this morning around 8am.. There were 3 automobiles pushed off the side of michigan where cresent lake flows out and under Michigan.. One truck was about 100ft off the road and into the woods.. (where people sometimes fish at the bottom of the hill).. I've got pics but, Not sure how to post them.. Also of Mobile hwy,where the carragie hills and Bayou Marcus I think spill into.. That whole bridge before massachutes was flooded over and running like a river.

Share

Pensacola Fishing Forum

Quote

Sources for additional reports

- News Media

Roadway followed natural low spot

Pensacola News Journal

Google Maps

Sources for additional reports

- News Media

This is not a waterway flooding a road…

…but a modern bridge which cannot drain fast enough!

Conflicting Attributions
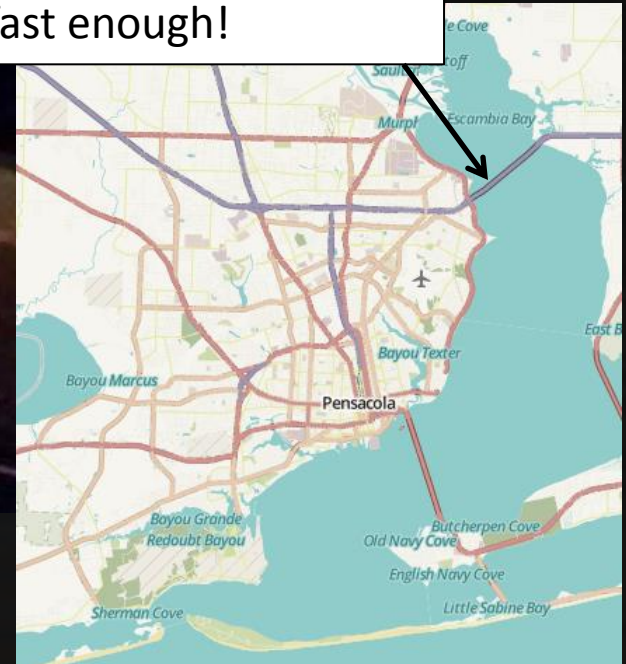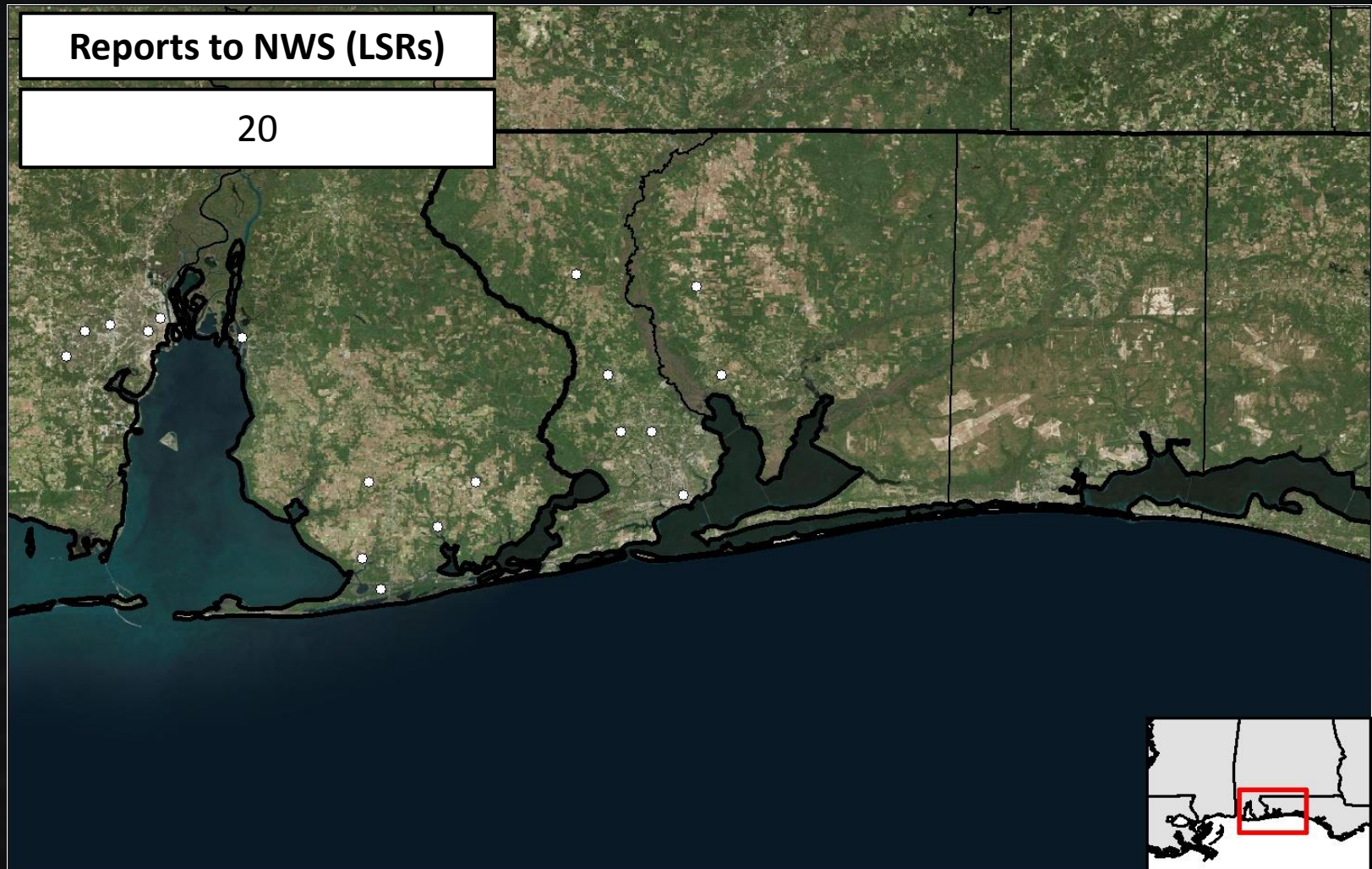
Quantifying report severity

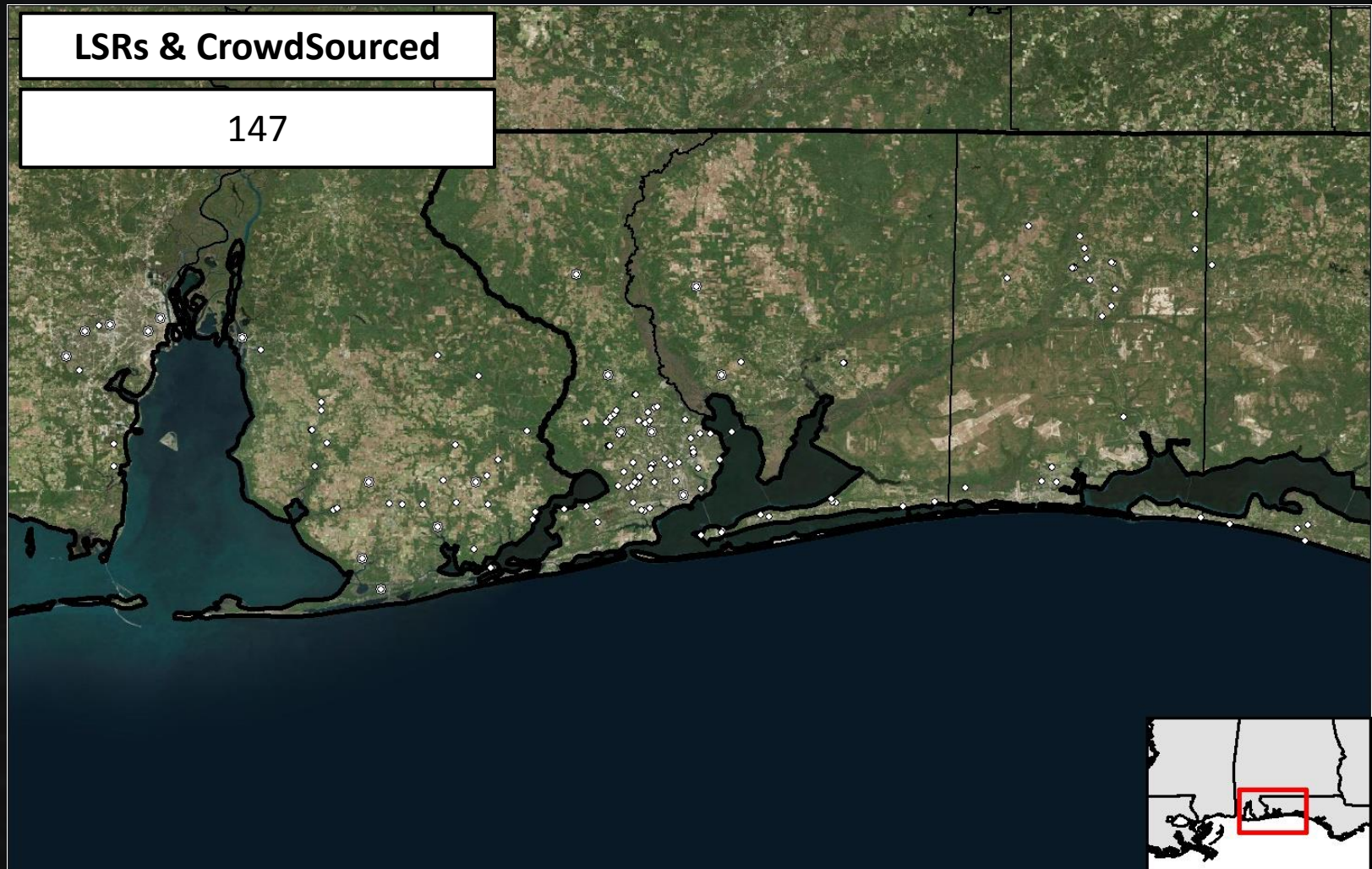| Severity Label	Description/Criteria
Roadway flooded	Minor nuisance flooding of roadways
Roadway flooded (major)	Flooding of roadways deep enough to stall cars, or overtopping of bridges along major highways of modern design standards
Structure flooded	Residences or businesses flooded
Washout	Roadways or culverts completely washed away
Water rescue	Reports of persons needing to be rescued from residences or their vehicles
Dam failure	Dam eroded away to allow impounded water to release uncontrolled
Unknown	Flooding reported but little additional information provided

Adapted from:

Lincoln, W. S., 2014: Analysis of the 15 June 2013 isolated extreme rainfall event in Springfield, Missouri. *J. Operational Meteor.*, **2** (19), 233–245.
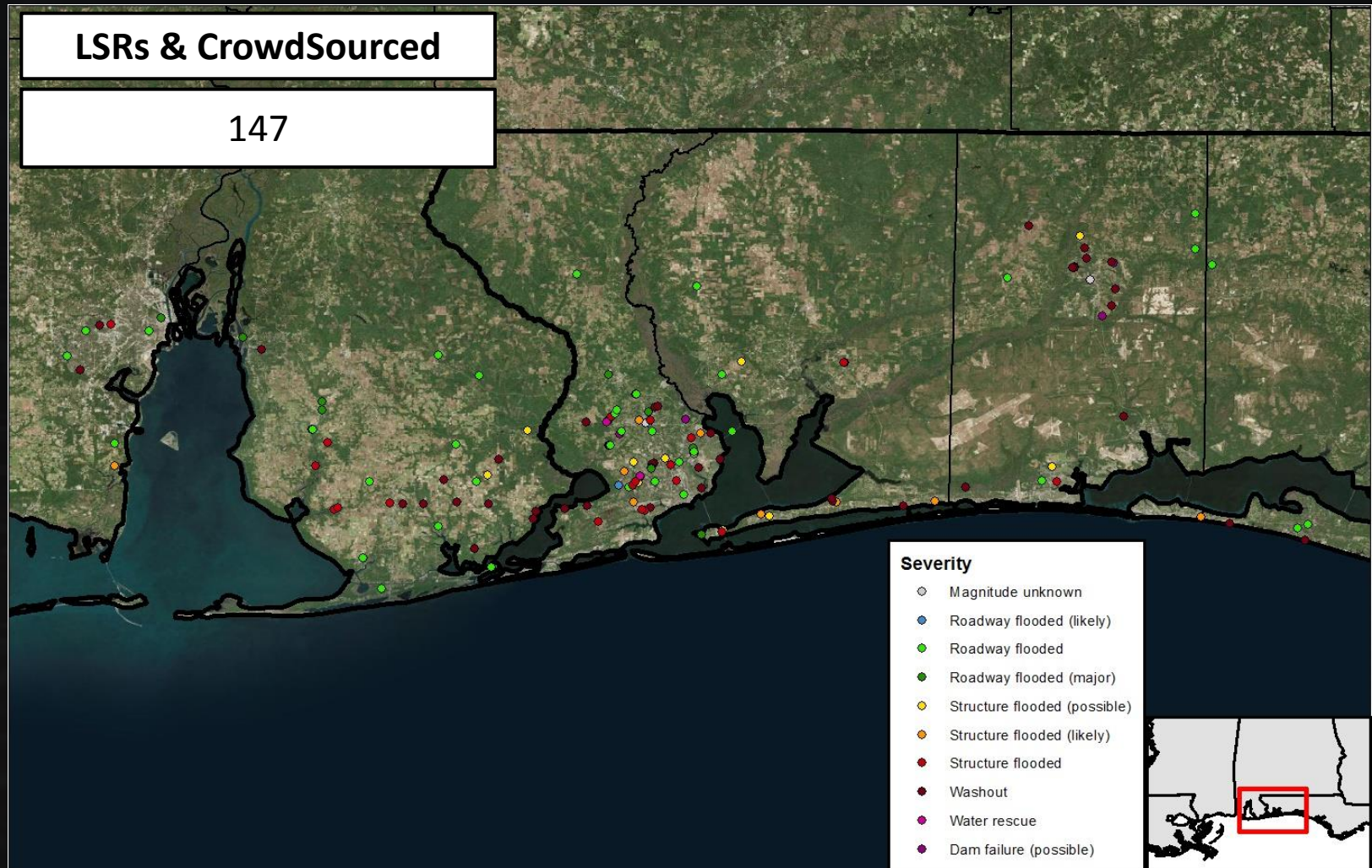
Case Study: April 2014 Pensacola

Reports to NWS (LSRs)

20

Case Study: April 2014 Pensacola

LSRs & CrowdSourced

147

Case Study: April 2014 Pensacola

LSRs & CrowdSourced

147

Severity
- ⊙ Magnitude unknown
- ⬤ Roadway flooded (likely)
- ⬤ Roadway flooded
- ⬤ Roadway flooded (major)
- ⬤ Structure flooded (possible)
- ⬤ Structure flooded (likely)
- ⬤ Structure flooded
- ⬤ Washout
- ⬤ Water rescue
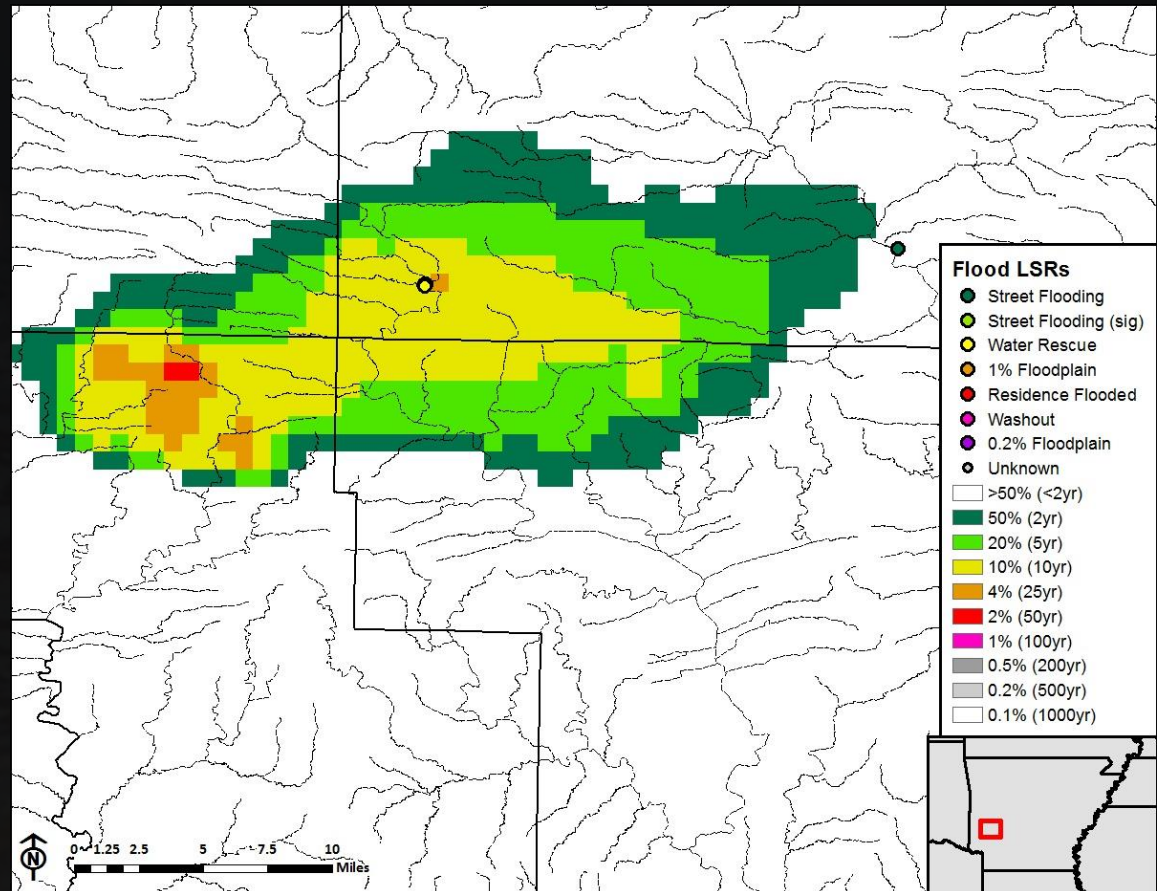- ⬤ Dam failure (possible)

Other Example Events

Ouachita Mountains, AR: June 2010

3hr Rainfall Average Recurrence Interval

Reports to NWS (LSRs)

5*

Ouachita Mountains, AR: June 2010

3hr Rainfall Average Recurrence Interval

Flood LSRs
- ● Street Flooding
- ● Street Flooding (sig)
- ○ Water Rescue
- ● 1% Floodplain
- ● Residence Flooded
- ● Washout
- ● 0.2% Floodplain
- ○ Unknown
- □ >50% (<2yr)
- ■ 50% (2yr)
- ■ 20% (5yr)
- ■ 10% (10yr)
- ■ 4% (25yr)
- ■ 2% (50yr)
- ■ 1% (100yr)
- ■ 0.5% (200yr)
- ■ 0.2% (500yr)
- □ 0.1% (1000yr)
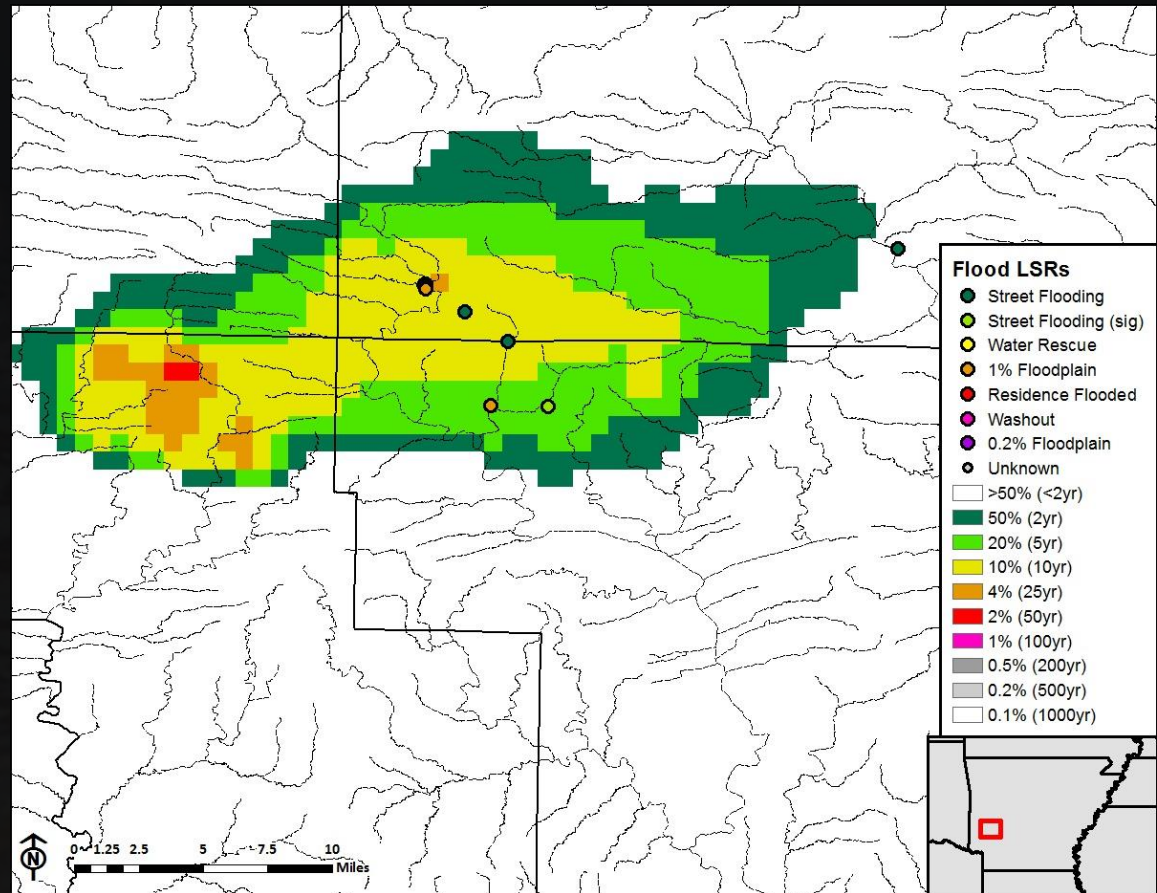
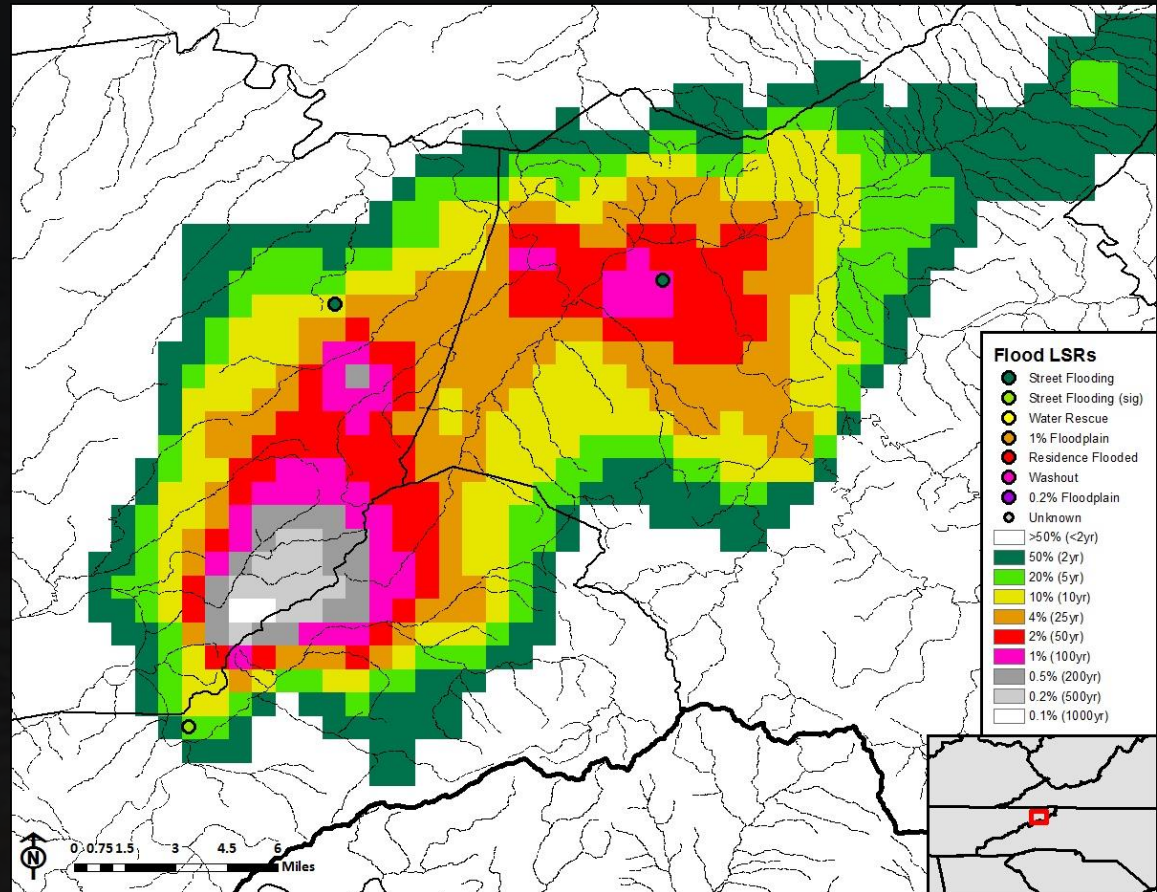| LSRs & CrowdSourced |
| --- |
| 11 |

Eastern TN: August 2012

3hr Rainfall Average Recurrence Interval

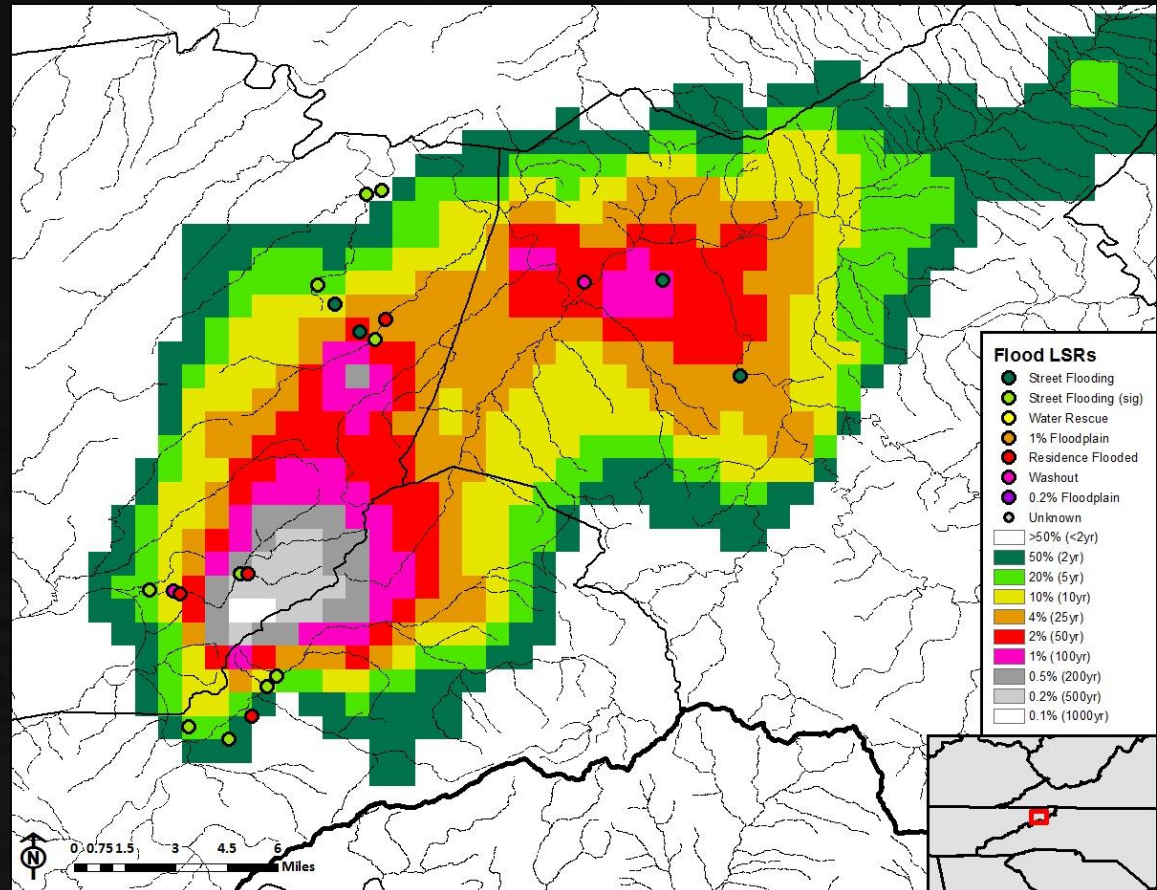**Reports to NWS (LSRs)**

3

Eastern TN: August 2012

3hr Rainfall Average Recurrence Interval
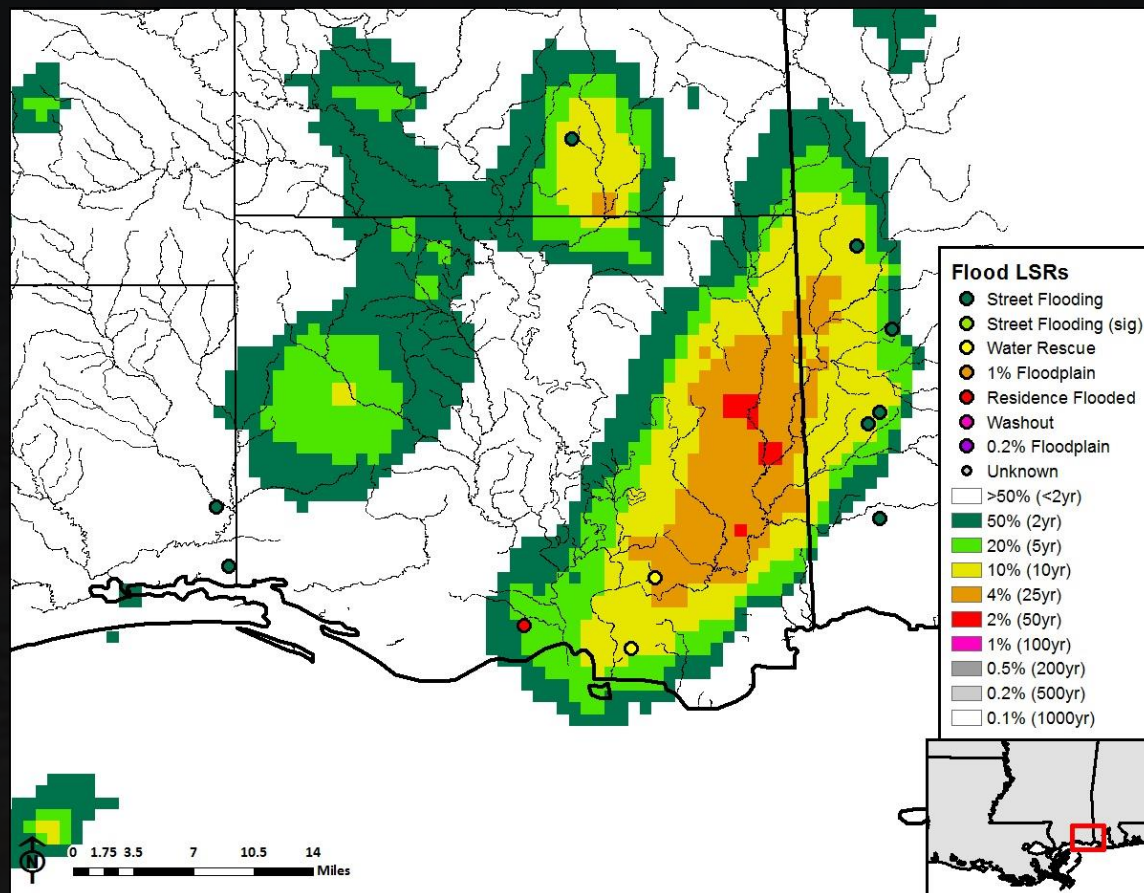

LSRs & CrowdSourced

20

Coastal MS: May 2013

3hr Rainfall Average Recurrence Interval

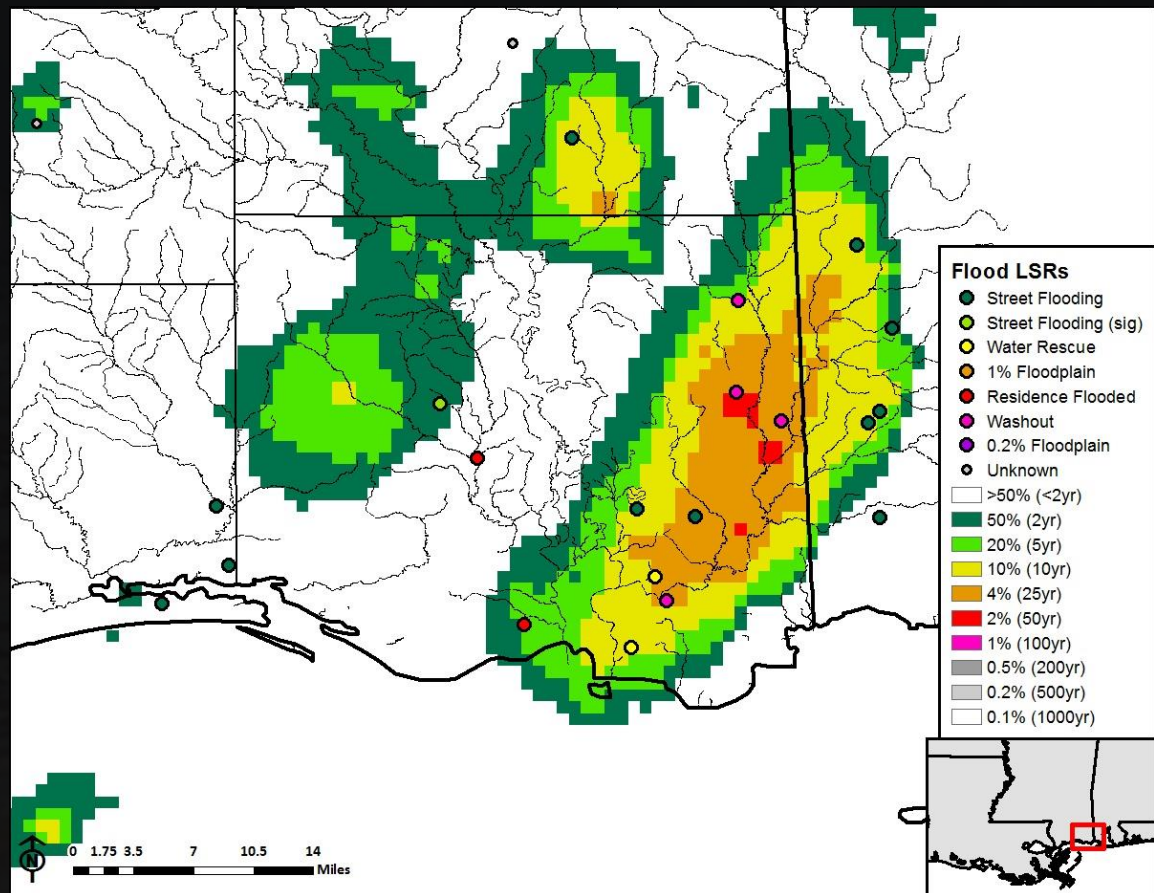**Reports to NWS (LSRs)**

12

Coastal MS: May 2013

3hr Rainfall Average Recurrence Interval
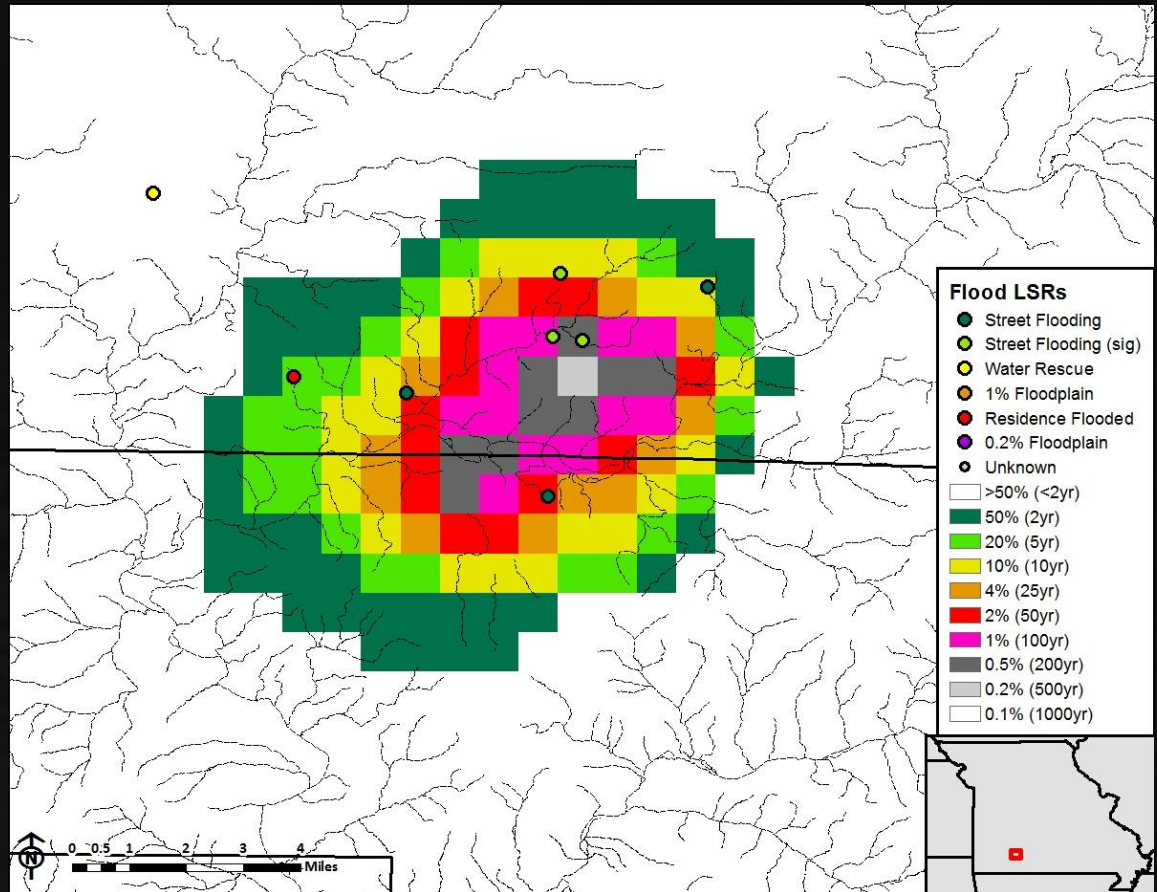

LSRs & CrowdSourced

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Springfield, MO: June 2013

3hr Rainfall Average Recurrence Interval

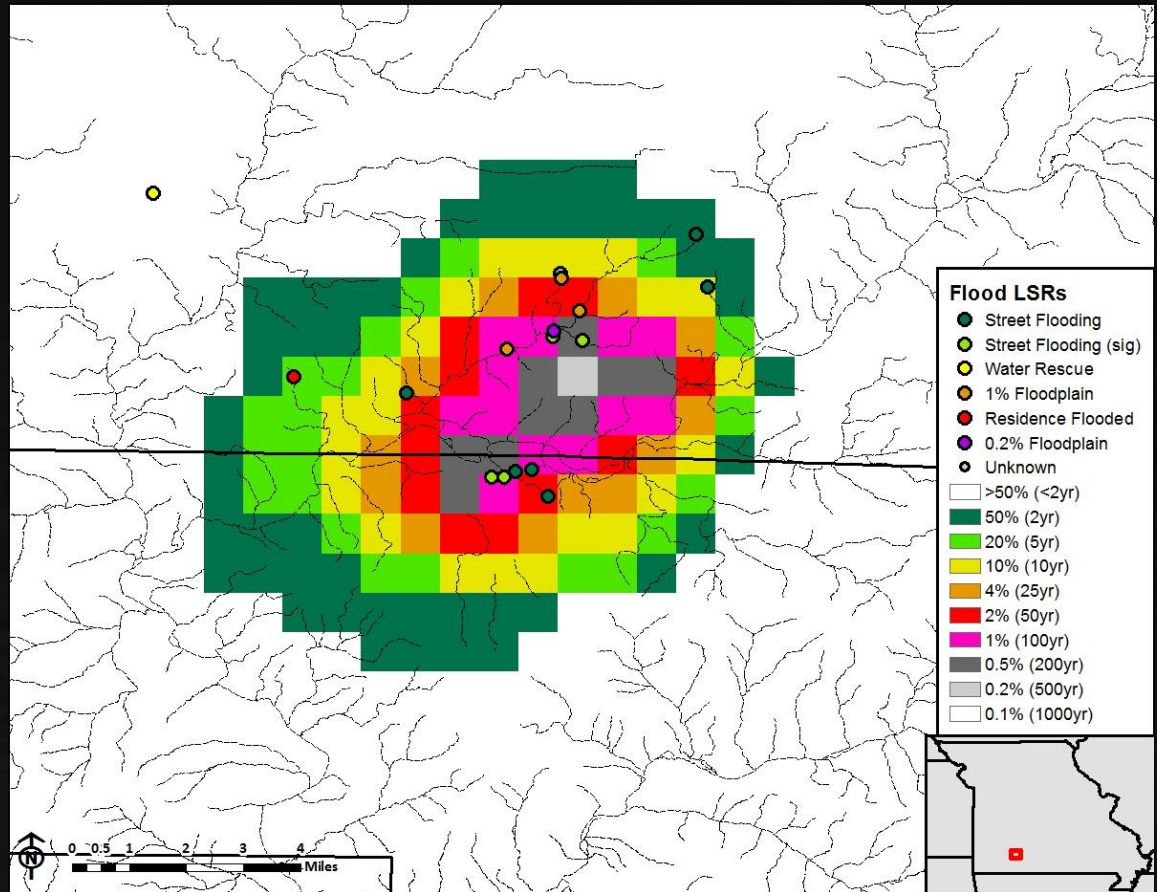**Reports to NWS (LSRs)**

8

Springfield, MO: June 2013

3hr Rainfall Average Recurrence Interval

LSRs & CrowdSourced

17

Southwest MS: March 2014

3hr Rainfall Average Recurrence Interval

Flood LSRs
- ● Street Flooding
- ● Street Flooding (sig)
- ● Water Rescue
- ● 1% Floodplain
- ● Residence Flooded
- ● Washout
- ● 0.2% Floodplain
- ○ Unknown
- ☐ >50% (<2yr)
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- ■ 10% (10yr)
- ■ 4% (25yr)
- ■ 2% (50yr)
- ■ 1% (100yr)
- ■ 0.5% (200yr)
- ■ 0.2% (500yr)
- ☐ 0.1% (1000yr)

Reports to NWS (LSRs)
2

Southwest MS: March 2014

3hr Rainfall Average Recurrence Interval

Flood LSRs
- Street Flooding
- Street Flooding (sig)
- Water Rescue
- 1% Floodplain
- Residence Flooded
- Washout
- 0.2% Floodplain
- Unknown
- >50% (<2yr)
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- 0.5% (200yr)
- 0.2% (500yr)
- 0.1% (1000yr)
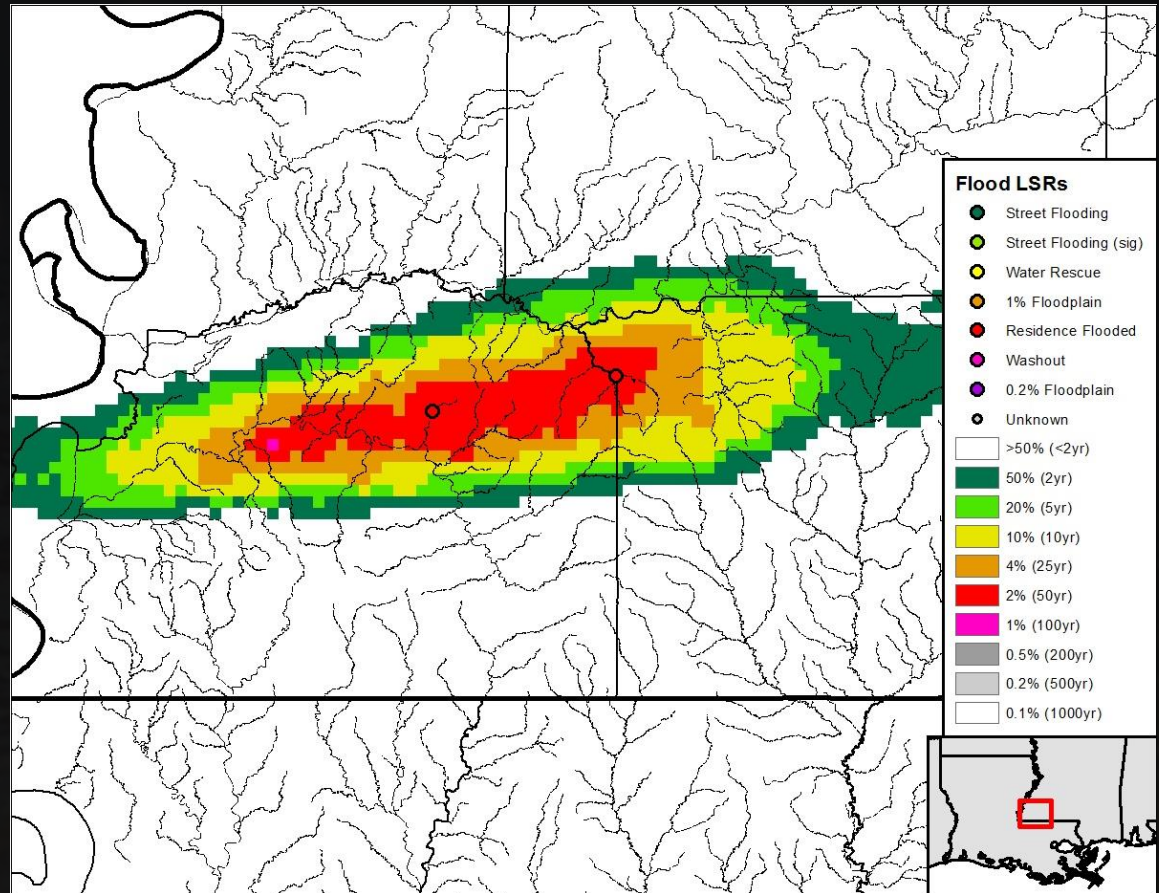
LSRs & CrowdSourced
26
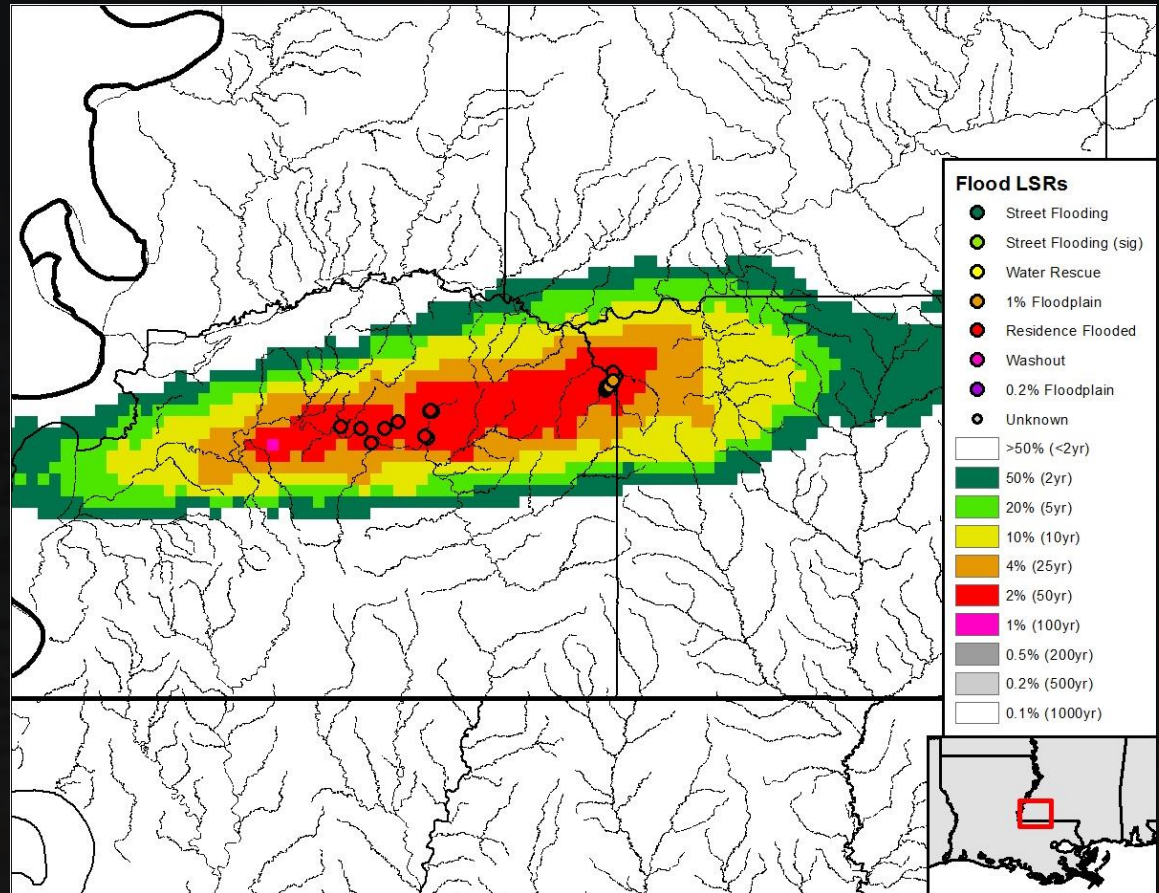
Summary

- New techniques for nowcasting flash flooding locations and severity currently being tested

- Verification of new techniques requires better flooding report data that current LSRs provide

- Data mining of social media, news media, and other web sources is one way to improve this data

Questions/Comments?

*Always follow safe procedures
while surveying flash flooding!*

W. Scott Lincoln
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