

Kansas Record Hail and the Power of Social Media

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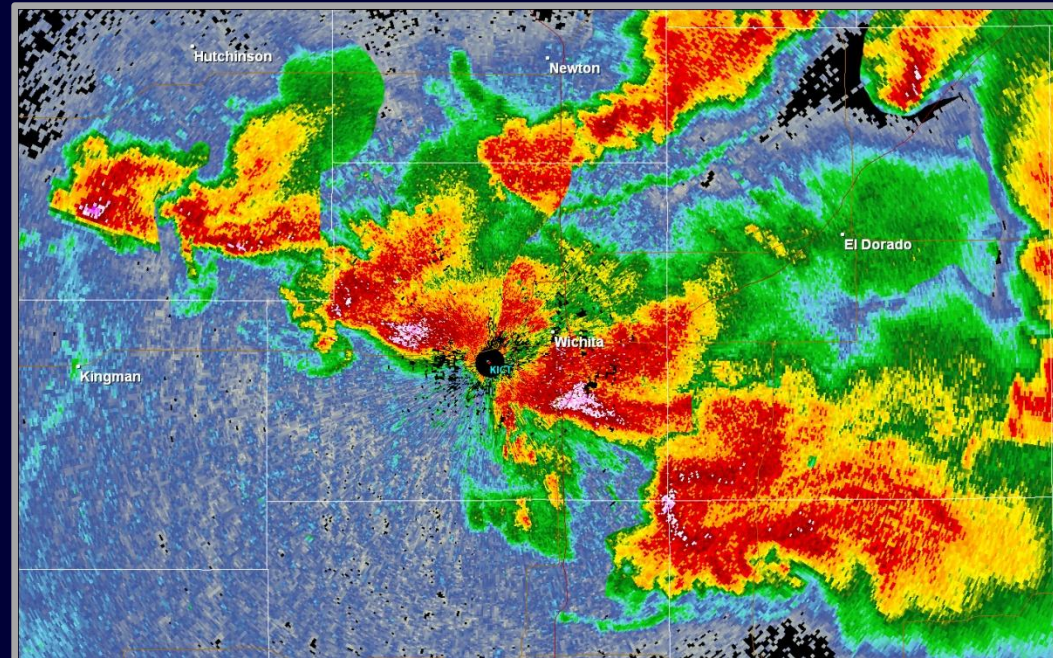


WEATHER

Introduction

15 September 2010

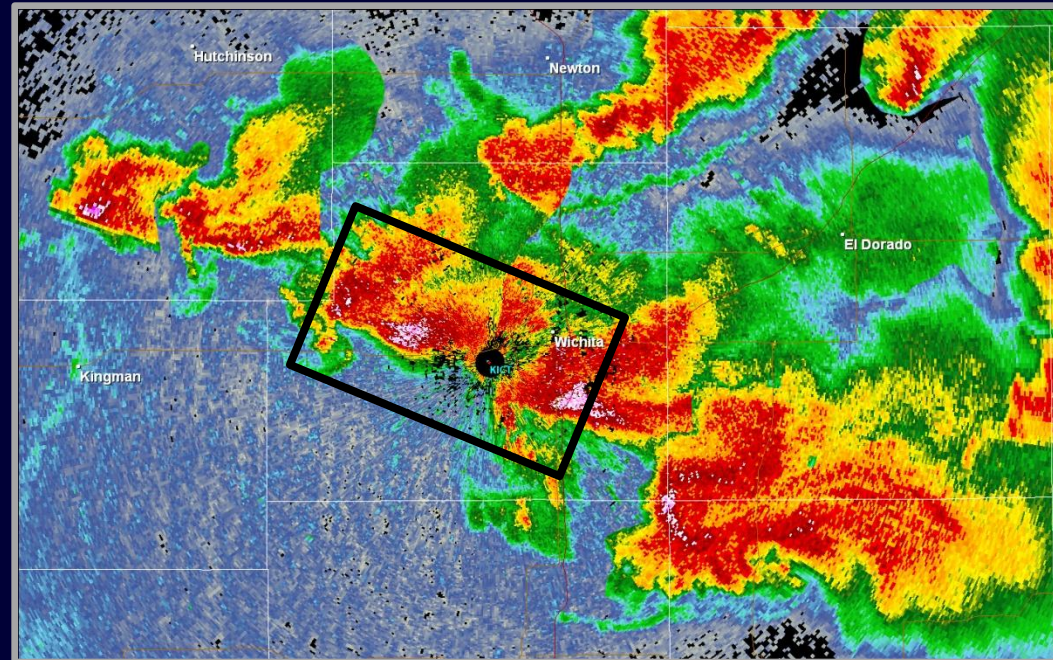
- Long-lived supercell (~6 hours) tracked from Reno County KS to Osage County OK
- Prolific large hail producer (2.75+ in.) over expansive swath
- State record diameter hail size certified (7.75 in.)
- A few weak tornadoes (EF0) confirmed along w/ areas of wind damage



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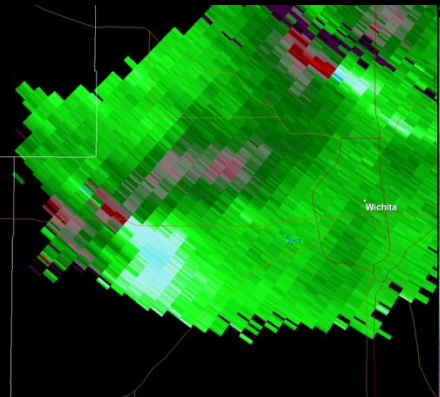
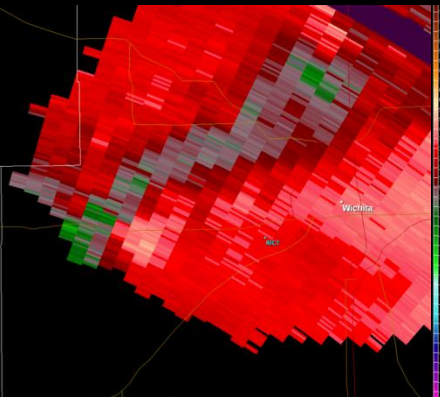
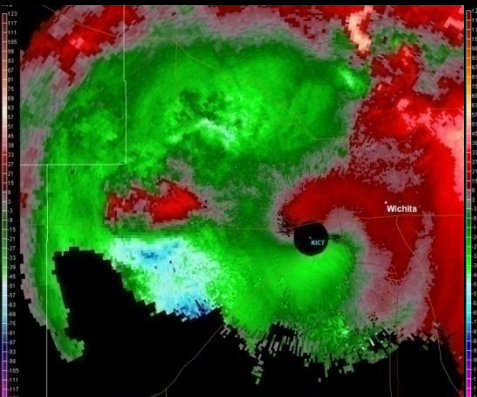
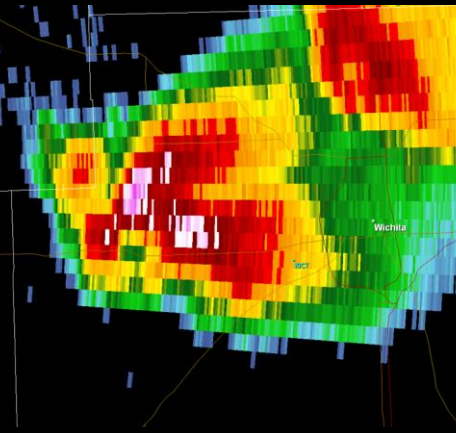
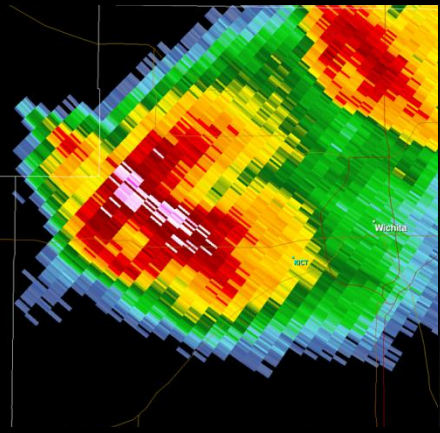
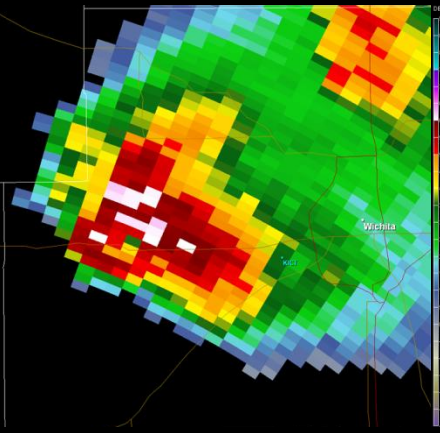
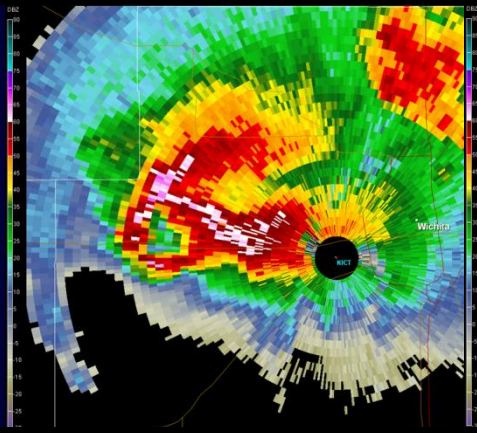


Overview

- Abbreviated radar-based analysis investigating giant hail (>4.00 in.) signals
 - Results of NWS Hail Survey (9/16/10)
 - Social media utility in physical science
- Reconstructing the Hail-Fall Character with all available 'tools' for future analysis
 - Additional findings derived from social media data



Mid-Level Structure



KICT

2220 Z

20,000 ft

KVNIX

2223 Z

24,000 ft

KTWX

2221 Z

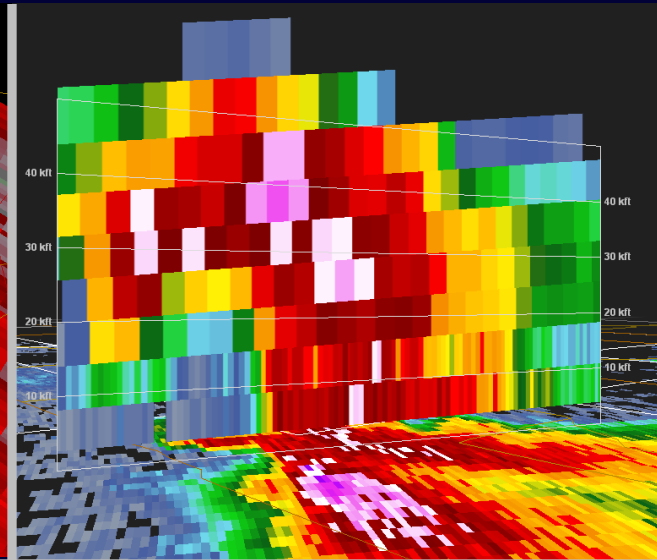
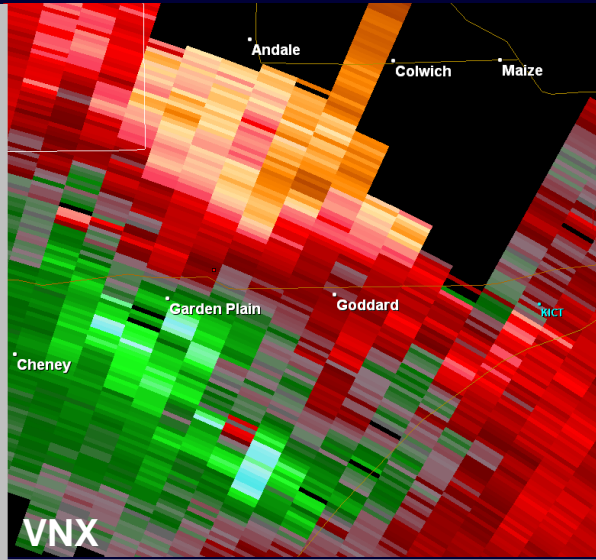
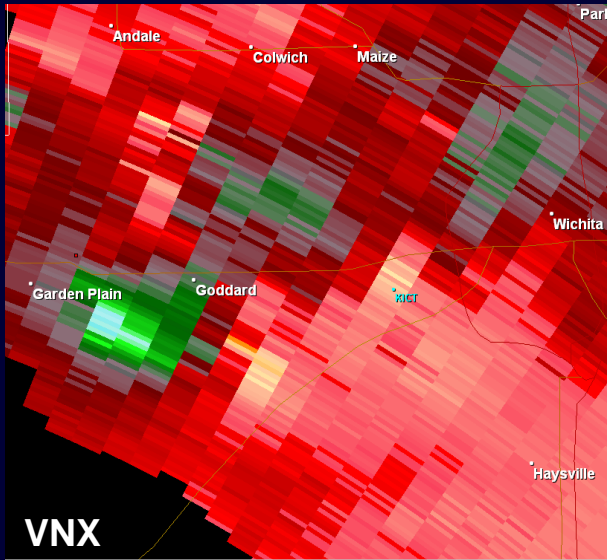
22,000 ft

KDDC

2222 Z

15,000 ft

Giant Hail Characteristics



Rotational Velocity

$$V_r = (|V_{min}| + |V_{max}|) / 2$$

$$V_r = \mathbf{69 \text{ kts}} \ (35.5 \text{ m s}^{-1})$$

23000 ft (7000 m)

Storm-Top Divergence

$$STD = (|V_{min}| + |V_{max}|)$$

$$STD = \mathbf{173 \text{ kts}} \ (89 \text{ m s}^{-1})$$

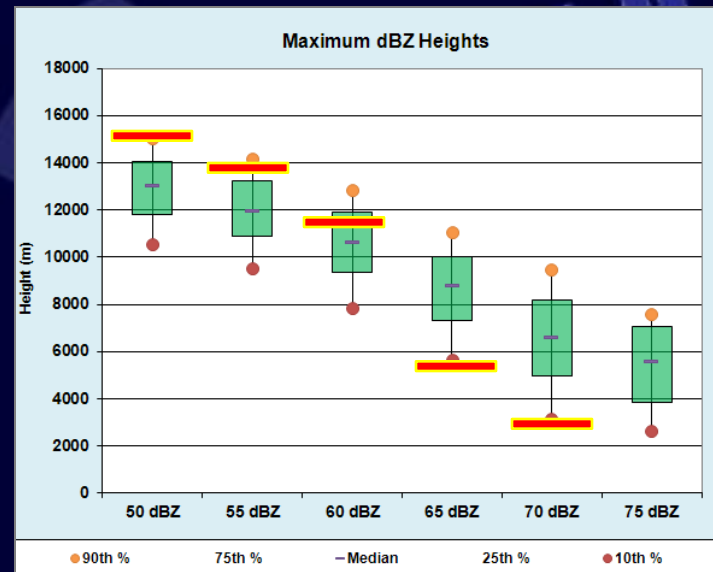
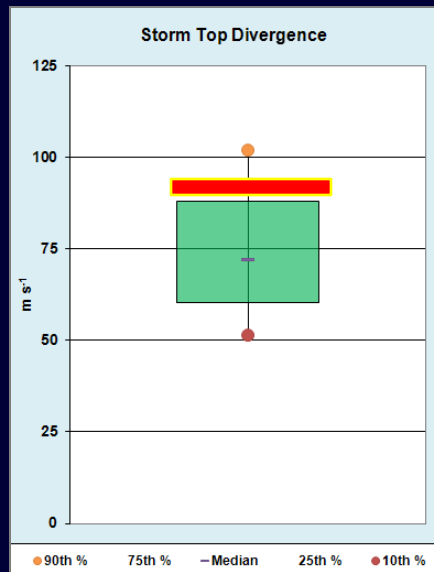
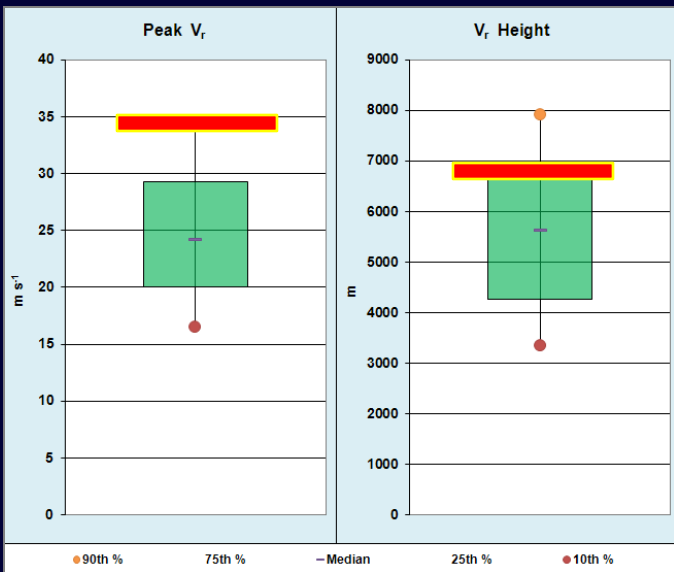
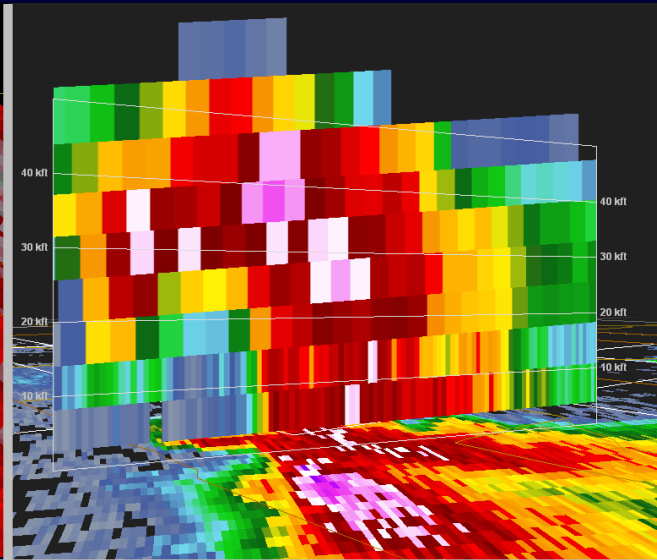
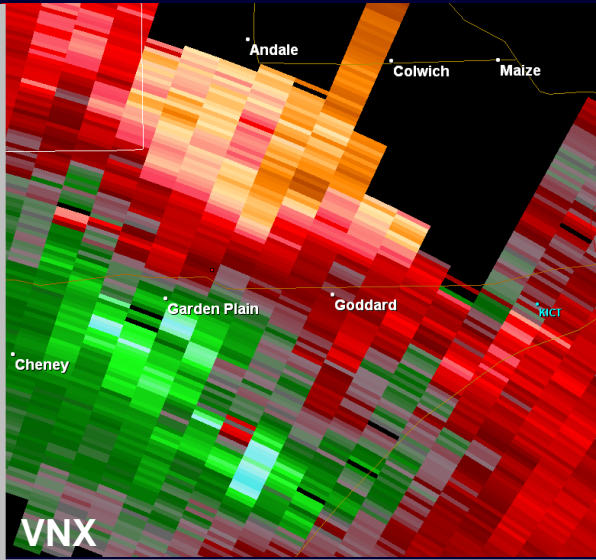
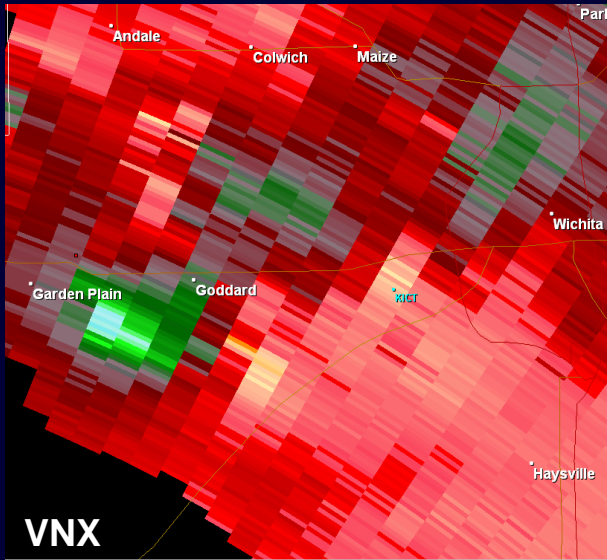
Maximum dBZ Heights

50 dBZ ~50500 ft

55 dBZ ~45000 ft

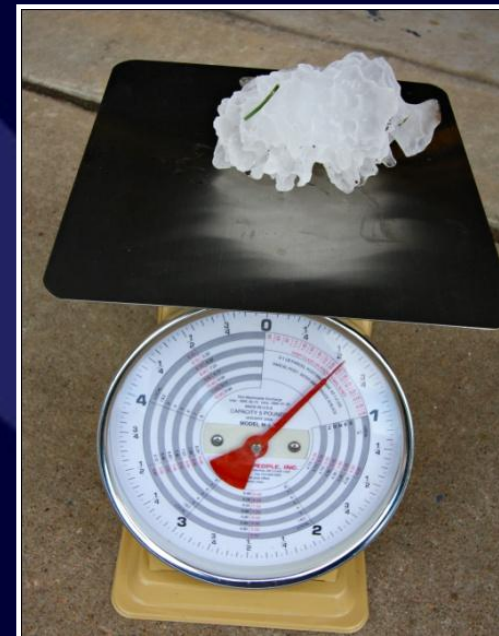
60 dBZ ~39500 ft

Giant Hail Characteristics



NWS Hail Survey

- Conducted due to initial reports of remarkably giant hail (7.00+ in.), urban area opportunity, and ongoing hail research
- Garden Plain / Goddard / Wichita Mid-Continent Airport (~15 mi. path)
- Focus on high-density reports in maximum hail size locations (improve resolution / identify larger)
- If residents preserved stones, diameter, circumference, and weight were measured and recorded
- Assisted WFO ICT with official measurements of record stone



NWS Hail Survey

- Established contact with ~60 residents
- Approximately 80% preserved stones in freezers (some melting/sublimation)
- Primary motivation insurance-driven (desired “proof”). Some stones ‘did not fit in the freezer.’
- All maximum diameter stones > 2.50 in. with median 4.00 in. Largest diameter stone 6.00 in.
- Significant property damage, stones broke through plywood roofs and wooden decks
- Reports to NWS (0%), media (6%)

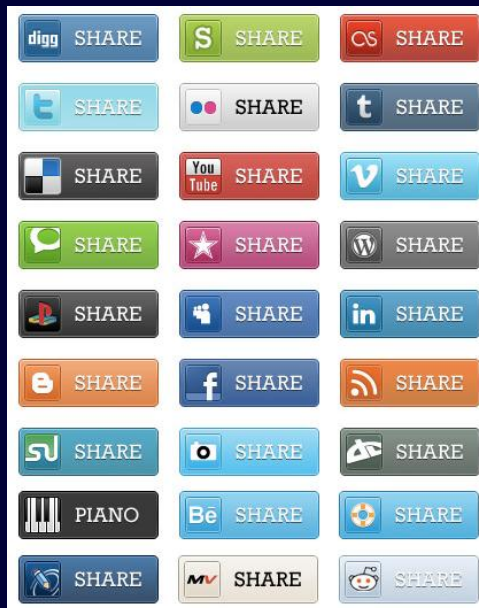


Social Media

“Forms of electronic communication through which users create online communities to share information, ideas, personal messages, and other content (as videos).”

Merriam-Webster

The creation, exchange, and interaction of user-generated content.



Communication

Blogger, ExpressionEngine, LiveJournal, Open Diary, TypePad, Vox, **Google+**, WordPress, Xanga, FMyLife, **Foursquare**, Jaiku, Plurk, Posterous, Tumblr, **Twitter**, Qaiku, Google Buzz, Identi.ca Nasza-Klasa.pl, Dailybooth, Geoloqi, **Gowalla**, Facebook places, The Hotlist, Google Latitude, ASmallWorld, Bebo, Cyworld, Diaspora, **Facebook**, Tuenti, Hi5, Hyves, LinkedIn, **MySpace**, Ning, Orkut, Plaxo, Tagged, XING, IRC, Yammer

Multimedia

deviantArt, **Flickr**, **Photobucket**, Picasa, SmugMug, Zoomr, sevenload, Viddler, **Vimeo**, **YouTube**, Dailymotion, Metacafe, Nico Nico Douga, Openfilm, Justin.tv, **Livestream**, OpenCU, **Skype**, Stickam, **Ustream**, blip.tv, oovoo

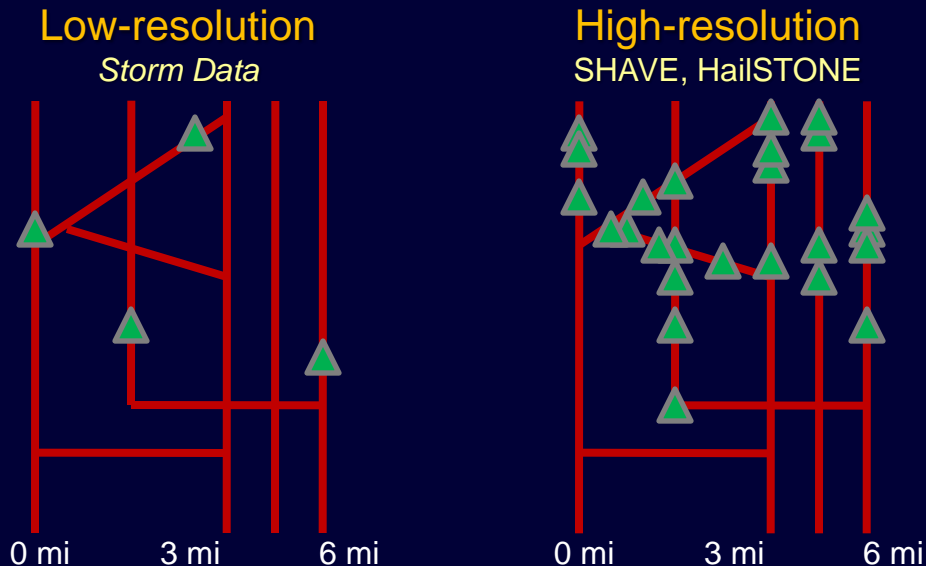
Social Media and NWS Operations

Real-time applications of social media becoming realized.

- Direct or indirect dissemination of warning information across a very wide audience (personalize the threat).
- Real-time severe weather reports (e.g. 9/15/10)

What are the post-storm benefits of social media?

- Additional verification of NWS warnings
- Substantial contribution to the physical science (e.g. what we've been “missing”)

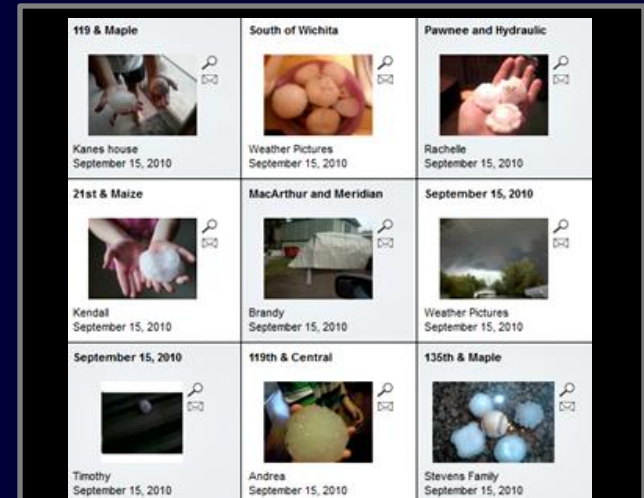


“NWS verification practices are designed to efficiently verify warnings, not to satisfy scientific studies...Due to the method of verification the largest hail to reach the ground is often not found.”

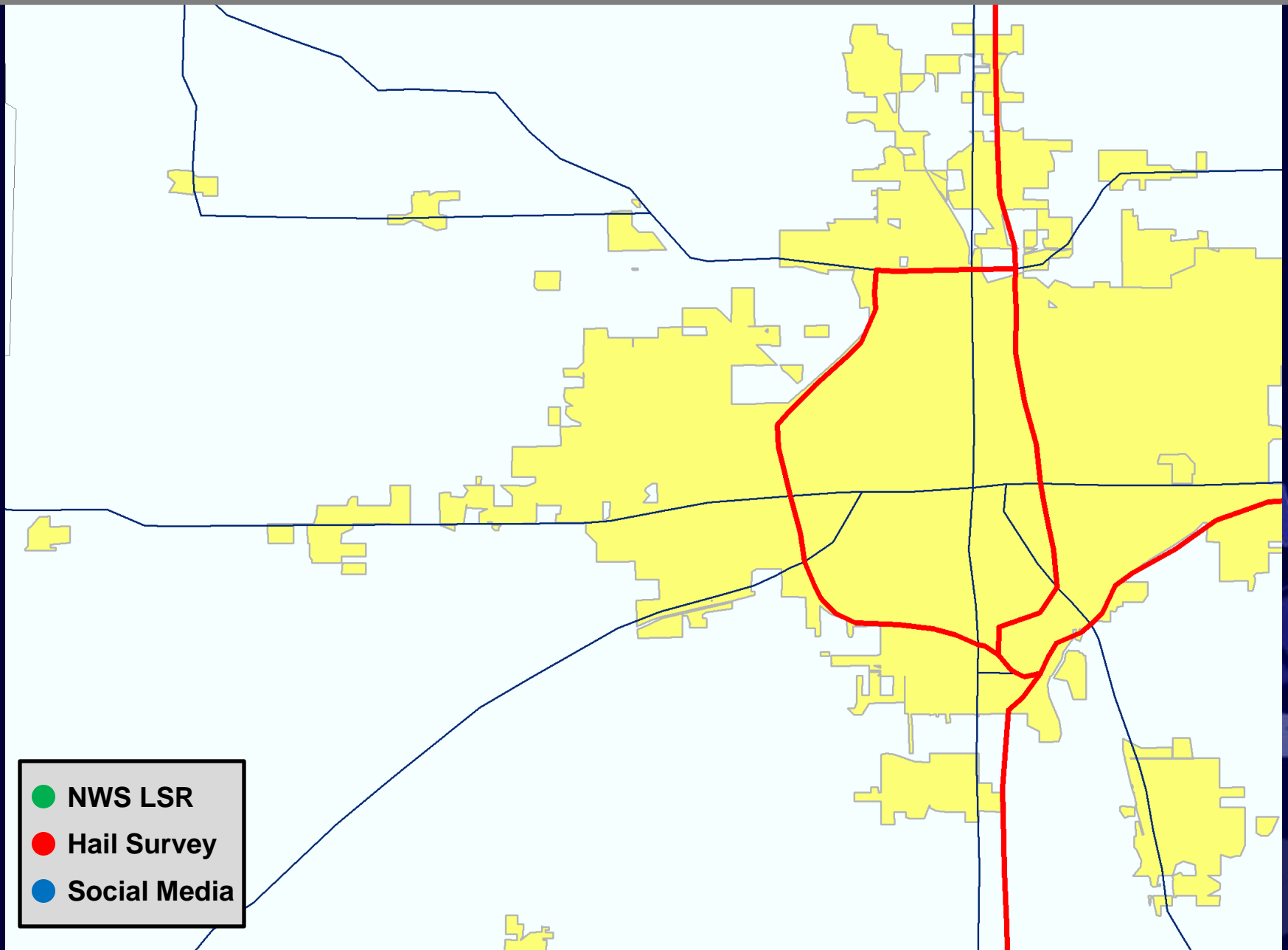
Amburn and Wolf (1997)

Reconstructing the Hail-Fall Character

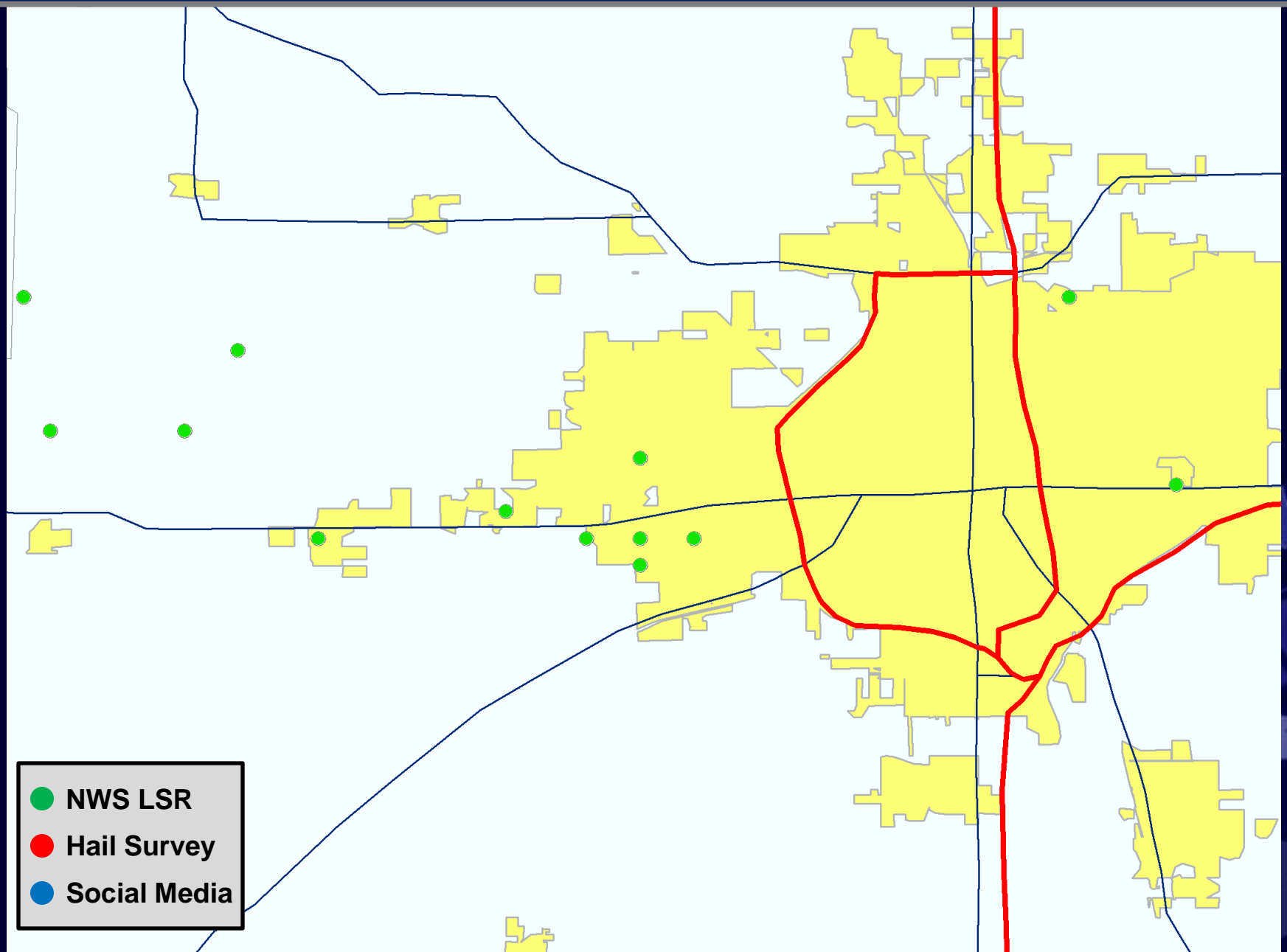
- Created lat/lon data for each report from NWS LSRs, NWS hail survey, and social media
- Utilized intersections from user content (Maize Rd and Haskell St)
- Majority of photos measured the stone or provided a common-size object for comparison (noted M vs. E)
- Recorded maximum diameter hail size in each photo (0.25" res), removed duplicates
- Contacted YouTube users for additional specifics



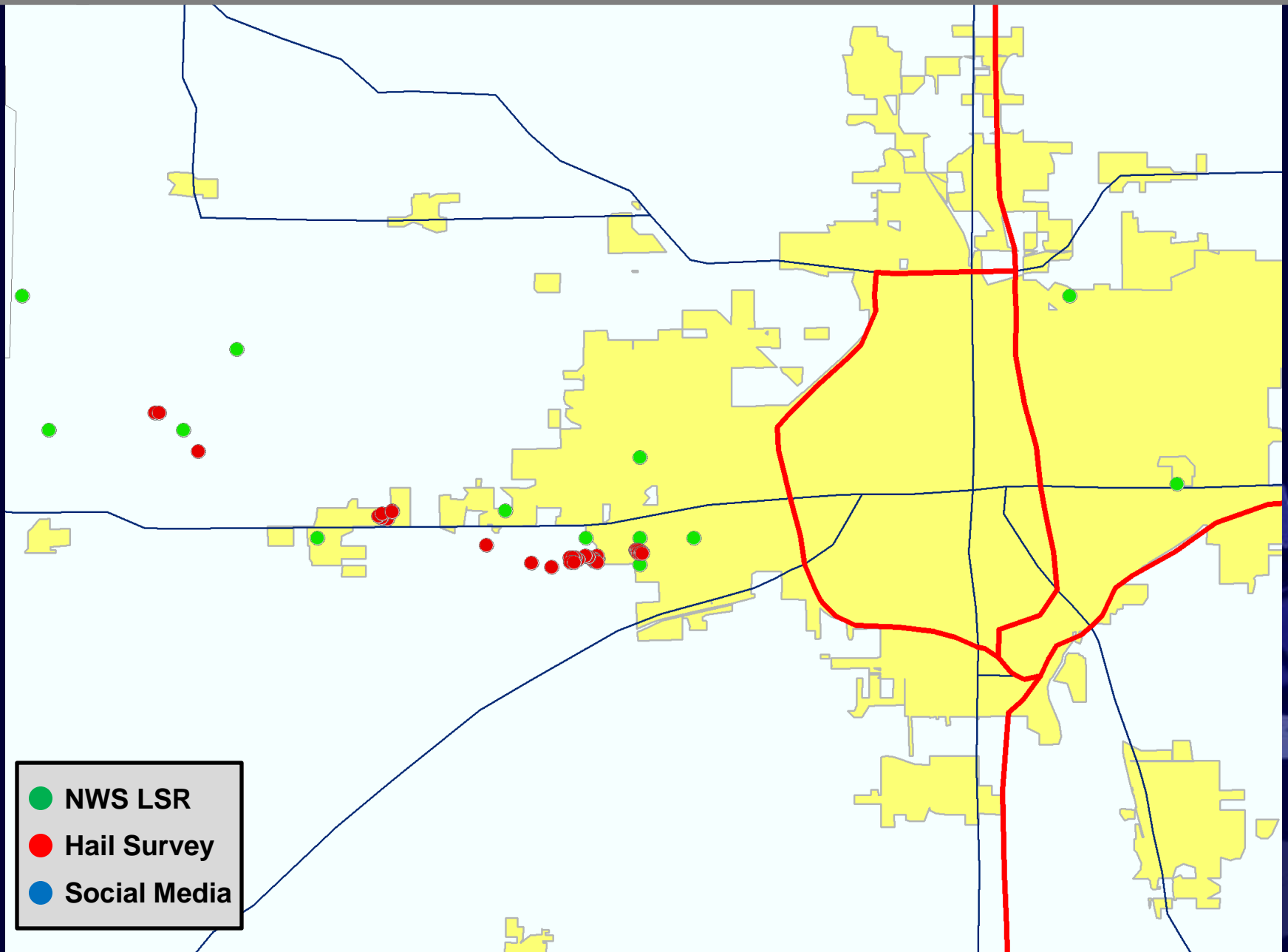
Reconstructing the Hail-Fall Character



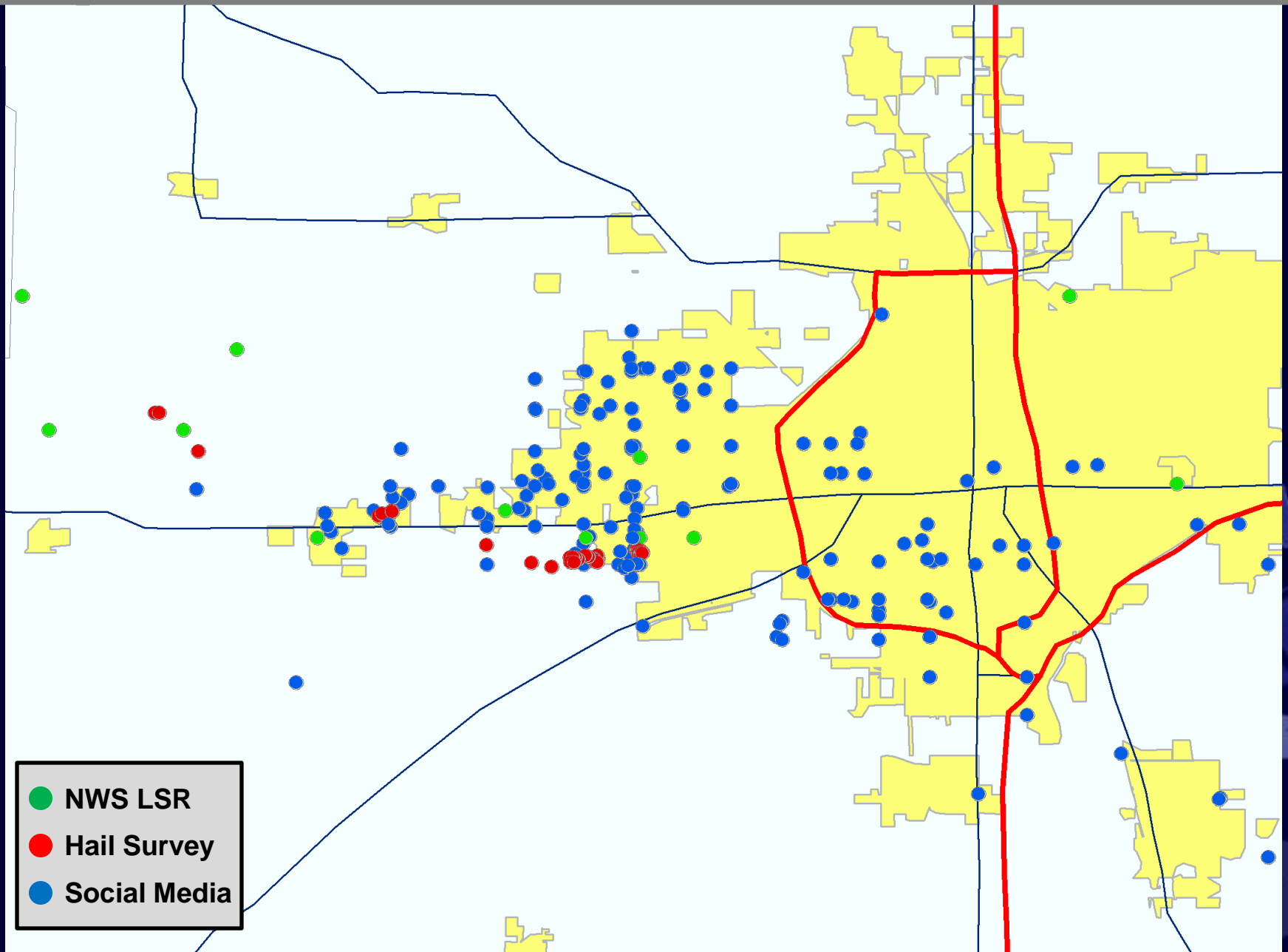
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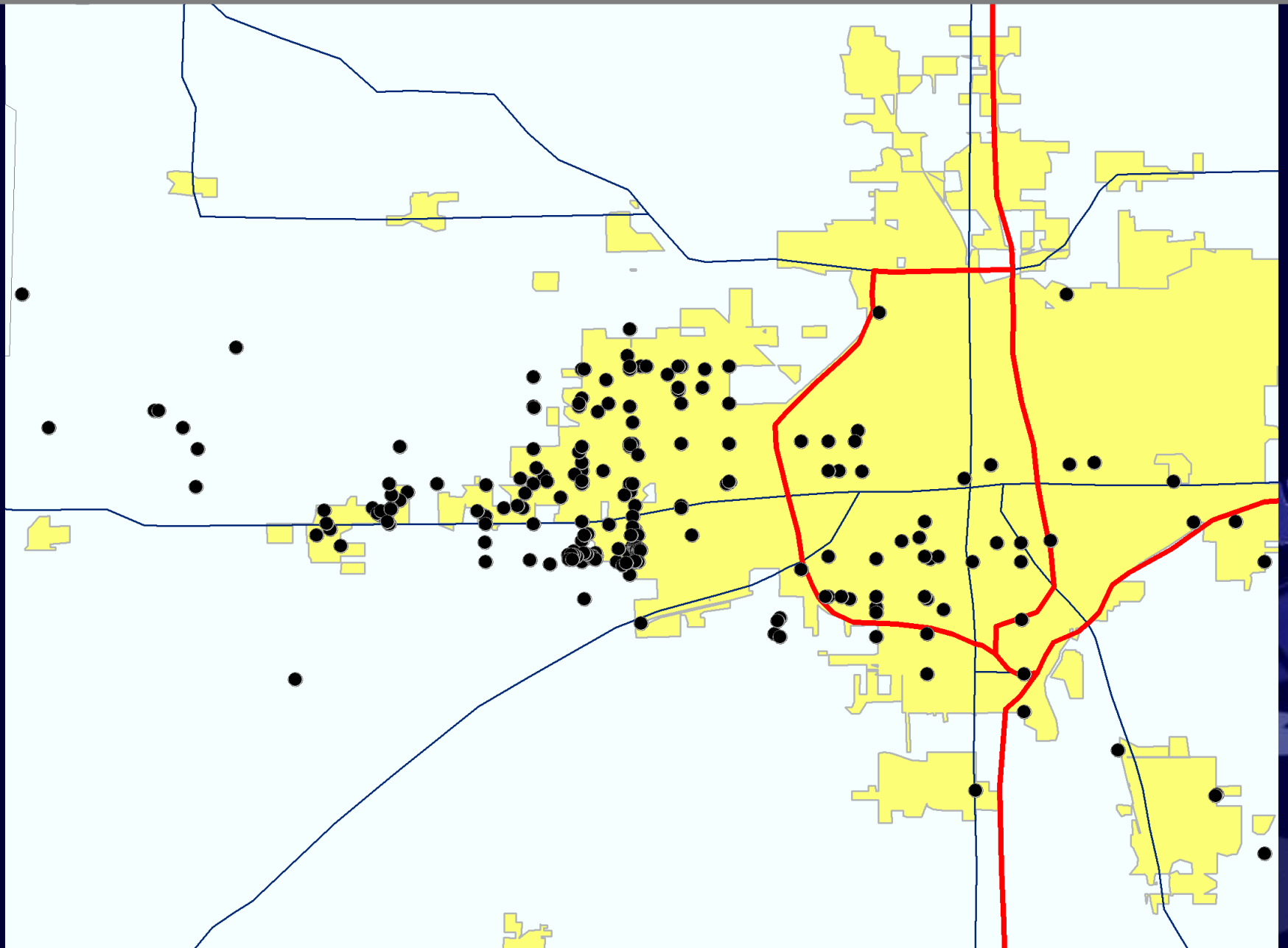
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Reconstructing the Hail-Fall Character

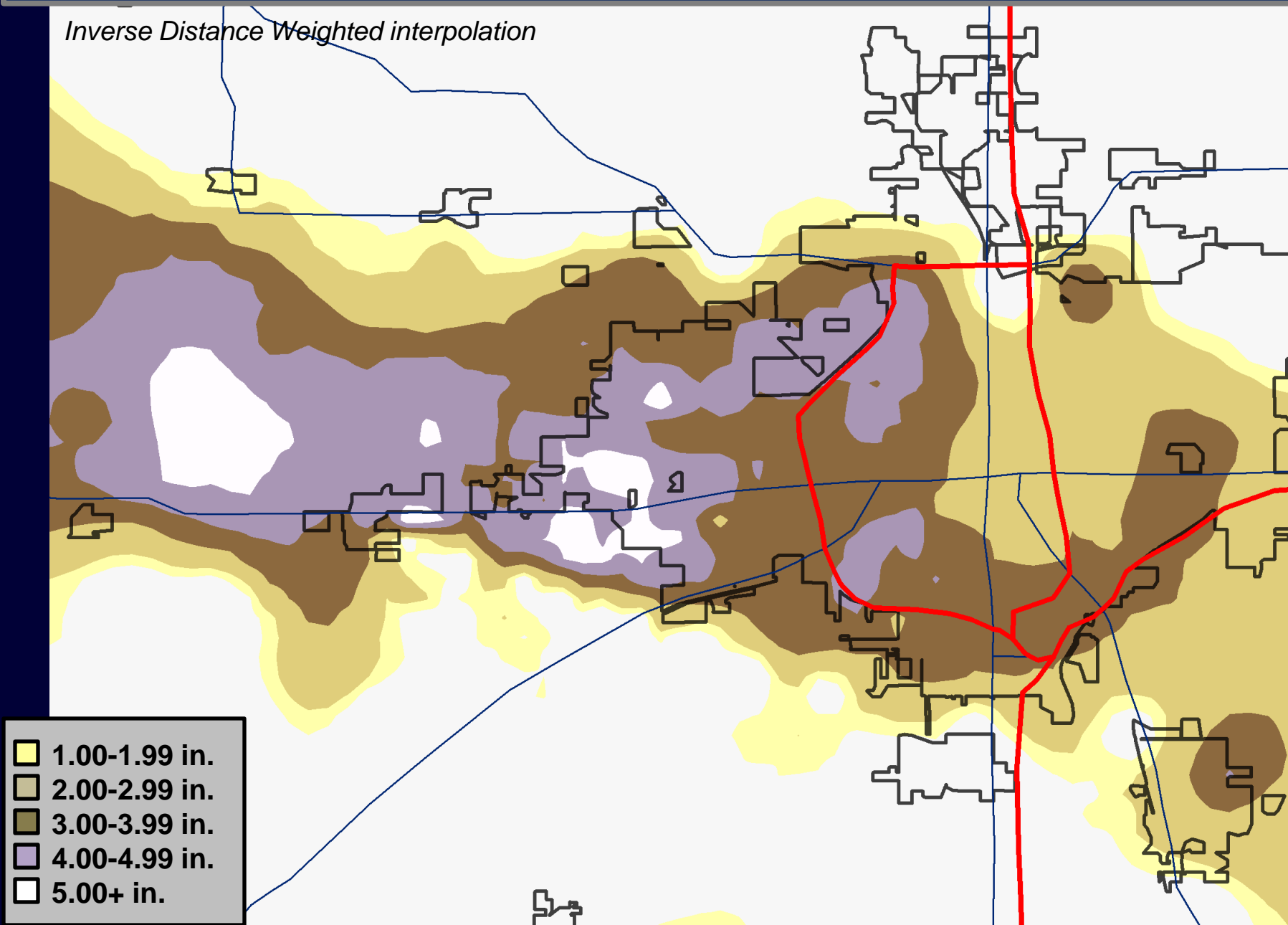


Reconstructing the Hail-Fall Character



Reconstructing the Hail-Fall Character

Inverse Distance Weighted interpolation



Reconstructing the Hail-Fall Character

- **Rare high-resolution (giant hail) dataset**
Extremely high spatial, no temporal
- Only efforts of SHAVE and HailSTONE comparable
(limited domain / operations)
 - **479 Data Points:**
387 Social Media, 47 NWS Hail Survey, 45 NWS LSR
- Photos available for **90%** of all hail data points
- Resolution critical to accurately gauge hail-fall behavior and discriminate sensitive changes in storm-scale and radar-based signatures

Kansas Record Hail



3 September 1970

Coffeyville, KS

Diameter: **5.67 in. (144 mm)**

Weight: **1.68 lb (765 g)**

Circumference: **17.5 in. (445 mm)**



15 September 2010

Wichita, KS

Diameter: **7.75 in. (197 mm)**

Weight: **1.10 lb (499 g)***

Circumference: **15.5 in. (394 mm)***

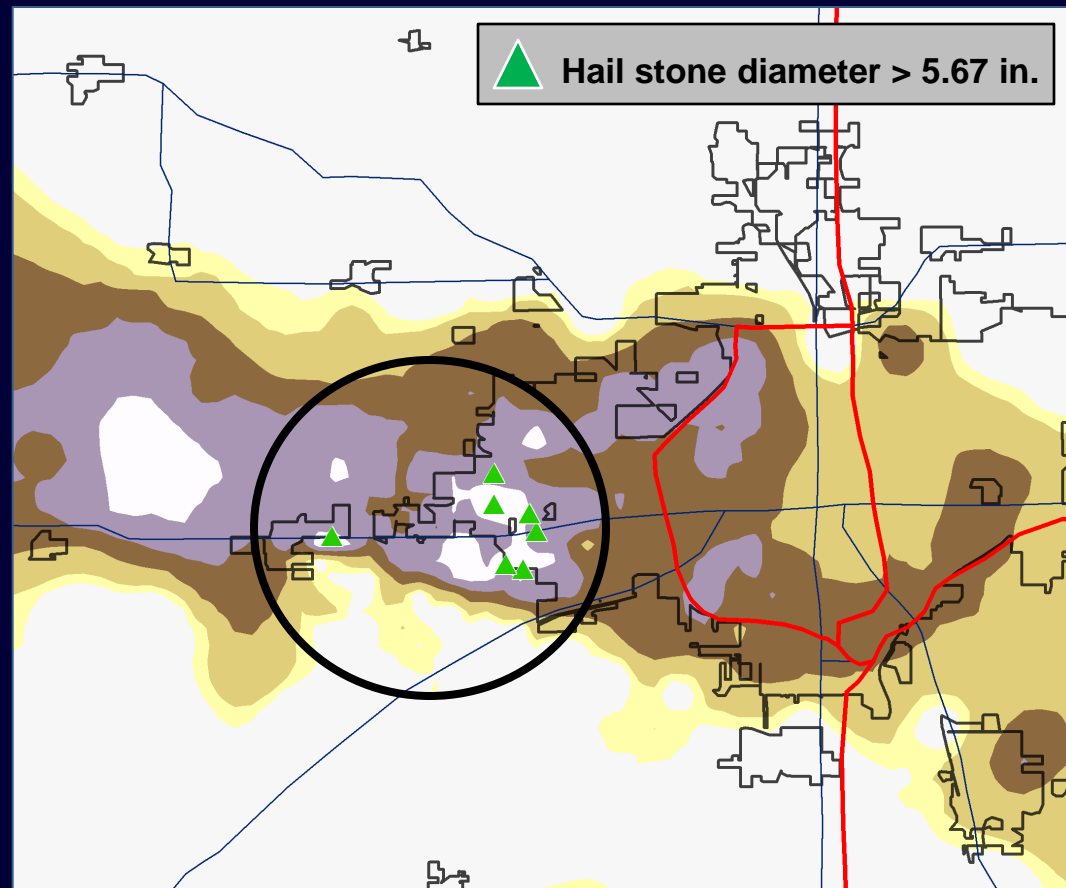
*Measured 15 hours post-storm

Kansas Record Hail

Eight hail stones were identified that exceeded the previous record diameter

All stones originated from the hail survey or social media
(Hail Survey, KSN, KAKE, KWCH, Kansas.com, YouTube)

Growing photo and video technologies and usage of social media are allowing us to observe and document meteorological events that were unreported in the past.





7.75 in.



6.00 in.



6.00 in.



6.00 in.



6.00 in.



5.75 in.

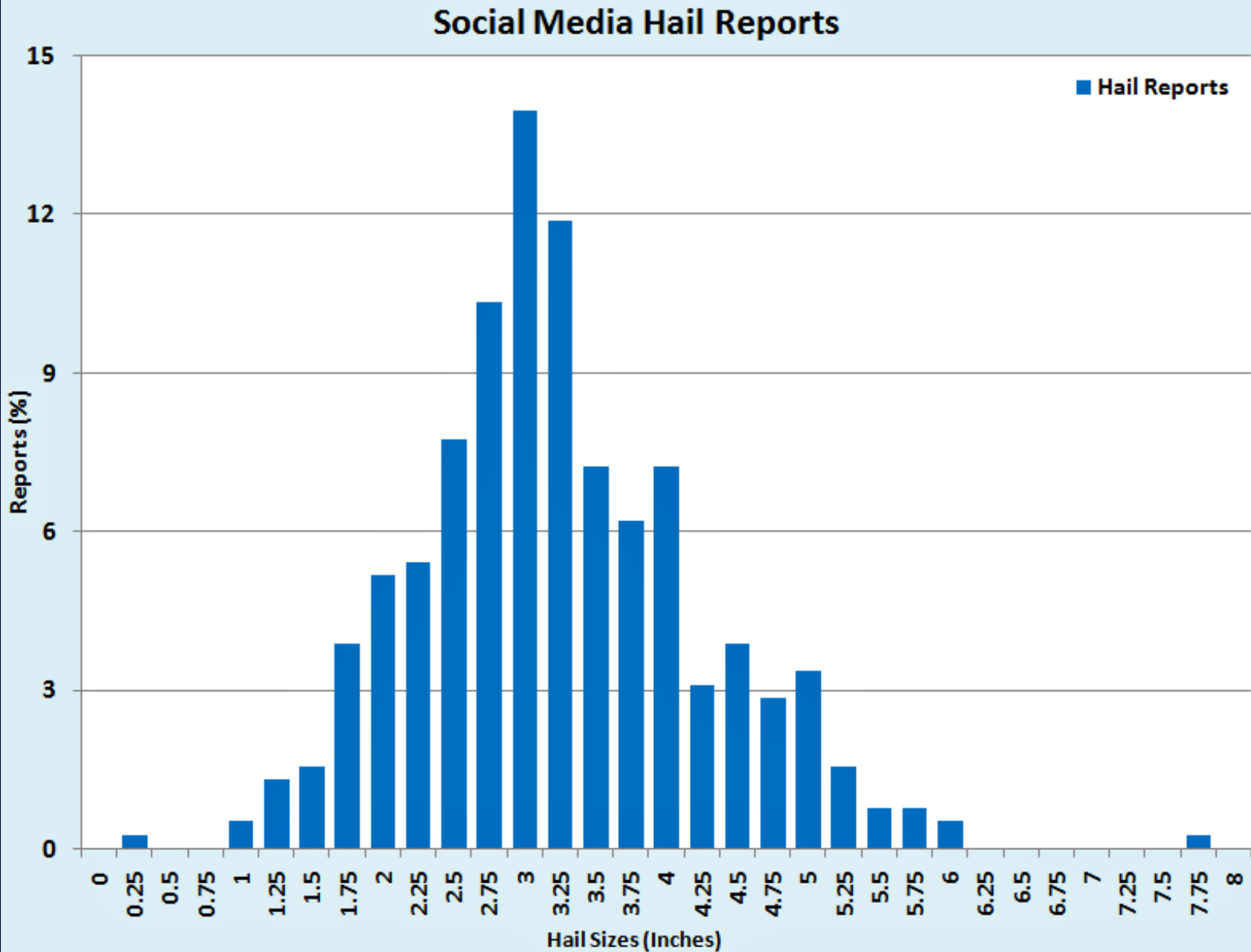


5.75 in.

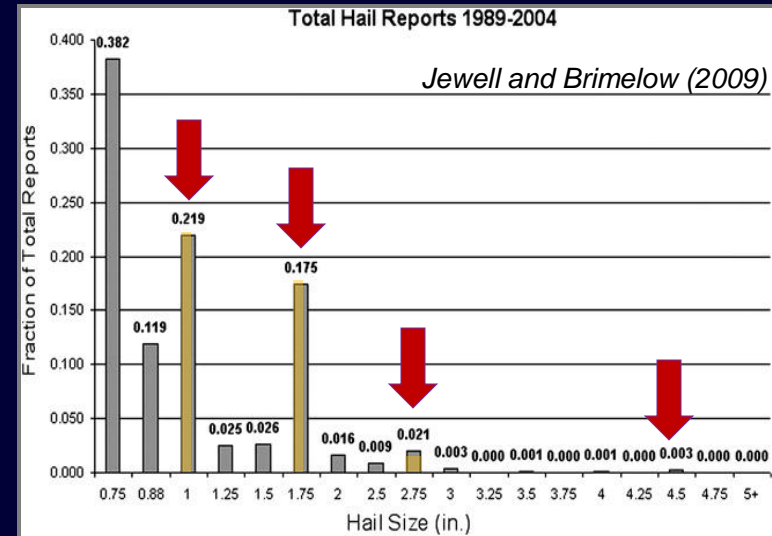
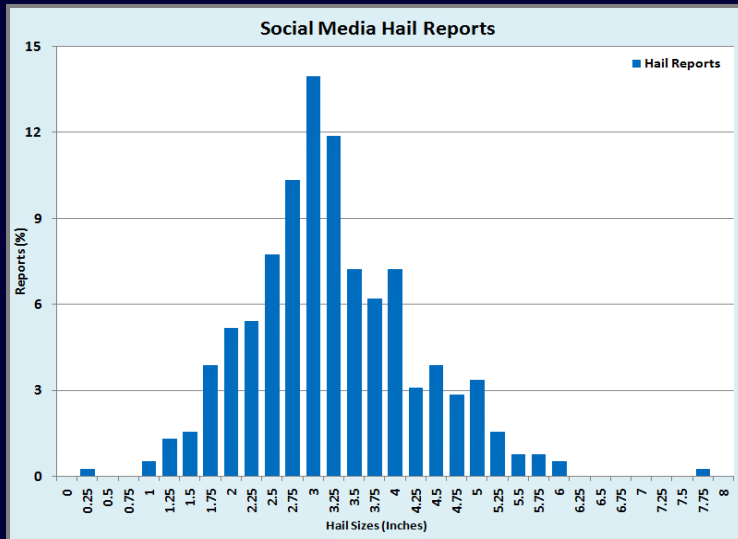


5.75 in.

Distribution of SM Hail Reports



Distribution of SM Hail Reports



- Approximately **36%** of uploaded stones **2.75-3.25 in.**
- The availability of photos for each report **eliminates potential spotter errors and 'coin/common size' object biases (high scientific value)**
- Insight to what residents find **significant enough to upload/report (function of hail size or specific event-driven? smaller hail in some areas not uploaded)**

Summary and Future Work

- Radar-based signals satisfied characteristics of giant hail producing storms (4.00+ in.)
- NWS Hail Survey revealed additional data available post-storm
- Significant contribution of Social Media in physical science
- Recreation of the 15 Sept 2010 hail-fall character one of the highest spatial resolution datasets available
- Additional benefits of actual photographic documentation for nearly all hail data points (8 record stones / eliminates biases)

**High-resolution hail datasets
critical for meaningful hail research**

Continued radar-based analysis on 15 Sept 2010 dataset

Acknowledgements

George Phillips (NWS TOP), Ken Cook and Chance Hayes (NWS ICT)
KAKE, KSN, KWCH, The Wichita Eagle, Twitter, The Weather Channel, YouTube