IBHS Hail Field Research Program: 2012-2014

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Background & Motivation

- Average annual insured hail losses of $1 billion (Changnon et al. 2009)
- Increasing trend in insured losses (MunichRe; Smith et al. 2012)
- Need to understand how hailstone characteristics influence building damage (new and old construction)
- Historical literature documents:
  - Size
  - Mass
  - Embryo type
  - Growth processes

Background & Motivation

- Standardized building material tests assume damage scales perfectly with impact kinetic energy (UL 2218; FM 4473)
- Discrepancies between product performance and standard test ratings in post-event surveys and closed claim studies
- How does hailstone “hardness” play a role?

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Objectives:

- Quality spatial resolution cross-swath hailstone measurements
  - Three dimension measurements
  - Mass
  - Compressive stress measurements—new instrument developed
  - Representative size distributions at each measurement location
  - Photographic documentation of hail distribution at each measurement location
- Validation data for laboratory impact testing of building materials—collect time histories of hail impact energies—new instrument developed
- Ground-truth validation for developing radar-based hail detection algorithms and for modeling applications

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Project Scope

- May-June 2012-2014
- Approximately 10-15 field days per year
- Operations region = U.S. Great Plains
- Forecast preference on supercells
- Nomadic operations

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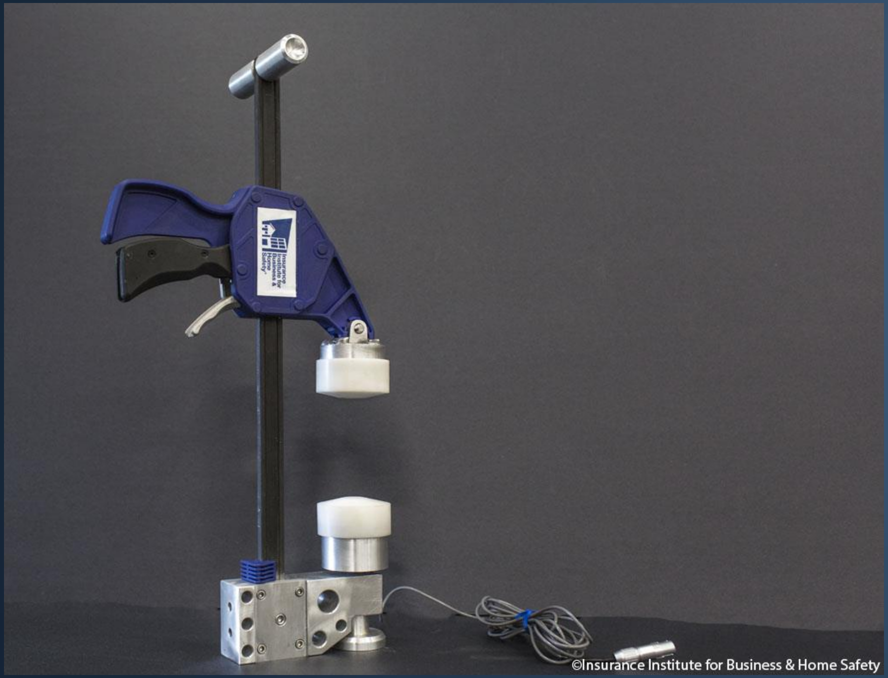
Novel Instrumentation

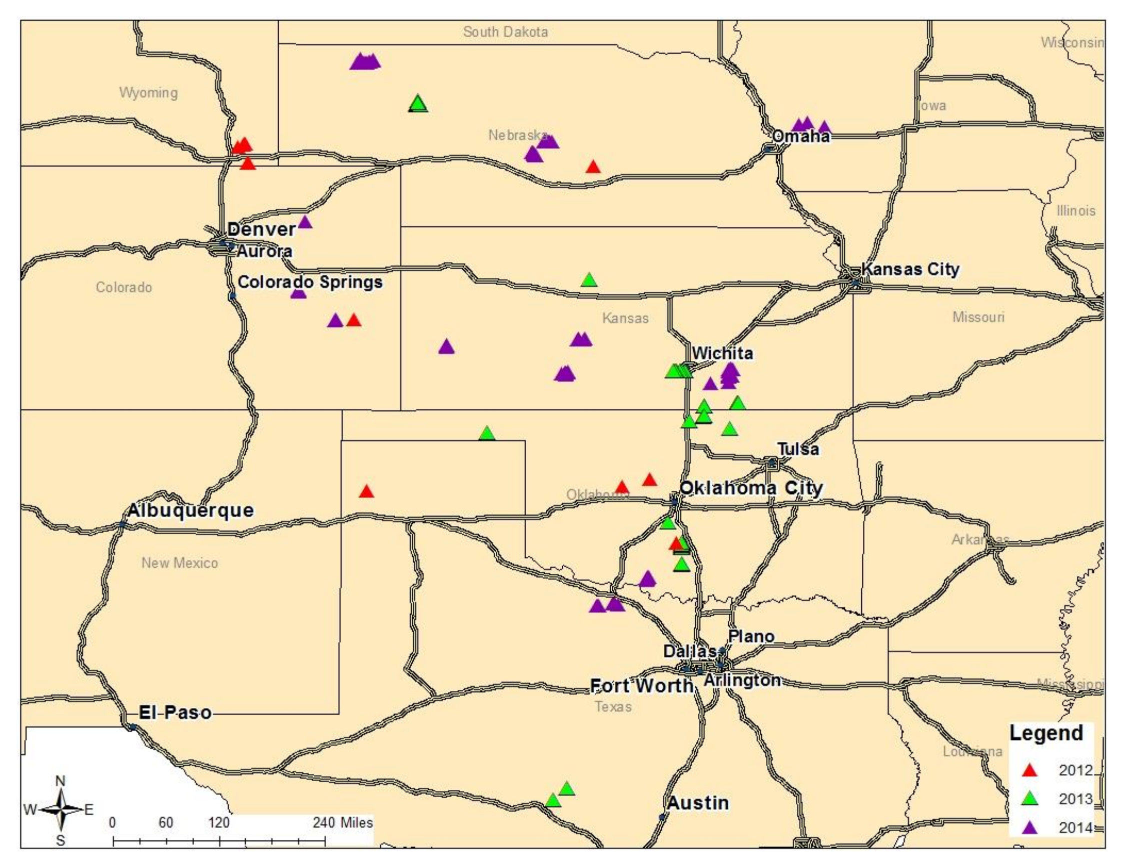


Daily Experimental Plan

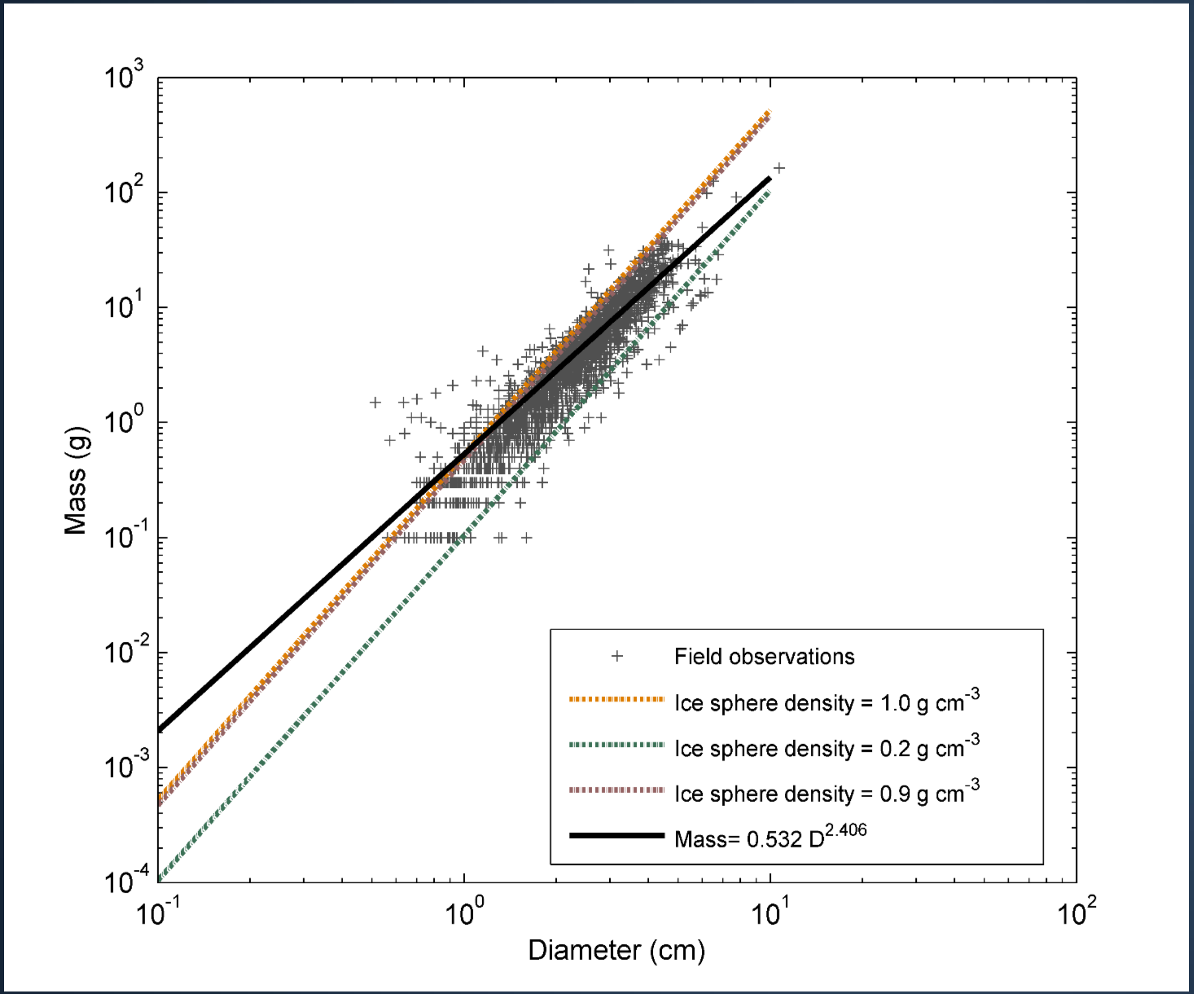
1. Target storm selected
   - Measurement teams positioned closely, but outside hailfall region
   - Hail impact disdrometer teams deployed probes and retreated to safety
2. After storm passage
   - All teams drove toward radar-indicated swath, stopping periodically to look for hail, and beginning measurements when found
   - Measurements made 0.4-1.6 km apart, dependent upon spatial extent of swath and proximity to nearby storms
   - Hailstones always measured at hail impact disdrometer probe locations

Hailstone Database

- 2012-2014
- 14 operations days
- 33 parent thunderstorms
- 2557 hailstones
  - Size: 0.11 cm – 10.7 cm (0.04 in – 4.21 in)
  - Mass: 0.1 g – 163.3 g
  - Compressive Stress: Unmeasurable – 55.15 mPa (~8000 psi)

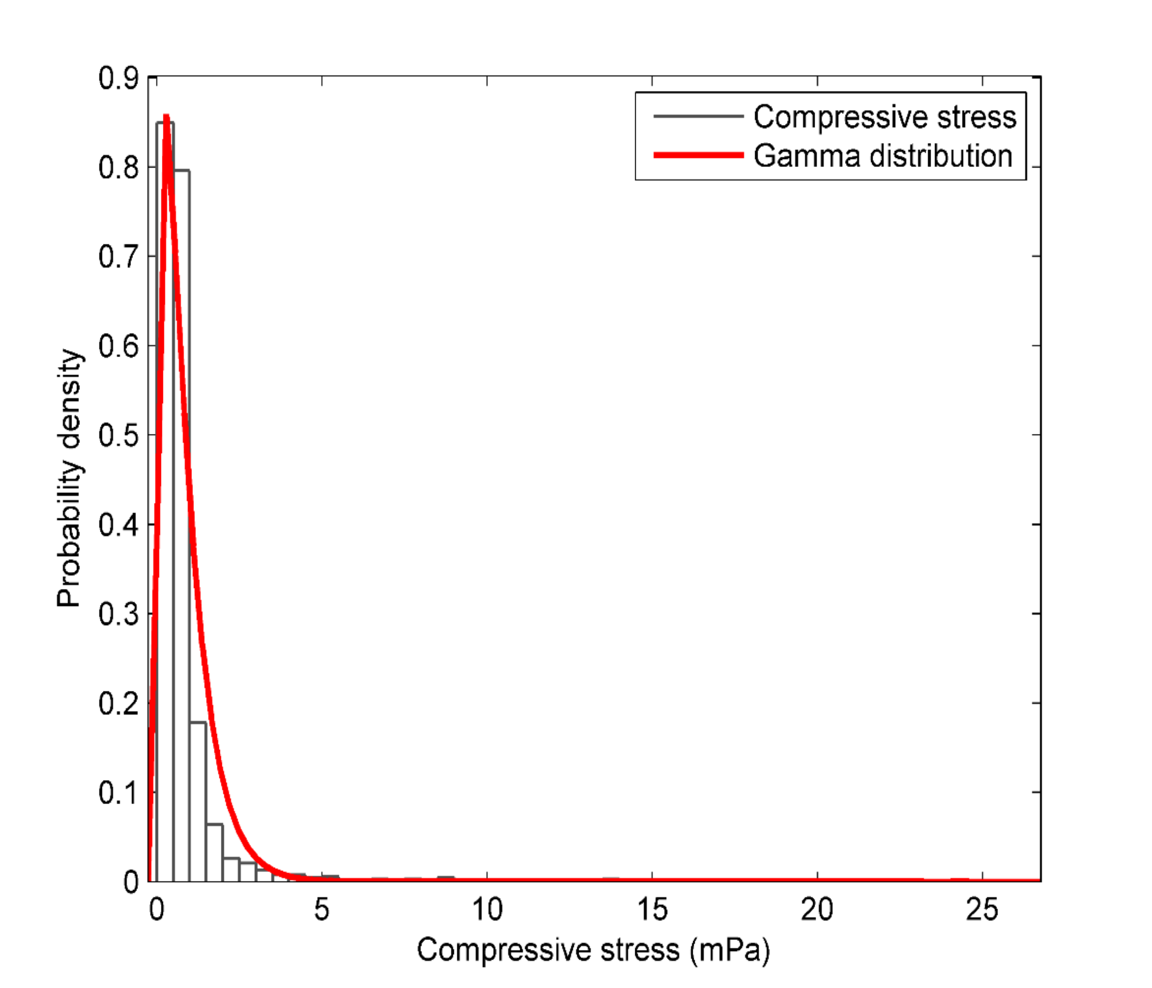


Hailstone Database: Mass-Diameter



- Mean mass = 4.72 g
- Max mass = 163.3 g

Hailstone Database: Compressive Stress



- Mean compressive stress = 0.88 mPa (128 psi)
- Max compressive stress = 55.15 mPa (8000 psi)

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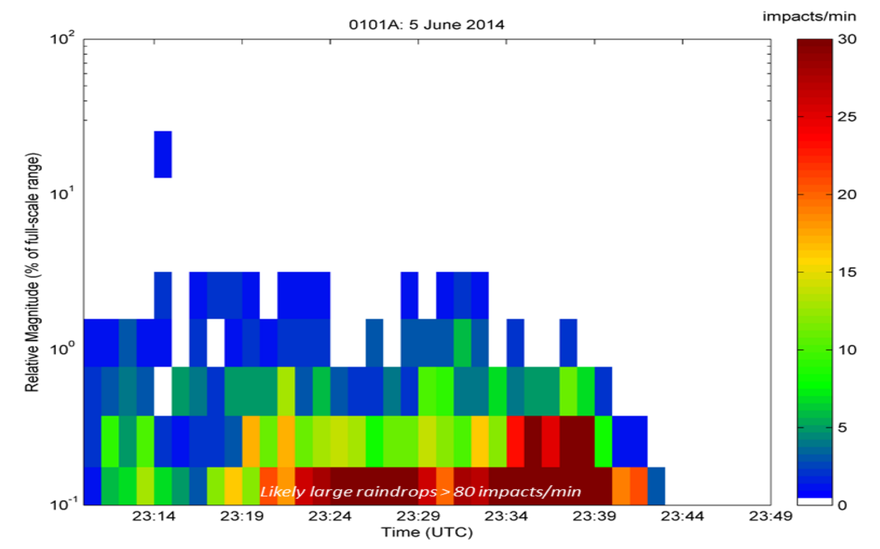
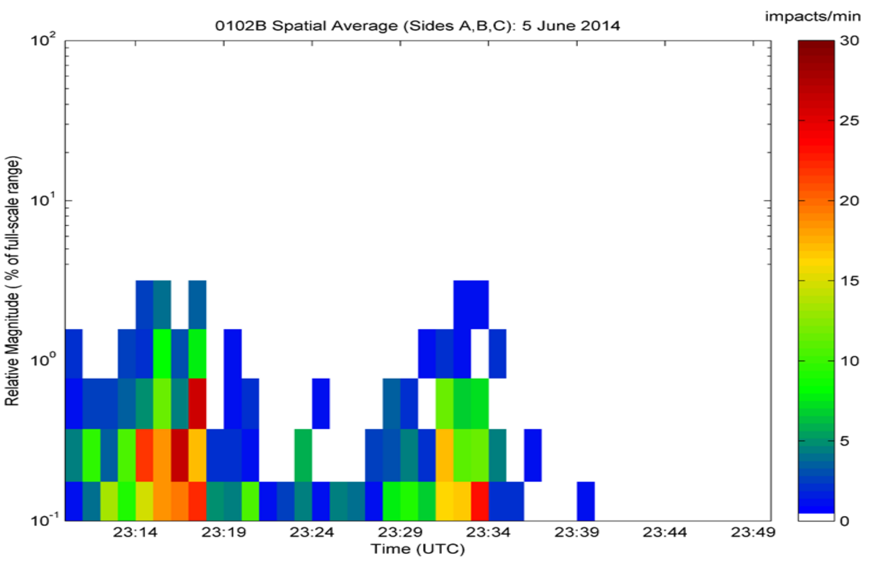
Hailstone Database: Impact Probe Example

Single piezo-electric sensor



Three piezo-electric sensors



- Punkin Center, CO on 5 June 2014
- Large volume of small hail
  - 10-20 impacts per minute

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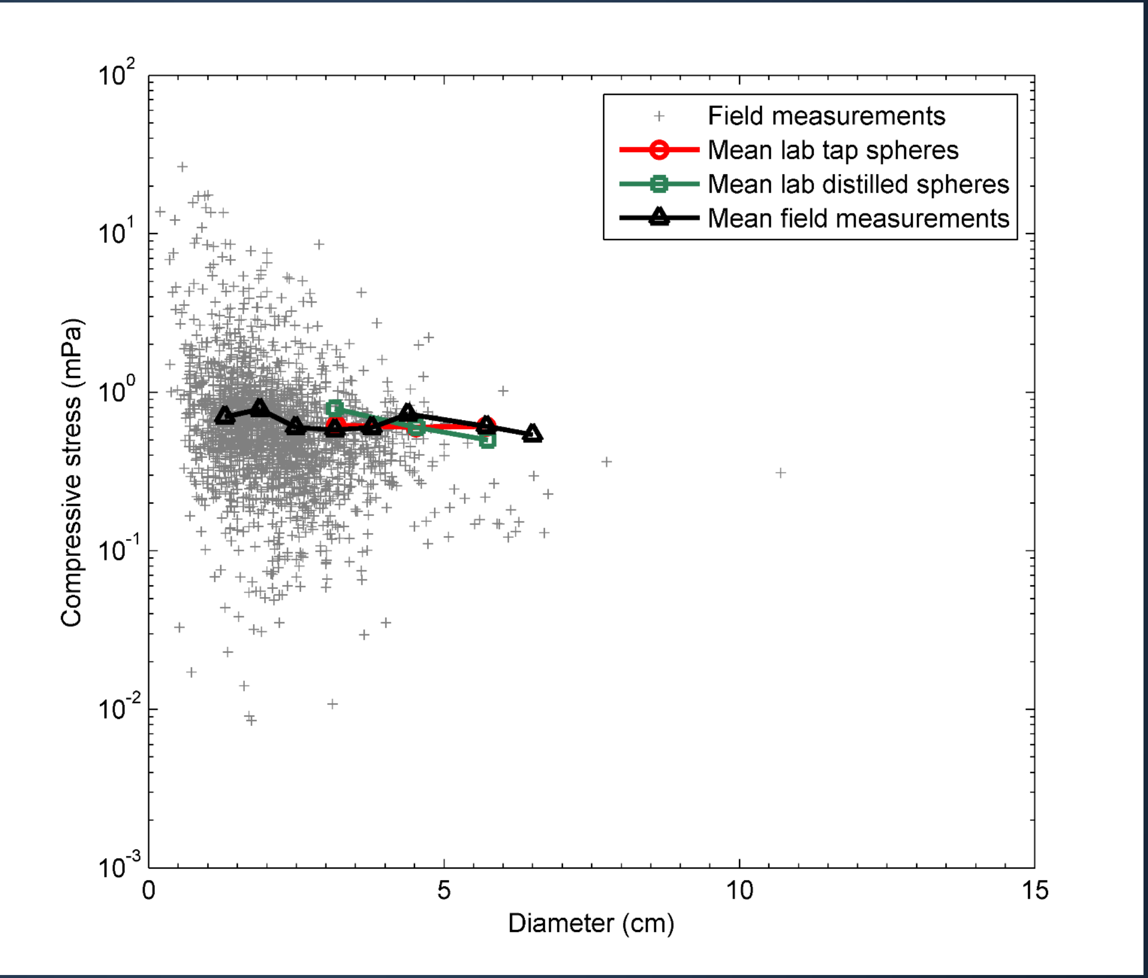
Lab-Field Comparisons

- Mean compressive stresses of lab data similar to field data
- Wide spread of field data
- Need more obs at sizes greater than 3.8 cm (1.5 in)



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Summary

- Baseline data collected to evaluate representativeness of laboratory impact tests
- Large research-quality database, but still small compared to number of hailstones in a single storm
- Experience gained from prototype hail disdrometer deployments will be used to develop:
  - Adaptive deployable network of probes
  - Fixed probes at mesonet weather stations

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Questions?
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See conference proceedings for references

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