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
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
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)
Hailstone Database: Impact Probe Example

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