Technical Investigation of the May 22, 2011, Tornado in Joplin, MO

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NCST Advisory
Committee Meeting

Emergency Communications, Public Response, and Tornado Deaths and Injuries

Erica D. Kuligowski
Joplin Task Leader
Engineering Laboratory, NIST

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Objective #4

- Determine the pattern, location, and cause of fatalities and injuries, and associated emergency communications systems and public response

Presentation Outline

1. Data Collection
2. Findings on casualties, emergency communications, and human response
   - Context
   - Emergency communications prior to May 22, 2011
   - Tornado history prior to May 22, 2011
   - Emergency communications on May 22, 2011
   - Fatalities, Injuries and Public Response

1. Data Collection

Data Collected on Public Response and Emergency Communications

- 168 survivors (telephone/face-to-face interviews)
- Sample demographics
  - Age: ranged from 18 to 88 (mean age = 51)
  - Gender: 59% women
  - Authoritative role: 10%
  - Information on the deceased: 10%
  - Injured: 10%
  - Geographic location: well distributed across the tornado path through Joplin, also in various types of buildings throughout the path (or outside of buildings)

- Over 100 media accounts of stories of survival
- Targeted interviews with and data collection from emergency response personnel (inside and outside City of Joplin, MO)

Data Collected on Fatalities/Injuries

- Death certificates obtained for all deaths from
  - Missouri Department of Health and Senior Services
  - Oklahoma State Department of Health
  - Kansas Department of Health and Environment's Office of Vital Statistics
- Additional sources on deaths : NWS; MO State Police; Dr. Andrew Curtis; media accounts; NIST survivor interviews; social media; obituaries; American Red Cross

- Information on injuries obtained from:
  - MO Department of Health and Senior Services
  - CDC EPI-Aid Study (Source: MO Department of Health and Senior Services)

2. Findings Related to the Pattern, Location, and Cause of Fatalities and Injuries, and Associated Performance of Emergency Communications Systems and Public Response

Findings (1) – Context

- F27: During the period from 1950 (i.e., the beginning of official tornado record keeping) through 2011, tornadoes caused approximately 5,600 fatalities in the United States. Within an 80–mile radius around Joplin, 233 deaths (including those caused by the Joplin tornado) were caused by tornadoes during the same period.

Findings (2) – Context and Fatalities

- F28: The Missouri State Police attributed 161 deaths and the City of Joplin attributed more than 1,000 injuries to the Joplin tornado, which affected an area with an estimated population of 20,820.

- F29: Of the 161 deaths resulting from this tornado:
  - 155 (96 percent) were caused by impact–related factors (i.e., multiple blunt force trauma to the body).
  - Others were caused by stress–induced heart attacks, pneumonia, or lightning.

Map of the Location of 161 Fatalities

Legend

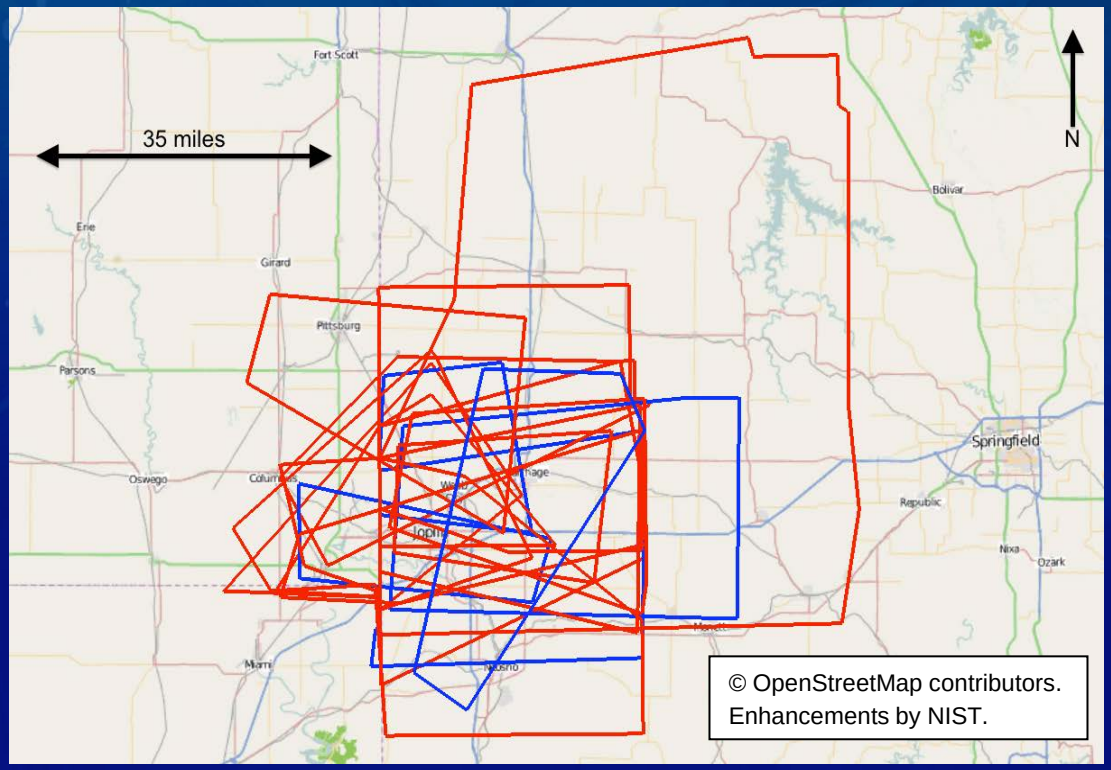
Tornado Path

Fatality Locations

- Apartments
- Places of Worship
- Detached Homes
- St. John's Regional Medical Center
- Elks Lodge
- Meadows Healthcare Facility
- Greenbriar Nursing Home
- Outdoor
- Walmart, Home Depot, Pizza Hut, AT&T Store and Golden Corral
- Stained Glass Theater
- Vehicles

Findings (3) – EC Prior to May 22, 2011

- F30/31: False alarm rates:
  - There was evidence of high false–alarm rates among the storm–based tornado warnings officially issued for Joplin.
  - Despite public perception, no evidence was found of high false–alarm rates for Joplin's outdoor siren system.

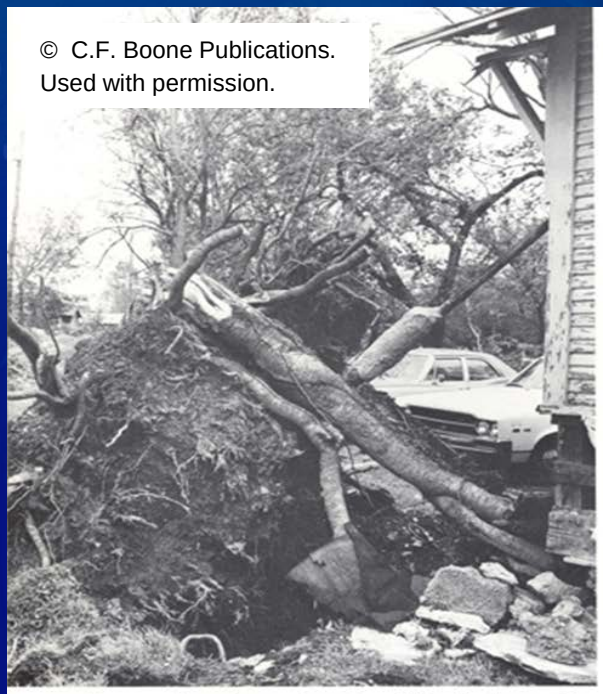


Findings (4) – EC Prior to May 22, 2011

- F32: Joplin residents interviewed after the Joplin tornado believed that there had been a high number of false alarms in Joplin from official tornado warnings and the City's outdoor siren system prior to 2011, even though the siren activation rate was once per year (on average).

Findings (5) – Tornado History Prior to May 22, 2011

- F33: Prior to 2011, the roughly 30–square–mile City of Joplin had experienced one tornado rated EF–2 or greater since 1950; this tornado occurred on May 5, 1971. However, also since 1950, 182 tornadoes rated EF–2 or higher had struck within an 80–mile radius of the City.



Heavy earth moving equipment could hardly do more than a tornado when it uproots a large tree.

The sign advertises hamburgers but the business it stands for was no longer standing.

Findings (6) – Tornado History Prior to May 22, 2011

- F34: Prior to the May 22, 2011, Joplin tornado, scientifically unfounded beliefs about tornado movements and the effects of regional topography contributed to a common public perception that the City of Joplin was immune to a direct tornado strike.

Findings (7) – Emergency Communications on May 22, 2011

- F35: Two official tornado warnings were issued on May 22, 2011.
  - After the first official warning, Joplin's sirens were sounded but no tornado occurred.
  - After the second official warning, the siren system was sounded again, 4 minutes after the tornado touched down and almost exactly when the tornado entered the City of Joplin.
  - Both siren soundings took the form of a continuous tone of 3 minutes duration.

- F36: Joplin's outdoor siren system, which could generally be heard indoors as well as outside, was the primary means by which individuals were alerted to a tornado event on May 22, 2011. Radio, television, and word of mouth were the primary means by which individuals were provided with warning information on May 22, 2011.

Findings (8) – Emergency Communications on May 22, 2011, cont.

- F37: The Joplin–Jasper County Reverse–9–1–1 telephone system was not used on May 22, 2011, due to its inability to disseminate information in a timely manner.

- F38: Functioning as an alerting system, only, the outdoor sirens prompted many Joplin residents and visitors to seek further information on May 22, 2011. The multiplicity of information sources, and the conflicting information provided by those sources, added to the public's confusion about the true hazard as additional information was sought.

Findings (9) – Emergency Communications on May 22, 2011, cont.

- F39: Across the country, there is no standard method for sounding outdoor public siren systems, which has led to variations in siren usage, activation procedures, and sounding patterns among U.S. communities. Also, there are no nationally accepted standard protocols for the issuance of an all–clear alert following a warning.

Findings (10) – Fatalities and Injuries

- F40: Of the 155 impact–related fatalities:
  - 135 (87 percent) involved persons who are known to have been located inside structures during the tornado.
  - The structures in which these people died included both residential (59 percent of the 135 victims) and non–residential (41 percent) buildings.

- F41: Virtually all of the buildings in which the 135 impact–related fatalities occurred experienced maximum estimated winds associated with tornadoes rated EF–3 or higher. Exceptions (EF2 or lower):
  - Meadows Healthcare facility, where two of the deaths occurred,
  - Five single–family homes that were the sites of six of the fatalities.

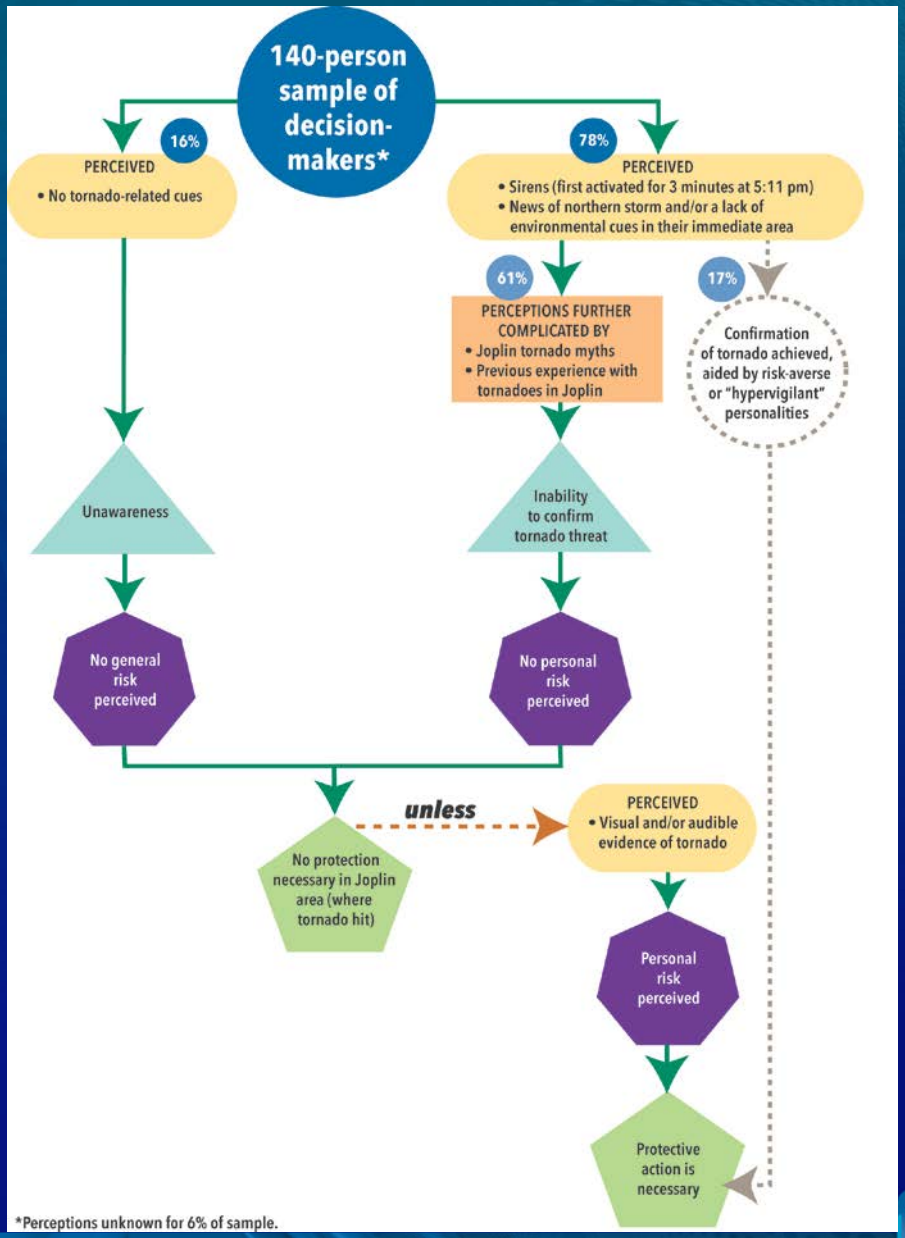
Findings (11) – Fatalities and Injuries

- F42: The hospital towers at SJRMC did not provide life–safety protection for all occupants, even though the towers did not collapse. Twelve impact–related fatalities occurred in the hospital, four of which involved patients in intensive care units.

Findings (12) – Public Response, cont.

- F43: Responses to the approaching tornado among members of the public, in many cases, were delayed or incomplete

- F44: Two factors were found to have contributed:
  - Lack of awareness
  - Inability to perceive personal risk



Findings (13) – Public Response, cont.

- F45: The main factor that convinced individuals to take shelter was the receipt of high–intensity cues, including hearing or seeing the tornado approaching or witnessing others' urgency related to taking protection.

- F46: No fatalities occurred in demolished, detached homes in which people took refuge in basements. Additionally, NIST found no evidence that any of those killed were located underground during the tornado.

Findings (14) – Public Response, cont.

- F47: A disproportionate number of people aged 60 years or older died or were injured as a result of this tornado. NIST analysis of the fatalities resulting from the Joplin tornado shows that approximately 8 fatalities occurred per thousand people in Joplin aged 60 years and over compared with 2 fatalities per thousand people in Joplin under 60 years.