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Tornado Knowledge and Perceptions as an Influence on Safety Actions Taken: Preliminary Results

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Abstract for DBER Group Discussion on 2013-03-28

Presenter, Department(s):

Matthew Van Den Broeke
Assistant Professor
Department of Earth and Atmospheric Sciences

Title:

Tornado Knowledge and Perceptions as an Influence on Safety Actions Taken: Preliminary Results

Abstract:

During fall 2012, 613 UNL students in introductory-level science courses were surveyed. Questions asked included home location and years lived in Nebraska, source from which participants learned about tornadoes and tornado safety, general responses to tornado warnings, specific responses to the most recent tornado warning experienced, and a variety of questions designed to test knowledge of tornadoes and appropriate tornado safety actions. Preliminary results will be presented for a subset of this data, with a focus on:

- 1) Geographic differences in participant knowledge of tornadoes and tornado safety,
- 2) Relationships between source of tornado-related knowledge, source of tornado warnings, and responses to tornado warnings, and
- 3) How perceptions of tornadoes may influence actions participants report to take when under a tornado warning.

Tornado Perceptions Study: Preliminary Results



Matthew Van Den Broeke
Earth and Atmospheric Sciences
28 March 2013

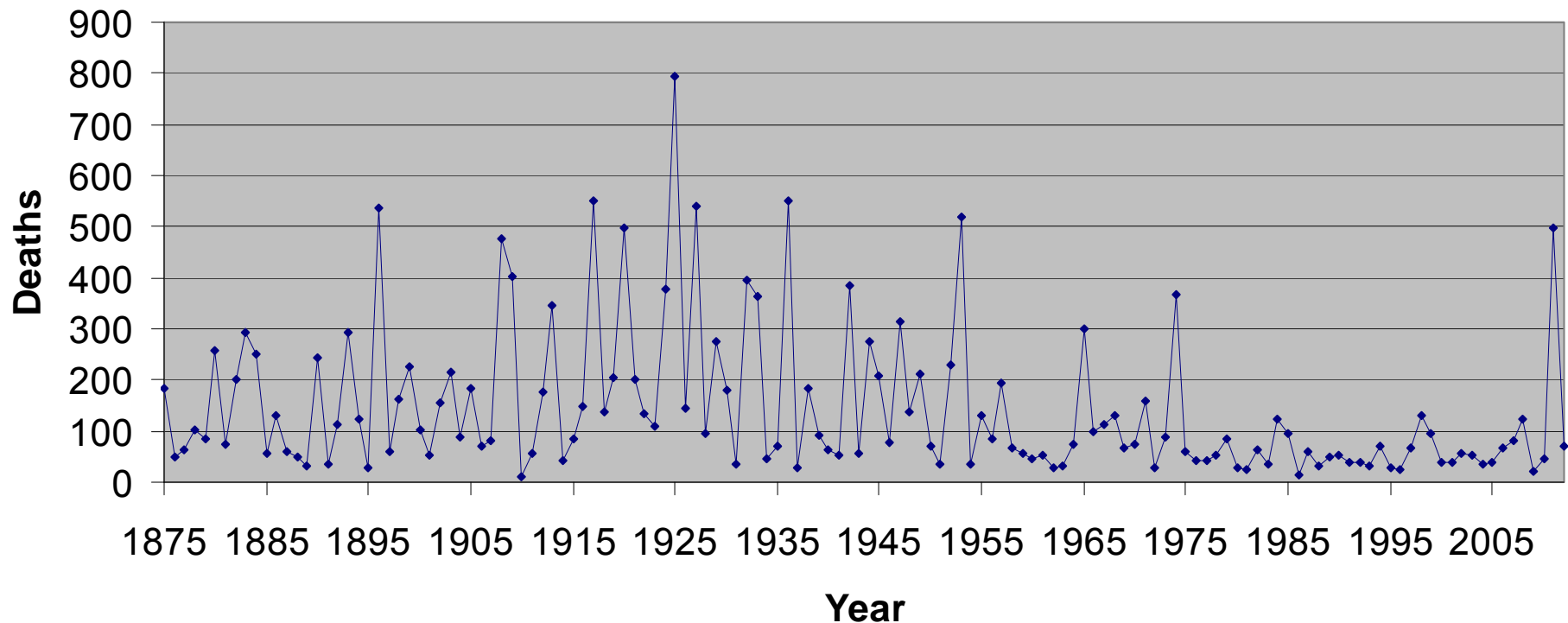
Acknowledgements

- Dr. Leilani Arthurs
- Andrew Gabel
- Faculty who allowed survey administration

General Motivation

- Tornadoes: still deadly
- Increasing future death toll?
- Develop guidelines for future action/teaching?

Tornado Deaths per Year, 1875 - 2012



Specific Motivation

- Recent events at U.S. universities:
 - 2001: U. Maryland
 - 2008: Union Univ.
 - 2008: Kansas State Univ.
 - 2013: U. of Southern Mississippi



Courtesy U. Maryland



Christianindex.org



Reuters

<http://www.youtube.com/watch?v=pgnyt-qWcX4>



Courtesy
KS State Univ.

Methodology

- Collected 613 surveys (Fall 2012)
- 24 questions
 - Participant classification
 - Knowledge of tornadoes
 - Knowledge of best safety practices
 - Self-reported responses to tornado threat
- 100 surveys recorded/transcribed so far
- Seeking correlations between responses
- Geographical differences?
- Transcribed responses also analyzed for patterns

Intercoder Reliability

- First 50 responses coded separately, results compared
 - Initially: 90.1% overall (61% - 100%)
 - Eliminated a question—strongly dependent on evaluator knowledge/interpretation
 - After comparison: increased to 100%
- Responses 51 – 100 recoded to be consistent with rubric changes

Participant Classification

1) Home state/country?

NE: 70%

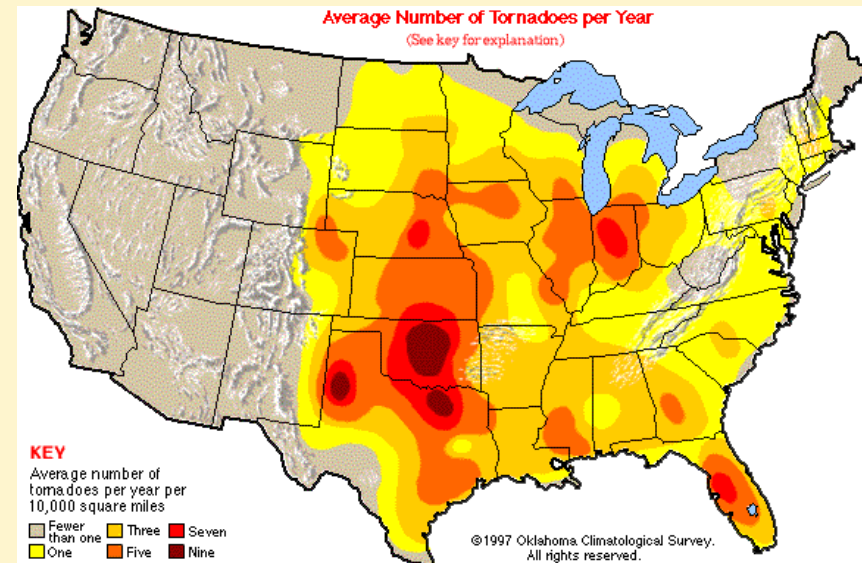
SD: 6%

IL: 4%

16 other states (17%)

Blank/undecipherable: 2%

Philippines (1%)



Participant Classification

- Years in Nebraska?
 - <1: 10%
 - 1 – 4: 17%
 - 5+: 72%
 - 1 response missing



Knowledge and Safety Scores

- One set of questions assessed:
 - Participant knowledge of tornado behavior
 - Participant understanding of appropriate safety actions
- Scores on questions in these categories summed to obtain '*knowledge score*' and '*safety score*' for each participant

Knowledge Score: Components

(1) What does it mean if a *tornado watch* is in effect for your area?

--Good response (1 pt.; 53%):

“Conditions are right for a tornado”

--Moderate response (0.5 pt.):

“You wait for further information.”

--Poor responses (0 pt.):

“get to safety”; “Tornado has been spotted”; “Sit and watch TV”

- Temporal confusion (days involved)
- Mix up watch and warning

Knowledge Score: Components

(2) What does it mean if a *tornado warning* is in effect for your area?

--Good response (1 pt.; 68%):

“There is a tornado in your area so you should follow safety actions.”

--Moderate response (0.5 pt.):

“There is going to be a tornado”

--Poor response (0 pt.):

“That a tornado might happen”

Knowledge Score: Components

(3) Compared to the rest of southeast Nebraska, how likely is the city of Lincoln to be affected by a tornado?

--Good response (1 pt.; 18%):

“About the same, no reason different”

--Moderate response (0.5 pt.):

“Quite likely seeing as though Nebraska weather is unpredictable”

--Poor responses (0 pt.):

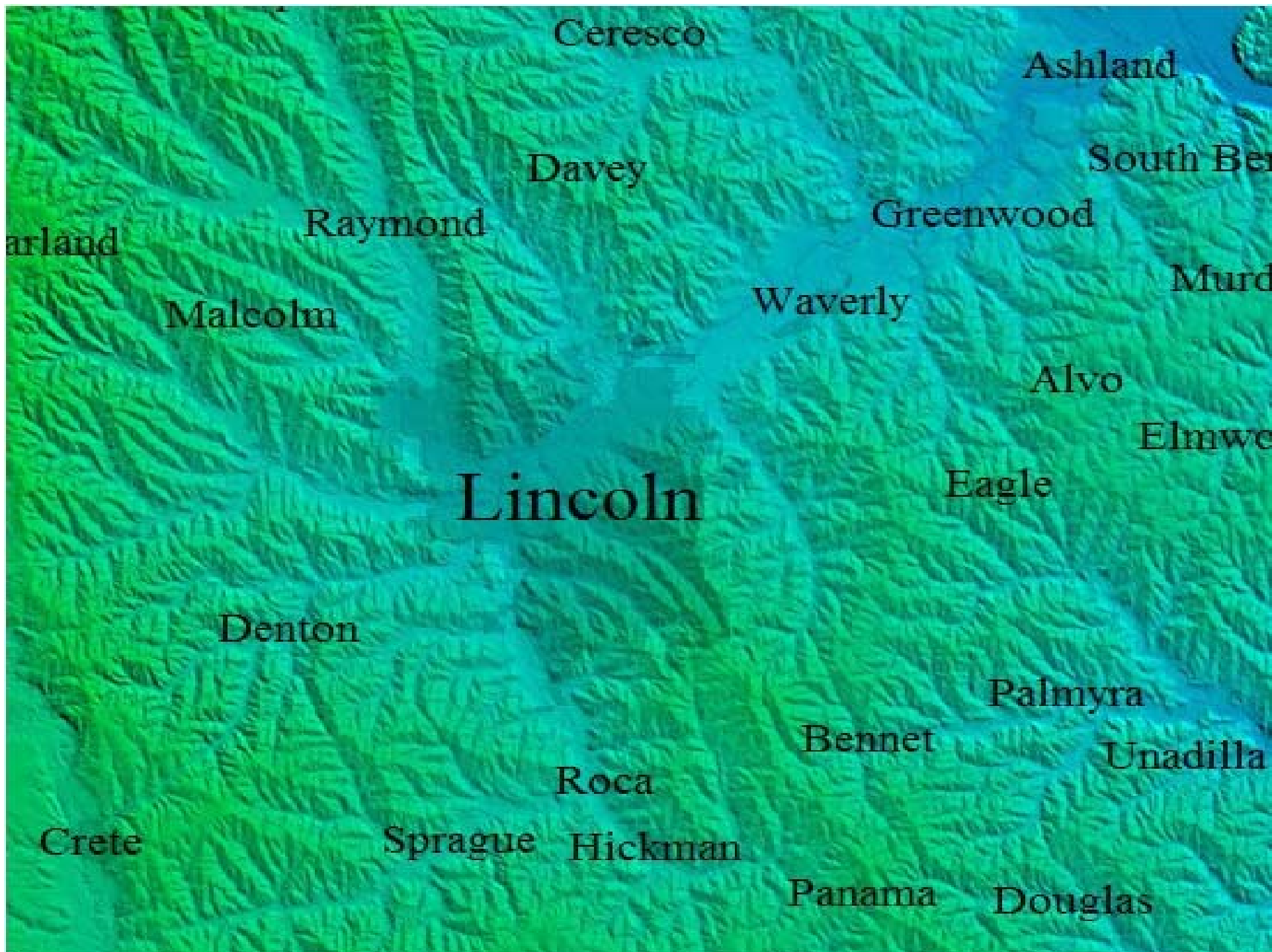
“Very unlikely, Lincoln is in a bowl...” (20%)

“Probably not so much because of surface friction”

“Minimal—due to knowledge from previous tornadoes & their prevalence”

“Less likely, haven’t happened in my 22 years”

“Probably not very likely. I have no clue; just hoping.”



Ceresco

Ashland

Davey

South Ber

arland

Raymond

Greenwood

Malcolm

Waverly

Murd

Alvo

Elmwe

Lincoln

Eagle

Denton

Palmyra

Bennet

Unadilla

Roca

Crete

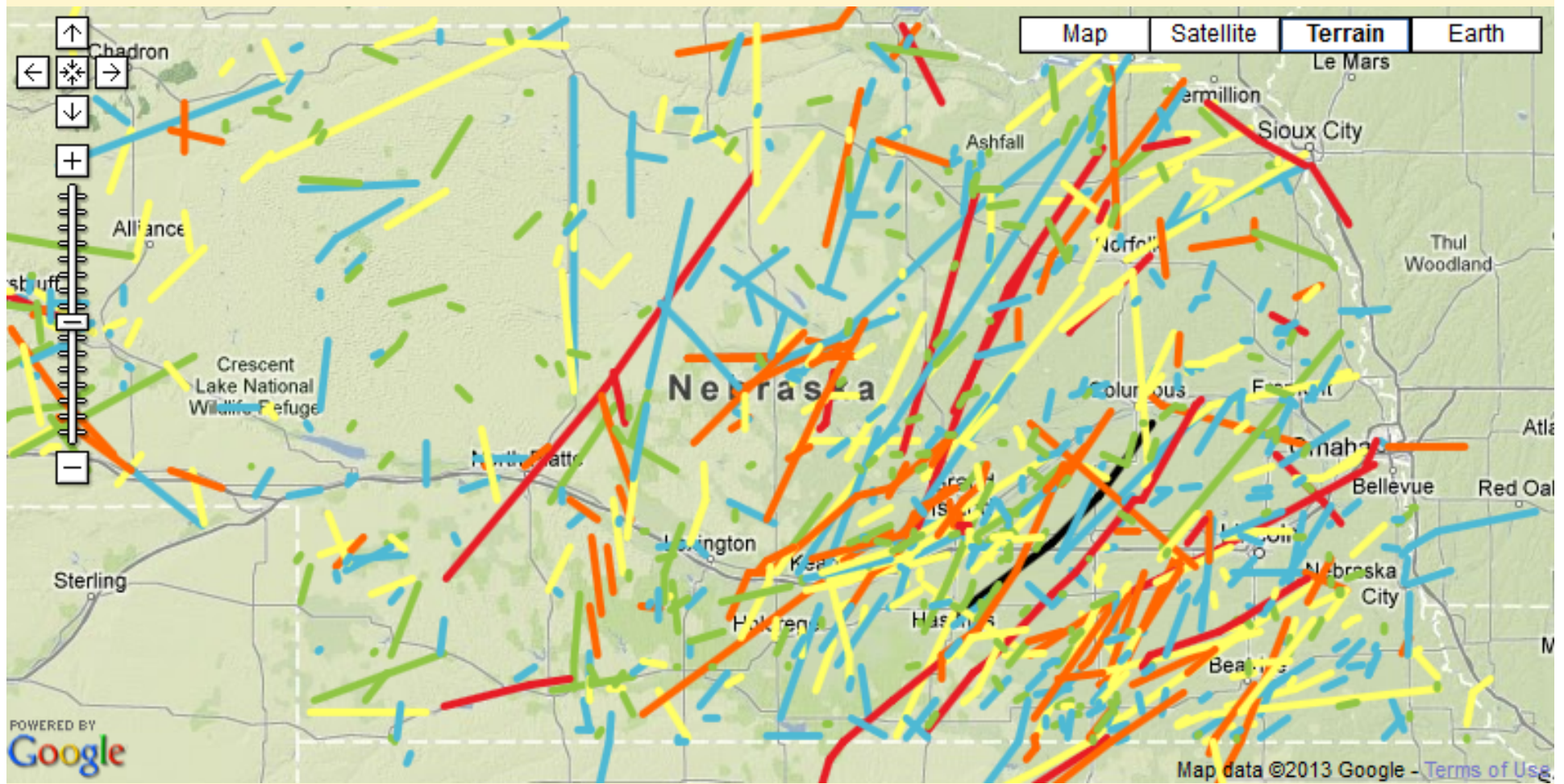
Sprague

Hickman

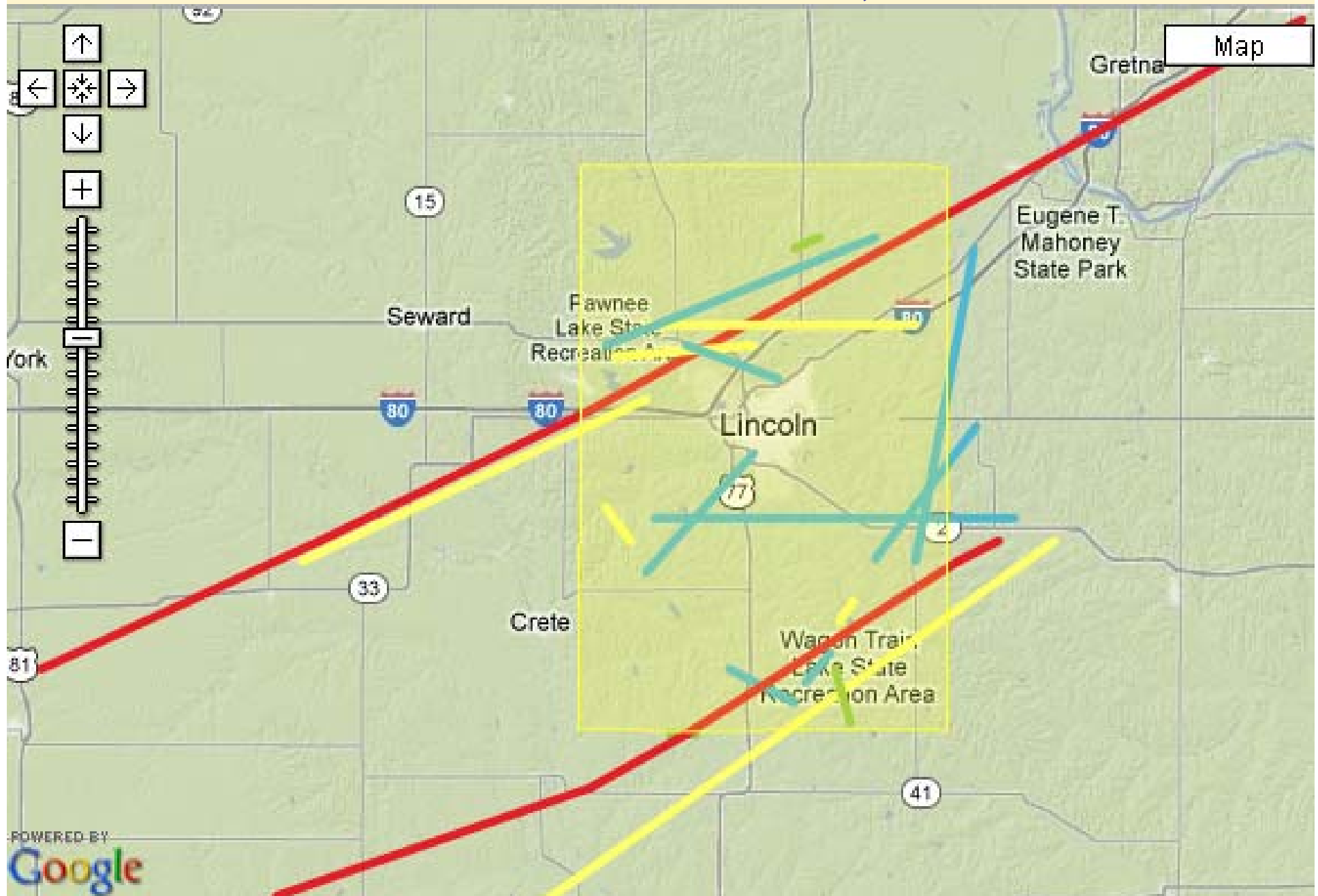
Panama

Douglas

Nebraska Tornadoes, 1950 – 2011



Lancaster Co. Tornadoes, 1950 - 2011



Knowledge Score: Components

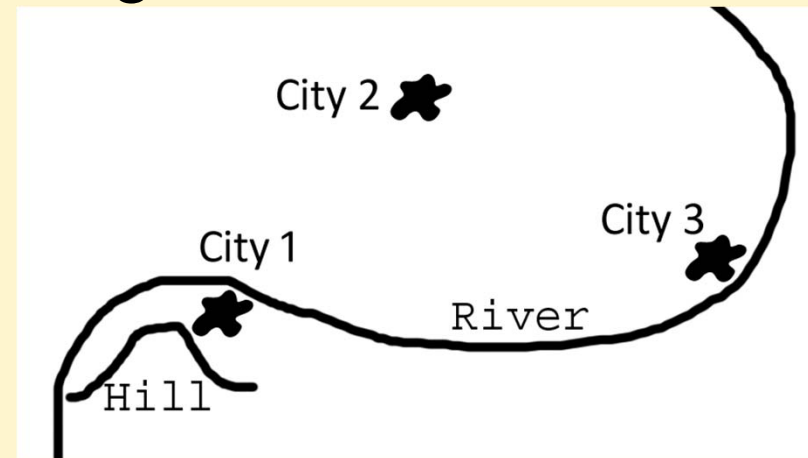
- (4) Three cities of the same size are located within a small area, shown on the drawing below. Briefly discuss the relative risk of being affected by a tornado in each city. Please provide your reasoning:

Hill Myth: 35% (20% no)

River Myth: 35% (19% no)

Common misconceptions:

- Flat ground is more tornado-prone
- River safer because cooler/moister/lower in elevation
- Hill's elevation makes City 1 *more* vulnerable



Knowledge Score: Components

(5) Could a tornado occur when there was snow on the ground?

YES NO Briefly provide your reasoning:

--Good response (1 pt.; 10%):

“They can occur as long as the conditions are there”

--Moderate response (0.5 pt.):

“changing temp”

--Poor response (0 pt.):

“Too cold and I’ve never heard of this happening”



Central
Nebraska,
Feb. 2012

wunderground.com

Knowledge Score: Components

(6) Could a tornado cross a mountainous area? YES NO

Briefly provide your reasoning:

--Good response (1 pt.; 4%):

“Although it is less likely tornadoes can happen anywhere.”

--Moderate response (0.5 pt.):

“Heard of it happening”

--Poor responses (0 pt.):

“Mountains are too tall for tornadoes to pass through.”

“With the surface friction, I doubt it”

“needs to be flat”



Scott Newton 2004

Rockwell Pass,
California (12,000')
2004
(Scott Newton)

Knowledge Score: Components

(7) What is a typical wind speed in a very strong tornado (please include units)?

Don't know: 10%

Missing: 8%

Correct (250+ mph): 5%

Too high: 2%

≤ 100 mph: 49%

≤ 75 mph: 19%

≤ 60 mph: 10% !

- Too low...may not take threat as seriously?

Knowledge Score: Components

- Additional components:
 - Why do tornadoes contain strong winds?
 - Briefly explain your understanding of how a tornado forms. Include a picture if it helps your explanation. (eliminated)
 - If a tornado does not appear to be reaching the ground, can it still be doing damage?
 - Briefly explain the relationship between tornado size and strength of the winds.
 - In which directions could a tornado move?

Safety Score: Components

- (1) Do you have a substantial, well-thought-out tornado safety plan you could use if a tornado was approaching your location...
- ...where you live? (No: 22%)
 - ...at work/school? (No: 28%)

Safety Score: Components

(2) In approximately what percentage of cases do you respond to a tornado warning?

100%: 31%

40% - 60%: 13%

25% or less: 32%

10% or less: 23%

Missing: 2%



Safety Score: Components

(3) How did you respond during the most recent tornado warning you experienced?

--Good response (1 pt.; 13%):

“went to designated safely area”

--Moderate response (0.5 pt.):

“Go to lowest level of house”

--Poor responses (0 pt.; 36%):

“I didn’t really pay attention to it”

“I went outside 😊 I have an obsession w/ tornadoes”

“I waited for extreme circumstances”

“Wasn’t too worried. Could see one outside once. If I was ever hurt I would change my mind.”

Safety Score: Components

(4) If no safe indoor location is available (you're caught outside), what should you do if a tornado is approaching?

--Good response (1/0.75 pt.; 38%):

“Lie in a ditch or low area. Cover head.”

--Moderate response (0.5 pt.):

“take cover in a ditch”

--Poor responses (0 pt.; 15%):

“Find a tree or other protective area...”

“RUN!”



Courtesy
UCAR

Safety Score: Components

- Additional components:
 - What would cause you to respond to a tornado warning (to *take action/seek safety* when you learned of the warning, or afterward)?
 - Is it safe to take shelter under a highway overpass during a tornado? (27% yes)
 - Is it appropriate to open windows before a tornado arrives? (22% yes)
 - If you have a basement available, where in it should you go to be safest in a tornado? (17% best practice)

Preliminary Results

- Removed participants with 5+ missing responses (in all analysis described here)
- Relationships between *knowledge/safety scores* and *geographic distribution*

| Location | Removed | Knowledge | Safety |
|-------------------|---------|-----------|--------|
| Nebraska (67) | 3 | 4.11 | 5.78 |
| Great Plains (8) | 0 | 5.63 | 5.91 |
| Great Lakes (6) | 0 | 3.58 | 4.81 |
| Other U.S. (11) | 2 | 3.73 | 4.96 |
| International (1) | 0 | 3 | 5.25 |

Preliminary Results

- Relationships between *source of tornado knowledge* and *knowledge/safety scores*

| Knowledge Source | Removed | Knowledge | Safety |
|--|---------|-----------|--------|
| Television (11) | 1 | 5.05 | 6.14 |
| Elem. School (49) | 4 | 3.97 | 5.53 |
| Parents/Family (10) | 0 | 4.30 | 6.48 |
| Internet (2) | 0 | 4.50 | 7.13 |
| High School/College (6) | 1 | 3.83 | 5.34 |
| Other indiv.; “common knowledge”; “news” (8) | 0 | 3.63 | 4.20 |
| Personal experience (4) | 0 | 4.88 | 6.31 |

Preliminary Results

- Relationships between *source of tornado knowledge* and *response* to warnings

| Knowledge Source | Average Response Score |
|---|------------------------|
| Television (11) | 0.32 |
| Elem. School (53) | 0.33 |
| Parents/Family (10) | 0.55 |
| Internet (2) | 0.25 |
| High School/College (7) | 0.64 |
| Other indiv.; “common knowledge” ; “news” (6) | 0.25 |
| Personal experience (3) | 0.50 |

Preliminary Results

- Relationships between *source of tornado warnings* and *response* to those warnings

| Knowledge Source | Average Response Score |
|-------------------------|------------------------|
| Television (53) | 0.41 |
| Sirens (20) | 0.35 |
| Mobile Devices (4) | 0.25 |
| Internet (1) | 0.00 |
| Radio/Wx Radio (12) | 0.46 |
| Visual observations (1) | 0.00 |
| Comm. with others (4) | 0.38 |

Preliminary Results

- Correlations between particular tornado perceptions and actions taken

| Variable | Correlation with Action in Most Recent Warning | Additional Observations |
|-------------------------------|--|--|
| Knowledge of “watch” | 0.11 | Knowledge = 0 → avg. resp. = 0.15 lower |
| Knowledge of “warning” | 0.10 | Little diff. between warning knowledge categories |
| Knowledge of wind speed | 0.00 | Wind ≤ 75 mph: avg. resp. 0.13 less than others |
| Lincoln’s Vulnerability | 0.11 | LNK not vuln. (57): avg. resp. 0.13 less than others |
| Directions a Tornado can Move | 0.17 | ---- |
| Safety Score | 0.48 | Above-avg score: average resp. 0.24 higher! (doubled) |
| Knowledge Score | 0.15 | Above-avg score: average resp. 0.15 higher |

Conclusions

- Many tornado myths remain!
- Geographic bias may exist (more data needed)
- Family or high school/college may be effective sources of knowledge
- ***Safely knowledge is valuable!***