Societal Impacts of the Super Tuesday Tornado Outbreak of February 5-6, 2008

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NCAR

The essentials!

- *Partnerships* among social scientist, research meteorologists, operational meteorologists, policy makers, practitioners, etc.
  - Daniel → links operational meteorologists, users
  - Julie → links users, social science research
  - All of us here in the room who have essential linkages

- *Interest and willingness* to work together, listen, learn, exchange ideas … co-produce knowledge

We learn a lot, inspire questions, and better approach problems … we are so much more effective together!

NWS service assessments

- Conducted to evaluate NWS performance during significant, high-impact events

- Historically primarily *inward, quantitative* assessment of NWS and its partners

- 2008 shift toward including *external, qualitative* assessment of members of public
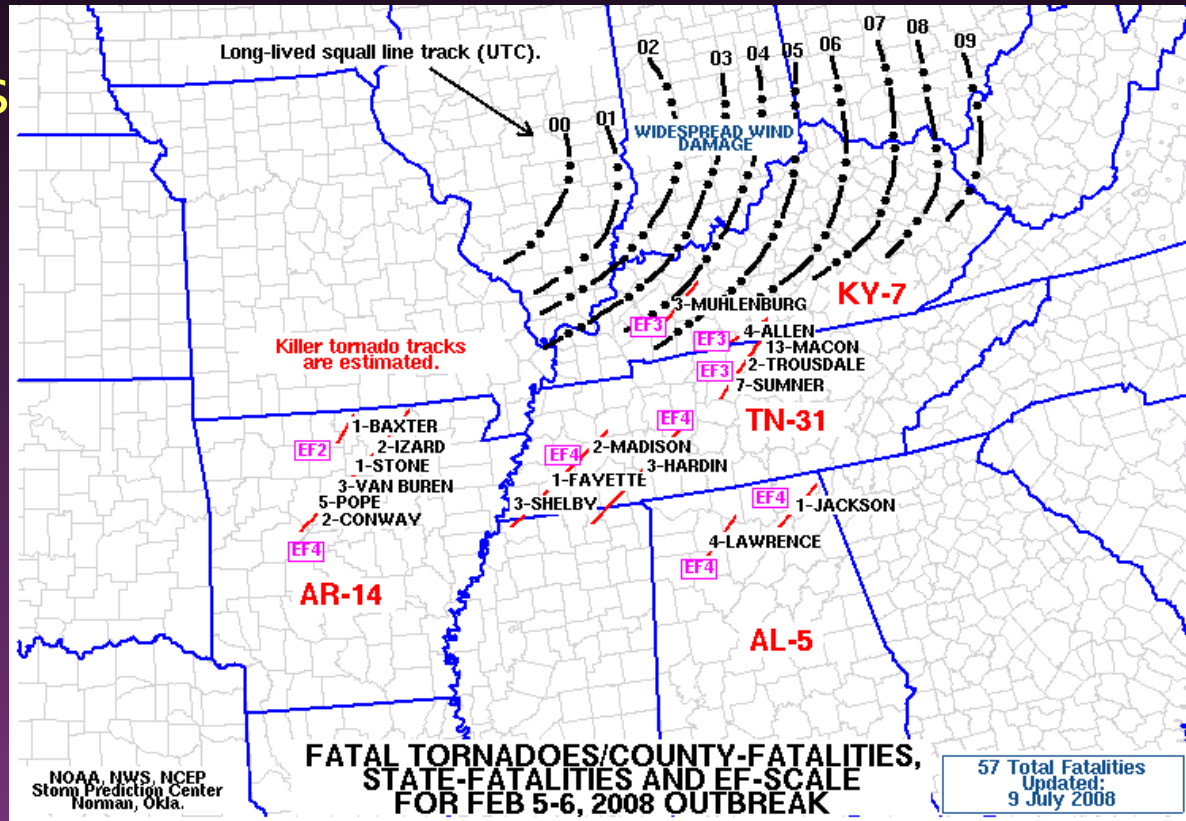 - Super Tuesday, Mother's Day, Midwest floods

February 5-6, 2008, tornado outbreak

- 13 months ago today!

- Excellent long lead-time predictions from NWS
  - First outlook issued 6 days prior
  - Day 3, Day 2, Day 1 outlooks zeroed in with slight, moderate, high risk
  - Day 1 outlook mentioned "potentially strong and long-track tornadoes"
  - Tornado watches in place with several hours lead time
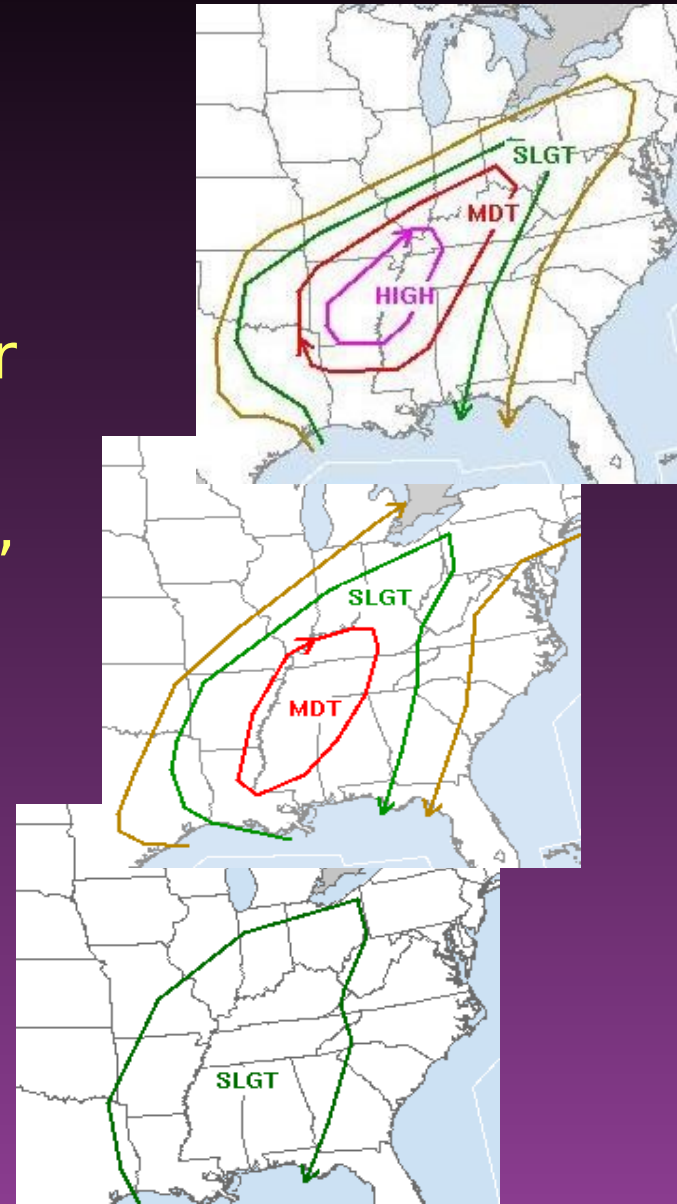
Impacts of the tornado outbreak

- 87 tornadoes
  - 5 EF-4 tornadoes
  - 1 tornado had a 123-mile long path
- 57 fatalities
  - most since May 31, 1985
  - 13th overall
- 350+ injuries
- $520M damage

Long-lived squall line track (UTC).

WIDESPREAD WIND DAMAGE

Killer tornado tracks are estimated.

KY-7
3-MUHLENBURG
EF3 4-ALLEN
EF3 13-MACON
EF3 2-TROUSDALE
7-SUMNER

EF4
TN-31

1-BAXTER
2-IZARD
EF2 1-STONE
3-VAN BUREN
5-POPE
2-CONWAY
EF4

AR-14

EF4 2-MADISON
3-HARDIN
1-FAYETTE
3-SHELBY

EF4 1-JACKSON
4-LAWRENCE
EF4

AL-5

NOAA, NWS, NCEP
Storm Prediction Center
Norman, Okla.

FATAL TORNADOES/COUNTY-FATALITIES, STATE-FATALITIES AND EF-SCALE FOR FEB 5-6, 2008 OUTBREAK

57 Total Fatalities
Updated:
9 July 2008

Ubiquitous questions

- This was a well-warned event, with good information, so...
  - Why did so many people die?
  - What questions do we have about what members of the public understand, think, do, want, ... etc.? How do we go about addressing these questions?
  - What could we (the weather community) do differently? Better?
  - How will continuously changing technology affect the how we analyze weather and communicate that information?

These are physical _and_ social science questions!

Integrating social science research

- The task – To *try* to understand why so many people died and the details of those fatalities
  - Age, gender, warning received, warning source, warning heeded, shelter sought, structure where they died, availability of safer shelter
- An opportunity – To gather empirical information about people's *actual* warning response behaviors
  - What info people had, how they interpreted it (knowledge)
  - How people perceived the situation & info (perceptions)

Highly interdependent iterative process

Methods and data

- Semi-structured interviews with the public; 41 interviews total by 3 sub-teams in the 6 WFOs
  - Kevin Barjenbruch → my essential other half in the field!

- Sampling: targeted, convenience, snowball

- Caveats: not generalizable, balance between scientific rigor and rapid operational needs. 1st

Some of the questions

- When did you first realize there was a threat of a tornado?
  - How did you learn about the threat? What were you thinking after you received that information? What did you do next?

- Have you ever been in a similar type of extreme-weather situation in the past?
  - Did anything from that experience influence what you did during this event? Have you ever been warned about an extreme weather event in the past that did not occur?

- Think back over the entire tornado event, from the time you learned there was a tornado threat through when the tornado actually occurred.
  - Do you feel that any of the information you received was unclear? Is there any other information you would have liked to have had?

Suspend judgment, be open-minded ... and learn!

Data analysis

- Analyzed iteratively, cooperatively by 2 coders

- Coded with Excel
  - Pre-determined categories
  - Categories created inductively during analysis

- Caveats and considerations!!
  - Not generalizable
  - Balance between scientific rigor and rapid operational needs
    - Paraphrasing vs. verbatim quotes
  - First step, hopefully leading to more related work in the future (more detailed analysis, in-depth studies, studies in various weather contexts)

Findings: People's knowledge

- People get information from multiple sources, multiple times
  - Majority via television
  - Also commonly from other people (family, friends, neighbors, co-workers)

- Tornado sirens are useful, but…
  - Misconceptions about sirens as a warning device
  - Misconceptions about what sirens mean

Julie's thoughts and questions

- Things I've learned
  - Communication → pre-event conference calls, NWS chat for before and during an event
  - Siren policies that varying widely by city, county
  - NWS, emergency managers, broadcasters handle tons of info

- Things I wonder and want to explore
  - How do the different actors — NWS forecasters, broadcasters, emergency managers — in the information chain perceive their roles and the roles of others?
  - Does this affect what info they convey? How?
  - How can we use technological advances *effectively* in conveying forecast and warning information?

Daniel's thoughts and questions
(I have hundreds!)

- Things I've learned
  - We all seem to have assumptions of our individual roles as team members
  - We are governed by policy and by software
  - Creativity must look beyond policy and software … change is a *process!*

- Things I wonder and want to explore
  - Does the "public" trust their source of warning information?
  - Do people know where their warning information originates? Do they care?
  - Is there such thing as too long of lead time?

Findings: People's perceptions of the time of year of the outbreak

- People integrate multiple pieces of information —seasonality, weather salience, situational awareness about the event
  - Majority of people associate tornado outbreaks as occurring in March or later...
  - ... so some minimized threat because they perceived it as being outside "traditional" tornado season
  - ... BUT, for many people, situational factors (e.g., unusually warm weather) heightened their awareness

Findings: People's personalization of the threat to them

- People often seek confirmation of the threat; a single source of info will not necessary spur protective action
  - Atkins, AR, woman

- Many people recognize a risk exists, but believe that their personal risk is less or that they aren't at risk at all (optimism bias)
  - Hardin County, TN, family
  - Arkansas family

Julie's thoughts and questions

- Things I've learned
  - NWS, broadcasters, emergency managers work to make every situation salient, unique
  - NWS can and does tailor their warnings and call-to-action statements
  - Broadcasters' visuals can help people personalize risks

- Things I wonder and want to explore
  - Should NWS, broadcasters, EMs, others assume people will seek confirmation?
  - Should what we communicate change according to the urgency of the threat? How can we do this effectively?
  - What different levels of protective action do people take, when, and why (response efficacy)?

Daniel's thoughts and questions

- Things I've learned
  - Some (many?) of us assume that people will learn about the warning and take *immediate* protective action
  - We want better ways to convey urgent information… ("tornado emergency", "face certain death…")

- Things I wonder and want to explore
  - What else can we tell them that would make a difference?
  - How beneficial would it be to have GIS data in our warnings …for the forecasters? (e.g., WFO Dallas/Fort Worth) …for the users?
    - Should this be our job??

Example of facilities within the Arkansas tornado warnings

Schools

Recreation

Mobile home
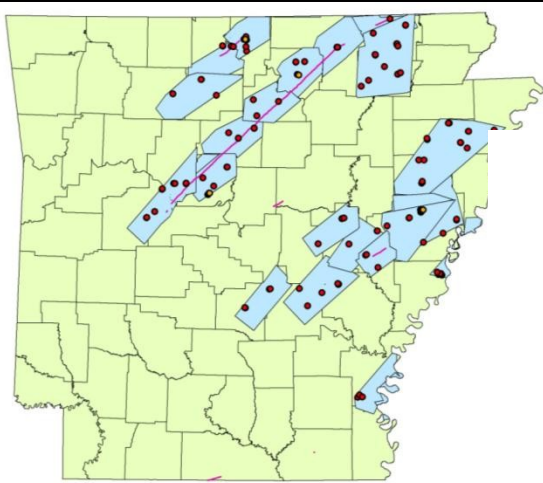
Legend
- Colleges
- K-12 Schools
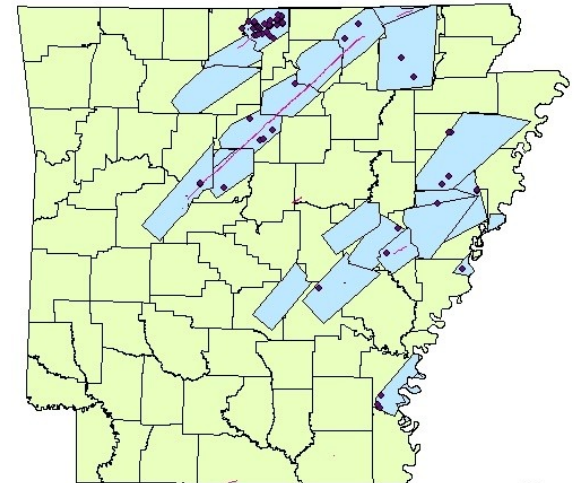- Tornado Path
- Tornado Warnings
- Arkansas Counties
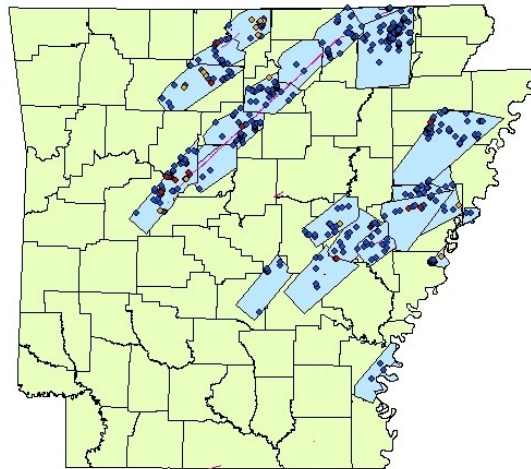
0 30 60

Legend
- Picnic Facilities
- Speedways and Fairgrounds
- Camping and Lodging
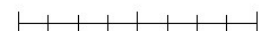- Tornado Path
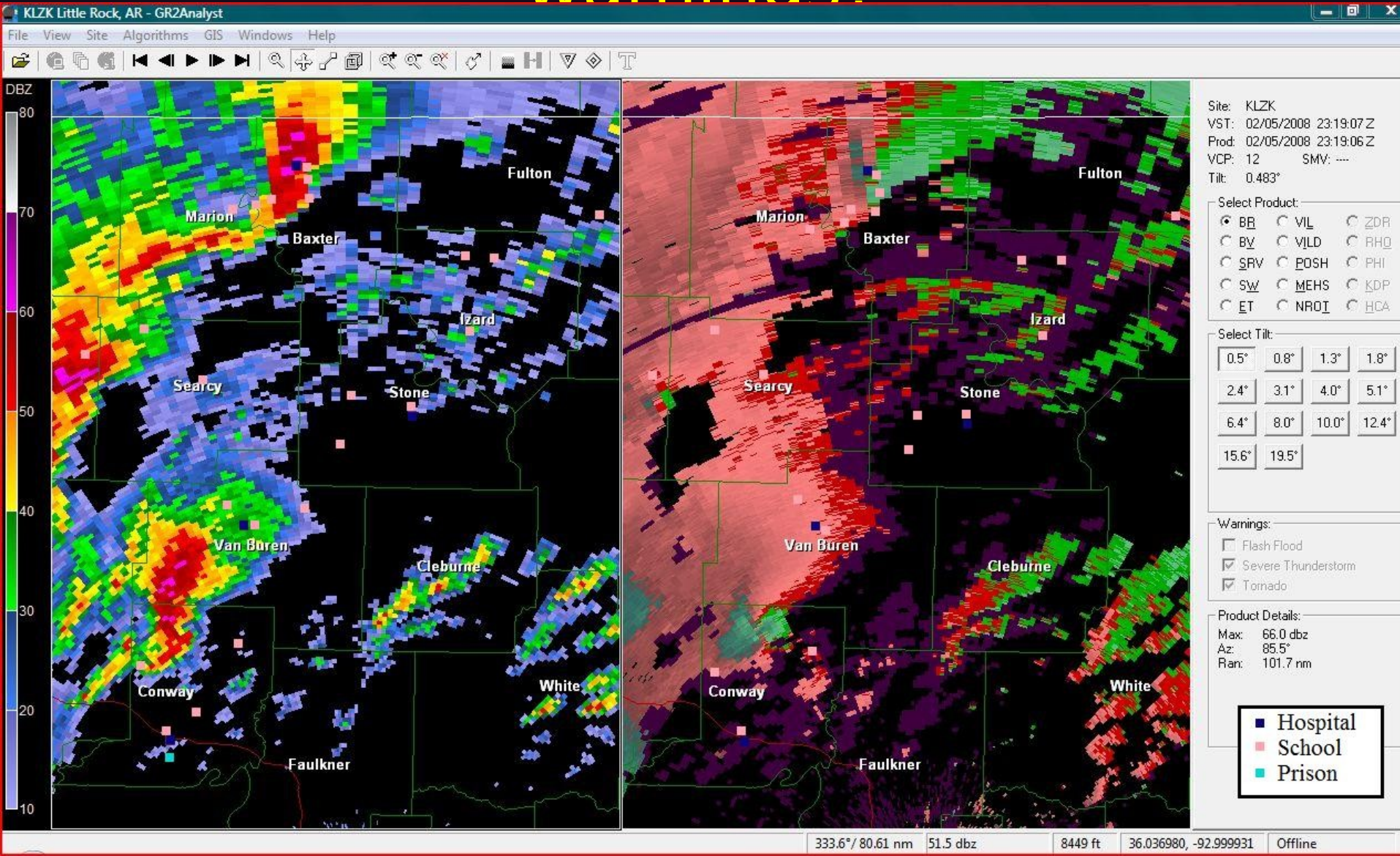- Tornado Warnings
- Arkansas Counties

0 30 60 120

N

Legend
- Mobile Home Parks
- Tornado Path
- Tornado Warnings
- Arkansas Counties

N

0 30 60 120 Mi

Would this information help forecasters issue more effective warnings?

What about Scout Camps?

June 11, 2008

Scout Camp EF3 Damage

Missouri River

Little Sioux

People's decision-making

- Decision-making is NOT a singular event … it happens numerous times and ways
  - Part of people's gathering and interpreting weather information to evaluate the risk
  - Seeking additional information is a decision!

- Decision to shelter
  - Vast majority of people (survivors and victims) who received warning heeded it and sought shelter in best location available to them
  - BUT … less than half of people had a basement, storm cellar, or safe room to shelter in
    - Nearly 2/3 of victims were in mobile homes; additional 15 in houses, 4 in warehouse, 1 in vehicle

Julie's thoughts and questions

- Things I've learned
  - NWS, emergency managers, broadcasters are integrating information about who is at risk, where, when … and this changes daily!
  - We are driven in our mission to save lives!

- Things I wonder and want to explore
  - Should mandatory protective action be taken at longer lead times (e.g., evacuating mobile home parks, dismissing classes, large-venue considerations)?
  - Should local, state, and federal governments partner (legislate?) to build local shelter facilities?

Daniel's thoughts and questions

- Things I've learned
  - We (the NWS and the "government" in general) want to help those who are asking about proper sheltering
  - We want proper shelters for all!
  - We can provide realistic, scientific data to event coordinators, engineers, etc. to help them with their decisions (is StormReady effective?)

- Things I wonder and want to explore
  - Polygons?
 - Probabilistic warnings?

Storm-based warnings

- Are they understood?
- Do the forecasters use them properly?
- Does the media handle them well?
- Does the public know if they are in the warning or not?
- Too large?
- Too small?
- Clearing?
- NWR ???
- Extensions?
- Verification?

18 minute lead time

1 minute lead time
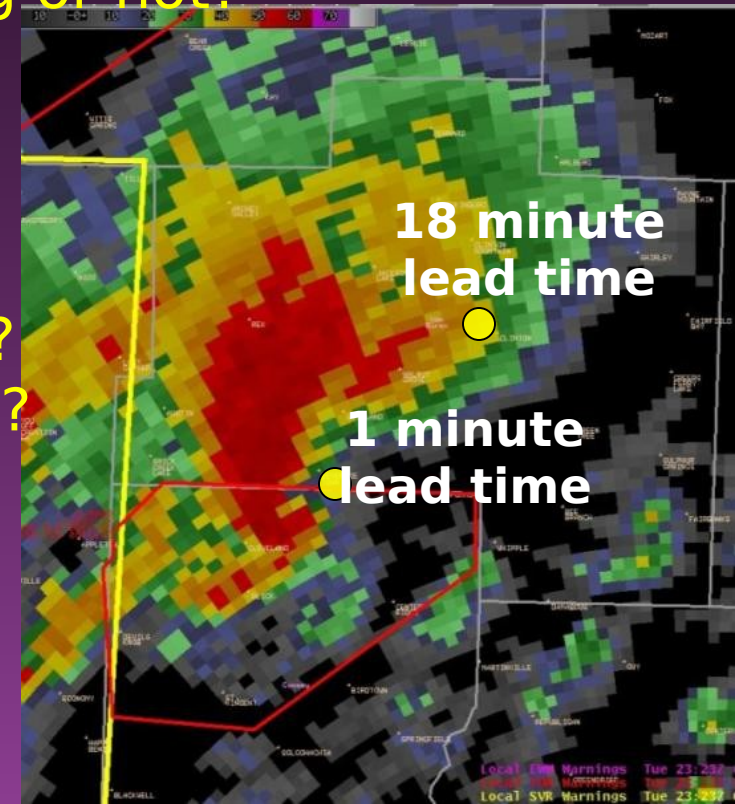
Using technology wisely

- Technology is changing what information we provide and how, but this alone doesn't make us effective ... *must* realize and consider the societal impacts!
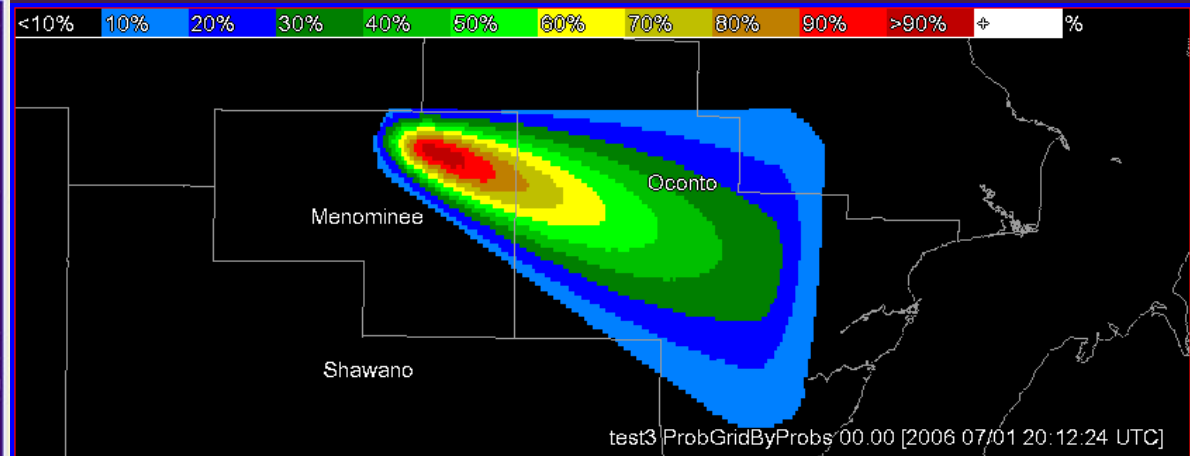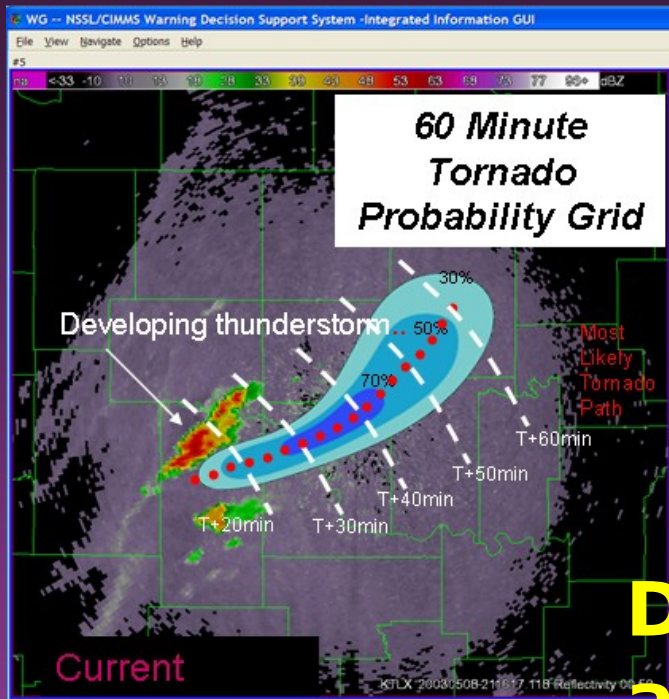
Do "they" *underns* what we are trying to communicate ???

Moving forward...

- We know a little, but there is so much more we need to know. We have a LOT of questions!

- Need integrated *physical* and *social science* work
  - Many social science theories, methods, tools, and concepts to build off of in weather context
  - Need empirical information about people's knowledge, perceptions, decision-making

- Necessity of numerous, strong partnerships

Ultimate goal is to provide better information that improves people's decision-making

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- Contact
  - Julie Demuth (jdemuth@ucar.edu)
  - Daniel Nietfeld (dan.nietfeld@noaa.gov)

- Super Tuesday Tornado Outbreak of February 5-6, 2008, NWS Service Assessment Report *(forthcoming)*

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