# Societal Impacts and Public Perception

Advanced Warning Operations Course

IC Core 5

Lesson 1: The Warning Response Process

Warning Decision Training Branch

Welcome to the Societal Impacts and Public Perception portion of the Advanced Warning Operations Course. This instructional component focuses on the impacts of hazardous weather warnings on society. This section does not cover the impacts of weather on society, only the warnings. Lesson 1 addresses the social-psychological process that people go through from the time a first warning is heard to the time people respond – The Warning Response Process.

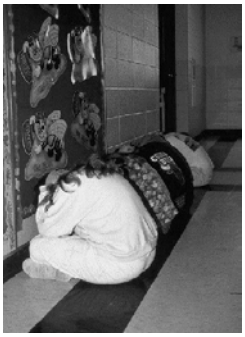
# Overview of Societal Impacts and Public Perception

- **Lesson 1: The Warning Response Process**
- Lesson 2: Effective Warnings
- Lesson 3: Social Science Lessons: What We Have Learned From Recent Floods and Warnings
  - Presenter – Eve Gruntfest

There are only three lessons in IC Core 5 Societal Impacts and Public Perception. Each lesson is an online “recorded” session of 20 to 45 minutes in length. After listening to the three modules, take the short 10 question quiz to receive credit for this instructional component.

# What response do you want?

- May 3, 1999 – Man crawls into sewer.
- May 4-10, 2003 – Missouri Emergency Management *"There were no surprises."*
- Is success in a warning event defined by FAR, POD, and Lead Time?



What are some of things a warning forecaster can do to get the desired response from the public? A man in the path of an F5 tornado actually crawled into a sewer to escape injury. Emergency managers were able to move road crews out of the way of an F4 tornado. What did NWS forecasters do to elicit these responses? FAR, POD, and Lead Time only partially measure the success of a warning event.

# Overview

- What is the social-psychological process that people go through from the time a first warning is heard to the time people respond?

> "A long way to go before we completely understand the relationship between warnings and behavioral response."
> - Dr. Eve Gruntfest
> Professor Geography and Environmental Studies
> University of Colorado, Colorado Springs

Although there is not a lot of research linking warnings and behavioral response, much of the research that does exist shows that there is a process that takes place between hearing the warning and reacting. The sender of the warning message can impact the actions of the receiver of that warning message. Therefore, it is important for forecasters that issue warnings to understand the process the public generally goes through prior to responding to the warning message.

# Learning Objective

1. Identify the common process between a person hearing the initial warning and responding.

There is only one objective to this lesson.

# The Warning Response Process

- Hearing
- Understanding
- Believing
- Personalizing
- Confirming
- Deciding and responding

People don’t just hear a warning and take action. There is a process that takes place between hearing the warning and reacting. That process can take only a few seconds or several minutes.

People go through a more or less sequential process in which they consider various aspects of the decision confronting them before acting. The sequence may not be the same for every person, and each stage is not necessary for a response to occur.

Importantly, the behavioral outcomes of the public are impacted by both the sender (issuing the warning) and receiver (those hearing the warning) factors.

# The Warning Response Process

- Hearing
  - Most people get warnings via TV
    - Interpretation (or misinterpretation?)
    - Presentation
  - Time of day
    - Less likely to hear at 3AM
  - Community preparedness
    - Sirens
    - Alert System

It can't be assumed that just because a warning is broadcast that people will hear it. Most people receive NWS warnings over TV. NWS Forecasters must partner closely with the local media to ensure the warnings are transmitted accurately and in a timely fashion. NWS Directive 10-1801 specifically addresses this aspect; " NWS offices should conduct training sessions for hazards community members so they know how to use our services and how to integrate them into their decision processes." The directive further directs the NWS to encourage the media to participate in drills to test all aspects of the integrated warning system.

# The Warning Response Process

- Understanding
  - Preparation
  - Climatology of event
  - Demographics
    - Older
    - More mobile
    - More diverse
    - More Spanish speaking

"… the value of being able to write warnings that are most meaningful to various segments of populations is also a growing need with tremendous benefit possibilities."
- Dr. Eve Gruntfest
Professor Geography and Environmental Studies
University of Colorado, Colorado Springs

After hearing the warning, the listener must understand the warning. The capabilities of the public to understand the warning has a lot to do with preparation. It is not just the duty of the Warning Coordination Meteorologist to educate and prepare the public. The entire NWS organization needs to help.

The public understanding is also impacted by the climatology of the event. For instance, the public's understanding of a severe thunderstorm warning is better in areas where severe thunderstorms are more common.

Demographics play into understanding. In 2000, one in eight Americans was over 65. By 2030 one in five Americans will be 65 or older. The increasing Spanish speaking populace especially in the South Central and Southwestern U.S. also is an issue in the public's understanding of a warning.

# The Warning Response Process

- Believing
  - Shift away from belief in “official” warnings
  - Public weighs several factors prior to deciding whether to react
    - Perceived susceptibility
    - Appraised severity of threat
    - Belief in positive outcome from response

Does the “cry wolf” syndrome have a major impact on believability?

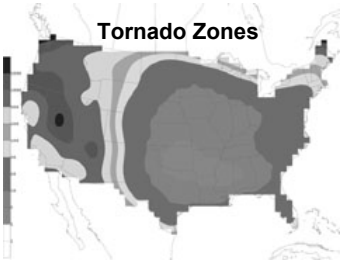
The warning may be heard and understood, but is it believed? Recent findings show that public reliance on “official” warnings from traditional sources may be shifting to more private and informal sources. (Baker 1995; Dow and Cutter, 1998; Drabek, 2001). People use new, previously unavailable sources of information and weigh several factors in their decisions about whether, how, and when to react to hazardous conditions.

The classic referenced case is the “cry wolf” syndrome. Limited studies have shown that a previous false alarm is not a common factor on the believability of a warning.

Believability is influenced by many factors associated with the method and contents of the warning. Much of this presentation will focus on how the warning forecaster can influence believability.

# The Warning Response Process

- Personalizing
  - Level of community interaction
  - Family composition
  - Length of residency
  - Emergency risk perception
    - Prior experience
    - Perceived proximity
    - Observation




People think of warnings in personal terms—what are the risks for themselves and family? The perception of risk is an important step in responding to a warning. If they feel “it can’t happen to me” they may well ignore a warning. The ability of the public to personalize the threat is to some degree set prior to the warning event. If an area has recently been hit by severe weather, the public will be much more likely to personalize the threat than people in an area that has not been threatened for several years.

# The Warning Response Process

- Confirming
  - Response is a consequence of a series of decisions
  - Most actively seek out additional information
    - Call friends and relatives
    - Go outside and observe
    - Change TV channels

"When warning information is received, most people try to verify what they heard by seeking out information in another warning message or from another warning source or person."

**-Dr Dennis Mileti**
**Senior Research Scientist Natural Hazards Research and Applications Information Center**

People are information hungry following the receipt of warnings. This can mean turning the TV to another station, checking with a neighbor, friend or family member, or going outside to look at the sky.

There is a need for a continuous flow of information. Even statements that repeat previously available information can help confirm the threat. That confirmation helps people better understand warnings, believe them, personalize the risk, and make response decisions.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
- Believing
- Personalizing
- Confirming
- Deciding and responding

Here is a recent example of a warning response process lifted from the pages of the July 19, 2004 NWS Focus. Understanding the behavioral aspects of the warning response process can help shape better warnings leading to a better outcome. In this case, an F4 tornado wrecked a manufacturing plant in Roanoke, IL, July 13, 2004, but a timely warning, a NOAA Weather Radio receiver, a prepared workforce, and reinforced shelters kept as many as 140 plant workers from harm.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
  - NWR receipt of a Severe Thunderstorm Warning 12 minutes prior to the tornado

In this case, the hearing aspect was from NOAA Weather Radio. This is not typical. Studies have shown that less than 5 percent of the population receive warnings from NOAA Weather Radio with most receiving warnings from TV and Radio. Most of the nation's workforce do not have access to TV and Radio at work. The local office led by the WCM can target workplaces to educate management at those sites of the cost benefit of a weather radio.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
  - Implements company severe weather plan
  - Activates employee spotters

Experience and training made understanding of the warning nearly instantaneous at the Parsons Manufacturing Plant. A severe thunderstorm warning activated the company's severe weather plan. Note that the plan did not send the employees immediately to shelter, rather activated designated employee spotters to seek confirmation of the threat.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
- Believing
  - Employees sent to designated shelters
  - Tornado Warning
    - Seven minutes prior to the tornado.

In this case, the employee spotters concluded it was time to take shelter within seconds of the time the Tornado Warning was issued. Note that the Tornado Warning was issued only 5 minutes after the Severe Thunderstorm Warning. This confirmation by both the employee spotters and the NWS warning forecaster led the employees to believe the threat was real.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
- Believing
- Personalizing
  - Strong safety plan
  - Monthly meetings
  - Tornado drills at least twice a year

The manager of the Parsons Manufacturing Plant had previously witnessed a tornado first hand. This personal experience resulted in the development of a strong safety plan, monthly meetings, and tornado drills at least twice a year.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
- Believing
- Personalizing
- Confirming
  - Cars blown from parking lot into side of building
  - Steel beams weighing up to a ton were “pulled into the vortex like match sticks.”

The combination of the employee spotters believing the threat, and the simultaneous receipt of the tornado warning was enough to send all employees to the designated shelters. For the employees in this case, the confirmation came when the tornado hit the plant.

# The Warning Response Process – Case Study

Tornado Strikes Parsons Manufacturing Plant July 13, 2004

- Hearing
- Understanding
- Believing
- Personalizing
- Confirming
- Deciding and responding
  - "Looking at the pictures of the nearly demolished plant, a person wouldn't think it possible that more than 120 employees got through that storm with no injuries."
    - Mike Looney, Chief NWS Central Region Services Division

The decision to seek shelter (or crawl into a sewer) is not made upon hearing a warning. Studies have shown that a warning must be understood, believed, personalized, and confirmed before a decision is made to respond.

# Response Item

You're at home watching the evening news, and you are surprised to hear your county/parish is under a Tornado Warning. What action do you take?

A. Seek shelter immediately
B. Tell the family to seek shelter while you go outside and look
C. Grab the camera, and jump in the car to chase
D. Call up some radar data on the internet
E. None of the above

OK now…tell the truth. If you answered A (seek shelter no ifs, ands, or buts) then congratulations you are enlightened. You are also in a minority of the population.

# Summary
# The Warning Response Process

- Hearing
- Understanding
- Believing
- Personalizing
- Confirming
- Deciding and responding

In summary, a warning forecaster's understanding of the behavioral warning response process can result in a positive response by the public.

# References


- The Role of Effective Communications in the Warning Process
  - Richard Smith, WDM III Workshop Presentation
- Communication of Emergency Public Warnings: A Social Science Perspective and State of the Art Assessment
  - Mileti and Sorensen, Aug 1990

# References


- Toward Improved Understanding of Warnings for Short Fuse Weather Events
  - Eve Gruntfest, March 2002
- Factors Related to Flood Warning Response
  - Denis S. Mileti, Nov 1996

# End of Lesson 1

**Questions about Lesson 1:**
**The Warning Response Process**
**iccore5@wdtb.noaa.gov**

You have completed Lesson 1 of AWOC IC Core 5. There are two more lessons in IC Core 5. If you have any questions about this lesson: 1) first ask your SOO 2) if you need additional help send an e-mail to iccore5@wdtb.noaa.gov (answers will be cc:'d to the SOO and considered for the FAQ page.) The test should be taken as soon as possible after completing IC Core 3 Lessons 1, 2, and 3.

# Societal Impacts and Public Perception

Advanced Warning Operations Course

IC Core 5

Lesson 2: Effective Warnings

Warning Decision Training Branch

Welcome to the Lesson 2 – Effective Warnings of the AWOC IC Core 5 Societal Impacts and Public Perception. This is the second lesson of a total of three lessons. This lesson focuses on how to issue effective warnings.

# Overview of Societal Impacts and Public Perception

- Lesson 1: The Warning Response Process
- **Lesson 2: Effective Warnings**
- Lesson 3: Social Science Lessons: What We Have Learned From Recent Floods and Warnings
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There are only three lessons in IC Core 5 Societal Impacts and Public Perception. Each lesson is an online “recorded” session of about 20 to 45 minutes in length. After listening to the three modules, you should take the short 10 question exam to receive credit for this instructional component.

# Overview

- Review of WFO Severe Weather Products Specifications
  - NWS Instruction 10-511
  - NWS Instruction 10-922
- What are the elements of an effective warning?

In this lesson we will first review the NWS “official” product specifications. Many of the elements of an effective warning are built into the product specifications. We will then discuss the elements of an effective warning, and discover ways to deliver effective warnings.

# Performance Objectives

1. Demonstrate the ability to apply the five characteristics of an effective warning.
   - Specificity,
   - Consistency,
   - Certainty,
   - Clarity, and
   - Accuracy.

There is one performance objective for this lesson. This performance objectives is a statement of the behaviors that participants will be able to demonstrate both in the simulations and on the job.

# Learning Objectives

1. According to NWS Instruction 10-511, be able to identify specifications of WFO Severe Weather Products.

2. Be able to name five characteristics of an effective warning.

3. Be able to identify effectively worded warning phrases.

There are only three objectives to this lesson.

# NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/010/pd01005011b.pdf

- Areal Outline Statement (SLS)
- **Severe Thunderstorm Warning (SVR)**
- **Tornado Warning (TOR)**
- **Severe Weather Statement (SVS)**
- Watch County Notification Message (WCN)

Department of Commerce • National Oceanic & Atmospheric Administration • National Weather Service

***NATIONAL WEATHER SERVICE INSTRUCTION 10-511***
***OCTOBER 1, 2003***

***Operations and Services***
***Public Weather Services, NWSPD 10-5***

***WFO SEVERE WEATHER PRODUCTS SPECIFICATION***

**NOTICE:** This publication is available at: http://www.nws.noaa.gov/directives/

**OPR:** OS22 (R. Okulski) **Certified by:** OS22 (J. Lee)
**Type of Issuance:** Routine

***SUMMARY OF REVISIONS:*** This directive supersedes NWSI 10-511, dated October 1, 2002 and OMI 99-05 filed with WSOM Chapter C-40, dated November 10, 1999. This directive adds the Valid Time Event Code to Severe Thunderstorm Warnings, Tornado Warnings, and Severe Weather Statements (Sections 3, 4, and 5). It also adds a new Watch By County Notification product specification (Section 6) and requires mandatory Latitude/Longitude Points for Severe Weather Statements (Section 5).

signed 04/04/03
Gregory A. Mandt Date
Director, Office of Climate,
Water, and Weather Services

A quick review of NWS Instruction 10-511 will be our starting point for a discussion of effective warnings. The focus here is on Severe Thunderstorm Warnings, Tornado Warnings, and Severe Weather Statements. Information on the Areal Outline Statement and Watch County Notification Message is available in other training sessions (not in AWOC).

# NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/010/pd01005011b.pdf

- Severe Thunderstorm Warning (SVR)
  - Gust of 50 kts (58 mph) and/or
  - Hail size of ¾ inch (penny) diameter or larger
  - Valid times should be **30 to 60** minutes
  - If Tornado Watch, include possibility of tornadoes
  - Should **not** combine with Flash Flood Warnings

Some of the highlights from the instruction on Severe Thunderstorm Warnings.

# NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/010/pd01005011b.pdf

- Tornado Warning (TOR)
  - Tornado
  - Valid times should be **15 to 45** minutes

Highlights from the instruction on Tornado Warnings.

# NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/010/pd01005011b.pdf

- SVR and TOR
  - Should use nine part divisions (I.e. northeast, east central, etc.) to identify portions of counties
  - Moves over coastal water -> Special Marine Warning
  - Keep bullets brief
  - Include call to action statements
    - May discontinue during widespread severe weather outbreaks
  - May use mileage markers of major highways as reference points

Instructions common to both Severe Thunderstorm Warnings and Tornado Warnings.

# NWS Instruction 10-511 Highlights

http://www.weather.gov/directives/010/pd01005011b.pdf

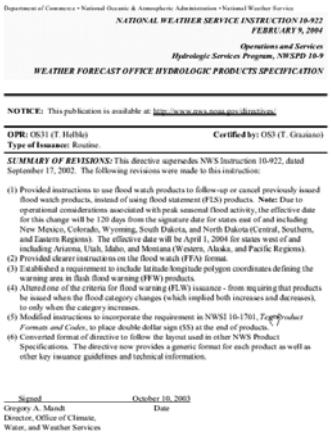
- Severe Weather Statement (SVS)
  - Include updated location
  - Include reports
  - Portions canceled or expired
  - **At least once** during valid time
  - Notify of expiration or erroneous counties
  - Include call to action statements if suspended in warnings

Highlights from the instruction on Severe Weather Statements.

# NWS Instruction 10-922 Highlights

http://www.weather.gov/directives/010/pd01009022b.pdf

- Hydrologic Outlook (ESF)
- Flood Watch (FFA)
- **Flash Flood Warning (FFW)**
- **Flash Flood Statement (FFS)**
- Flood Warning (FLW)
- Flood Statement (FLS)
- RVS, RVA, RVD, RRx, Hyx, AHPS



Department of Commerce • National Oceanic & Atmospheric Administration • National Weather Service

***NATIONAL WEATHER SERVICE INSTRUCTION 10-922***
***FEBRUARY 9, 2004***

***Operations and Services***
***Hydrologic Services Program, NWSPD 10-9***

***WEATHER FORECAST OFFICE HYDROLOGIC PRODUCTS SPECIFICATION***

**NOTICE:** This publication is available at: http://www.nws.noaa.gov/directives/

**OPR:** OS31 (T. Hebble) **Certified by:** OS3 (T. Graziano)
**Type of Issuance:** Routine.

***SUMMARY OF REVISIONS:*** This directive supersedes NWS Instruction 10-922, dated September 17, 2002. The following revisions were made to this instruction:

(1) Provided instructions to use flood watch products to follow-up or cancel previously issued flood watch products, instead of using flood statement (FLS) products. **Note:** Due to operational considerations associated with peak seasonal flood activity, the effective date for this change will be 120 days from the signature date for states east of and including New Mexico, Colorado, Wyoming, South Dakota, and North Dakota (Central, Southern, and Eastern Regions). The effective date will be April 1, 2004 for states west of and including Arizona, Utah, Idaho, and Montana (Western, Alaska, and Pacific Regions).
(2) Provided clearer instructions on the flood watch (FFA) format.
(3) Established a requirement to include latitude/longitude polygon coordinates defining the warning area in flash flood warning (FFW) products.
(4) Altered one of the criteria for flood warning (FLW) issuance - from requiring that products be issued when the flood category changes (which implied both increases and decreases), to only when the category increases.
(5) Modified instructions to incorporate the requirement in NWSI 10-1701, *Text Product Formats and Codes*, to place double dollar sign ($$) at the end of products.
(6) Converted format of directive to follow the layout used in other NWS Product Specifications. The directive now provides a generic format for each product as well as other key issuance guidelines and technical information.

Signed October 10, 2003
Gregory A. Mandt Date
Director, Office of Climate,
Water, and Weather Services

Flash Flood Warning product specification is in NWS Instruction 10-922. The focus here is on Flash Flood Warnings and Statements. Refer to the instruction (link is in the subtitle) for information on the other WFO Hydrologic Products.

# NWS Instruction 10-922 Highlights

http://www.weather.gov/directives/010/pd01009022b.pdf

- Flash Flood Warning (FFW)
  - *"Short-term events which require immediate action to protect lives and property"*
    - Dangerous small stream or urban flooding
    - Dam or levee failures
  - Valid Time. *"… until flooding (requiring immediate actions to protect lives and property) is expected to end"*

A flash flood warning will be issued when:

a. Flash flooding is reported;
b. Precipitation capable of causing flash flooding is indicated by radar, rain gages, and/or satellite;
c. Local flash flood monitoring and prediction tools indicate flash flooding is likely;
d. The effective time of a pre-existing warning changes;
e. The geographical area covered by a pre-existing flash flood warning increases;
f. A dam or levee fails;
g. A sudden failure of a naturally-caused stream obstruction (including debris slide, avalanche, or ice jam) is imminent or occurring; or
h. Small basin hydrologic models indicate flash flooding for specific locations along small streams.

# NWS Instruction 10-922 Highlights

http://www.weather.gov/directives/010/pd01009022b.pdf

- Flash Flood Statement (FFS)
  - Supplemental information on current flash flood warning products
    - Updated observations
    - Impact information
  - Announce cancellation or expiration of a flash flood warning
    - Expires within 15 minutes of warning expiration

Flash Flood Statements should include the latest information on the current flash flood warning products. Focus on useful information that will help customers and partners direct mitigation activities where waters continue to present a danger to lives and property.

# Response Item

According to NWS Instruction 10-511, a Tornado Warning should not be valid for more than __ minutes.

A. 15 minutes
B. 30 minutes
C. 45 minutes
D. 60 minutes
E. None of the above

# What is an effective warning?

- Effective = Having an effect; producing a result
- Effective warnings…
  - Are accurate and timely
  - Are composed to highlight the threat and expected impacts
  - Are aimed at those most at risk

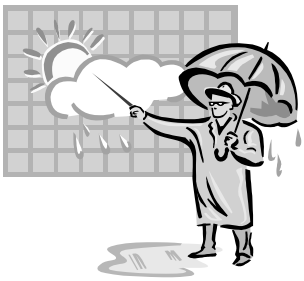
First we learned that you as the sender of information can impact public response. We then quickly reviewed the “requirements” for a thunderstorm warning. Now we will look at how you can issue effective warnings.

# Use Technology to Help…

- AWIPS/Warngen
  - Issue warnings faster
  - Be sure technology does not mean good quality information is lost
  - It's still the forecaster's job to
    - Interpret radar/other information
    - Make the warning decision
    - Relay useful information via warnings and statements

Technology, such as AWIPS and Warngen, can help in the warning process, but the forecaster still has to make the warning decision and issue warnings and statements that meet the needs of the users.

# Characteristics of Effective Warnings



- Specificity
  - What, when, where
- Consistency
  - Internal/external
- Certainty
  - The tone of the message
- Clarity
  - Simple words with precise meaning
- Accuracy
  - Timely, accurate and complete information

Recall that the behavioral outcomes of the public in a warning situation are impacted by both the sender (issuing the warning) and receiver (those hearing the warning) factors. Severe weather warnings that include these five characteristics will have the best chance for a positive outcome.

# Specificity

- Provide as much specific, detailed information as possible about
  - The risk
  - Where it is
  - What those in the path can expect
- Be as specific as possible; provide as much information as possible

Although the what, when, and where is a requirement in a severe weather warning, the warning forecaster has latitude in the specificity of the warning. There are many occasions when specificity cannot be high. Include what you know in the warning message, be as specific as possible without exceeding the capabilities of the science and technology.

# Specificity
# Highlight the Threat

- Damaging Winds
  - **RADAR INDICATED DANGEROUS THUNDERSTORMS CAPABLE OF PRODUCING WINDS IN EXCESS OF 80 MPH…**
  - **RADAR INDICATED SEVERE THUNDERSTORMS WITH HURRICANE FORCE WINDS**
- Large Hail
  - **RADAR INDICATED A SEVERE THUNDERSTORM CAPABLE OF PRODUCING HAIL UP TO GOLFBALL SIZE**
  - **SPOTTERS 5 MILES WEST OF MAYBERRY REPORTED QUARTER SIZE HAIL**

Be as specific as possible about the threat.

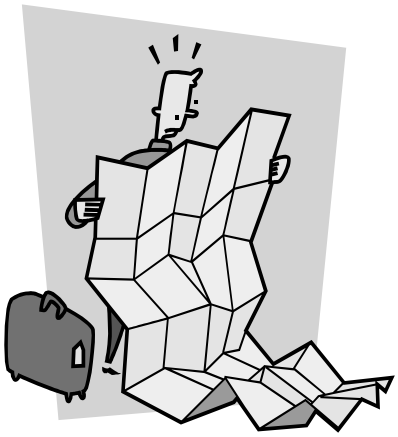
# Specificity
# Location, Location, Location

- Where is the storm?
- Where is it headed?

- Do people understand the storm positions and forecasts we provide?

# Specificity
# Location, Location, Location

- Use well-known locations
  - Larger cities, county seats
  - Interstate/other major highways
    - Mile markers/exits
  - Landmarks
    - Lakes, parks, etc



# Specificity
# Location, Location, Location

- What can we do to help travelers and others who are geographically challenged?

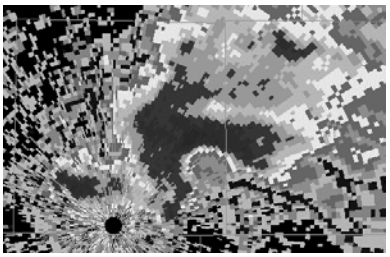
# Specificity

- **"… THE MAIN THREAT WITH THIS STORM IS DIME TO NICKLE SIZE HAIL. THE HAIL MAY CAUSE SOME VEHICLE OR ROOF DAMAGE. STRONG AND GUSTY WINDS UP TO 50 MPH CAN ALSO BE EXPECTED."**
- **"…THIS TORNADO WILL CROSS INTERSTATE 135 NEAR THE MEADOWS MALL…"**
- **"PEOPLE TRAVELING EAST ON INTERSTATE 40 BETWEEN EXITS 270 AND 275 SHOULD EXIT AND FIND SUBSTANTIAL SHELTER …IF POSSIBLE. GOLFBALL SIZE HAIL IS LIKELY WITH THIS STORM."**

Here are three example of actual statements in warnings. With each statement, what are potential outcomes? Are these the desired outcomes?

# Pathcasts

- WarnGen makes it easy
  - BUT!!
    - Are we that good???
    - Are we exceeding our abilities???

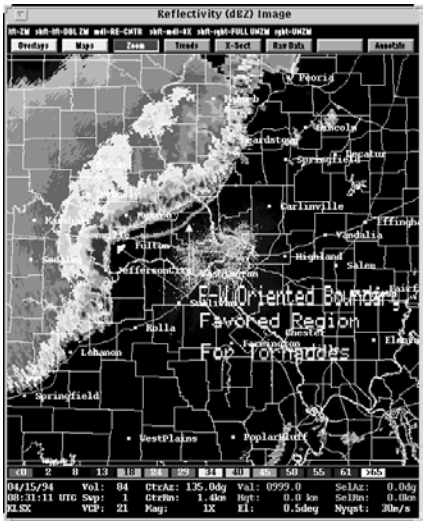


# Pathcasting Cautions

- Too much detail?
  - *** THE TORNADO WILL BE NEAR**
    **HUTCHENS ELEMENTARY SCHOOL BY 715 AM**
    **MAGNOLIA GROVE GOLF COURSE BY 725 AM**
    **LOTT AND COLEMAN DAIRY ROADS BY 730 AM**
  - *** SEVERE THUNDERSTORM WILL BE NEAR**
    **GREEN HILLS MALL AT 1220 PM**
    **VILLAGE MALL AT 1220 PM**
    **ONE HUNDRED OAKS MALL AT 1225 PM**
    **HARDING MALL AT 1225 PM**
    **HICKORY HOLLOW MALL AT 1225 PM**

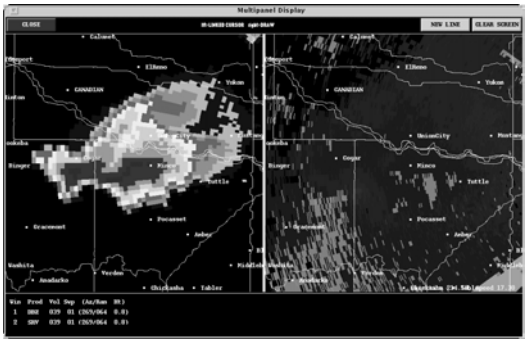
# Pathcasting Cautions

- WHAT are you tracking?
  - Gust front
  - Leading edge of precipitation
  - High reflectivity gradient
  - High reflectivity cores



# Pathcasting Cautions

- WHAT are you tracking?
  - Tornado location
  - Mesocyclone
  - Leading edge of precipitation
  - Large hail core
  - Gust front



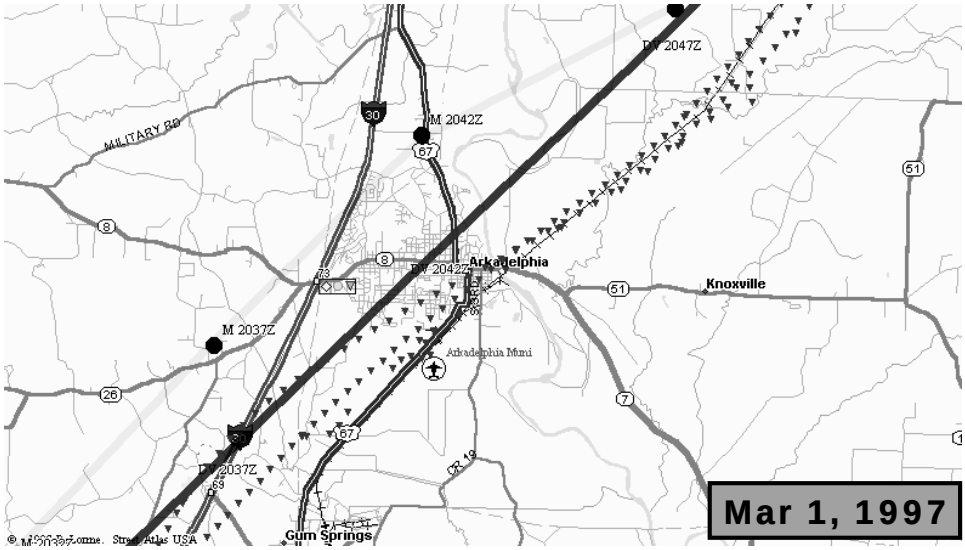
# Pathcasting Cautions

- Technological Limitations
  - Radar resolution and range
  - Background map inaccuracies
  - Large and/or irregularly shaped cities
  - Radar algorithm time differential

# Pathcasting Cautions

- Meteorological Concerns
  - Erratic storm motion – speed/direction
  - Storm interactions – splits, mergers
  - Mesocyclone uncertainties
  - Multiple threats from a single storm
    - Tracking tornado arrival time may expose people in the path to large hail, damaging winds, flooding rains

# The Dangers of False Precision




Here is a comparison of tracks from the Mesocyclone algorithm (yellow), TVS algorithm (red), actual tornado (red triangles). The radar circulation signature may be some distance from where the tornado is occurring. This becomes an even greater problem using a linear extrapolation pathcast since the track will usually be non-linear.

Reference: **Correlation Between Tornado Damage Paths and WSR-88D Signatures, and Resulting Implications for the use of Pathcasts in Tornado Warnings**

Steven Piltz and Richard Smith: NWS, Tulsa OK

# Making Pathcasts more effective (realistic)

- Only forecast short distance ahead in initial warning with frequent updates
- Use range of arrival times based on storm type/threat/motion
- Simply mention towns in path for the valid period of the warning – more precise updates via the SVS

Some suggestions on pathcasts.

# Response Item

A. “AT 217PM...SPOTTERS REPORTED SEVERE WEATHER 5 MILES NORTH OF SPRINGFIELD ... MOVING SOUTH AT 20 MPH.”

B. “AT 625 PM…SPOTTERS REPORTED BASEBALL SIZE HAIL WITH A SEVERE THUNDERSTORM LOCATED 5 MILES SOUTH OF MANSFIELD

C. “AT 1230 AM…DAMAGING WINDS ALONG THE LEADING EDGE OF A LINE OF SEVERE THUNDERSTORMS EXTENDED FROM NEAR…

Which one of these statements suffers from lack of specificity? What are potential behavioral outcomes by the public from this lack of specificity?

# Consistency

- Improves credibility
- Increases likelihood of appropriate action
- Important within the warning message
  - Proofread for consistent message
- Important across messages
  - Reference or repeat:
    - What was just said
    - What has changed
    - Why it has changed

A consistent message is important in establishing the credibility of the message. Often different warning forecasters are writing warnings and statements, and sometimes neighboring offices will be writing statements about the same storm. Frequent communication within the office and between neighboring offices is necessary to ensure a consistent message.

Use of the “Call-To-Action” statements in Warngen can sometime result in an inconsistent message within an individual warning or statement. A quick proofread of the warning prior to issuance can help keep the message consistent.

Keep the flow from message to message consistent by referencing or repeating previous statements.

# Consistency

**TORNADO WARNING**
**NATIONAL WEATHER SERVICE ~~~**
**448 PM ~~~**
**___**

*** AT 443 PM EDT NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A DEVELOPING TORNADO 9 MILES NORTH OF ~~~ AIRPORT. MOVING SOUTH AT 10 MPH.**

*** SOME LOCATIONS NEAR THE PATH OF THE STORM THROUGH 515 PM EDT...**
**~~~ AIRPORT AND ~~~...**

**VERY LARGE HAIL IS POSSIBLE WITH THE PARENT THUNDERSTORM. IF YOU ARE IN THE PATH OF THE STORM...PUT YOUR CAR IN A GARAGE.**

The intent might have been to indicate that the hail is in a different location than the tornado. This problem is the confused public may go outside to put the car in the garage as a tornado hits.

Call to action statements that are not consistent with the body of the warning happens more than we would like. Proofreading your warning for consistency of message before issuing may help.

# Consistency

**AT 903 AM CDT…AMATEUR RADIO WEATHER SPOTTERS REPORTED A BRIEF TORNADO TOUCHDOWN 8 MILES NORTH OF AKINS.**

**THIS IS AN EXTREMELY DANGEROUS AND LIFE THREATENING SITUATION. IF YOU ARE IN THE PATH OF THIS LARGE AND DESTRUCTIVE TORNADO…TAKE COVER IMMEDIATELY.**

And another example of where call-to-action statements in Warngen can cause problems in consistency of the message.

# Consistency

**AT 1234 PM EST...SEVERE THUNDERSTORM WITH STRONG ROTATION OVER SOUTH CENTRAL TAYLOR COUNTY...MOVING NORTHEAST AT 35 MPH...THIS DANGEROUS STORM COULD PRODUCE A TORNADO AT ANY TIME.**

*** OTHER LOCATIONS IN THE PATH OF THIS STORM INCLUDE …SPRINGFIELD**

**CONFIRMED REPORT FROM SPOTTER OF TORNADO 10 MILES SOUTHWEST OF ANYTOWN AT 1239 PM EST.**

Another example of where call-to-action statements in Warngen can cause problems in consistency of the message.

# Certainty

> *"When faced with uncertainty we frequently base our commitments to particular action on factors other than the facts."*
>
> - Dr. Roger Pielke Jr.
> Director CIRES Center for Science and Technology Policy Research

- State with certainty, even when there is ambiguity associated with the hazard's impact
- Avoid hedging terms (possibly, may, could…)

A warning message should be stated with certainty even in circumstances in which there is ambiguity associated with the hazard's impact. "Hedging" terms tend to spur the listener into "inaction" rather than action. Using terms which indicate action or development can fill the gap in listener's minds between "nothing's happening" to "it's too late now".

# Certainty

- **…DOPPLER RADAR INDICATED A SEVERE THUNDERSTORM CAPABLE OF PRODUCING A TORNADO. THE MOST DANGEROUS PORTION OF THE STORM WAS LOCATED 4 MILES EAST OF…**
- **…AT 812 PM CDT…DOPPLER RADAR INDICATED A RAPIDLY INTENSIFYING SEVERE THUNDERSTORM CAPABLE OF PRODUCING A TORNADO. THE MOST DANGEROUS PORTION OF THE STORM WAS LOCATED…**
- **…A BRIEF TOUCHDOWN OF A TORNADO WAS REPORTED 5 MILES NORTH OF BEETOWN. THE TORNADO HAS LIFTED BUT IS EXPECTED TO REDEVELOP AT ANY TIME…**

Even though the impacts in all of these situations are uncertain, these statements have included a degree of certainty that would tend to spur the listener to action.

# Clarity

- Warnings MUST be worded in simple language that can be understood
  - Tailored to your area
  - Avoid technical jargon
- Focus Call-To-Action statements
  - Impacts expected with THIS storm
  - Quick, targeted safety information
  - General statements about complicated subject
  - Focus on the MAIN threat
    - Can’t give every possible safety rule

# Call to Action Statements

- **THIS TORNADO IS WRAPPED IN RAIN – IF YOU WAIT UNTIL YOU SEE OR HEAR IT COMING IT MAY BE TOO LATE TO GET TO A SAFE PLACE. TAKE COVER NOW!**
- **THIS STORM SHOWS STRONG ROTATION AND MAY PRODUCE A TORNADO AT ANY TIME. DO NOT WAIT...GO TO A SAFE PLACE NOW! PUT AS MANY WALLS BETWEEN YOU AND THE OUTSIDE AS POSSIBLE.**
- **GET TO A SAFE PLACE NOW! STAY AWAY FROM WINDOWS AND OUTSIDE WALLS. PUT AS MANY WALLS BETWEEN YOU AND THE OUTSIDE AS POSSIBLE**

Clarity is especially important in “Call To Action” statements. Keep it simple!

# Call to Action Statements

- **DESTRUCTIVE WINDS CAN BE EXPECTED. IF YOU CANNOT GET UNDERGROUND... GO TO AN INTERIOR ROOM ON THE LOWEST FLOOR OF A STURDY BUILDING. AVOID WINDOWS!**
- **DAMAGING WINDS MAY OCCUR UP TO !** **! MILES AHEAD OF THE RAIN. GO TO A SAFE PLACE UNTIL THE STORMS HAVE PASSED.**
- **A TORNADO WATCH IS ALSO IN EFFECT. TORNADOES CAN DEVELOP SUDDENLY FROM SEVERE THUNDERSTORMS.**

More examples of simply worded “Call-To-Action” statements.

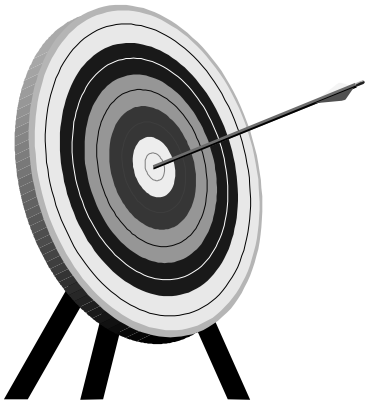
# Clarity?

- SPOTTERS REPORT AN INCIPIENT TORNADO
- REPORTS HAVE BEEN RECEIVED THAT THE PARENT THUNDERSTORM PRODUCED TWO TORNADO FUNNELS
- THIS STORM HAS HAD A HISTORY OF PRODUCING A BRIEF TORNADO TOUCHDOWN
- A THUNDERSTORM NEAR THE TOWN OF OROVILLE REPORTED LARGE HAIL
- NUMEROUS REPORTS OF TORNADOES WERE REPORTED

What is wrong with each of these statements?

# Accuracy

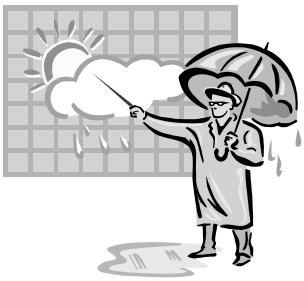
- Timely, accurate and complete information
- Simple typos, spelling, incorrect locations
- Header errors
  - e.g., SVR under SVS header



# Accuracy

- AT 301 PM CST...DOPPLER WEATHER RADAR INDICATED A SEVERE THUNDERSTORM 162 MILES NORTH OF SALEM OR 155 MILES NORTH OF MOKO... MOVING NORTHEAST AT 40 MPH.
- HAIL UP TO 10 INCHES IN DIAMETER HAS BEEN REPORTED WITH THIS STORM
- THIS IS A VIOLENT THUNDERSTORM PRODUCING HUGH HAIL!

# Characteristics of Effective Warnings



- Specificity
  - Where, when, what
- Consistency
  - Internal/external
- Certainty
  - The tone of the message
- Clarity
  - Simple words with precise meaning
- Accuracy
  - Timely, accurate and complete information

# Response Item

Which characteristic(s) of an effective warning are missed in the example wording?

RADAR CURRENTLY SHOWS STRONG WEST WINDS JUST TO THE SOUTHWEST OF MAYBERRY AND NOW EAST OF STORMYVILLE. THESE WINDS ARE ACCOMPANIED BY VERY HEAVY RAIN AND EXPECTED THUNDER AND LIGHTNING AND ARE CONTINUING TO MOVE TOWARD THE EAST AT ABOUT 15 KT. WINDS TO THE NORTH OF THIS AREA ARE FROM THE SOUTHEAST …THIS HAS CAUSED THE RADAR TO ISSUE A MESOCYCLONE ALERT TO THE WEST OF VORT CITY.

A. Specificity
B. Consistency
C. Certainty
D. Clarity
E. Accuracy
F. There is nothing wrong with this wording.

This was taken from a warning with the names changed. If you answered F, start this presentation over from the beginning.

# References


- The Role of Effective Communications in the Warning Process
  - Richard Smith, WDM III Workshop Presentation
- Communication of Emergency Public Warnings: A Social Science Perspective and State of the Art Assessment
  - Mileti and Sorensen, Aug 1990
- Correlation Between Tornado Damage Paths and WSR-88D Signatures, and Resulting Implications for the use of Pathcasts in Tornado Warnings
  - Steven Piltz and Richard Smith: NWS, Tulsa OK

# References


- Toward Improved Understanding of Warnings for Short Fuse Weather Events
  - Eve Gruntfest, March 2002
- Factors Related to Flood Warning Response
  - Denis S. Mileti, Nov 1996
- NWS Instruction 10-511 WFO Severe Weather Products Specification, October 2003
- NWS Instruction 10-922 WFO Hydrologic Products Specification, February 2004

# End of Lesson 2

**Questions about**
**Lesson 2: Effective Warnings**
**iccore5@wdtb.noaa.gov**

Congratulations. You have completed Lesson 2 of AWOC IC Core 5

Remember…there is one more lesson in IC Core 5.

If you have any questions about this lesson: 1) first ask your SOO 2) if you need additional help send an e-mail to ***iccore5@wdtb.noaa.gov*** – answers will be cc:'d to the SOO and considered for the FAQ page.

The exam should be taken as soon as possible after completing IC Core 5 Lesson 3.

Remember…the exam covers Lessons 1, 2, and 3.

# Societal Impacts and Public Perception

Advanced Warning Operations Course

IC Core 5

Lesson 3:Social Science Lessons-What Have We Learned From Recent Floods & Warnings?

Eve Gruntfest - University of Colorado
Colorado Springs

I am extremely pleased that this presentation is included in the course. I welcome comments & questions & hope to hear from students regularly.

# My role – applied geographer

- **Social scientist in world of engineers & physical scientists**
- **Mostly flash floods & warning systems**

Please let me know if you have case studies to share of user surveys or other collaborations between social and physical scientists. Also, please let me know if I can help with the development of questionnaires or surveys.

# Five part outline

- What we have learned since the 1976 Big Thompson Flood
- Recent Boulder, CO project
- 2003 flash floods
- Lessons from elsewhere
- Where we go from here

# Learning Objectives

1. Identify changes in aspects of the warning process since the 1976 Big Thompson Flash Flood.
2. As shown by the Boulder study, how have sources and dissemination changed?
3. Identify impacts and conventional wisdom that Dr. Eve Gruntfest is evaluating in the 2003-2006 National Science Foundation study.

# Social science can no longer be an add on

- **Meteorologists, hydrologists & engineers & social scientists**

- **Need for**
  hydro-meteorologists

**Constant cooperation – a Must**

What differences will new models and faster computers make if the messages do not get to the vulnerable populations in a timely fashion? Incorporate impact studies when new methods are first adopted.

# Social science lessons

- People do not panic in response to warnings
- People rarely get too much information

- "Cry wolf“ syndrome may not be applicable if previous misses are understood

These “lessons” are derived from old research. New in-depth studies must be undertaken to challenge these assumptions & earlier findings.

# Social science lessons

- Public wants information from multiple sources
- People actively seek to confirm risk

## The Big Thompson Flood in Colorado
## 140 died – July 31, 1976

- Who lived?
- Who died?
- Studied the behaviors that night

# The Big Thompson Flood

**New focus for next generation of policy makers & scientists involved in flood mitigation**

Now that generation is retiring. We need to keep this catastrophic event in public memory so residents, officials, & forecasters recognize that

# 1986
# Ten years later

- Signs
- FLASH FLOODS are recognized as different from slow rise floods
- Fewer people
- Real time detection

# 2004

## Changes in aspects of the warning process

- More federal agencies flood warning
- Increased vulnerability
- ALERT user groups combine detection / response

# 2004

## Changes in aspects of the warning process

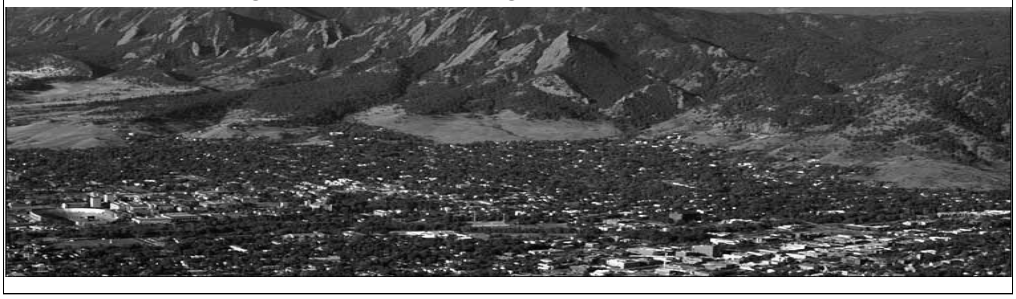
- Real time data – graphical formats
- Very high expectations of NWS forecasts and warnings
- Aging dams/ infrastructure

# An Evaluation of the Boulder Creek Local Flood Warning System - 2002

www.udfcd.org/FWP/LFWSresearch.htm

# Report addressed

- Public understanding of flood/flash flood terminology
- How & how often the public wants to be warned
- How the public will respond during a flash flood
- Where & how often the public obtains flash flood information
- To what degree false warnings will alter public response



# Methodology

- 60 question survey
- Defined 2 populations of Boulder Creek Floodplain Residents
  - Population A: Not in University of Colorado Family Housing
  - Population B: Living in University of Colorado Family Housing
- Sampled only residents in 100-year floodplain
- 291 respondents, 40% response rate

# Knowledge of flood terminology

Q. What does the term “100-year flood” mean?

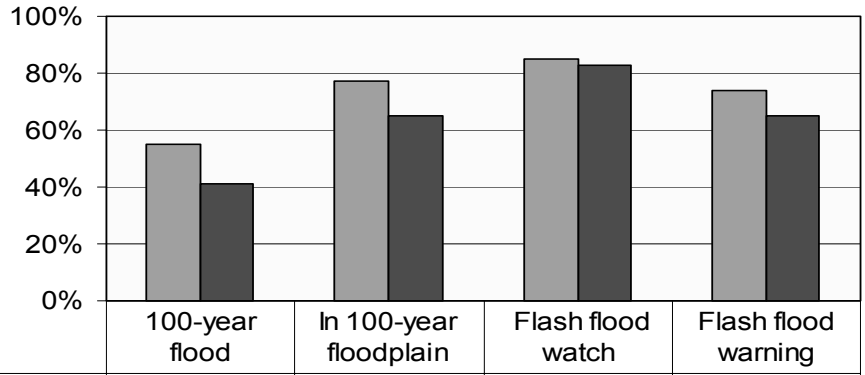
Q. Is your residence in the “100-year floodplain”?

Q. What does a “flash flood watch” mean?

Q. What does a “flash flood warning” mean?

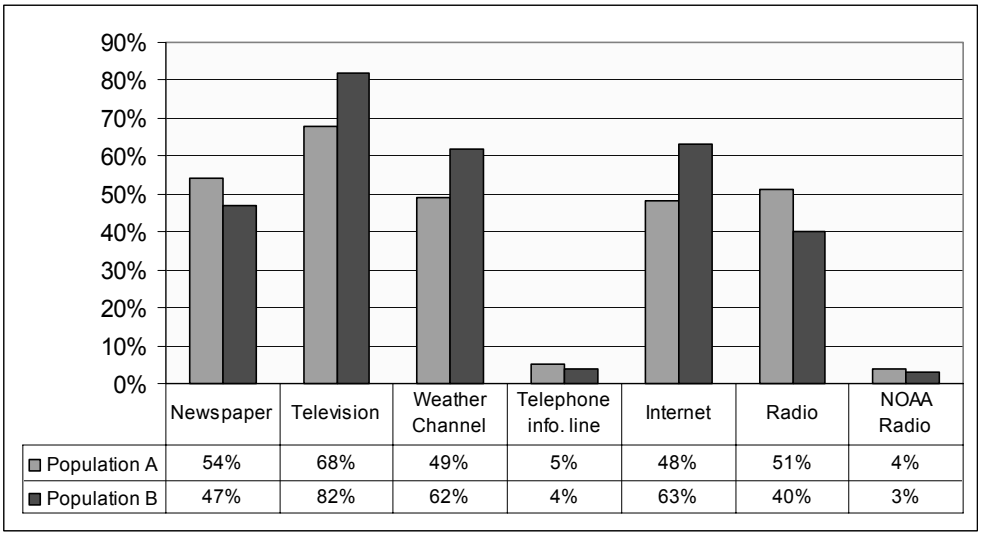
**30% answered all four questions correctly**

# Knowledge of Boulder Creek floodplain residents




| | 100-year flood | In 100-year floodplain | Flash flood watch | Flash flood warning |
|---|---|---|---|---|
| Pop. A | 55% | 77% | 85% | 74% |
| Pop. B | 41% | 65% | 83% | 65% |

# What are your weather information sources?




| | Newspaper | Television | Weather Channel | Telephone info. line | Internet | Radio | NOAA Radio |
|---|---|---|---|---|---|---|---|
| Population A | 54% | 68% | 49% | 5% | 48% | 51% | 4% |
| Population B | 47% | 82% | 62% | 4% | 63% | 40% | 3% |

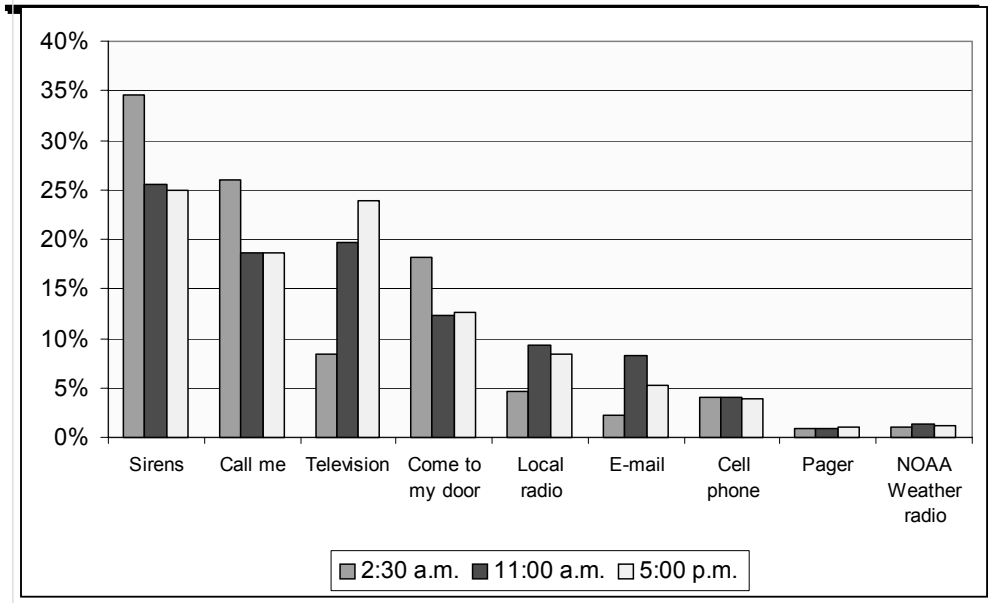
# Warning preferences

- Current dissemination via
  - Sirens, Automated call system (R-911)
  - Cable television, Radio, NOAA weather radio

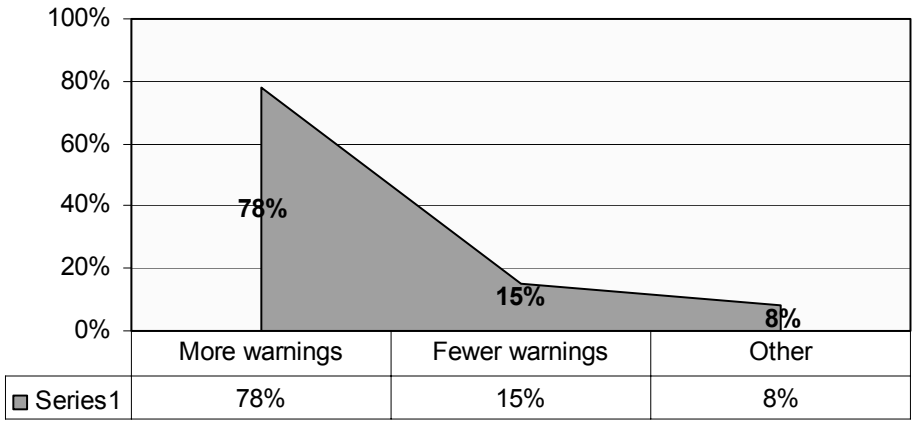
Q. What would be the best way(s) for officials to warn you about imminent flash floods at the following times:

2:30 a.m., 11:00 a.m., 5:00 p.m.

# Preferred methods



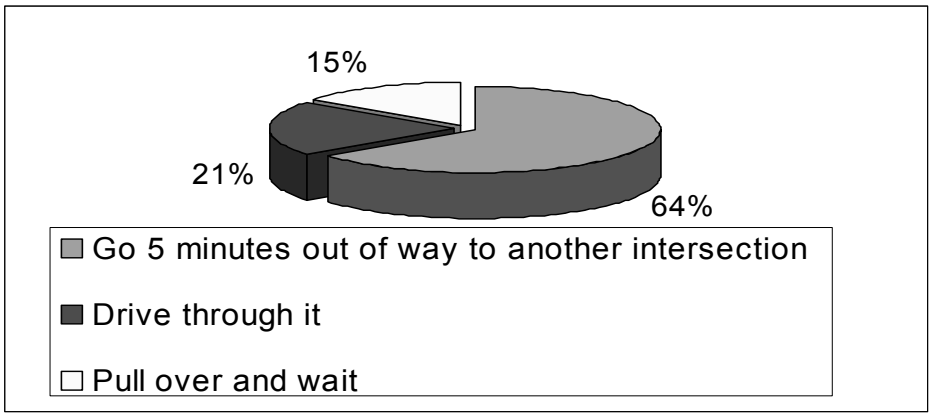
# Would you prefer more warnings even if there were false alarms rather than a missed event?




| | More warnings | Fewer warnings | Other |
|---|---|---|---|
| Series1 | 78% | 15% | 8% |

# Likely actions – driving in deep water

Q. You are driving & come to an intersection covered in water up to the middle of your tires, what do you do?



# Most important findings

- Now we have baseline data to evaluate existing/new efforts
- Don’t wait another 25 years
- Is the Boulder study good &/or bad news?!

# The last major research findings on warnings are 30 years old

- What about cell phones, Internet, private & public sources of information?
- How are diverse urban populations interpreting warnings?
- What about new “millennium” views of government?

# Our 2003-2006 National Science Foundation project will

- Evaluate impacts of
  - Demographic change
  - New & different sources of information
- Test conventional wisdom about
  - False alarms/ close calls
  - Lead times

**For Flash Floods & Tornadoes studying Denver and Austin**

# Toward improved understanding of warnings for short-fuse weather events

- Research team of psychologists & geographers
- Results from this research will provide new directions for future warning procedures

# Recent US flash flood statistics

- **1998-2002**
  - 369 fatalities (74/year)
  - 67% vehicle related
- **2003**
  - 79+ fatalities
  - 50% vehicle related
  - Deadliest event: Dec 25th Waterman Creek, CA

# 2003 noteworthy flash floods

**Las Vegas 19**
**August 2003**

# Jacob Creek/Kansas turnpike flash flood

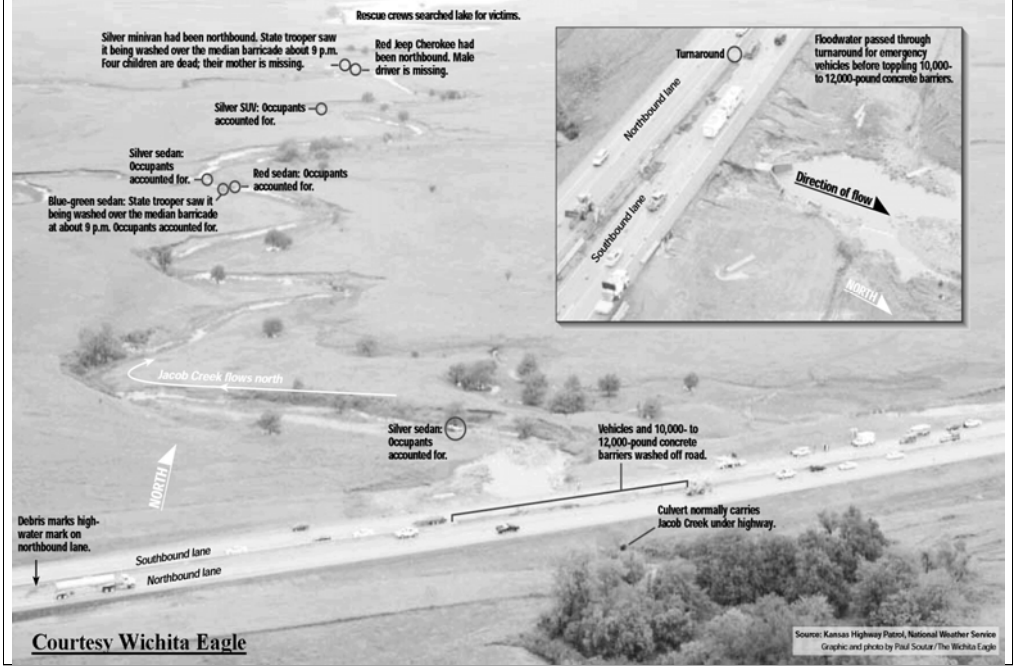
- 30 August 2003
- Chase/Lyon County line
- Small rural basin along interstate
- 3-4” in 3 hours

# 30 August 2003-- Kansas turnpike

- 7 vehicles (mostly abandoned) washed downstream 1 vehicle had 5 fatalities
- Should people abandon vehicles?
- Did 9-1-1 advise people to stay in cars?
- “Turn around don’t drown” was not a realistic option in this case.
- Was it really a freak rainfall & freak event?

# Jacob Creek's fatal flood

About 9 p.m. Saturday, heavy rain swept several motorists off I-35 south of Emporia at Jacob Creek. Extremely heavy rainfall caused the creek to overwhelm the culvert and overflow the highway, carrying with it concrete barricades and seven vehicles. Four people are confirmed dead. Two are missing.




Courtesy Wichita Eagle

Source: Kansas Highway Patrol, National Weather Service
Graphic and photo by Paul Soutar/The Wichita Eagle

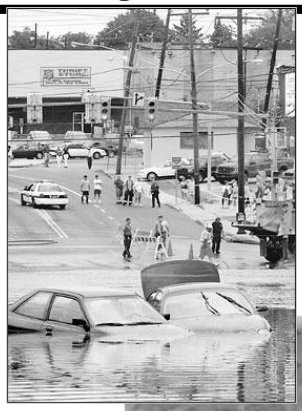
# Southern California flash flooding & debris flows

- Christmas day 2003
- San Bernardino County
  - Waterman Canyon
- 12-15 ft debris flow following peak rainfall rates of 3.36 in in one hour

The mudslides hit areas that were ravaged by wildfires in October.

**Did early warnings & closures following the fires save lives?**

# How can we convince people they are better wet than dead?



# Up against the auto industry

**Ad says: Warning: use the cup holders at your own risk**

# Lessons from elsewhere

# Research issues

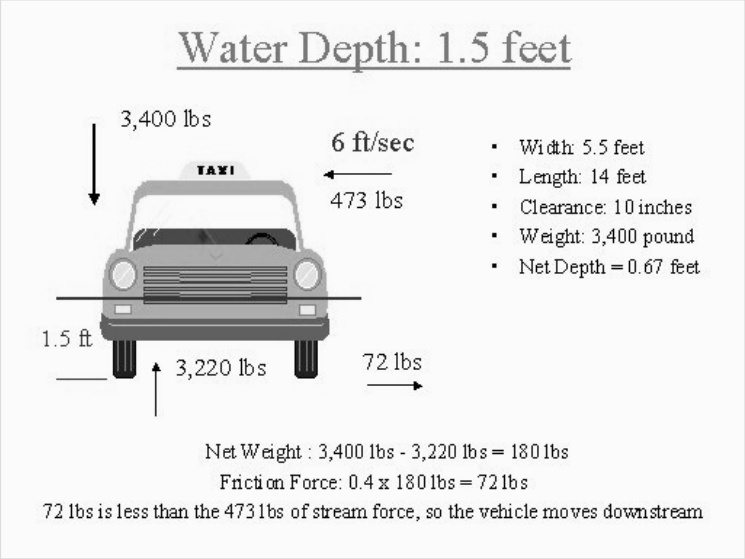
- Knowing more does not translate to reduced property losses – vulnerability increasing – account for age, gender, migration patterns

# Graphical images are everywhere

- How local?
- How real time?
- How useful?

# The car is not a boat

## At 1.5 feet the vehicle moves downstream – public education Maricopa County, Arizona



**Las Vegas Billboards 2003**

# 58 seconds in Tucson, Arizona June 22, 1977.

Photos copyright Jack Sheaffer *Arizona Daily Star*

# Dow & Cutter - Hurricanes Bertha & Fran – South Carolina

- People search elsewhere for information to assess their own risk

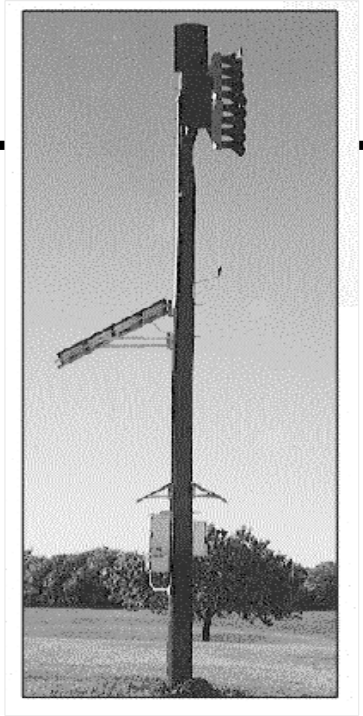
- "Official" sources are only some of many sources of information

Weather channel, quality of home construction, family situations, fear of delays in being allowed back home

## False alarm- Ventura, CA a siren test that went wrong

- Most said they would heed next siren
- Confidence in warning process was not reduced
- Served as a hands on practice for real emergency – family plans were developed

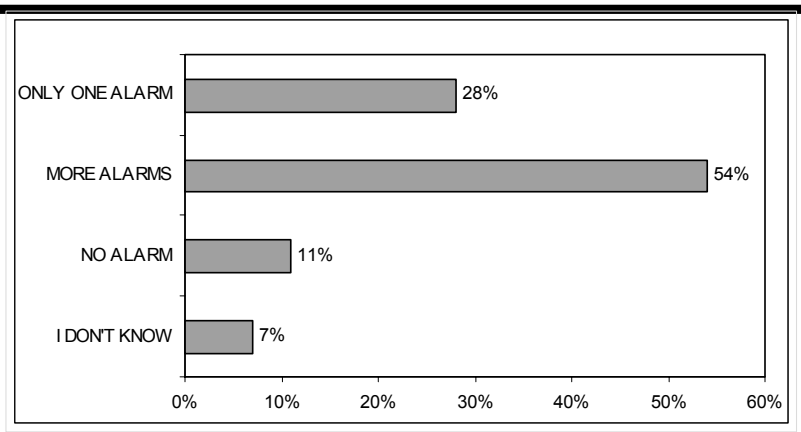
**Carsell's 2001 findings**



# Engineers & social scientists work together – outside the US

- Italian hydrologic engineer Enrica Caporali's flood warning follow-up study
- Two flood warnings in October 1992
  - Telephone survey of 518 residents

# Memory of the warnings




**82% remembered the warnings**

**28% remembered only one alarm**

**54% remembered two**

# After they heard the alarm

- 43% did nothing - 29% moved vehicles
- 83% judged the warnings positively

High level of public satisfaction with warning
-- but….

**THERE WAS NO FLOOD!**

- We rarely study warning response –
  but never when no flood occurs

# Not all floods are equal

- What are acceptable levels of risk?
- How do we address nuisance events vs catastrophic events?

**If 28 people die in Texas or France or 1000 people in Bangladesh– were the warnings successful?**

# Some events are so rare - Are warnings likely?

1999

- 30,000 dead Venezuela

2004

- 3000 dead Haiti

How can such deadly flash flood catastrophes occur with our current levels forecasting technologies?

# Key steps

- Develop a national warning strategy
- Identify definitions- for flash floods, for service missions
- Provide incentives for students and researchers
  - Research & workshops

# Who or what warning agency was most credible during the 1993 Midwestern U.S. floods?

Observing a slow rise flood is so much different than observing a flash flood, so when I had the opportunity to go to Missouri in 1993 during the devastating midwest floods, I did. Was the answer to the question the Corps of Engineers, the River Forecast Center, the tv meteorolologist or some others? I went to Hermann, Missouri for a few days, away from the commotion in St. Louis.

Gentlemen from Hermann, MO on the Missouri River. They have local knowledge & technical data from NWS, Corps of Engineers, local tv/radio and… latest news from “Dave” from the highway department who stops by to give them the an update about whether the access road to the bridges will force road closures later in the day, or whether current heavy rains at Kansas City will compound their local flooding or whether a levee break in an upstream down might reduce their local threat. They also use the “stick” for accurate local measurement.

Here are the Hermann residents 11 years later. Note that they have a laptop, a PDA, and a cell phone that provides real-time weather and river data. Would you think that they would also have a new truck? They also still have the “stick”.

# Expectations for 2014

- Numerous “natural” problem solving collaborations between social scientists, physical scientists, & practitioners
- Many “measured” successes – reduced losses
- Reduced vulnerability & integrated warning systems

Physical science & engineering advancements will only make a difference if research on warnings, warning response, & risk communication are better understood