

# Technological Innovations, Disaster Management, and End-User Needs: Challenges and Opportunities for Emergency Managers and Practitioners

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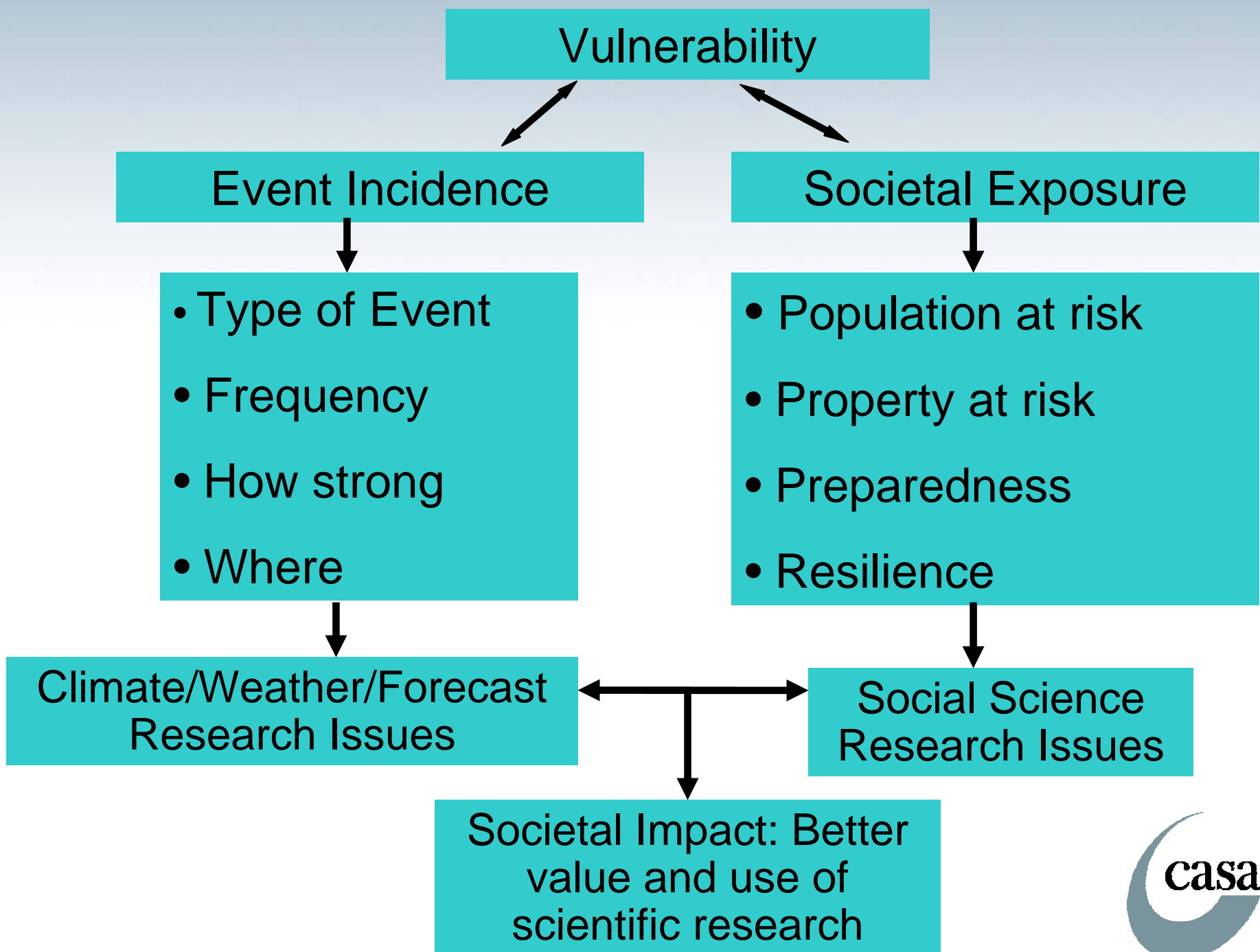
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# Disaster Losses

- Disaster losses result from the interaction of:
  - ❖ Physical environment (hazard events)
  - ❖ Built environment (infrastructure)
  - ❖ Social environment (population & community characteristics)

See Mileti, 1999



# Engineering Research Center for Collaborative Adaptive Sensing of the Atmosphere (CASA)

- “Revolutionize our ability to observe the lower troposphere through Distributed Collaborative Adaptive Sensing (DCAS), vastly improving our ability to detect, understand, and predict severe storms, floods, and other atmospheric and airborne hazards”



# CASA System Test-beds

- ❖ Oklahoma (wind sensing and severe storm detection, tracking, and predicting with an emphasis on tornadoes)
- ❖ Houston, Texas (urban flooding)
- ❖ Puerto Rico (tropical storms and hurricanes)

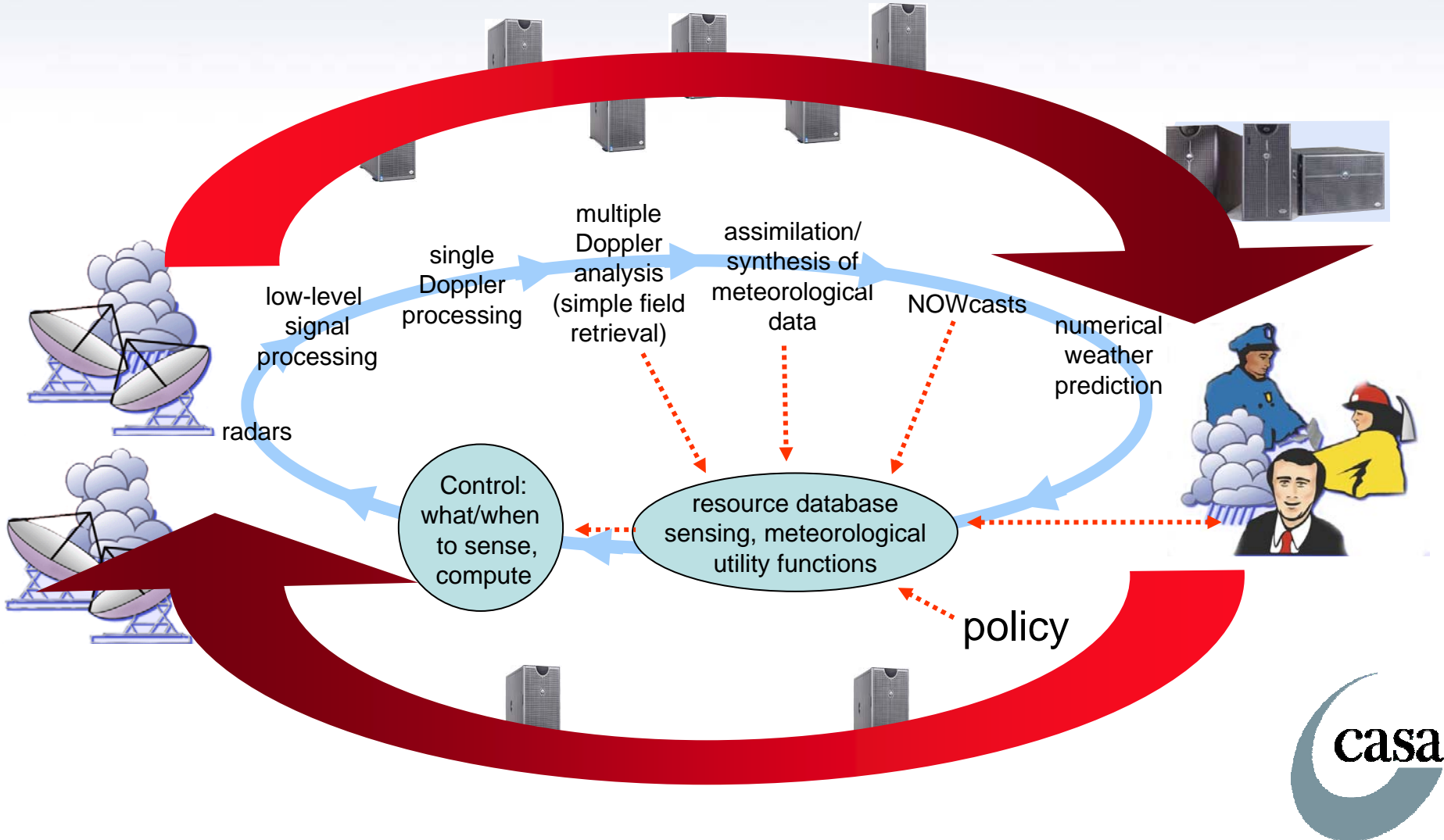


# CASA Collaborators & Partners

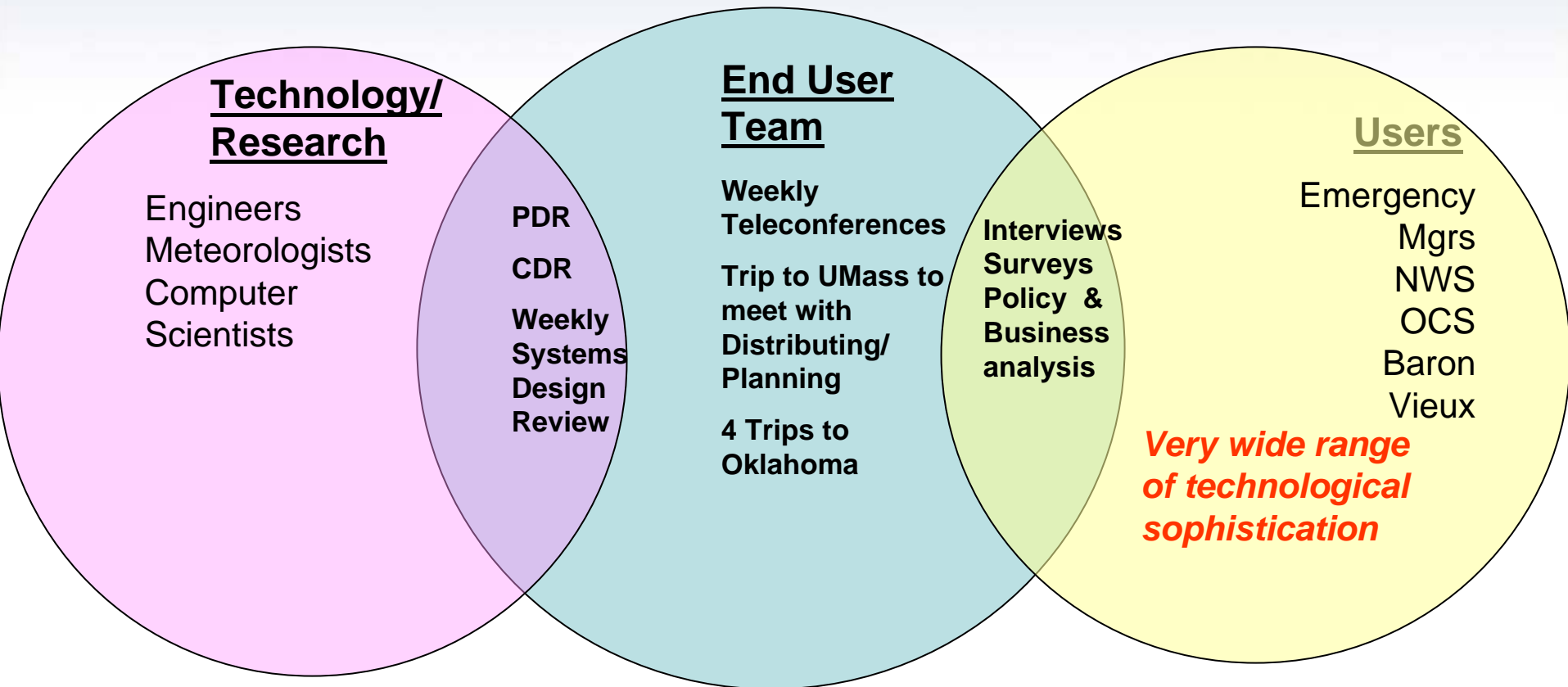
- ❖ Engineers
- ❖ Computer Scientists
- ❖ Meteorologists
- ❖ Social Scientists
- ❖ Graduate and undergraduate students
- ❖ Industry and government representatives



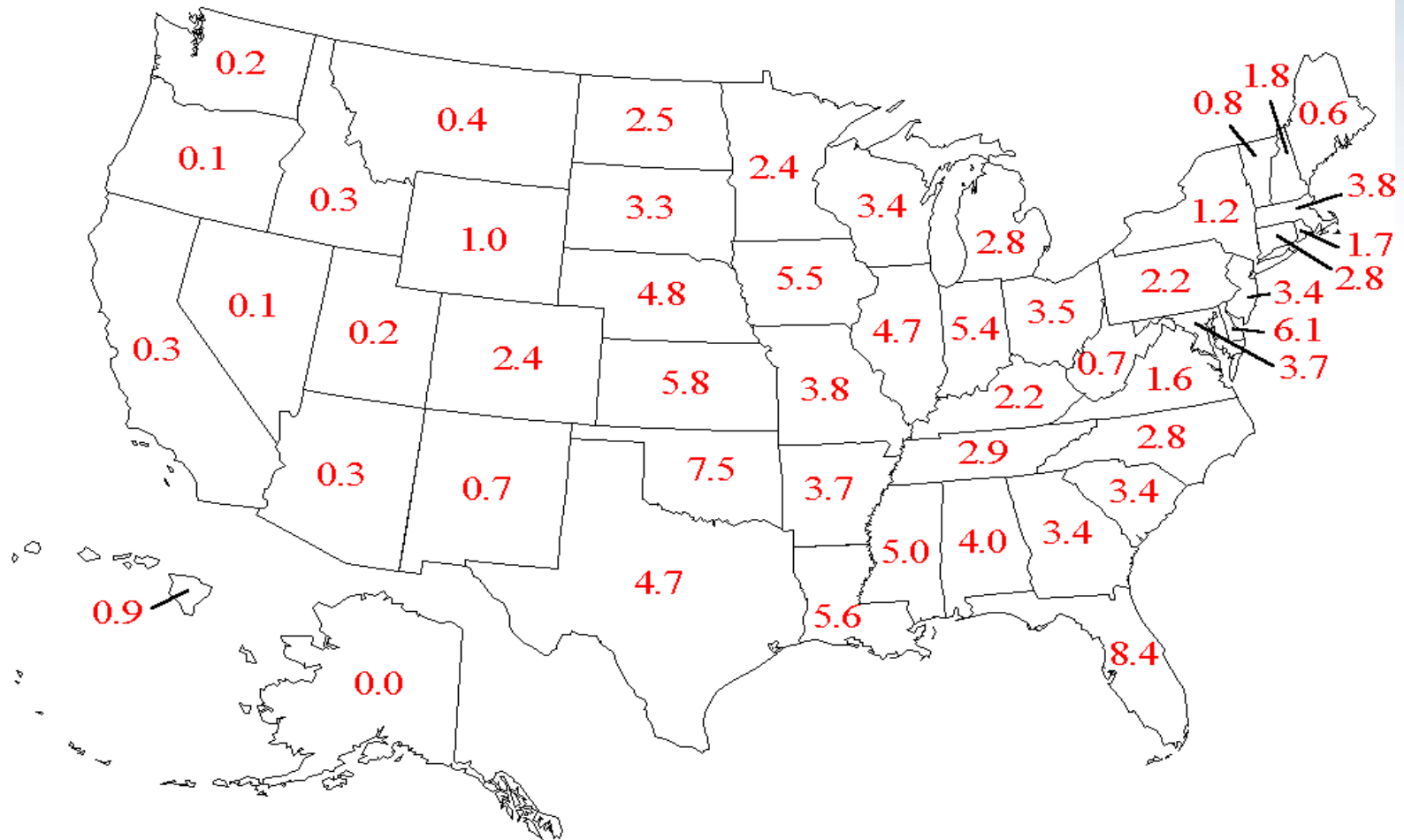
# DCAS View



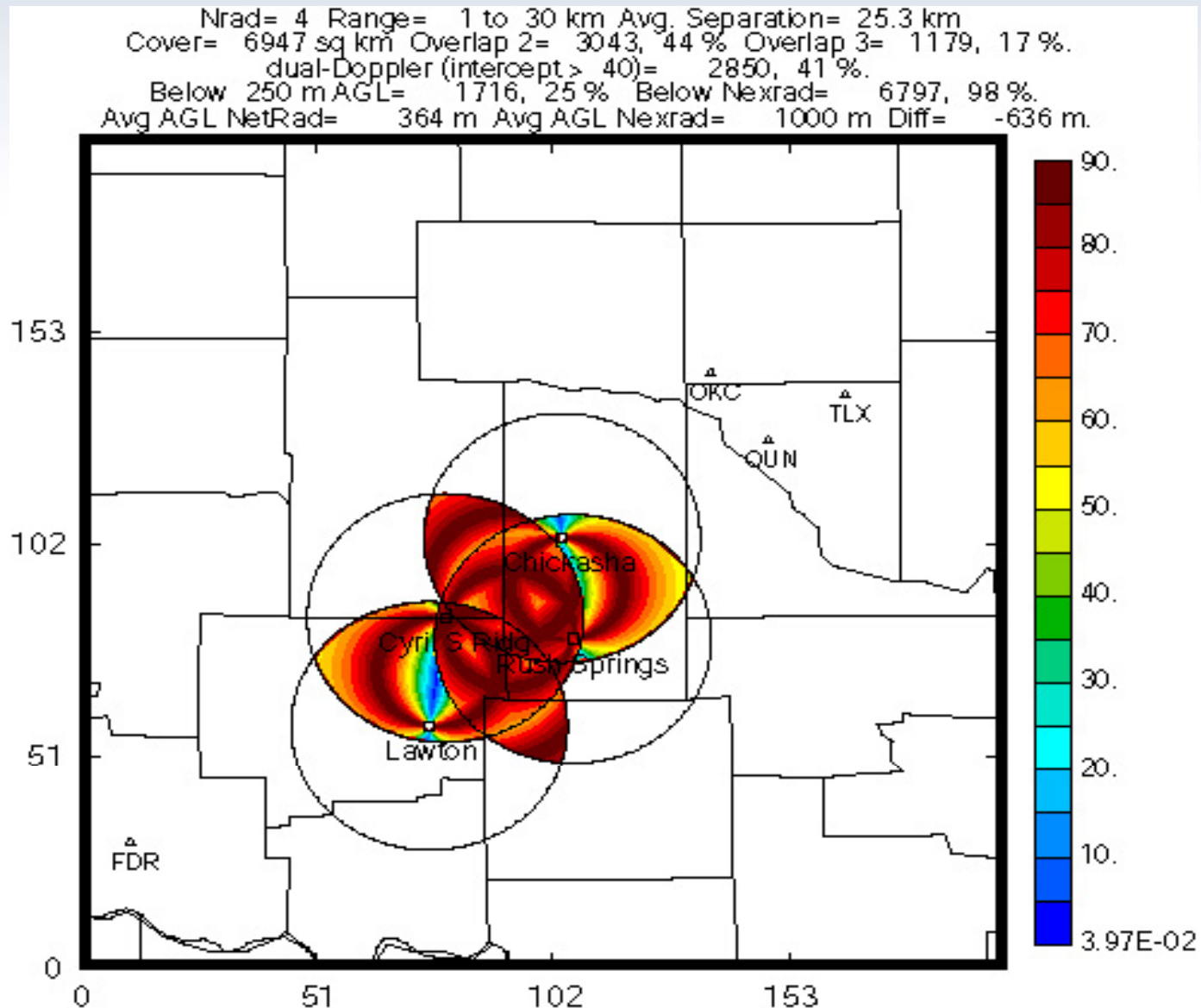
# Process View – End User Integration



## Annual Average Number of Tornadoes per 10,000 Square Miles by State, 1950-1995



# Oklahoma Test-Bed Region



# End-User Team Objectives

- Incorporate end-user needs into the system design from day one
- Identify users' perceptions:
  - ❖ advantages & limitations of current weather observation and warning systems
  - ❖ how the media and public perceive, understand, and respond to weather forecasts and warning information
- ❖ Policy determinations and enhancing weather technology

# Sample and Methodology

- Data were gathered from 72 participants of the 2003 Oklahoma Emergency Management Association's (OEMA) annual conference
- Respondents included local, county, and state emergency managers; fire department representatives; local and county government officials; insurance representatives; and other organizations commonly involved in disaster mitigation and preparedness activities
- It is important to note that this was a convenience, non-random sample



# Objectives of the Survey

- Address issues regarding the perspectives, needs, and problems confronted by emergency management organizations frequently involved in accessing weather information, radar support, emergency warning information, organizational limitations, and so on.

# Some Surveys Results: Problems and Concerns

- ❖ Inadequate radar coverage
- ❖ Updating of weather information is slow
- ❖ Limited warning time
- ❖ Inadequate communication with the public or between and within agencies
- ❖ Lack of training and experience among personnel

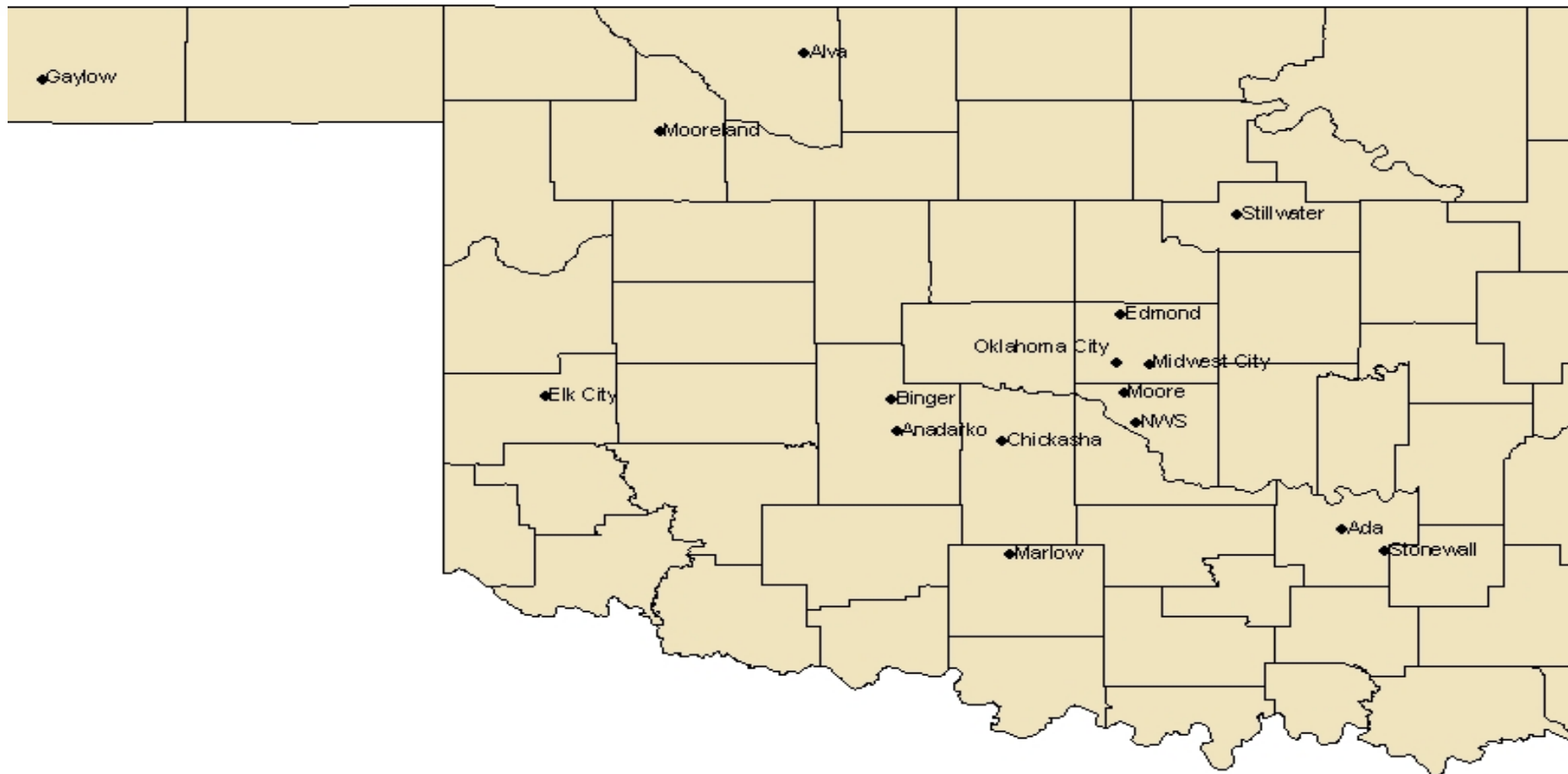
The survey results allowed us to develop a detailed and comprehensive instrument or semi-structured questionnaire which was used for in-depth interviews with a broad pool of local, county, and state emergency managers and representatives from the National Weather Service (NWS).



# In-depth Interviews

- Snowball sample
- Sample consisted of 38 personnel from emergency management community, the National Weather Service, Spotters, and Ham Radio Operators, among others
- In-depth interviews lasting from 1.5 to 2.5 hours

# Geographical Distribution of In-depth interviews Conducted with the End-User Community



# Hazard Threats

- Historically, floods cause more damage and deaths. However, emergency managers interviewed consider tornados the most dangerous weather event given their unpredictable nature

*“If I don’t give the warning for a flood, I’m still going to be here tomorrow...if I don’t blow the sirens before the tornado hits the city limits, I won’t be here tomorrow” (Emergency Manager)*

- Flood mitigation measures may potentially provide respondents and their constituencies with a “false sense of security” thus increasing their vulnerability to such events

# Radar Information and Data

## ■ More frequent updates of radar data

*“Quicker updates [of radar data] would be the number one thing for me. Because it’s a long five minutes when you have a tornado coming down your throat here, and you’re hitting the reload button...”* (Emergency Manager)

# Tracking and Visualization

## ■ Precise tracking of tornadoes :

*“It would be great to be able to say that there is a large vortex up to a quarter mile wide centered at this intersection, and five minutes from now it’s going to be at this intersection, and to be very specific in that way.”*

## ■ Visualization:

- ❖ Real-time weather information
- ❖ Sophisticated users want access to ‘raw’ radar data
- ❖ Enhanced graphics
- ❖ User-friendly information and graphics



# False Alarms

## ■ Regarding False alarms:

- ❖ Over warning is preferred
- ❖ However, there is concern about the impact of FARs at the organizational level

*“In fact, there are parts of the country now where tornado warnings get routinely issued and there are places that I know where 30 or more tornado warnings have been issued in a day and there wasn’t a single tornado associated with it. You figure that at some point in time, that’s going to have an impact” (Emergency Manager)*

# False Alarms

- An NWS representative indicated:

*“Well, false alarms are always a problem to some degree, because when you tell someone there’s a threat and nothing materializes, there’s some element of that that may be harmful to your credibility...you run the risk of people losing confidence to some degree that you know what you’re talking about.”*

- According to historical data from NWS, the current FARs for tornadoes is .675 for the state of Oklahoma and .756 for the United States

# Lead-time

- Some emergency managers discussed the negative impact of having more lead-time:

*“Well if it was going to be one extreme or the other and I couldn’t find that perfect time in there and it was either going to be 6 or 8 minutes before something hits or 20 minutes before it hits I’d rather go for the earlier time because you don’t want people jumping in their cars and trying to get somewhere.”*

*“Well, for lack of anything else, the lead time is, right, what’s the maximum time that you can tell me that a tornado may strike that town, or that part of the city. Right now in Oklahoma, 20-30 minutes is a good warning time. That should be more than enough to prevent anyone from getting killed or injured—should be.”*



# Redundancy of Information

- Resiliency of the communication infrastructure is needed
- Having multiple information sources can be a benefit
  - ❖ However, multiple information sources can also lead to confusion and impact public response, particularly when contradictory and incorrect information is provided by some sources

# Spotters

- A heavy reliance on spotters, particularly in rural areas, was reported by emergency managers:

*“One without the other [technology and spotters] is a disaster asking itself to happen. If you were an emergency manager with no spotters, you will definitely send the people to cover so often that it will get to the point where it’s cry wolf.”*

*“With the spotters in the field, you not only give the people correct, absolute, real life information but you also give the National Weather Service the same thing.”*



# Spotters

■ However, emergency managers reported some problems that may be generated by spotters, particularly regarding:

- ❖ Absence of adequate training
- ❖ Reliability of spotter's reports:

*“...an awful lot of spotters I’ve found over the years are unreliable. People have to be good...but out of the 10 or 12 they send out, there are only two of them [spotters] [that] you want to listen to.”*

# The Role of the Media

- Respondents agreed that the media plays an important role in the communication of disaster information. However, they also identified a number of problems with the media:

*“they’re [the media] interested in revenue of course, that’s what they’re interested in...you try to give them all the information [during a severe hazard event] and then you listen to what they put out and it’s like “that’s what I said?”*

*“It’s a media market issue. The television stations are very sensitive to where their population demographics lie and they’re not going to devote a lot of air time to a storm that’s far from the people because they get complaints,” reported an NWS representative.*

# Public Response

- People do not always respond appropriately to weather information and warnings:

*“But a tornado warning you probably got about 30% [individuals] that if they see it coming their way, I mean at their house, they may do something. The other 70% will probably go outside and look at it.”*

# *Limited Resources: Internet Access*

- Emergency managers depend quite extensively on internet-based weather information sources
- However, offices located in rural areas may not have access to broadband connection; limited access to any kind of internet services

*“of course there [are] tornadoes that happen in every place but in our [or] your rural area out here we don’t have the resources that they have in the city”* (Emergency Manager in rural area)



# Limited Resources

- Competing tasks and employment responsibilities for emergency managers impact training, preparedness, and response
- Limited budget and resources as highlighted by emergency managers:

*“We are spread as emergency managers, not only in weather, but [in] many other functions also. So, therefore, we do the best we can with the training we’ve got and have been given.”*

*“There are no funds, the county doesn’t have any money so we get a little bit of help on the fire service part of it but, other than that, most of ours [funds] are city provided...all of our vehicles are equipped, paid by us out of our pockets.”*



# Limited Resources

- The lack of resources has negative implications for the growth and development of emergency managers, their professional training and, therefore, on their ability to adequately prepare and respond to hazard events in their communities
- Consequently, communities and their populations may be negatively impacted. Emphasizing this point, a respondent in the upper echelons of the emergency management bureaucracy indicates:

*“Oh, absolutely it impacts. If, and we’ve heard this from a lot of our emergency managers, my boss won’t let me take off time to go to the training. He’s got to take his vacation time to go to the conferences and the training that is important to do the emergency management job...is the employer willing to fund him, give them paid time off, probably not in most cases. So does it impact? Sure!”*

# Education & Communication Issues

- Public awareness and education and response to severe weather warnings must be understood and improved
- Examine communication within and between emergency management organizations, the media, and the general public
- How to effectively communicate with an increasingly diverse population



# Concluding Remarks

- Improving weather forecasts, reducing FAR's, and increasing lead times is only part of the equation in determining the ultimate effectiveness of organizational and individual preparedness and response to hazards

# Concluding Remarks

- Individual response to forecasts and warnings is often influenced by factors that have little to do with the technical features of weather forecasts, such as:
  - ❖ Social class
  - ❖ Education
  - ❖ Gender
  - ❖ Race/ethnicity and cultural background, among others

# Concluding Remarks

- Risk and disasters are socially constructed phenomenon, influenced by cultural norms, prejudices, and values
- The communication of risk and crisis information must take into account the societal context in which the event occurs
- Continued emphasis on the development of technology, while ignoring the social forces that shape disaster behavior and response is not the solution to the problem

# Concluding Remarks

- We must actively engage end-users in identifying their risks, disaster planning and management, development of technology, and the communication process
- We must respond to the needs, interests, and the limitations that end-users confront, if we are to achieve the desired outcome: reduction in the loss of life, injuries, and property damage
- The role of CASA is extremely important, particularly as it relates to education, training, and communication with end-users



# The Importance of Integrating the Needs of the End-Users

- There is a need to bring scientific output and user needs closer together (NRC, 1999):

*“I’d like to say thank you on behalf of people like me for including us in the early stages [of this project]. I think that’s important. I’ve seen a lot of projects where the user input was not considered and I think that was a mistake but I think this is a great effort and I appreciate you doing this and inviting me to help”* (Emergency Manager in Oklahoma)

# For Additional Information

- Visit the DRC facilities at:
  - ❖ 87 E. Main Street, Newark, DE  
(302) 831-6618
- Visit the DRC webpage:
  - ❖ [www.udel.edu/DRC/](http://www.udel.edu/DRC/)