

Improving Communication of Weather Forecast Uncertainty: A Path Forward

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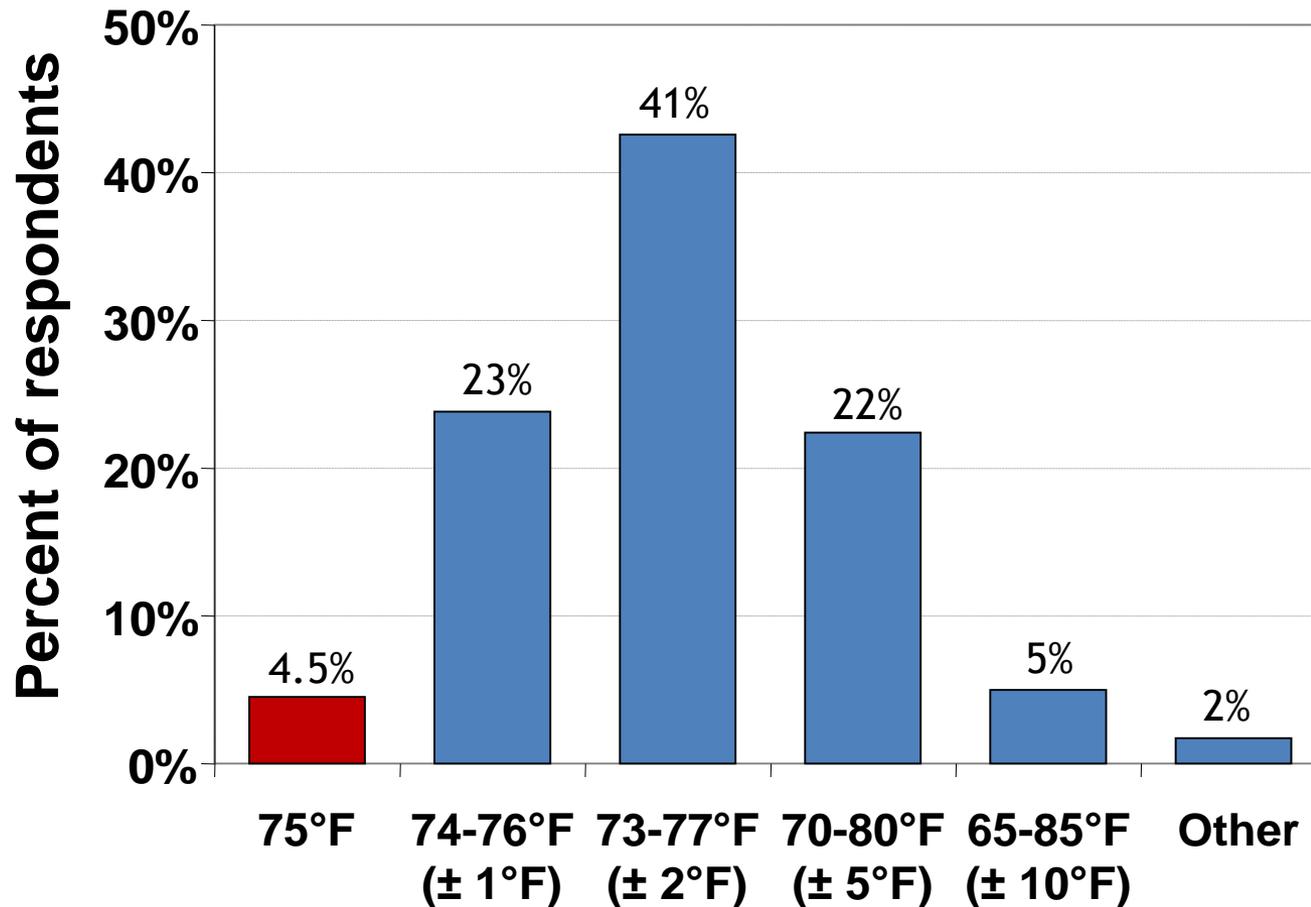


Forecast uncertainty in context

- **People understand that weather forecasts are uncertain (and so is everything else)**

Suppose the forecast high temperature for tomorrow for your area is **75°F**.

What do you think the actual high temperature will be?



Forecast uncertainty in context

- **People understand that weather forecasts are uncertain (and so is everything else)**
- **People can make decisions under uncertainty (using uncertainty information)**

Suppose the forecast is “There is a 60% chance of rain tomorrow”.

Which of the options do you think best describes what the forecast means?

Response option	Percent of respondents
It will rain tomorrow in 60% of the region.	16%
It will rain tomorrow for 60% of the time.	10%
It will rain on 60% of the days like tomorrow.*	19%
60% of weather forecasters believe that it will rain tomorrow.	23%
I don't know.	9%
Other (please explain)	24%

* Technically correct interpretation, according to how PoP forecasts are verified (Gigerenzer et al. 2005)

Probability of Precipitation (PoP)

- **Open-ended interpretations of PoP**
 - Many responses repeat PoP, without clarification
 - Variety of other responses, some from “personal” or “use” perspective
- **Most people don't know technically correct definition of PoP — 60% chance of what?**
 - *But ~70% of respondents said PoP was very or extremely important information in a forecast*
 - **Can people use and obtain value from information that they don't fully understand?**

**Whether/how forecast
uncertainty information is used**



**More
“sophisticated”
user**

**“Expert”
user**

**Less
“sophisticated”
user**

**“Non-expert”
(general public)
user**

**Whether/how forecast
uncertainty information is used**



**Ability and tools to
use quantitative (or
complex) uncertainty
information**

**More qualitative
use of
uncertainty
information**

**More engaged
with weather
forecasts /
uncertainty**

Less engaged

**Different
perspectives on
different risks**

More interested

Less interested

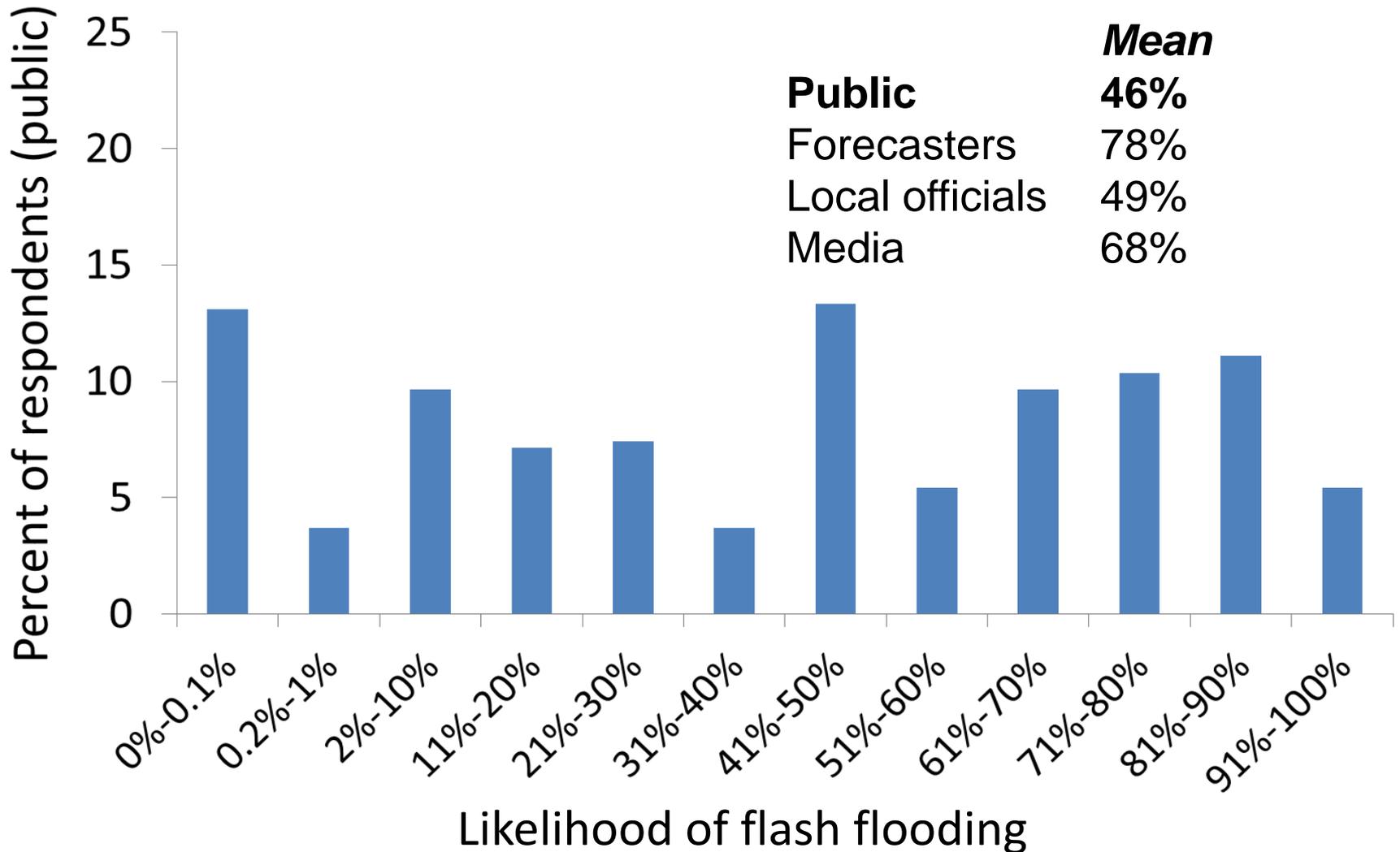
Improving uncertainty communication

- **Different people interpret information and risks differently (sometimes counterintuitively)**

If a flash flood warning is issued, how likely is flash flooding in the next 24 hours?

	<i>Mean</i>
Public	46%
Forecasters	78%
Local officials	49%
Media	68%

If a flash flood warning is issued, how likely is flash flooding in the next 24 hours?



Improving uncertainty communication

- Different people interpret information and risks differently (sometimes counterintuitively)
 - These interpretations, along with many other factors, influence use of weather information
- Giving people more / more accurate / more detailed information is often *not* the answer
- Instead, meet people where they are
 - ▣ Understand (and appreciate) their perspective
 - ▣ Test forecast products! (early and often)

Lessons from risk communication research and practice (adapted from Fischhoff 1995)

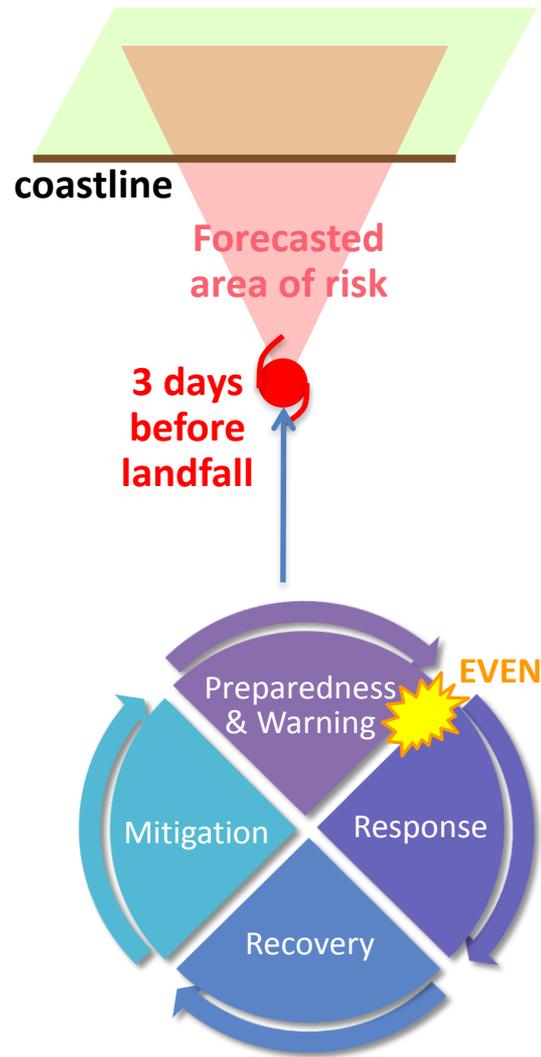
Developmental stages in risk communication:

1. “All we have to do is get the numbers right”
2. “All we have to do is tell them the numbers”
3. “All we have to do is explain what we mean by the numbers”
- 4-5. All we have to do is show them that it has value
6. “All we have to do is treat them nice” (when communicating)
7. “All we have to do is make them partners”

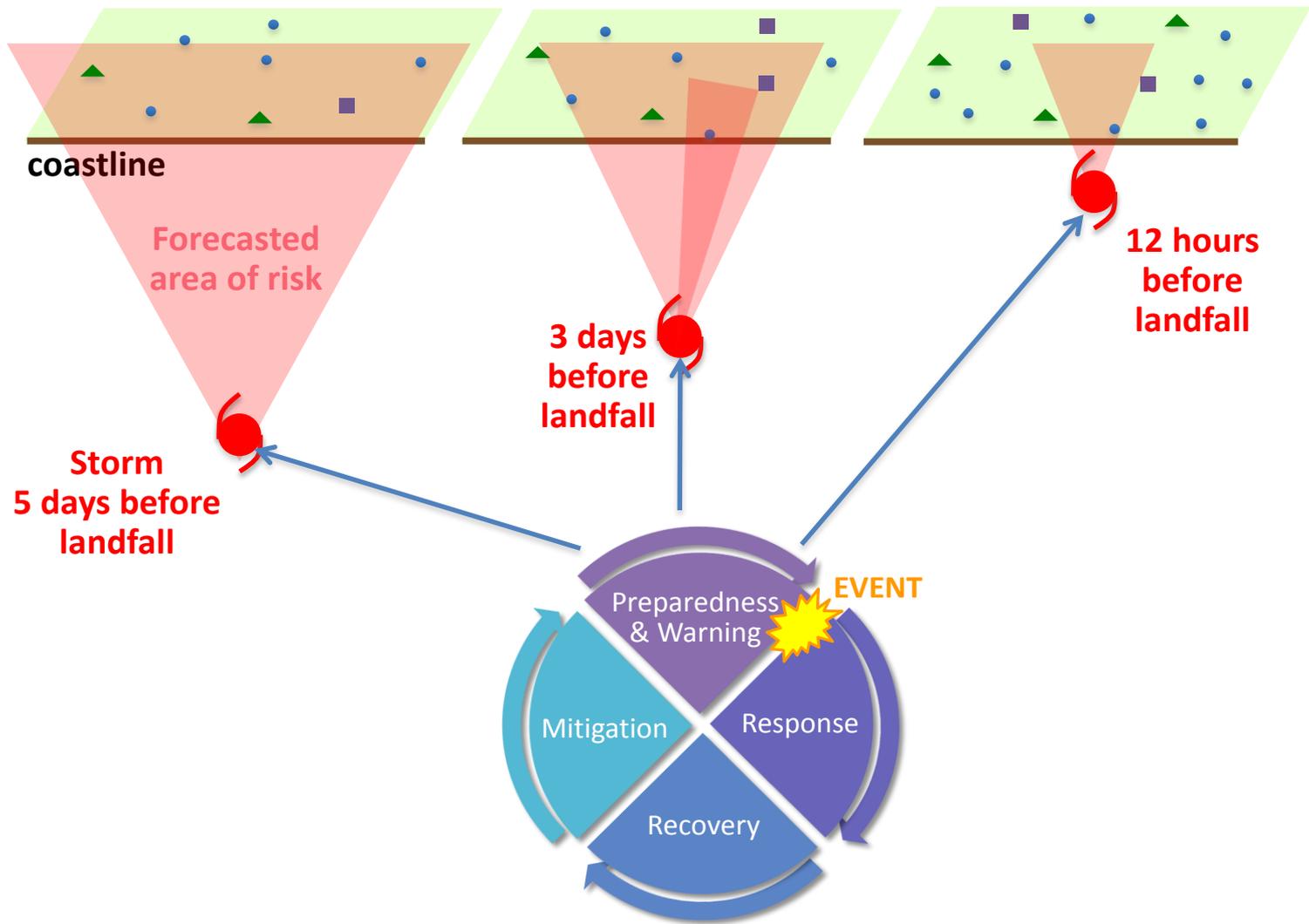
How do we advance weather risk communication?

Ask questions such as:

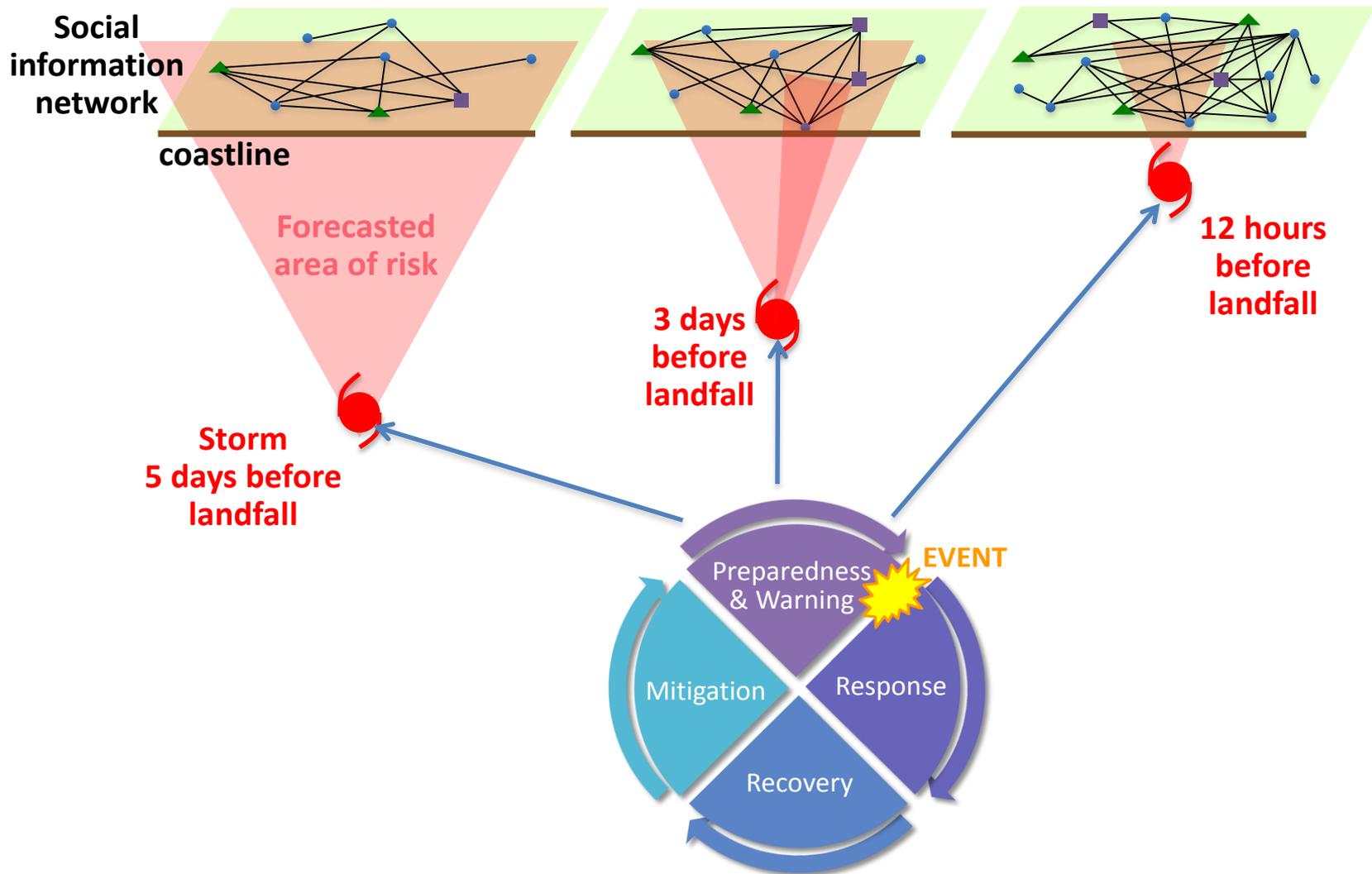
- **How (potentially) important is weather forecast uncertainty for a decision, when?**
- **What aspects of forecast (un)certainty are most important for people to know or understand?**
- **What other information is important?**
 - **And how do we best communicate that?**
 - **to different audiences**
 - **given the complexity of real-world information communication, risk interpretations, and decision making**



Traditional Hazard/Disaster Cycle:
Response to a Weather Forecast/Warning



How do we communicate weather forecasts and warnings effectively in the “modern information environment”?



If you hear a flash flood warning and you are ... outdoors, you should _____

Move to higher location	85%
Move to different location	10%
Avoid risky areas	9%
Assess situation	4%
Be alert	2%
Seek more information	0.5%
Depends	3%
Don't know	0.5%
Other	4%



If you hear a flash flood warning, you should ...

“Climb to safety.”

“Go to higher ground.”

“Get to higher ground
and hold on.”

“Run like nuts.”

“Get to high ground.
Climb tree.”

“Get as high as
possible.”

“Keep your eyes
open ...”

“Move ... out of
canyon areas.”

“Be cautious.”

“Stay away from
creeks and rivers.”

“It depends on where you are?”

**“Have high ground picked out nearby and go
to it if you see the water and debris coming.”**

“Think! Assess vulnerability of location and act accordingly ...”



Cliff Grassmick / Daily Camera



Mark Leffingwell / Daily Camera



Jeremy Papasso / Daily Camera

“Keep your eyes open ...”

“Be cautious.”

**Rapid evolution of hazard +
spatial variability +
situation-dependent vulnerability**



**Complexity and uncertainty in
protective decision making**

“Move ... out of
canyon areas.”

“Stay away from
creeks and rivers.”

**How do we communicate about
risks and protective options in
ways that aid complex decisions?**

“Ha
to it

go
.”

“Think! Assess vulnerability of location and act accordingly ...”

Summary

- **Communicating weather forecast uncertainty more effectively requires understanding**
 - ▣ Forecast and uncertainty estimation capabilities
 - ▣ How audiences perceive weather-related risks, obtain and interpret information, and make decisions (in theory and in reality)
- **Concepts and knowledge from risk communication, economics, and other social sciences can help**
 - ▣ But weather forecast and warning communication also presents its own challenges

Moving forward ...

- “[People] want to know three things: what does it mean to them, what does it mean to their family, and what do they need to do right now. And so don’t speak like a meteorologist. Tell me what we need to know.” (television meteorologist interviewee, Demuth et al. 2012)
- Learn how to improve communication of (un)certainty, impacts, and risks
 - ▣ Understand not just what to communicate in a specific situation, but also why

