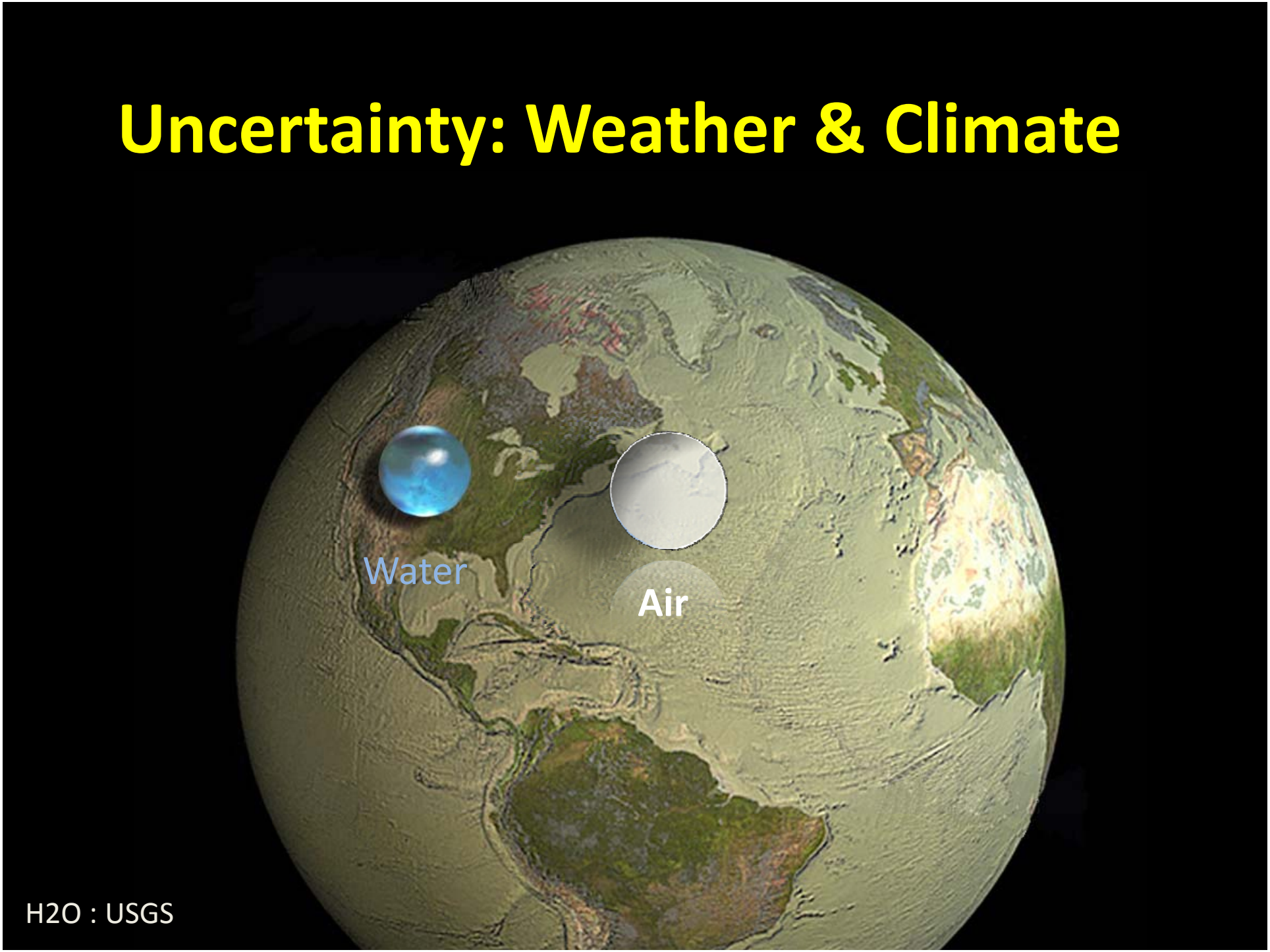
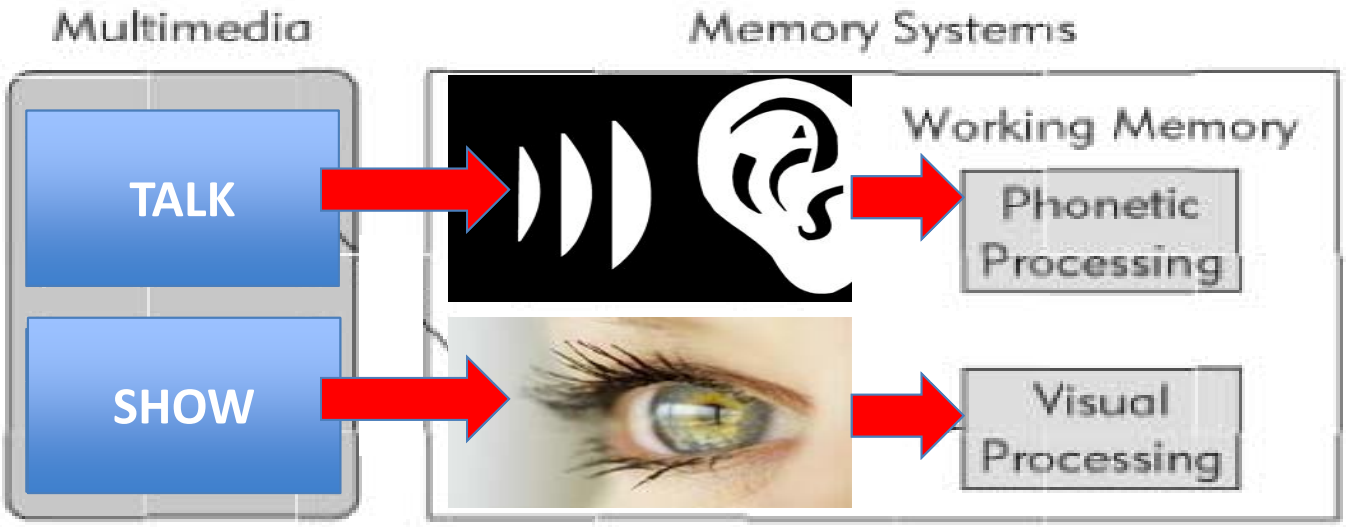
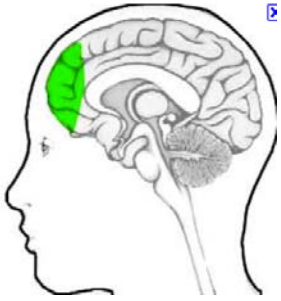
Uncertainty: Weather & Climate



H2O : USGS

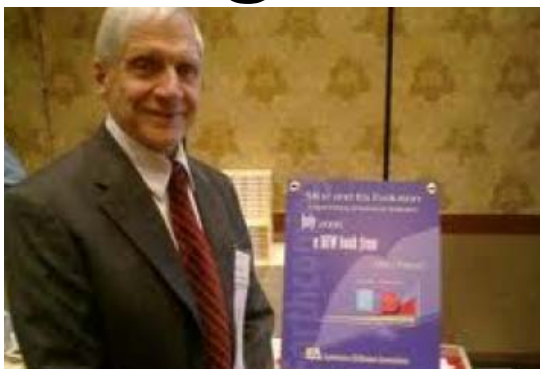

WGN9 WEA ER CENTER


Multimedia
Memory Systems
TALK
SHOW
Working Memory
Phonetic Processing
Visual Processing

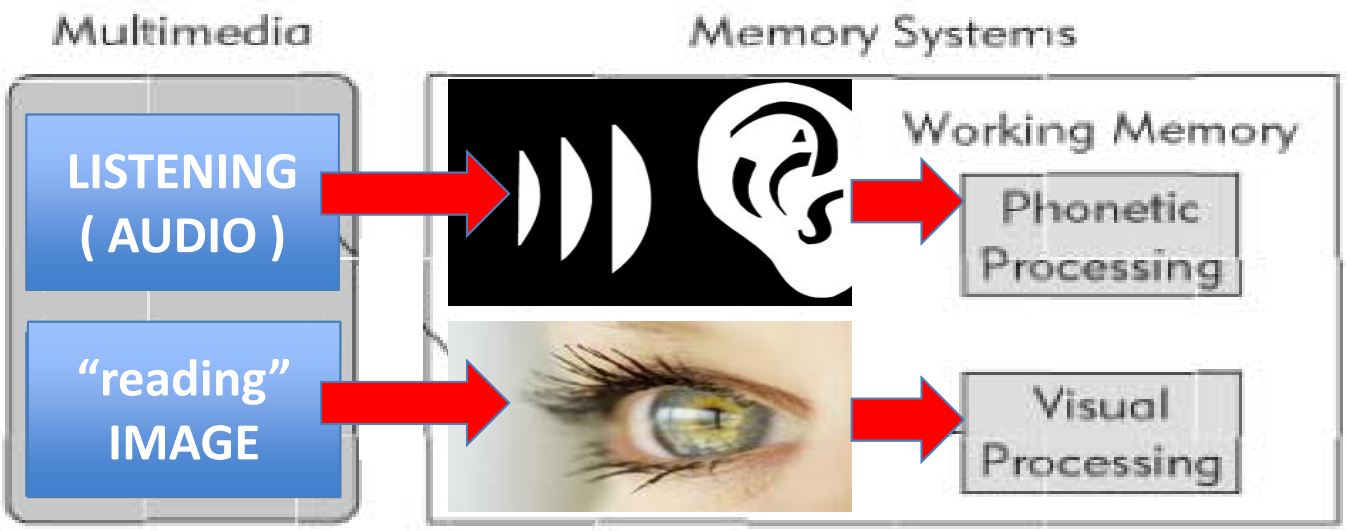


VIEWER

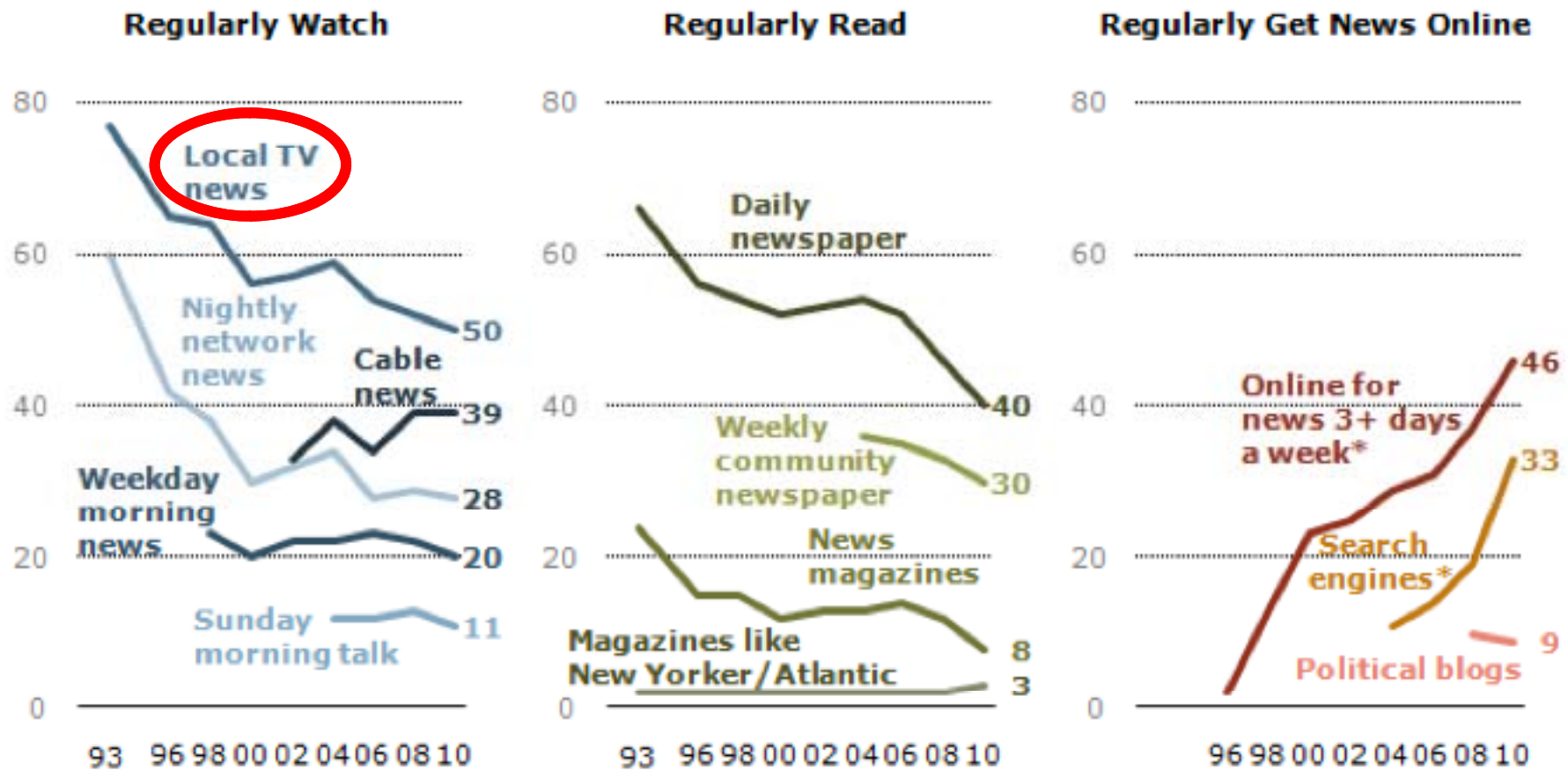
Dual-coding Learning Theory



Allan Paivio
Canadian Psychologist
1969

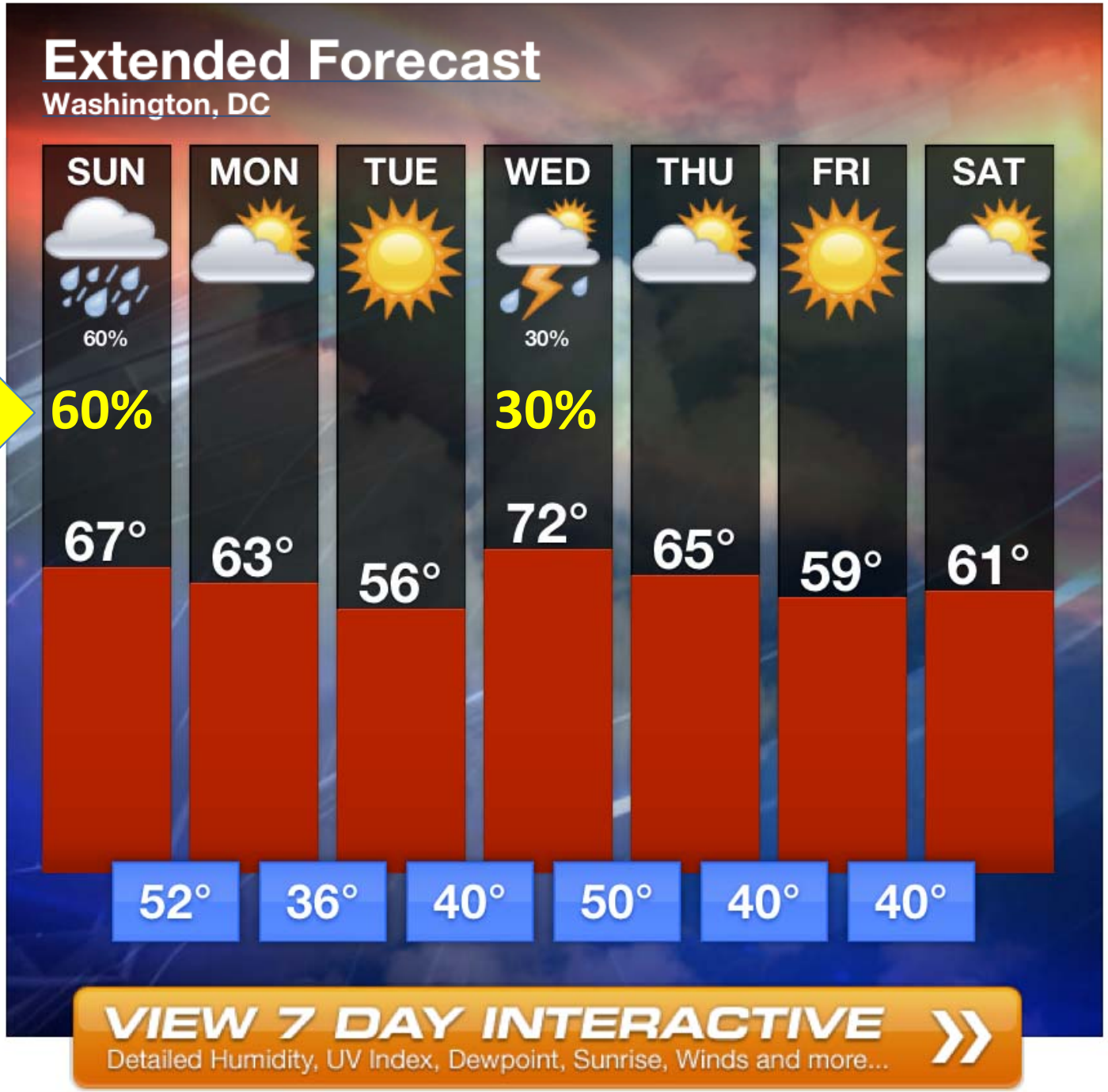


Trends in Regular News Sources



PEW RESEARCH CENTER June 8-28, 2010. Q28aF1,bF1,k,o,p, Q30a-d, Q41, Q43, Q46 based on total.
* Search engine use and general news online three or more days a week. All other trends are percent who use "regularly."

Uncertainty



What is a 60% chance of Rain?

- A. 60% of the day will be wet?
  - or
- B. 60% of the area will be wet?
  - or
- C.. 60% chance of .01” at one spot

60% chance of rain today.

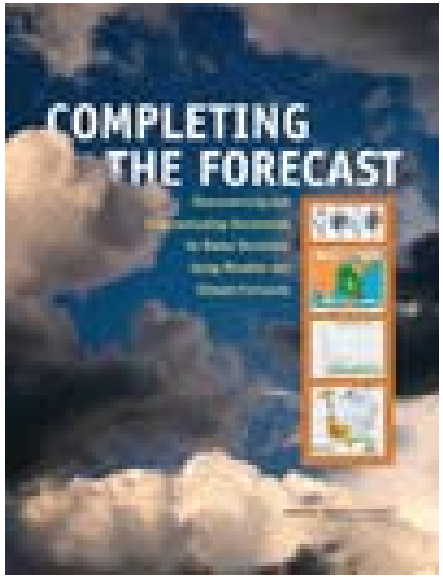
Out of 100 days with the same atmospheric conditions

it will rain* on 60 out of those 100 days

…….40 of the days will be DRY!

* >0.01 inch at a given spot.

Range (High)	Numeric Expression	Linguistic Expression	Colored Icon	Arrow Icon	
0	0%	Absolutely Impossible			** *
0-.9	5%	Rarely			
.9-.18	14%	Very Unlikely			**
.18-.27	23%	Fairly Unlikely			*
.27-.36	32%	Somewhat Unlikely			**
.36-.45	41%	Uncertain			
.45-.54	50%	Tossup			** *
.54-.63	59%	Better Than Even			
.63-.72	68%	Rather Likely			**
.72-.81	77%	Quite Likely			*
.81-.90	86%	Highly Probable			**
.90-1	95%	Almost Certain			
1.0	100%	Absolutely Certain			** *



Completing the Forecast: Characterizing and Communicating Uncertainty for Better Decisions Using Weather and Climate Forecasts

National Research Council

ISBN: 0-309-66261-3, 124 pages, 8 1/2 x 11,

2006

nbc4.com

With Probability

Without Probability

nbc4.com

With Probability

Without Probability

Would it be useful for you to see the probability of rain or thunderstorms on the StormCenter4 forecast graphic?

Choice	Votes	Percent of 5895 votes
Yes	5710	97%
No	185	3%

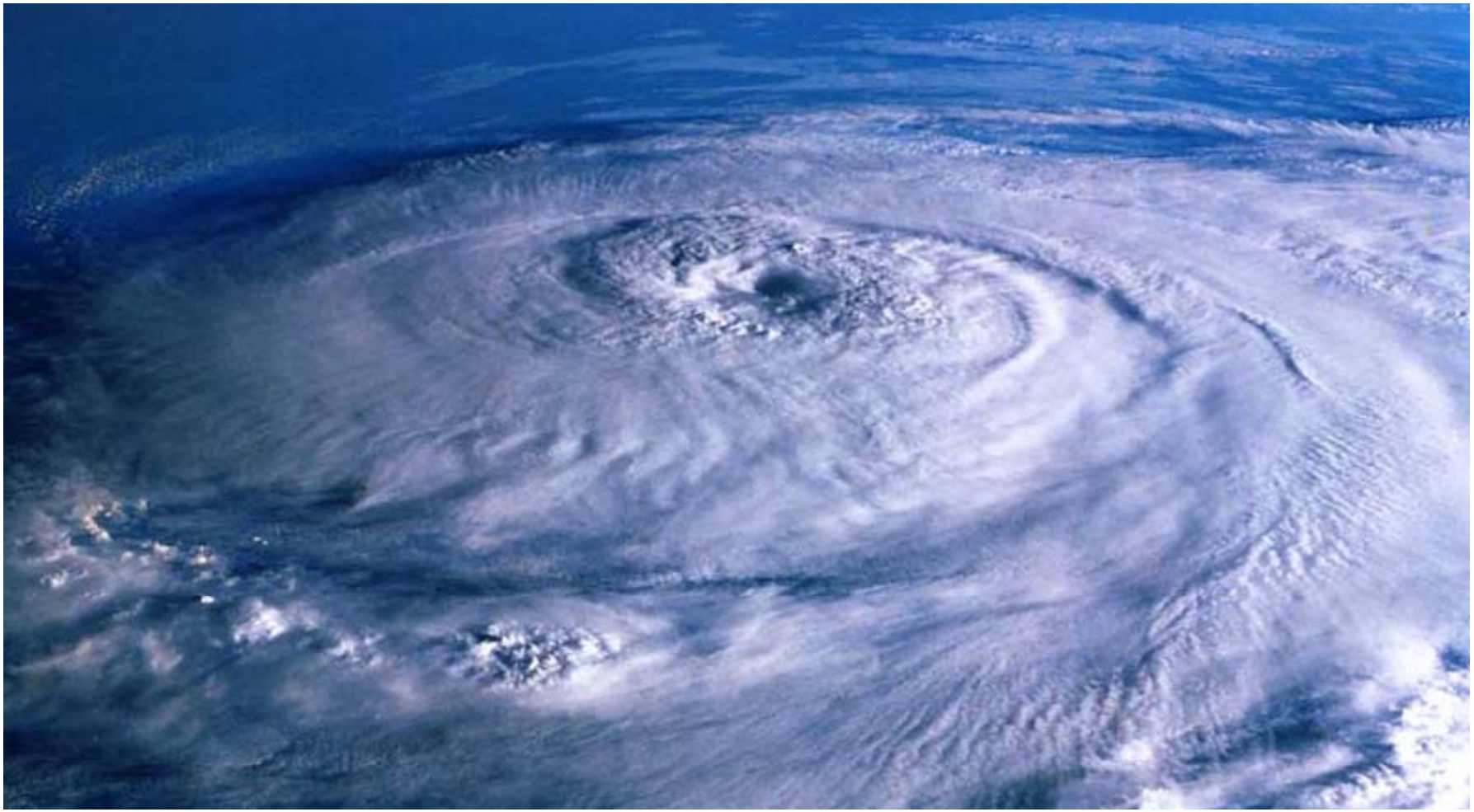
Thank you for taking the time to fill out our survey!


ra 1 Live Stream
WED
53
24
THU
42
22
FRI
30
17
SAT
36
18
SUN
43
21
MON
45
23
TUE
48
7 DAY FORECAST
PINPOINT WEATHER

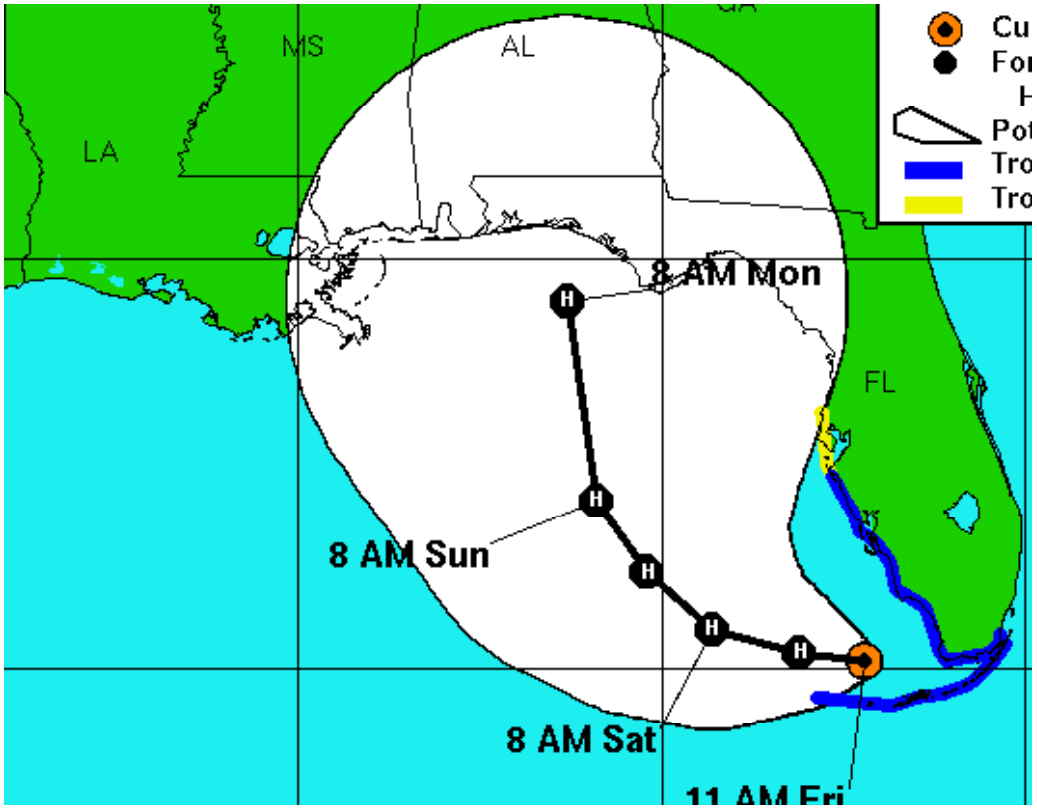
Where?


PINPOINT 4
MONDAY
Blowing Snow
Raton
Las Vegas
Blizzard Watch
- 8"-12" of Snow
-Dangerours Conditions
I-40 and I-25

Hurricane Uncertainty



Cone of Uncertainty



Misinterpretations of the "Cone of Uncertainty" in Florida during the 2004 Hurricane Season

BY KENNETH BROAD, ANTHONY LEISEROWITZ, JESSICA WEINKLE, AND MARISSA STEKETEE

Rigorous pretesting, including insights from social science, could improve hurricane forecast graphics aimed at the general public.

“... social science...

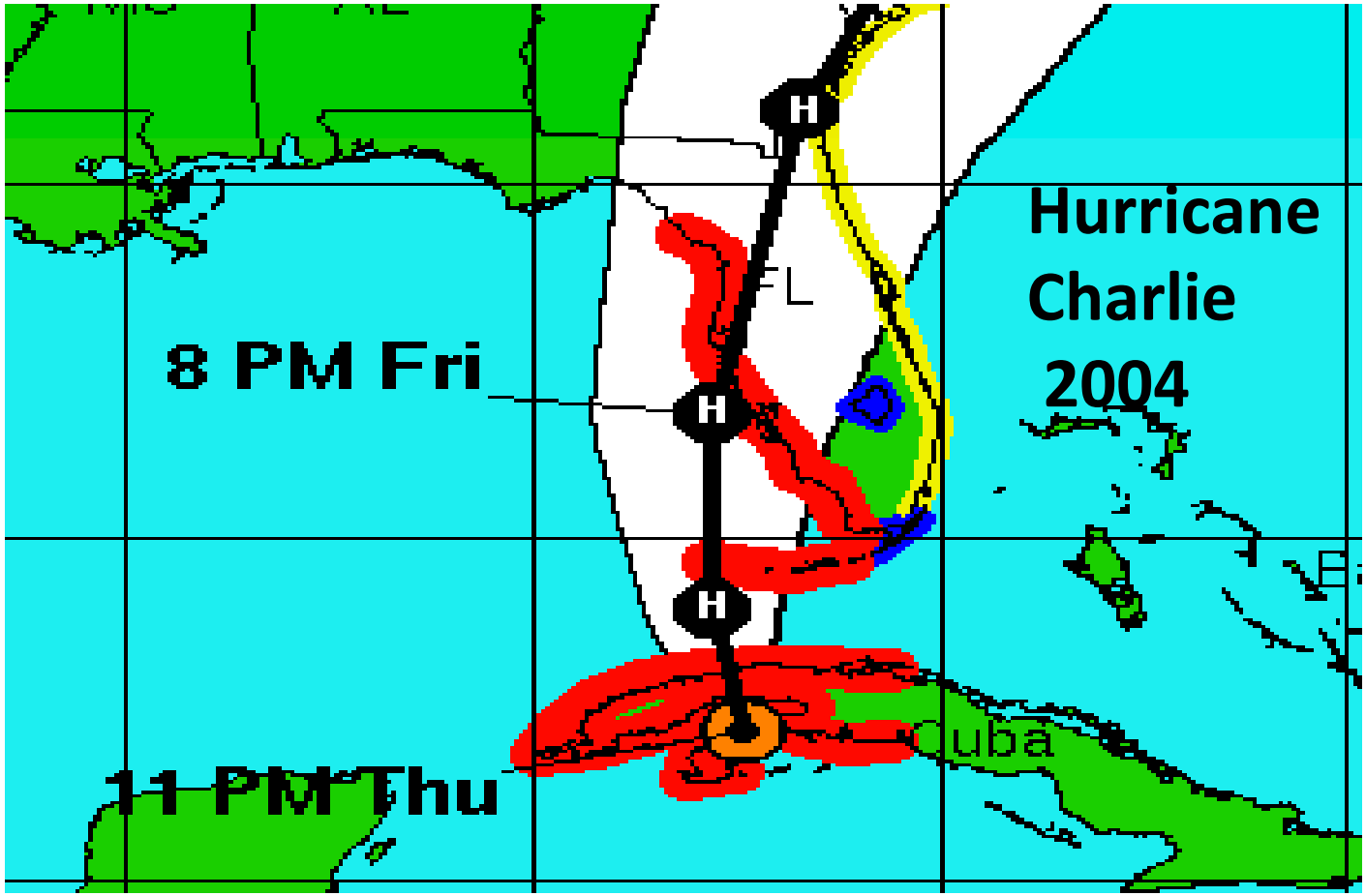
could improve hurricane graphics ....”

Kenneth BROAD,
Anthony
LEISEROWITZ,
Jessica WEINKLE,
Marissa STEKETEE

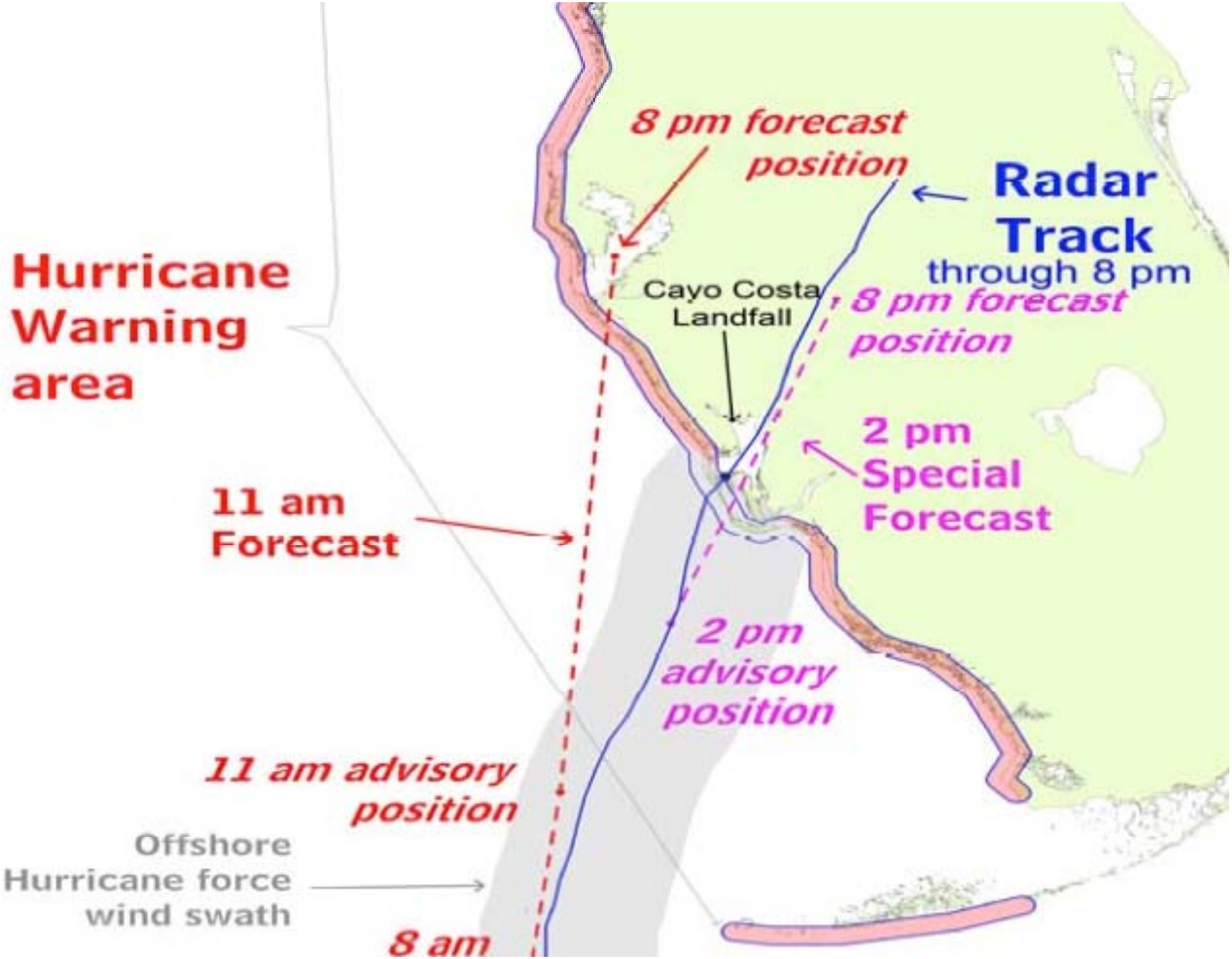
Max Mayfield, Director of Nat'l Hurricane Center

"that was a very good forecast."

(Stone 2005, in Broad, et al.2007)

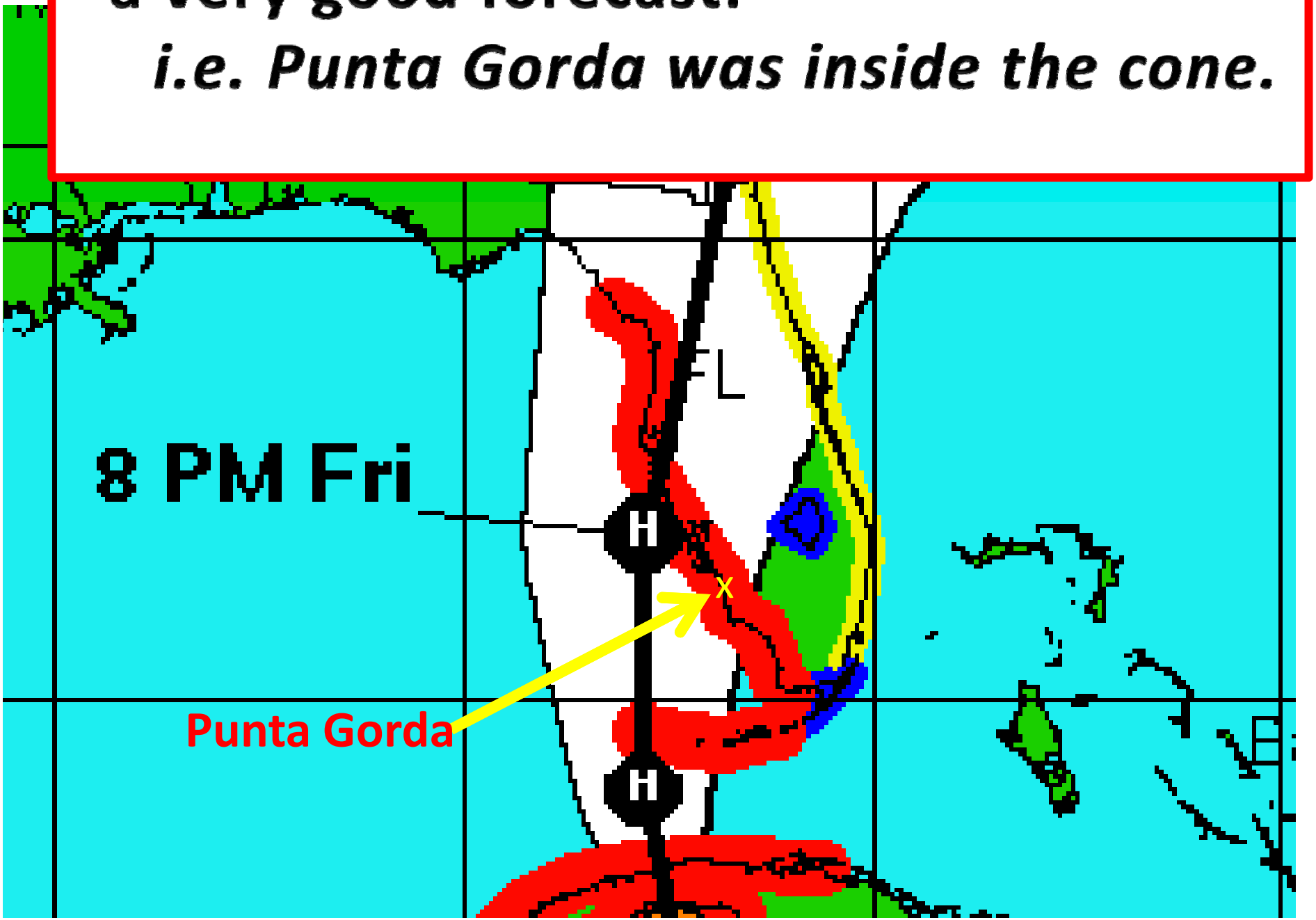


Residents of Punta Gorda did not understand the NOAA graphical message!


8 pm forecast position
Radar Track through 8 pm
Hurricane Warning area
Cayo Costa Landfall
8 pm forecast position
2 pm Special Forecast
11 am Forecast
2 pm advisory position
11 am advisory position
Offshore Hurricane force wind swath
8 am

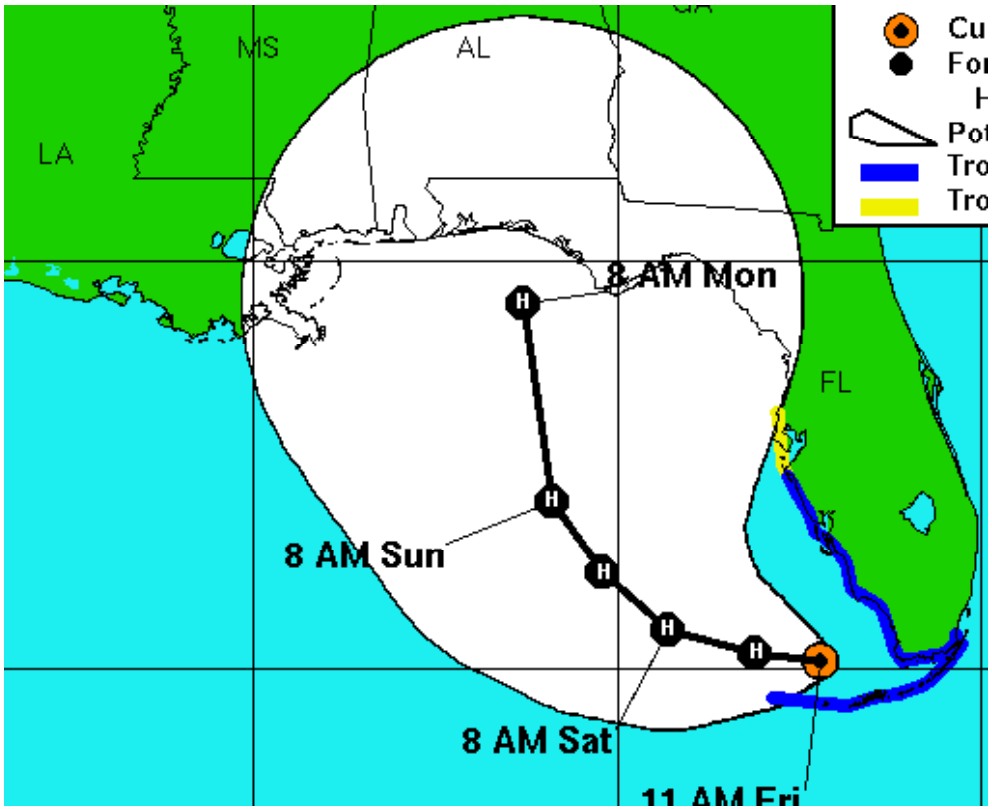
“a very good forecast.”

i.e. Punta Gorda was inside the cone.

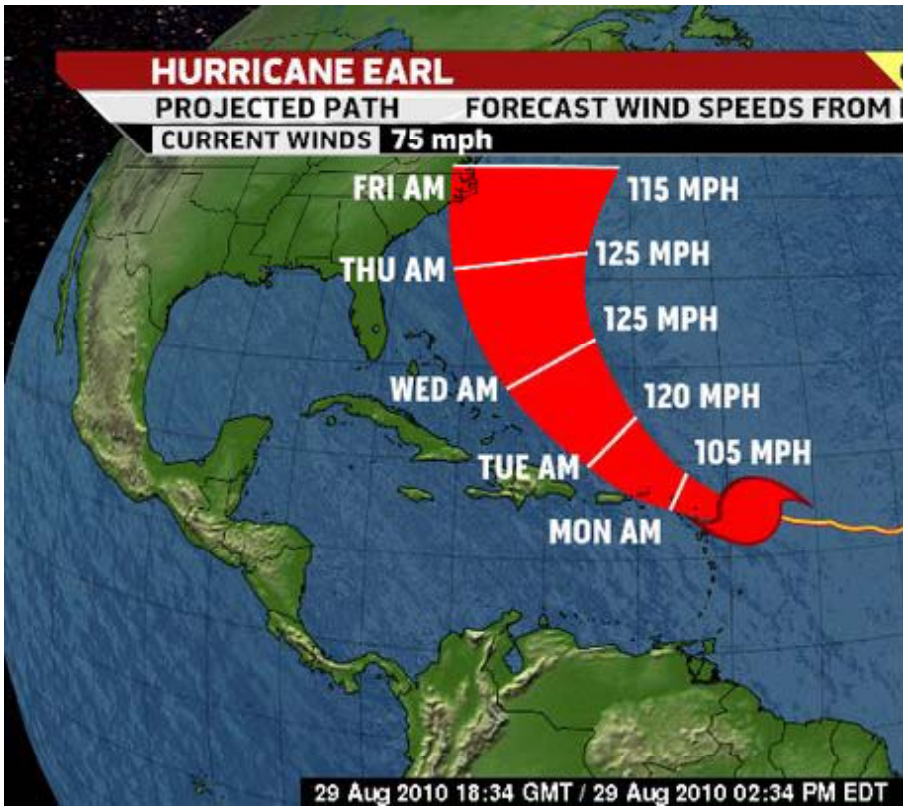


Cone of Uncertainty

A Blob?



Red Curve?



Hurricane Forecast Cone:

The cone = **probable track of the center** of hurricane

Based on the past 5 years,

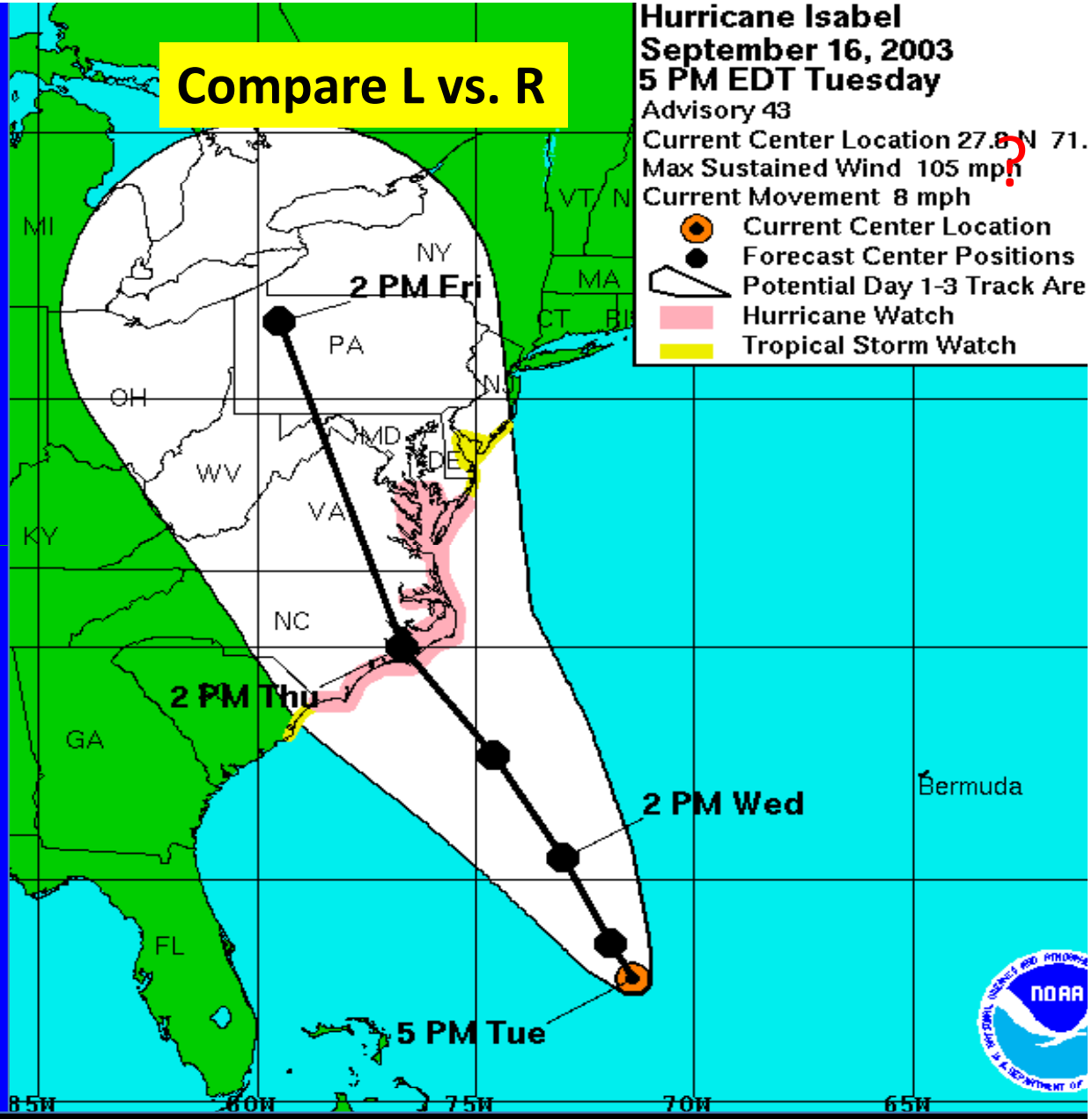
60-70% of the time the "eye" will be within the cone

Hurricane Zeta

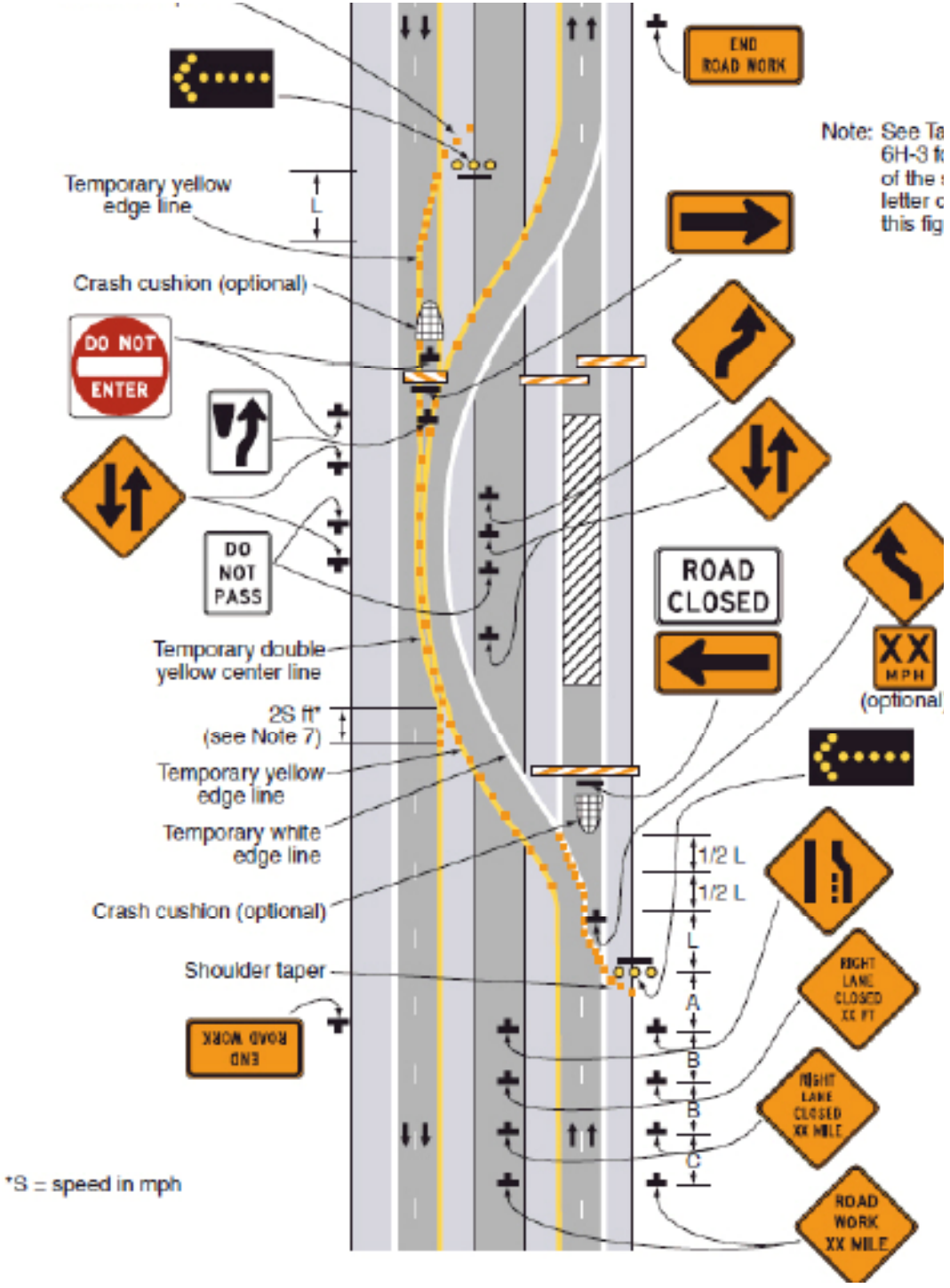
Cat 3:
Winds: 120

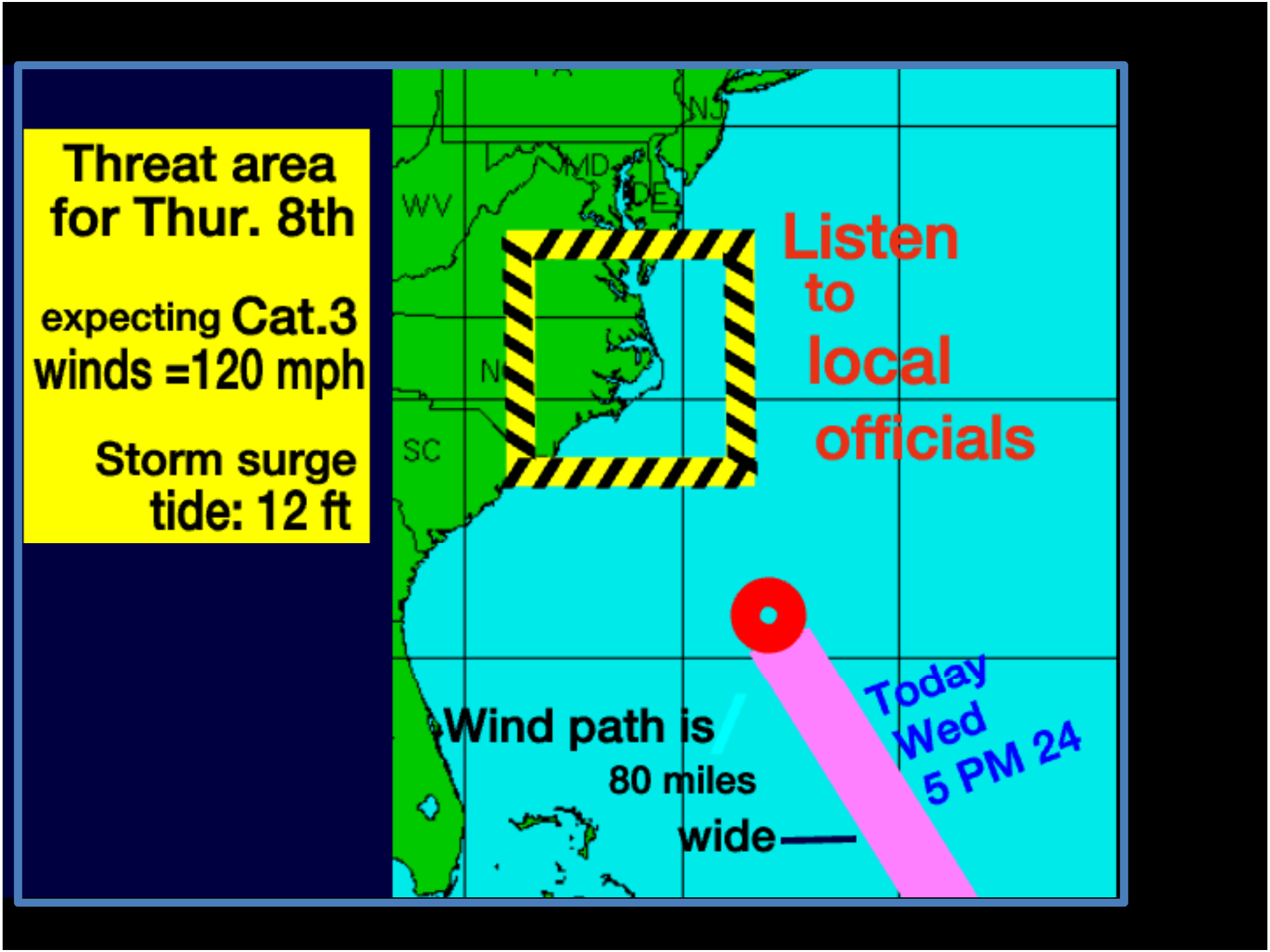
Major wind damage

Listen to local officials



Uncertainty "processing" at 50 mph!




Threat area
for Thur. 8th
expecting Cat.3
winds =120 mph
Storm surge
tide: 12 ft
NJ
MD
DE
WV
N
SC
Listen
to
local
officials
Wind path is
80 miles
wide
Today
Wed
5 PM 24

Keep it Simple & Relevant

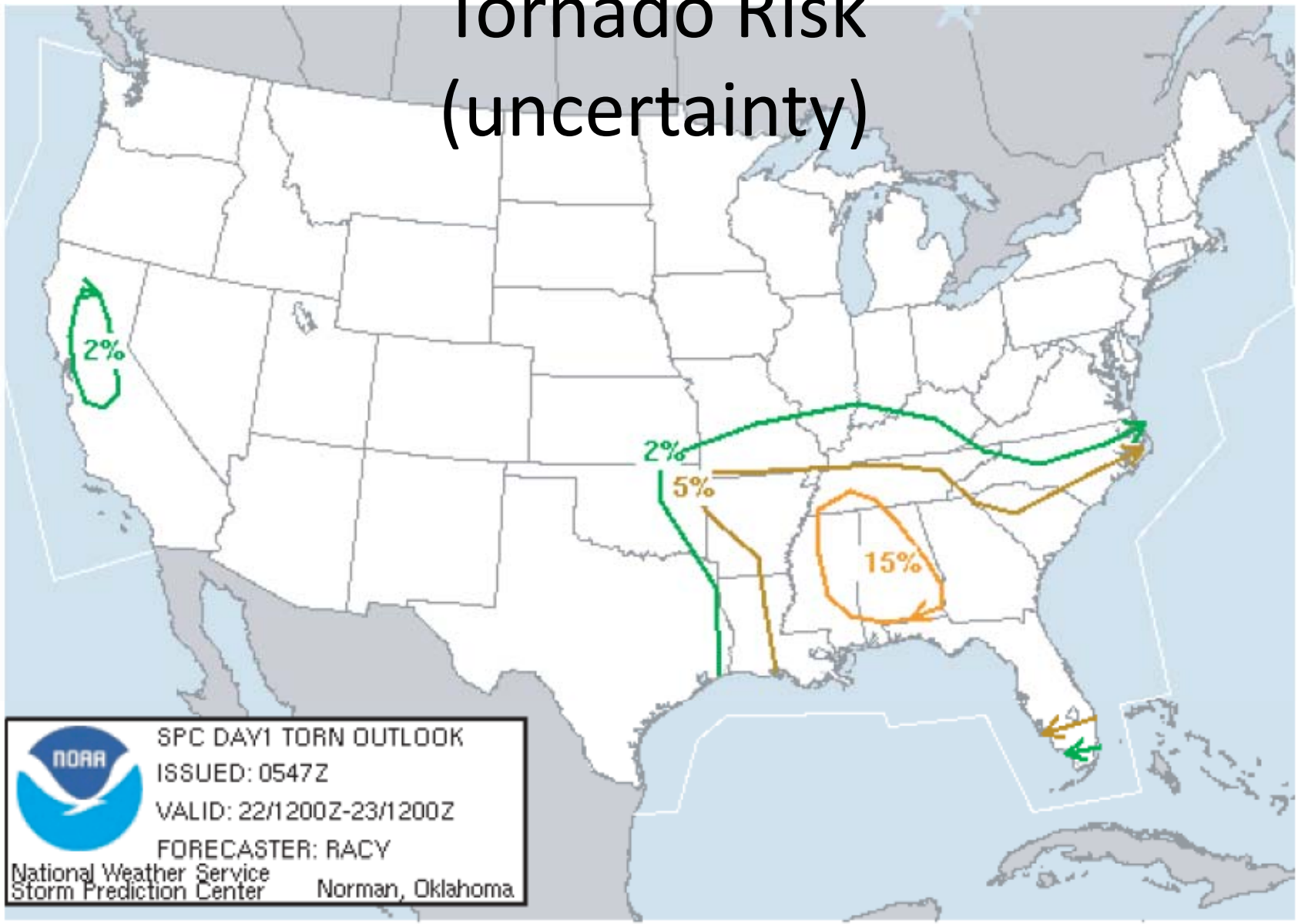
- 150 mph winds =

4” /hour rainfall=

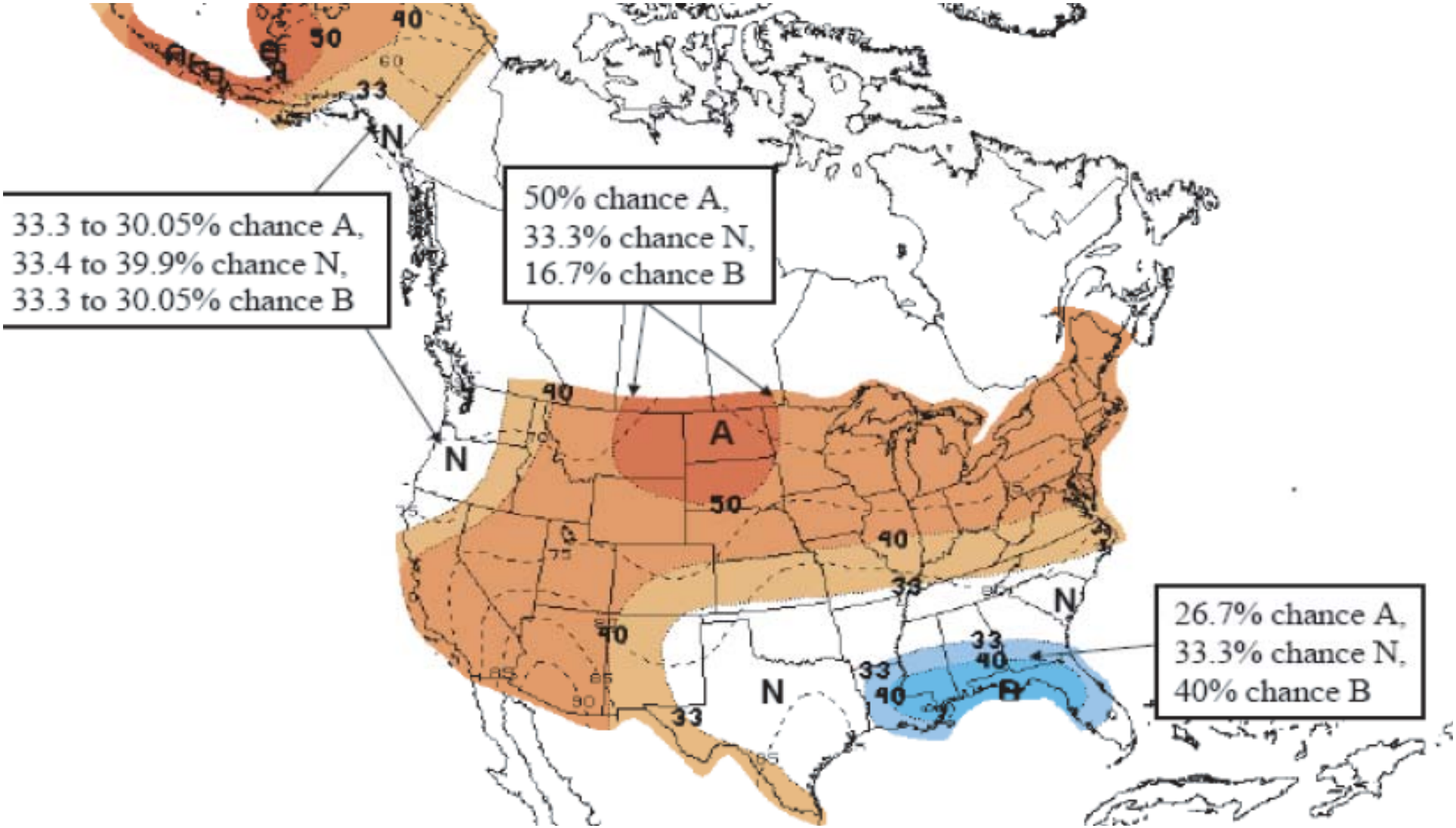
20’ waves=

TWC: Lyons

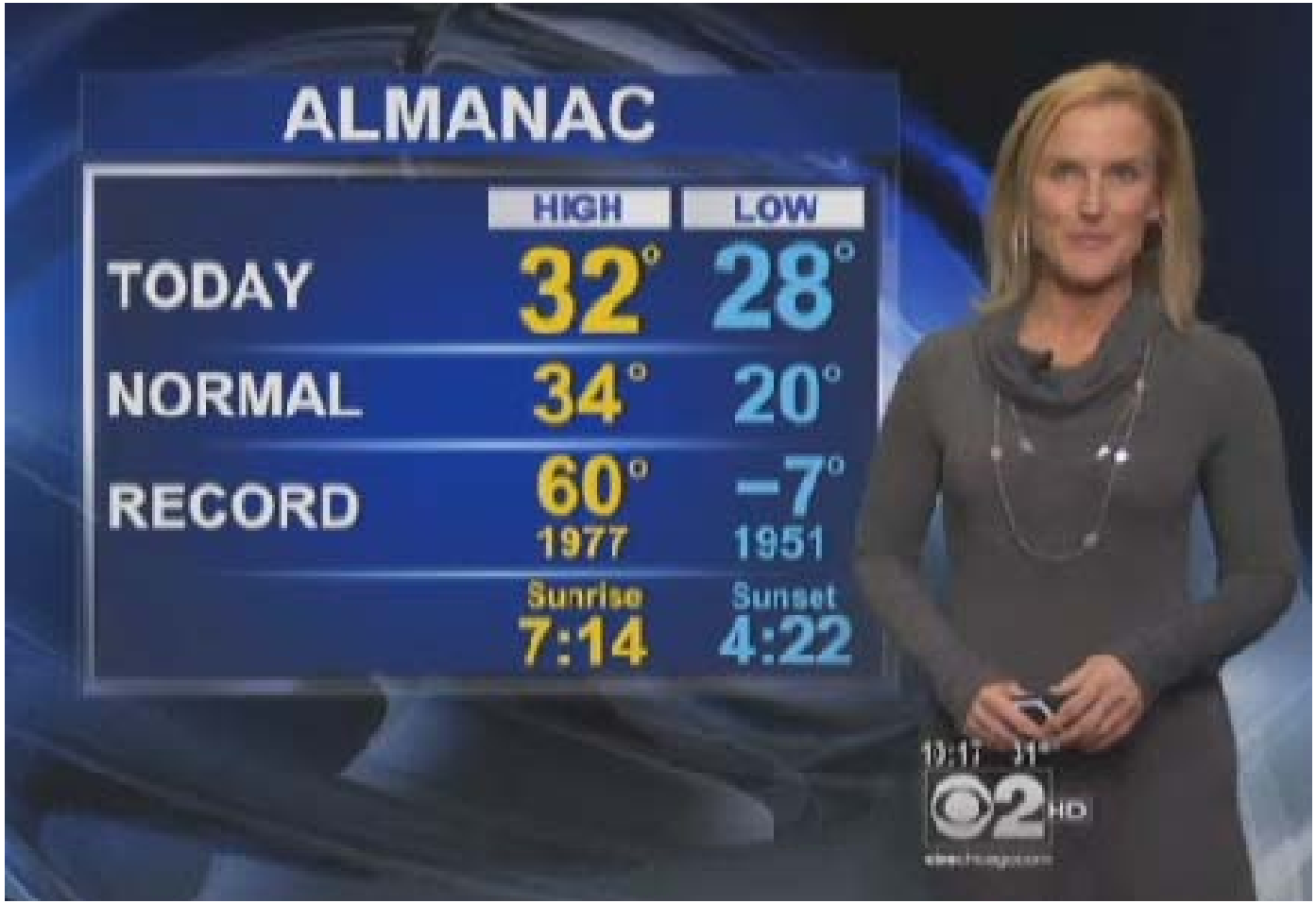
Tornado Risk (uncertainty)



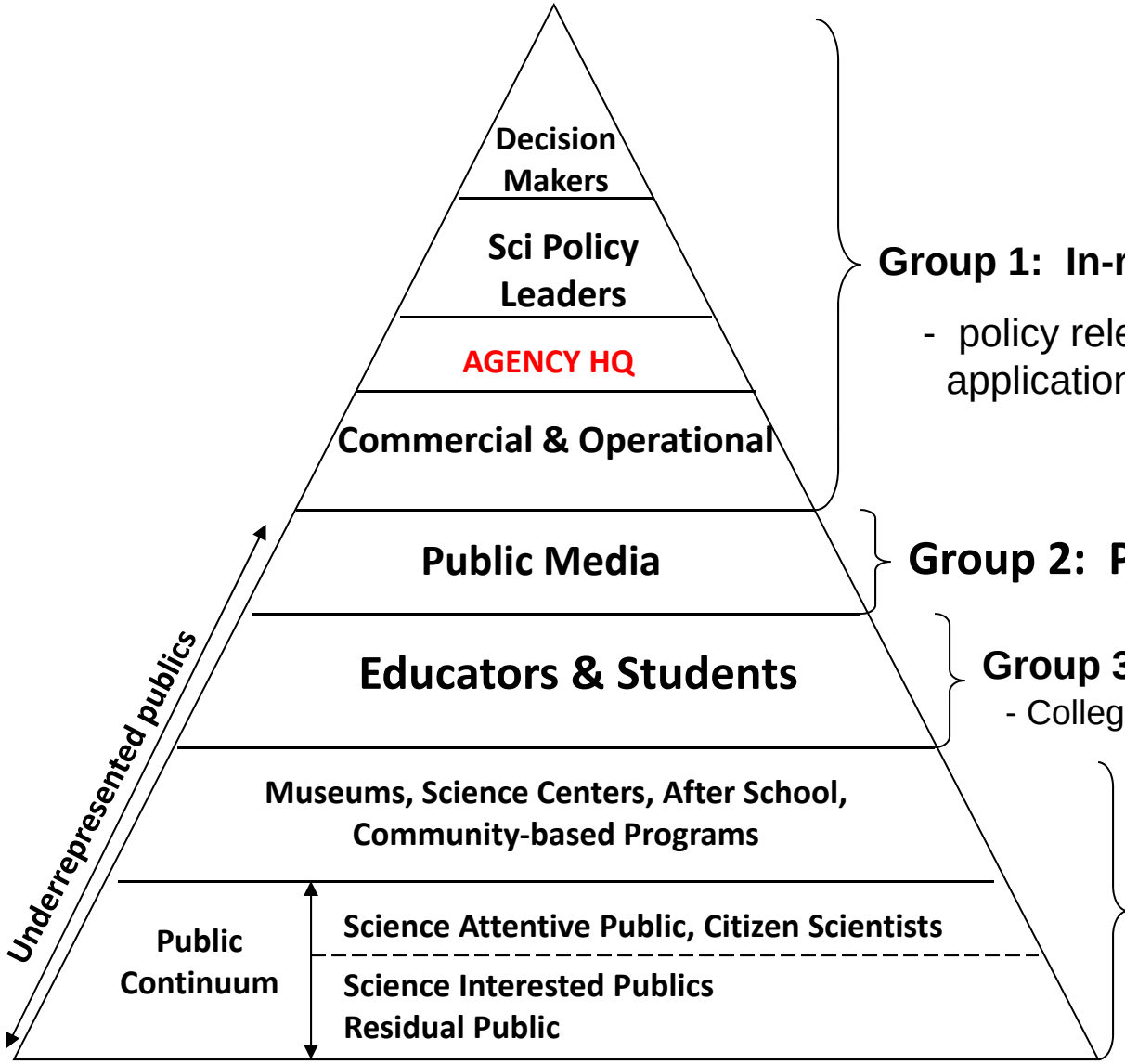
Climate Forecast: 1 month



Climate Every Day



1st Rule: KNOW YOUR AUDIENCEs



Group 1: In-reach / Outreach

- policy relevance &/or societal applications

Group 2: Public Media

Group 3: Formal Education

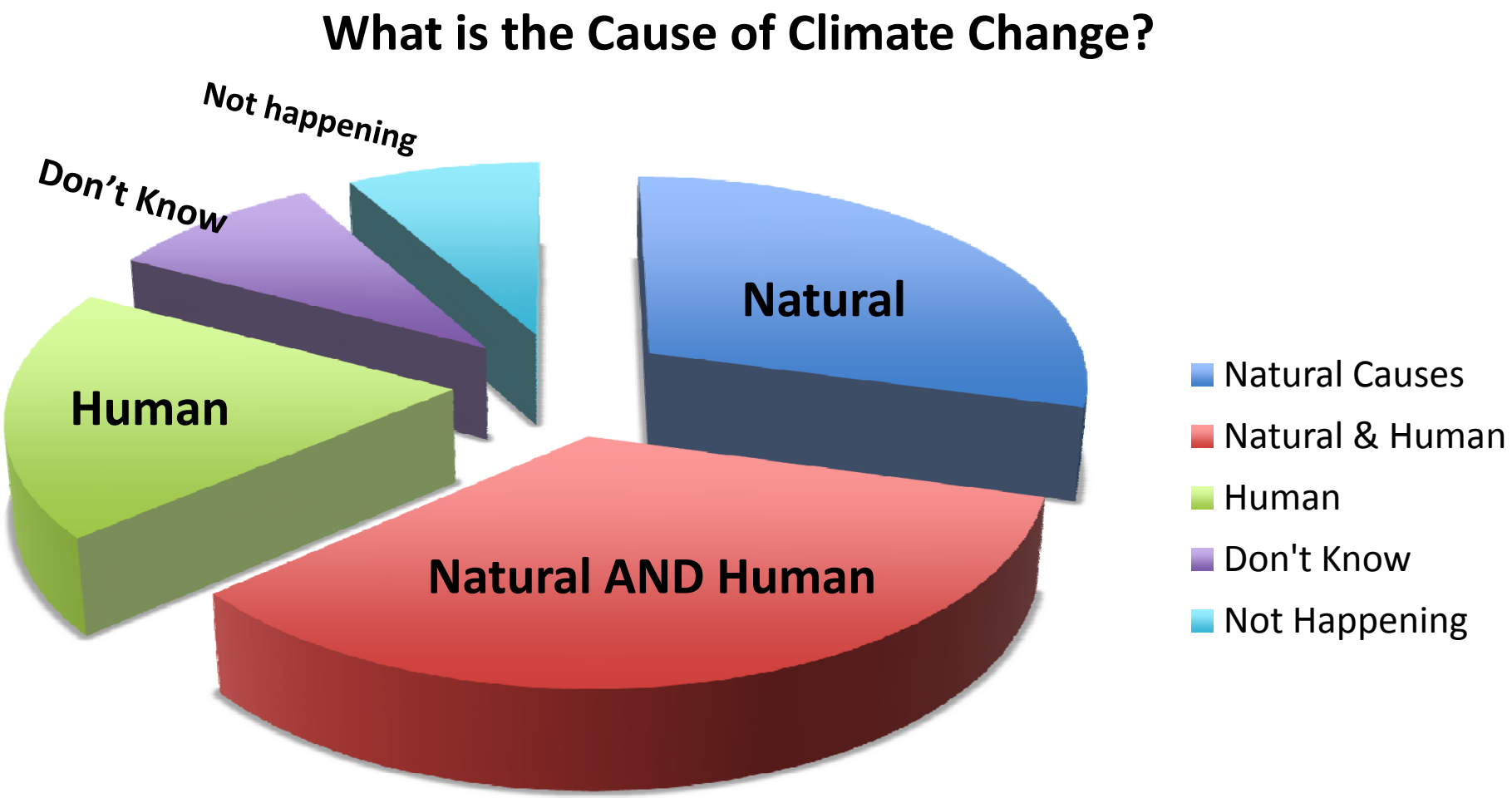
- Colleges, High Schools, K-12

Group 4: Informal Ed

- Museums
- Zoos
- Aquaria

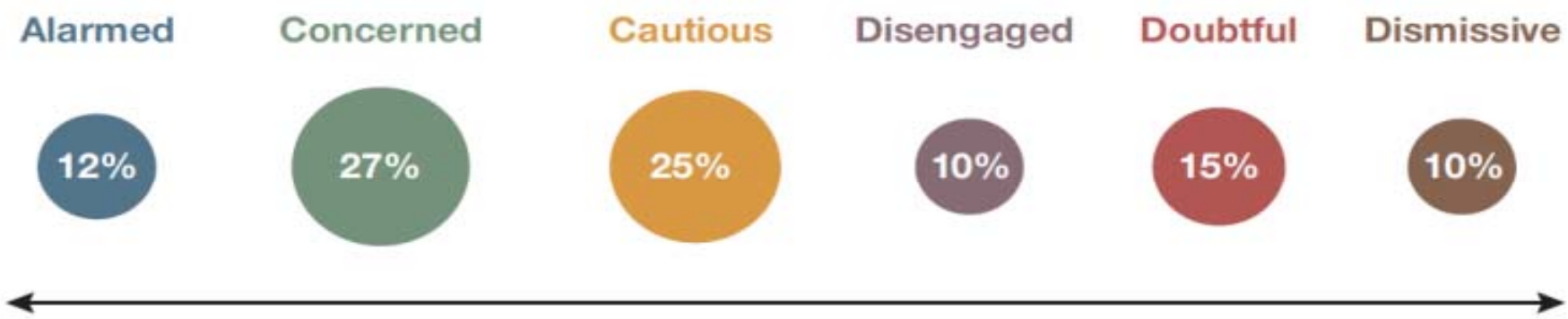
modified from D. Herring

5 categories of TV Meteorologists



GMU Survey Winter 2011

FIGURE 1 | Proportion of the U.S. Population in the Six Americas, May 2011



Proportion represented by area

Source: Yale/George Mason University

Uncertainties of Climate Beliefs (a few samples)

Concerned 27%: GW is real. Don't see personal threat.

Cautious 25%: Think that scientist disagree.

Disengaged 10%: (Apathetic) haven't thought about it.
Isn't it far in the future?

Doubtful 15%: Have actively thought about it.
How can humans cause it. Isn't it natural?

Uncertainties

1. **Is it Real? (happening now and here?)**
2. **Is it Bad?**
3. **Is it caused by Humans?**
4. **Do Scientists Agree?**
5. **What can we do?**

+ others

Susan Hassol: Climate science word “meanings”

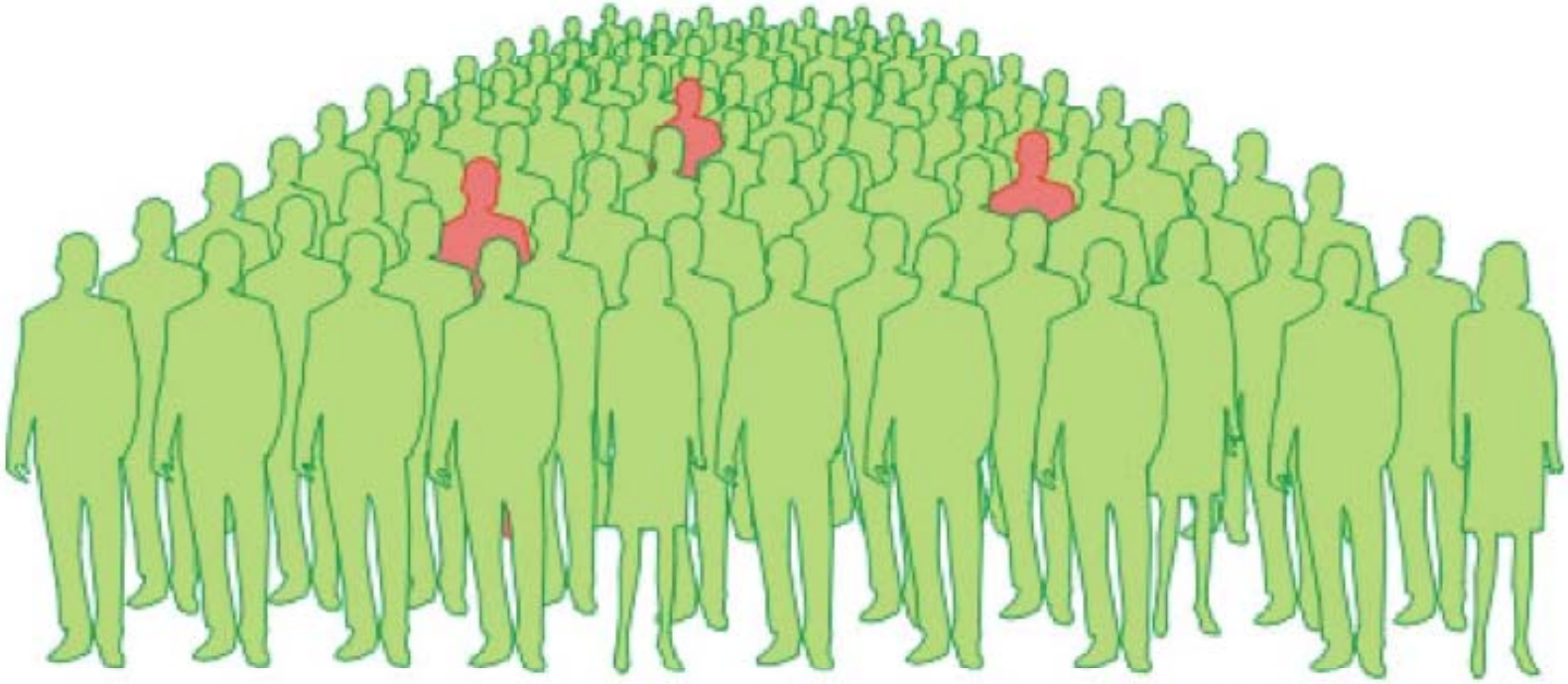
Terms that have different meanings for scientists and the public		
Scientific term	**Public meaning**	**Better choice**
enhance	improve	intensify, increase
aerosol	spray can	tiny atmospheric particle
positive trend	good trend	upward trend
positive feedback	good response, praise	vicious cycle, self-reinforcing cycle
theory	hunch, speculation	scientific understanding
uncertainty	ignorance	range
error	mistake, wrong, incorrect	difference from exact true number
bias	distortion, political motive	offset from an observation
sign	indication, astrological sign	plus or minus sign

How is climate different?
Climate vs. Weather

Man is tipping the odds* with CO2

Consensus of Climate Scientists

97 out of 100 climate experts think
humans are changing global temperature



Doran et al 2009, Anderegg et al 2010

- High resolution JPEG (1024 pixels wide)

Analogies: Medical 1

When you are sure about climate change, then tell me.

Dr.: ‘Well, I am very concerned about your heart condition. I think you should be on a low cholesterol diet and exercise.

Would anybody say to their doctor ‘If you can't tell me precisely when am I going to have the heart attack and how severe it will be.’ then why should I change my lifestyle?' -

Inspired by Stephen Schneider, Ph.D.

Insurance Companies & Risk

- “ When you are certain, come back and talk to us.'”

- That is not the way it works in any other form of life.
- Not in business. Not in health. Not in security.

- In climate we have pretty good ideas about what could happen. We do not have the detailed picture and we are not going to for several decades.
- What we are doing is taking a risk with the life support system of the earth and humans have to decide if we want to slow that down."

climatebites.org/

Extreme Weather:
“is a preview”

The science tells us that we will see more and more extreme weather as the earth warms. Think of today's extreme weather as a "sneak preview" of what lies ahead on our current path.

Recently, Kevin Trenberth, Jim Hansen and a number of other leading climate scientists have stopped saying the standard line

"Extreme weather has many causes, and there's no way to tell whether warming caused this event," and begun emphasizing instead that warming almost certainly contributed to the event

climatebites.org/

Extreme 2

Saying global warming isn't real because last winter was cold and snowy, is like saying that spring's not happening because Friday was cooler than Monday. You have to look at the longer trend.

We tend to overestimate the probably of events that are current or easy to remember

Computer Models

“Essentially, all models are wrong, but some are useful” — George E. P. Box

.

Climate scientists are NOT trying to make 'absolute' predictions; what scientists are really doing is trying to identify, within given probabilities, the outcomes that are likely to result in a variety of circumstances.

Quantifying uncertainties is important in all scientific research: without an estimate of confidence, a result cannot be placed in context, cannot be given meaning. But it is essential in climate science because climate is, by definition, the statistics of weather: and statistics is the science of uncertainty.

Family Safety 1

Would you put your grandkids on an airplane that 97% of aerospace engineers declared unsafe,
because you heard 3% say "no problem, it's perfectly sound?"

climatebites.org/

Schwarzenegger

"If 97 doctors say my son is ill and needs medication and two say, 'No, he doesn't, he is fine,' I will go with the ninety-seven. It's common sense - the same with global warming. We go with the majority, the large majority."

Schwarzenegger's original quote refers to 98% instead of 97% due to rounding. To be conservative, we corrected this to 97%.

climatebites.org/

Science is a jigsaw puzzle not a house of cards.

The evidence for human-caused climate change is not a house of cards that will collapse as soon as one piece is taken away. It's more like a mountain of pebbles: scrape a couple of pebbles off the top, but the mountain is still there.

Scientific knowledge accumulates bit by bit, over decades of laborious research. Gradually, the overall picture emerges. Even if you remove a few pieces, the overall picture doesn't change

climatebites.org/

Mother Nature is neither Republican nor Democrat.

Mother Nature is just chemistry, biology and physics.

That's all she is. You cannot sweet-talk her.
You cannot spin her.

Mother Nature is going to do whatever chemistry, biology and physics dictate”

"Mother Nature always bats last, and she always bats 1.000" — Rob Watson

climatebites.org/

CO2= steroids for the atmosphere

"Just as steroids make the baseball player stronger and increase his chances of hitting home runs, greenhouse gases are the steroids of the climate system, they increase the chances of record breaking heat to occur compared to record breaking cold."

—Dr. Gerald Meehl, UCAR

Overcoming Barriers:

Goal	Challenge		
	Easy	Difficult	Very Difficult
Earn **C**onfidence		☑	
Create **A**wareness	☑		
Deepen **U**nderstanding		☑	
Gain **S**atisfaction			☑
Motivate **E**nactment			☑

K. Rowan: CAUSE Model of Risk Communication

Political Beliefs and World Views

- People tend to push back when presented information that appears to challenge their predominant group (tribe) view.
- Birds of a feather flock together.
- The status of their group needs to be protected.

Certainties

1. It is Real! (happening now and here?)
2. It is Bad!
3. It is caused by Humans!
4. Scientists Agree!
5. We can do something!