



# Forecasting a Continuum of Environmental Threats (FACETs)

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The SEED is Germinating

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Satellite Science Week 2014

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Acting Deputy Director  
NSSL



# The SEED

- **NOAA's Office of Oceanic and Atmospheric Research (OAR) Special Early-Stage Experimental or Development (SEED) two-year funding.**
- **Goal: Develop means of converting forecast guidance (e.g., Warn-on-Forecast model output, satellite-derived forecast data, etc.) into operations-ready probabilistic hazard information (PHI).**

# DISCLAIMER!!!!

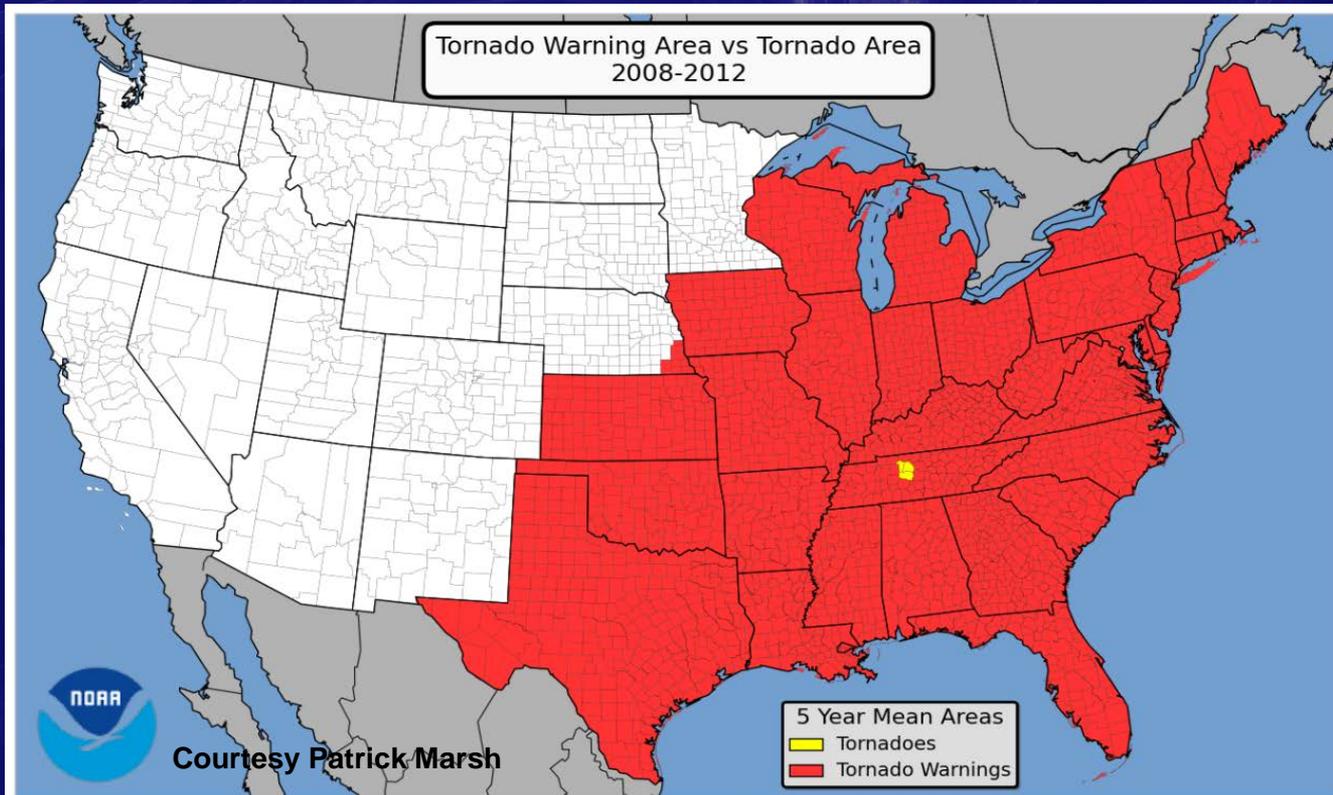
- The concepts presented herein are *under development and exploration* by the National Severe Storms Laboratory.
- They are NOT the accepted and adopted plans of the National Weather Service
  - *...although NWS is partnering in the exploration.*

# Current Watch/Warning System “Challenges”

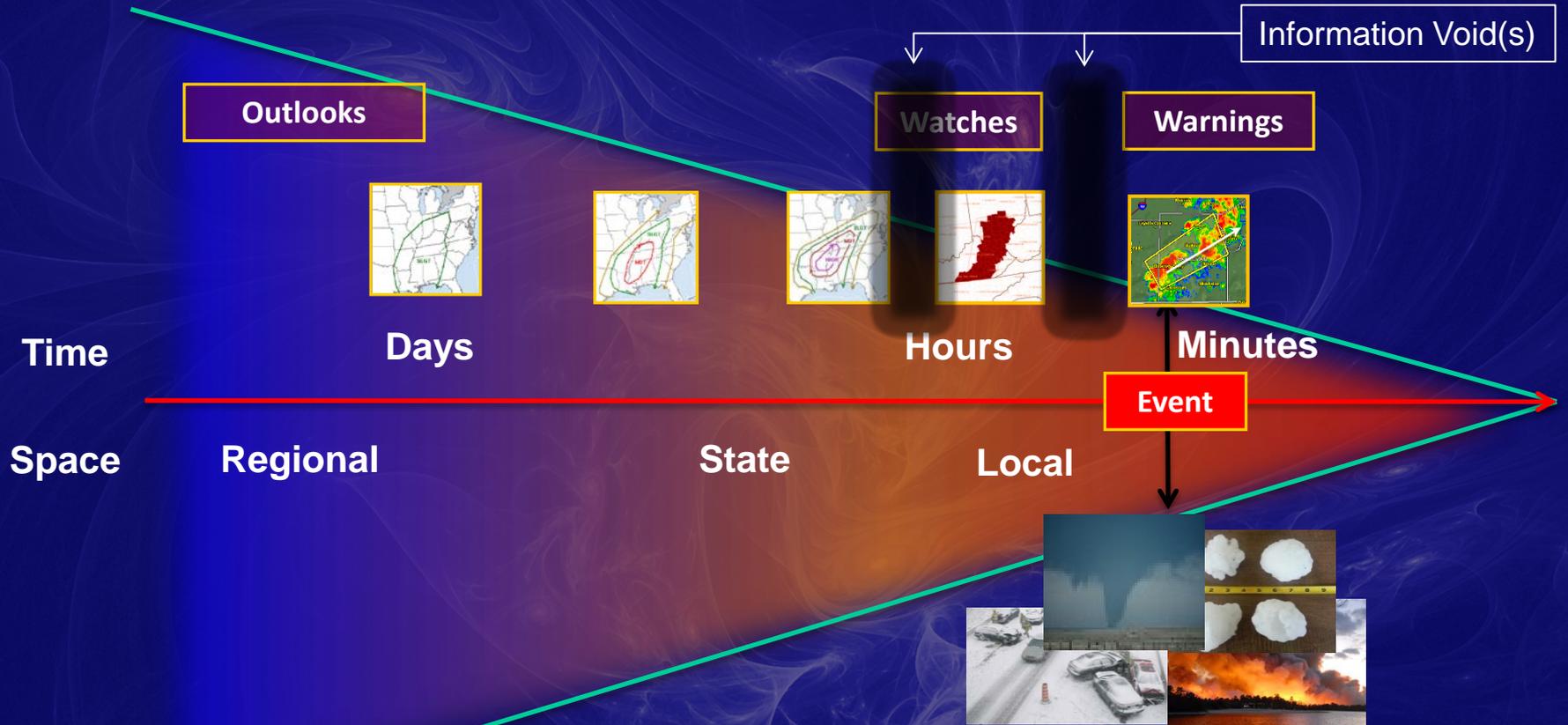
- Warning methodologies have changed little in over 40 years.
  - *Except for “bullet format” and “storm-based” issuance.*
- Society has changed....
  - *Technology*
  - *Science*
  - *Social diversity*
  - *Lifestyles*
  - *Vulnerability*

# Current Watch/Warning System “Challenges”

- Warning polygons are blunt instruments for communicating a dynamic, small-scale, multi-phenomenon threat.



# Current Watch/Warning System “Challenges”



- **Product-centric, deterministic (binary), and presumptuous.**
- **More information needed.**
- **More information available.**

Adapted from Dr. Heather Lazrus (NCAR)

# Seminal Question

## (Triggered by WRN)

- Should we continue addressing these challenges in an ad-hoc, piecemeal manner (i.e., tinker) ...

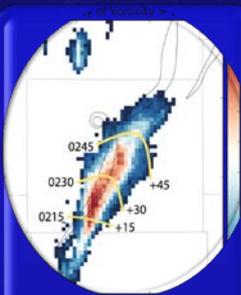
*...or develop a **new watch/warning paradigm** that addresses the challenges comprehensively (i.e., reinvent)?*

- Or, perhaps a little of both?

# Forecasting a Continuum of Environmental Threats



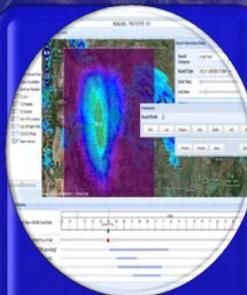
**Grid-Based Probabilistic Threats**



**Observations & Guidance**



**The Forecaster**



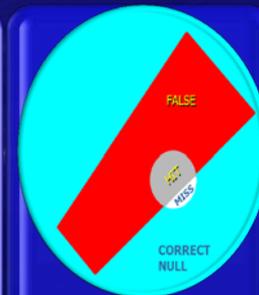
**Threat Grid Tools**



**Useful Output**



**Effective Response**



**Verification Methods**

**Follows the flow of "The Warning Process"**



# Facet #1: Grid-Based Probabilistic Threats

- The method or “nature” of watches and warnings.
  - *Now: Deterministic (binary), “all-caps” text-based messages created from polygons.*
  - *FACETs: Grid-based, probabilistic threats.*



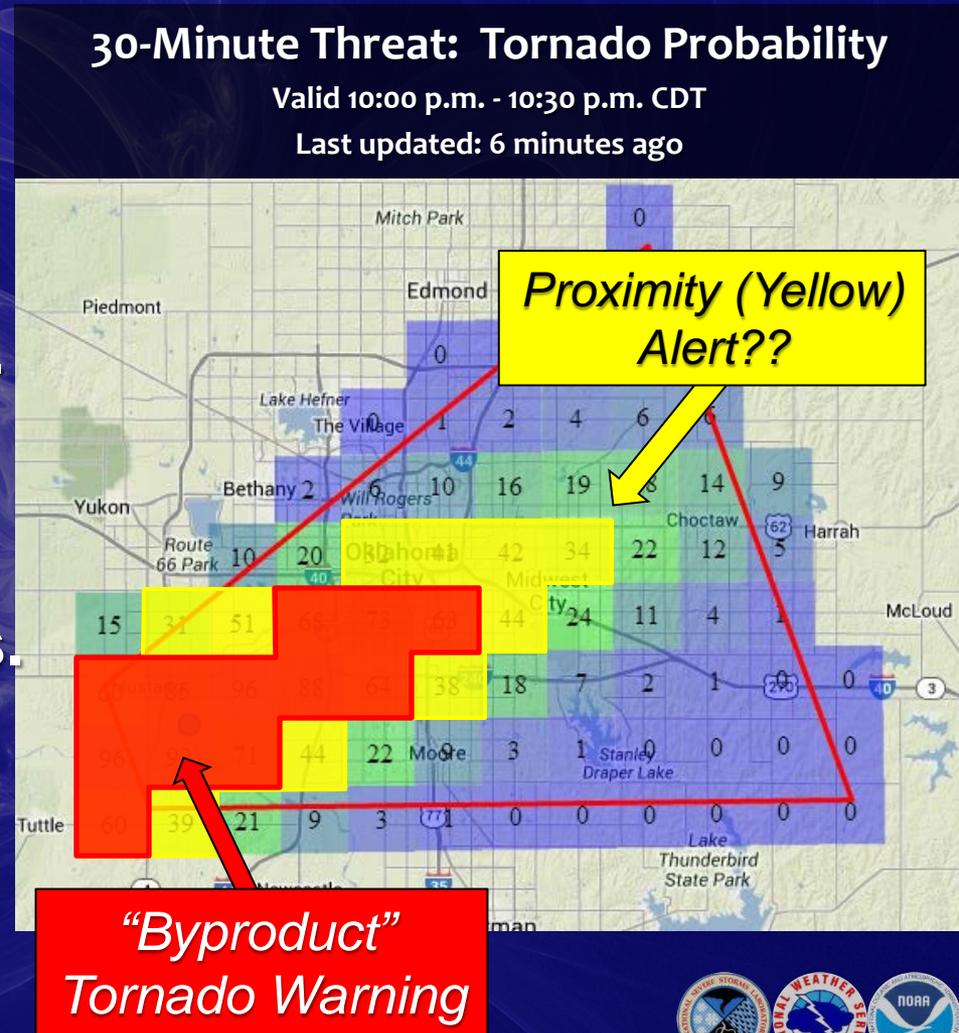
Grid-Based  
Probabilistic  
Threats

1



# Facet #1: Grid-Based Probabilistic Threats

- Legacy products (watches/warnings) result from pre-determined thresholds.
- Enables new products and messages.
- Not only severe storms.
  - Winter storms, fire weather, flooding, etc.



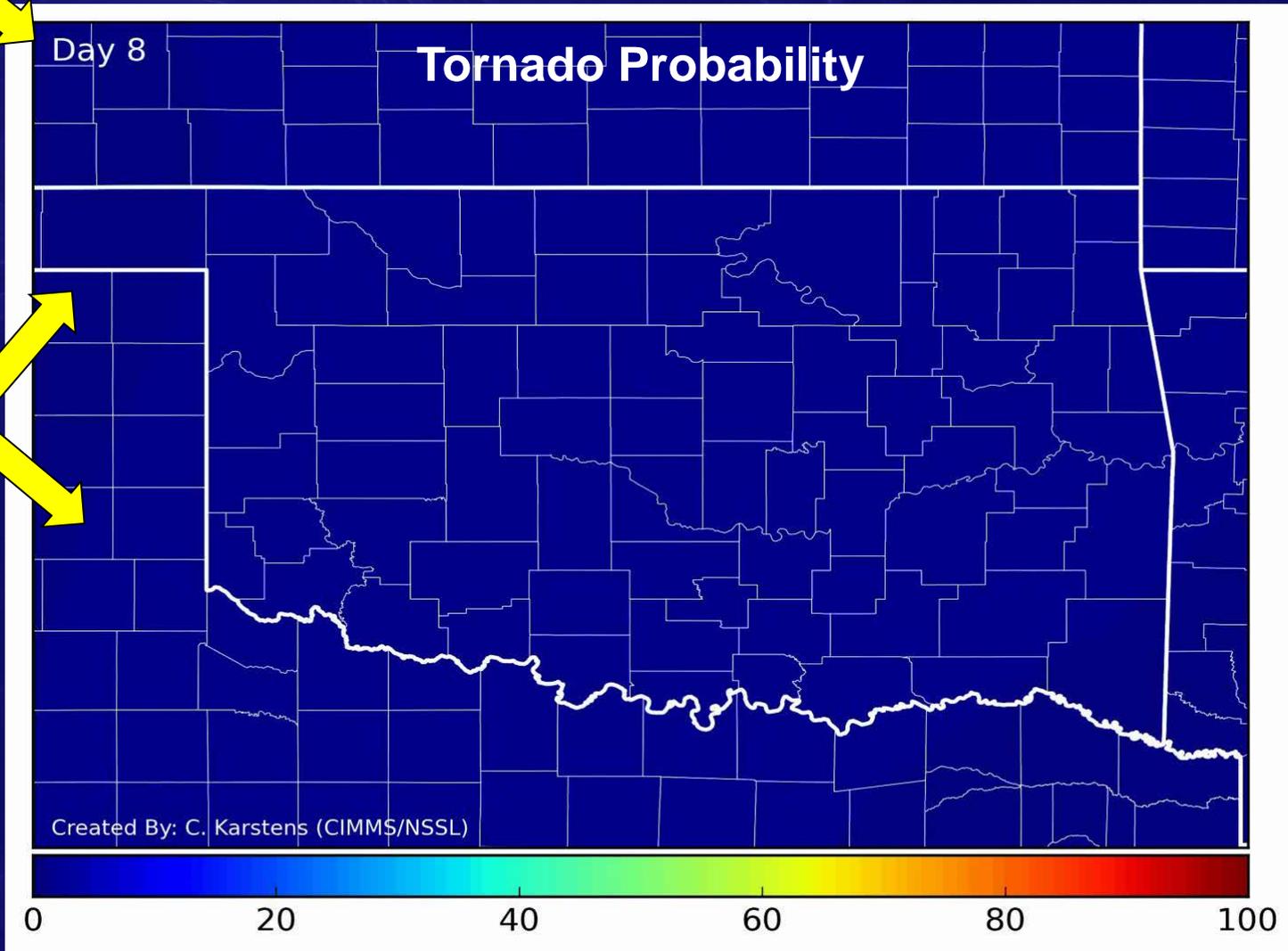
# The PHI Continua

Days to Seconds

Temporal

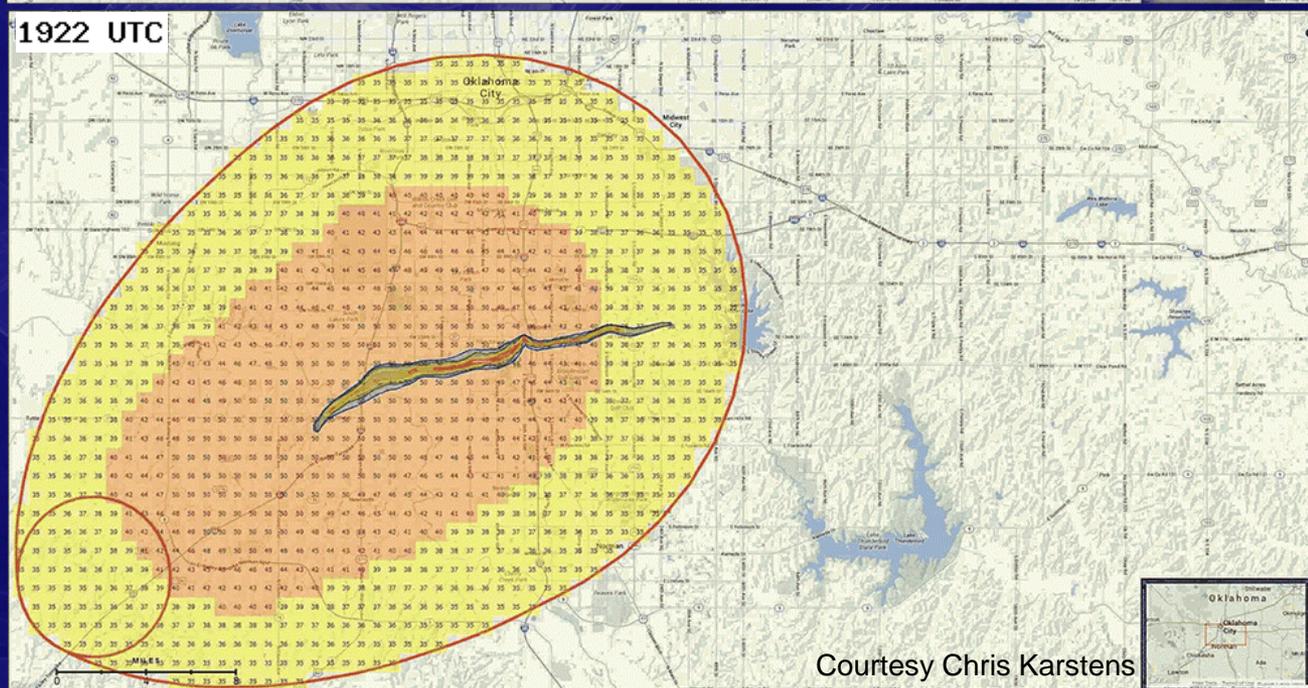
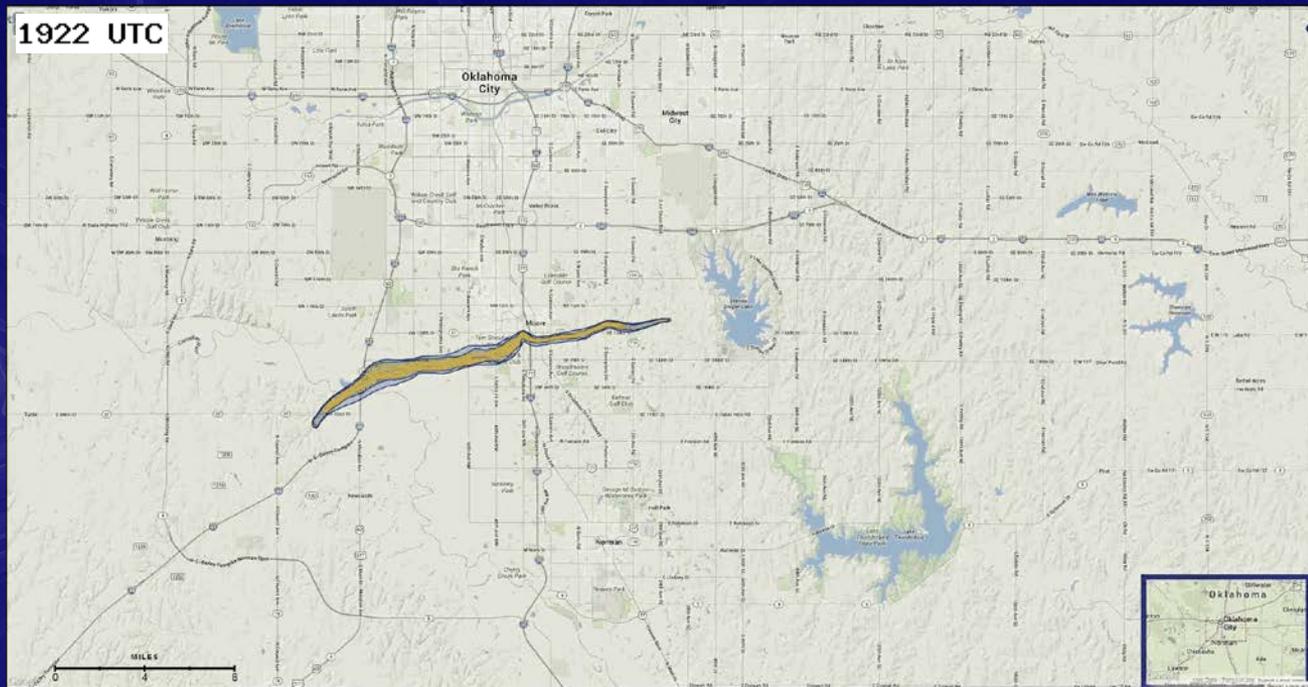


Spatial



# FACETs PHI\* Comparison: Newcastle/Moore Tornado

- Don't think “product-centric, deterministic warnings.”
- Think “continuous flow of relevant, actionable information.”



\*Probabilistic Hazard  
Information

Courtesy Chris Karstens

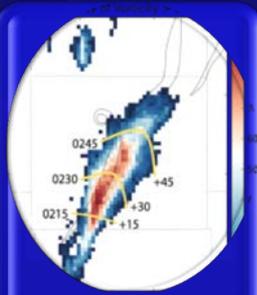
# Facet #2: Obs & Guidance

- What forecasters use to make decisions.
  - *Radar, satellites, models, observations, other forecasters, etc.*



Grid-Based  
Probabilistic  
Threats

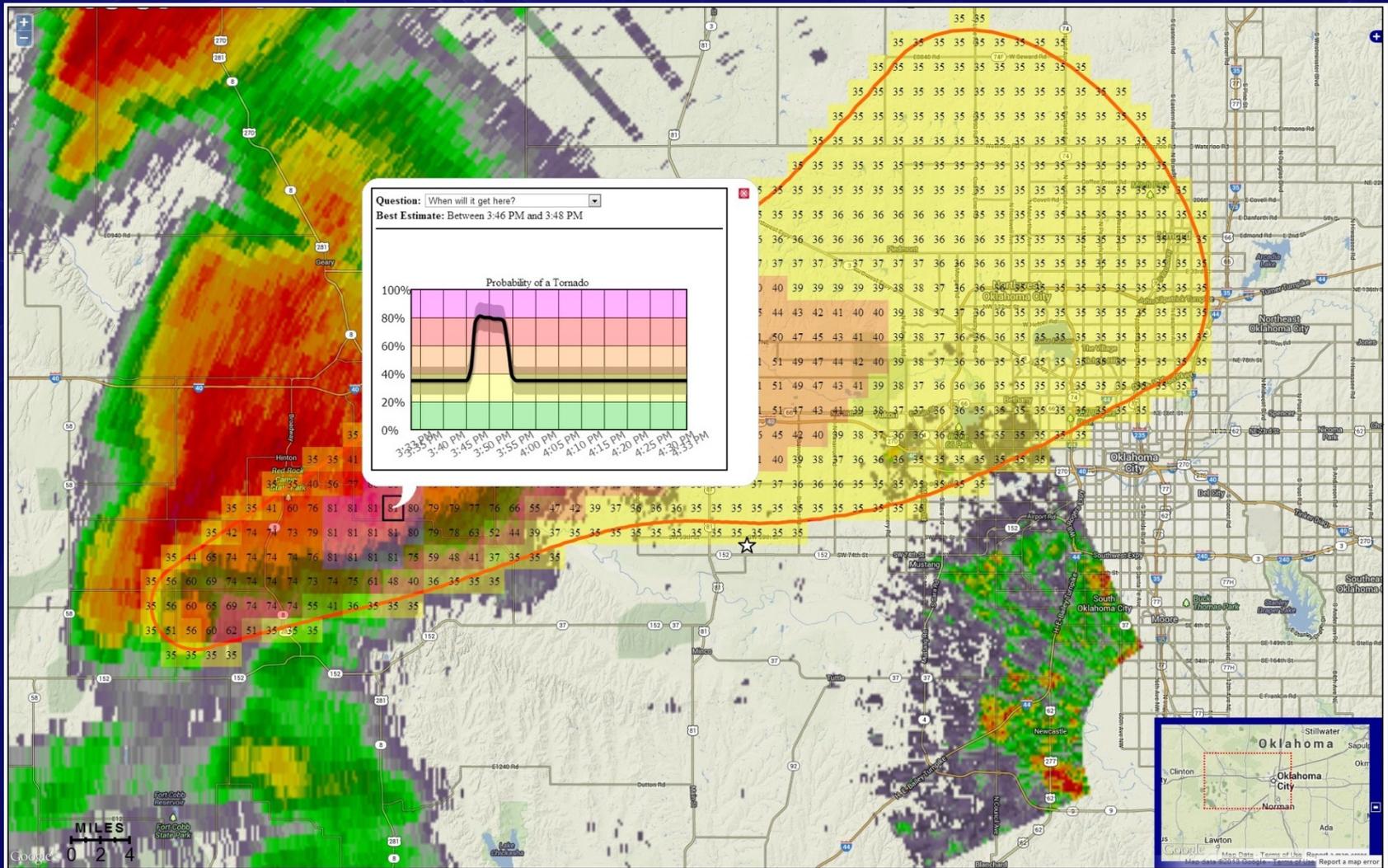
1



Observations  
& Guidance

2

# MPAR + WoF + FACETS



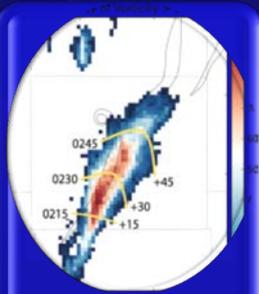
# Facet #3: The Forecaster

- The person making the watch/warning decisions.
  - *Knowledge, skills and abilities.*
  - *The human brain (wetware).*



**Grid-Based  
Probabilistic  
Threats**

**1**



**Observations  
& Guidance**

**2**



**The  
Forecaster**

**3**

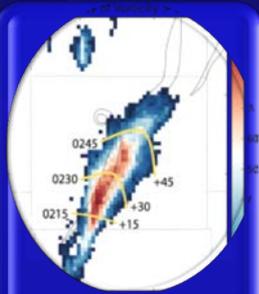
# Facet #4: Threat Grid Tools

- What forecasters use to create the hazard information.
  - *Hardware & software.*



Grid-Based  
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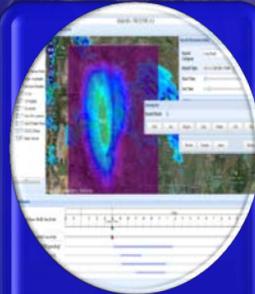
Observations  
& Guidance

2



The  
Forecaster

3



Threat Grid  
Tools

4

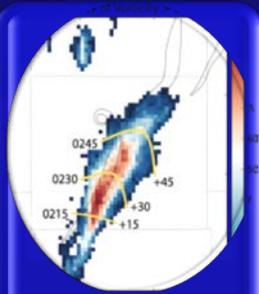
# Facet #5: Useful Output

- What the end user sees and hears.
  - *Graphical, textual, auditory.*



Grid-Based  
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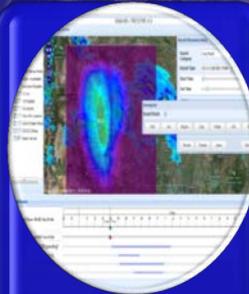
Observations  
& Guidance

2



The  
Forecaster

3



Threat Grid  
Tools

4



Useful  
Output

5

# Location-Derived Information

TOA: 3:18 – 3:21 PM      3:22:45

TOD: 3:27 – 3:36 PM      3:25:23

Max Probability: 92%      100%

## Moore Medical Center



20:15      20:20      20:25      20:30      20:35      20:40

Time (UTC)



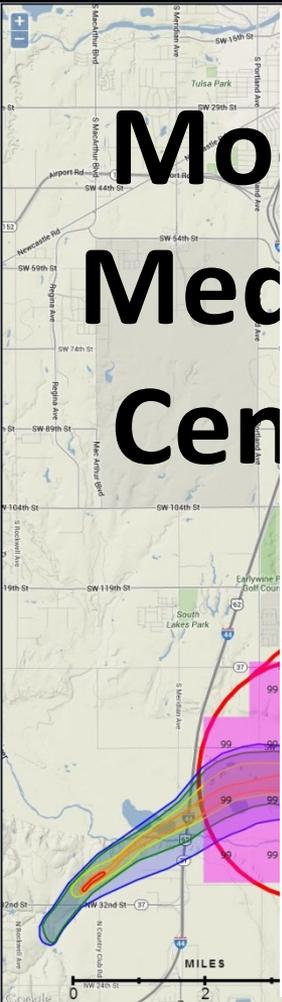
Expanded Threat Duration



Inner Threat Duration



Estimated Tornado Duration



8 UTC



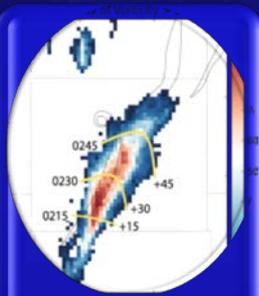
# Facet #6: Effective Response

- What the end user does.
  - *The science/human interface.*
  - *Where social/behavioral sciences pay off.*
  - *Determined by preceding facets, though.*



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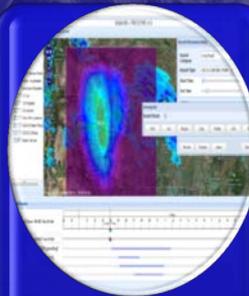
Observations  
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The  
Forecaster

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Threat Grid  
Tools

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Useful  
Output

5



Effective  
Response

6

# Integrated Social, Behavioral & Physical Sciences

## Physical Sciences

Sociology

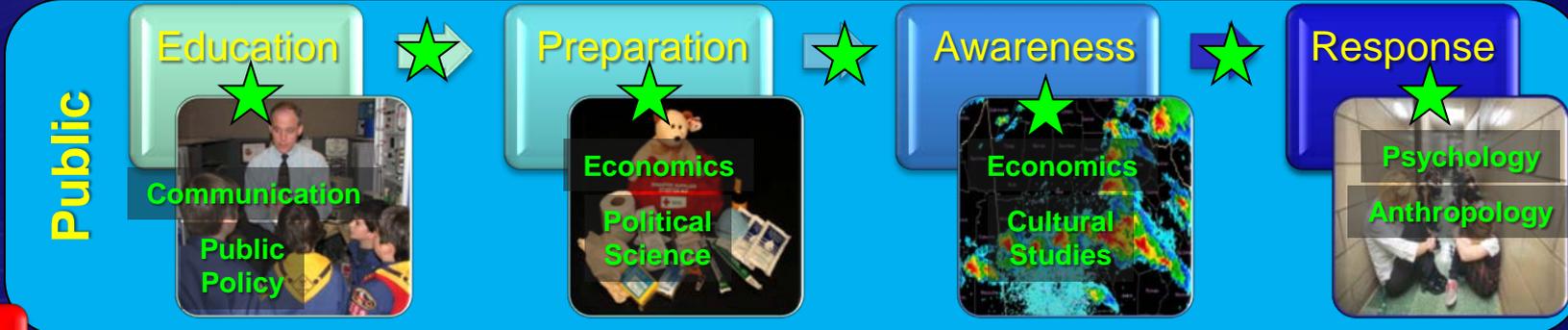
Psychology

Economics

Anthropology

Sociology

Law



The Impact



Human Geography

Cultural Studies

## The FACETs Epoxy: Integrated Social, Behavioral and Physical Sciences

Linguistics



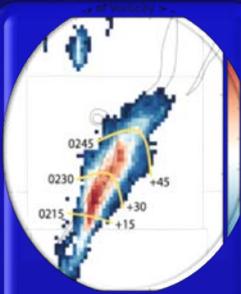
# Facet #7: Verification

- Evaluating system effectiveness.
  - *Measuring more than just forecast skill...*
  - *...measure the response, too!*



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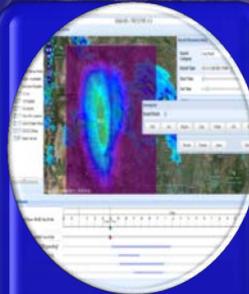
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Threat Grid  
Tools

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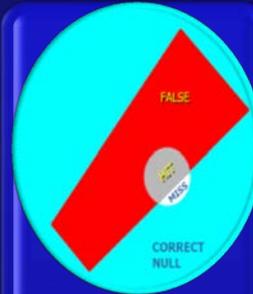
Useful  
Output

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Effective  
Response

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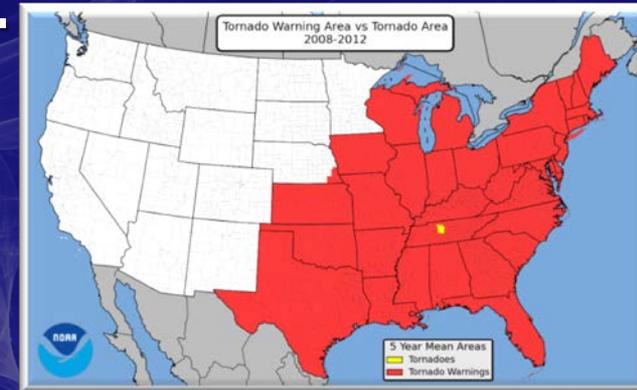
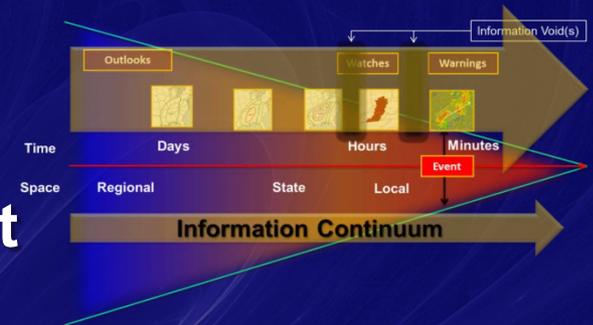


Verification  
Methods

7

# Expected FACETs Benefits

1. A fully-integrated information continuum of threat forecasts (days to seconds);
2. “False Alarm Area” reduced by at least 30%;
3. New private sector opportunities.
4. More useful, actionable, and recipient-specific information.
5. And more!!



# In Summary...

- FACETs is...
  - ... *a new, all-hazard watch/warning paradigm (grid-based, probabilistic threats) redesigned with social/behavioral science infused;*
  - ... *a framework intended to organize and guide reinvention efforts;*
  - ... *under development and awaiting your input, suggestions, concerns and **collaboration!***

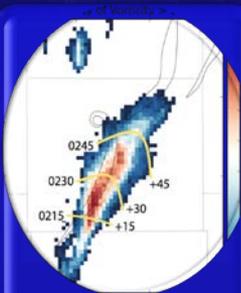


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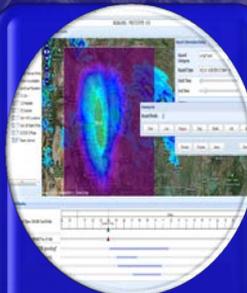
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**The  
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