Findings from the 2014 Hazardous Weather Testbed Probabilistic Hazard Information Experiment

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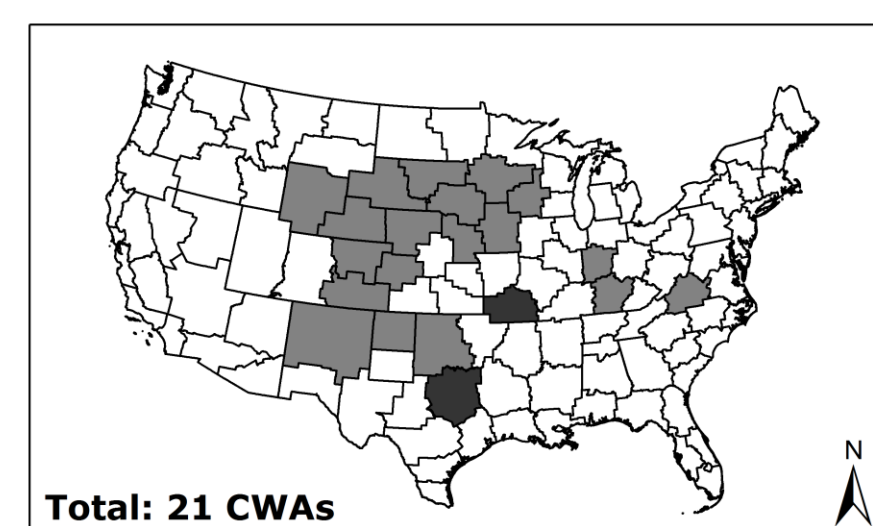[1]Cooperative Institute for Mesoscale Meteorological Studies, Norman, OK; [2]NOAA/OAR/National Severe Storms Laboratory, Norman, OK; [3]NOAA/NWS/Meteorological Development Laboratory, Silver Spring, MD; [4]University of Akron, Akron, OH; [5]University of Oklahoma, Norman, OK; [6]NOAA/NWS/Storm Prediction Center, Norman, OK
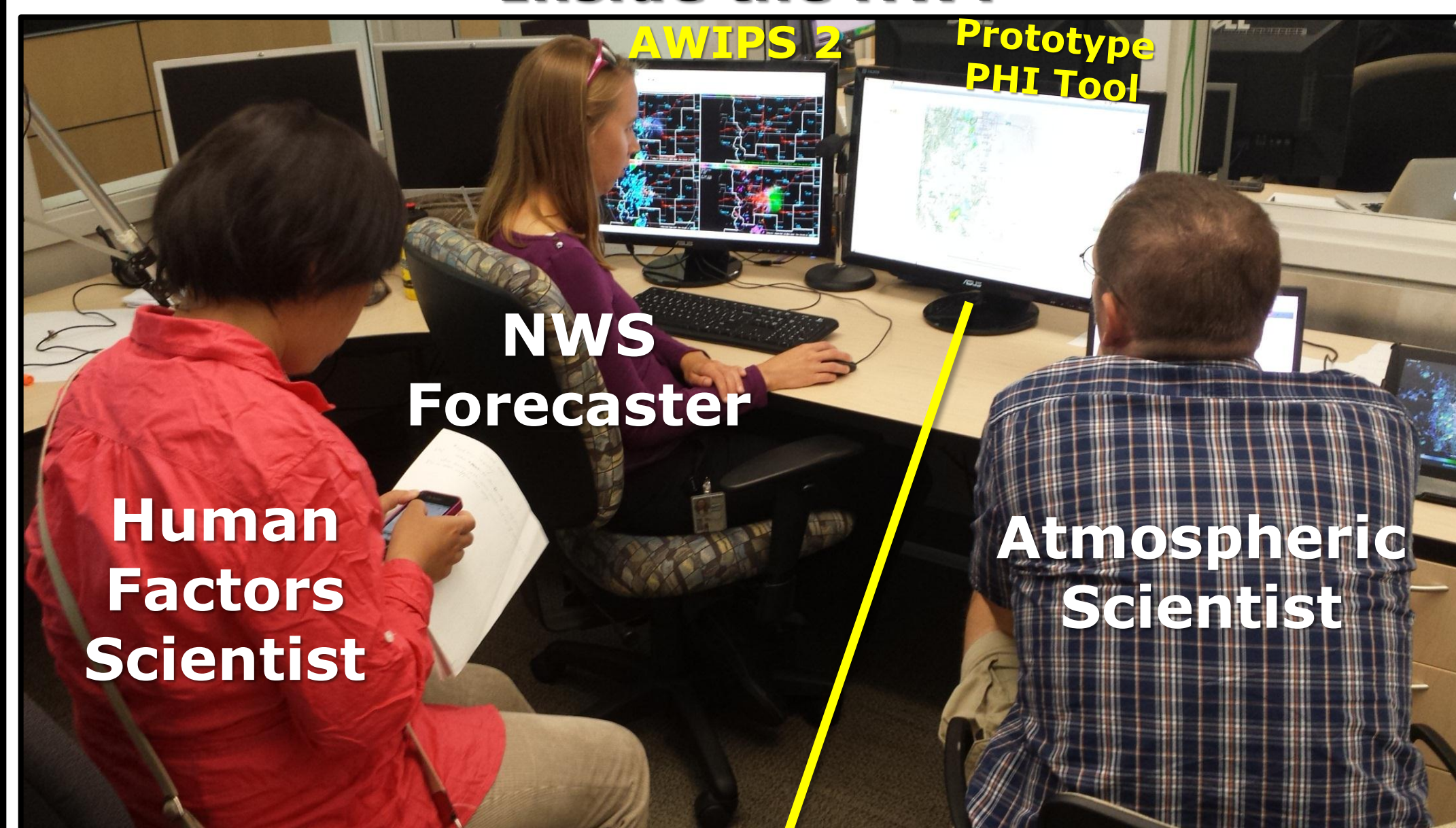
Experiment Setup

- **3 Week Alternation**
  - 5 - 9 May
  - 19 - 23 May
  - 2 - 6 June
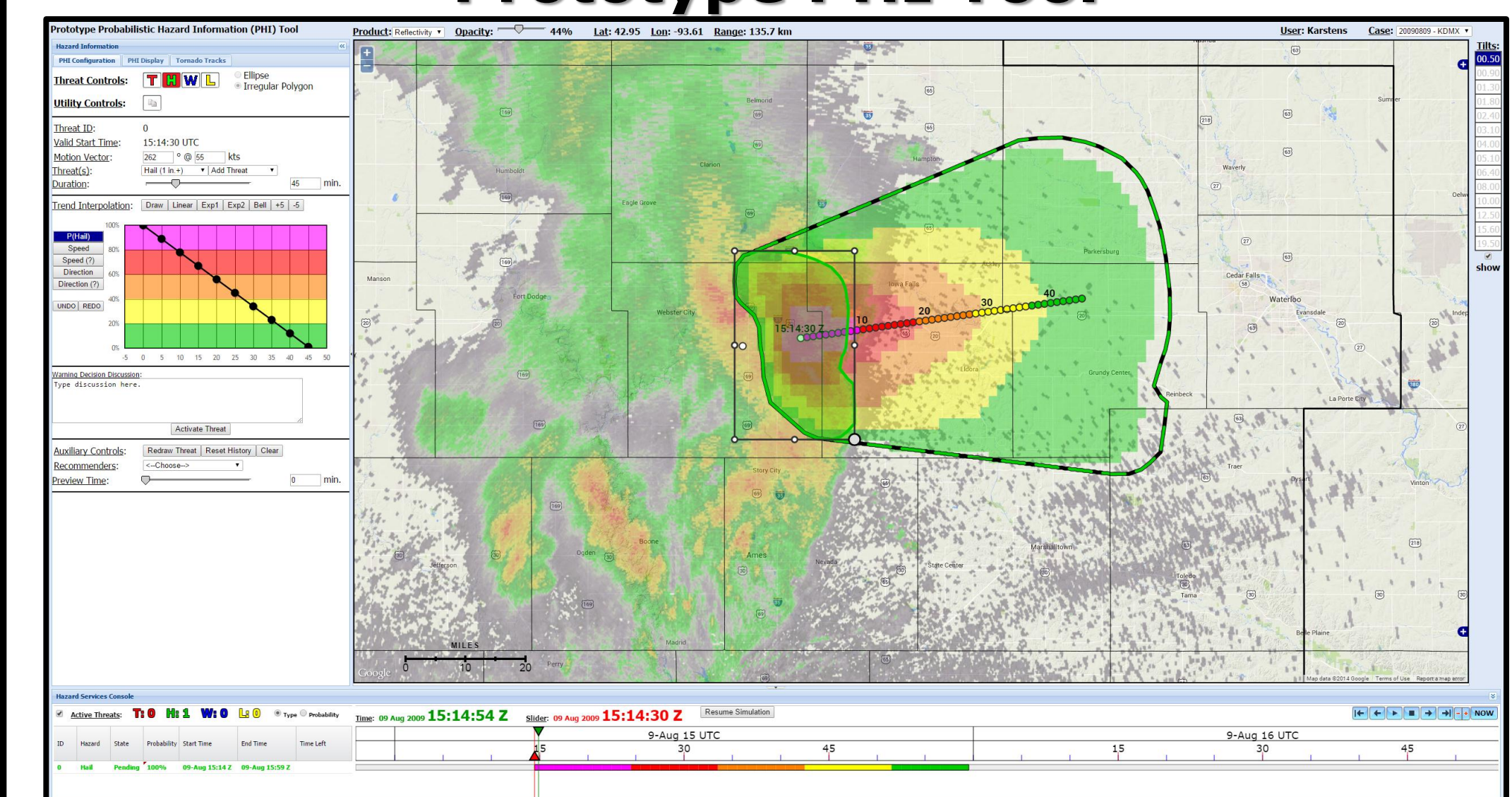- **2 Forecasters / week**
  - 6 total
  - Represented 4 NWS regions

Total: 21 CWAs

Inside the HWT

NWS Forecaster

Human Factors Scientist

Atmospheric Scientist
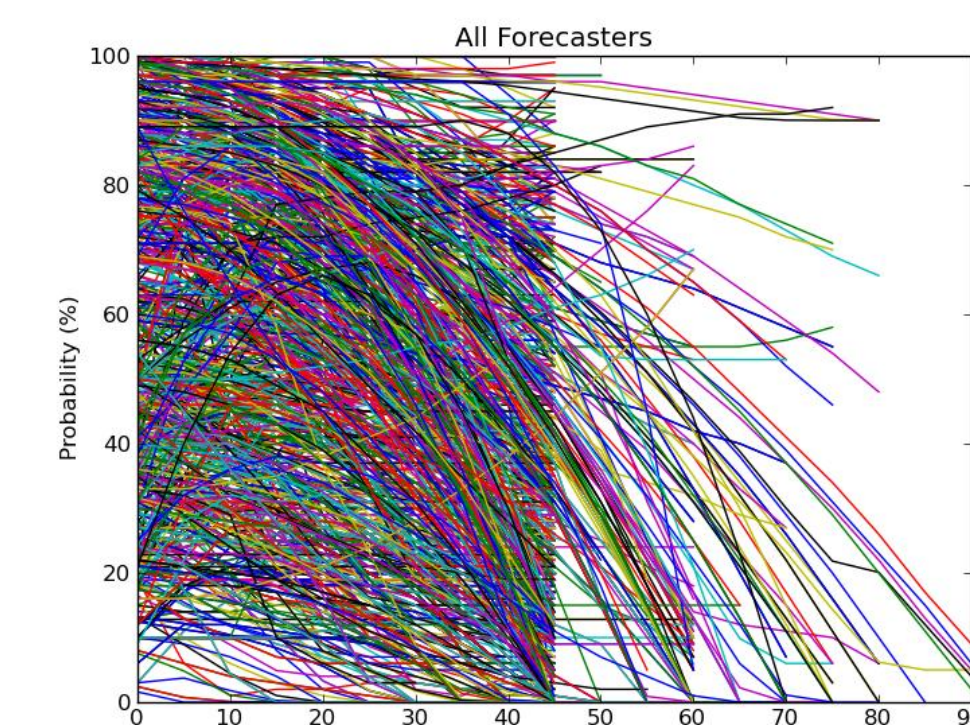
Prototype PHI Tool

- Interactive Geospatial Web Application
  - OpenLayers, JSTS, ExtJS, JQPlot, and Kinetic javascript libraries
  - Real-time and displaced real-time events
- Layout Mimics Hazard Services & AWIPS 2
- Generates Feature-Following Objects (geospatial and serializable)
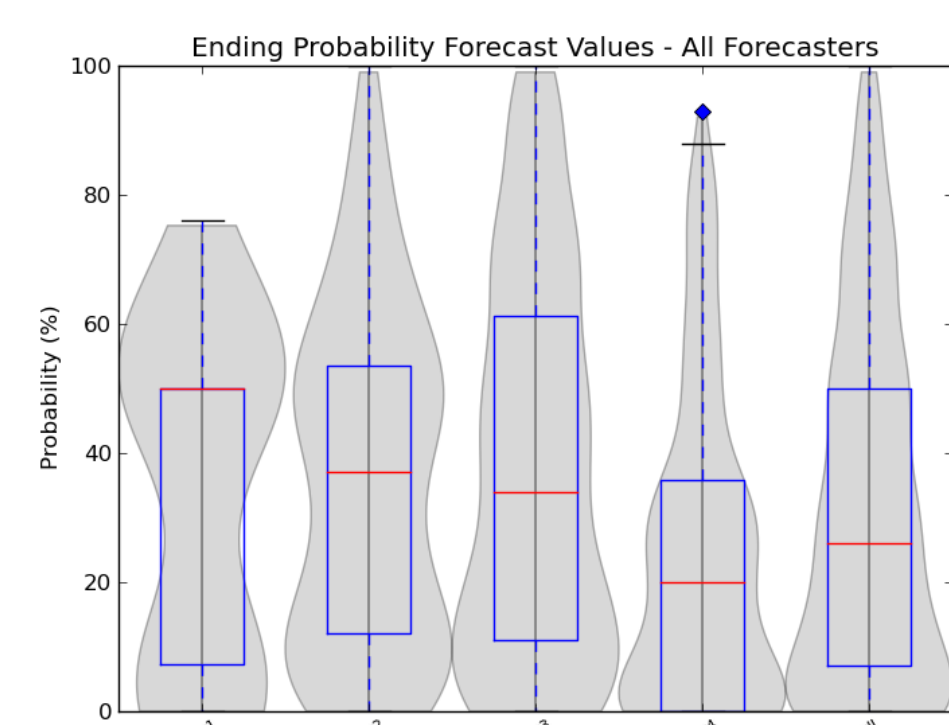- Probabilistic grids viewable in AWIPS 2

Weekly Schedule

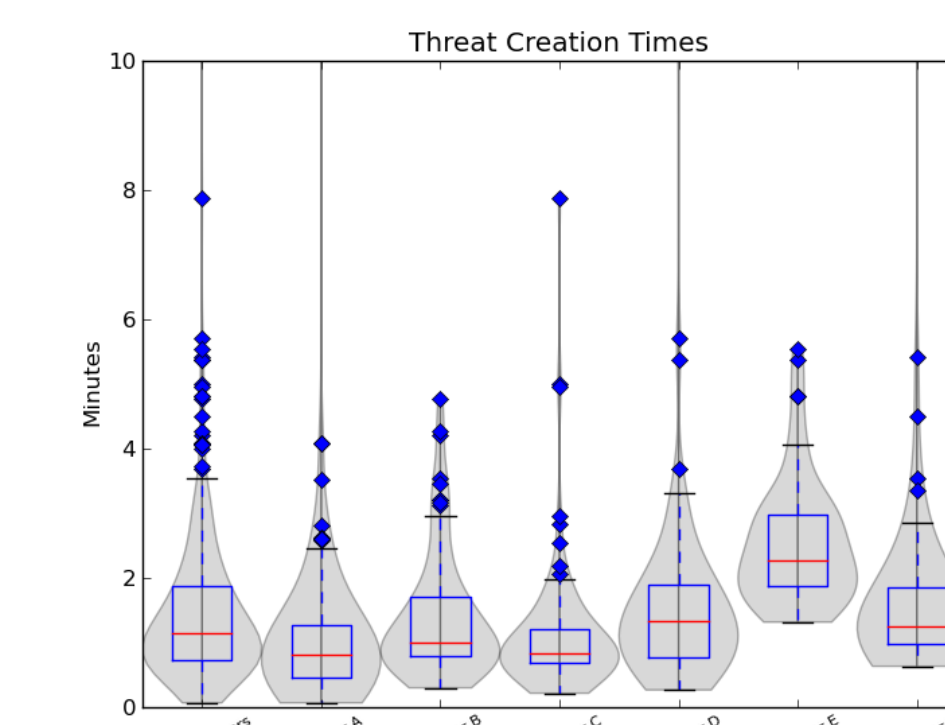|	Monday	Tuesday	Wednesday	Thursday	Friday
9:00	Introductions FACETs Conv. NWC Tour				End-of-Week Interview
10:00	PHI Disc. Expectations				End-of-Week Interview
11:00	Working Lunch				Lunch
12:00					
13:00	EFP Map Disc.			EFP Map Disc.	
14:00	Intro to PHI Tool Q/A	Controlled Exp. Control Case AWIPS 2 & WarnGEN	Controlled Exp. Test Case AWIPS 2 & Prototype PHI Tool		Intensive Operating Period Real-time
15:00		Case Interview	Case Interview		
16:00	Build AWIPS 2 Procedures	EFP Briefing	EFP Briefing	EFP Briefing	
17:00		Relaxed Operating Period Real-time	Relaxed Operating Period Real-time	Intensive Operating Period Real-time	
18:00					
19:00		Relaxed Operating Period Real-time	Relaxed Operating Period Real-time	Intensive Operating Period Real-time	
20:00		Survey / Disc.	Survey / Disc.	Survey / Disc.	
21:00					

Prototype PHI Tool Usage

Probability Trends
- Forecasters used default duration of **45 minutes** 75% of the time
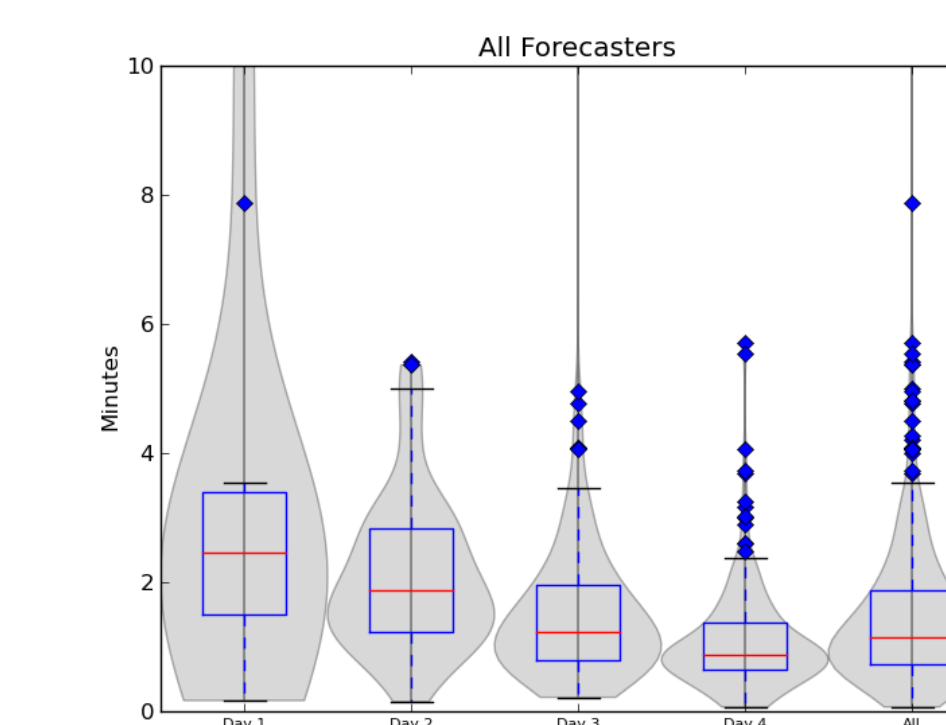- **Cutoff** in trends at high values implies **incompleteness** in forecasts

Trend Evolution
- Ending probability value from trends **progressively decreased** throughout the week

Creation Times
- **5 of 6 forecasters** were able to generate probabilistic forecasts in **1-2 minutes** (2-3 minutes for remaining forecaster)
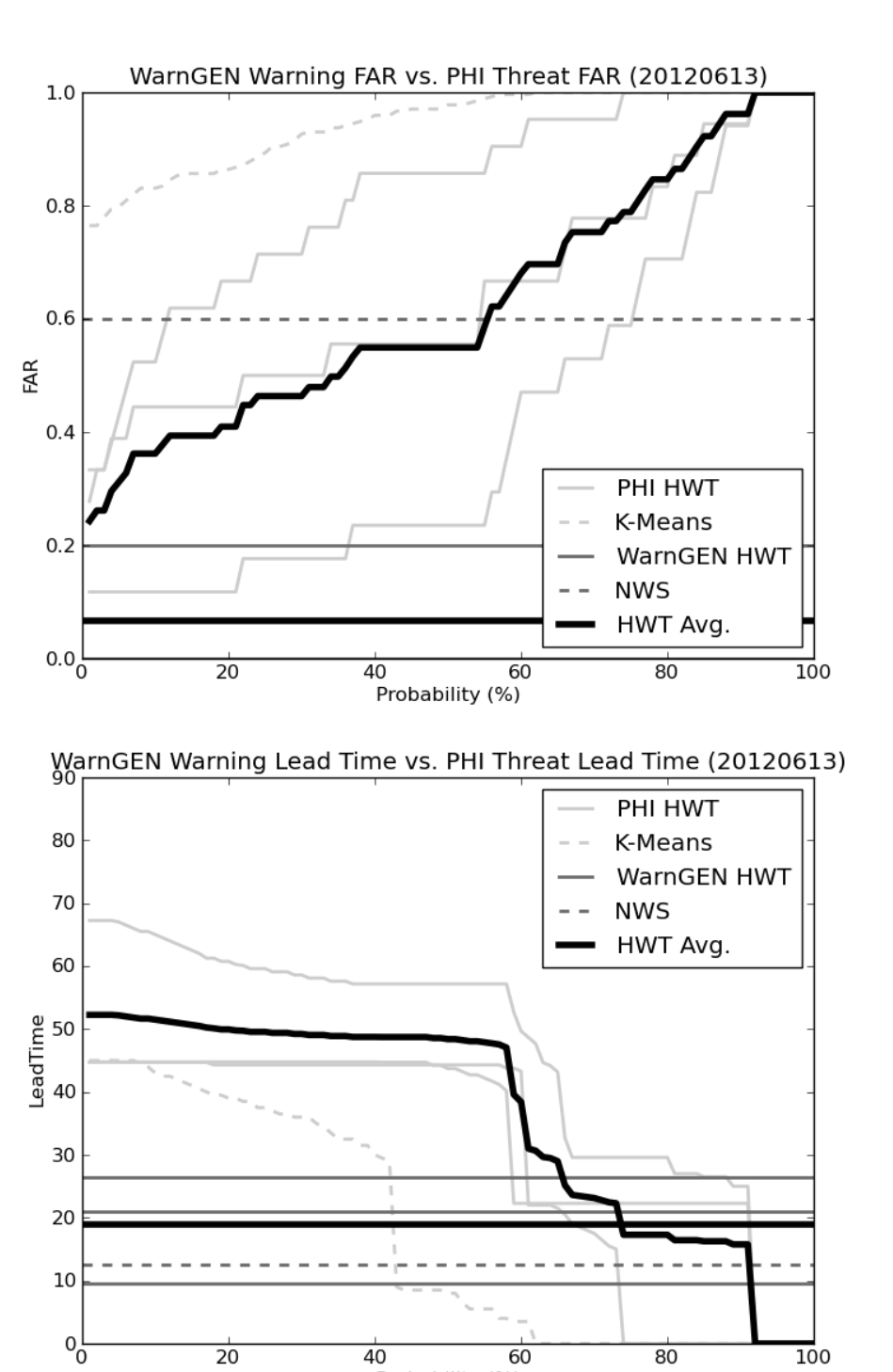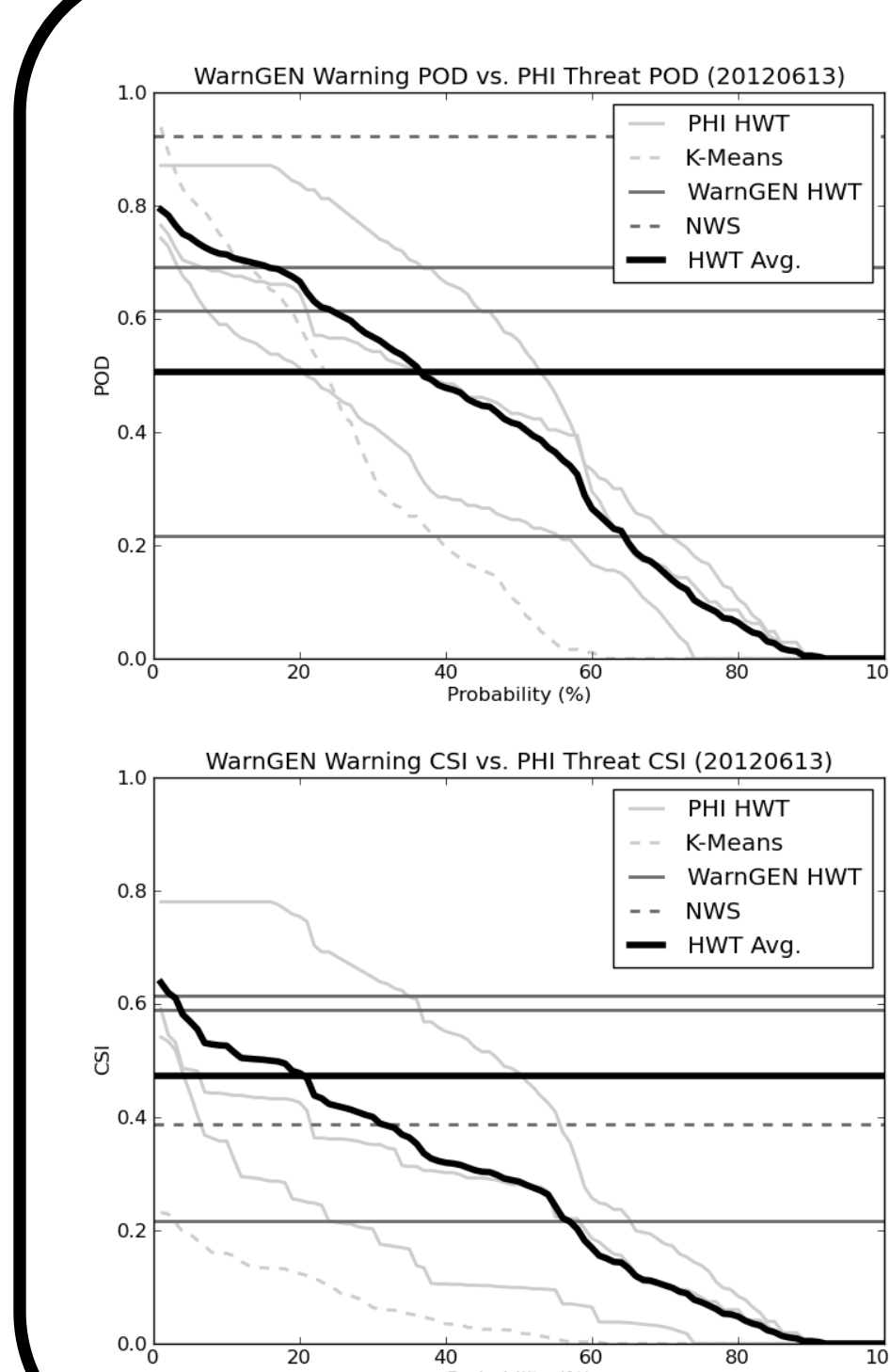
Creation Evolution
- Time needed to generate probabilistic forecasts **progressively decreased** throughout the week (to near 1 minute)
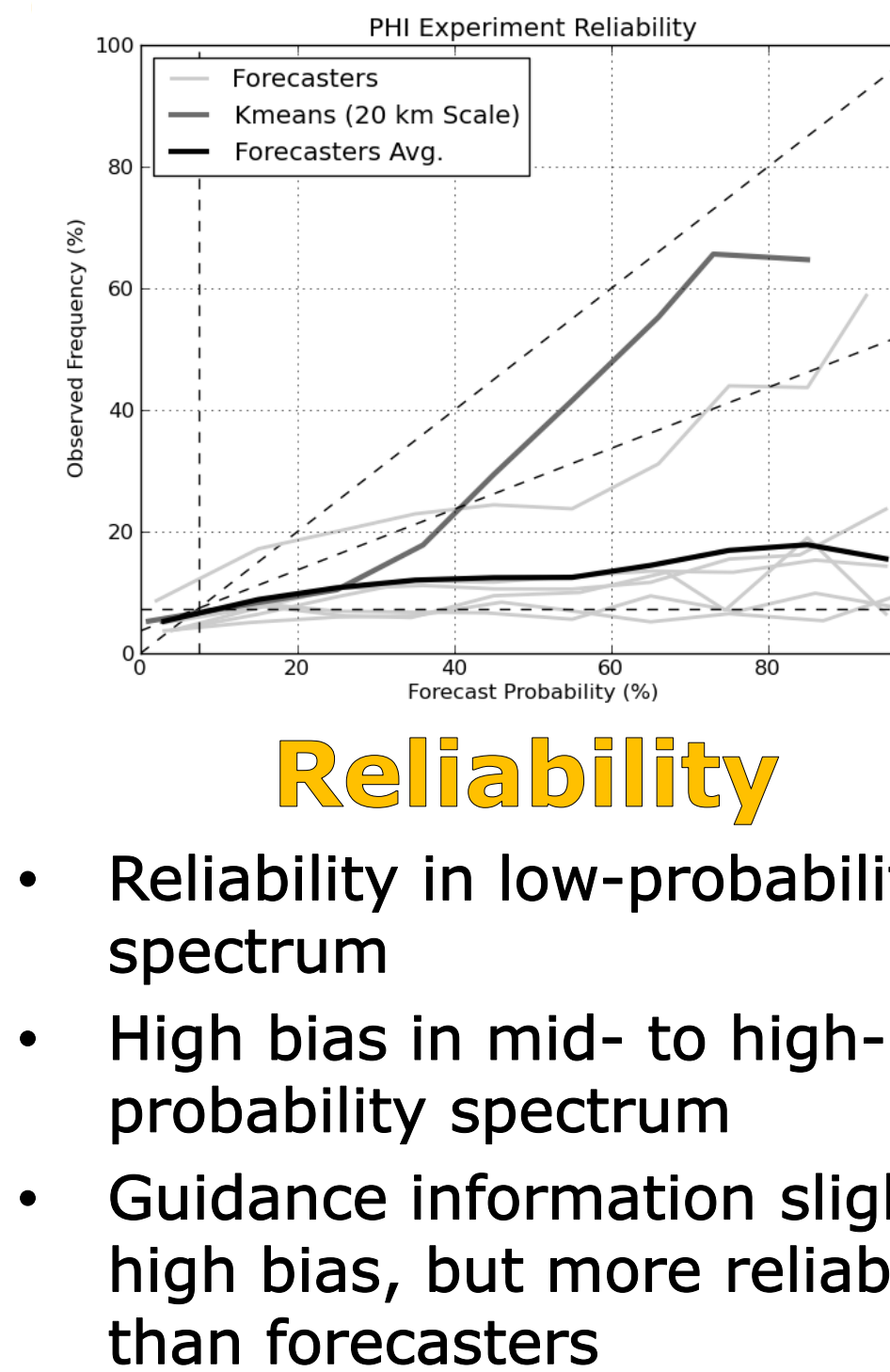
Implications
- Redesign tool to remove automatic assignment of default duration
  - *Forecasters should choose duration*
  - *Include training*
- Rapid creation times are encouraging
  - *Work to maintain*

Controlled Experiment

Traditional Verification
- **Skill** of WarnGEN warnings and probabilistic forecasts **comparable** in low-probability spectrum
  - *Encouraging (do no harm)*
- **Degradation of skill** in mid- to high-probability spectrum
  - *Attributable to tracked-event method of verification*
- Significant **increase in lead-time** with probabilistic forecasts near **1 hour**
  - *Attributable to Threats-In-Motion concept*

Reliability
- Reliability in low-probability spectrum
- High bias in mid- to high-probability spectrum
- Guidance information slight high bias, but more reliability than forecasters

Implications
- Need to incorporate more appropriate methods for verifying probabilistic forecasts
  - *Grid-based / object-based methods, practically-perfect method*
- Need to more intelligently incorporate guidance information
  - *Leverage computational abilities of automation with pattern recognition abilities of forecasters*

Forecaster Thoughts

"On-The-Fence" Decision Points are Reduced Significantly.
- Allows for low-probability hazard information to be communicated to the public.
- Workload is a non-issue when no more than ~4-5 hazards or storm is "well-behaved".
- **Need to intelligently infuse algorithms to provide first-guesses to offset workload, particularly for multi-mode events with complex evolution.**
  - Leverage computational power with human pattern recognition

Thoughts on Paradigm Shift
- Forecasters welcome the proposed changes to the watch/warning system
- Feel that a change is needed

Different Way of Thinking
- Forecasters are thinking more about the meteorology (i.e., structure/development of storms) of the event as compared to current warning system.
  - Enhanced situational awareness.
  - Implies sectorizing of forecasters into geographic regions as opposed to hazard type.
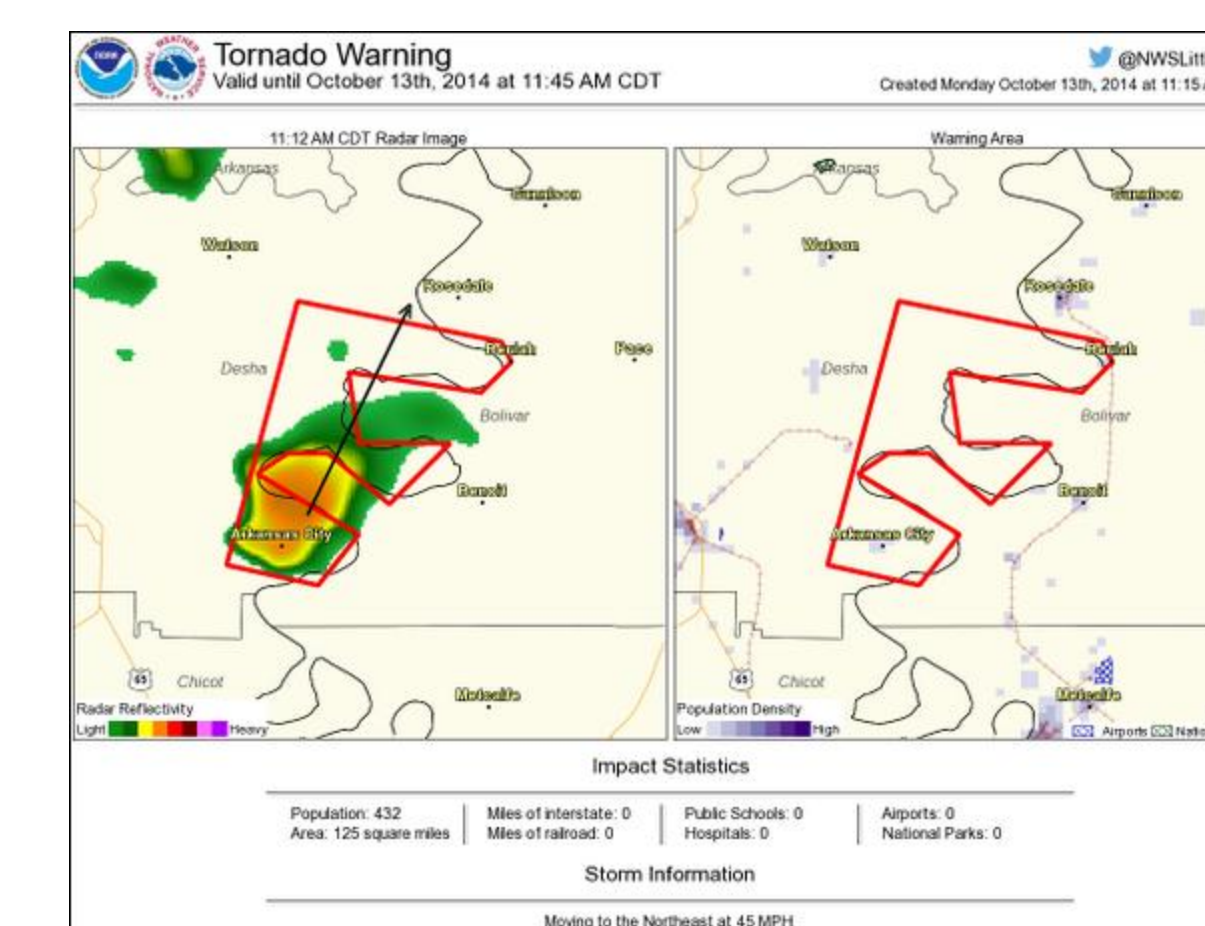- Current system – forecasters more concerned about "polygonology".

Need to Address CWA / County-Clipping
- Longer lead-times can result from hazard grids spanning multiple CWAs.
- Tools needed to:
  - Work collaboratively and/or
  - Establish hand-off procedures
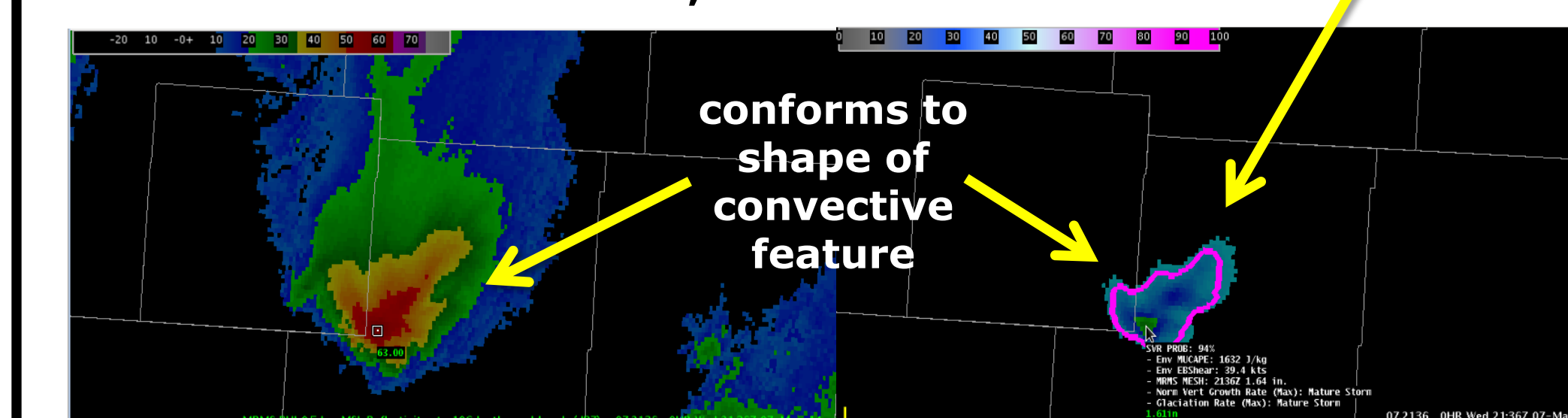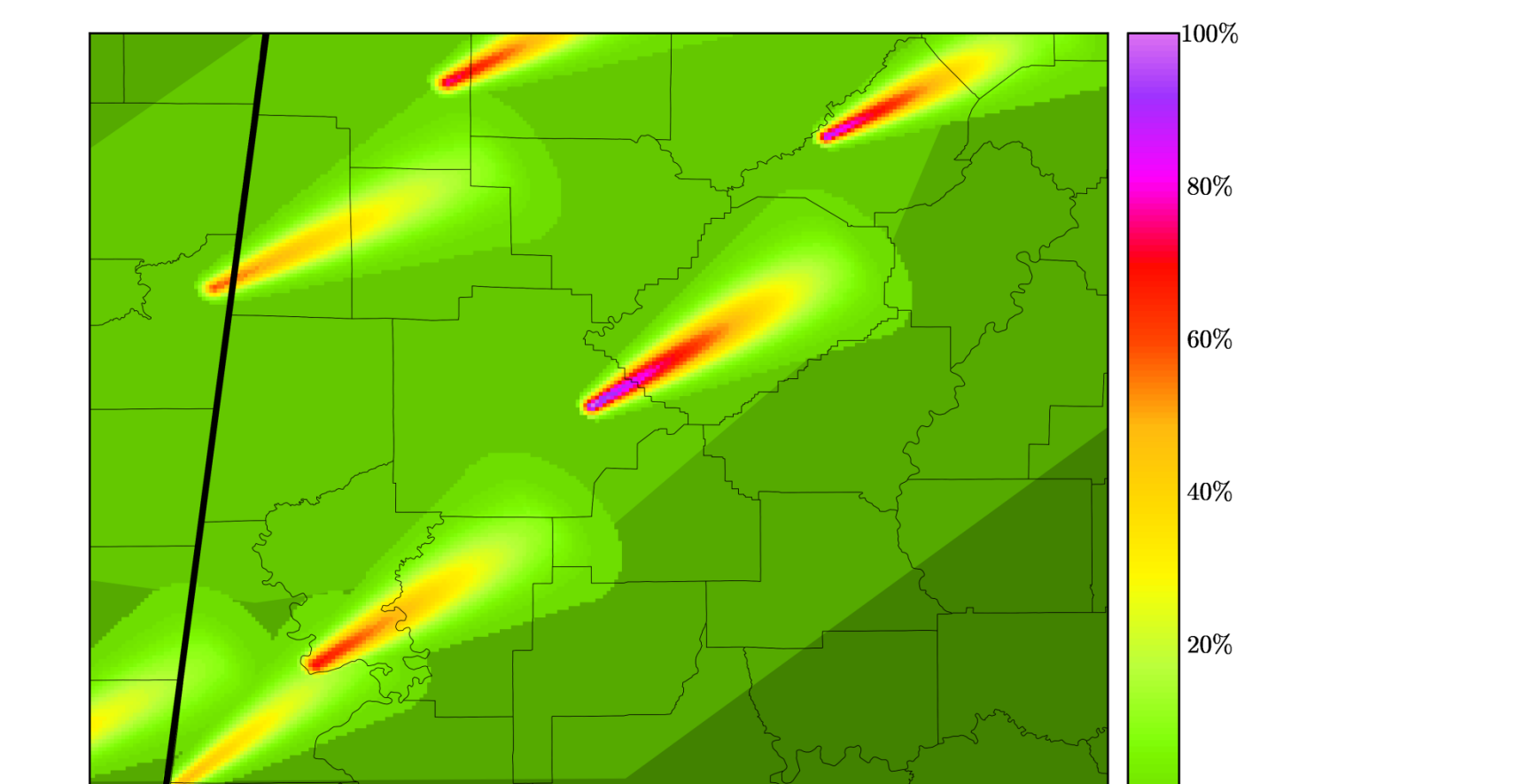- Post-processing tools to produce legacy products

Future Development

- **Integration of new/emerging information**
  - Severe storm climatology (MYRORSS)
  - Radar-Satellite-Environment objects (ProbSevere)
  - Warn-on-Forecast, etc.
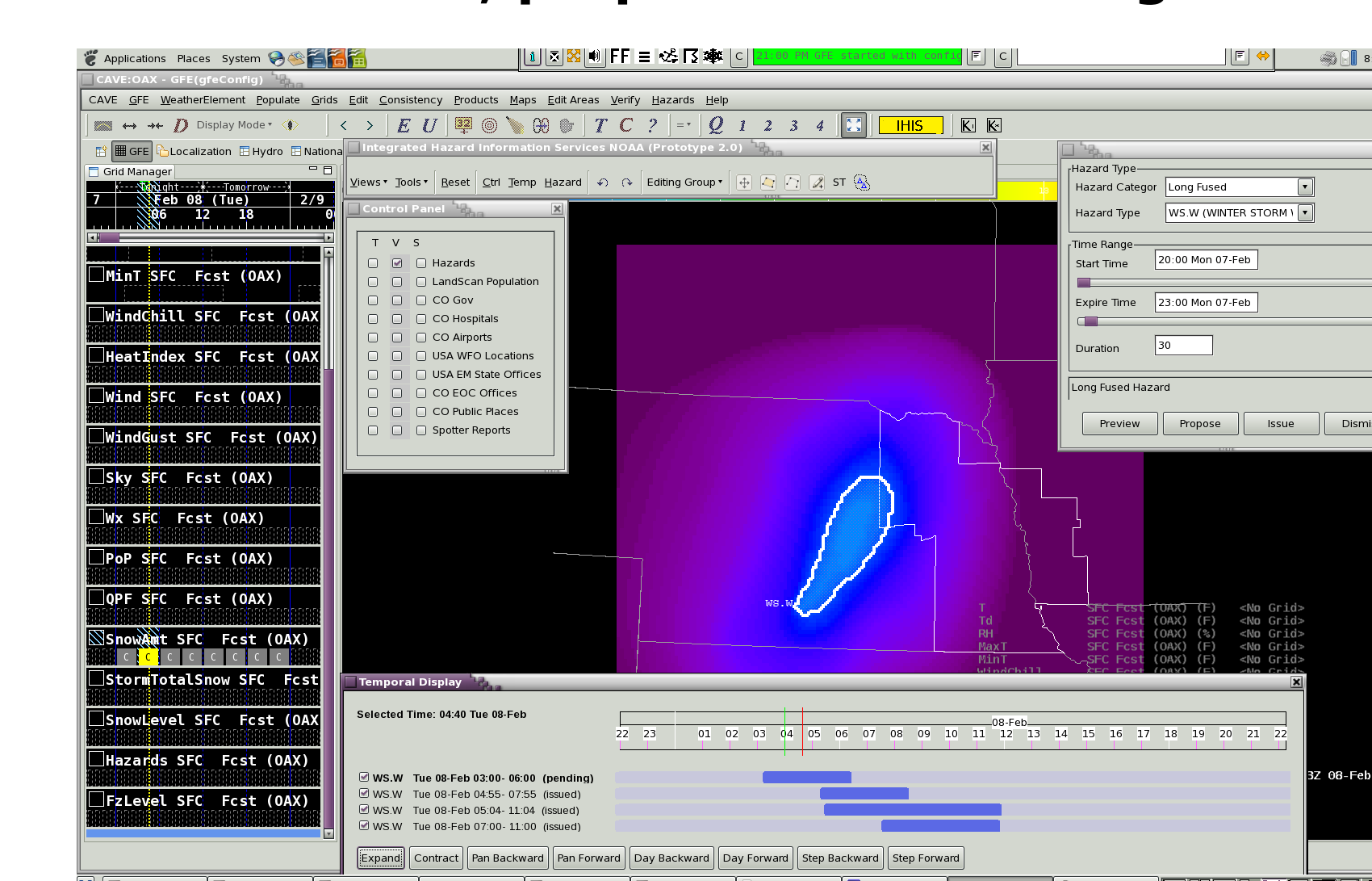

conforms to shape of convective feature

- **Establishing a continuum of probabilistic information**
  - Bridge time/space scales
  - Convective outlooks -> MDs -> watches -> warnings

- **Verification**
  - Grid-based / object-based techniques
  - Practically-perfect method

Contingency Table		Grid point within range of tornado hazard at that time	
		Yes	**No**
Grid point is warned at that time	**Yes**	A = Hit	B = False Alarm
	No	C = Miss	D = Correct Null

- **Integration of robust PHI techniques into Hazard Services / AWIPS 2**
  - Work initiated, proposals forthcoming

- **2015 HWT PHI Experiment**
  - Small experiment similar to 2014
  - Simultaneous experiment with emergency managers