

# **Test and Evaluation of Rapid Post-Processing and Information Extraction From Large Convection Allowing Ensembles Applied to 0-3hr Tornado Outlooks**

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*Thanks to WoF (NSSL & GSD), FACETS, PHI collaborators*

# ***Reminder - R20: Where do we fit?***

## **Addresses NOAA objective:**

“...post-processing tools and techniques to provide effective decision support for high-impact weather.”

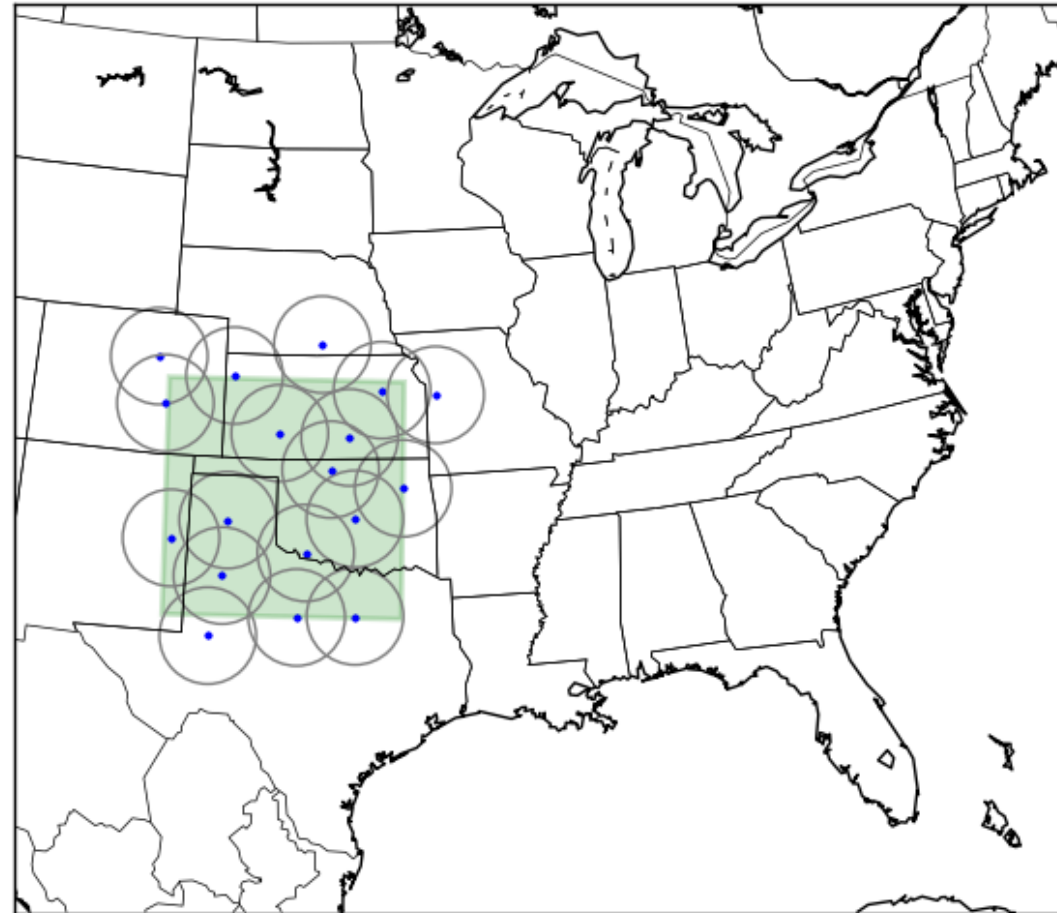
## **Addresses high priority topic 4:**

“...daily severe weather prediction using **rapidly updating** ensemble radar data assimilation and forecasts while **minimizing** data **latency** via post processing strategies for **information extraction**.”

# Warn on Forecast in HWT: NEWS-e

- 18 member mixed physics ensemble
- Init by HRRR-E\*
- Cycled radar data assimilation (15min)
- 90 minute forecasts
- 00 & 30 past the hour
- 1900-0300 UTC

3-km HRRRE background and nested NEWS-e grid

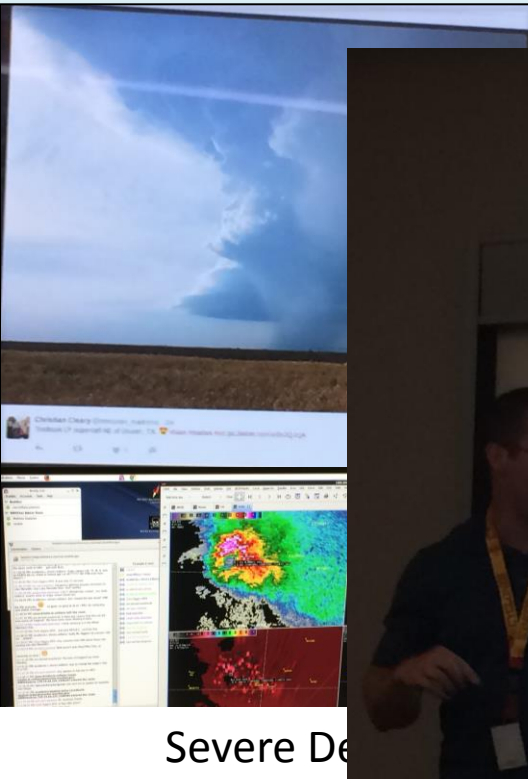


Radar locations within NEWS-e grid shown as blue dots with 150-km range rings

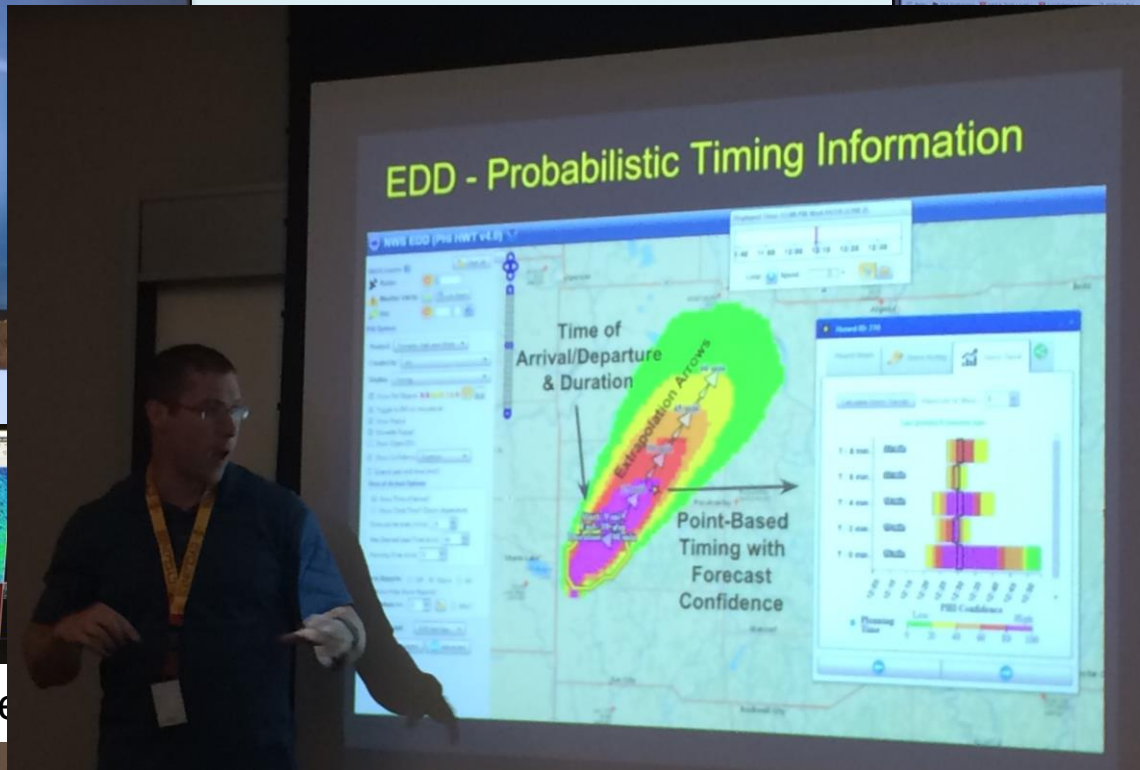
NSSL Experimental Warn on forecast System for Ensembles (NEWS-e)

\*HRRR-E run by GSD as part of the Warn on Forecast initiative

# 2017 Probabilistic Hazard Information Prototype Experiment



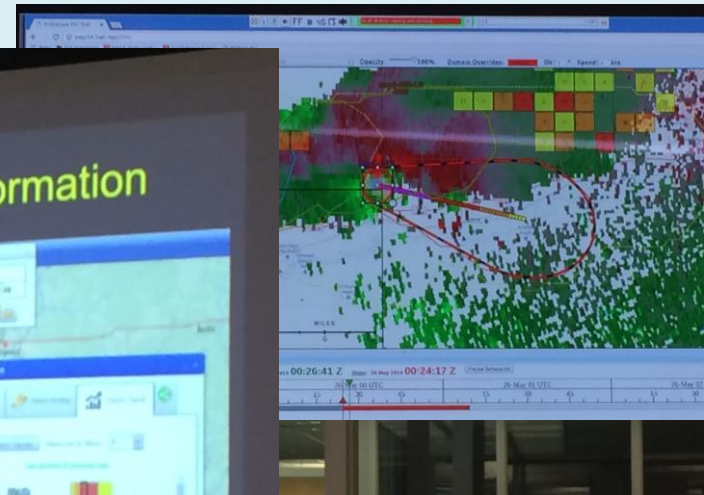
Severe De



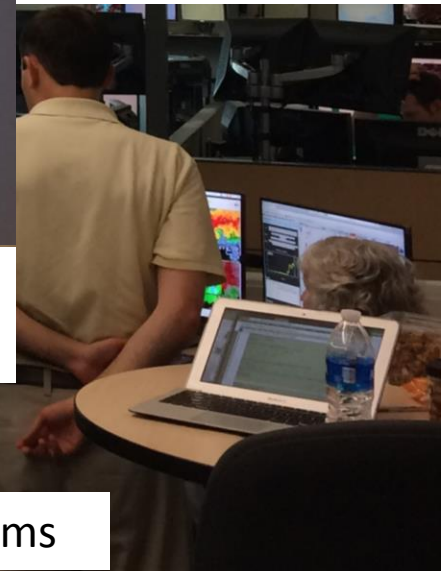
Deterministic warnings to probabilistic information & warnings co-created with EMs and broadcasters

- share your thoughts/experience in these situations
- You have fostered an insight!
  - Helps us reach our goal of our co-creation leading to performance improvements!

Expectations: Looking for insight current & future paradigms



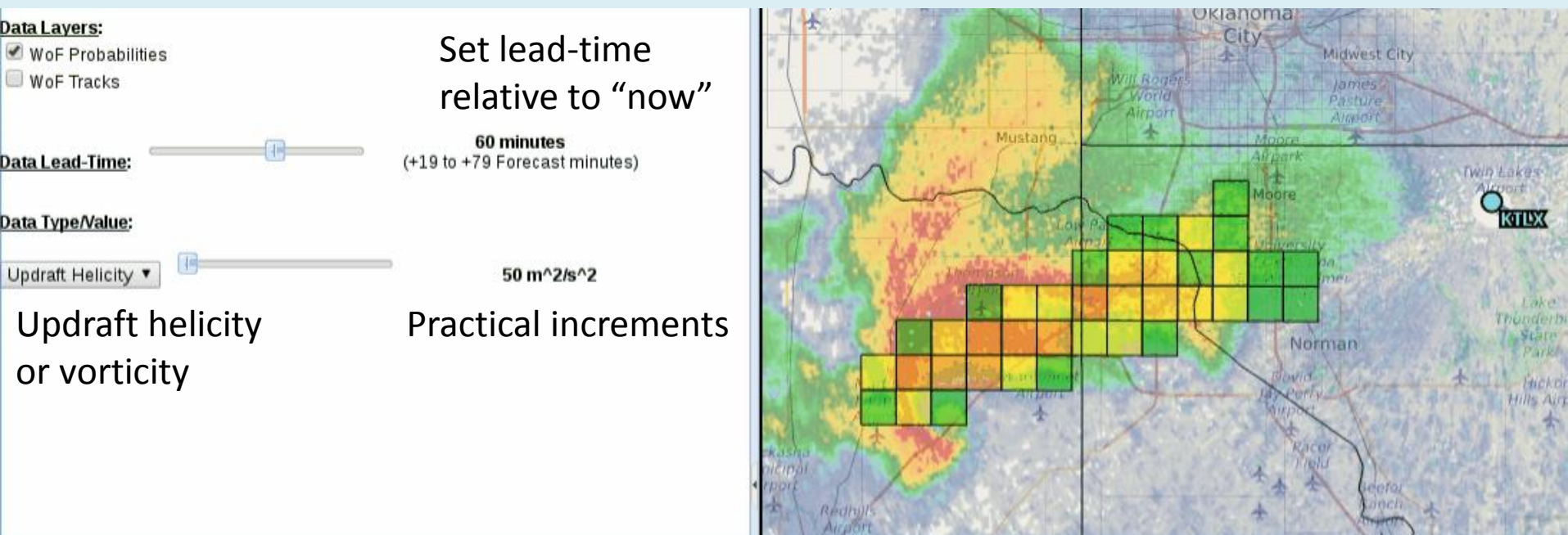
Tornado Desk



# 2016 HWT PHI Experiment Display

## Approach as a TIME based problem

1. Set the lead time to match your warning task
2. Set the intensity to match the warning task by storm



Introduce slider bars for the query: post-processing is working **FOR** the *forecaster*

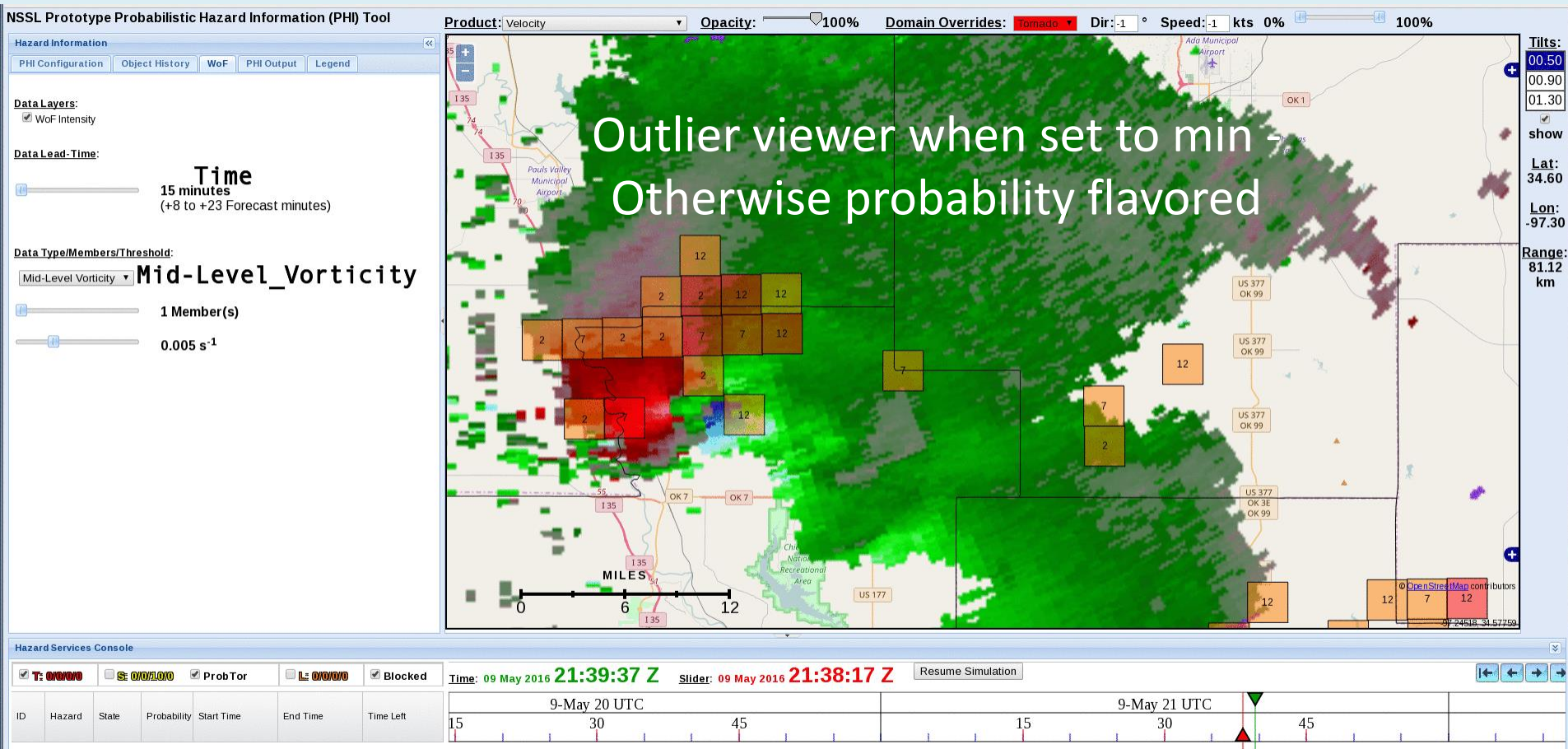


# 2017 HWT PHI Experiment Display

Approach as a TIME based problem

Set lead time to match task  
Set Member count  
Set Intensity

Offer control of base data through query  
Data dynamically adjusts every minute



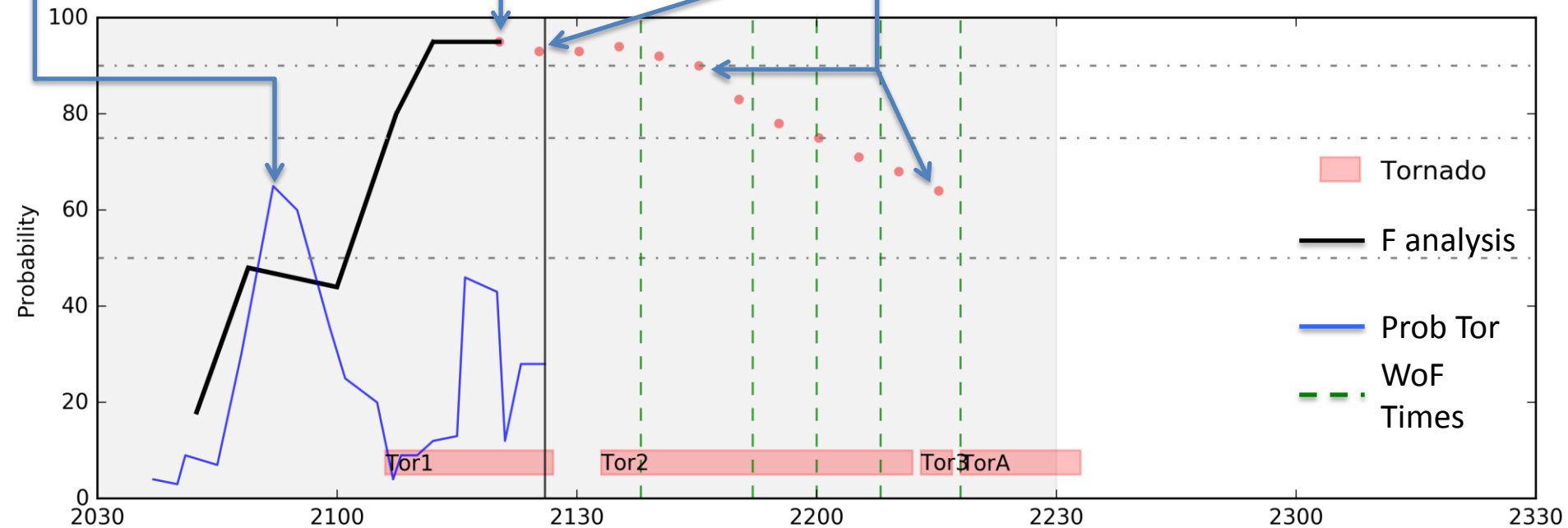
# HWT case: 9 May 2016

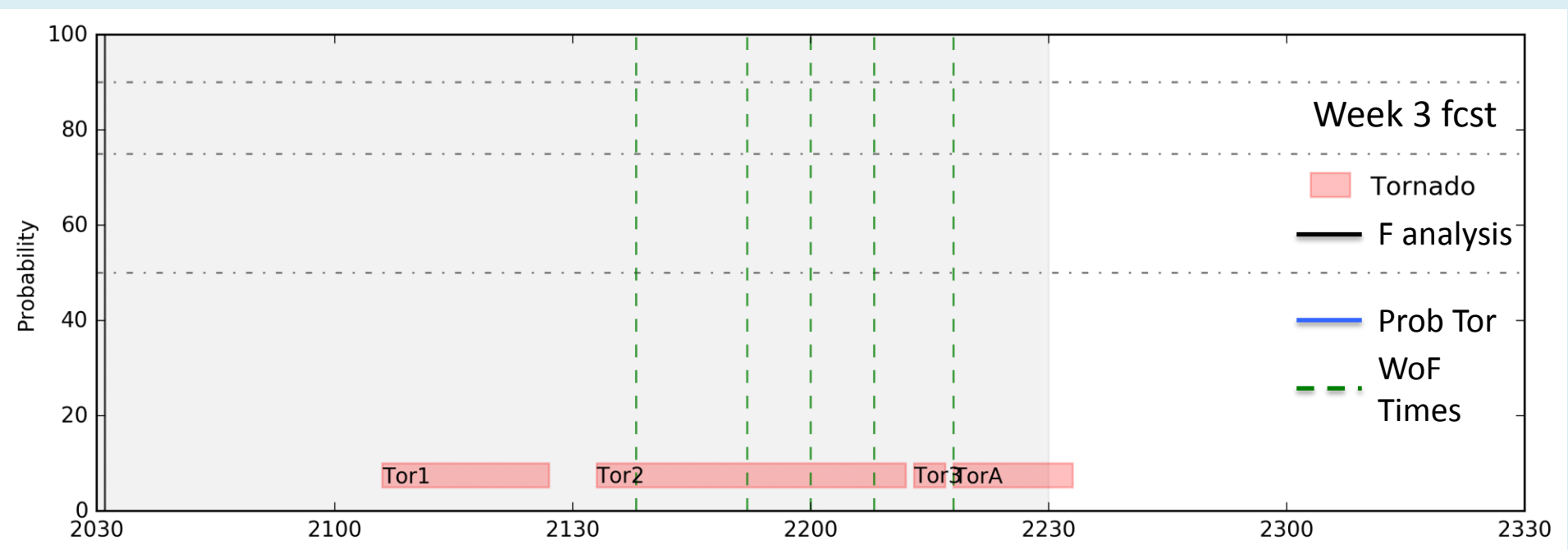
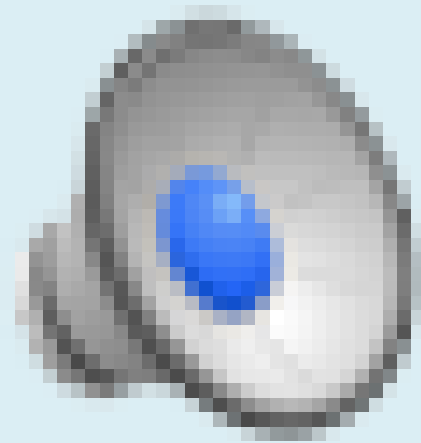
## Warnings & PHI: Tornadic supercell

T0: Forecasters subjective probability e.g. confidence

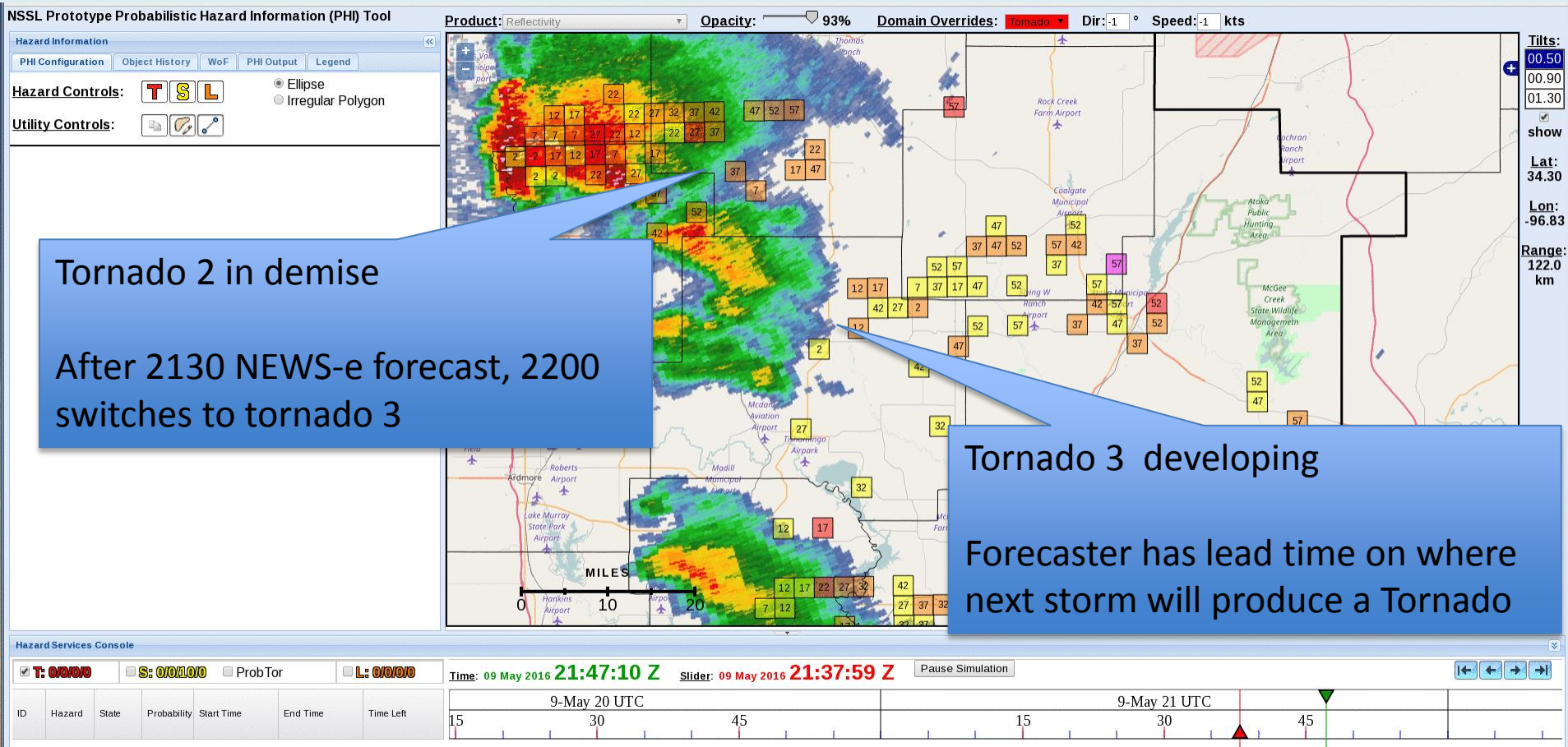
ProbTor: CIMSS Wisconsin

Forecast: Forecasters subjective probability e.g. confidence









Summarize model info rapidly, matched to task

Need to draw attention to “details” in model

How do we get forecasters to use, trust these “details”?

# Challenge is to match information to the task

When & why use NWP?

- PHI represents more judgments -> Risk:
  - Existence of threat/hazard
  - Intensity (modeled after IBW)
  - Longevity (mesocyclone or tornado?)
  - Confidence (as a subjective probability)

What job does NWP help the forecaster do and how does NWP do it?

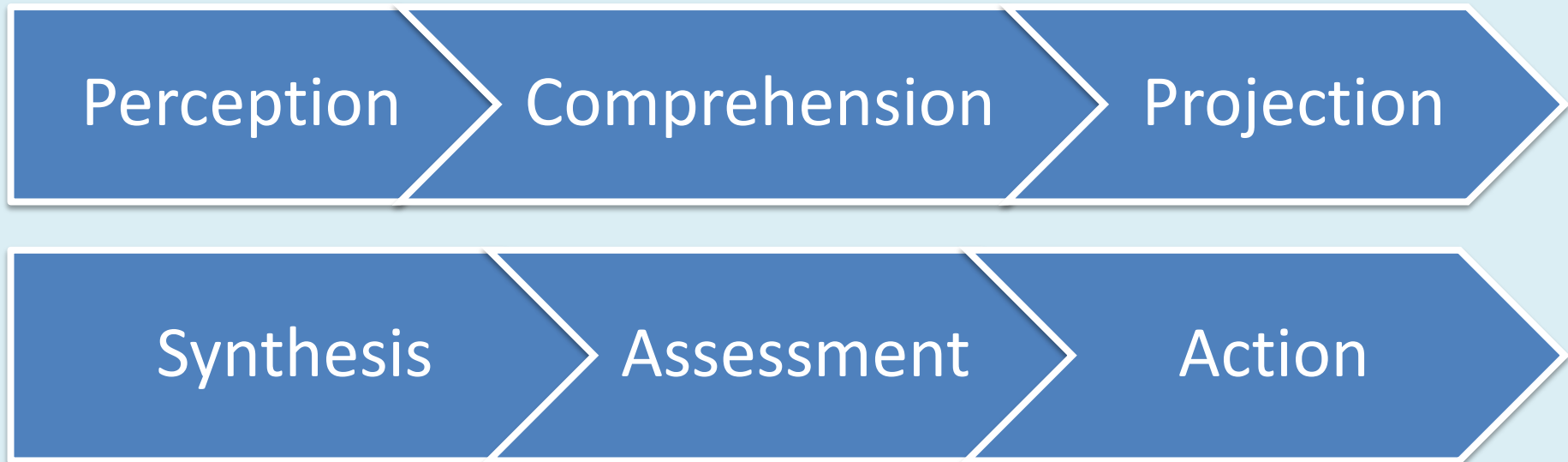
- All of the above?
- Confidence & Confirmation of threats ... because:

**“Always in a constant state of analysis” ...**

# Situational Awareness

(Endsley et al 1995)

“...not enough to keep up with the pace of information...  
It must be **interpreted** and **related** to other information  
and to the task requirements.”



“...and, at its highest level, **predict future events**  
and system states based on this understanding.”

# Prelim 2017 HWT observations

**“Always in a constant state of analysis”**

But in an analysis state, not in projection space – what could happen, when, and how intense?

**“Cant algorithm everything”**

Agile post processing and interactive displays  
Make the PP relevant to the forecaster

**Probability is a tool,**  
**not a solution**

NWP doesn't fit reliably into forecasters analysis but does fit in the projection phase of SA

Forecasters need to develop the (un)**justified** (mis)**trust** that comes with experience & feedback.

# Summary

- Post-Processing designed with the Display in mind
  - Data matched to the warning task
  - Rapidly provided **more** information **w/ less** data
  - Agile probabilities through data mining
- Social and physical science combo working
  - Interviews & experiment exposed Challenges for NWP in Operations
    - NWP has trust issues on the warning desk
  - Better questions thru co-creation
    - Researchers & Participants, Forecasters and Partners
  - Social scientist and tools needed to collect relevant DATA on the design and implementation of tools, techniques and outcomes.





# Deliverables

- Interviewed NWS forecasters
  - Learned that CAM trust is low b/c of low familiarity and un-calibrated expectations
  - CAM knowledge & use variable – f(available in A2, experience)
- Min(data) & Max(*information*) (size: 20kb vs 18MB)
  - Meet forecasters where they are, in real-time
  - Data adjust dynamically with Time
  - Latency of PP was 2-4m from ensemble completion
- Confirmation was primary use
- As Sit Aware increased, NEWS-e became usable to the production of Probabilistic Hazard Information (PHI)
  - Forecasters spent more time in projection rather than diagnosis and understanding via radar interrogation

**From previous years talk**

# ***Preliminary HWT observations***

- Forecasters used guidance to Identify ‘hot spots & attention’ –**F1,6**
  - Confidence in warning decisions (warn & not to warn) because: “**right now we have no tornado guidance**” – **All**
  - “**Always in a constant state of analysis**” -- **All**
  - But “**Cant algorithm everything**” --**F1,4,5,9**
- Develop *TRUST* (justified & unjustified; Hoffman 2012)
  - Need to understand ensemble capability & skill –**All**
  - “**I’ve never used this before.**” --**All**
- Similar dichotomies seen
  - Wanted to increase confidence on marginal events vs Focus on higher impacts – **F1,2,5,9**
  - Always used rapid animation or all-tilts radar (like querying) but Rarely used model queries b/c 30 min updates couldn’t compete with 2 min updates for attention --**F4,7,8,9**

# ***Reminder: Post-processing Strategy***

- The proposed post-processing paradigm will consist of five steps:
  1. Rapid ID of predefined but broad objects for the purposes of filtering and data reduction,
  2. Transmitting reduced data sets while retaining information (why send zeros!)
  3. Reception and regridding data (adaptable)
  4. Generation of predefined probabilities (static probabilities – broad applicability)
  5. Generation of user-defined probabilities (on-the-fly post processing for INSIGHT in Scientific forecasting)



# 2016 HWT PHI Experiment Display

A Time based problem

Summation of signals in **Time** -> adaptation

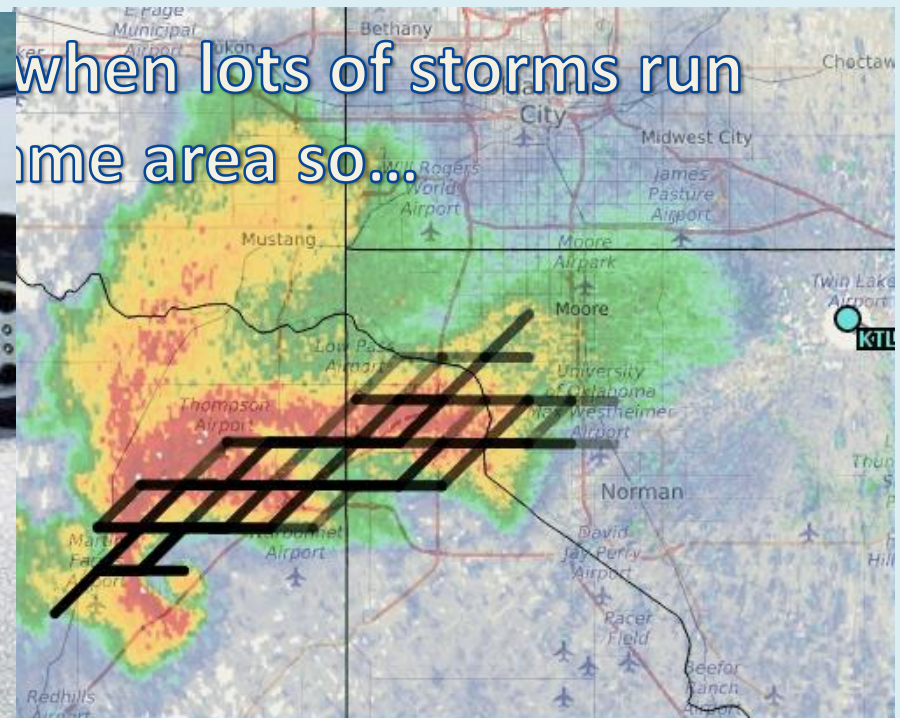
Frequency  $f(\text{members, location, time})$   
can quantify variability

Can see motion, variability but under-  
dispersion hides frequency

“Hiding” temporal variability within  
lead time window



Frequency Display



Track Display