Temporal and Spatial Aspects of Emergency Manager Use of Prototype Probabilistic Hazard Information

NWS Hazards Simplification Project:

Dr. Daphne LaDue[1], Dr. Chris Karstens[2], Dr. James Correia Jr.[3], James Hocker[4], Shadya Sanders[5], Michelle Dovil[5], Cassandra Shivers[5], Anjerrika Bean[5], Dr. Terri Adams[5], Alan Gerard[6]

[1]OU CAPS, [2]OU CIMMS & NOAA NSSL, [3]OU CIMMS & NOAA SPC, [4]OCS, [5]Howard U., [6]NOAA NSSL

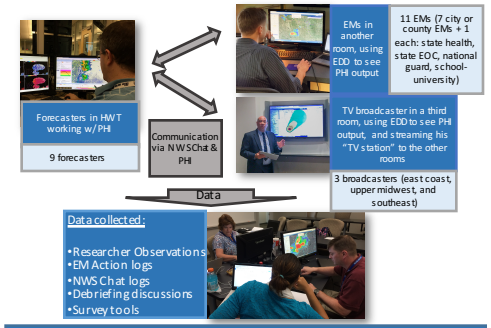
Introduction

Each year emergency managers and their local constituencies must make difficult decisions about severe convective weather threatening their area. The timing and spatial aspects of these challenges were studied during the 2016 Hazardous Weather Testbed (HWT) Probabilistic Hazard Information (PHI) project (see Karstens et al. in this conference), which falls within the convective timescale of Forecasting a Continuum of Environmental Threats (FACETs) goals.

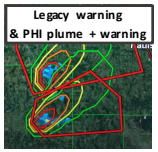
This work focuses on the spatial and temporal aspects of decision that city, county and state level emergency managers made while simulating their jobs using the PHI information that issued by National Weather Service forecasters in an other room. Additionally, a broadcast meteorologist operated a mock TV station that provided live broadcasts to the EM and forecaster rooms (see Obermeier et al. in this conference), creating an integrated warning team (IWT), all cooperatively working the same displaced real time and live weather events.

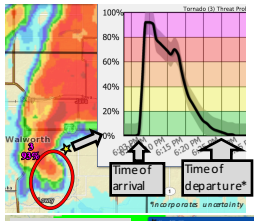
Testbed Design:

Simulated Integrated Warning Team



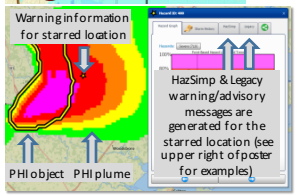
PHI & Hazard Simplification





PHI Severe objects are generated from ProbSevere and tightly surround the echo. The plumes forward are calculated from forecaster settings, including probability trends.

EMs and TV Broadcasters could query information for a specific points by setting a star (both images to the right), or look at object-based information for any object.



Strengths and Limitations

Strengths:

- The IWT design allowed the group to quickly iterate toward ways to use the PHI concept in useful ways.
- Several Emergency Support Function types were included
- IWT members put pressure on forecasters that helped mitigate the "no one is going to die" effect of testbeds and simulations.

Limitations:

- By implementing an integrated warning team concept we limited our ability to compare decisions across cases over the three weeks of the project; individual decisions had a cascading effect on others' decisions.
- There was no public component to this project, thus the full impact of a Hazard Simplification is not known.
- Generalizability may be limited despite purposefully sampling diverse EMs and ESF types.
- Participants would have liked to see verification to build trust through the week.

Spatial & Temporal

Jurisdiction size and type of Emergency Support Function drive the EM's perspective

City and county EMs are very focused on their jurisdiction:

- *"Normally took my area of concern or my, my jurisdiction, my location and looked to see what was upstream from me."*
- He continued: *"...sometimes you back it out and you look at the...the big picture, too, [for a] clue to how the storms upstream from me are going to evolve...or whether the threat's really [elsewhere]."* — Example quotation from City EM 4

In contrast, some EMs have responsibility for larger regions (State-level Communications) or specific points within larger areas (National Guard, State Health).

- National Guard has specific facilities scattered throughout the state
- State Health monitors access to hospitals across the state and coordinates access to appropriate facility levels

Focused attention:

- PHI better at discriminating areas of concern
- would be very helpful when local situation different: big exam days (hard to make up) vs. "ordinary" days
- *"What I like about PHI was even just the computer algorithm features helped me. If there was a lot of storm activity it was a lot easier to kind of look at that and get an idea where I need to concentrate versus trying just to look all up and down a line or a complex."* — Military EM 2

Current warnings are much larger than PHI plums, leading to more false alarms for specific cities or locations

- *"I don't cry wolf. Because I learned not to do that real quick!"* — City EM 3

Current issues:

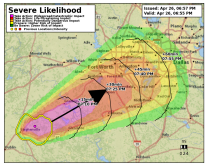
- some confusion about the area over which the probabilities applied
- *"it hasn't really been proven with verification"*

Thresholds for actions:

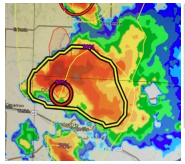
- some EMs have legal documents that specify behaviors at defined thresholds while other EMs have flexible guidance for more dynamic decision making
- both must closely follow weather!

Decisions made earlier:

- PHI better at discriminating areas of concern
- would be very helpful when local situation different: big exam days (hard to make up) vs. "ordinary" days
- *"What I like about PHI was even just the computer algorithm features helped me. If there was a lot of storm activity it was a lot easier to kind of look at that and get an idea where I need to concentrate versus trying just to look all up and down a line or a complex."* — Military EM 2



The social media graphic was enormously popular among both EMs and TV broadcasters, except: 1) green should not be a threat level — green means "okay", and 2) the words we assigned to levels were *terrible*.

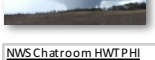


The Dodge City storm on May 24, 2016: Forecasters were challenged to keep up with PH tornado objects for the cycling mesocyclones, but EMs greatly appreciated the refined threat areas in which to coordinate search and rescue activities.

31 March 2016 Case *Case suggested by 2015 PHI participant*

30 minutes prior to the bad report, and when the storm mesocyclone was stronger:

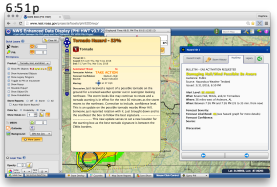
~32 miles west of Ardmore Photo from Sheriff (not a tornado!)



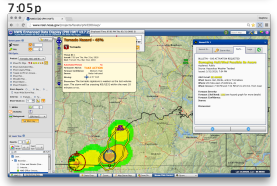
Bad report comes in ~30 min later when the mesocyclone is 1) closer to the radar, and 2) not as strong

From the actual warning:
Hazard...Damaging tornado
Source...Law enforcement confirmed
Tornado...Observed

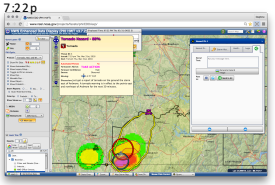
6:51p



7:05p



7:22p



NWS Chatroom HWT PHI

6:39p: WCM: Law enforcement reporting rotation seen northeast of Anderson, AL. Would be near where Lauderdale, Limestone and Giles counties come together.
6:40p: County EM 7: Alan, did Law Enforcement give a direction in which the rotation is tracking?
6:41p: WCM: Negative
6:42p: County EM 7: Sounding outdoor warning sirens in Lester.

NWS Chatroom HWT PHI

7:33p: County EM 7: Report of a Tornado on the ground in Ardmore, AL and headed east reported via Law Enforcement
7:34p: WCM: Thanks, County EM7. Passed the report on.
7:34p: County EM 7: Sounding Outdoor Warning Sirens in Ardmore, AL
7:37p: Contacted Law Enforcement on the tornado report, and found out that they were relaying what they saw on twitter.

...the real source of the report (via Twitter):

Comments about this case

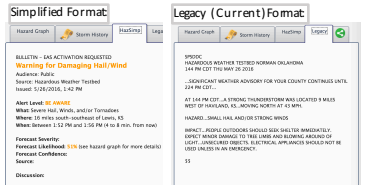
By week 3 we had enough info from Huntsville to simulate the event as it had happened!

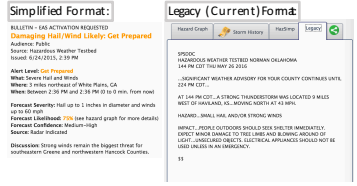
Participants were unanimous that this was their life: marginally severe weather, uncertainty about what is happening, lots of confusion.

PHI allowed the forecaster the flexibility to issue only two warnings, and otherwise use a tornado advisory type product. He was pleased with his performance after learning what happened.

Hazard Simplification

Tested ideas generated at the Hazard Simplification Workshop in Kansas City in October 2015. Key ideas: 1) "be aware" or "get prepared" as alternatives to the Significant Weather Advisory, and 2) use of color to indicate likelihood of event occurring.





"I think [simplifying the hazard message is] the right idea" but multiple levels of information are needed:

- TV2: *"I think there is some tweaking to do...but being able to send things in one format o [EMs] and to the general public, I think that's the right idea."*
- Forecaster P: *"There are different tiers of what people need: EMs versus the publics"* and added *"I wouldn't want to take away from what [EMs] could see to simplify it for the public."*
- School-Univ EM2: *"[It is important to have] the opportunity to calibrate our decisions as you switch paradigms. You can't simply leave one paradigm and go to the other one, you are going to have to have some legacy information to make that transition or you are just sort of throwing darts at that point."*
- Military EM2: *"You're gonna have to have different levels of complexity throughout the system. If you dumb it down then it's just a crap product all around."*

Sentences vs. bullets:

- Sentences: County EM 6: *"the people working in radio are not weather experts. ... The conversational piece of it is so important in a radio environment ...text-to-speech,...[those machines] can read a conversational speech and an end user can make sense of that."*
- Bullets: were very effective for quickly taking in new information when busy (EMs) or on-air (TV).

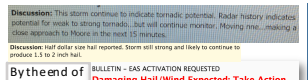
Terminology:

- Did *not* like "enhanced, slight"; maybe "low, low-medium, medium etc." okay
- Neither "Be Aware" or "Get Prepared" (alternate wording to SVS) were appropriate wording for every context!

When blending the PHI concept with HazSimp:

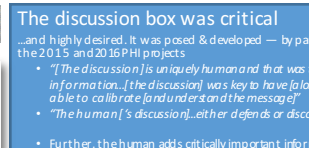
- Forecasters
  - want to be able to express nuance in any form of warning, e.g. high confidence of small, brief tornadoes is a very different message than slight confidence of a violent tornado — is this difference clear?
  - want to be able to decide when to alert cell phones (warn)
- EMs used both confidence and likelihood to make decisions
- TV broadcasters need more than probability (from PHI) to decide whether to cut in to programming

The Discussion Box



By the end of each week, discussions contained information such as:

- location,
- trend information and
- forecaster thoughts about the storm.



The discussion box was critical

...and highly desired. It was posed & developed — by participants — EVERY week of the 2015 and 2016 PHI projects

- *"[The discussion] is uniquely human and that was the most important piece of information...[the discussion] was key to have [along with probability] to be able to calibrate [and understand the message]"*
- *"The human ['s discussion]...either defends or discounts the probability."*
- Further, the human adds critically important information: *"Every tornado starts as a rain storm. Every single one. And knowing which one the forecaster thinks is most likely to produce a tornado...[is] extremely valuable information."*
- When missing, EMs *"didn't like it at all. I was missing the expertise."*
- The discussion resolved situations where multiple objects affected an area; clarified what was important
- *"If it wasn't for the forecaster I would only have the automation to go on at that point and that's not enough information."*

Closing Thoughts

Our very rich dataset has much more to tell us.

PHI made interrogation more dynamic for EMs, and coverage on-air more dynamic for TV broadcasters: they developed a flow of looking at tornado threats, then at severe, then at lightning.

EMs expressed that their decision making must take all aspects of information into account and will handle that information differently depending on the situation. For example, a large venue, outdoor event with a low chance (30%) of subsevere but potentially impactful winds to tents and equipment might spur action when on another day they would not act until 60%.

When EMs know the forecasters writing their products they understand the information much better (see also our CT interview work). To make the best decisions EMs strongly assert that they need to have forecasters' added information (see Discussion Box above).

Acknowledgements

This work was prepared by the authors with funding provided by the NOAA/Office of Oceanic and Atmospheric Research under NOAA-University of Oklahoma Cooperative Agreement #NA11OAR320072, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.