

How university and school district officials anticipated and responded to National Weather Service tornado warnings: Spring 2011 case studies

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Eve Gruntfest

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Warn-on-Forecast and High Impact
Weather Workshop





<http://clothesexpression.blogspot.com/6>



http://www.westernbus.com/blue_Bird.php



6 School Districts- 11 Participants



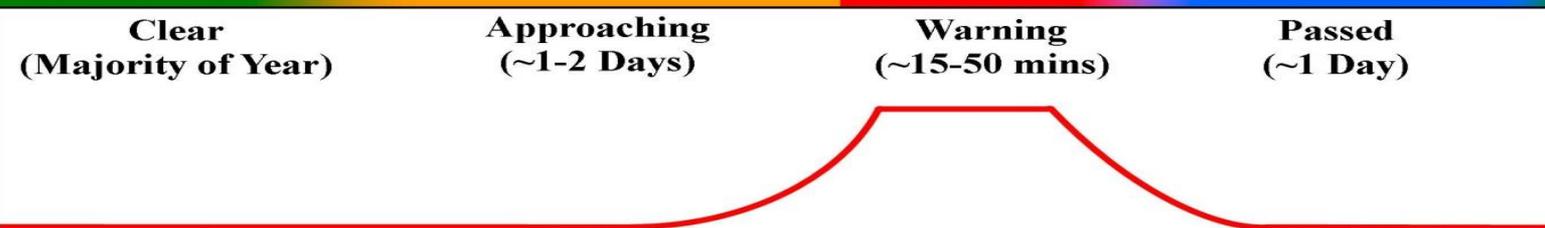
5 Public Universities- 10 Participants

Amount of Data	Nichols	Hoekstra
Hrs of Interviews	~11 hours	~10 hours
Hrs to Transcribe	~55 hours	~40 hours
Pgs of Transcription	165 pages	154 pages



Weather Information Used

Local TV stations
 NOAA websites
 NOAA Weather radios
 Local universities/meteorologists
 Transportation/Safety Director



Severe Weather Status at School Districts



Weather Information Used

Local TV stations
 NOAA websites
 NOAA Weather radios
 Local universities/meteorologists
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Clear (Majority of Year)	Approaching (~1-2 Days)	Warning (~15-50 mins)	Passed (~1 Day)
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Severe Weather Status at School Districts



Weather Information Used

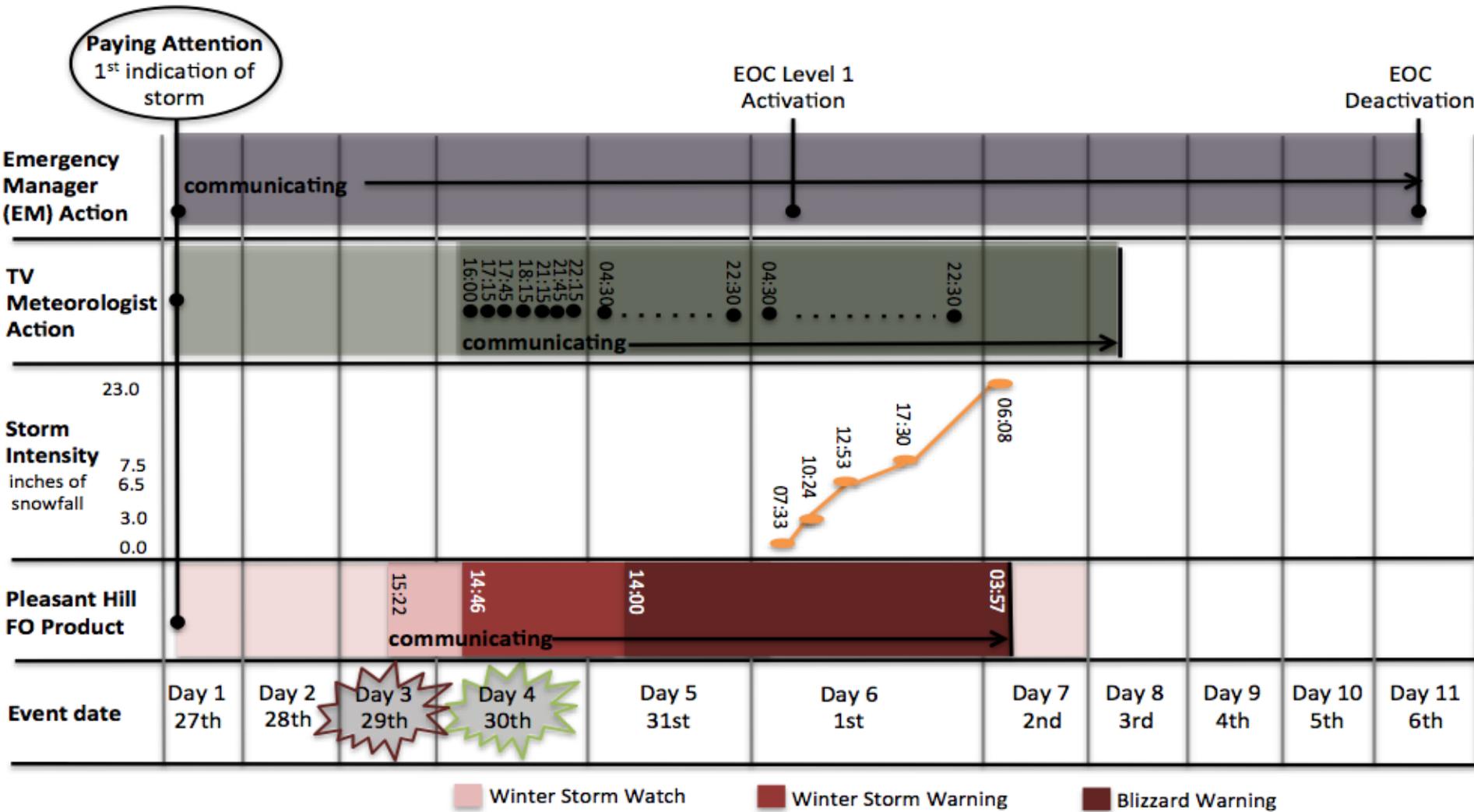
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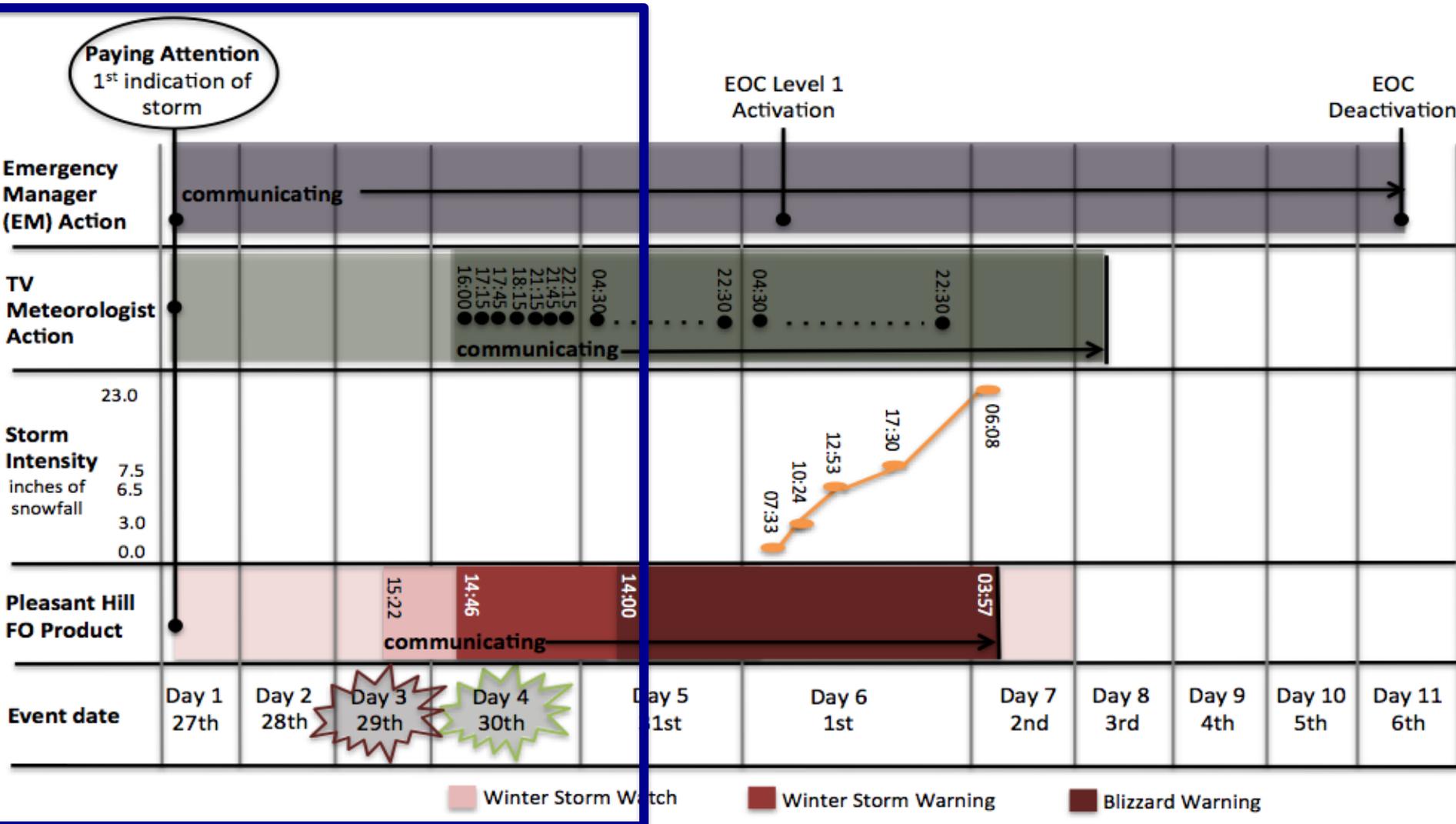
Severe Weather Status at School Districts



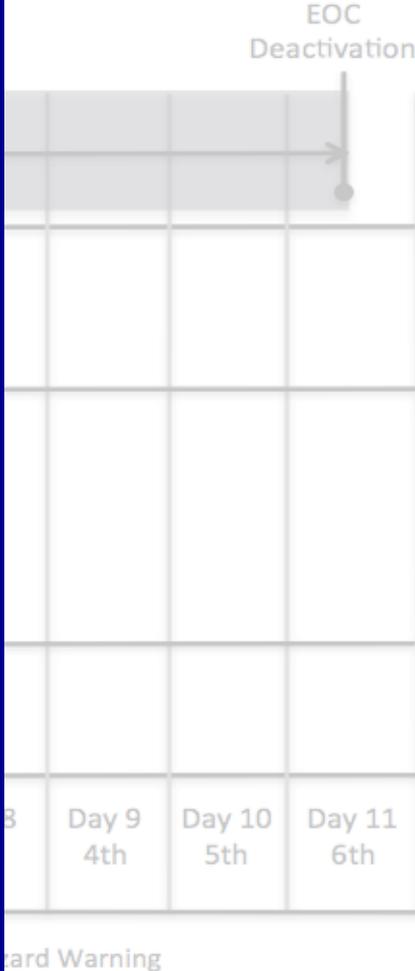
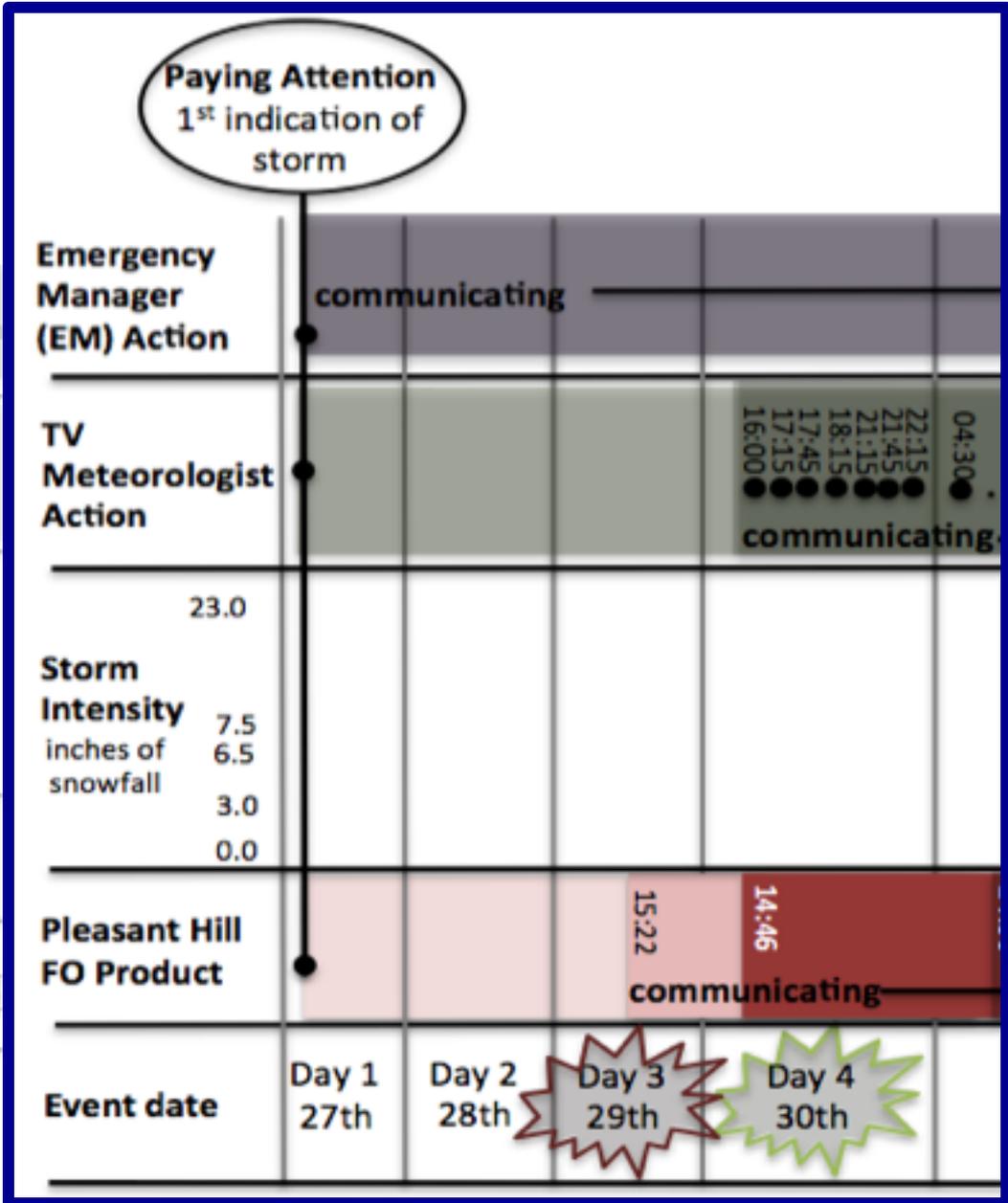
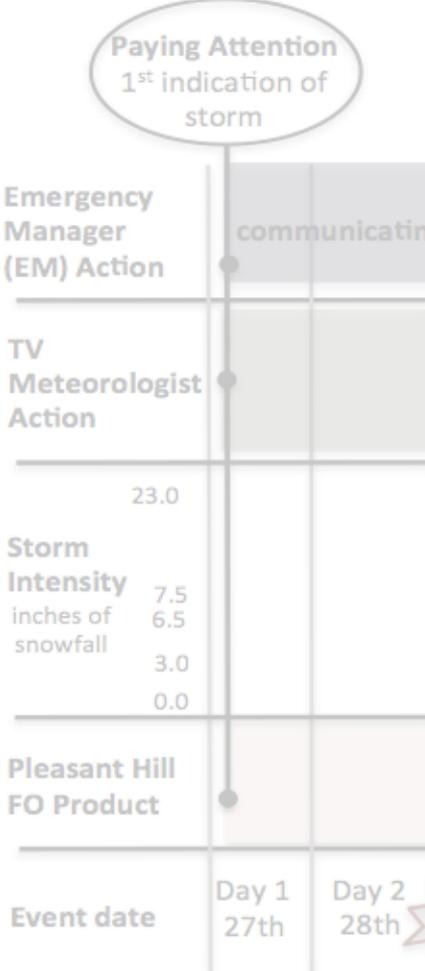
Spinney and Gruntfest 2012



Spinney and Gruntfest 2012



Spinney and Gruntfest 2012



SPC Survey: Pilot Project (Stough et al. 2012)

- How do “first-order” user groups use SPC products?
 - Most using the MD rather than the Watch for action
 - *One size fits all falls flat*: all use different products for different needs (ex. Rely on the text but show the watch graphic)

“We don’t have a lot of time to read ...we rely on pictures.”

-Emergency Manager

“We use those (Outlooks) to disseminate information to our viewers.”

-TV Meteorologist

	Relative Product Rank	Avg. Adjusted Rank
1	Convective Outlooks	7.667
2	Mesoscale Discussions	5.815
3	Watches	2.444
4	Forecast Tools	1.185
5	Status Messages	0.851
6	Website Overview	0.518
7	Storm Reports	0.418
8	Thunderstorm Events	0.222
9	Public Wx Outlook	0.111



Weather Information Used

Radar Services
 Local Emergency Managers
 Private Weather Services
 NWS Forecasts
 NWS Briefings/Packets

Forecasts

Watches

TO Warning

Warning Expiration
 Radar Services

Monitor Weather

Monitor Weather / Communicate with
 Weather Information Providers

Prepare/Write Plans

Relay of Weather Information to
 Administration/Staff/Departments

Modify Systems

Spatial Assessment
 of Severe Weather
 for Possible
 Impacts to Campus

Build Relationships

Exercises

Determine Special
 Events on Campus

Education

Activate
 Emergency
 Notification
 Systems

Assess Impacts

Other Event Types

Assess
 Vulnerabilities

Coordinate Staff
 and Recovery

Non-Severe
 (Majority of Year)

Severe Weather
 Approaching
 (~1-2 Days)

Warning
 (~30-50 mins)

Severe Weather
 Passed
 (~1 Day)



Severe Weather Status at Universities

SSWIM



Weaving Social Science Into Weather and Climate Research and Practice

Weather Information Used

	Radar Services Local Emergency Managers Private Weather Services		
	NWS Forecasts NWS Briefings/Packets	Watches	TO Warning
Forecasts			Warning Expiration Radar Services

Monitor Weather	Monitor Weather / Communicate with Weather Information Providers		
Prepare/Write Plans	Relay of Weather Information to Administration/Staff/Departments		
Modify Systems		Spatial Assessment of Severe Weather for Possible Impacts to Campus	
Build Relationships			
Exercises	Determine Special Events on Campus	Activate Emergency Notification Systems	Assess Impacts
Education	Assess Vulnerabilities		Coordinate Staff and Recovery
Other Event Types			

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Severe Weather Status at Universities



Sources of information

Why they use them...

Trust
Credibility
Accuracy
Convenience
Relevancy
Redundancy



Permission from Matt Meister



http://science.nasa.gov/science-news/science-at-nasa/2009/22apr_severeweather/

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School District Officials

Positive personal relationship between the officials and the source of information



University EMs

Positive working relationship between the EM and the source of information

SSWIM

Stakeholder weather preferences

WFOs should reach out to their stakeholders and create these relationships



Stakeholder weather preferences

WFOs should reach out to their stakeholders and create these relationships



"...to get a high level of precision on where those storms are is sometimes really tricky, and it does raise the question... do we put maybe the northern end of the district into sort of an emergency procedure mode when only the southern end of the district is being impacted?... it became very clear very quickly that this is entirely gray... we don't have an answer for that yet, we're struggling through that."

-Technology Director



Stakeholder weather preferences

WFOs should reach out to their stakeholders and create these relationships

Other Related Findings (Losego et al. 2012)

- “School staff have little to no training in meteorology yet interpret weather and advise on critical decisions”
- “Most school officials are unfamiliar with useful NWS products (e.g. Hourly Weather Graph) “



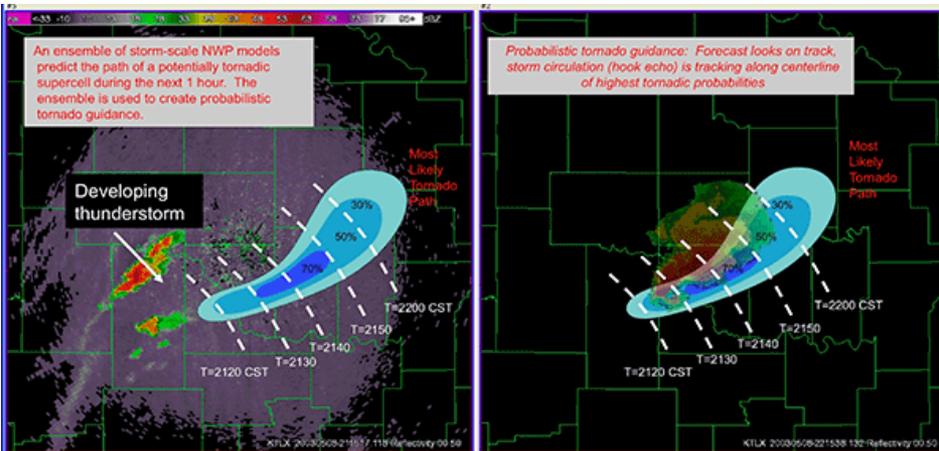
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Stakeholder weather preferences

- More spatial, timing, and intensity specificity to determine impacts and give advanced notice



<http://www.nssl.noaa.gov/projects/wof/>



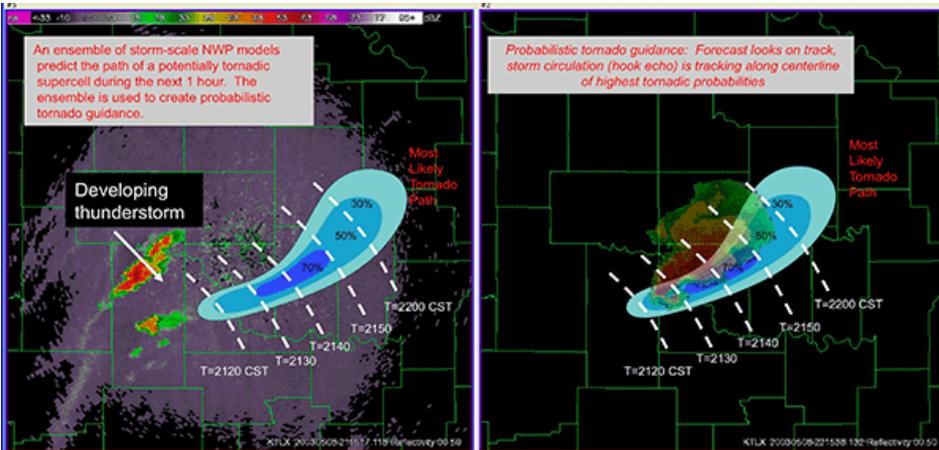
Stakeholder weather preferences

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“To have more detailed and exact information, preferably on a radar screen of the indication of a possible tornado or a confirmed tornado and the direction of travel would be a big help. Speed would be a big help. Those are the things that... would help us... focus on where these hazards might be heading and give us a little bit more time to send out an alert.”

–University Emergency Manager

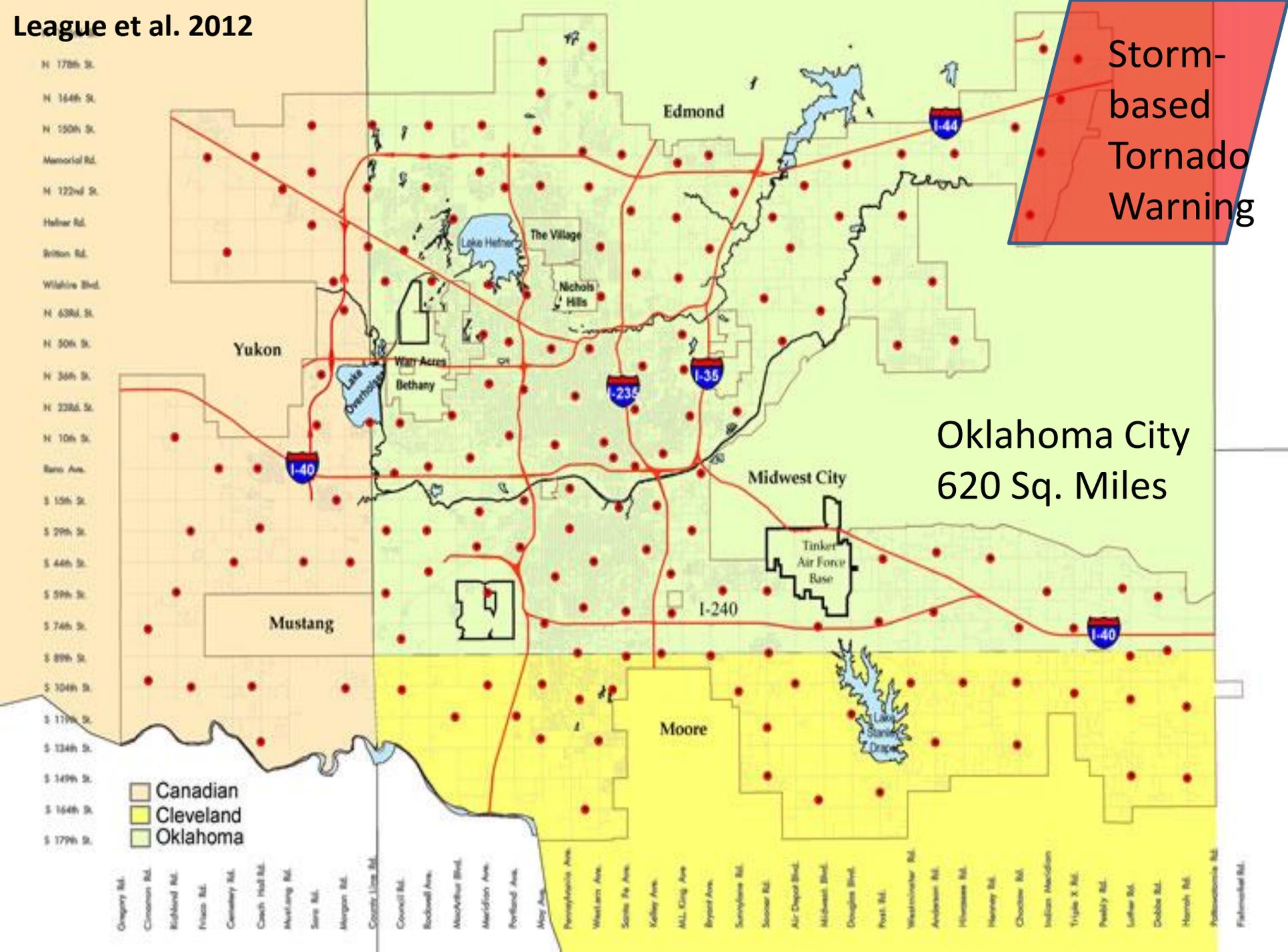


<http://www.nssl.noaa.gov/projects/wof/>

SSWIM

Storm-based Tornado Warning

Oklahoma City
620 Sq. Miles



- Canadian
- Cleveland
- Oklahoma

Gregory Bl., Cimarron Bl., Richmond Bl., Frisco Bl., Cemetery Bl., Cawth Hall Bl., Mustang Bl., Sans Bl., Mangum Bl., Coonrod, Liza Bl., Covell Bl., Redwell Ave., MacArthur Blvd., Meridian Ave., Powell Ave., May Ave., Pennsylvania Ave., Western Ave., Santa Fe Ave., Kelley Ave., M.L. King Ave., Bryant Ave., Sawyers Bl., Sooner Bl., Air Depot Blvd., Midwest Blvd., Douglas Blvd., Post Bl., Westminster Bl., Anderson Bl., Hussare Bl., Henry Bl., Choate Bl., Indian Medicine, Triple X Bl., Peckly Bl., Luffer Bl., Cobble Bl., Harrah Bl., Postonville Bl., Fairmount Bl.

N 178th St.
 N 164th St.
 N 150th St.
 Memorial Rd.
 N 122nd St.
 Halper Rd.
 Britton Rd.
 Wilshire Blvd.
 N 63rd St.
 N 50th St.
 N 36th St.
 N 23rd St.
 N 10th St.
 Reno Ave.
 S 15th St.
 S 29th St.
 S 44th St.
 S 59th St.
 S 74th St.
 S 89th St.
 S 104th St.
 S 119th St.
 S 134th St.
 S 149th St.
 S 164th St.
 S 179th St.

Q: Does your EM operation have the capability to warn **SUBREGIONS or areas within its jurisdiction?**

	OK (n=93)	TX (n=97)
YES	44%	66%
No	56%	34%

Subregional Warning Frequency	OK (n=37)	TX (n=64)
80% or more of the time	48%	19%
60-79% of the time	10%	8%
40-59% of the time	3%	9%
20-39% of the time	0%	5%
<20% of the time or Never	33%	48%
I don't know	8%	11%

Stakeholder views on increased lead time

- **Mixed reviews**
 - Increased lead time vs. spatial specificity, accuracy, and false alarms

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-School District Superintendent



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- Increased lead time vs. spatial specificity, accuracy, and false alarms



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-School District Superintendent

Other Related Findings (League et al. 2012)

- **Best amount of time to warn community about tornado threat:**
 - OK EMs: Med.= 20 mins
 - TX EMs: Med.= 17.5 mins

“It loses its emergency status.”

-OK Emergency Manager



Stakeholder views on increased lead time

- **Increased lead-time with uncertainty will provide time to go over plans and communicate with departments on campus**
 - **Very similar to what already takes place with advanced notice from SPC and NWS Outlooks**



<http://minnesota.publicradio.org/display/web/2007/08/09/strain/>

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“... would give us time to digest, to begin to look at questions, to begin to say okay do we have all the facts right now? It would give us a lot of decision making power... It would give us the ability to better respond. ”

-School District Technology Director



<http://minnesota.publicradio.org/display/web/2007/08/09/strain/>



Stakeholder views on increased lead time

- Increased lead-time with uncertainty will provide time to go over plans and communicate with departments on campus
 - Very similar to what already takes place with advanced notice from SPC and NWS Outlooks
 - Many would hold off on taking action until the weather became more imminent



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Stakeholder views on increased lead time

- **Warn-on-Forecast will force school districts and universities to modify existing plans**



Stakeholder views on increased lead time

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“... we’d probably have to look at the way we communicate with the campus community in terms of the language that would be used... But that’s not the way the National Weather Service operates right now.... So if they did start to operate that way, I don’t know what we’d do. I’m sure we’d take another look at it. I know we’d take another look at it.”

-University Spokesperson and Emergency Communication Sub-Committee Member



Stakeholder views on increased lead time

- Warn-on-Forecast will force school districts and universities to modify existing plans

Other Related Findings (Butterworth 2010)

- What implications will there be for the broadcast industry?
 - Broadcasters are used to staying on for the duration of a warning. What happens if the warning is two hours long?



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Other social science related work

Evaluating the efficacy of Call-to-Action statements

Garfield et al. 2011

- Compares current CTAs with new CTAs that are extensions of findings in risk communication studies
 - <http://ams.confex.com/ams/39BROADCAST/recordingredirect.cgi/id/18179>

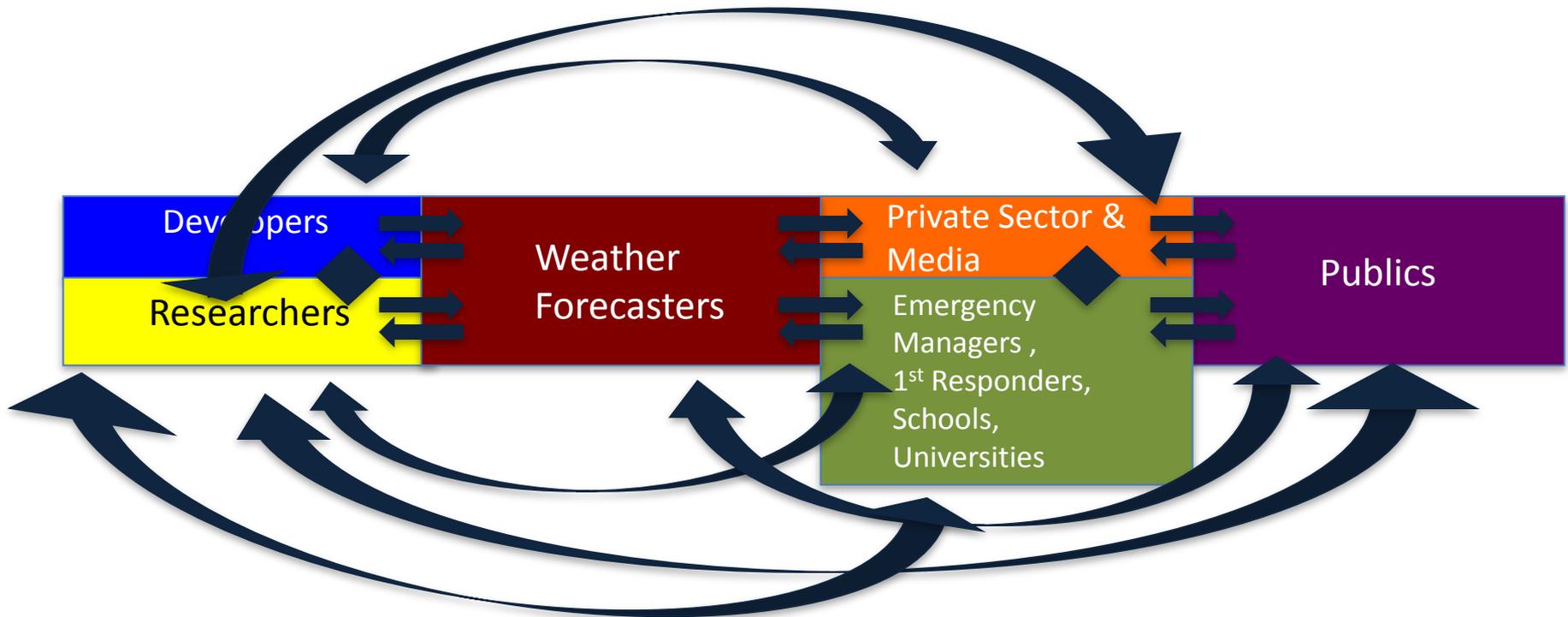
Examination of individual responses to tornado warnings

Klockow Dissertation

- Interviews about April 27 outbreak
 - Recorded talk available soon from AMS 2012 Annual Meeting
- Real-world case studies
- Applied cognitive psychology experiments



Several research projects have highlighted how different stakeholder groups make weather sensitive decisions, providing insight necessary for the development of new meteorological products and operations.



Warn-on-Forecast needs to know how stakeholders use weather information to support their decisions

Observations and suggestions

1. Warnings under the Warn-on-Forecast paradigm will have to be reframed and redefined with the input of stakeholder groups.
 - How will current warning systems work with the WoF paradigm? *How can a siren communicate a 30% probability?*
 - Will warnings with uncertainty be a “warning”, an “enhanced watch”, or something entirely different?



Observations and suggestions

2. The idea of lead time needs to be re-conceptualized from the perspective of users
 - **Lead-time can be defined in very different ways by different people**
3. Expansion of research on what people are doing with the time they have now
 - **What decisions are being made and why?**
 - Not just during the warning but with preparedness, forecasts, outlooks, and watches



Concluding thoughts...

- Product development must occur with the inclusion of ALL user perspectives and needs
- Needs are individualistic



http://commons.wikimedia.org/wiki/File:FEMA_-_36205_-_Federal_and_Local_Emergency_Managers_work_together_in_Palo,Iowa.jpg



<http://www.renci.org/news/releases/ncema-conference-to-reveal-new-disaster-management-tools>



<http://insighteatorlando.com/index.php/rollingfeatured/master-disaster-plan>



Q: Does your jurisdiction **ALWAYS** warn the public when the NWS issues a tornado warning that includes some portion of your jurisdiction?

	Oklahoma (n=93)	Texas (n=95)
YES	64%	61%
NO	36%	39%

Q: Has, or would, your EM organization warn the public about a tornado threat when the NWS **HAS NOT YET** issued a warning for your area of jurisdiction?

	Oklahoma (n=91)	Texas (n=92)
YES	79%	60%
NO	21%	40%

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A one size fits all approach is ineffective... and now we have evidence of this



Concluding thoughts...

- **What are the ways that WoF can accommodate these findings to make its research most useful to weather sensitive decision makers?**
- **A substantial investment is needed to ensure that WoF is developed in a useful and meaningful way**
- **Social science requires multiple studies by multiple scientists to understand the complexities of decision making**



<http://www.garner-es.com/eocSupport/>



<http://www.nationalguard.mil/news/archives/2010/04/042710-Mongolian.aspx>



Acknowledgements

- **Thank you Warn-on-Forecast project and Hazardous Weather Testbed for your support throughout these master's theses.**
- **Jen Spinney and the SSWIM team thanks Steve Koch for funding the Global Systems Division (GSD) IHIS Ethnographic Project.**



Additional resources

- **Annotated Bibliography written by SSWIM**
 - Social science perspective of time and hazards
 - <http://www.evegrunfest.com/SSWIM/pdfs/SswimTimeLit.pdf>
- **Weather and Society Watch Newsletter from NCAR's Societal Impacts Program**
 - <http://www.sip.ucar.edu/news/>
- **AMS Weather Warnings and Communication Conference in Oklahoma City, OK in June 2011**
 - <http://ams.confex.com/ams/39BROADCAST/webprogram/1STORMWARN.html>
- **AMS Annual Meeting Symposium on Policy and Socio-Economic Research in New Orleans, LA in January 2012**
 - <http://ams.confex.com/ams/92Annual/webprogram/7POLICY.html>



References

- Butterworth, R.E. 2010. *The diffusion of new media and radar technology and the role of broadcasters' prior experience and public perceptions in television severe weather coverage*, Thesis, University of Oklahoma.
- Garfield, G., K. Klockow, S. Hoekstra, and S. Cobb. 2011. The tornado warning: Evaluating the efficacy of Call-To-Action statements. American Meteorological Society Conference of Weather Warnings and Communication, June 23.
- Losego, J.L., K.J. Galluppi, and B.R. Montz. 2012. Improving risk characterization for NWS decision support for emergency management. *Weather and Society Watch*, 6(1), 13-15.
- League, C., B. Philips, E.J. Bass, and W. Diaz. 2012. *Tornado warning communication and emergency manager decision-making*. American Meteorological Society Symposium on Policy and Socio-economic Research. January 24.
- Spinney, J. and E. Grunfest. 2012. *Integrated Hazards Information Services (IHIS): Incorporating partner preferences into Global Systems Division forecasting software*. American Meteorological Society Conference on Interactive Information Processing Systems. January 23.
- Stough, S., E.M. Leitman, J.L. Peters, and J. Correia. 2012. *On the role of Storm Prediction Center products in decision making leading up to hazardous weather events*. American Meteorological Society Symposium on Policy and Socio-economic Research. January 24.



Thank You

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http://www.westernbus.com/blue_Bird.php

