Lake Effect Snow Warning Polygon Experiment Verification

David Church GLOMW - Cleveland, OH May 01-03, 2018

Background



- Current NWS warnings issue long-fused Lake Effect Snow Watches and Warnings on a zone basis
 - Most NWS zones are counties
 - This is true in the Buffalo CWA with the exception of Cayuga County







Highly Localized / Transient





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- Warning Polygons would be issued to delineate the highest impact areas
- As the lake effect snow moves, polygon areas change spatially and temporally



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EXPERIMENTAL CONTENT BELOW ... DO NOT USE OPERATIONALLY
PLEASE SEE BELOW LINKS FOR MORE INFORMATION ON THIS EXPERIMENT
HTTP://WWW.WEATHER.GOV/BUF/POLYGON PDD
HTTP://WWW.NWS.NOAA.GOV/OS/NOTIFICATION/PNS15LAKE EFFECT SNOW.HTM
TO VIEW THE EXPERIMENTAL POLYGONS PLEASE SEE:
HTTP://WWW.WEATHER.GOV/BUF/LESPOLYGON
COORD...4391 7516 4380 7620 4354 7638 4341 7619
        4342 7550 4360 7513
TIME 160101T0000Z-160101T1200Z
COORD...4402 7516 4402 7559 4387 7628 4367 7620
        4377 7552
TIME 160101T1200Z-160101T1800Z
COORD...4387 7556 4378 7620 4354 7638 4343 7558
        4359 7545
TIME 160101T1800Z-160102T0000Z
COORD...4348 7581 4350 7536 4364 7527 4366 7611
        4335 7668 4322 7587
TIME 160102T0000Z-160102T1200Z
COORD...4388 7544 4387 7622 4352 7623 4342 7550
        4360 7513
TIME 160102T1200Z-160103T0000Z
$$
```

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Benefits



- Area of False Alarm would be reduced thus increasing the effectiveness of the warning
- Ever-increasing use of point specific information requires the NWS to communicate this location-specific impact information in a more efficient means
- Enhanced information provided in polygon lake effect warning areas would allow for a more organized and cost-effective use of public resources to minimize the effects of these high-impact lake effect events
- Minimize the effect of LES events on transportation and commerce



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2016-2017 Season

Forecast Hourly Snowfall Rate

al Weather Service Buffalo NY Created: 1234 PM TH 11/04/1



- Polygons were created for lake effect snows off both Lakes Erie and Ontario in the Buffalo CWA
- Updates to web display





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Background

- Polygons created when zone-based Lake Effect Snow Warning issued
- > 2 to 6 polygons per lake per event
 - Timing & location information!
- Polygons can be updated at ANY time (ESTF)
 - Always the latest and best forecast information available
 - "Goal posts" can be set wide to start and narrowed as confidence increases





Intense band of #lakeeffectsnow (2-3"/hr) to reach #Buffalo metro area during peak rush hour this evening. Adjust commute plans if possible





9:55 AM - 5 Jan 2017

26

21

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Are we any good? What value is added?



Methodology – The problem

- Verification Nightmare
 - Hundreds of polygons over a multi day event
 - Reliable snowfall reports on 24 hour cycle
 - Most polygons between 6 and 18 hours long
 - Polygon emphasis on area of high impact
 - Verification emphasis on snow amount, not rate / impact



Methodology – The Solution

- Verification for FIRST warning issuance only
 - This should be our "worst case" scenario
 - Median first-issuance polygon issued 24 hours before it goes into effect, 75th percentile polygon 39 hours!
- Develop a spatial verification scheme
 - Combine radar data and reports to define impact area during polygon valid time
 - GIS used to compare spatial footprint of impact area, polygon warning and zone warning
 - Level playing field for POD, FAR, CSI stats



First Issuance Polygons Example





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Spatial Verification Scheme Example



Spatial Verification Scheme Example

Lake Ontario Polygon #2 12/10/17 21Z to 12/11/17 03Z Issued 26 hr lead time; 6 hr duration



158,894

2

Spatial Verification Statistics 2016–2018 (2 seasons, 131 polygons)

	Median	POD	FAR	CSI	
	Zone	0.99	0.60	0.39	
	Polygon	0.71	0.22	0.56	
	Change	-0.28	-0.38	+0.17	
Now repeat			t 131	l tim	es

- Easy to have a high POD when "casting a wide net"
- FAR fell more than POD: a good thing!
- Net result: Polygon warnings provided more skilled information than zone warnings
- Not shown: Population weighted stats very similar



Spatial Verification Statistics 2016–2018 (2 seasons, 131 polygons)



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Population Reduction from Zone-Based Warning

- Correct population reduction averages 2 orders of magnitude greater than incorrect reduction
- Median people
 correctly removed: 196,888
- Median people incorrectly removed 1,624



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Spatial Verification Statistics 2016–2017 (1 season, 77 polygons, 5 verifiers)

Polygon vs Zone POD, FAR, CSI: Standard Deviation of Verifier



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Spatial Verification Statistics 2016-2017 (1 season, 77 polygons, 5 verifiers)

- 4 out of 5 verifiers agree, polygons are good for you!
 - Average Polygon CSI: 0.50, Zone CSI: 0.43
 - 1 verifier found Polygon CSI: 0.45, Zone CSI: 0.50
- Subjectivity does matter, but results don't vary dramatically
- Remember, these first-issuance polygons should be the *worst* verifying of the bunch



Methodology – The Solution

- How does the total warning time change in a polygon warning scheme?
 - Worst case scenario is zero warning time saved
 - So what is the best case?
 - Use the "zero lead time" or valid polygons
 - GIS use to compare how long the average person is warned in a zone-based world and a polygon-based world for each event



Radar and Valid Polygons





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Zone Based Warning Hours

Lake Effect Storm "E" Zone Warning Hours





Polygon Based Warning Hours





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Event E - Warning Time Matters!



- Population Weighted Warning Times:
 - Zone Based
 - Avg 29.79 hrs
 - Polygons
 - Avg 16.93 hrs
- Avg reduced 12.8 hrs or 43% less time!



Warning Time Savings

- The average person in an average event was warned:
 - Polygons hours: 16.1 hrs
 - Zone hours: 29.3 hrs
- Most reduction warnine: 36.4 hrs
- Increased specificity of the warning
 - When will it snow at MY house?
 - When will MY section of interstate need to be plowed?
 - When will MY county be impacted?



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Summary

- Polygons overall show slightly better skill in defining area of impact
 - POD declines, but FAR declines more!
 - Stats only calculated on expected worst case / first issuance only, should improve with updates!
- Polygon Warnings can add significant value both *spatially* and *temporally*
 - Reductions in population and area warned
 - Reductions in **TIME** a location/person is warned
 - IDSS!



Future Work

- Explore the future of impact based long-fuse polygons
 - What place does this product have in a HazSimp world?
 - Expansion to other Great Lakes Offices?
 - Can these polygons be useful in other long-fuse products?
 - High wind events
 - Mesoscale banding in winter storms

