Product/Service Description Document
Experimental Lake Effect Snow Warning Polygons
WFOs Albany, Binghamton, Buffalo and Cleveland
Updated October, 2021

PART 1: MISSION CONNECTION

Product / Service Description

Lake effect snow (LES) is a unique winter event which can cause localized extreme winter weather with high impact to the public and commerce. Snowfall rates of up to three inches per hour can be common in these snow bands and in extreme cases can exceed four inches per hour. It is known that snowfall rate can have a higher impact than actual snowfall totals. In many cases, the focus of these bands of snow will have widths of only ten to twenty miles across.

Weather Forecast Offices (WFOs) serving the Great Lakes issue long-fused Winter Storm Watches, Warnings, and Advisories on a zone by zone basis and highlight lake effect snow in these products. A problem with this issuance scheme is that due to the localized nature of lake effect snow, significant portions of counties within the warning may not be receiving substantial, if any, snowfall. Another issue is the transient nature that some of these events can exhibit as shifting winds move the high-impact intense snows across the region resulting in confusion as to where the highest impacted areas are within a warned zone or county.

Through the winter of 2021-2022, WFOs Albany, Binghamton, Cleveland, and Buffalo will create polygons to be used in lake effect snow situations, delineating the locations of the highest impact of the lake effect snow. The polygons will not be produced for Winter Storm Watches and Winter Weather Advisories. As the lake effect snow band moves, polygon areas will change spatially and temporally within the warned area to best delineate the areas of highest impact over the course of the lake effect snow event (for example, snowfall rate, blizzard-like conditions, total snowfall). Issuance of the product will be based upon forecaster confidence of reaching 12-hour and 24-hour Winter Storm / Lake Effect Snow Warning criteria, as noted in NWSI 10-513, pages D-9 and D-10.

The experiment adds latitude/longitude coordinates to segments of the Winter Weather Message text products and provides increased specificity with polygons issued for sub-county areas. These coordinates will be added to products containing the LES Warning Valid Time Event code (LE.W) for certain zones in western and central New York and northeastern Ohio, along and downwind of Lake Erie and Lake Ontario.

Purpose/ Intended Use

Polygon-based Lake Effect Snow Warnings provide enhanced information as to the highest impact areas bordering Lake Ontario and eastern Lake Erie. Reducing the size of the false alarm area increases the effectiveness of the warning. During the 2016-2017 season, the reduction in spatial false alarm rate (FAR) fell from 0.54 for zone-based warnings to 0.20 for polygon based warnings. This reduction to the false alarm ratio resulted in a 0.17 point (or a 30 percent improvement) in the critical success index for

the winter seasons from 2016-2018.

The science of forecasting lake effect snow has progressed to the point where snowfall forecasts with associated impacts can be produced with temporal and spatial resolutions that are greater than our current zone-based system. The ever-increasing use of point-specific information through the internet, smartphones, etc. requires the NWS to communicate this location-specific impact information in a more efficient means.

The enhanced information provided in polygon Lake Effect Snow Warning areas will allow for a more organized and cost-effective use of public resources to minimize the effects of these high-impact lake effect snow events. This, in turn, will minimize the effect of lake effect snow events on transportation and commerce.

An added service improvement that has resulted from the previous years' experiments is the warning time savings. The average person under a warning was under a zone-based warning for approximately 29.3 hours, while for a polygon-based warning, the average person only spent approximately 16.1 hours under the warning. This resulted in an average time savings of about 45% over the course of the season.

For more information regarding Lake Effect Snow Warning Polygon verification, please refer to Eastern Region Technical Attachment 2021-01 Lake Effect Snow Warning Polygon Experiment: Verification, authored by David Church, NWS WFO Buffalo, NY.

The continued multi-office usage of the lake effect snow polygon experiment will allow us to learn about office-to-office collaboration and how the polygons are coordinated in both space and time across multiple WFO county warning areas.

Audience

The lake effect snow polygon warning area is intended for a wide audience. The delineation of areas of impact will not only serve our emergency response and Government partners but also be a viable method to be used by the broadcast media to display site specific impact information. Anyone needing specific lake effect snow location in time would find this information valuable, including the general public, through polygon displays on National Weather Service (NWS) Webpages.

Presentation Format

Lake Effect Snow Warning area information is presented in several formats, increasing the user audience of this product. Graphically, the polygon information is available via a public-facing web page. The vertices of the polygon delineation will be available via text product (similar to the polygon latitude/longitude information on NWS Severe Thunderstorm Warnings). This information will also be made available in a downloadable KML/KMZ file for the higher-end Geographical Information System (GIS) users.

Evaluation/Feedback Method

Feedback is expected through interaction with core NWS customers and partners, via this survey:

https://www.surveymonkey.com/r/LakeEffectSnowWarningPolygons_2021

A verification method including an evaluation of the decrease in false alarm area and affected population will continue to be conducted during the test phase.

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Future Plans

Consideration is underway for the evolution of the Experimental Lake Effect Snow Warning polygons into operational use. The NWS as a whole is exploring the transition from zone-based long-fuse hazard products into polygon-based long-fuse hazard products, however there is no estimated time that this process will be complete. Given extremely favorable feedback received since this experiment was introduced in 2015, the NWS does not favor a premature end to this product before this capability is fully realized. Options that will continue to be explored during this year's experiment include: 1) Transition to operational use of polygons for Lake Effect Snow Warnings prior to the broader transition to polygons for all long-fuse products; 2) transition to operational status of the WFO Buffalo Lake Effect Snow Warning polygon website display, while zone based polygons would still display on the official Watch/Warning/Advisory (WWA) map; and 3) transition the Lake Effect Snow Warning polygons to operational status for display on a different viewing platform, such as the NWS GIS Enterprise Viewer or the NWS Weather and Data Hazard Viewer, while zone based polygons would still display on the official WWA map.

PART II: TECHNICAL DESCRIPTION

Format and Science Basis

A Graphical Forecast Editor (GFE) procedure will be used by forecasters to create an area warranting a polygon. The primary inputs to the polygon will be forecast snow amount and county-based hazards, although other variables related to blizzard-like conditions may be used as well. For example, one might focus on areas expected to receive >1"/hour within counties designated in a Lake Effect Snow Warning as determined through forecaster collaboration, with the option of choosing a different snow rate and additional forecast elements needed to create a set of highly focused polygons that key into the most significant areas within a set of counties over a period of time.

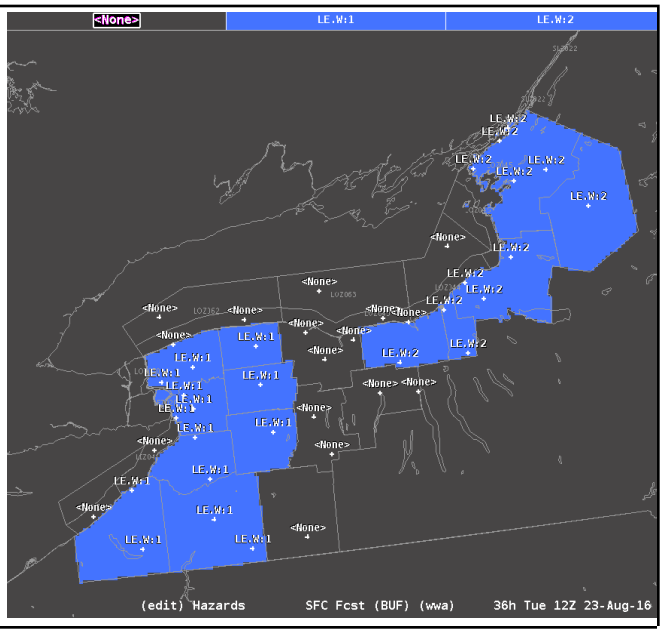
This procedure will output a set of LAT…LON/TIME paired lines denoting the polygon and valid time with as few as three and as many as 20 vertices. These lines will be embedded experimentally within the winter warning product text (WSW) between the && and the $$ delineators. The output should resemble the LAT…LON/TIME lines found in short-fused products like Severe Thunderstorm Warnings (SVR) substituting COORD for LAT…LON and TIME formatted as Y##M##D##T####Z (see below for example). However, since the warning area may change with time, there may be multiple LAT…LON/TIME pairs for each valid time of a polygon. The county-based warning will continue to be used as the official warning and source for official verification, while the polygons will fine tune the hardest hit areas with time. The maximum number of COORD/TIME pairs will depend on the forecaster. Grouping COORD /TIME pairs in 6 or 12 hour increments with 5-6 vertices may provide a desirable text output.

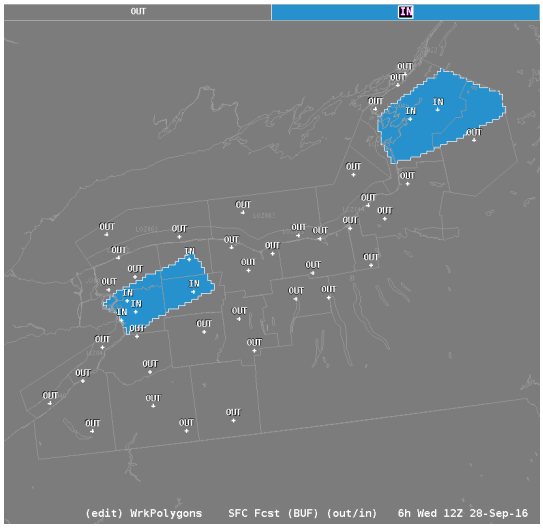
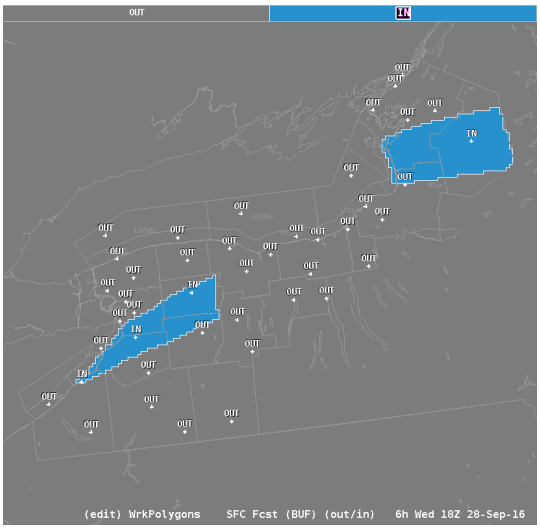
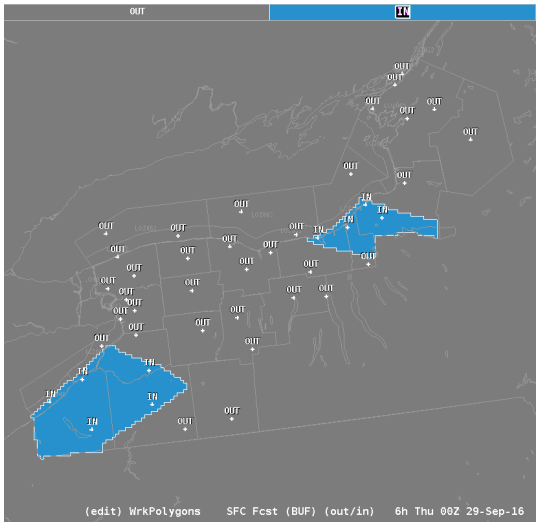
An example below shows a typical warning for a lake effect snow event downwind of Lakes Erie and Ontario. Seven counties downwind of Lake Erie (in blue) are under a warning: Niagara, Orleans, Erie, Genesee, Wyoming, Chautauqua, and Cattaraugus and five counties downwind of Lake Ontario (in blue) are under a warning: Wayne, Northern Cayuga, Oswego, Jefferson and Lewis, but only a small section of those counties may be affected during different times. When looking at the warning without polygon detail, it is very difficult to determine where and when the lake band might be at any given time. Proposed polygons (blue) delineate the affected areas. This example shows polygons moving once

every several hours.

The text output for the warnings downwind of Lake Erie would have 6 lines of text for this event. Three separate polygons are shown with a lake effect snow band slowly moving southward. The first two polygons have 4 vertices while the other polygon has 5 vertices. In the scenario below, spotters within each of the 5 counties might eventually verify the warning, although several portions of each county may never see a single snowflake.

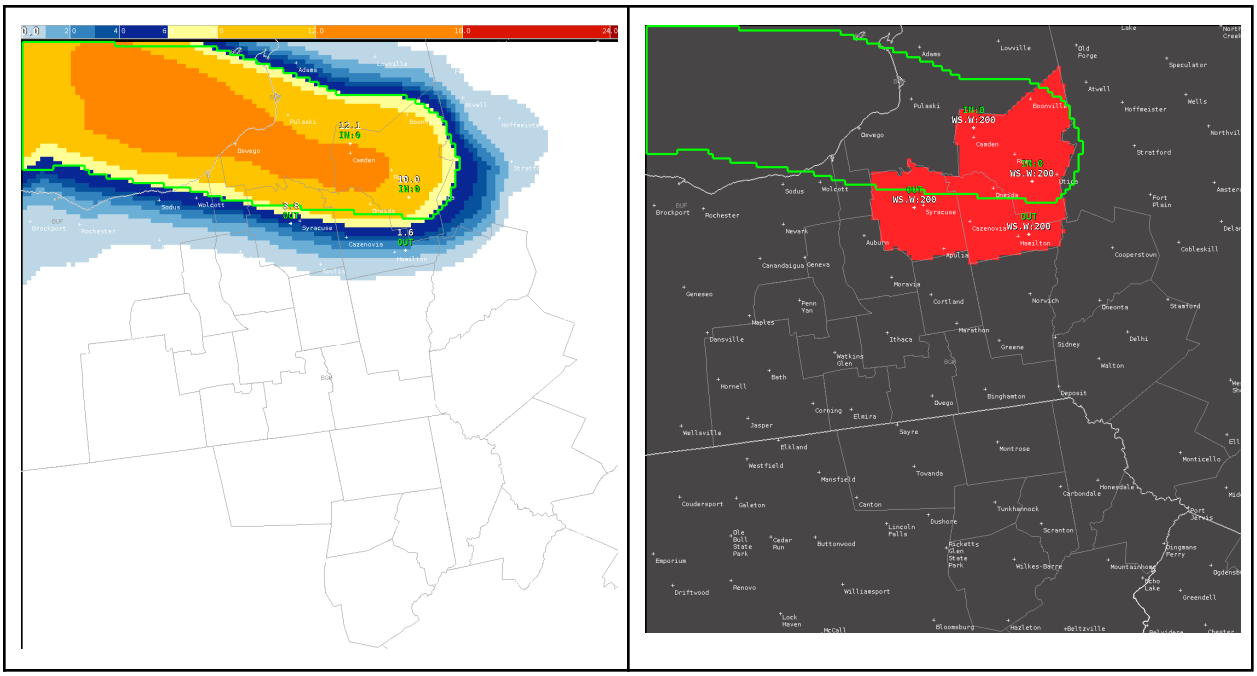
COORD 4323 7819 4304 7802 4234 8003 4252 8022
TIME Y15M12D30T2100Z-Y15M12D31T0000Z
COORD 4307 7805 4274 7278 4250 7797 4230 8019
TIME Y15M12D31T0000Z-Y15M12D31T1200Z
COORD 4276 7913 4240 7841 4200 7889 4200 7976 4252 7978
TIME Y15M12D31T1200Z-Y16M01D01T0000Z

Twelve counties in a sample warning without polygons: Near Lake Erie: Niagara Orleans, Erie, Genesee, Wyoming, Chautauqua, Cattaraugus Near Lake Ontario: Wayne, Northern Cayuga, Oswego, Jefferson and Lewis	

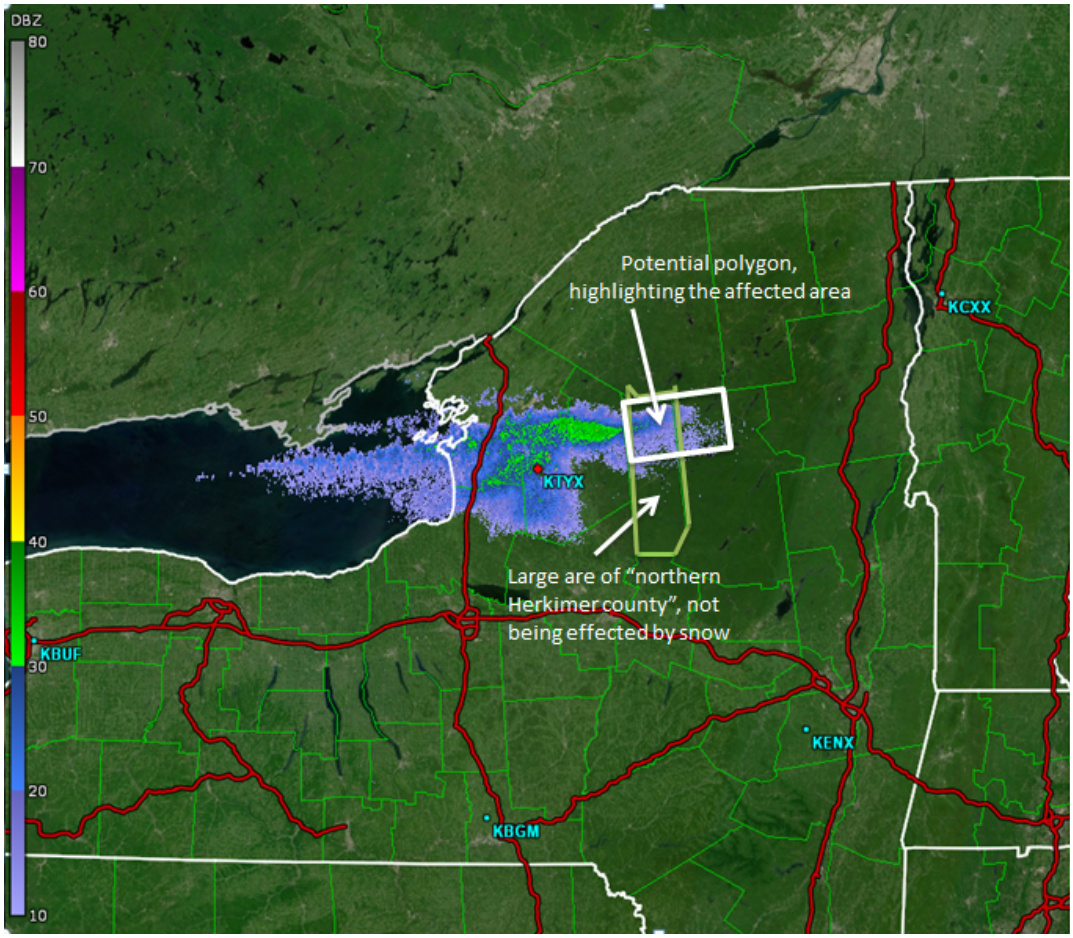
2100-0000Z: All counties are in the current warning, but only a small portion of the area is affected by the lake snows. Near Lake Erie, this includes southern Niagara and Orleans and northern Erie and Genesee counties. Near Lake Ontario, this includes central Jefferson and northern Lewis counties. The remainder of the counties are not forecast to be under the lake band during this time, despite being under the warning.	
0000-1200Z: All counties are in the current warning, but only a small portion of the area is affected by the lake snows. Near Lake Erie, this includes Erie, Genesee and northern Wyoming counties. Near Lake Ontario, this includes southern Jefferson, central Lewis and northern Oswego counties. The remainder of the counties are not forecast to be under the lake band during this time, despite being under the warning.	
1200-0000Z: All counties are in the current warning, but only a small portion of the area is affected by the lake snows. Near Lake Erie, this includes southern Erie, Chautauqua and western Cattaraugus counties. Near Lake Ontario, this includes northeast Wayne, northern Cayuga and southern Oswego counties. The remainder of the counties are not forecast to be under the lake band during this time, despite being under the warning.	

In addition to the text output and a graphic display on NWS webpages, KML/KMZ data will also be available.

Additionally, NWS WFOs are able to better target the areas where significant impacts from lake effect snow are possible downwind of the lakeshore counties with polygon-based warnings than with the traditional county-based warnings. The left image below is an example of a storm-total snowfall forecast for a lake effect snow event from WFO Binghamton. In this case, the snow band is predicted to extend east-southeastward from Lake Ontario into northern portions of the WFO Binghamton County Warning Area. All of Oneida, Onondaga, and Madison Counties in central N.Y. would be under a Winter Storm Warning under the county-based warning system (shaded in red in the right image below). Note how the southern two-thirds of Madison and Onondaga Counties, including the city of Syracuse, are included in the county-based warning even though they are located south of where the heaviest and most persistent snow band is expected. The green contour on the same right image below outlines a much more geographically-targeted warning that is possible with a polygon-based system. The warning polyon includes only those locations that are expected to experience significant impacts from this LES event.



Similarly, in the example below, a snow band extends east from Lake Ontario across the western Adirondacks of northern New York, affecting only a small portion of Herkimer county in WFO Albany's county warning area. A large area of the "northern Herkimer county" zone (outlined in green) is not being affected by lake effect snow, yet the current system would have the entire "northern Herkimer county" zone in a warning. The proposed polygon (outlined in white) would highlight only the area being affected.



Availability

The text portion of the polygons will be available experimentally via the WSW using an already familiar COORD/TIME format. Graphical products and links to GIS files will be available via the Internet. The graphical products will be easy to use and provide users with simple navigation capabilities similar to looping radar.

Additional Technical Information

The text output will be created using software provided by NOAA Global Systems Division (GSD) and locally modified to fit into the existing WSW format. This software will simplify polygons to a user choice of 3-20 vertices. Short-fetch (multi-banded) lake effect snow events will require wide polygons with lower snow rate thresholds. However, even multi-banded lake effect snow events should show some movement with time and therefore show reduced areal extent when compared to static county-based warnings.