Ensuring Effective Snow Squall Messaging and Action by Decreasing False Alarms

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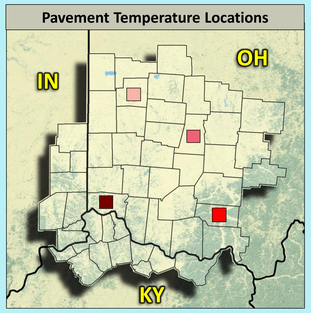
Introduction

Each year snow squalls, intense short-lived bursts of heavy snowfall that lead to a quick reduction in visibilities and are often accompanied by gusty winds, cause significant impacts to motorists. Ensuring that appropriate safety precautions are taken by the public relies on a low false alarm rate. The snow squall (SNSQ) parameter [1] and other ingredients-based research have helped extensively in snow squall forecasting. However, not all days highlighted as potential snow squall days based on these parameters end up producing impactful, dangerous snow squalls. This study evaluated data over a two year period for days in which the NWS Wilmington, OH forecast area was highlighted with values >1 by the SNSQ parameter. The objective of this study was to examine a variety of factors and determine which of these helped lead to either a high or low impact event.

Methodology

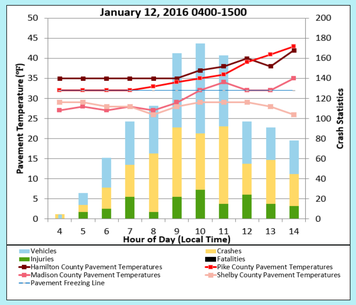
- Twenty three events were evaluated during the winters of 2015-2016 and 2016-2017 where the SNSQ parameter showed a value of >1 the day before the event.
- Crash statistics were utilized to determine which events had more impacts to motorists.
- Radar reflectivity, time of day, surface winds, surface air temperatures, and pavement temperatures were examined to determine which factors were potentially more substantial in leading to impactful snow squalls.
- RAP and LAPS model data were examined for upper-tropospheric potential vorticity (PV) anomalies in addition to the spatial coverage and the magnitude of the SNSQ parameter.

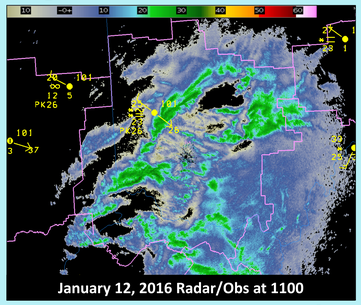


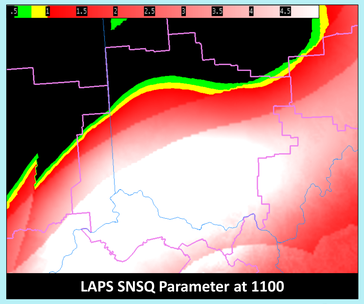
Partnership to Save Lives

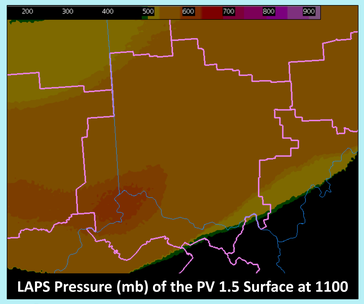
The Ohio Department of Transportation reaches motorists where they are impacted based off of NWS products.

Case Study Results: January 12, 2016 and April 2, 2016

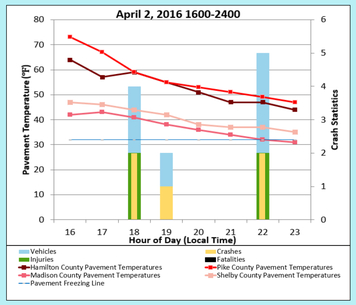


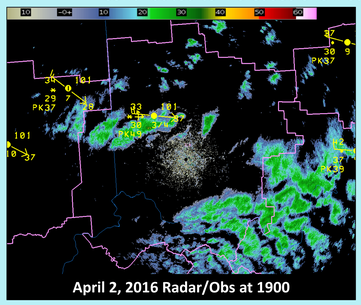

January 12, 2016 Radar/Obs at 1100

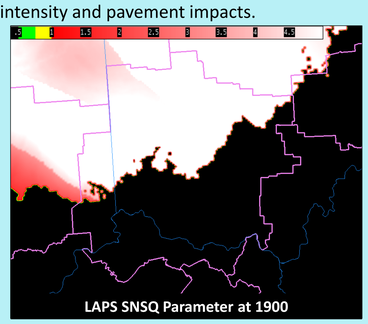

LAPS SNSQ Parameter at 1100

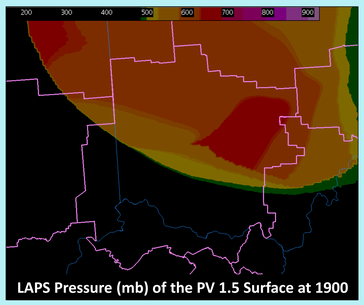

LAPS Pressure (mb) of the PV 1.5 Surface at 1100

Large pileups with numerous crashes occurred with pavement temperatures in the 30s°F. Gusty winds, air temperatures in the middle 20s°F to lower 30°Fs, and an approaching PV anomaly contributed to increased snow squall intensity and pavement impacts.




April 2, 2016 Radar/Obs at 1900


LAPS SNSQ Parameter at 1900


LAPS Pressure (mb) of the PV 1.5 Surface at 1900

Although there were high SNSQ parameter values, a PV anomaly, a concentrated maximum in the 1.5 PV pressure level within the PV anomaly, gusty winds, and higher radar returns, there were very little impacts with warmer pavement temperatures. The Madison and Shelby county sensors were more representative of the SNSQ locations earlier in the event and then the Hamilton and Pike county sensors were later in the event. Thus pavement temperatures in the snow squall area remained primarily above 40°F.

Conclusions

SNSQ parameter characteristics can be deciphered by looking at expected winds, air temperatures, and PV anomalies. Stronger wind gusts and higher moisture can lead to higher SNSQ parameter values, but warmer pavement temperatures can mitigate impacts. Examining pavement temperatures along with the other ingredients listed below, can lead to improved forecasting, decreased false alarms, and subsequently the potential for better response and mitigated impacts.

Pavement Temperatures

There were significant impacts when pavement temperatures leading into an event were 35°F and below and remained at or below 38°F through the event. Substantial impacts also occurred if pavement temperatures fell into the 30s°F early, however impacts were greatly reduced above 40°F and pavement temperatures above 50°F had virtually no impacts due to snow squalls.

PV Anomalies

PV anomalies, especially having a concentrated maximum in the 1.5 PV pressure level within the PV anomaly, were an important component of snow squall formation due to enhanced large scale ascent and especially the reduction in lower level stability.

Wind Gusts

Values >30 knots were noted in the top three events and helped lead to reduced visibilities, however this was not a lone determining factor on whether there were significant impacts.

Snow Squall Characteristics

Snow squalls in a banded orientation were much more impactful than discrete cellular squalls. Seven of the top nine most impactful events had primarily banded snow squall characteristics, while events ordered 10 to 23 based on impacts had primarily discrete cellular squalls when squalls were present. Overall, discrete cellular events also had less observations with visibilities of a ½ mile or less. Although the top three events had radar reflectivity values in excess of 35 dBZ, this was not a determining factor for how impactful an event was.

Time of Day

The most impactful hours were during the day, especially from 1500 to 1900 local time.

Air Temperatures

Changes in temperature were not as important as the air temperatures themselves. Air temperatures from the middle 20s°F to 34°F had the most visibility reductions of a ½ mi or below.

Acknowledgements

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References

[1] Banacos, P. C., A. N. Loconto, and G. A. DeVoir, 2014: Snow squalls: Forecasting and hazard mitigation. *J. Operational Meteor.*, **2** (12), 130-151.

Kentucky State Police-Kentucky Collision Database http://crashinformationky.org

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