Snow Squalls: An Observed Sounding Perspective

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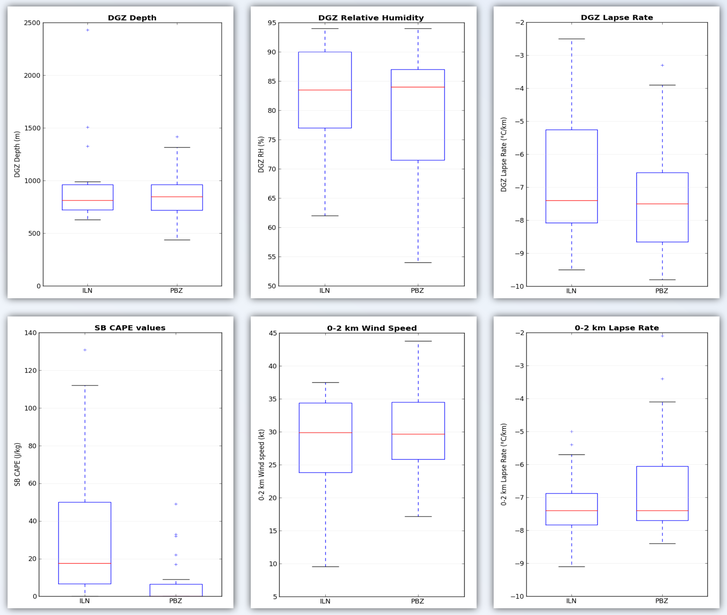
Introduction

Snow squalls are characterized by gusty winds and rapid onset of heavy snow, often leading to near-zero visibilities. These conditions have resulted in numerous high impact vehicle pileups, interstate closures, and traffic fatalities. Extensive research has been conducted on synoptic and mesoscale snow squall environments in the Northeast to develop a parameter (SNSQ) that has proven to be useful in forecasting environments conducive to snow squall development. This study builds off research surrounding the SNSQ parameter by developing a 15-year observed sounding analysis for environments with confirmed snow squalls across the middle and upper Ohio Valley.

Methodology

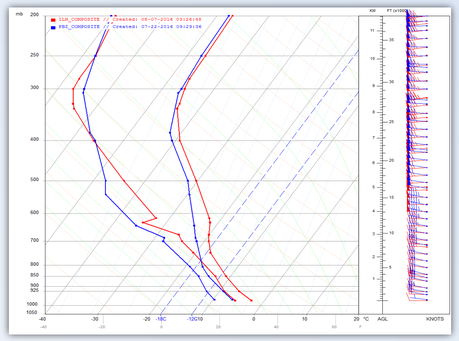
- Wilmington, OH (KILN) and Pittsburgh, PA (KPBZ) upper air stations were selected for a study of snow squall events spanning 15 winter seasons from 2001-2002 through 2015-2016
- METARs for Wilmington, OH (KILN) and Pittsburgh, PA (KPIT) were queried for cases where visibility ≤ 0.25 mile, wind speed ≥ 10 kt, and present weather = +SN
- Each case was confirmed via radar analysis to exclude synoptic winter storms, yielding a total of 43 snow squall events (16 at KILN and 27 at KPBZ)
- Soundings closest in time were selected for each snow squall event, and data was analyzed using RAOB software



Dendritic Growth Zone (DGZ): *area on sounding between -12°C and -18°C where snow crystal growth and aggregation are maximized*

Surface-Based Convective Available Potential Energy (SB CAPE): *total amount of potential energy available to a parcel of air originating at the surface and being lifted to its level of free convection*

Results



Composite soundings for all snow squall events at KILN (red) and KPBZ (blue).

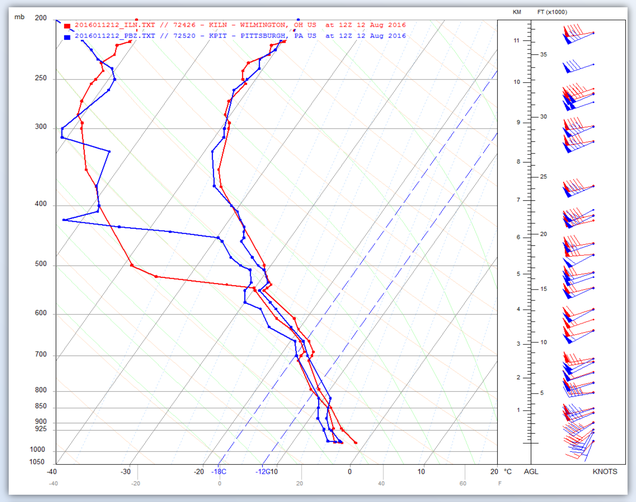
	SB CAPE (J/kg)	0-2 km Wind Speed (kt)	0-2 km RH (%)
Upper Quartile	50/7/59	34/35/25	85/86/82
Median	18/0/36	30/30/23	83/81/77
Lower Quartile	7/0/12	24/26/17	71/71/71

Various parameter values for KILN (red) and KPBZ (blue) compared to those from Banacos et al. 2014 (black).

Conclusions

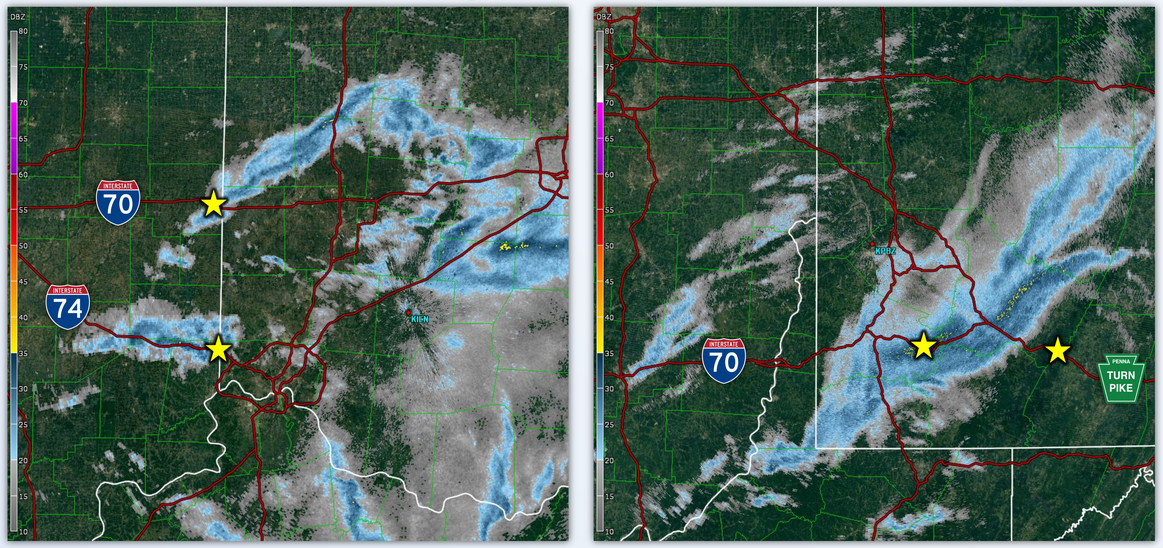
- DGZ depth averaged 900 m and was at least 600 m for all but one event, which suggests that the likelihood of snow squalls decreases when DGZ depth < 600 m
- DGZ RH was 70% or higher for the majority (80%) of events
- With SB CAPE values generally higher than DGZ CAPE (not shown), SB CAPE appears to be more important for snow squall development than DGZ CAPE
- 0-2 km winds were 20 knots or higher for 88% of events and significantly higher than those in Banacos et al. 2014
- Median DGZ and 0-2 km lapse rates were both -7.4°C/km

Case Study: Ohio Valley Snow Squalls of 12 January 2016



	DGZ Depth (m)	DGZ RH (%)	DGZ Lapse Rate (°C/km)	0-2 km Lapse Rate (°C/km)	0-2 km Wind Speed (kt)	SB CAPE (J/kg)
ILN	1394	89	-4.6	-6.3	43.3	0
PBZ	1136	87	-5.5	-5.0	40.2	0

DGZ depths at ILN and PBZ for this event were both at the 90th percentile. 0-2 km winds were an extreme for ILN and at the 95th percentile for PBZ. Other parameters fell within the 10th and 90th percentiles for both stations.



Radar images from KILN at 1513 UTC (left) and KPBZ at 1852 UTC (right) on 12 Jan 2016 showing intense snow squalls that caused several major interstate pileups across the region, locations of which are denoted by yellow stars. Reflectivity values of 30-35 dBZ in these areas indicate intense bursts of snow that resulted in sudden whiteout conditions with near-zero visibility.

Impacts

- 4 major pileups (2 near IN/OH border and 2 in southwest PA), involving estimated 136 vehicles total
- Several vehicle entrapments and at least 15 minor injuries reported
- Nearly 30 hours of combined interstate closure time

A 40-vehicle pileup on I-74 near the IN/OH border completely shut down the interstate for nearly 10 hours (courtesy Indiana State Police).

References

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

Milrad, S. M., J. R. Gyakum, E. H. Atallah, and J. F. Smith, 2011: A diagnostic examination of the eastern Ontario and western Quebec wintertime convection event of 28 January 2010. Wea. Forecasting, **26**, 301-318.

Acknowledgments

We thank Seth Binau (SOO, NWS Wilmington, OH) and Ashley Novak (General Forecaster, NWS Wilmington, OH) for their helpful insights and suggestions.

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