Characteristics of Mixed Precipitation Storms

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Introduction and Background

- Goal: to compare the structure and characteristics of mixed precipitation events that include transitions among snow, sleet, freezing rain, and rain.
- Events are examined using vertically pointing MicroRainRadar (MRR) data located at Poga Mountain, NC and Stony Brook, NY.

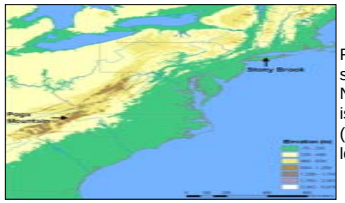


Figure 1: Regional topographic map showing the location of Poga Mountain, NC and Stony Brook, NY. Poga Mountain is located on mountainous terrain (elevation 1137 m) and Stony Brook is located on flat terrain (elevation 27 m).

- MRR makes it possible to observe the vertical profile of reflectivity and Doppler velocity at high time and spatial resolution.
- Transitions among precipitation types are difficult to observe with scanning weather radar since shallow, near surface, cold and warm layers often occur below the lowest level scanned.
- Results will be used to improve short term forecasts.

Mixed Precipitation Storms Summary

Poga Mountain, North Carolina

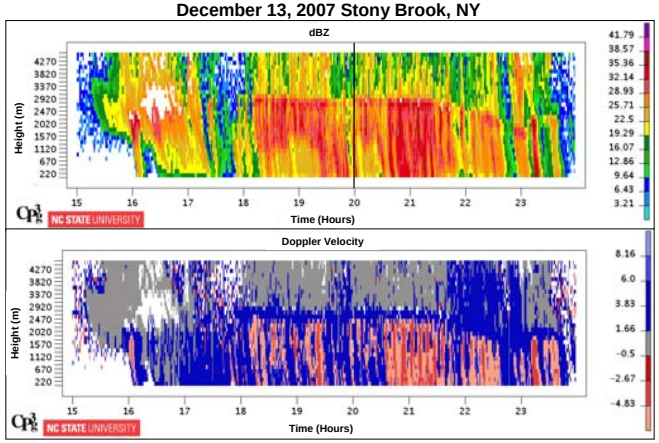
Year	Month	Day	Start Time (UTC)	Duration (hrs)	Type of Transition
2006	11	12	00:00	17	Cold Front/Discontinuous
2006	11	19	09:00	28	Cold Front/Discontinuous
2007	01	28	08:00	18	Cold Front/Discontinuous
2007	02	14	12:00	21	Cold Front/Discontinuous
2007	03	15	19:00	45	Cold Front/Discontinuous
2007	04	15	05:00	24	Cold Front/Discontinuous
2007	11	15	00:00	23	Cold Front/Discontinuous
2007	11	22	15:00	10	Cold Front/Discontinuous
2007	12	05	20:00	6	Cold Front/Continuous
2007	12	07	05:00	9	Complex/Discontinuous
2007	12	16	00:00	29	Cold Front/Discontinuous
2008	01	17	00:00	16	Warm Front/Continuous
2008	02	13	05:00	11	Cold Front/Discontinuous
2008	02	24	20:00	8	Complex/Continuous
2008	02	26	11:00	49	Cold Front/Discontinuous
2008	02	29	21:00	6	Cold Front/Continuous
2008	03	08	02:00	21	Cold Front/Discontinuous
2008	03	20	00:00	12	Cold Front/Discontinuous

Stony Brook, New York

Year	Month	Day	Start Time (UTC)	Duration (hrs)	Type of Transition
2007	12	02	12:00	11	Warm Front/Discontinuous
2007	12	13	16:00	8	Warm Front/Continuous
2007	12	16	06:00	17	Complex/Discontinuous
2007	12	27	00:00	19	Cold Front/Discontinuous
2008	01	14	02:00	19	Cold Front/Discontinuous
2008	01	17	23:00	14	Warm Front/Continuous
2008	02	09	15:00	9	Warm Front/Continuous
2008	02	12	20:00	27	Warm Front/Continuous
2008	02	22	07:00	15	Warm Front/Continuous
2008	03	01	02:00	12	Warm Front/Continuous

Data

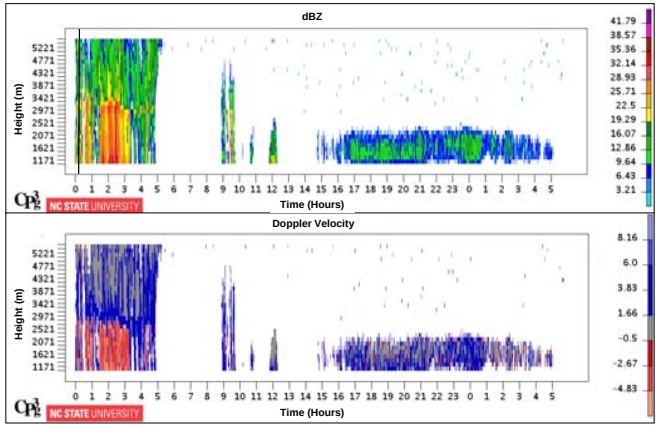
December 13, 2007 Stony Brook, NY



Time-height plots of reflectivity (Z) and Doppler velocity (Vr=w+Vt) where Vr is measured Doppler velocity (positive downwards), w is vertical air motion and Vt is fall speed of particles. For snow Vt~2 ms^{-1} so Vr< 2 ms^{-1} indicates regions of upward motion. Z is shown in the top image and Vr is shown in the bottom image.

Figure 2: Horizontal radar scan at 20:01 UTC from WSR-88D NEXRAD located at Upton, NY (KOKX). White marker indicates the location of the MRR at Stony Brook, NY

December 16 -17, 2007 Poga Mountain, NC



Time-height plots of Z (top), and Vr (bottom).

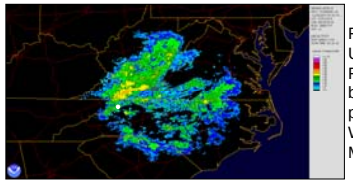
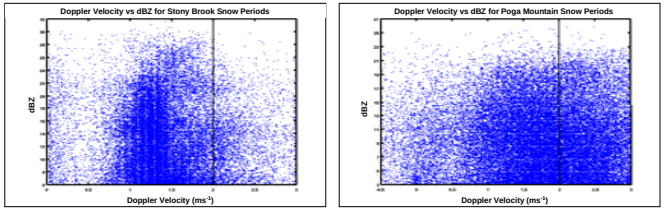
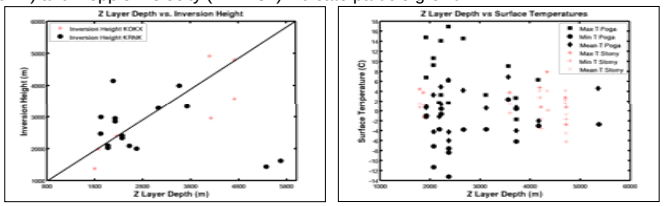


Figure 3: Horizontal radar scan at 00:16 UTC from WSR-88D NEXRAD located at Roanoke, VA (KFCX). The radar beam is blocked near Poga Mountain so precipitation echoes will be underestimated. White marker indicates the location of the MRR at Poga Mountain, NC

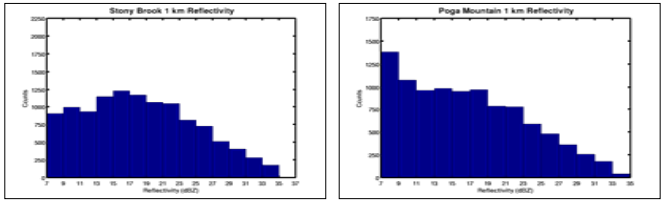
Analysis



Scatter plots of Doppler velocity vs. reflectivity for all snow periods at Stony Brook, NY (left) and at Poga Mountain, NC (right). Points with moderate reflectivity (> 20 dBZ) and Doppler velocity (< 2 ms^{-1}) indicate particle growth.



For events with inversions, Z layer depth is plotted versus inversion height from Blacksburg, VA (KRNK) soundings for Poga Mountain and from Upton, NY (KOKX) for Stony Brook (left). For each site, Z layer depth is plotted against the maximum, minimum, and mean surface temperature (right).



Histograms of 1 km of reflectivity (dBZ) for all mixed precipitation events at Stony Brook (left) and Poga Mountain (right).

Conclusions

- There is no clear relationship between Doppler velocity and reflectivity during the snow portions of mixed precipitation events.
- The mode of Doppler velocity for Stony Brook is between 1 ms^{-1} and 1.5 ms^{-1} for Z values less than 22 dBZ and between 1.5 ms^{-1} and 2 ms^{-1} for values greater than 22 dBZ. Poga Mountain has a widely spread distribution.
- When inversions were present, the Z layer depth at Poga Mountain and Stony Brook was strongly correlated to the inversion height from the nearby soundings.
- There is no clear relationship between Z layer depth and surface air temperature (max, min, mean) at either location.
- The distribution of reflectivity at Stony Brook and Poga Mountain at 1 km altitude above ground level is skewed with most values less than 23 dBZ.
- 6 out of 10 events studied at Stony Brook had continuous transitions during warm frontal passages where the trends in freezing level height were visible on the MRR.
- 13 out of 18 events studied at Poga Mountain had discontinuous transitions from cold frontal passages where the trends in the freezing level height were less visible on the MRR.

Acknowledgements

Thanks to the North Carolina State University Undergraduate Research Grant for supporting this research. Thanks also goes to John McGuire for GIS support and to the National Climatic Data Center for archived WSR-88D NEXRAD data.