Atmospheric Influences on New Snowfall Density in the Southern Appalachian Mountains, USA

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Introduction and Background

o Variations in new snowfall density have a significant influence on new snowfall totals, as the same liquid equivalent precipitation forecast from numerical model output can yield wide differences in actual snowfall.

o New snowfall density variability and the associated atmospheric influences remain poorly understood, particularly in mountainous regions where orographic effects predominate.

o The research objectives of this poster are to:
- Analyze the atmospheric influences on snow density among and within snowfall events.
- Summarize new snowfall densities on Poga Mountain, NC, during a two-year period.
- Compare new snowfall densities by low-level wind direction and surface temperature.

Field Site, Instrumentation, and Methods

o Snowfall and SWE measurements were taken at 00Z, 12Z, and 18Z during snow events at 1018 m using a snowboard and a 10-cm diameter precipitation gauge to extract a core.

o Meteorological data were obtained using a portable station at 1137 m while a vertically-pointing Ku-band MicroRainRadar, Parsivel disdrometer, and Pluvio weighing precipitation gauge provided additional data at 1018 m.

o During the 2007-2008 snow season, the research team also released rawinsondes every three hours during snow events from 1018 m.

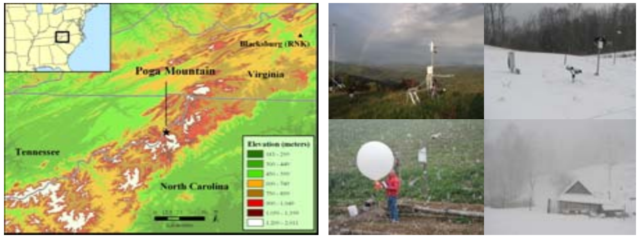

Figure 1. Location of field site and topographic setting (left) and instrumentation (right).

Surface Analyses for Selected Snowfall Events

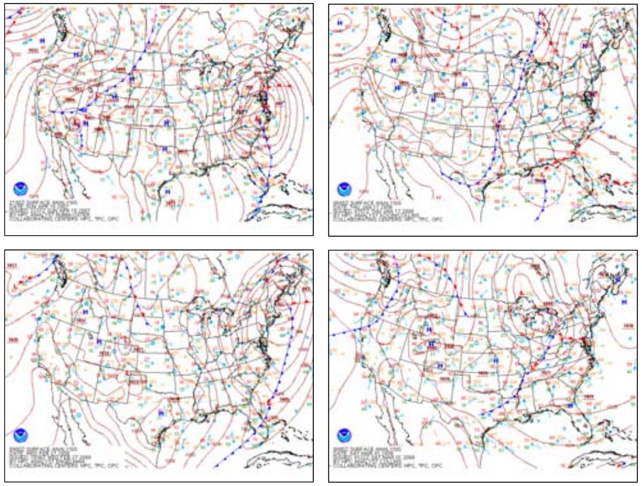

Figure 2. Surface analyses at event maturation for selected snowfall events during study period: 1) late-season Miller A with NW flow on 16 Apr 2007 (upper left), 2) Miller A transition to freezing rain on 17 Jan 2008 (upper right), 3) NW flow on 27 Feb 2008 (bottom left), and 4) Ohio Valley disturbance (1 Mar 2008).

Selected Snowfall Events

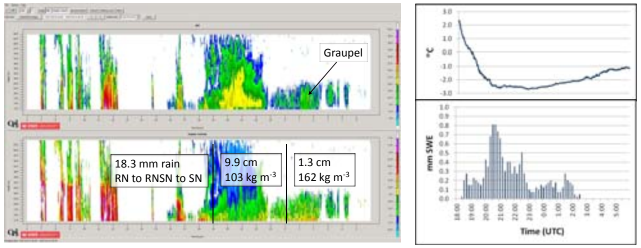

Figure 3a. 15-16 Apr 2007 (11.2 cm, 109 kg m^{-3}) 3b. Temperature and precipitation

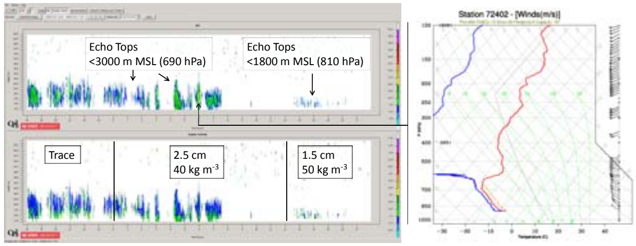

Figure 4a. 1-3 Jan 2008 (10.2 cm, 33 kg m^{-3}) 4b. 06Z Poga Sounding

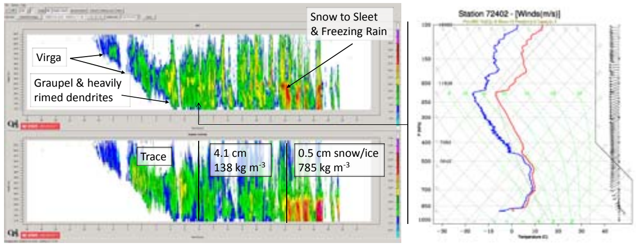

Figure 5a. 16-17 Jan 2008 (4.6 cm, 184 kg m^{-3}) 4b. 06Z Poga Sounding

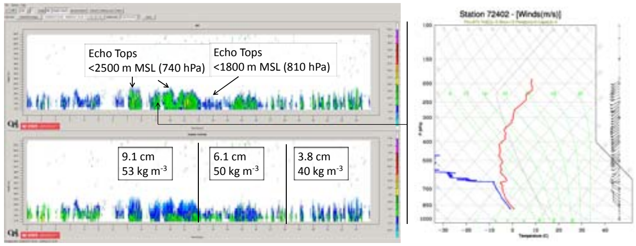

Figure 6a. 27-28 Feb 2008 (21.1 cm, 47 kg m^{-3}) 6b. 09Z Poga Sounding

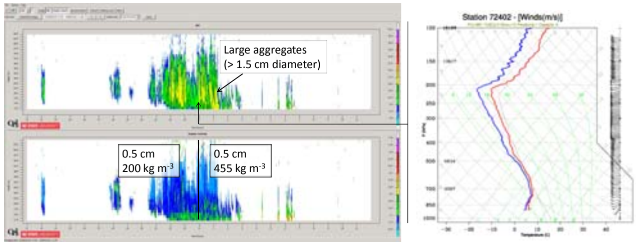

Figure 7a. 29 Feb – 1 Mar 2008 (1.0 cm, 328 kg m^{-3}) 7b. 00Z Poga Sounding

Results

o Twenty-four (88%) of the snowfall events during the study period were associated with low-level northwest flow at event maturation, ranging between 270 and 315 degrees.

o Fifteen events (56%) exhibited new snowfall densities between 25 and 75 kg m^{-3}, with 8 events (30%) greater than 100 kg m^{-3}.

o Surface temperature and new snowfall density are moderately correlated (R = 0.67).

o The mean new snowfall density for all events was 69 kg m^{-3}, with cold (< 2 C) northwest flow events having the lowest (55 kg m^{-3}). Both warm (> 2 C) northwest flow events and the small sample (n = 3) of other synoptic types had the highest new snowfall densities (149 kg m^{-3}).

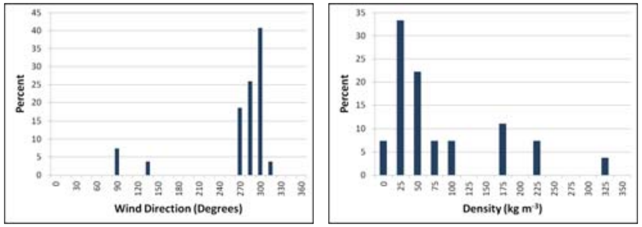

Figure 8. Percent snow events by wind direction (left) and snow density (right).

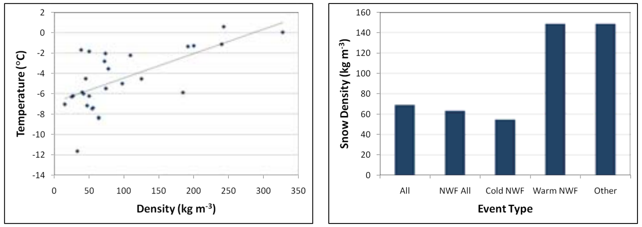

Figure 9. New snowfall density vs. surface temperature at event maturation (left) and new snowfall density by event type (right).

Conclusions

o Snowfall was most commonly low density, with a two-year mean value of 69 kg m^{-3}. New snowfall densities varied widely among events, ranging from 15 to 328 kg m^{-3}.

o Most of the snowfall (93 %) and SWE (84 %) occurred in association with low-level NW flow at event maturation.

o The lowest new snowfall densities (< 40 kg m^{-3}) were associated with low surface temperatures and a shallow moist layer.

o The highest new snowfall densities (> 110 kg m^{-3}) were associated with high surface temperatures and/or the presence of a warm near-freezing moist layer. Graupel and heavily rimed snow crystals also contributed to high new snowfall densities at times.

o Surface air temperature displayed a modest relationship to new snowfall densities, with a correlation coefficient of 0.67. Other atmospheric variables were weakly correlated with new snowfall densities.

Acknowledgements

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