Observed Characteristics of Mesoscale Banding in Coastal Northeast U.S. Snow Storms

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Clouds and Precipitation Processes and Patterns Group

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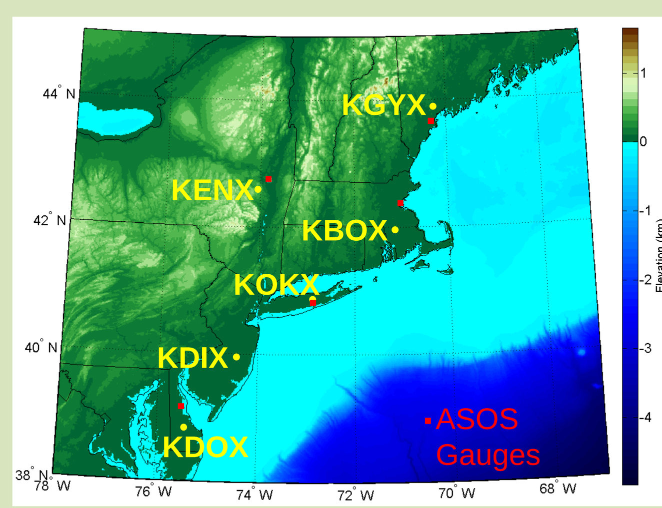
I. Introduction

Quantitative precipitation forecasting in winter storms is sensitive to the occurrence and intensity of mesoscale snowbands. Single and multiple bands can occur in a wide range of spatial arrangements that change as the storm evolves. Previous work has shown that some mesoscale snowbands, especially stronger and longer bands, are associated with frontal circulations. The dynamical controls originating and maintaining weaker multi-bands are less clear. This study uses regional operational WSR-88D radar data centered along the New York City to Boston corridor to characterize observed characteristics of mesoscale snowbands. We also examine data from a Multi-Angle Snowflake Camera (MASC) and a vertically-pointing radar in Stony Brook, NY to describe the types and sizes of snowflakes within a mesoscale snowband.

II. Dataset

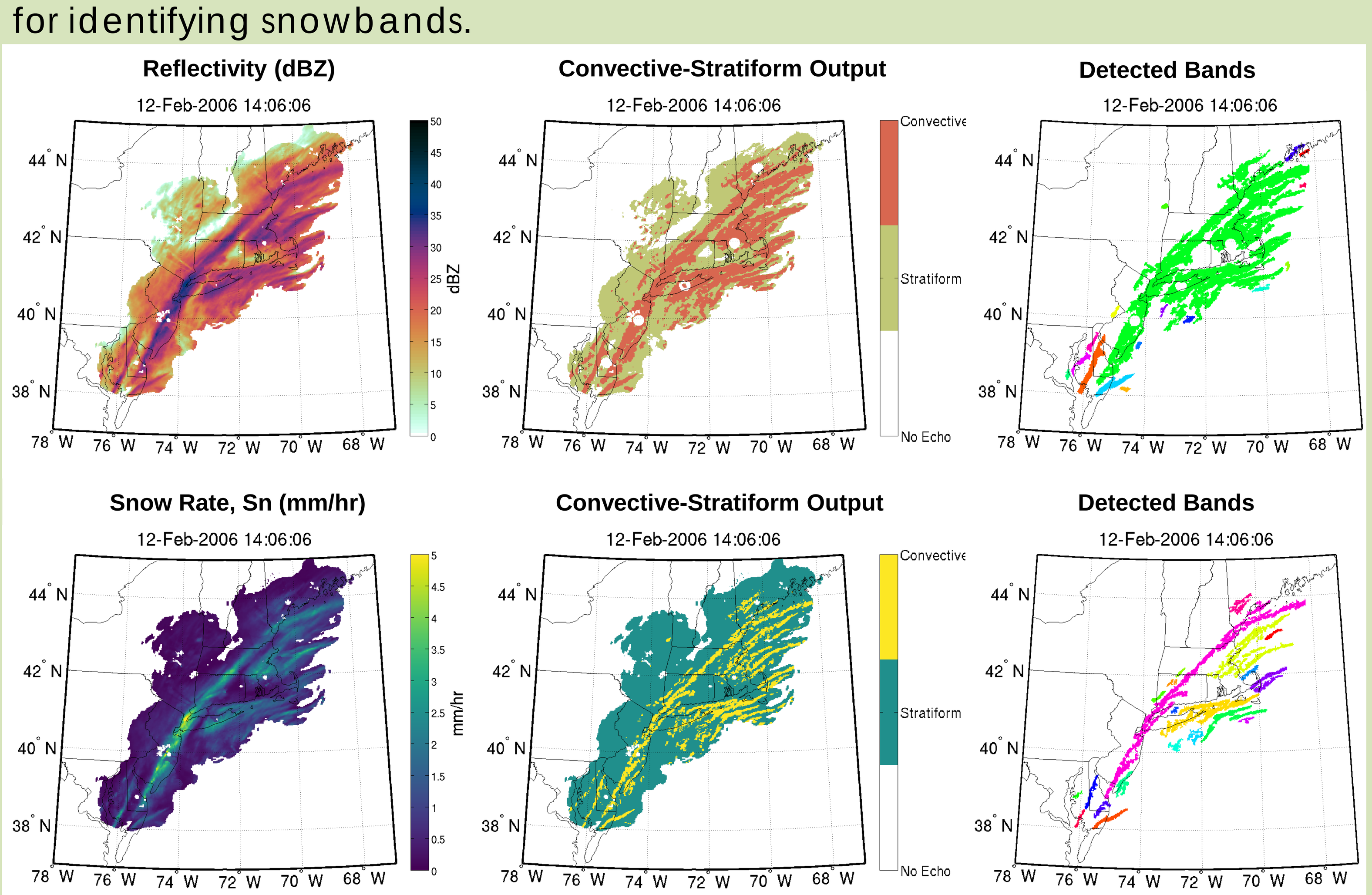
We identified 78 snow storms during the cold season (October-March) from 1996-2015 using cases identified from ASOS snow liquid equivalent and previously documented snowband cases. Data from six radars (KOKX, KBOX, KDIX, KENX, KGYS, KDOX) are combined to make regional maps of radar reflectivity (in dBZ) and estimated liquid equivalent snow rate (Sn in mm/hr) every 6-10 minutes during each storm. Composites of all available storm data shows no strong topographic forcing.

Radar	Totals Hours of Active Storm Data	Percent of Matching Hours to KOKX
KOKX	2056	100 %
KBOX	1990	97 %
KDIX	1905	93 %
KENX	1885	92 %
KGYX	1797	87 %
KDOX	1277	62 %



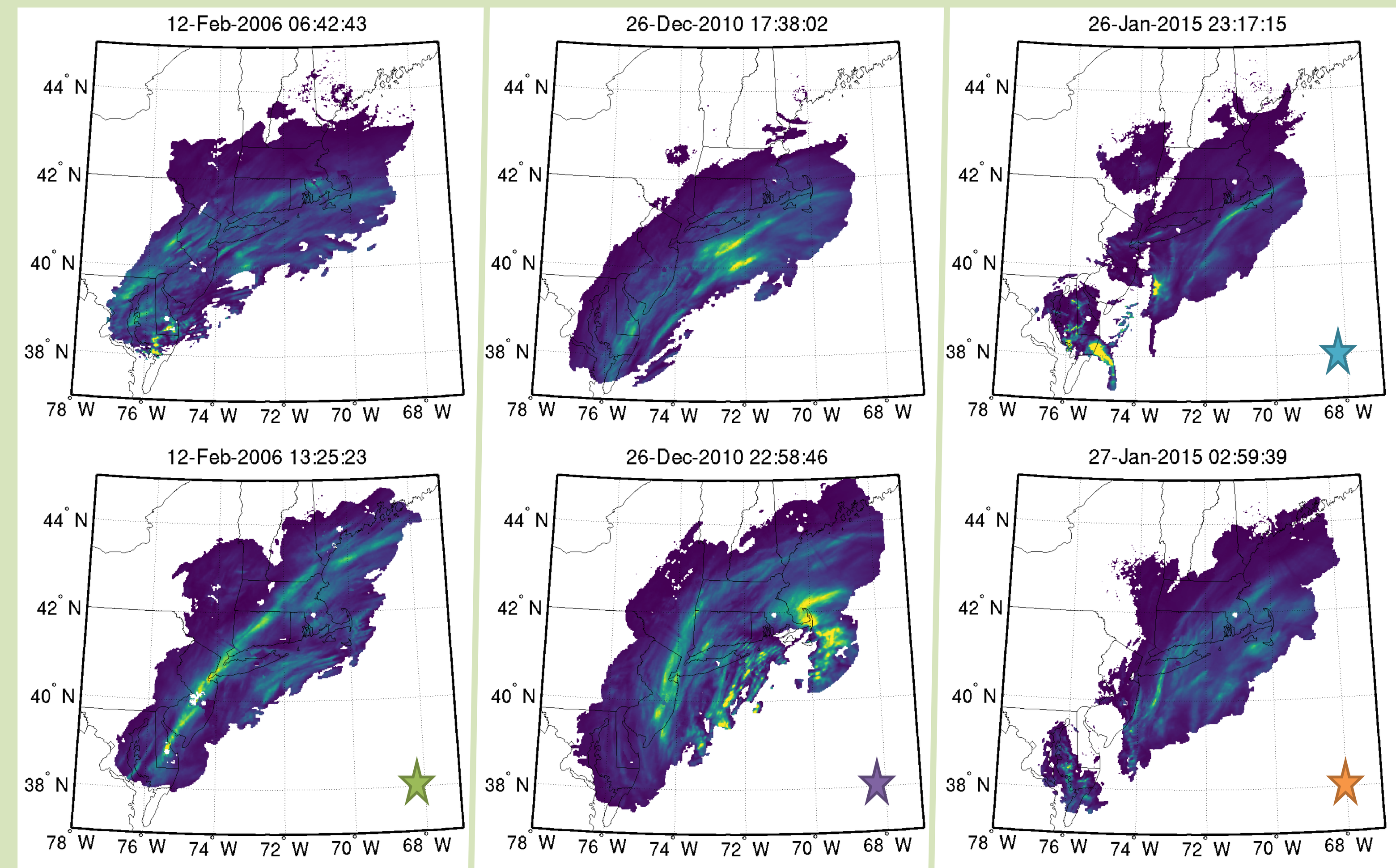
III. Band Detection Methods

Regional maps show interpolated values from the lowest 3 km. Sn is estimated following Rasmussen (2003, JAMC). Mesoscale snowbands are isolated using a combination of image processing techniques, including a local peakedness criterion based on a convective-stratiform algorithm and contiguous blob detection. We found the Sn-scaled images outperformed Z for identifying snowbands.



Example from 12 Feb 2006 1406 UTC shows reflectivity and Sn fields along with output from the convective-stratiform algorithm and band detection.

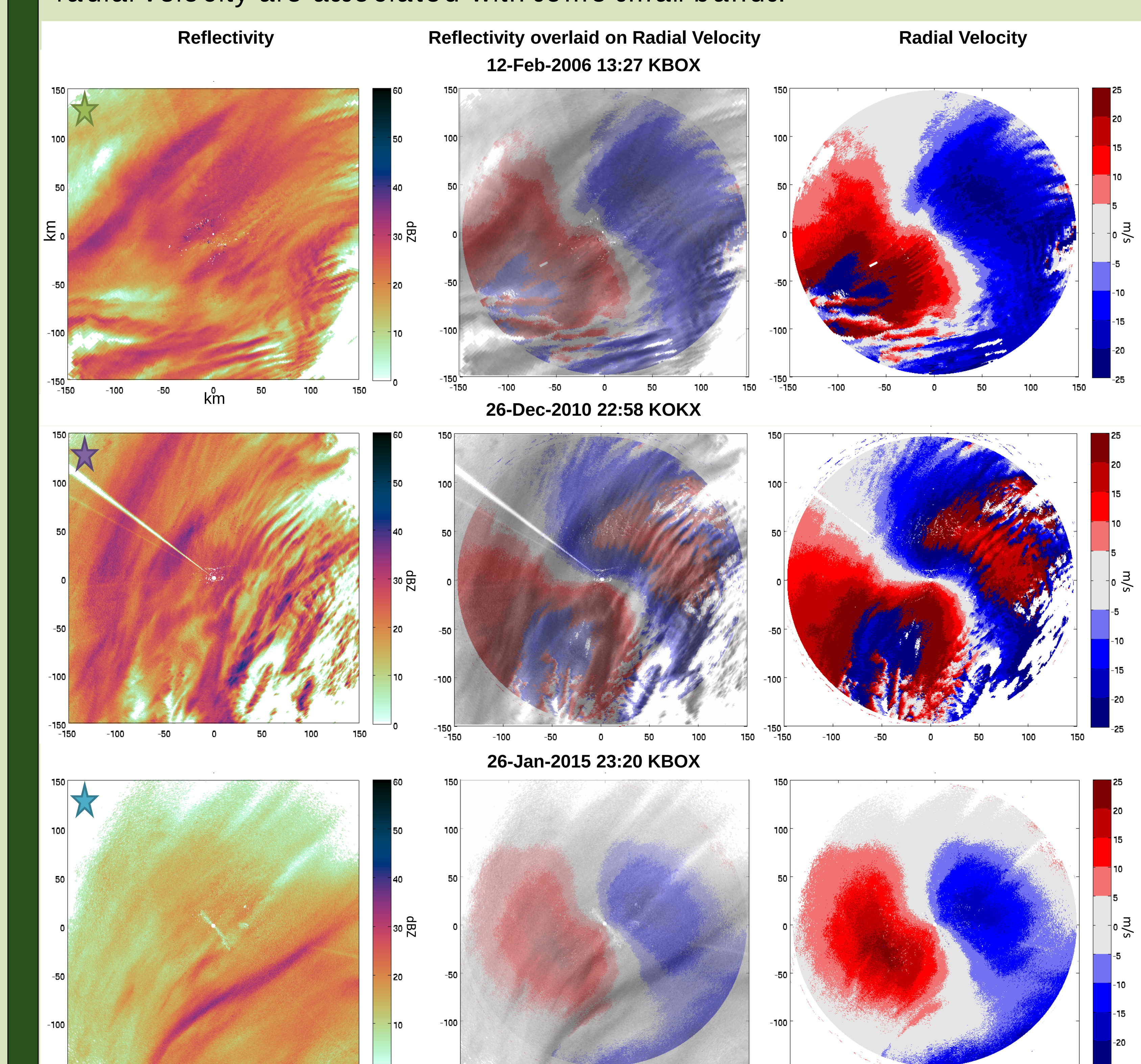
IV. Example Snowband Configurations



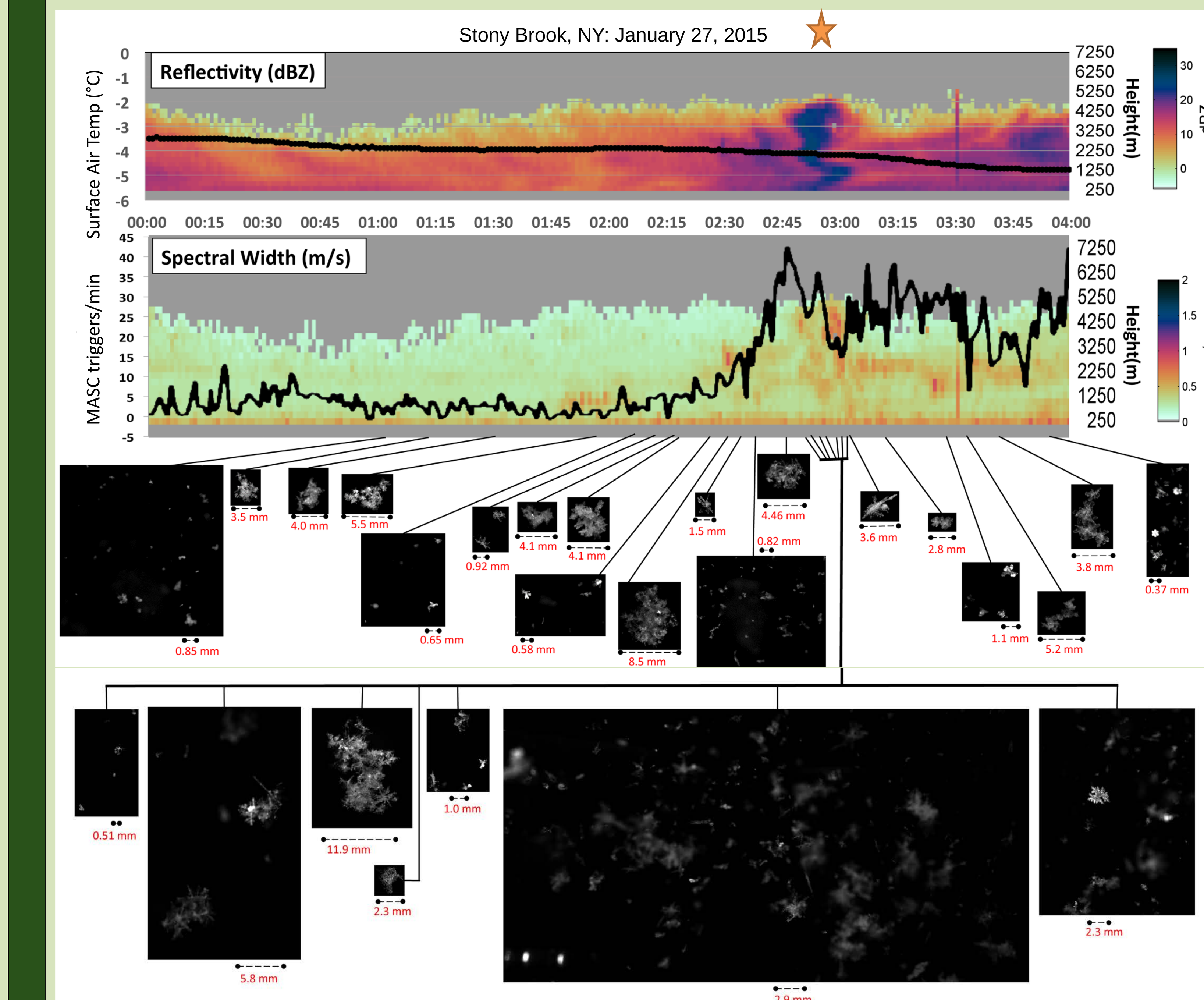
Examples of bands from three storms in the 78 storm dataset. Bands can be organized into one strong band or multiple smaller bands. Often, a longer stronger band and smaller multiple bands co-occur. Stars in lower right indicate times corresponding to detailed single-radar images below. Movies of the Sn field for the entirety of these storms can be accessed on the web via the QR in upper right of this poster.

V. Dynamical Context for Bands

Preliminary work indicates that transient small scale wave motions observed in radial velocity are associated with some small bands.



VI. Snowflake Characteristics within a Snowband



Time-height plots of reflectivity with surface air temperature overlaid (top) and spectral width (a measure of turbulence) with number of camera triggers per minute (middle). Example flakes from the MASC are shown below the plots. Radar reflectivity within snow is a function of the number, size and density of snow particles within the radar resolution volume. Whereas the MASC is designed to trigger on single flakes, so many flakes were falling during band passage that individual MASC images frequently contained multiple aggregates of different sizes. The high camera trigger rate and the large number of flakes in each image frame suggest that number concentration may be an important contribution to enhanced reflectivity within the band.

VII. Preliminary Conclusions/Future Work

- Across the 78 storms, mesoscale bands undergo diverse evolutions within the snow storm. Some sets of multi-bands are subsumed into longer, stronger bands whereas other bands simply dissipate. Storms with a single band can transition into multiple bands.
- Radial velocity features associated with bands are often subtle. Transient small scale waves are sometimes observed in conjunction with multiple band features.
- Snowflake photographs obtained within one strong band indicate a high number concentration of flakes including aggregates.
- Future work will refine snowband isolation. We will track bands to determine splits and mergers as well as lifecycle characteristics such as duration and intensity relative to synoptic context.
- We will continue data collection with the MASC and vertically-pointing radar at Stony Brook in the coming winter seasons to document snow flake physical characteristics inside and outside of bands.

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