Quantitative precipitation forecasts for extratropical snow storms have long been a challenge. Locally intense snowfall within mesoscale snow bands can have large impacts on snow accumulation. Previous work has shown that longer, single bands > 250 km in length and 20 to 50 km wide - are less clear. This study uses operational WSR-88D radar data along with ASOS snow measurements. Data from six radars (KOKX, KBOX, KDIX, KENX, KGYS, KDOX) are combined to make regional maps every 6-10 minutes of radar reflectivity and estimated liquid equivalent snow rate (i.e. mm/hr) during each storm. We have approximately 3,000 hours of data from the KOKX radar alone.

Meso-scale snow bands are identified using a variation of a convective/stratiform precipitation identification algorithm that utilizes a local peakedness criterion to identify areas of local precipitation enhancement. Following Ganetis et al. (2015), snow storms were classified based on the geometry of snow band structures identified throughout the storm’s duration. The four categories are: single band, coexisting single and multi-bands, multi-band, and non-banded. Snow storms with only multi-bands were found to be the most common followed by snow storms with coexisting single and multi-bands, snow storms with no band features, and snow storms with only single bands.

Velocity bands within the Doppler radial velocity fields were identified by subtracting two consecutive fields (A & B) yielding a temporal difference field (C). To obtain spatial separation between the velocity bands, only the negative portion of the temporal difference field is used (D). Velocity bands identified in multiple radars were combined to make regional maps. The motion of the bands relative to the low level flow suggests that these velocity features may be gravity waves. Velocity bands tend to be associated with multi-bands. Snow storms without multi-bands rarely had velocity bands associated with them. Velocity bands and snow bands were found to move in similar directions in the lower troposphere (0–2 km). Within the same storm, velocity bands usually moved faster than snow bands indicating these velocity features are not locked to the snow bands.

We discovered moving bands of velocity change within snowstorms. The bands are consistent with waves moving faster than snow bands. The frequent co-occurrence and similar orientations of velocity features move perpendicular to the mean low level flow in a manner similar to gravity waves. These features move perpendicular to the mean low level flow in a manner similar to gravity waves. The difference between snow band and waves was calculated for times when the difference in their direction of movement was less than 45 degrees. A positive speed difference represents a time when waves are moving faster than snow bands.

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Conclusions and Implications

• No clear, sustained convergence signatures were found to be locked with multi-bands across 108 snow storms. Multi-bands do not consist of persistent, active updrafts in contrast to convective-scale generating cells. With or without snow bands present, generating cells are nearly ubiquitous in the upper levels of snow storm radar echo.

• We discovered moving bands of velocity change within snowstorms. The bands are consistent across adjacent radar domains and appear to originate outside of the precipitation echo. These features move perpendicular to the mean low level flow in a manner similar to gravity waves.

• 70% of the occurrences of multi-bands (with or without coexisting single bands) are associated with velocity waves. The velocity waves were found to generally move faster (average of 4.5 m/s) than the snow bands. The frequent co-occurrence and similar orientations of the velocity waves and multi-band snow bands suggest a connection.

• Future work: Determine the mechanism and origination of the velocity waves and their potential roles in snow band initiation and maintenance. Determine if radially moving snow bands and parallel moving snow bands have similar physical mechanisms.


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