Characteristics of Enhanced Spectrum Width Layers Within Northeast United States Coastal Winter Storms

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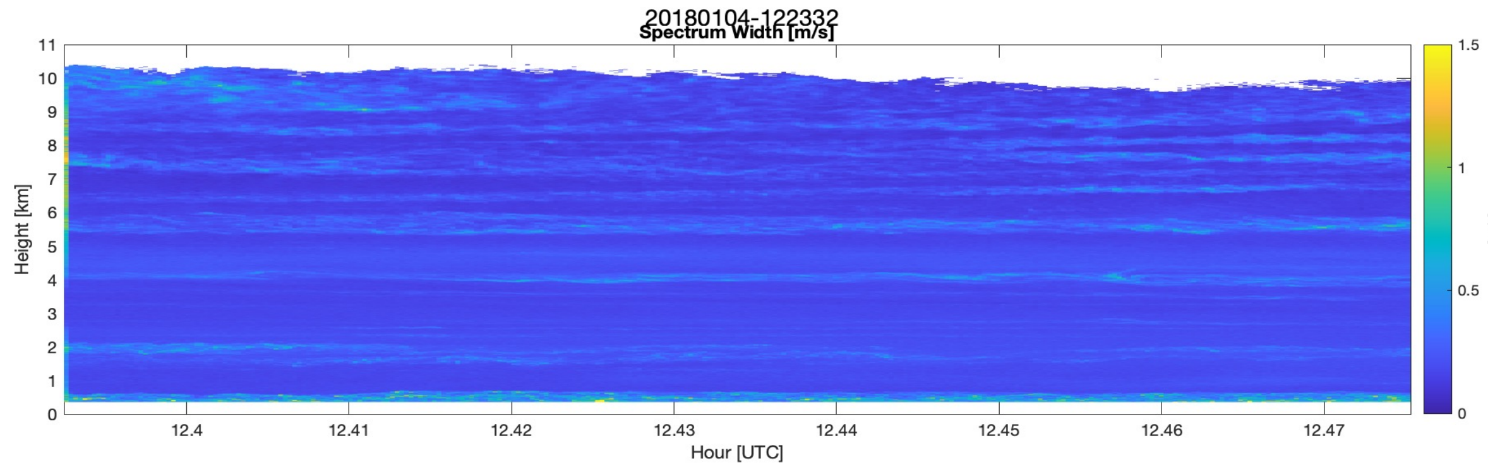
1. Introduction

Horizontal layers of enhanced spectrum width (SW) are often observed in Northeast United States coastal winter storms by the Ka-Band Scanning Polarimetric Radar (KASPR) at the Stony Brook Radar Observatory at Stony Brook University on Long Island, NY. Unlike other mesoscale features such as snow bands, generating cells, and gravity waves, the origins of these enhanced SW layers have not been well studied. This preliminary investigation provides a basic understanding of the spatial and temporal characteristics of the SW layers and illustrates relationships between KASPR observables such as reflectivity and mean doppler velocity with the SW layers.

Fig. 1a



KASPR Vertically Pointing SW

Fig. 1b

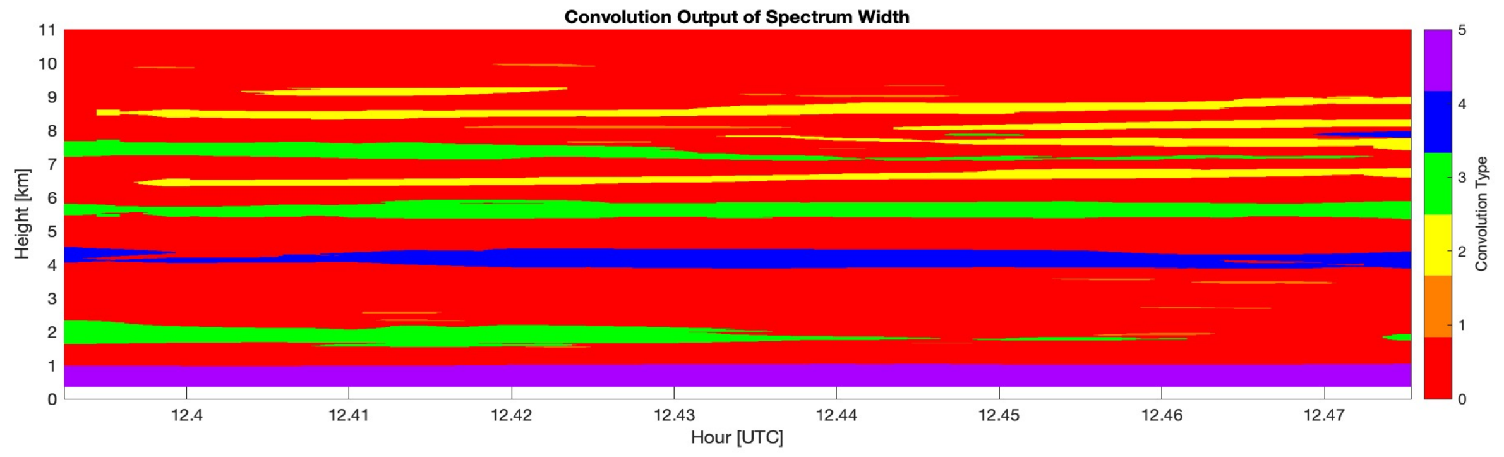


Fig. 1c KASPR PPI

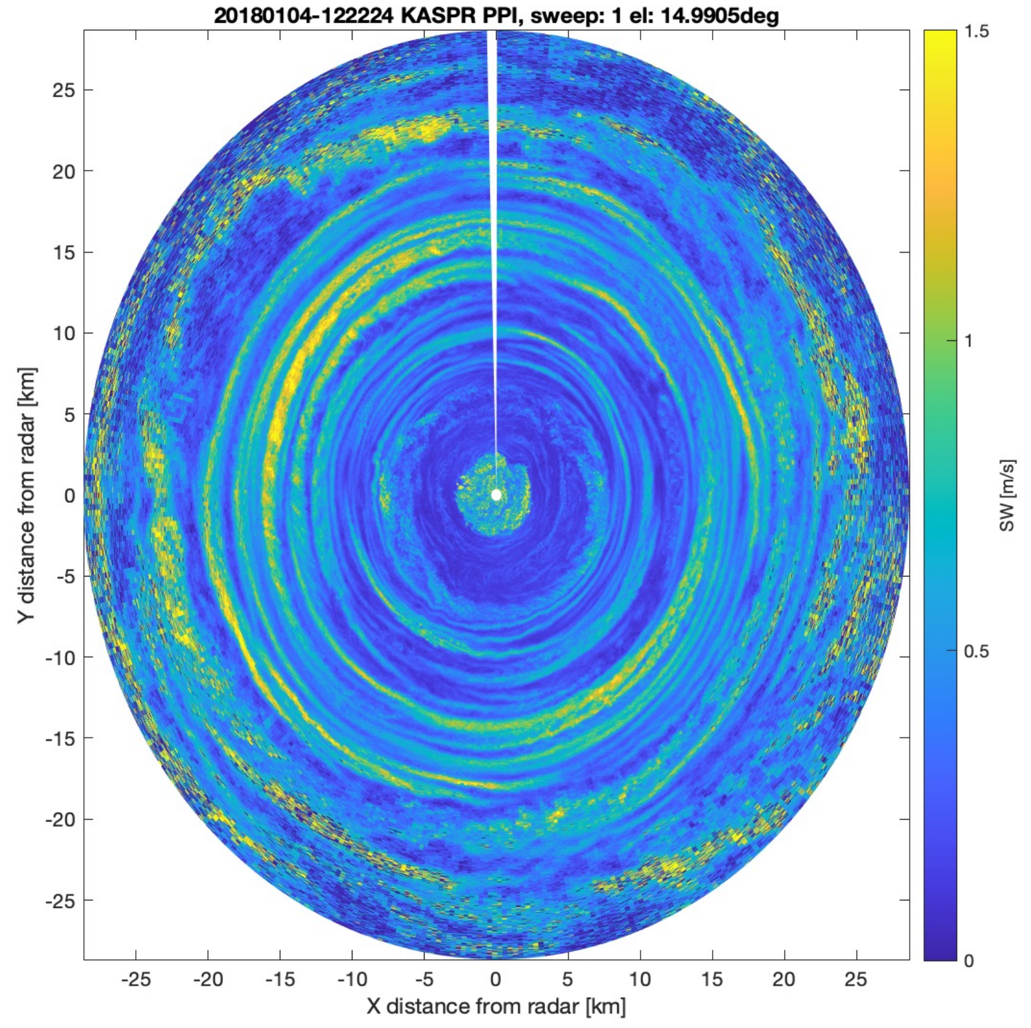
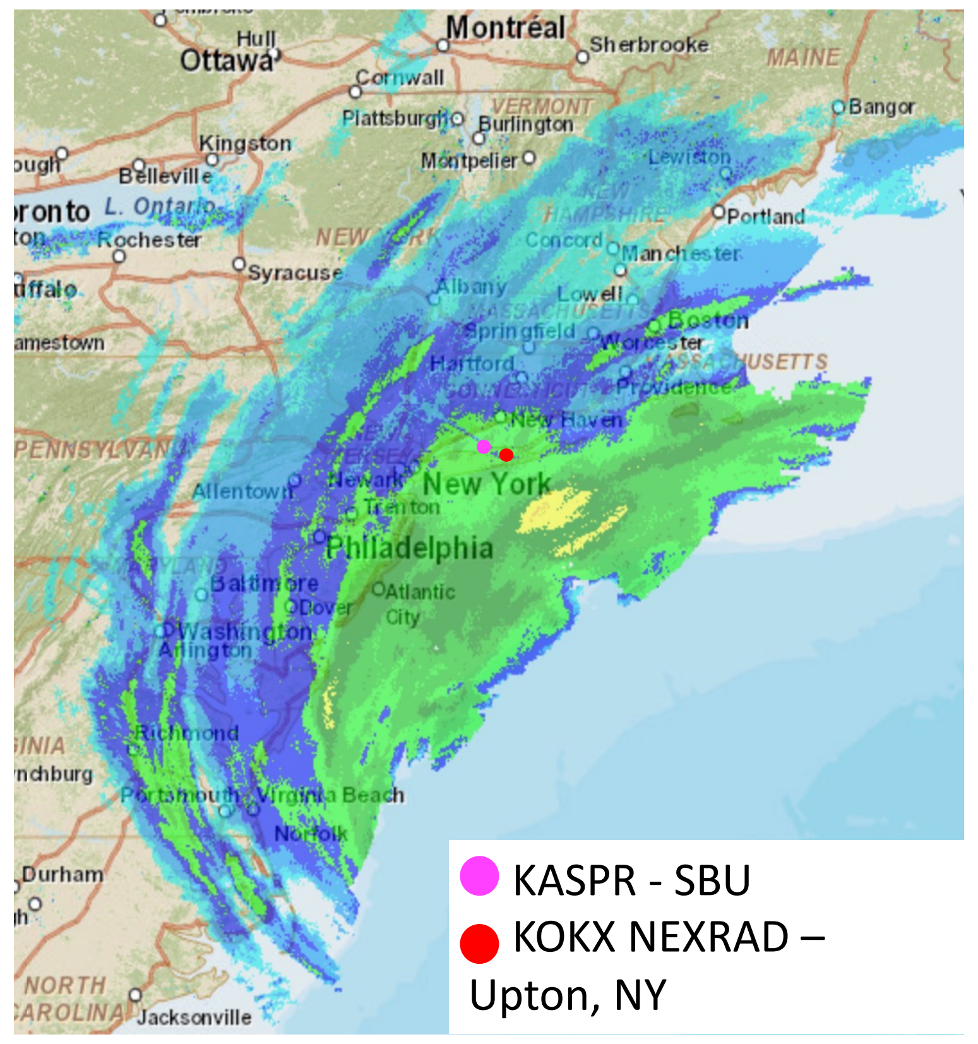


Fig. 1d NEXRAD Composite



Questions:

1. How often are these SW layers present? What is their typical thickness, duration, altitude, etc.?
2. Are these SW layers resulting from the observed banding? (future)
3. Which region of the storm are they more common (if any)? (future)
4. What are their microphysical impacts? (future)

2. Data & Methods

- KASPR vertically pointing profiles
- 26 individual winter storms, 95+ hours of KASPR vertical profiles
- 2D convolution-based feature recognition, using a threshold of 0.2 m/s. 5 convolutions were performed to identify layers of various thicknesses
- 22,330 individual SW layers identified

3. SW Layer Characteristics – Entire Dataset

Fig. 2a

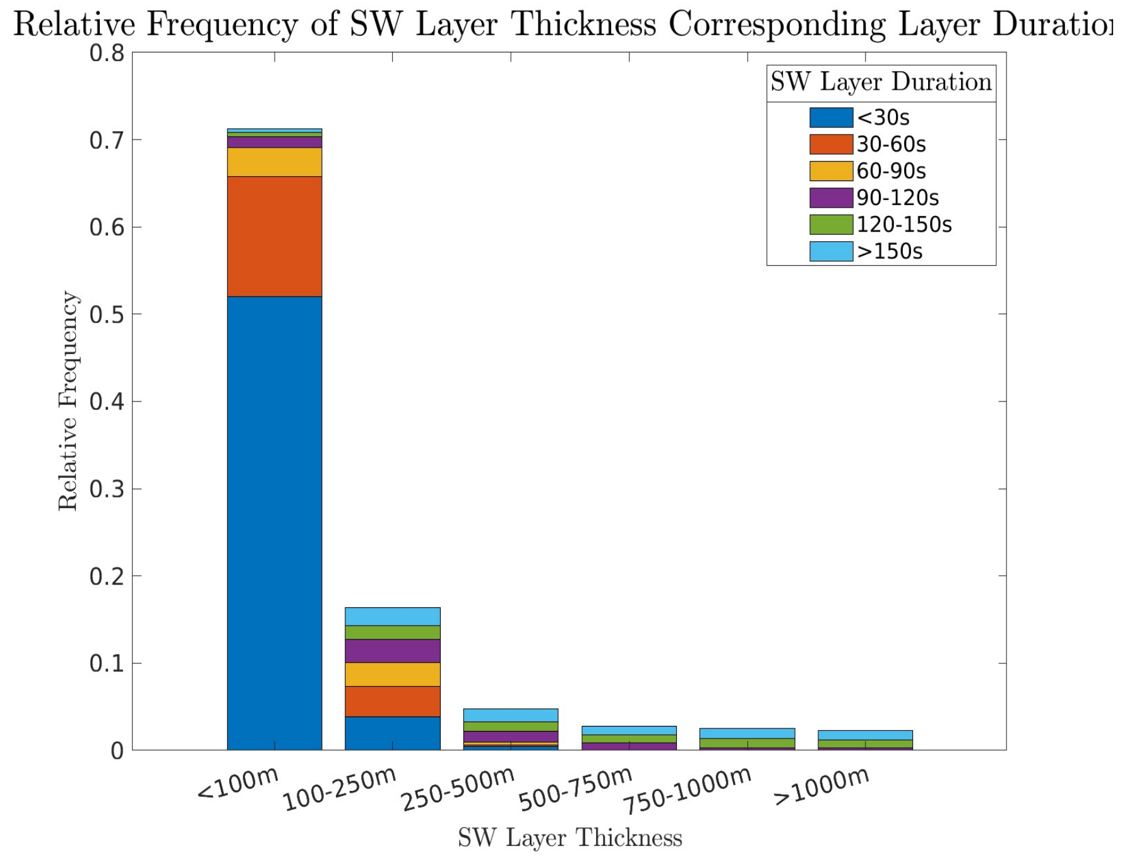
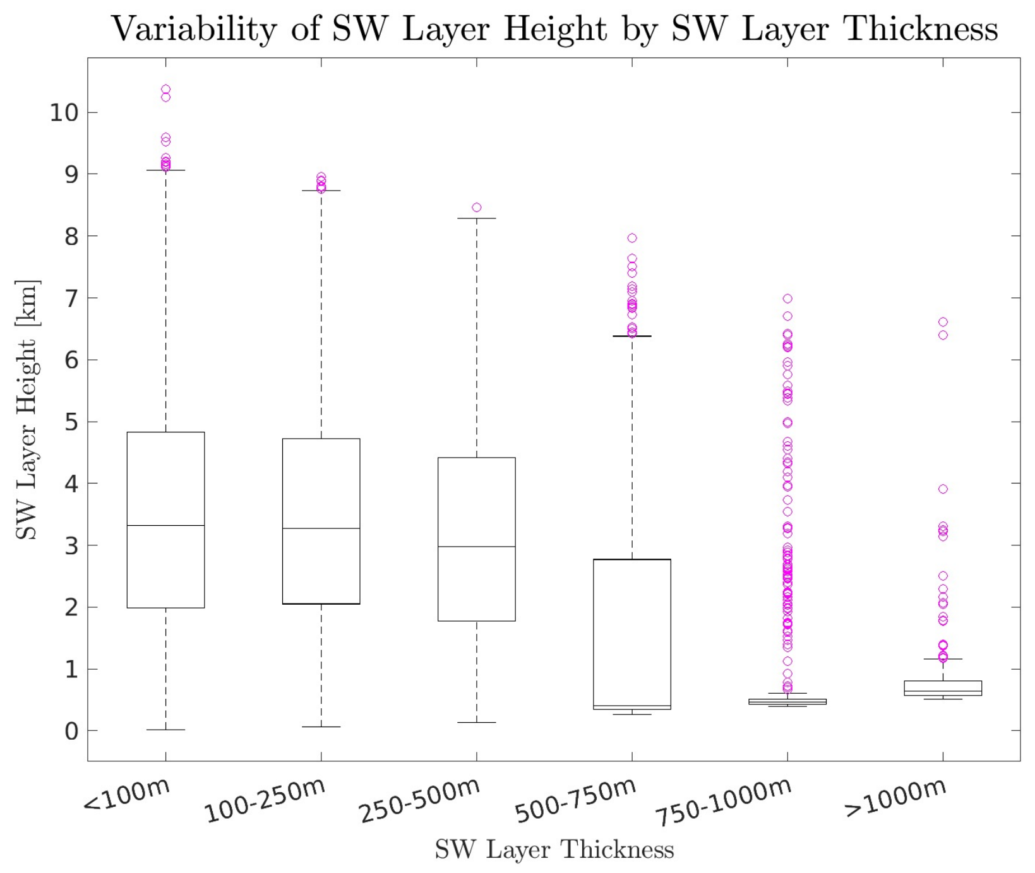
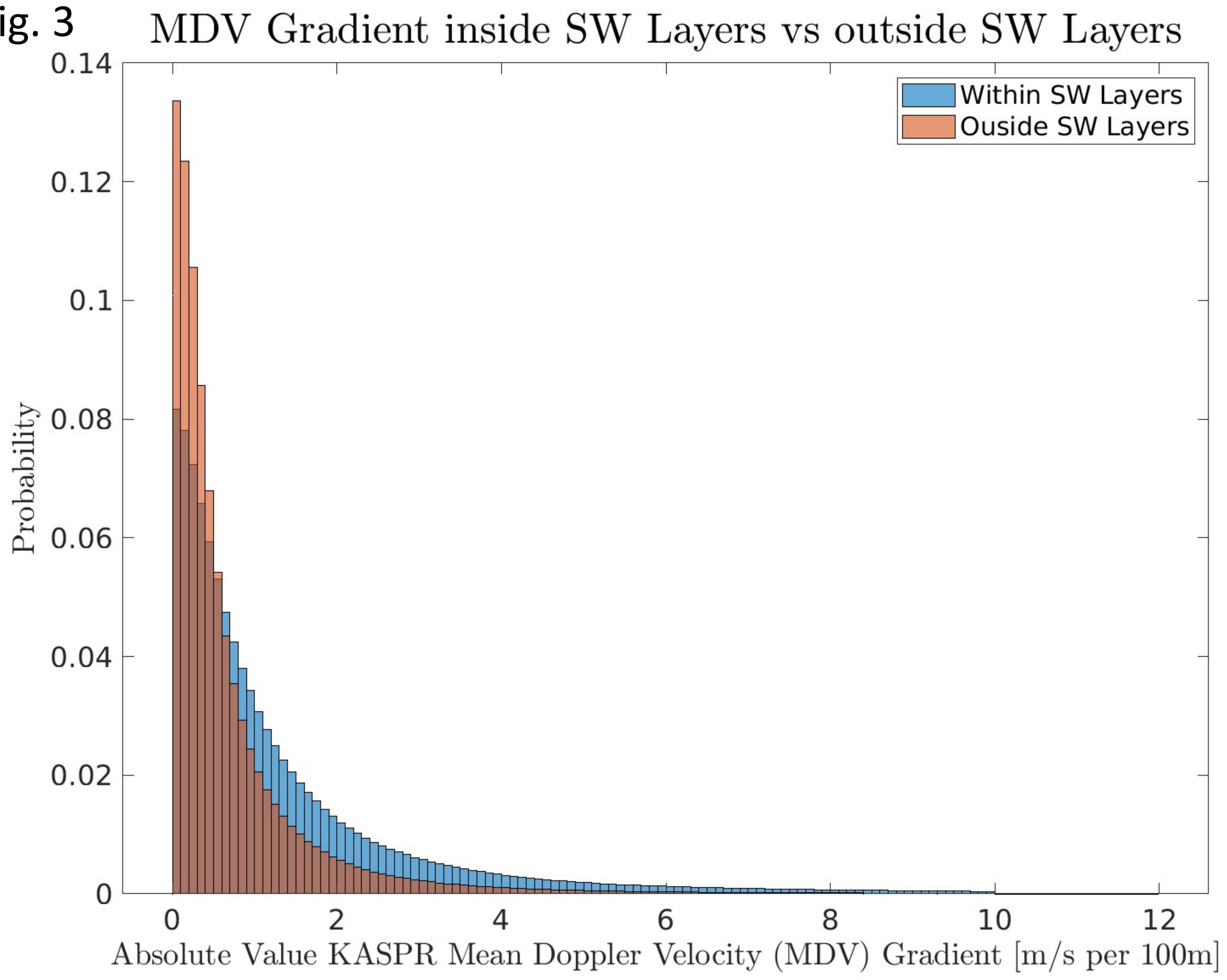


Fig. 2b



- ~70% of all SW layers are < 100m thick
- ~50% of all SW layers are observed for <30s
- Generally, SW layer duration increases as SW layer thickness increases
- The median of the average SW layer height decreases with increasing SW layer thickness

Fig. 3



**Increases in wind speed with increasing height = positive MDV gradient*
**MDV is from vertically pointing KASPR profiles – only vertical motions!*

- MDV gradient is more likely to be ~0m/s in the environment outside of SW layer than it is within SW layers themselves
- SW layers span a larger range of MDV gradients than does the environment outside of the SW layers
- SW layers exist in regions of positive MDV gradient:
  - Exist in updrafts
  - Can this possibly indicate regions where hydrometeors break apart as they descend and have slower fall speeds?

4. SW Layer Characteristics – by Storm

Fig. 4a

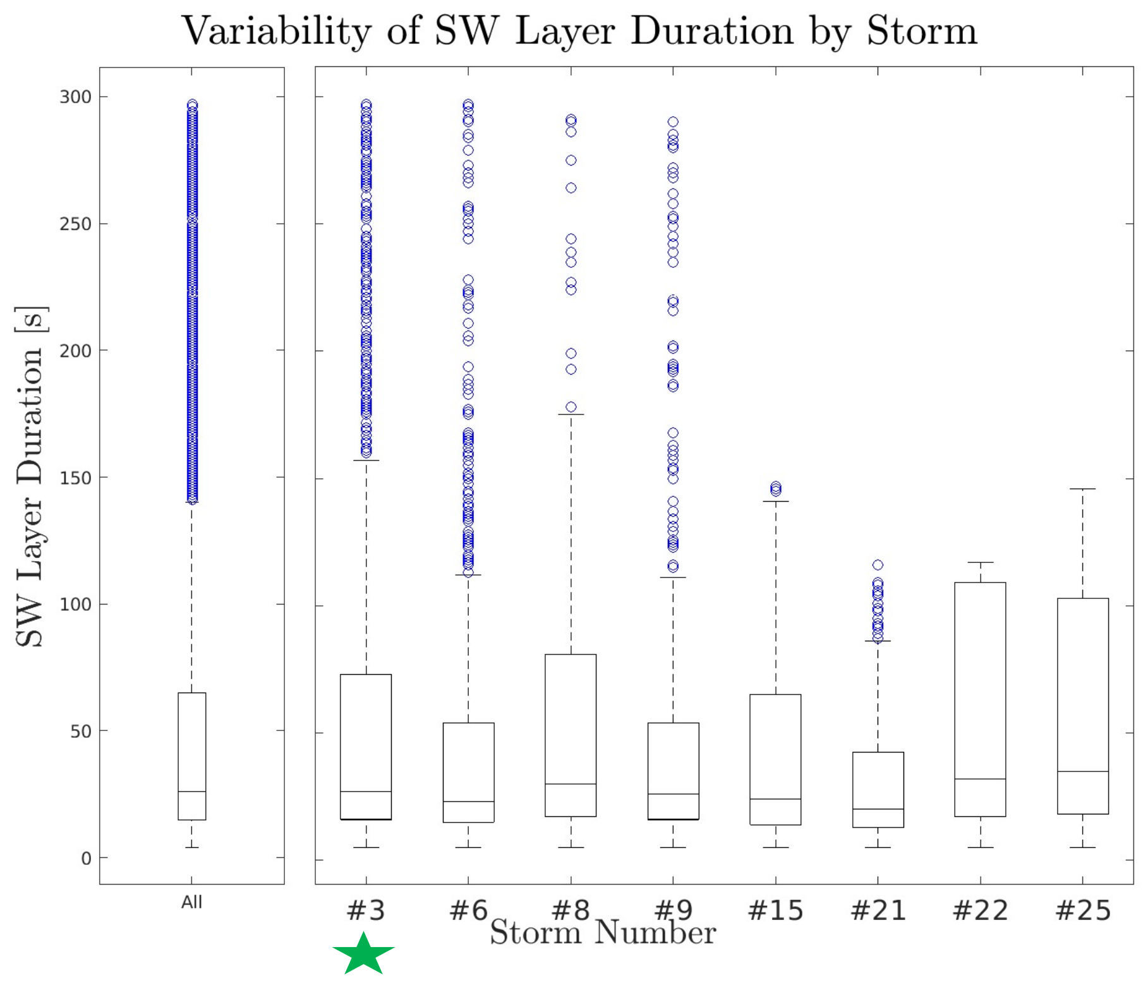


Fig. 4b

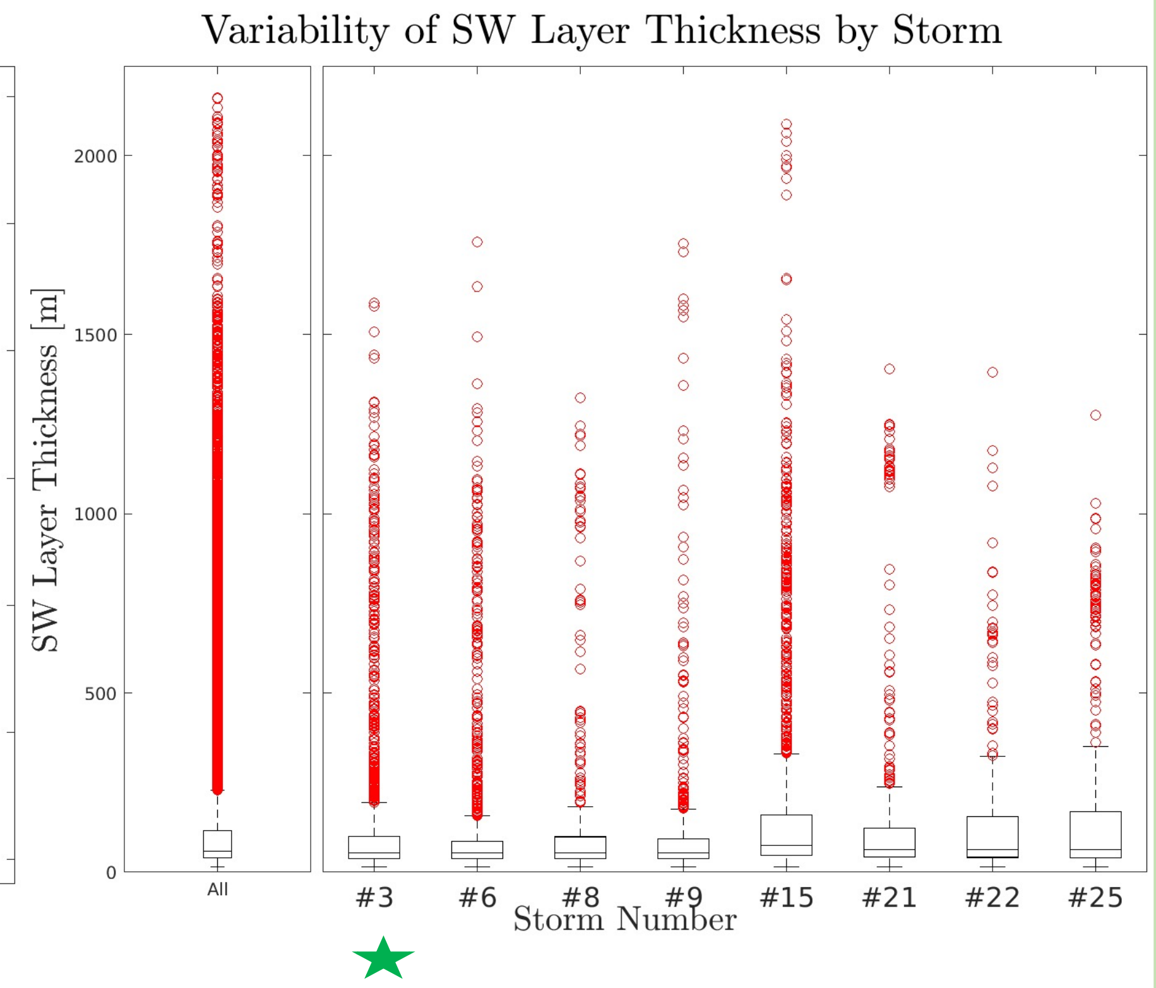


Fig. 4c

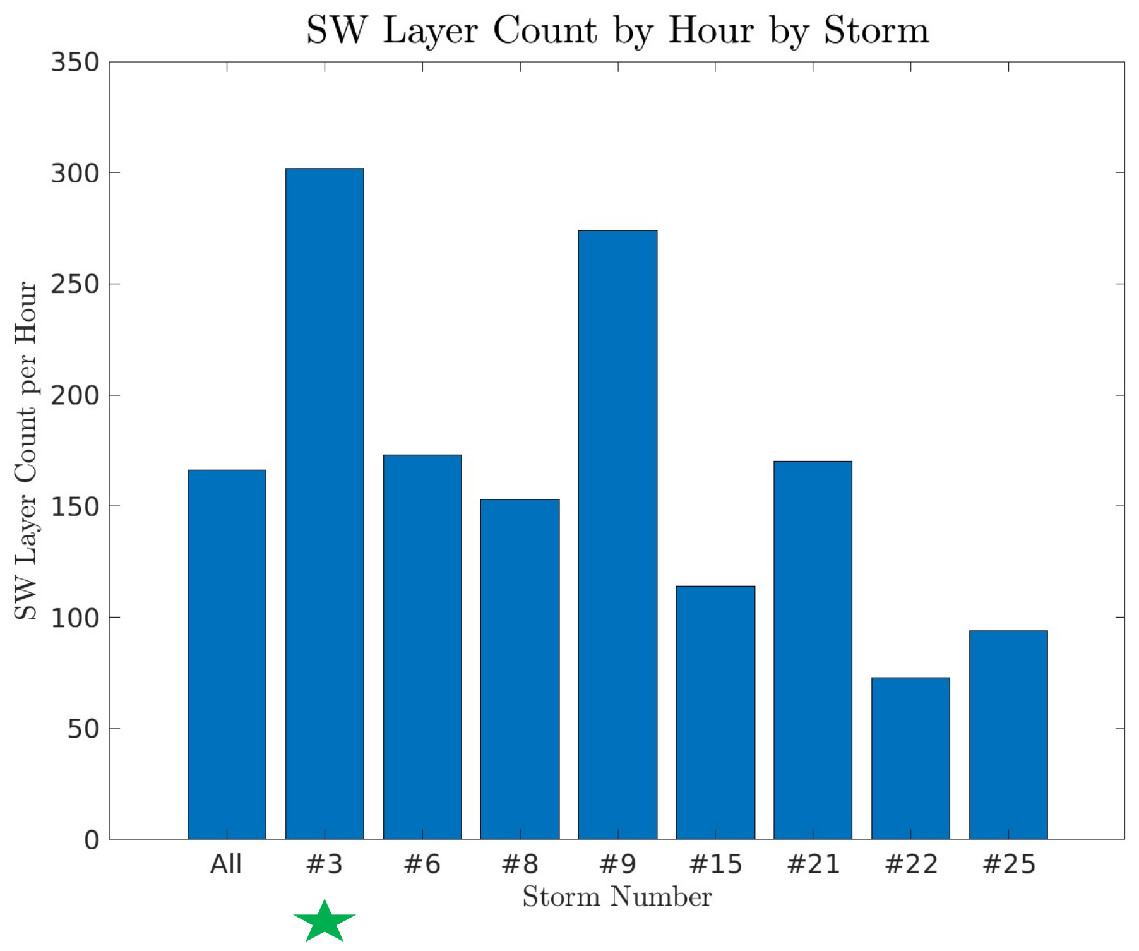
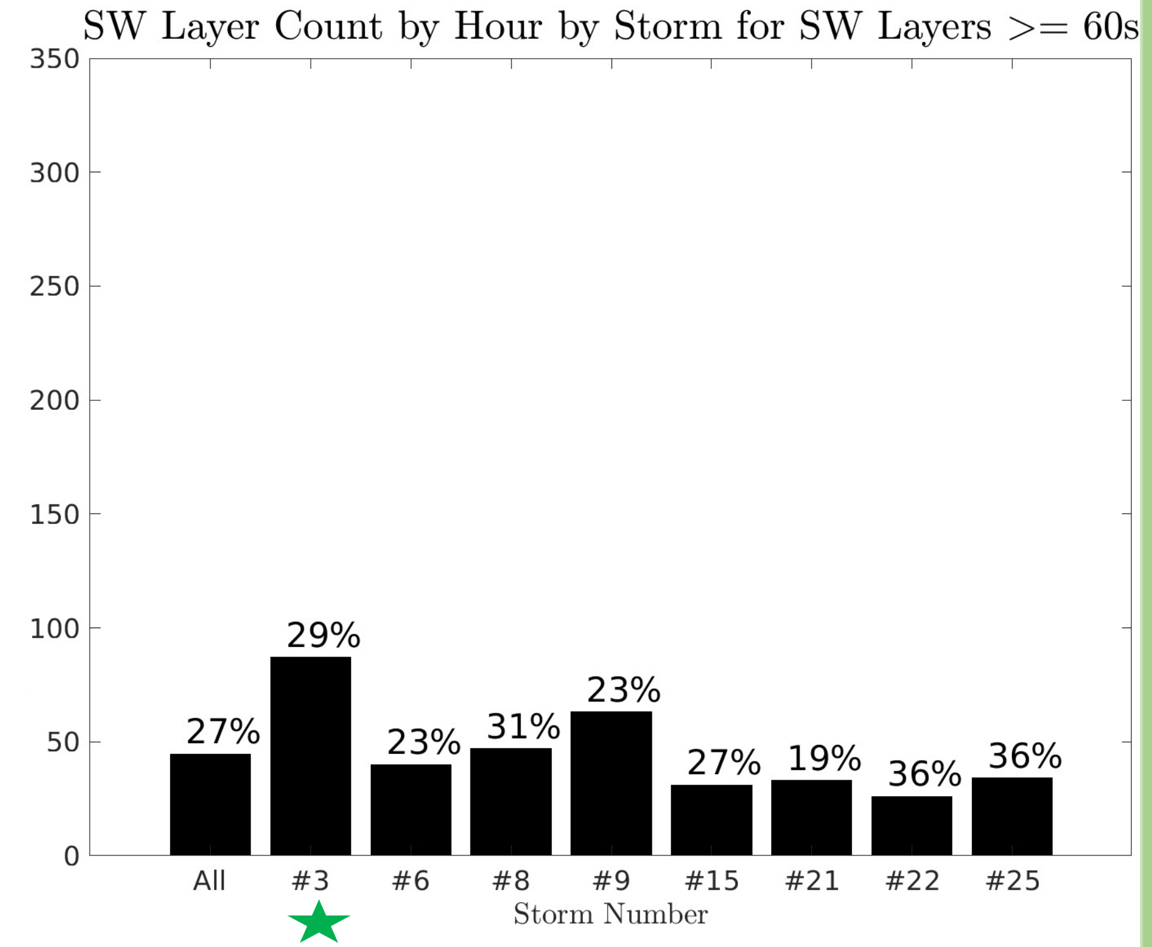


Fig. 4d



% indicates the percentage of entire layer count per hour for each storm (Fig. 4c)

★ January 4, 2018 - Storm for Fig. 1a-1d

- KASPR scan times were changed from ~290s for Storms #3, #6, #8, and #9 to ~150s for Storms #15, #21, #22, #25
- SW layer duration varies with each storm, yet the median of SW layer duration remains <50s (4a)
- 75% of SW layer thickness are < 200m (4b)
- Average number of SW layers per hour across all 26 storms is about 170
- The normalized number of layers per storm is variable (4c)
- The percentage of longer-lived layers (>=60s) varies for each storm (4d). What processes produce these longer-lived layers, and what microphysical implications do they have?
- Future Work: track SW layers across multiple scans in order to track the evolution of its magnitude, thickness, height, etc.

6. Future Work

- Incorporate soundings launched from SBU & from NWS in Upton, NY
- Incorporate ERA5 reanalysis data to fill-in the time gaps between sounding data
- Incorporate RHI and PPI scans to further enhance our understanding of the 3D structure of the SW layers, and their corresponding KASPR observables