Developing a Hail Probability Product for the Probabilistic Hazards Information Framework

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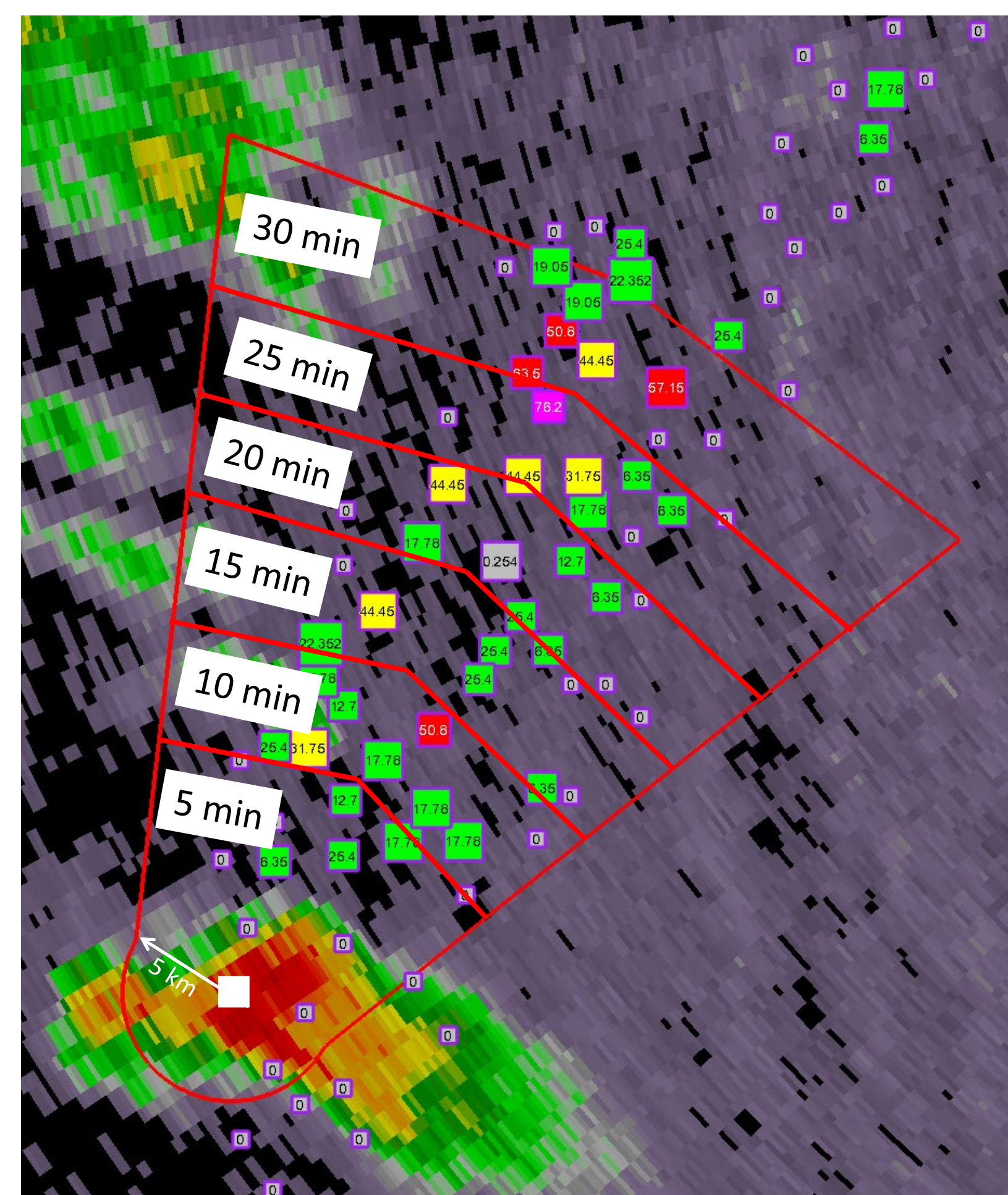### OU/CIMMS and NOAA/OAR/NSSL

Introduction

- Grid point-by-grid point probability of hail is a goal for FACETs
- Probabilistic swaths are a spatial, temporal, and hail diameter product
- Resulting products could include probability of hail diameter exceedance, "most likely" hail diameter, maximal hail diameter
- Explore techniques to understand needed level of sophistication for accuracy/reliability

Data and Methods

- 130 storms from SHAVE operations 2006-2012
- 1,417 radar volumes were manually tracked
- Storm location and motion used to create a cone to pair reports and radar data
- Used unsupervised techniques to investigate whether storms producing similar hail sizes w/in 30 minutes had similar characteristics
- Neural networks used to try to develop probabilities for maximal hail size class w/in 30 minutes

- Initial 5 km half-circle
- ± 22.5°, maximum 30-min length cone
- Lead time to reports found using storm location, motion, and report locations
- MRMS data
  - Vertical reflectivity profile
  - LL & ML shear
- NSE data
  - Isothermal heights
- Manual interrogations
  - TBSS, WER, ETs

Data Exploration

No = No hail   Non = D < 25 mm   Svr = 25 mm ≤ D < 51 mm   Sig = D ≥ 51 mm

Clustering
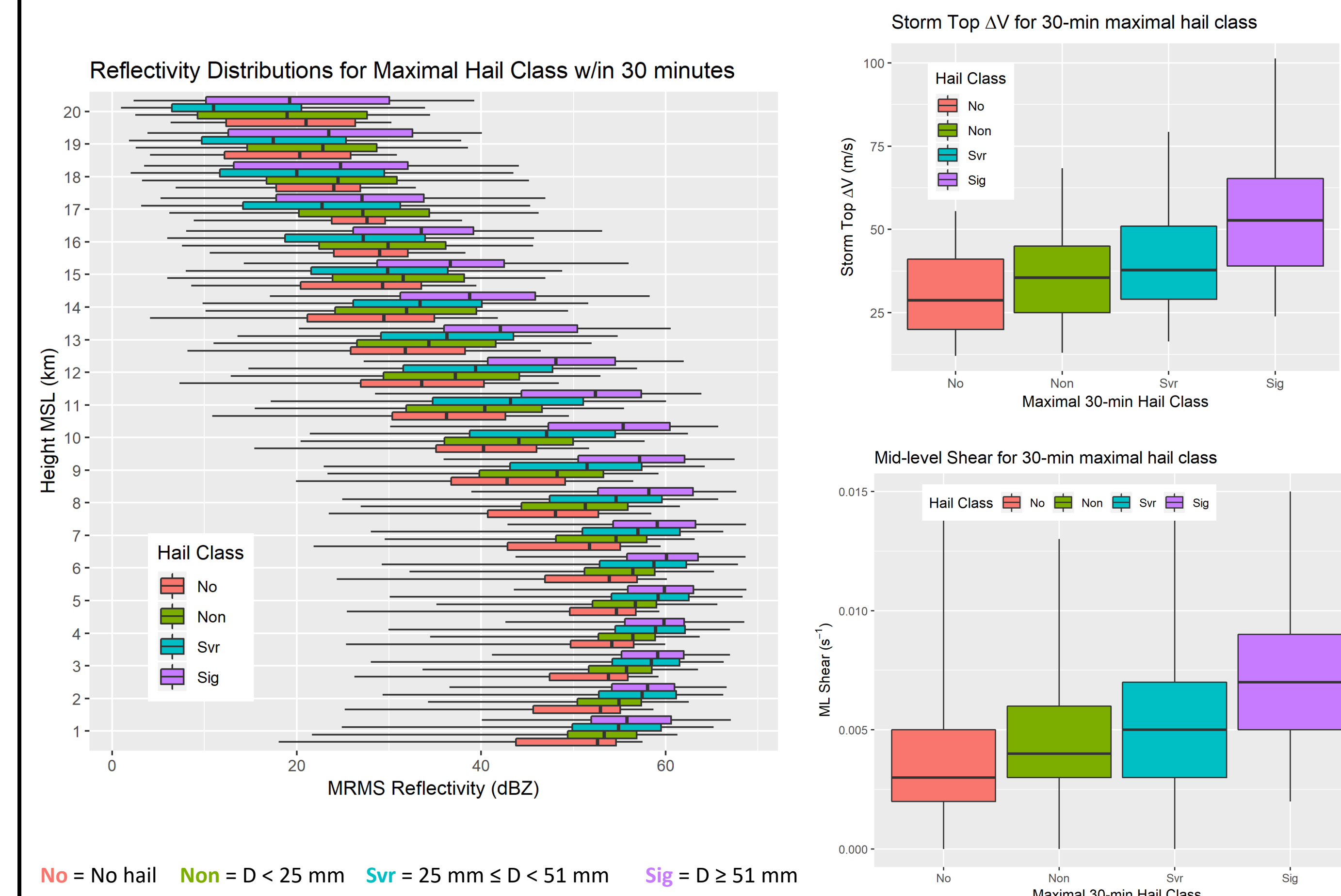
Modeling

- There was not enough data to properly train a model
- More SHAVE case analysis is ongoing
  - But would only realistically double available data
- Supplement with *Storm Data*?
  - Sparse data, only of severe+ sized hail
  - Augment with "synthetic" verification?
- Needed data set may be too large for current method
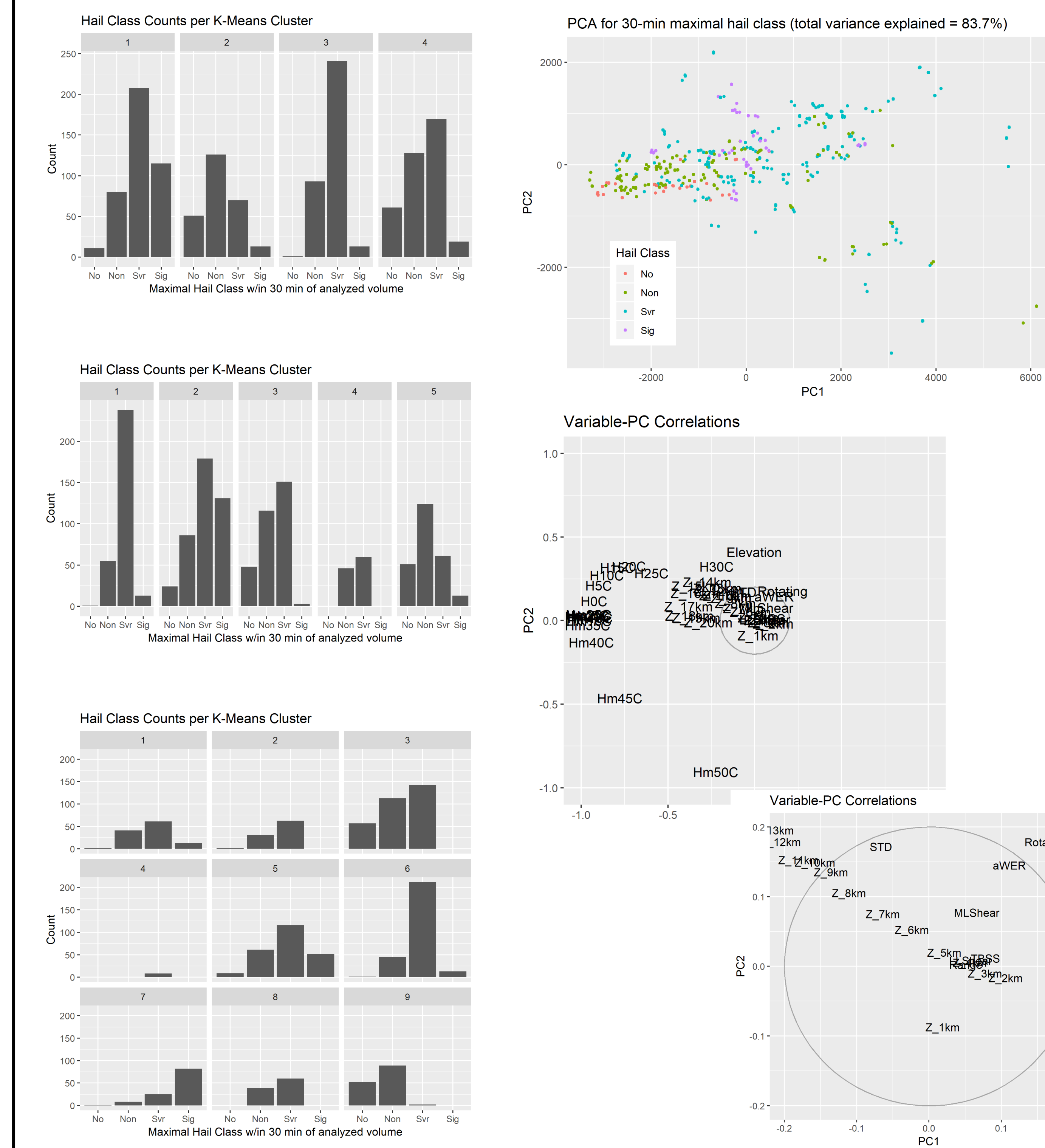
Discussion & Future Work

- Selected storm attributes and reflectivity profiles show capability to discriminate hail size classes
- Unsupervised clustering is not possible due to large overlaps of the attributes' parameter space
  - Even when using large number of classes (e.g., clusters for unorganized and then cluster(s) per hail size class)
- PCA reveals large impact of isothermal heights
  - Future work: incorporate full sounding; create 2 models (sounding and radar), combine into a single, final model
- Method to create probabilistic swath
  - "Simple" ML method projecting probability on motion centerline and then smoothed
  - Fully convolutional?