# *Predicting Severe Hail Events in South Florida*

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## Abstract

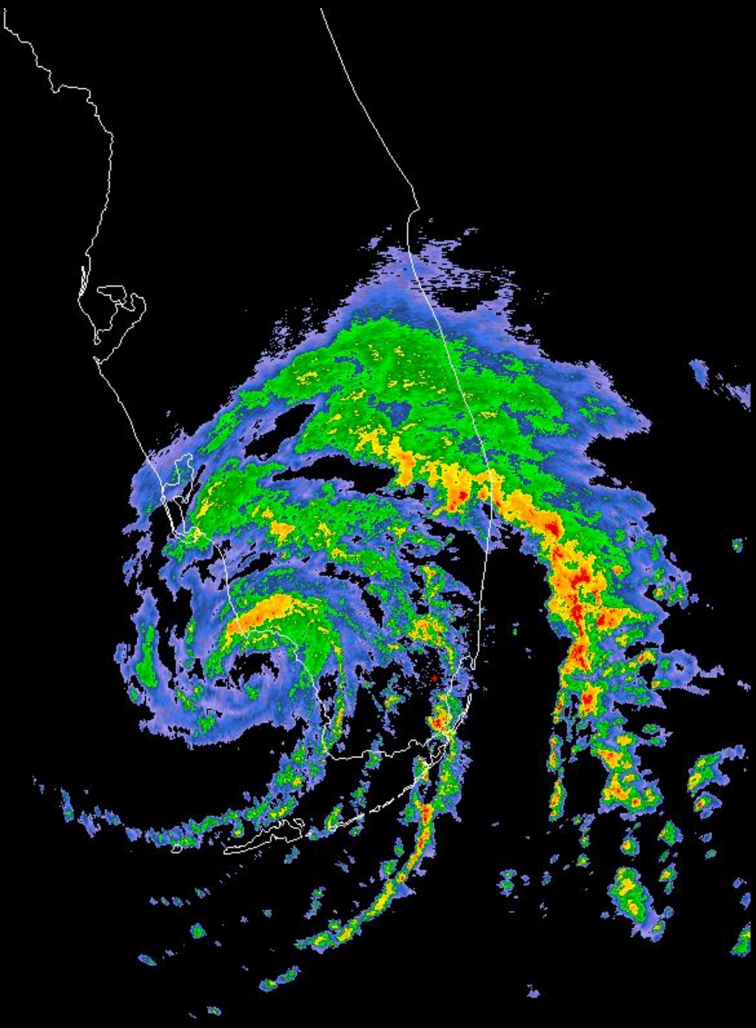
Various weather radar-based severe weather parameters have been developed with the intent of assisting National Weather Service meteorologists in their decision making regarding whether a particular storm will produce severe hail. Although less common in the subtropical climate of South Florida than in higher latitudes, severe thunderstorms do pose a significant threat to life and property. A noteworthy study initiated for the Southern High Plains by Porter et al. sought to develop a linear correlation between the elevation of storm reflectivity cores, height of the freezing level, and reports of severe criterion hail. This method proved a successful aide for use in NWS operations and was subsequently studied and implemented operationally in the Northern High Planes by Donovan and Jungbluth and Mid-Atlantic region by Kramar and Waters. The latter study was able to provide a distinct relationship between the aforementioned factors despite having a typically different local storm environment than the previous two. This presentation will include the results of a study to determine whether a technique used to predict severe hail at higher latitudes can be applied in South Florida. It also identifies temporal and seasonal tendencies of severe-hail producing thunderstorms.

After gathering a dataset of 1 inch diameter hail reports, rawinsonde observations representative of the near-storm environment of 54 storms producing hail one inch or greater in diameter (the criterion used by the NWS) were analyzed and the heights of the freezing level were cataloged. More than 70% of the events occurred between 1:00 and 5:00 pm local time and nearly 80% occurred between the months of May and July. Archived WSR-88D radar data from Key West, Miami, Melbourne, and Tampa were used, as appropriate, to determine the height above sea-level of the highest 50 dBZ reflectivity in each storm core. The height of the 50 dBZ reflectivity was strongly correlated with reports of severe hail, indicating it does have predictive value in the subtropics.

Given this result a procedure was developed on the Advanced Weather Information System (AWIPS) used by the forecasters at the NWS Miami Weather Forecast Office to display the 10th and 50th percentile heights of the 50 dBZ cores of the storms used in this study. The Local Analysis and Prediction System is used to indicate the observed freezing level height. This information, in conjunction with the radar display, allows the Miami forecasters to compare the observed 50 dBZ height with the percentiles derived from our study. If the height of the observed 50 dBZ core exceeds that of the 50th percentile of the storms in the study there is a good chance the storm will produce severe hail on the surface within about 10 to 15 minutes. Examples of the use of the procedure will be shown.

# Outline

- Introduction
- Methodology
  - Data Collection
  - Quality Control
  - Plotting the Event
- Results
  - How It Works?
  - Example
  - Comparison
- Conclusion
- Future Work



# Methodology

Event Data Collection – NCDC Database (00-12)

- Filter by Size ( 1 Inch and greater )
- Events: 143
- Errors: 15 (Without Coordinates)
- Potential Events: 128

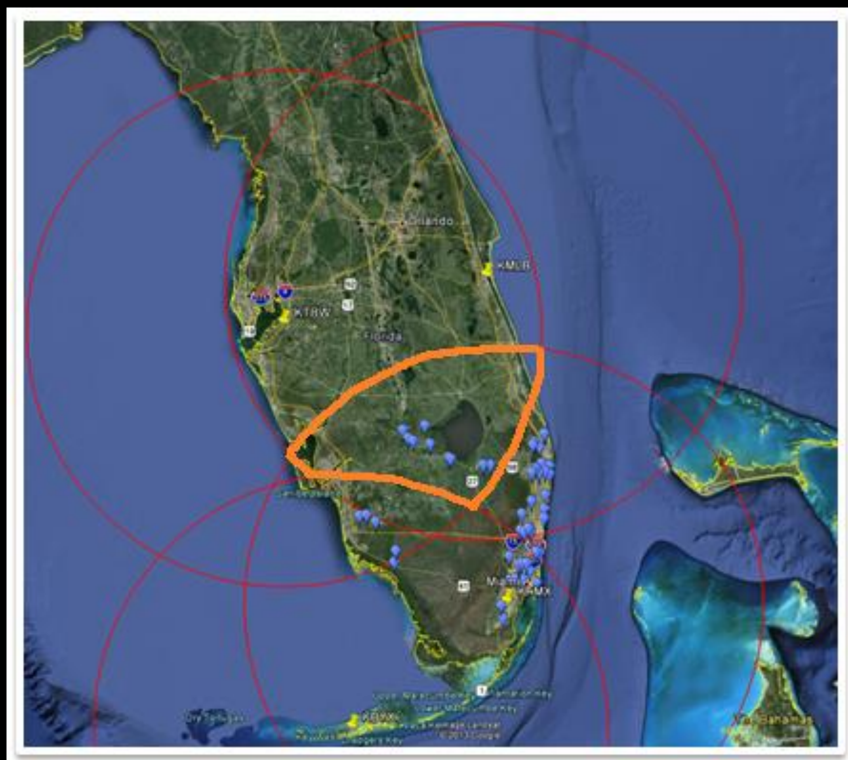
Next Step: Radar Data Collection

# Methodology

Radar Data Collection – NCDC Database

- One Hour Before/20 Minutes After Event (Downloaded data actually is 2h/40m)
- Temporal Limits (Changnon 1970)
  - "Full-grown hailstone could take on order of ten minutes to fall out of the updraft and reach the surface"
- Volume Coverage Pattern 11/12 – Resolution

# Methodology




Problems

- Glades
- Palm Beach
- Miami Dade

Solution

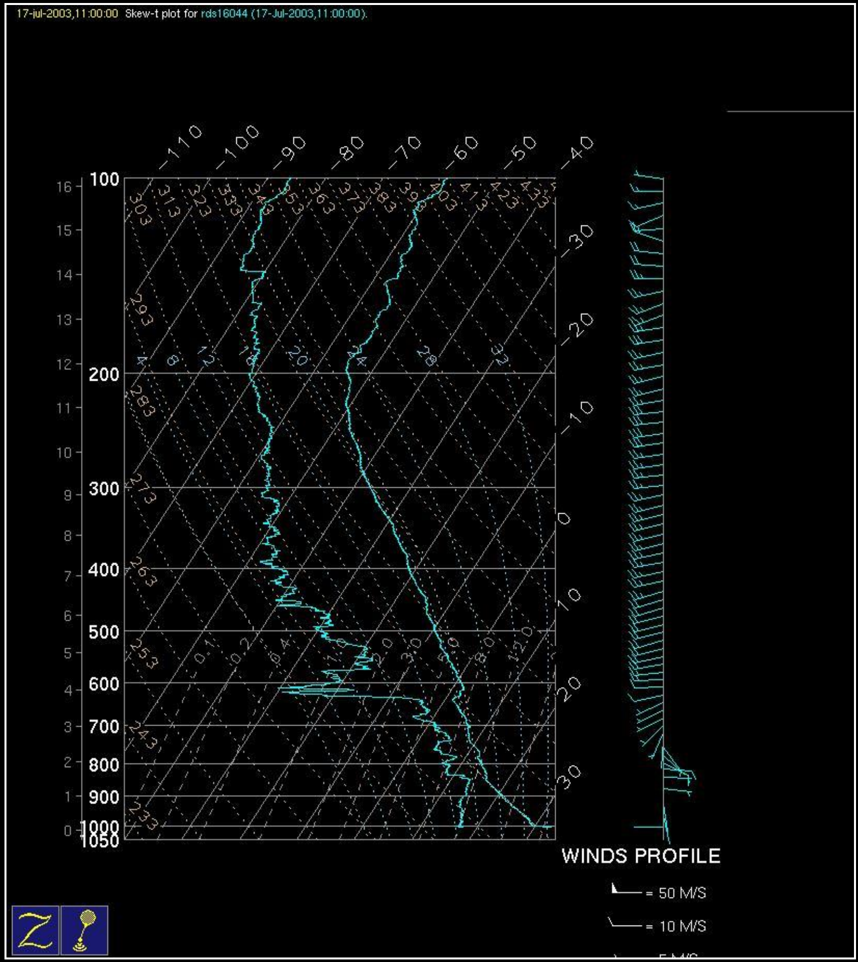
- Interpolation

Next Step: Sounding Data Collection

# Methodology

Sounding Data Collection

- University of Wyoming
  - Soundings Used: 00/12 for each date
  - Special Cases: 06/18*



# Methodology

Quality Control → 74 Examples Remain

- Description Relocation
- Multiple Examples in the Same Day *
- Not Available Radar Data for the Day
- Storm does not Represent Event

Next Step: Plotting the Event

# Methodology

Plotting Event

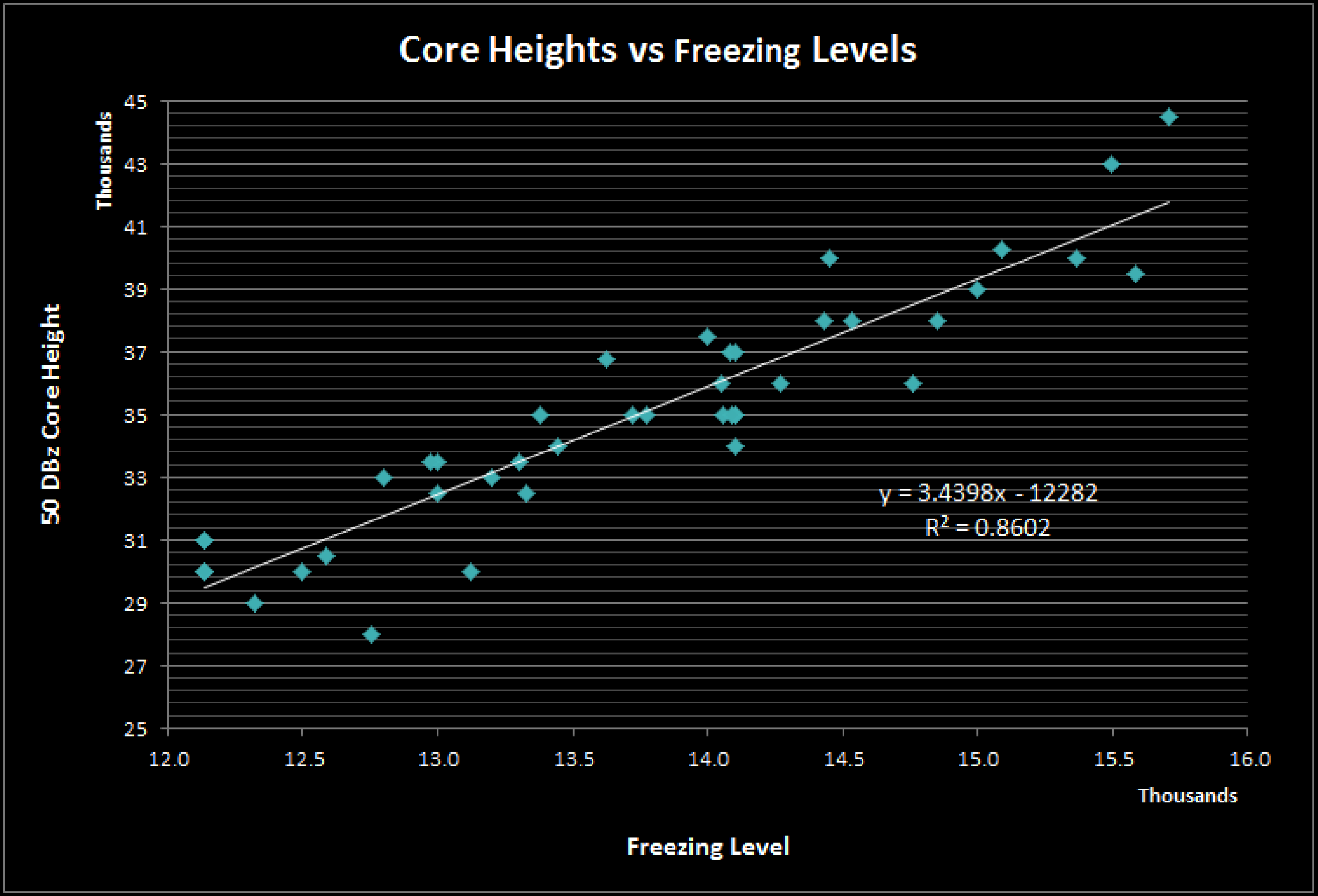
- Interpolation between Freezing Levels
- Interpolation of Radar Data (e.g. Glades)
- Events Plotted  Evaluation
- Revisit the Events
- Outliers Removed
- 54 Examples Remain

Next Step: Plotting the Event

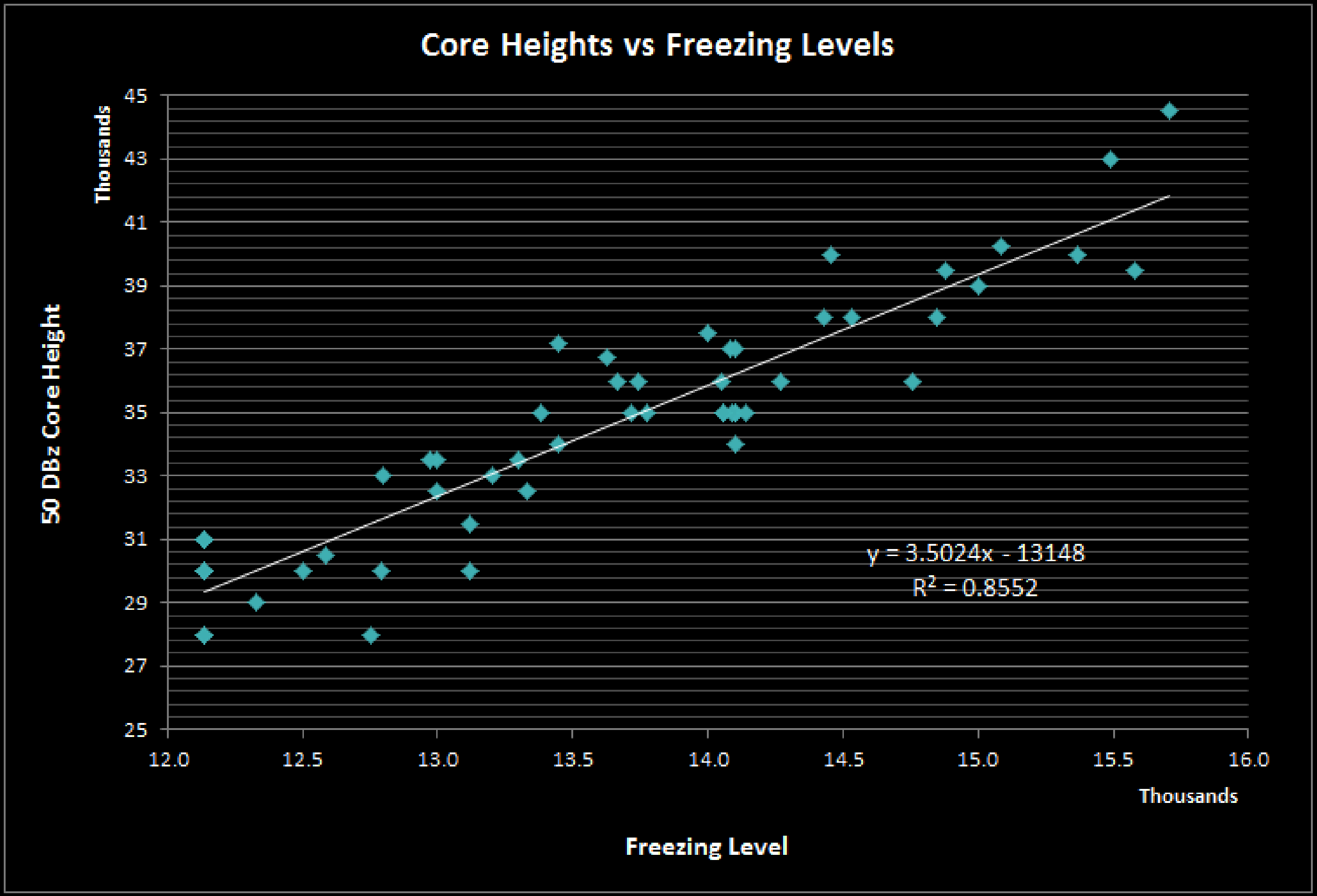
# Results

- One Inch Hail LR
  - 42 Examples
- All Events(1 – 1.75 in)LR
  - 54 Examples
- All Events 10% Quantile LR
- Frequency of Events by Month
- Frequency of Events DT

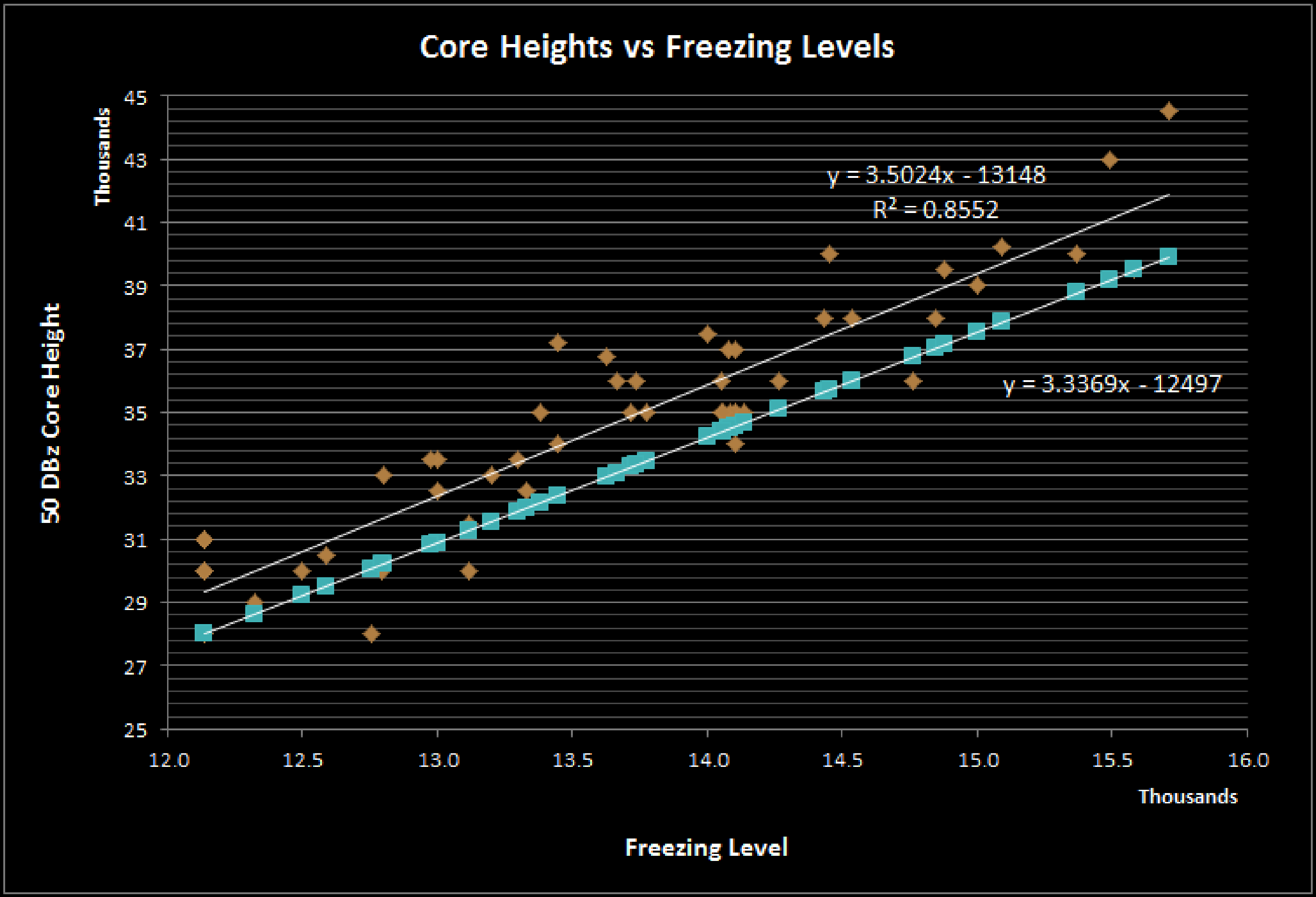
# One Inch Hail



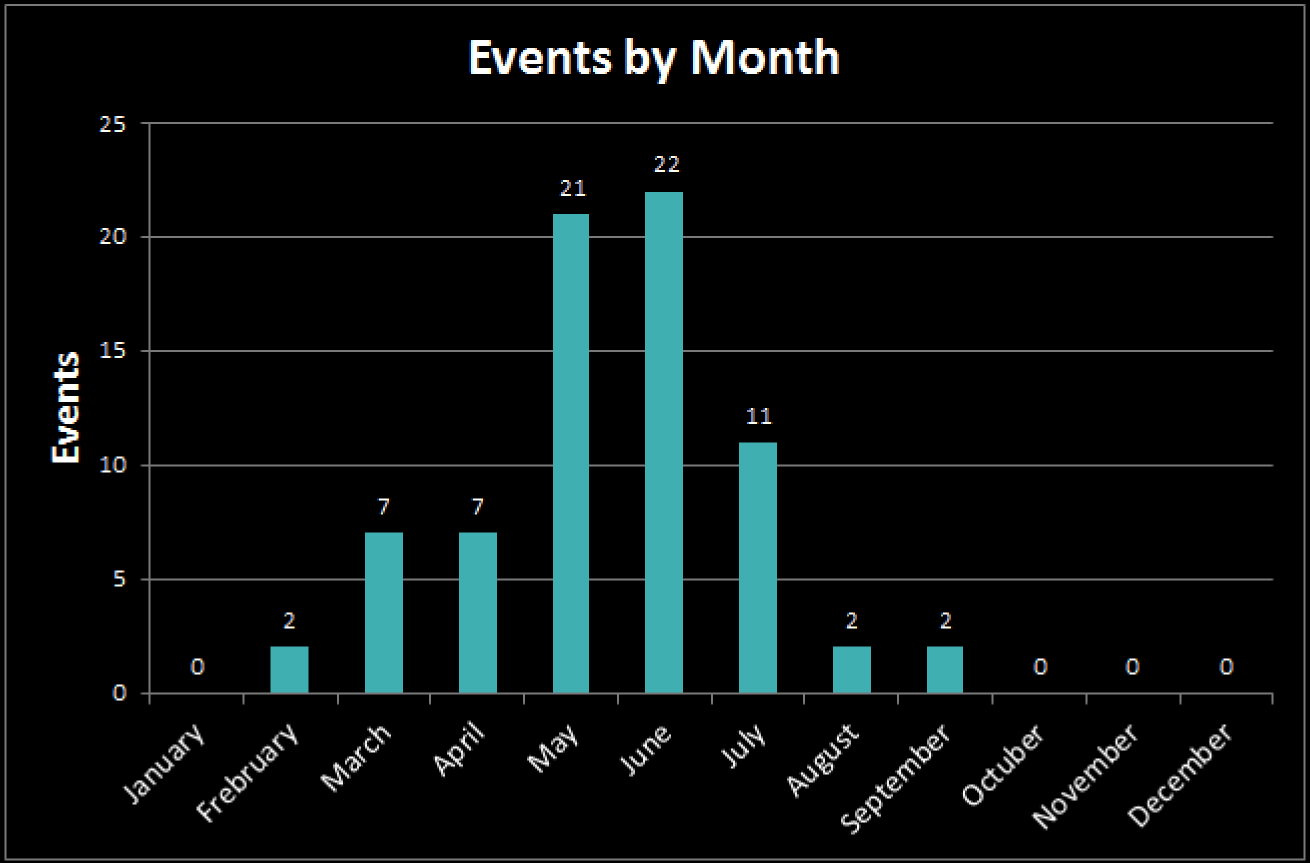
# One to 1.75 Inch Hail



# One to 1.75 Inch Hail with 10%

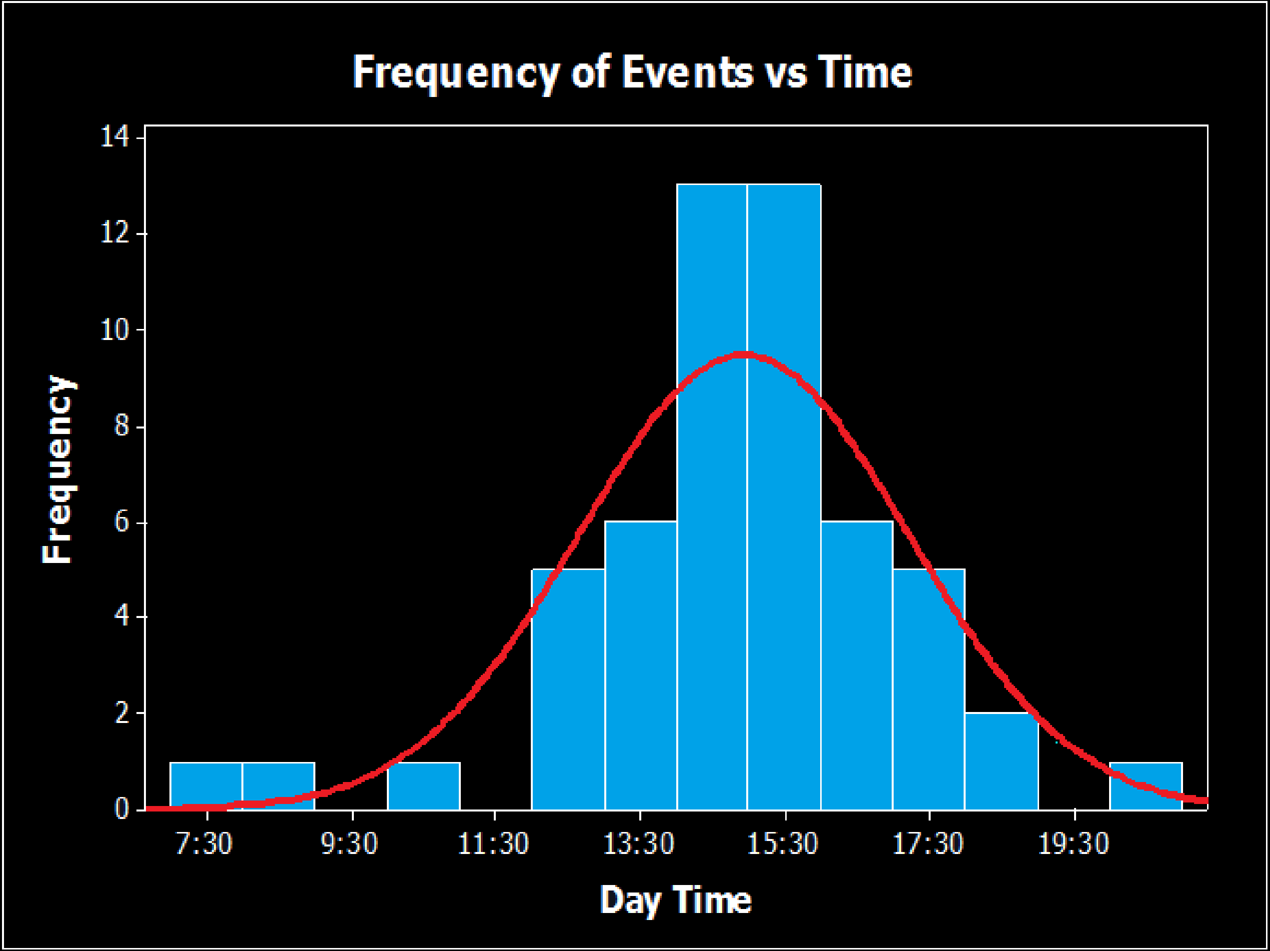


# Events by Month




74 Examples – After QC

# Frequency of Events by Hour




After Interpolation and more QC: 54Events

# Results

How It Works?

1. Identify Accurate Freezing Level of the Day

   Taking into Consideration: Time of the Day

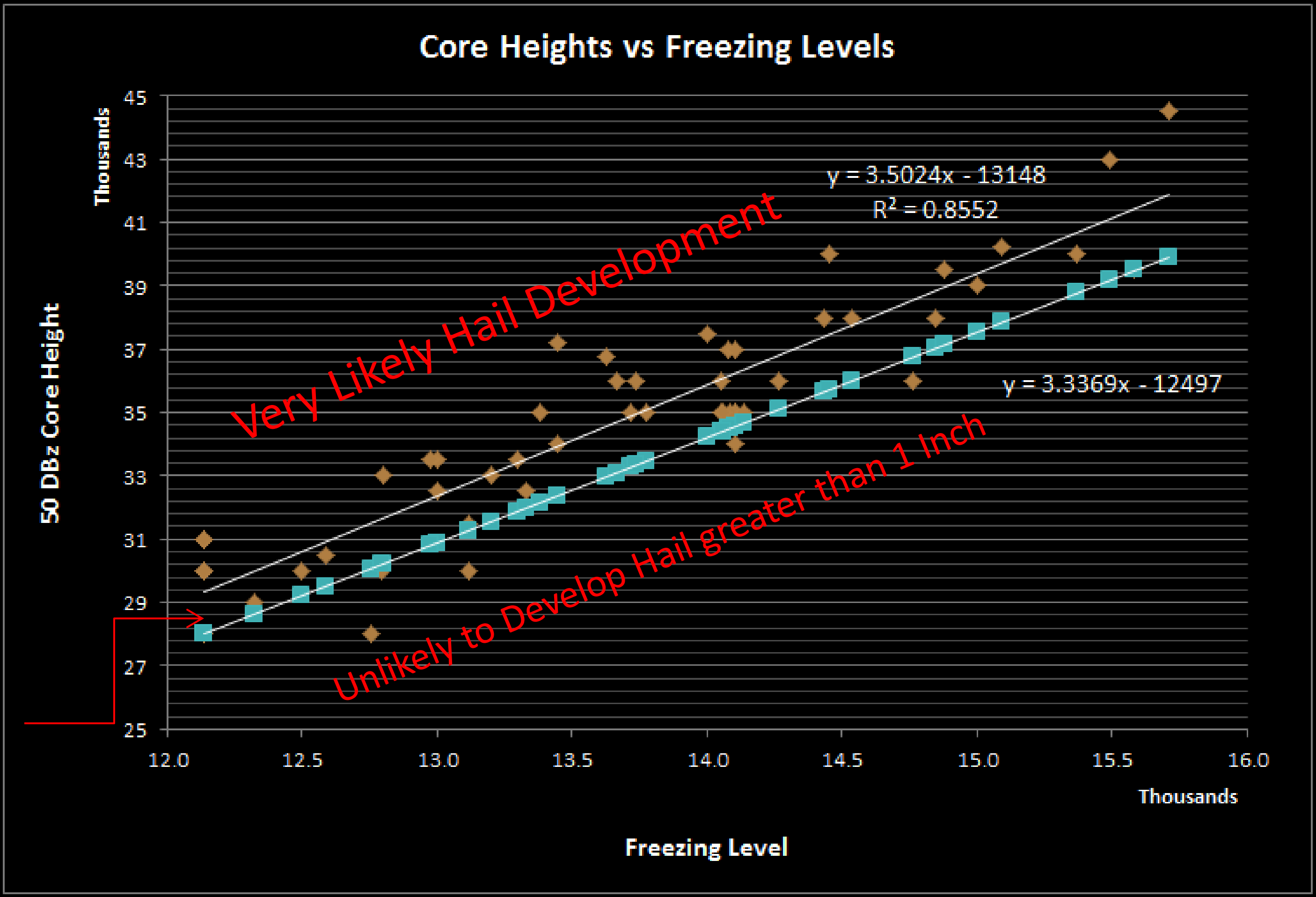
2. Identify highest level of 50 DBZ Core of the Storm

   Interrogating the storm with the appropriate radar

3. Compare the results with the curves

   The 3 Regions to make the prediction

# One to 1.75 Inch Hail with 10%




More information will be needed to issue a warning

# Results

Example Location: Boca Raton

1. Freezing Levels

    00Z/15,104ft: 12Z/15,401

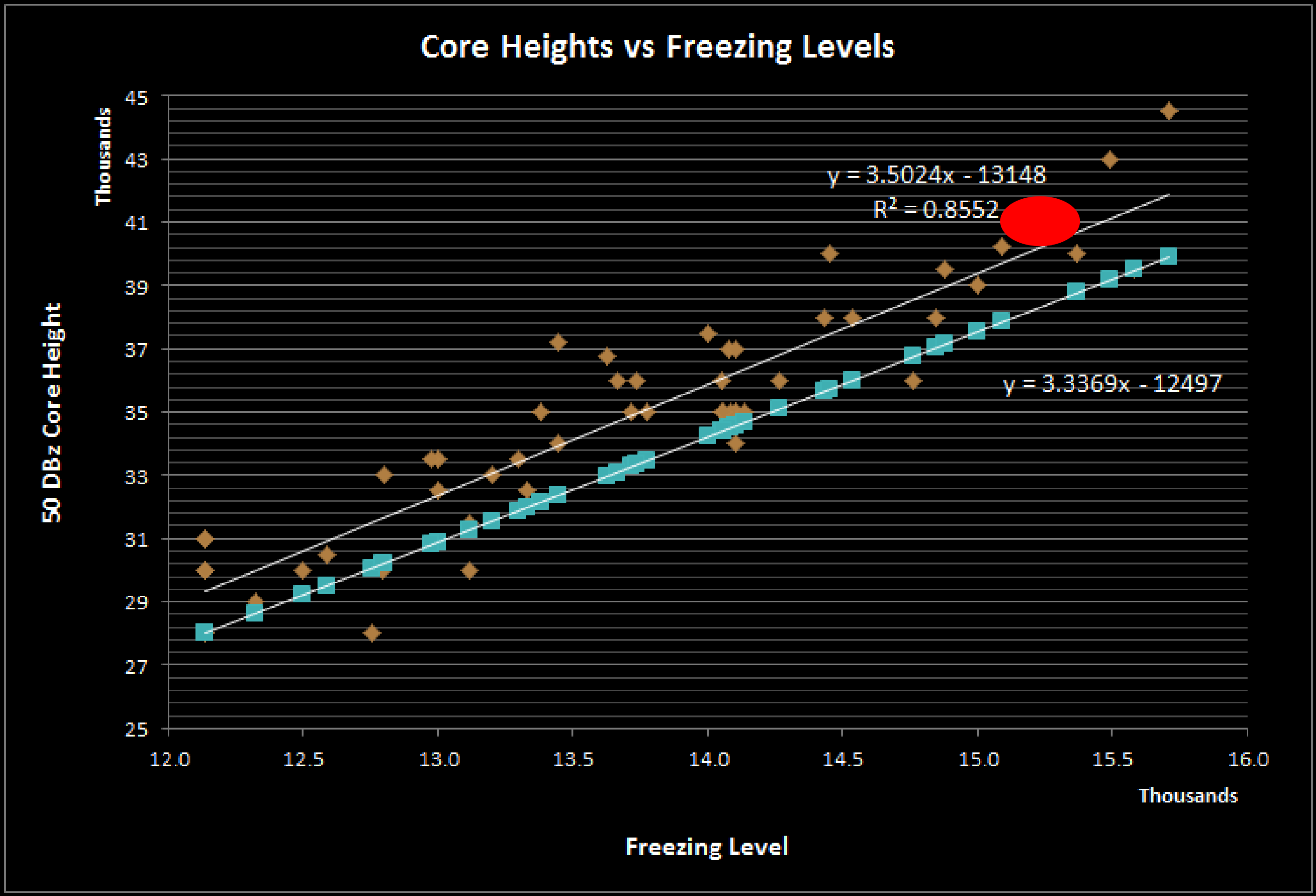
2. 50 DBz Storm Core sustained for 2 vol. scans

    18:47:17

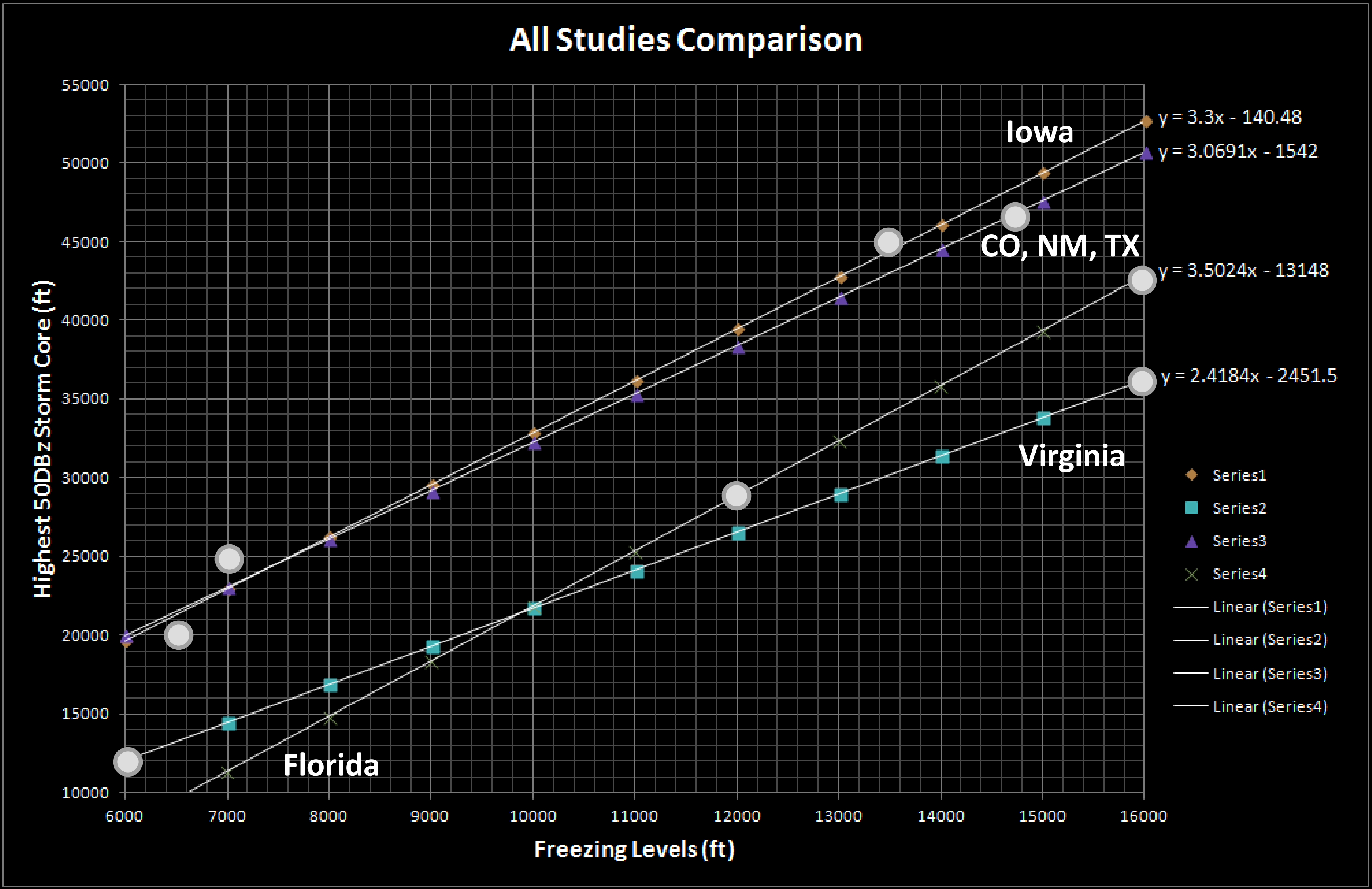
3. Graph the Results

    FL ~ 15200ft      50DBz Core ~ 41500ft

# One to 1.75 Inch Hail with 10%



# All Studies Together



# Conclusions

- It was possible to establish a linear relationship between the Freezing Level and the 50DBz Cores of Storms to predict hail with a correlation coefficient of .8552 given the parameters.

- This relationship now allows us to predict severe hail in South Florida. It is intended to be used along with the other products as ZDR, ϕDP, VIL, LC, etc.

- It is ***strongly*** recommended to the WFOs to verify each event reported with a *GIS* software in order to develop a research quality database.

- This study compares well with previous studies.

# Future Work

- Extend the Study Database
- Another approach to the 60 DBz Cores
- Expand study to small hail for the issuance of SPS for hail
- Relate the Polarimetric Products w/ Results