On the Precision of Threats in National Weather Service Severe Weather Warnings

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Purpose

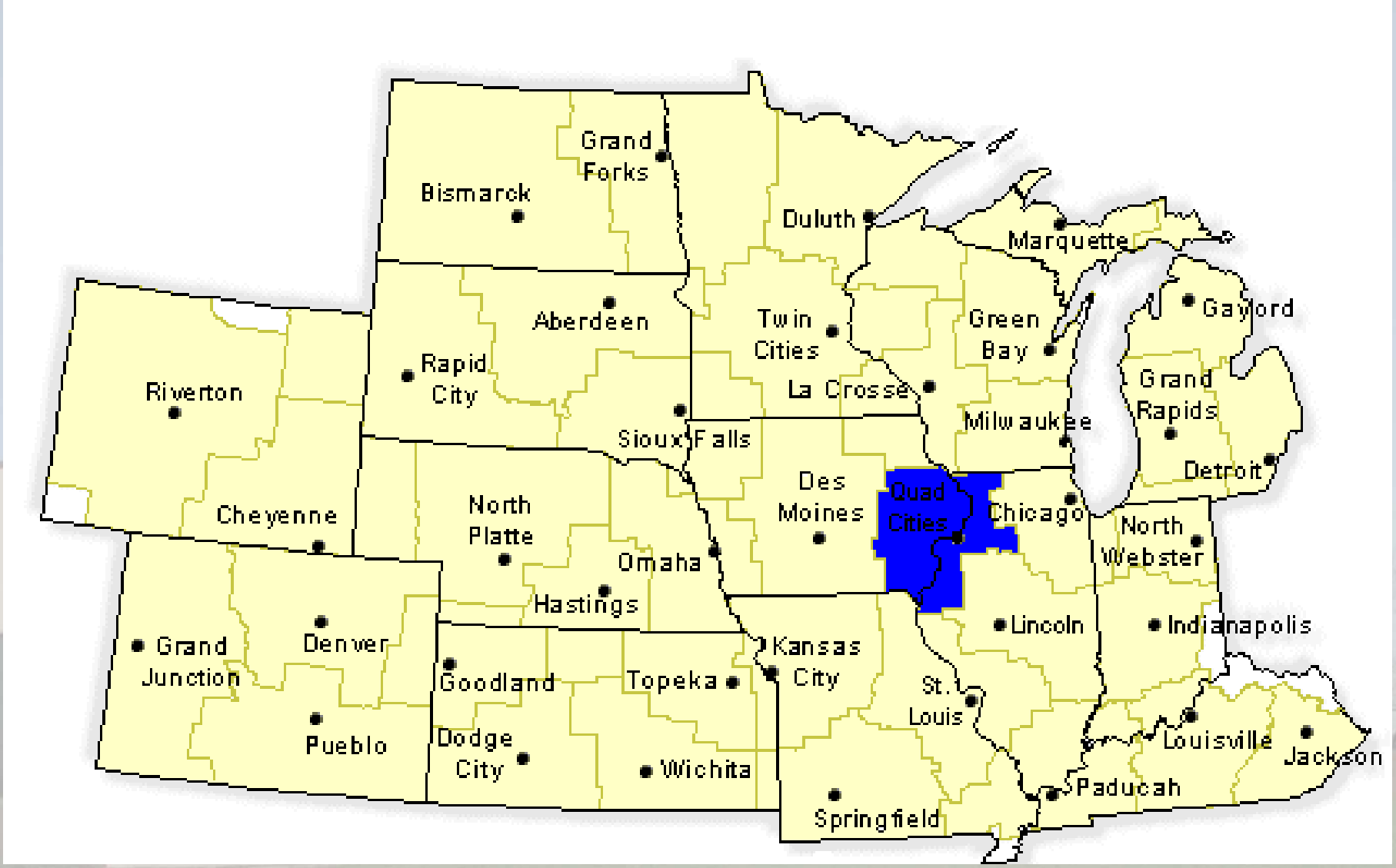
- To assess the accuracy and precision (type and magnitude) of threats described in NWS severe weather warnings as a first step toward improving warning skill of those parameters.

AT 835 PM CDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A LINE OF SEVERE THUNDERSTORMS CAPABLE OF PRODUCING ***DESTRUCTIVE WINDS IN EXCESS OF 70 MPH***.

3 Types of Verification

- Administrative – as conducted by the NWS – POD, FAR, Lead time
- Social – from the perspective of the end user
- Scientific – approach used in this study

Study Area


Grand Forks
Bismarck
Duluth
Marquette
Aberdeen
Twin Cities
Green Bay
Gaylord
Rapid City
Riverton
La Crosse
Grand Rapids
Milwaukee
Sioux Falls
Detroit
Des Moines
Quad Cities
Chicago
Cheyenne
North Platte
North Webster
Omaha
Hastings
Lincoln
Indianapolis
Grand Junction
Denver
Kansas City
Goodland
Topeka
St. Louis
Pueblo
Dodge City
Wichita
Louisville
Jackson
Paducah
Springfield

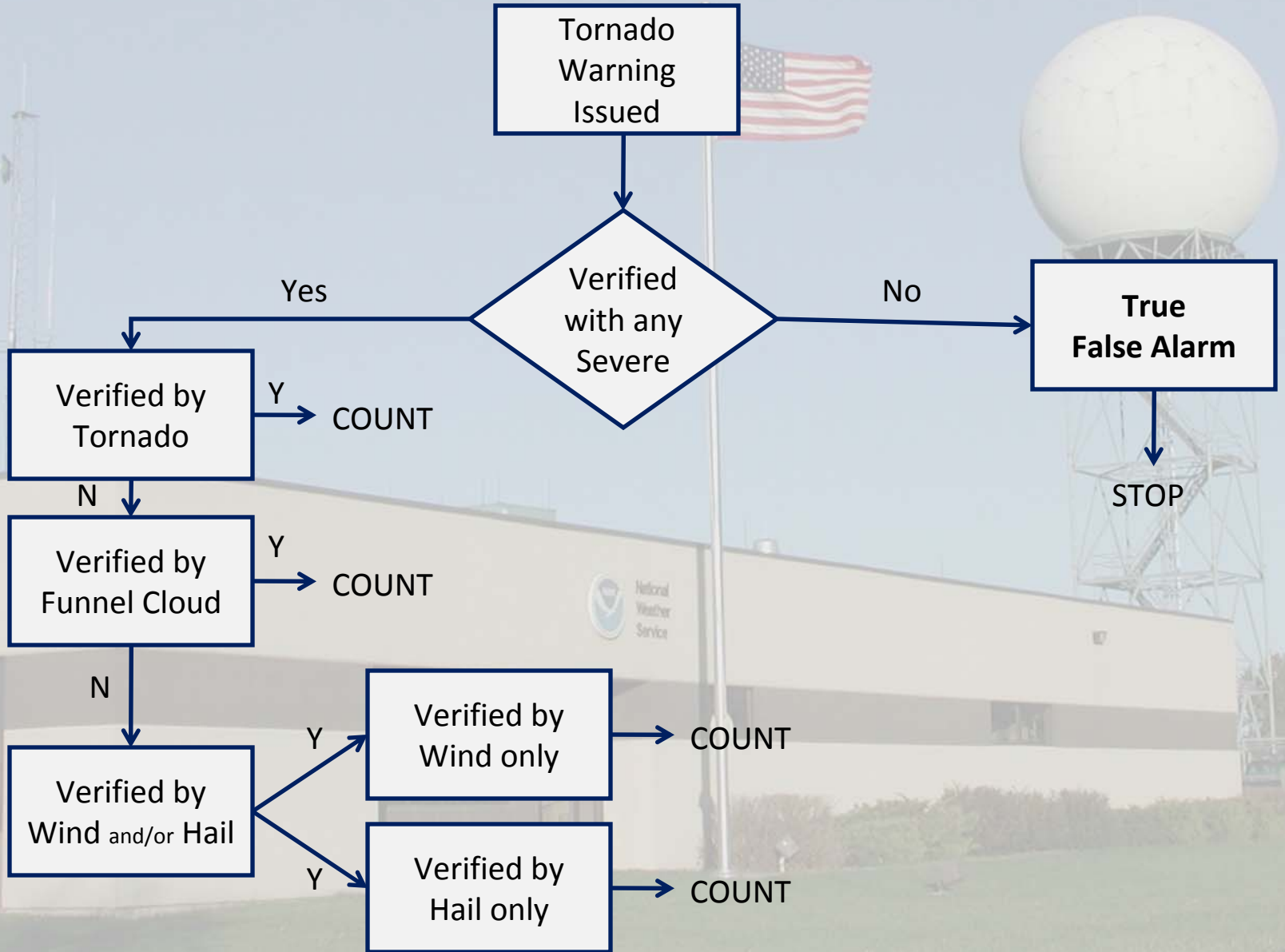
Method – Data

- Tornado and severe thunderstorm warnings from 2005-2008
  - Quantitative wind speed and hail size included in severe thunderstorm warnings.
  - Tornado threat explicit via tornado warning issuance.
  - The warning parameter is the unit of measure.
  - Does not include missed events and *true* false alarms (no severe report of any kind).

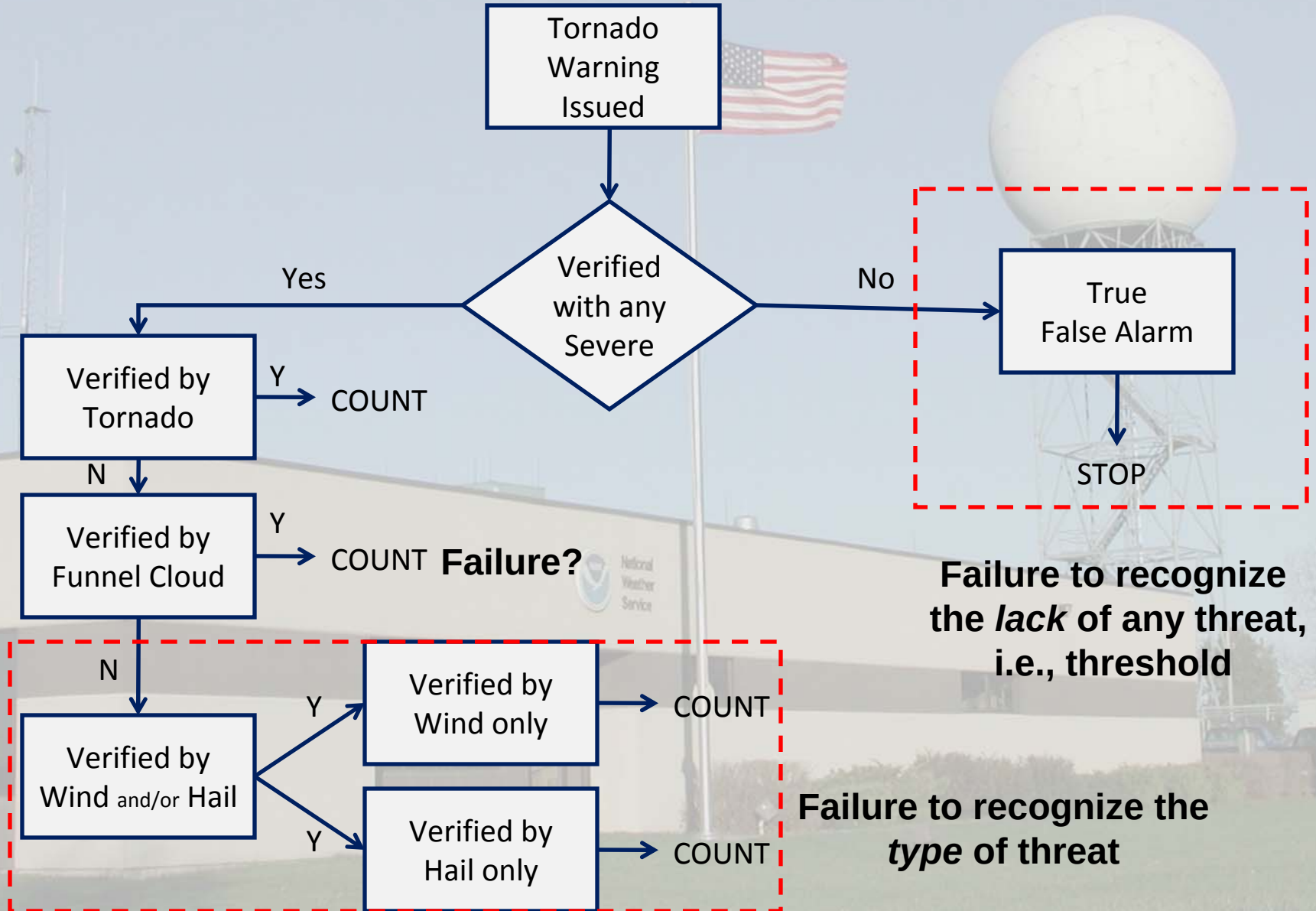
Method – Tornado Warnings

- Data quality issues
  - o Sampling
  - o Nocturnal events
  - o Tornado vs. funnel cloud
  - o Diagnosis of wind vs. tornado damage

Method – Tornado Warnings

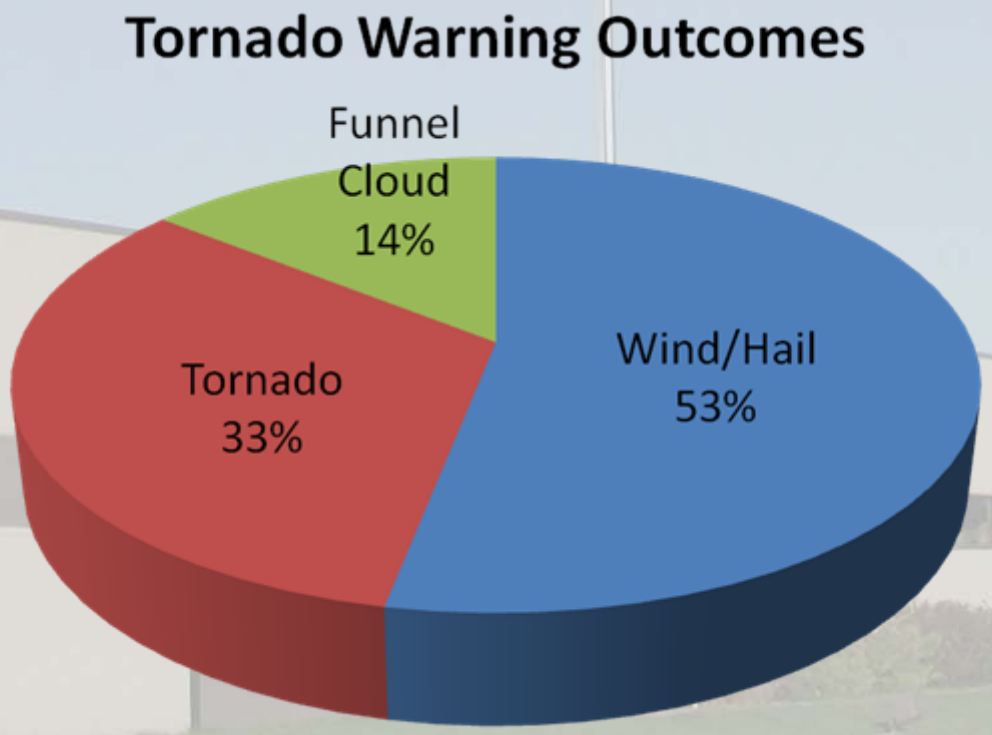


Method – Tornado Warnings

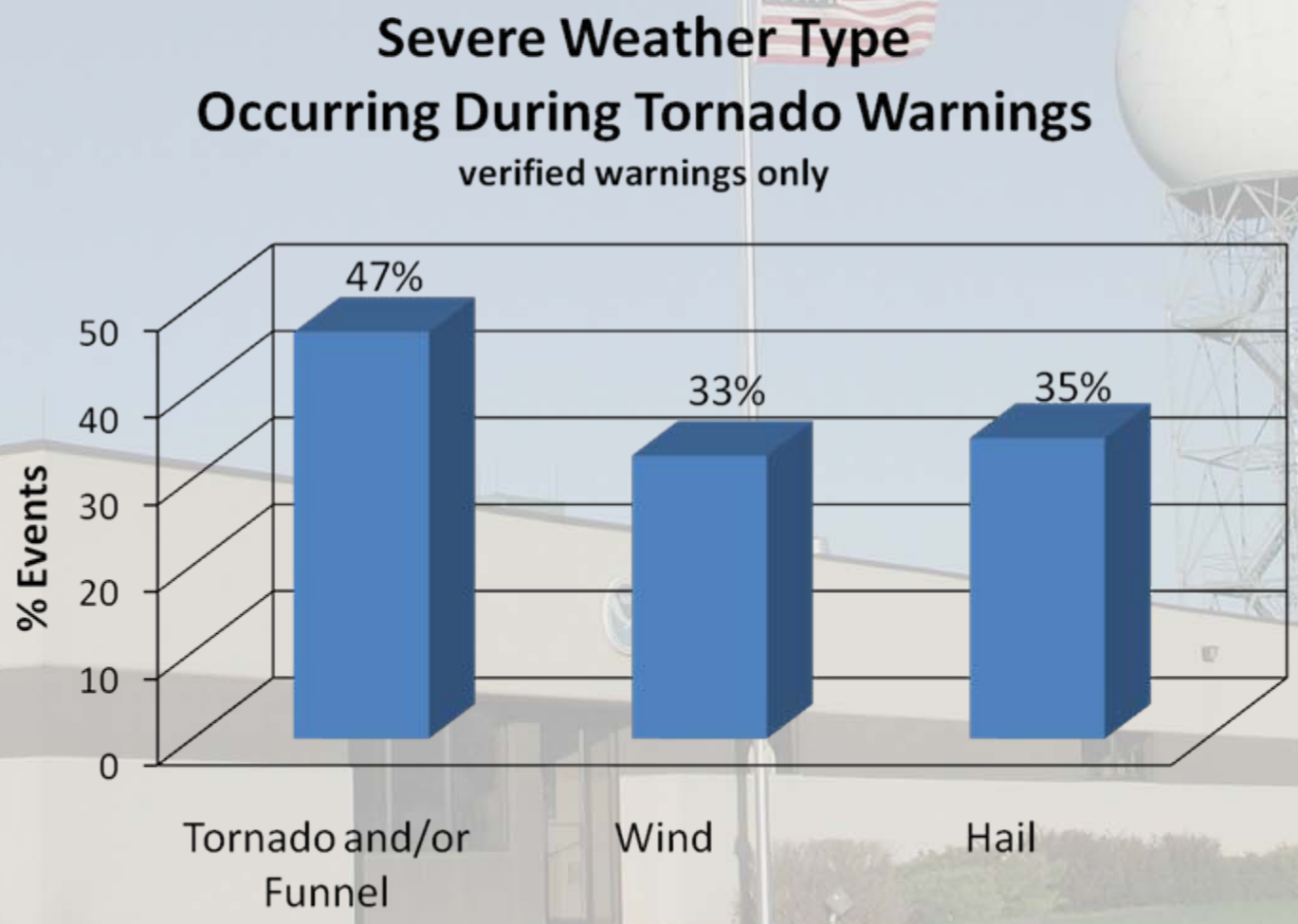


Results – Tornado Warnings

- 101 warnings issued, 49 verified
  - True False Alarm Rate = 51%



Results – Tornado Warnings



Method – Severe > Wind

For each severe thunderstorm warning (SVR) with wind mentioned as a threat:

- Calculate verifying threat type (wind and/or hail)

For SVRs where wind is forecast and observed

- Calculate Forecast – Observed speed

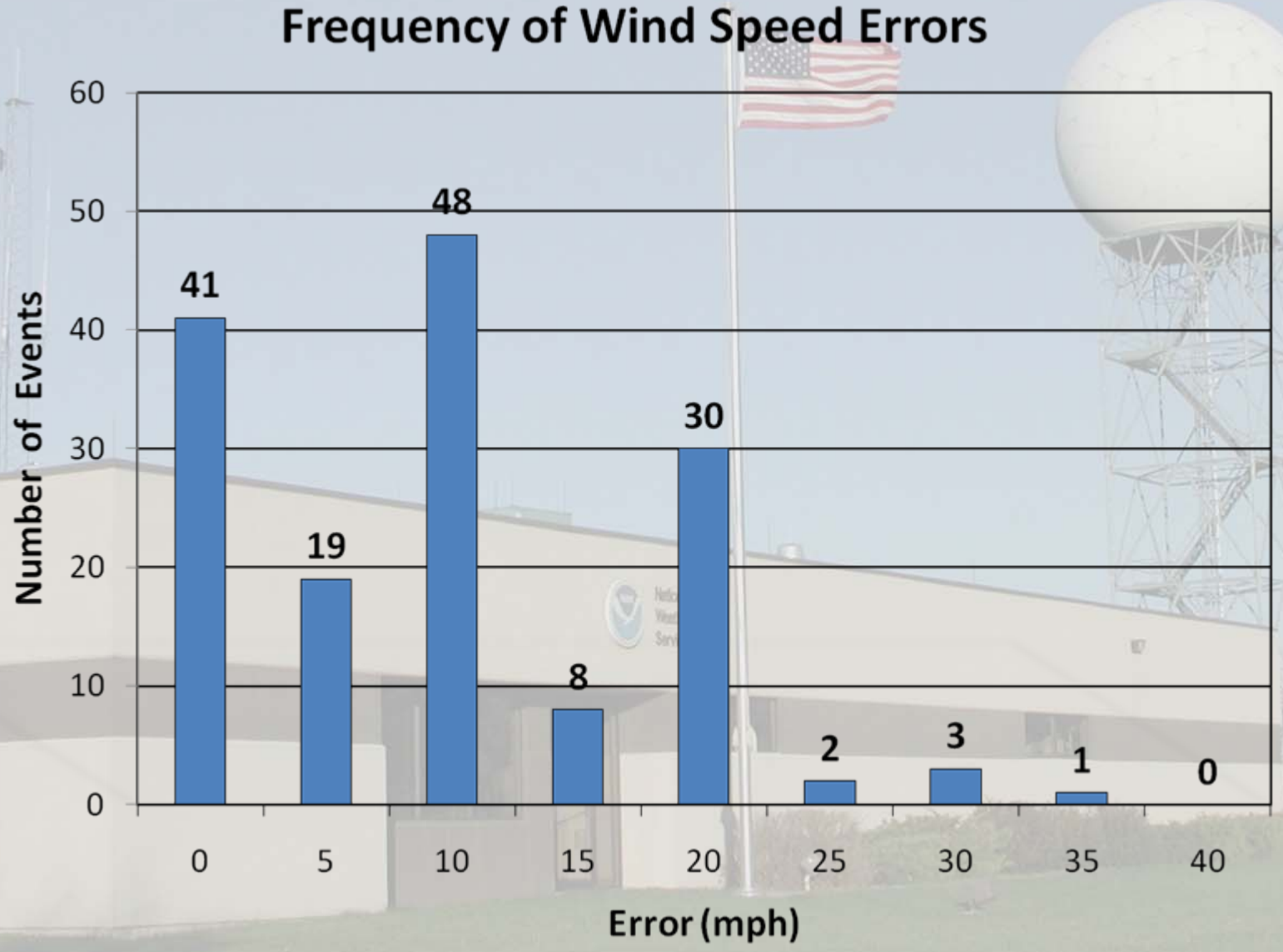
Method – Severe > Wind

- Data quality issues
  - o Sampling (storm relative and effort to get report)
  - o Spotter wind speed estimates
  - o Instrument/siting errors for measured speeds
  - o Translation from damage to speed estimate

Results – Severe > Wind

- 228 SVRs wind forecast
- 67% wind observed
- 5% wind observed and not forecast
- 4% each tornado or funnel occurs
- About 1/3 of SVRs mentioning wind verify only by hail, thus **we overwarn on wind.**
  - Frequently 60 mph is a default choice.

Results – Severe > Wind



Results – Severe > Wind

- When wind is forecast and occurs:
  - MAE = 9.6 mph
  - Bias = -1.5 mph
- Not related directly to this study…since 1994
  - 4 fatalities due to thunderstorm winds
    - All resulted from downed trees in “high end” storms
    - Siren policy in many counties now includes “high end” SVRs
  - 1 fatality due to a tornado (mobile home at night)

Method – Severe > Hail

For each severe thunderstorm warning (SVR) with hail mentioned as a threat:

- Calculate verifying threat type (wind and/or hail)

For SVRs where hail is forecast and observed

- Calculate Forecast – Observed size

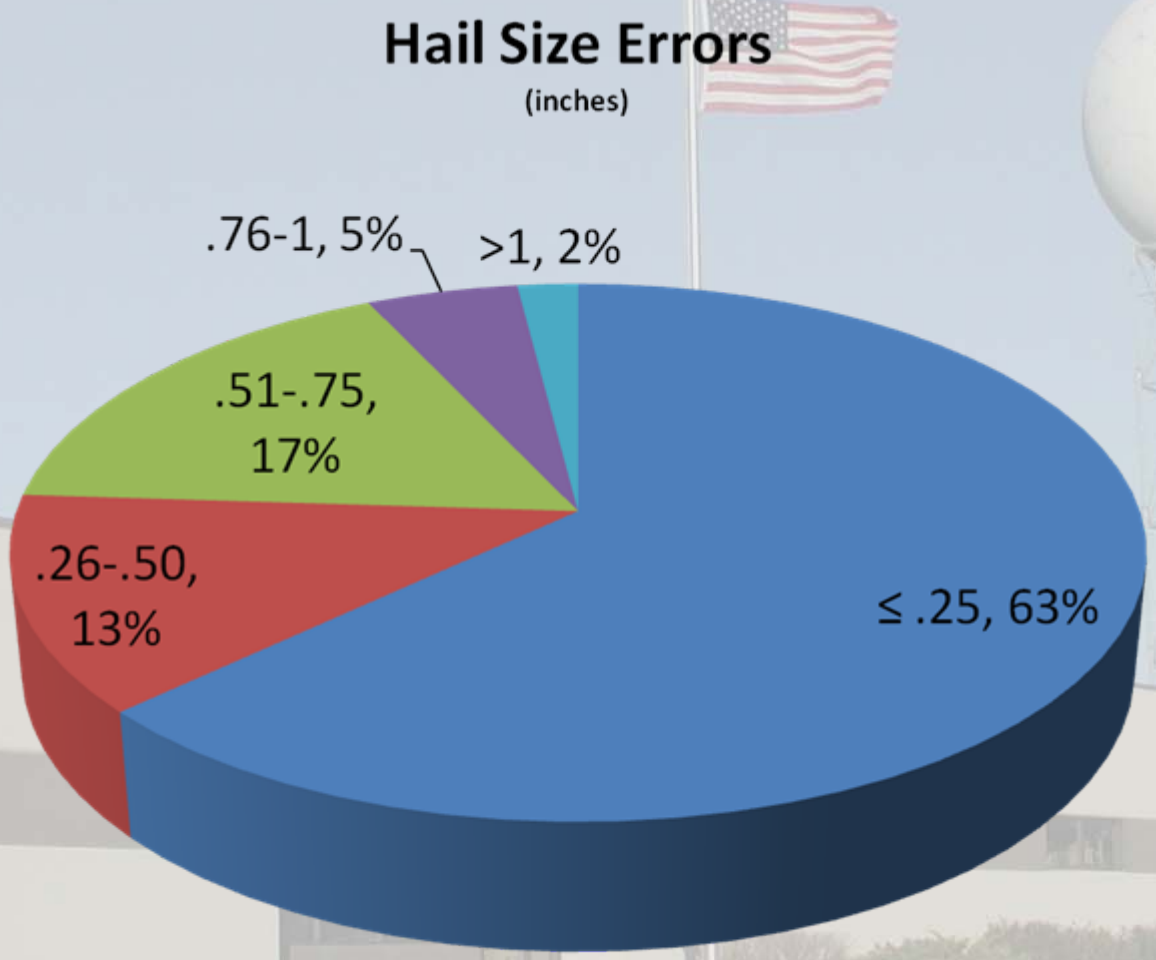
Method – Severe > Hail

- Data quality issues
  - Sampling (storm relative and effort to get report)
  - Size estimates

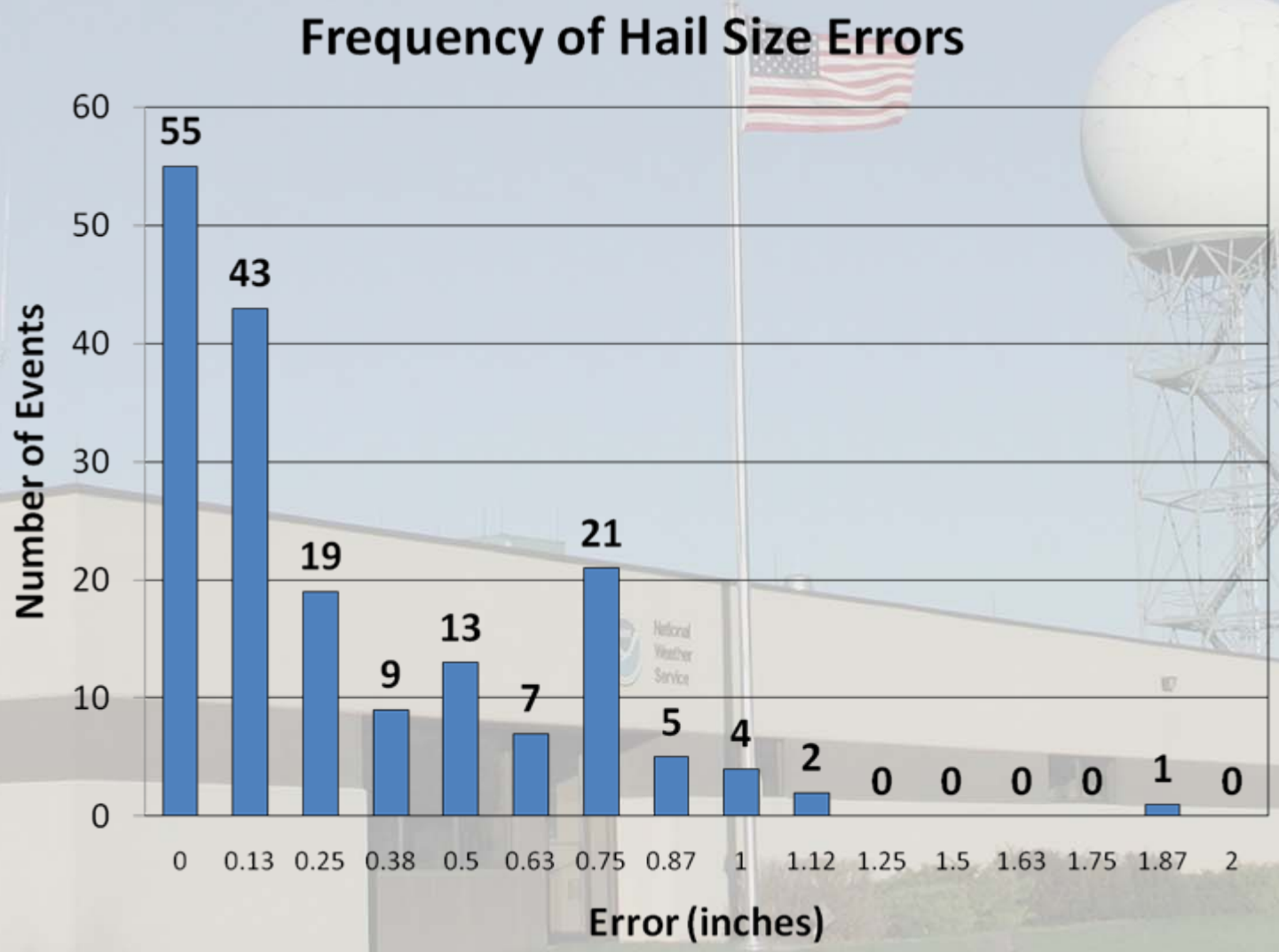
Results – Severe > Hail

- 260 SVRs hail forecast
- 73% hail observed
- 3% hail occurs and not forecast
- About 1/4 of SVR warnings mentioning hail verify only by wind, thus **we overwarn on hail.**
  - Hail is a default choice when issuing SVRs.
  - Overforecasting seems to occur more in late summer.

Results – Severe > Hail



Results – Severe > Hail



Summary

- Increased understanding of warning quality beyond traditional measures.
- Greater effort needed to understand and diagnose tornadic environments and storms from their non-tornadic counterparts.
- Overwarning on hail and wind may be partially corrected by increasing forecaster awareness to select those parameters only when expected.
- Baseline performance documented prior to dual pol technology and super res data.

The Future

- Data collection was very labor intensive
- Experimental automated threat magnitude coding under testing in NWS Central Region

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LAT...LON 3882 9418 3857 9414 3859 9458 3868 9460

TIME...MOT...LOC 1556Z 259DEG 31KT 3866 9451

WIND...HAIL 70MPH 1.75IN

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- Permits automated and routine verification of skill in forecasting parameter magnitudes