Preliminary Evaluation of Forecasting Techniques for High-Shear, Low-CAPE Environments

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Motivation

- 2-3 times/year we sit on a fence...
Recent Outbreaks:
- Nov. 17th, 2013 (16)
- Apr. 19th, 2011 (6)
- Oct. 26th, 2010 (13)

Half of total tornadoes since 2010

Only 3 high(er)-CAPE outbreaks (>5) in 10 years
Sherburn and Parker (2014)

- Addressed the need for better understanding and forecasts of high-shear, low-CAPE (HSLC) convection
- Focused on significant severe convection (tornadoes $>\text{EF2}$, wind gusts $>65\text{ kts}$, or hail $>2\text{ in.}$)
- What about any severe?

HSLC significant severe reports by NWS CWA (2006-2011)

(Sherburn & Parker, 2014)
Developed two new composite parameters

\[
SHERBE = \left( \frac{ESHR}{27 \text{ m s}^{-1}} \right) \times \left( \frac{LLLR}{5.2 \text{ K km}^{-1}} \right) \times \left( \frac{LR75}{5.6 \text{ K km}^{-1}} \right).
\]

\[
SHERBS3 = \left( \frac{S3MG}{26 \text{ m s}^{-1}} \right) \times \left( \frac{LLLR}{5.2 \text{ K km}^{-1}} \right) \times \left( \frac{LR75}{5.6 \text{ K km}^{-1}} \right).
\]

ESH\text{R} = \text{effective shear}, \ S3MG = 0-3\text{ km bulk shear}, \ LLLR = 0-3\text{ km lapse rate}, \ LR75 = 700-500\text{ mb lapse rate}

Values \geq 1 \text{ significant}
Max TSS for discriminating HSLC significant severe and nulls (2006-2011)

(Sherburn & Parker, 2014)
Methods

To Start
• KILN Upper Air Data
• $T_{sfc} > 10^\circ C \text{ & } Wind_{850mb} > 30 \text{ kts}$?

Outlook?
• Storm Prediction Center
• Initial 06Z SLGT Risk or higher?

HSLC?
• 0-6km shear $\geq 35 \text{ kts}$?
• SBCAPE $\leq 500 \text{ J/kg}$?
• MUCAPE $\leq 1000 \text{ J/kg}$?
Methods (cont.)

Hit/Miss?
- More than 1 severe report that day?
- If not, counted as “null”

SHERB3?
- Calculated from RUC/RAP Bufr Soundings
- Use max value from 5 sites in our CWA

Results
- Compared to other severe parameters
- Search for commonalities/forecasting aids
Results (2005-2014)

- Identified 10 “hits” & 12 “nulls”

Number of HSLC Events (and Nulls) by Month

- Hit
- Null
Results (2005-2014)

- Identified 10 "hits" & 12 "nulls"

Number of HSLC Events (and Nulls) by Hour

- Time (UTC)
  - 00-03
  - 03-06
  - 06-09
  - 09-12
  - 12-15
  - 15-18
  - 18-21
  - 21-00

- Hit
- Null
Composite Charts (300mb wind)

Hits

Nulls
Composite Charts (500mb height)
Composite Charts (700mb wind)

700mb Winds (m/s) Composite Mean
4/11 6z 10/26/10 12z 04/20/11 0z 01/30/08 0z 04/08/10 0z 02/17/06
NCEP/NCAR Reanalysis

Hits

Nulls
SHERBS3 Results

SHERBS3 Distribution

“Null” Average: 0.81
“Hit” Average: 1.22
Other Severe Parameters

**Effective Shear Distribution**

- Kts.
  - <30: 4
  - 30-40: 5
  - 40-50: 4
  - 50-60: 6
  - 60-70: 3

**SWEAT Distribution**

- Kts.
  - <200: 2
  - 200-300: 3
  - 300-400: 4
  - 400-500: 5
  - 500-600: 6
  - 600-700: 1

*Hit* and *Null* categories are indicated by red and blue bars respectively.
2\textsuperscript{nd} Null Set (2005-2014)

- Any HSLC day with 100\% FAR for SVR or TOR warnings (22)

Number of Warning Nulls by Month

- Jan
- Feb
- Mar
- Apr (6)
- May (4)
- June
- July
- Aug
- Sep
- Oct
- Nov (1)
- Dec
2nd Null Set (2005-2014)

- Any HSLC day with 100% FAR for SVR or TOR warnings (22)
SHERBS3 Results (2nd Null Set)

Average: 0.77
January 29th, 2008

- Only 4 severe wind reports in IWX
- Better instability & SHERBS3 just to our south (though still low)
- Strongly forced
April 18th, 2013

- SHERBS3 (and most other parameters) suggested high threat
- MDT risk and PDS TOR Watch
- Bust for IWX
April 18th, 2013

- Several rounds of rain early
- Very limited instability
- Elevated (weak) convection
- Outflow dominant
Summary

• SHERBS3 shows some skill over traditional parameters for differentiating severe vs. null HSLC events
• Limited number of events & some notable exceptions
• As always, requires holistic approach
• Conveying confidence, while difficult, is crucial