The May 16, 2009 Severe Weather Outbreak

Part I : The pre-storm environment
May 16, 2009

• 3 Tornadoes – 1 EF2 tornado and 2 EFO tornadoes
• 9 severe wind reports
• 5 large hail reports
Tornado Tracks

Tornado Tracks, Intensities and Times - May 16, 2009

EF2 - 434-437 pm
EF0 - 424 pm
EF0 - 5 pm
Outline

• Large-scale pattern
• CAPE forecasts and evaluation
• SPC analyses
500 mb heights and vorticity
Sea-level pressure and 925 hPa temperature
Surface analysis – 18z May 16
WSR-88D Reflectivity – 18z May 16
MLCAPE and 0-6 km shear
Summary

- A 500 mb trough was located over the western Great Lakes, moving slowly east. Forcing with this trough over central NY was minimal.
- A surface cold front was moving east across the eastern Great Lakes.
- A surface trough was moving east downstream from the front, across central NY. Storms developed along this trough.
- Another trough was located over northeast Pennsylvania. The flow was from the southeast east of this trough, and southwest to the west and north.
- Modest CAPE and strong deep-layer shear combined with these features to set the stage for severe weather on the 16th.
Forecasts for SYR made 12z May 15, 2009
Forecasts for SYR made at 12z
May 16, 2009
SREF probability of CAPE greater than 500 J/kg
SREF probability of CAPE greater than 1000 J/kg
RUC forecast for SYR at 15z May 16

<table>
<thead>
<tr>
<th>Date</th>
<th>Nwp</th>
<th>Indices</th>
<th>Precip Type</th>
<th>Lapse Rates</th>
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<tr>
<td></td>
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<td>CAPE 871</td>
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<td>CIN 20</td>
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<td>HELCTY 312</td>
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<td>EHI 1.70</td>
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<td>DRN 42.18</td>
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<td>Sholetr -2</td>
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<td>SWEAT 334</td>
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</table>

Precipitation: 0.000 Hr, 0.000 Total
Convert Precip: 0.000 Hr, 0.000 Total
Pcpble Water: 1.465

LCL 907 mb, CCL 875 mb, LFC 792 mb, EQL 279 mb
2,551°, 3,520°, 6,157°, 35,300°
Visible satellite imagery – 15z-18z
May 16, 2009
Severe Weather Checklist

<table>
<thead>
<tr>
<th>Event</th>
<th>Type</th>
<th>Hazard</th>
<th>Flash Flood Reports</th>
<th>Damaging Wind Reports</th>
<th>Hal Reports</th>
<th>Tornado Reports</th>
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<tbody>
<tr>
<td>1</td>
<td>0500003</td>
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<td>Wind</td>
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<td>5</td>
<td>0509998</td>
<td>Broken Line</td>
<td>Wind</td>
<td>0</td>
<td>1</td>
<td>0</td>
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</tbody>
</table>

Your Values

- **Surface Weather Patterns = Progressive Cold Front**
  - **CAPE = 1000**
  - **NCAPE = 10**
  - **Lapse Rate 950 to 700 mb (c/km) = 7.5 c/km**
  - **Lapse Rate 700 to 500 mb (c/km) = 6.5 c/km**
  - **Max. Dewpoint Depression from 700-500 mb (c) = 8°**
  - **0-1 km Bulk Shear = 30 kts**
  - **0-3 km Bulk Shear = 35 kts**
  - **0-6 km Bulk Shear = 45 kts**
  - **Direction Shear = 250 degrees**
  - **The Precipitable Water entered was 1.4 inches. For the month of May the expected precipitable water is 215% of normal. Greater than 150% is favorable for flooding.**

Reference information:
Similar historical event – high CAPE

<table>
<thead>
<tr>
<th>Event</th>
<th>Type</th>
<th>Hazard</th>
<th>Flash Flood Reports</th>
<th>Damaging Wind Reports</th>
<th>Fatal Reports</th>
<th>Tornado Reports</th>
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</thead>
<tbody>
<tr>
<td>05/01/03</td>
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<td>Wind/Hail null</td>
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<td>2</td>
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<td>05/22/00</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>05/24/03</td>
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<td>05/01/03 values</td>
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<td>06/28/00</td>
<td>NCAPE</td>
<td>10</td>
<td>0.11</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| Your Values | | | | | |
|-------------|-------------|-------------------|--------------------|-----------------------|---------------|----------------|
| Lapse Rate 700 to 700 mb (c/km) = 6.5 c/km | 6.0 to 9.8 - conditionally unstable |
| Lapse Rate 700 to 500 mb (c/km) | 8.2 |
| Lapse Rate 700 to 500 mb (c/km) | 6.3 |
| Precipitable Water | 1.4 |
| 0-1 km bulk shear | 30 |
| 0-3 km bulk shear | 35 |
| 0-6 km bulk shear | 45 |
| 0-3 km directional shear | 250 |
| Lapse Rate Max Td | 8 |

Maximum Dewpoint Depression from 700-500 mb (c) = 8°C
Less than 10 degrees C - Less potential for enhanced downburst speeds.

0-1 km Bulk Shear = 30 kts
Greater than 20 kts - Enhanced chance of significant tornadoes.

0-3 km Bulk Shear = 35 kts
20 - 40 kts - Poor echoes with greatest threats for damaging wind.

0-6 km Bulk Shear = 45 kts
Greater than 40 kts - Supercells likely.

Directional Shear = 250 degrees
Not a Northwest flow case.

The Precipitable Water entered was 1.4 inches. For the month of May the entered precipitable water is 215% of normal. Greater than 150% is favorable for flooding.

Percipitable water greater than 150% of normal is associated with many flash flood events.
Similar historical event – highCAPE – radar image

May 1, 2003

Several severe thunderstorm warnings were issued between 19z and 23z with this event across our northern counties that did not verify. A Warning for wind verified in Ocmulgee County.

Click on an image for a larger view.

May 01, 2003

BUFKIT Data
Similar historical event – low CAPE
Similar historical event – low CAPE – radar imagery

May 17, 2008

Synoptic Pattern: A cold front moved southeast across the area late in the afternoon in association with a strong upper low digging southeast across Ontario.

A broken line of showers with isolated thunderstorms moved east across the area late in the afternoon. A few isolated thunderstorm cells also moved east across the area. One of these cells produced a brief F0 tornado touchdown in Onanda county. Another cell produced 3/4 inch hail in Cassadaga county.

Click on an image for a larger view.
SPC analyzed CAPE – 17z May 16
Summary

• Anticipating the amount of CAPE available for this event was challenging
• The NAM forecast much less CAPE than the GFS
• The severe checklist and a look at similar historical events indicated that the amount of CAPE would have a large impact on the severity of the event
• Subsequent RUC forecasts and the SPC analysis indicated that the “real” CAPE for this event was about mid-way between the NAM and GFS forecasts
0-1 km shear and SRH
Nomograms – 0-1 km SRH

Mean 0-1 km SRH
By Supercell Set

0-1 km SRH

NonTor  nonsigTor  SigTor
LCL height and 0-1 km EHI
Nomogram – LCL height and 0-1 km EHI

LCL height versus 0-1 km EHI
nontornadic v. significant tornadic
0-3 km CAPE and 0-3 km lapse rate
Nomogram – 0-3 km CAPE

RUC-2 cases

0-3 km AGL CAPE (J kg\(^{-1}\))

most unstable surface or mixed parcel in bottom 100 mb (non-virtual)

RUC-2 cases

0-3 km AGL CAPE (J kg\(^{-1}\))

supercells: non tor (155) F2-F5 (83)
Sig Tor Parameter and 0-3 km VGP
Nomogram – VGP vs. 0-1 km shear

<table>
<thead>
<tr>
<th>0-1 km shear (kts)</th>
<th>0 - 3 km VGP</th>
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<tbody>
<tr>
<td></td>
<td>&gt; .4</td>
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<tr>
<td>&gt; 35</td>
<td>.708</td>
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<tr>
<td>25 - 35</td>
<td>.683</td>
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<tr>
<td>20 - 25</td>
<td>.578</td>
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<td>15 - 20</td>
<td>.483</td>
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<tr>
<td>10 - 15</td>
<td>.278</td>
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<tr>
<td>&lt; 10</td>
<td>.143</td>
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</table>

Tornado frequencies (F2 or greater)
Summary – The May 16, 2009 central New York tornado event...

- Occurred in an environment with modest mid-upper tropospheric forcing for upward motion
- Occurred along a surface trough, ahead of moderately strong surface cold front
- Occurred in an environment characterized by modest CAPE and strong deep layer shear
- Occurred in an environment characterized by strong low-level shear and low LCL heights, resulting in large values for some severe weather composite indices (such as the significant tornado parameter, EHI and VGP).
- Model differences in CAPE forecasts prior to the event made it difficult to anticipate the event’s severity prior to the event onset.
References

