

# **P9.5 AN APPLICATION OF A CUTOFF LOW FORECASTER PATTERN RECOGNITION** MODEL TO THE 30 JUNE – 2 JULY 2009 SIGNIFICANT EVENT FOR THE NORTHEAST Thomas A. Wasula (1), N. A. Stuart, M. A. Scalora (2), L. F. Bosart (3), and D. Keyser

### **Motivation**

- CSTAR III with SUNYA at Albany (2007-2010) examined the sensible and extreme weather with warm season cutoffs

- Goal was to establish pattern recognition or conceptual models for significant weather cutoff days over the Northeast based on the tilt of the longwave 500 hPa trough

- Lower-, middle-, and upper-level synoptic and mesoscale features are examined (temperature and moisture profiles, jet streaks, anomalies, etc.) for each pattern

CSTAR Grant #: NA07NWS4680001

### Some Results: CSTAR I-II Work (2000-06)

- Tracks or categories of warm season cutoff lows (Great Lakes and Northwest favored from May to September)

- Climatological daily rainfall distributions from cutoffs in the Northeast including % of normal precipitation (June-September 1948-1998) from cutoffs

- Movement of vorticity maxima's around cutoff based on tilt and the location of jet streaks can yield heavy rainfall events

### **Subjective Climatology**



Source: (Novak et al. 2002) -> See preprint for reference

#### June Composite and % Normal **Precipitation from Cutoff Lows (1948-98)**



1948-1998 June a) Composite Precipitation Days from Cutoffs daily values and b) % of Climatology Precipitation due to Cutoffs Source: (Najuch 2004) -> See preprint for reference

# **5** Pattern Recognition Schematics or Conceptual Models based on the Tilt of 500 hPa Cutoff







### POSITIVE TILT "TYPE A"





**POSITIVE TILT "TYPE B**<sup>1</sup> Severe Weather: Average is 6 reports Precipitation Modes Stratiform bands with <sup>5</sup> mbedded convection N = 6/20 cases

Scalora (2009) examined 20 warm season cutoff cases from June to Sept 2000-08 based on 45 "Storm Days". One of these days was classified based on precipitation (fraction in domain), precipitable water and wind anomaly data in conjunction with synoptic-scale pattern and storm reports.



(1) NOAA/National Weather Service, Albany, NY (2) NOAA/National Weather Service, New York, NY (3) SUNY/University at Albany, Albany, NY



500 hPa Heights (dam), Temps (°C) & Winds (kts)



**300 hPa Heights (dam), Streamlines** 

& Divergence (10<sup>-5</sup>s<sup>-1</sup>)

1500 UTC 30 June 2009 SREF

3-hr Forecasts for 1800 UTC





Mean 500 hPa Heights & Anomalies

they apple and

b. SREF Consensus Forecast (contour) &



850 hPa U & V **Wind Anomalies** 



1000 hPa Mean **PWAT & Anomalies** 



# **30 June 2009 Case**

1800 UTC 30 June 2009 0.5° GFS Initial Analysis

### 500 hPa Heights (dam), Absolute Vorticity (10<sup>-5</sup>s<sup>-1</sup>) & Winds (kts)

# 850 hPa Oe (K) & Winds (kts)



500 hPa Thickness (dam),

MSLP (hPa), 1000-500 hPa Thickness (dam), & 250 hPa Winds (m/s)

**SBCAPES (J kg<sup>-1</sup>) & 1000-500** hPa Shear (kts)

# Satellite, Surface & **Sounding Analysis**



1500 UTC Surface Map (MSLP and Fronts), METARS, & IR Image



## **1710 UTC Visible Satellite Image** ALB 090630/1800 (Observed RN Shear = 13 m#/sª 6km SR Wind = /ere = 16529 m3/s3 kers Right = kers Left = ikm Agl Lapse Rate = 8.5 C/km km Agl Lapse Rate = 5.8 C/km 🛛 rfidi Downshear = 223/45 kt rfidi Upshear = 267/18 kt 500mb Lapse Rate = 6.4 C/km | Sig Tor (fixed) = 0.8 )-500mb Lapse Rate = 5.7 C/km

### **1800 UTC KALB Sounding**

NEAR TERM /UNTIL 6 PM THIS EVENING/ AS OF 400 AM EDT...THE LATEST SATELLITE IMAGERY THIS MORNING HAS A OFF LOW CENTERED NEAR LAKE HURON. THIS CUTOFF WITH ITS IATED COLD POOL /H500 TEMPS OF -15C TO -17C OVER MI/ WILL BE NTIAL OF STRONG TO SEVERE CONVECTION. PAST AND PRESENT CSTAR ARCH ON WARM SEASON CUTOFF LOWS HAS SHOWN MINOR/MAJOR SEVERE HER BOUTS CAN OCCUR OVER THE NORTHEAST. THE SYNOPTIC PATTE CONVECTIVE PARAMETERS FROM THE NAM/GFS INDICATE MARGINAL ERE HAIL AND/OR WIND DAMAGE WITH BOWING SEGMENTS WILL BE SSIBLE. WE AGREE WITH SPC FOR THE SLIGHT RISK TODAY ACROSS ERM

HE CUTOFF HAS A NEUTRAL TILT WITH A SHORT WAVE TROUGH THAT WILI SLICING THROUGH THE REGION DURING THE PM. AT THE SFC...AN OCCLUD! ONT IN ASSOCIATION WITH THE MID LEVEL SHORT WAVE WILL FOCUS THE HOMEDS AND THIMDEDSTODMS STOOMS DIFFEDENTIAL SYCLONIC VODICITY DVECTION WILL BE ONGOING. ALOFT. ... A MID-/UPPER- LEVEL JET STREAM ILL BE SETTING UP OVER THE MID ATLANTIC REGION/SRN NY/SRN NEW RNGLAND. AN ARRA OF UPPER LEVEL DIVERGENCE WILL BE OVER EEN NY ANI WRN NEW ENGLAND... AS WE WILL BE LOCATED ON THE CYCLONIC EXIT REGION/LEFT FRONT OUADRANT OF THE JET STREAKS. SFC DEWPOINTS WIL BE POOLING IN THE SOUTHERLY FLOW IN THE BOUNDARY LAYER INTO THE SOS TO POSSIBLY MID 60S. PRECIPITABLE WATER VALUES WILL ENERALLY BE IN THE 1-1.50 INCH RANGE. LOW-LEVEL THETA-E ADVECTION WILL BE INCREASING AHEAD OF THE IMPULSE ROTATING AROUND THE JTOFF. SBCAPE VALUES ARE IN THE 1000-1500 J/KG RANGE FROM THE AM...WITH POCKETS OF SLIGHTLY GREATER AMOUNTS. THE GFS SHOWS SOMI CIN AND LIMITED INSTABILITY SOUTH OF THE CAPITAL REGION DUE TO TRATUS/LIMITED HEATING FROM THE MARINE AIR. WE THINK THIS IS A TTLE OVERDONE...AND THINK SECAPE VALUES OF AT LEAST 1000 J/KG RE POSSIBLE THERE. THE H500 TEMPS ARE GOING TO COOL TO -12C TO 15C OVER THE REGION. MID LEVEL LAPSE RATES APPROACH 6-6.5C/KM. THE DETERMINISTIC GUIDANCE DOESN/T COOL THEM MUCH LOWER...SINCE HE CORE OF THE COLDEST AIR REMAINS WEST OF THE HUDSON RIVER

THE 0-6 KM BULK SHEAR IS GENERALLY 30-40 KTS WITH ORGANIZE ONVECTION LIKELY OF THE MULTI-CELLULAR VARIETY EVOLVING INTO NES/CLUSTERS. IN TERMS OF THE HAIL THREAT...FREEZING LEVEL AN YET BULB ZERO HEIGHTS ARE IN THE 8.5-10 KFT AGL RANGE...WHICH PAS FFICE RESEARCH HAS SHOWN TO BE QUITE OPTIMAL FOR SEVERE HAIL.. IF BCAPE VALUES OF AROUND 1000 J/KG ARE REALIZED. OUR LOCAL MAGLENTA SVERE WEATHER INDEX YIELDS A MINOR SEVERE EVENT DUE TO LOW EHI ALUES WELL UNDER 1...AND 0-3 KM SRH VALUES WELL UNDER 100. THIS ONDITIONAL SEVERE WEATHER INDEX WILL HAVE A BETTER HANDLE OF THE OTENTIAL SEVERE WEATHER SITUATION WITH A 12/18Z SOUNDING. E EXPECT SOME SUNSHINE TO OCCUR ACROSS MUCH OF ERN NY IN THE PM TO HELP DESTABILIZE THE BOUNDARY LAYER...AND ALLOWING MAX TEMPS IN THI ID 70S TO NEAR 80 IN THE VALLEYS...AND U60S TO MID 70S OVER THE ILLS AND MINS. WE PLACED ENHANCED WORDING FOR POSSIBLE SEVERE HUNDERSTORMS...WITH DAMAGING WINDS...AND LARGE HAIL. HVY RAINFAL WILL ALSO BE POSSIBLE WITH ANY CONVECTION.

**WFO ALB 30 June 2009** 

**4 AM Discussion** 







• A Great Lakes cur weather (around 40
• The cutoff fit well
<ul> <li>Local forecast dis for the potential sev</li> </ul>
<ul> <li>A short-wave trous</li> <li>shear (25-35 kts) ar</li> </ul>
<ul> <li>The mid-level laps freezing levels favo</li> </ul>
Low-level 850 hPa     advected in Atlantic



### Summary

toff low impacted portions of the Northeast with severe reports) and isolated flash flooding on 30 June 2009

into the Neutral-Tilt "Type A" conceptual model

scussions identified the key synoptic and mesoscale features evere weather with the conceptual model

ugh and favorable jet dynamics coupled with adequate deep nd large instability allowed multicell clusters to form

ose rates were marginal, but low wet-bulb zero heights, and ored large hail

Pa +V anomalies (1 to 3 standard deviations above normal) ic moisture (PWATs not anomalously high) for heavy rainfall and flooding due to training convection (June 30<sup>th</sup> and July 1<sup>st</sup>)