P9.140

Identifying key features to predict significant severe weather outbreaks in the northeastern U.S.

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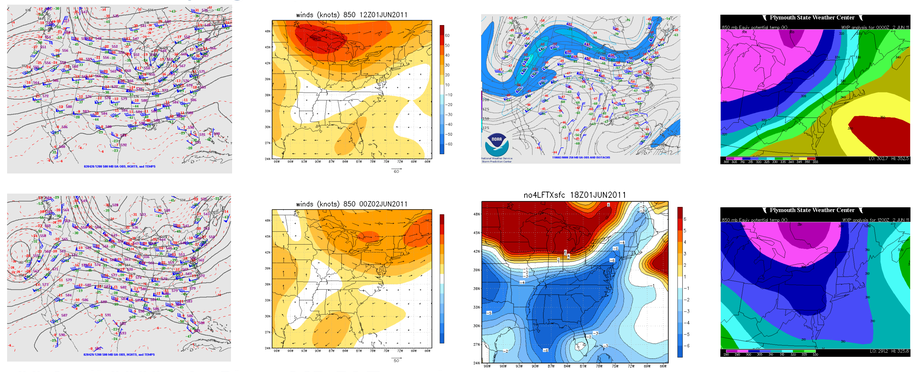
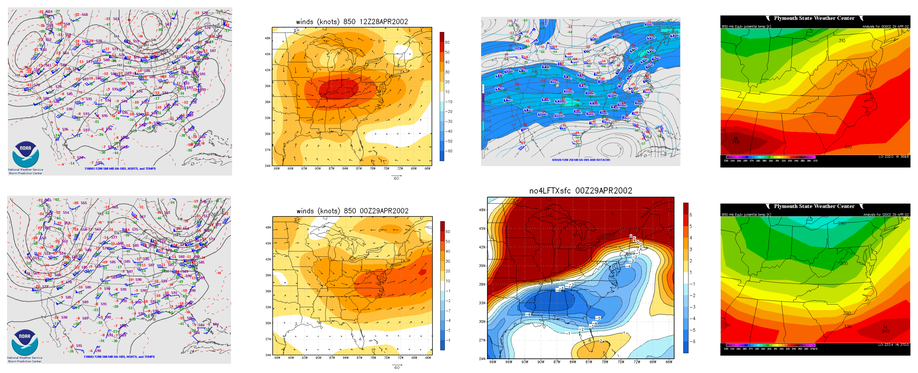
Significant severe outbreaks

1 June 2011 – Springfield, MA EF3 Tornado

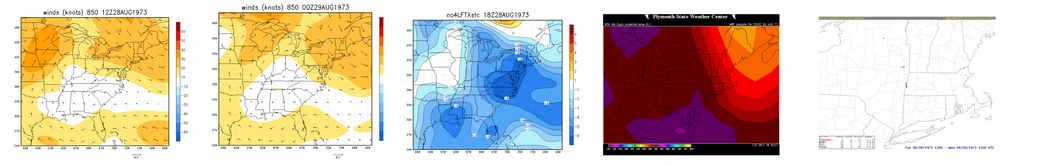


28 April 2002 – La Plata, MD F4 Tornado

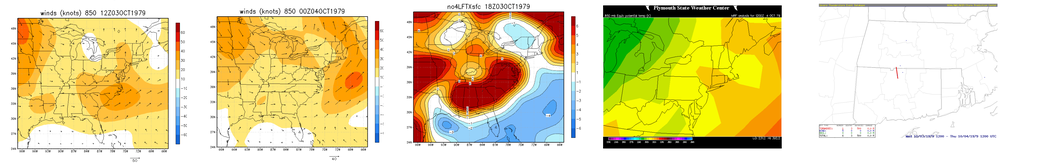


Outlier events

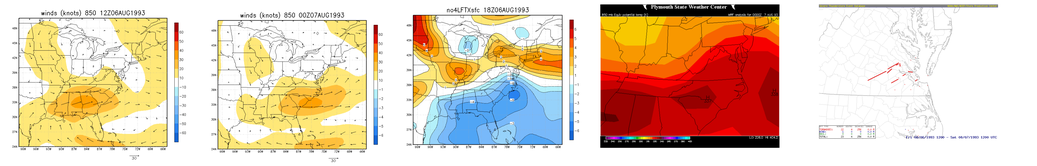
28 August 1973 Stockbridge, MA F4



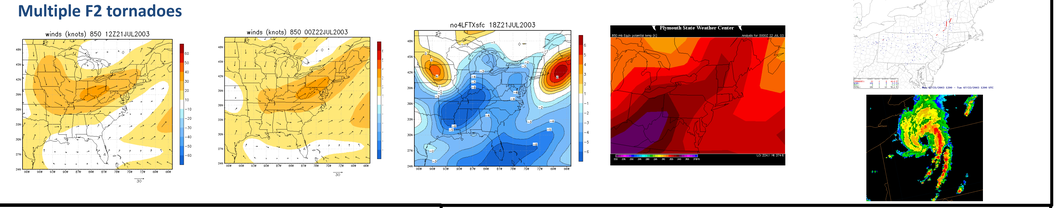
3 October 1979 Windsor Locks, CT F4



6 August 1993 Petersburg, VA F4

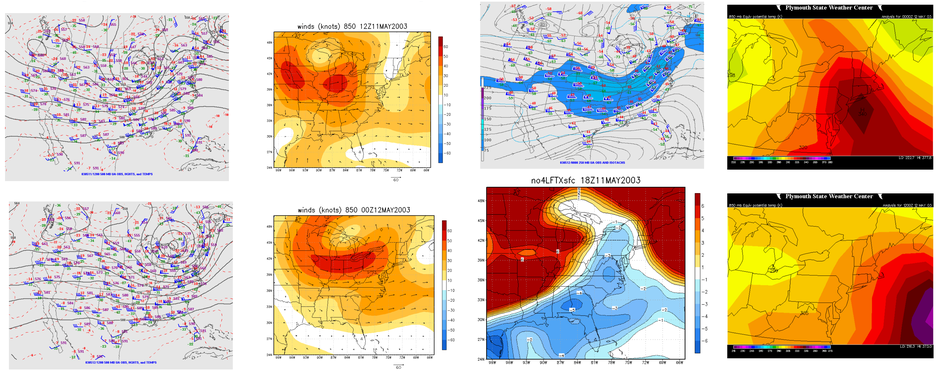


21 July 2003 Multiple F2 tornadoes

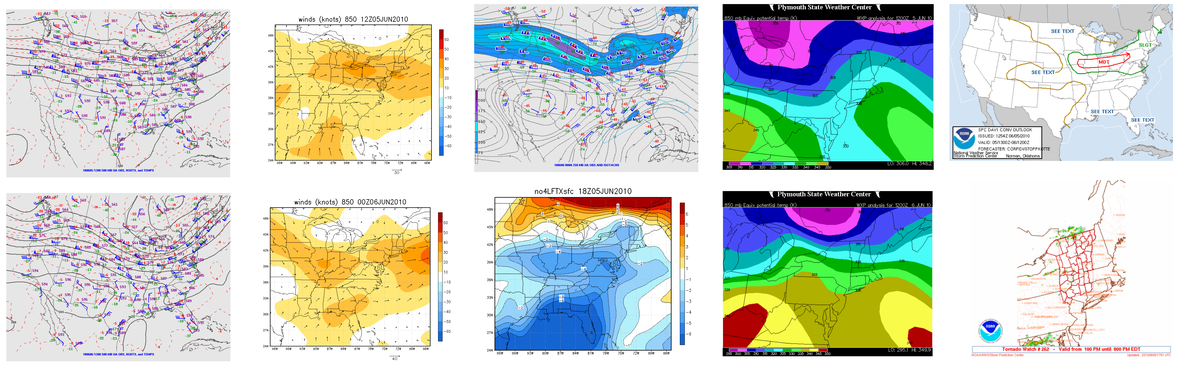


Forecast busts

11 May 2003 – The end of a multi-day historical tornado outbreak



5 June 2010 – One weak EF1 tornado in northern VT



Cases Studied

Northeastern U.S. Events	Observed Severe Weather
3 June 1953	Worcester, MA F4 tornado
2 May 1983	Multiple F2+ tornadoes
31 May 1985	Multiple F2+ tornadoes
10 July 1989	Multiple F2+ tornadoes
29 May 1995	Great Barrington, MA F4 tornado
3 July 1997	Multiple F2 tornadoes
31 May 1998	Mechanicville, NY F3 tornado
1 June 2011	Springfield, MA EF3 tornado

Mid-Atlantic Events	Observed Severe Weather
28 March 1984	Multiple F2+ tornadoes
8 May 1984	Multiple F2+ tornadoes
14 October 1986	Multiple F2+ tornadoes
28 November 1988	Multiple F2+ tornadoes
4 May 1990	Multiple F2+ tornadoes
4 November 1992	Multiple F0/F1 tornadoes
23 November 1992	Multiple F2+ tornadoes
7 January 1995	Widespread winds and F0/F1 tornadoes
11 November 1995	Widespread winds and F0/F1 tornadoes
1 April 1998	F3 tornado
24 September 2001	Multiple F2+ tornadoes
28 April 2002	Multiple F2+ tornadoes
2 May 2002	Widespread wind and hail
28 April 2008	Multiple EF2+ tornadoes
16 April 2011	Multiple EF2+ tornadoes
28 April 2011	Multiple EF2+ tornadoes

Forecast Busts	No Observed Severe Weather
11 May 2003	Moderate Risk and Tornado Watch
31 May 2004	Slight Risk and Tornado Watch
5 June 2010*	Slight Risk and Tornado Watch

*1 brief EF1 tornado in the northeast corner of a Tornado Watch

Outlier Events	Weak Low-Level Forcing and/or 850 hPa Wind
29 August 1973	West Stockbridge, MA F4 tornado
3 October 1979	Windsor Locks, CT F4 tornado
6 August 1993	Petersburg, VA F4 tornado
21 July 2003*	Multiple F2+ tornadoes

*Unusually strong midlevel vortex with high instability and shear

In summary

- It is not often that the low-level forcing, shear and instability exist simultaneously in one region east of the Appalachian Mountains
- That is why significant severe weather outbreaks are so rare in the mid-Atlantic and northeastern U.S.
- Significant severe weather outbreaks occur when all these parameters are present
  - 500 hPa and 850 hPa systems cross east of the Appalachian Mountains within 24 hours
  - 500 hPa system may be a well-defined impulse tracking around the periphery of a parent upper low
  - Favorable upper jet structure coincident with Low-level features and instability
    - Core of ≥ 35 Kt 850 hPa winds passes through the region
    - 850 hPa Θ_e gradient of 25K tracks through the region in 24 hours
    - 4 layer Lifted Index exceeding -2

Caveats

- Each severe weather event is unique –
  - Weaker tornadoes, < 2” hail and wind damage can occur if one threshold for one parameter is met
  - Important that 850 hPa features cross east of Appalachian Mountains in 24 hours
- Outlier significant severe weather events can occur under much weaker atmospheric conditions but are extremely rare
- Analysis of 850 hPa winds and Θ_e can be subjective depending on if it is based on observations or Global Reanalysis sets

Acknowledgments – Graphics courtesy of the National Centers for Environmental Prediction, the Storm Prediction Center, Plymouth State University and the Air Resources Laboratory

Future work – Elevated mixed layers, CAPE, parcel trajectories