Finding the Best Link Between SPC Tornado Forecast Verifications and Known Severe Weather Parameters

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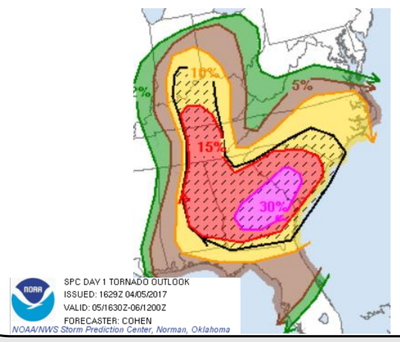
Motivation

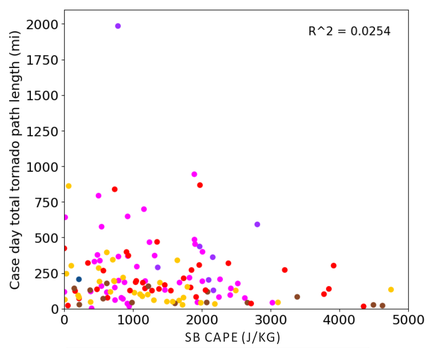
- The Storm Prediction Center (SPC) has been criticized for overblowing forecasts since outlooks started coming out
- Ever since the SPC started issuing tornado probabilistic forecasts in 2003, then revised in 2006, there have been many such cases where high risk days are overblown. Such as a 25% day on April 11th, 2005, day where only 3 tornadoes occurred
- Between streamwise vorticity (ω_s), Storm Relative Helicity (SRH), and Convective Available Potential Energy (CAPE), is there a parameter that is most helpful in determining if a SPC forecast pans out?

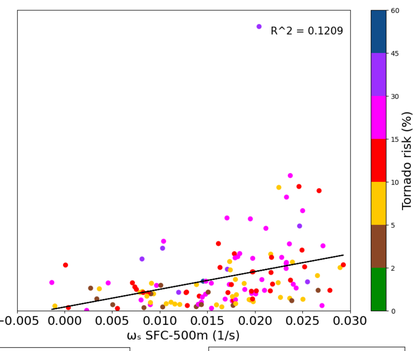
Method

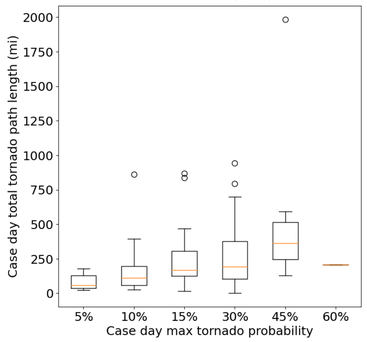
- All days that had a tornado risk >15%, all (E)F4-5, and a few special cases were compiled into a 133 list of case days to analyze tornado count, path length, and maximum outlook values
- Time frame for each day was 12z to 12z the next day
- The sum of path length was prioritized as a comparison value over tornado count as it gave weight towards long track tornadoes
- Environmental data from each case day was gathered using ERA5
- A sounding for each case day was chosen at the center track of the highest rated tornado with the longest track
- Time was based of the nearest hour before the start time

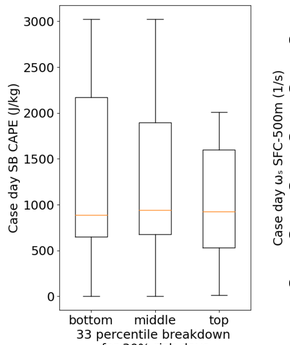


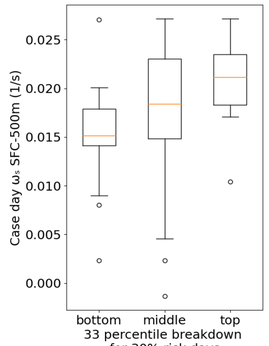
Results

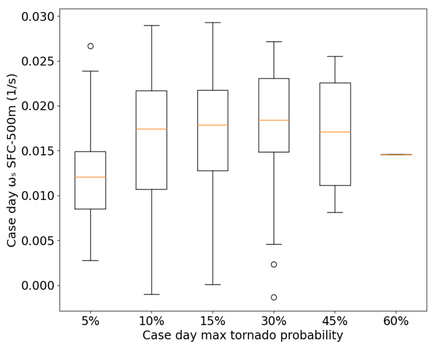


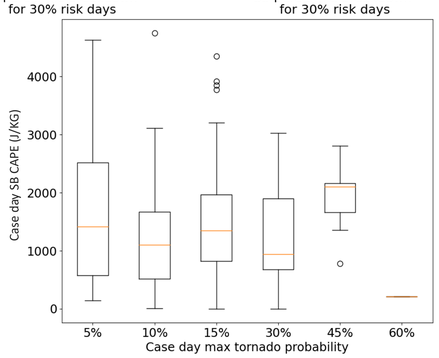




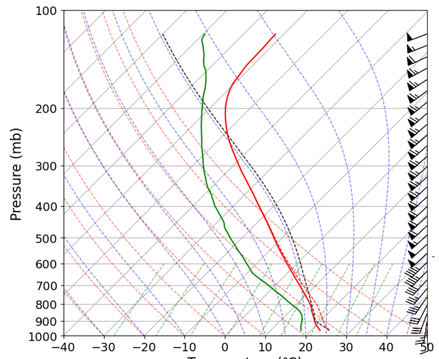


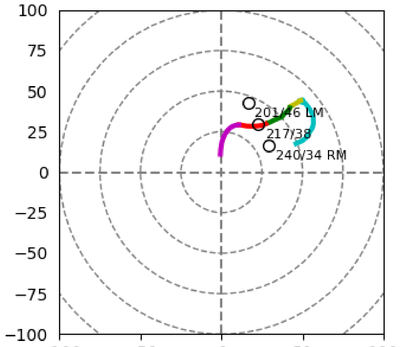






Composite Sounding of Bottom 33 Percentile of 30% Tornado Risk Days

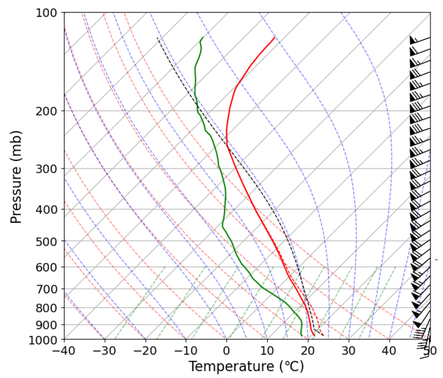


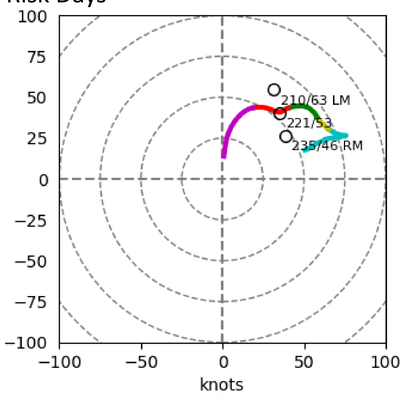


Parcel	CAPE	ECAPE	CINH	LCL	LFC	EL
SFC	1054	1088	-59	898	738	242
MU	1054	1088	-59	898	738	242
ML	969	1009	-57	838	767	228

	SRH	SW Vort
SFC-500m	115	0.0154
SFC-1k	158	0.011
SFC-3k	209	0.0058

Composite Sounding of Top 33 Percentile of 30% Tornado Risk Days





Parcel	CAPE	ECAPE	CINH	LCL	LFC	EL
SFC	906	1027	-42	931	761	259
MU	906	1027	-42	931	761	259
ML	822	947	-48	864	794	245

	SRH	SW Vort
SFC-500m	199	0.0213
SFC-1k	301	0.0173
SFC-3k	388	0.0087

CAPE, ECAPE, and CINH in J/kg. LCL, LFC, EL in mb. SRH in m^2/s^2. ω_s in 1/s.
Storm motion in degrees and knots. Note: Parcel path uses virtual temperature

Summary

- Convective Available Potential Energy (CAPE) appears to have minimal impact on the total path of tornadoes for the day
- Meanwhile streamwise vorticity and SRH give a bit clearer signal. As with more shear comes bigger outbreak chance but does not guarantee it.
- Other indicators of a bigger outbreak are, higher storm motions, more curved and wider hodographs, lower LCL and CIN, and slightly lower surface temperatures
- It is clear the SPC do not make shear and CAPE the only factors but use other variables in their decision making
- The True Skill Statistic (TSS), which is a skill score. Where 1 is the best skill and 0 is the worst. In the data it represents how good the variable is at differentiating between the high and low end events. ω_s is 0.52, SB CAPE is only 0.02, while the SPC runs at 0.41
- In all, the SPC forecasts are more likely to fail in low sheared environments verses that of low CAPE values

Future Work

- Develop a way to choose a more accurate sounding that best represents the environment of the day
- Better way to analyze if a day busted as there are a few cases where most tornadoes fell outside the high risk
- Find a quick way to analyze all tornado events to get a better representation
- Look at more severe parameters and other factors to help reason out why the events paned out as they did

Acknowledgments

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