

# On the usage of composite parameters in high-shear, low-CAPE environments

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## Introduction

- Recognized as a considerable forecasting challenge, high-shear, low-CAPE (HSLC; here defined as  $\text{SBCAPE} \leq 500 \text{ J kg}^{-1}$  and  $0\text{--}6 \text{ km shear} \geq 18 \text{ m s}^{-1}$ ) environments have been the subject of many climatologies and case studies over the last 15 years.

- CAPE-dependent composite forecasting parameters may underestimate the threat of severe convection in HSLC environments.

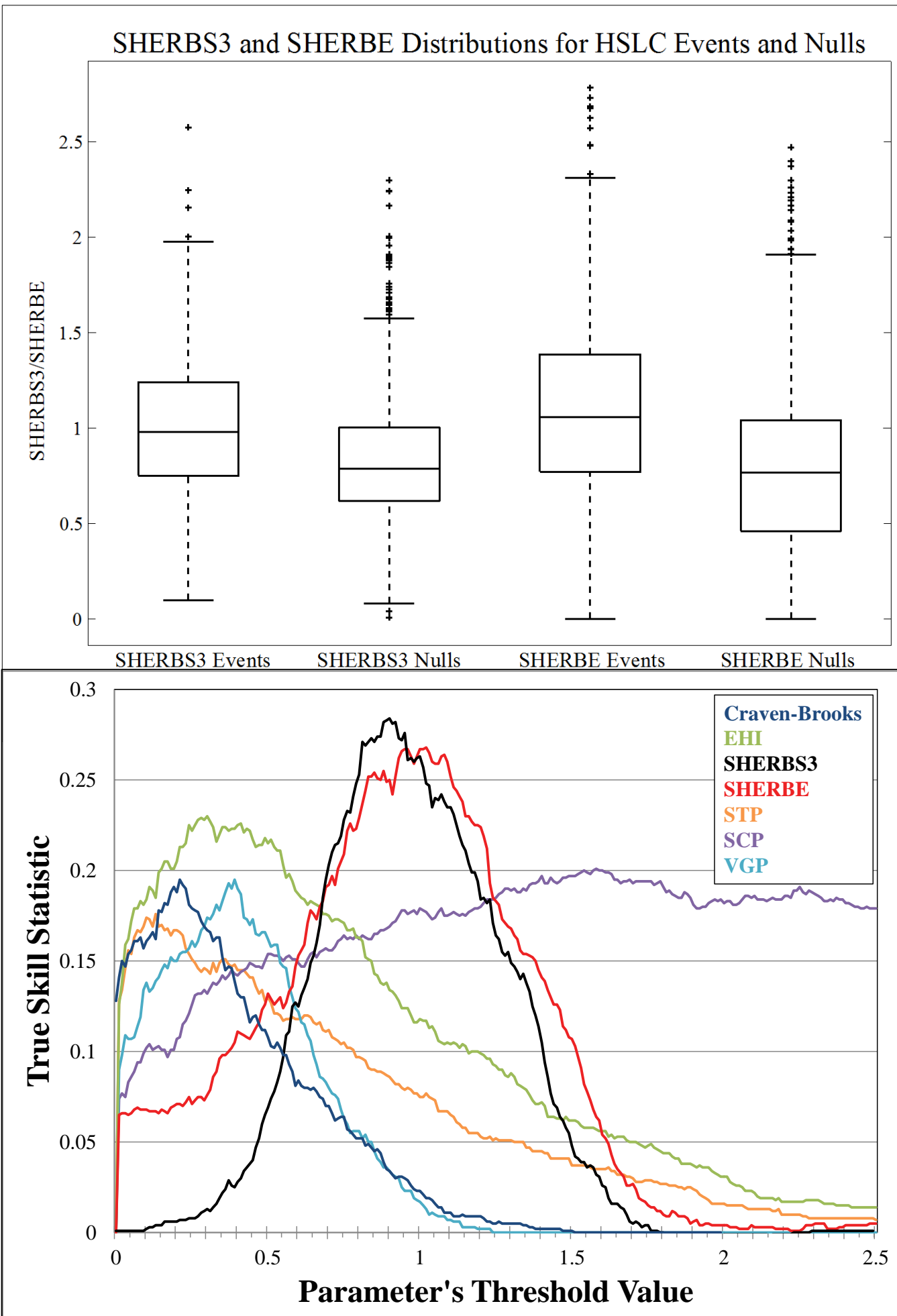
- Sherburn and Parker (2014) identified a combination of parameters that exhibit statistical skill in discriminating between HSLC significant severe convection and unverified warnings:

$$\text{SHERBS3} = (0\text{--}3 \text{ km lapse rate} * 700\text{--}500 \text{ hPa lapse rate} * 0\text{--}3 \text{ km shear magnitude}) / (5.6 \text{ K km}^{-1} * 5.2 \text{ K km}^{-1} * 26 \text{ m s}^{-1})$$

$$\text{SHERBE} = (0\text{--}3 \text{ km lapse rate} * 700\text{--}500 \text{ hPa lapse rate} * \text{effective shear magnitude}) / (5.6 \text{ K km}^{-1} * 5.2 \text{ K km}^{-1} * 27 \text{ m s}^{-1})$$

Goals of this work:

- Provide a general overview of synoptic scale and mesoscale features associated with severe and non-severe HSLC convection
- Spatially evaluate composite forecasting parameters using report-relative and null-relative composites.



Top: From Sherburn and Parker (2014), distributions of SHERBS3 and SHERBE across HSLC significant severe reports and nulls (i.e., unverified warnings). Bottom: From same study, comparisons of true skill statistic curves when discriminating between significant severe reports and nulls.

## Event-relative composites

- Created using NCEP's North American Regional Reanalysis (NARR) archive ( $0.3^\circ$  and 3 h spatial and temporal resolutions)

- Separate maps for 26 HSLC significant tornadoes, 39 significant winds, and 75 nulls

- Used closest NARR data time,  $40^\circ$  by  $40^\circ$  lat/lon box surrounding each report or null

- Only one report or null (nearest in time) used for each hour; maximum 1.5 h offset

**Shared features for significant tornadoes, significant winds, and nulls...**

- Strong upper-level trough
- Surface low and cold front
- Intense low-level jet (LLJ)
- Plentiful low-level moisture
- MLCAPE ridge
- Occur on northern edge of MLCIN gradient

*All noted in previous HSLC case studies!*

## Subtle Differences

### NULLS

- Surface cyclone and trough weaker and spatially displaced to northwest
- Broader, stronger upper-level jet
- Weaker LLJ and moisture convergence

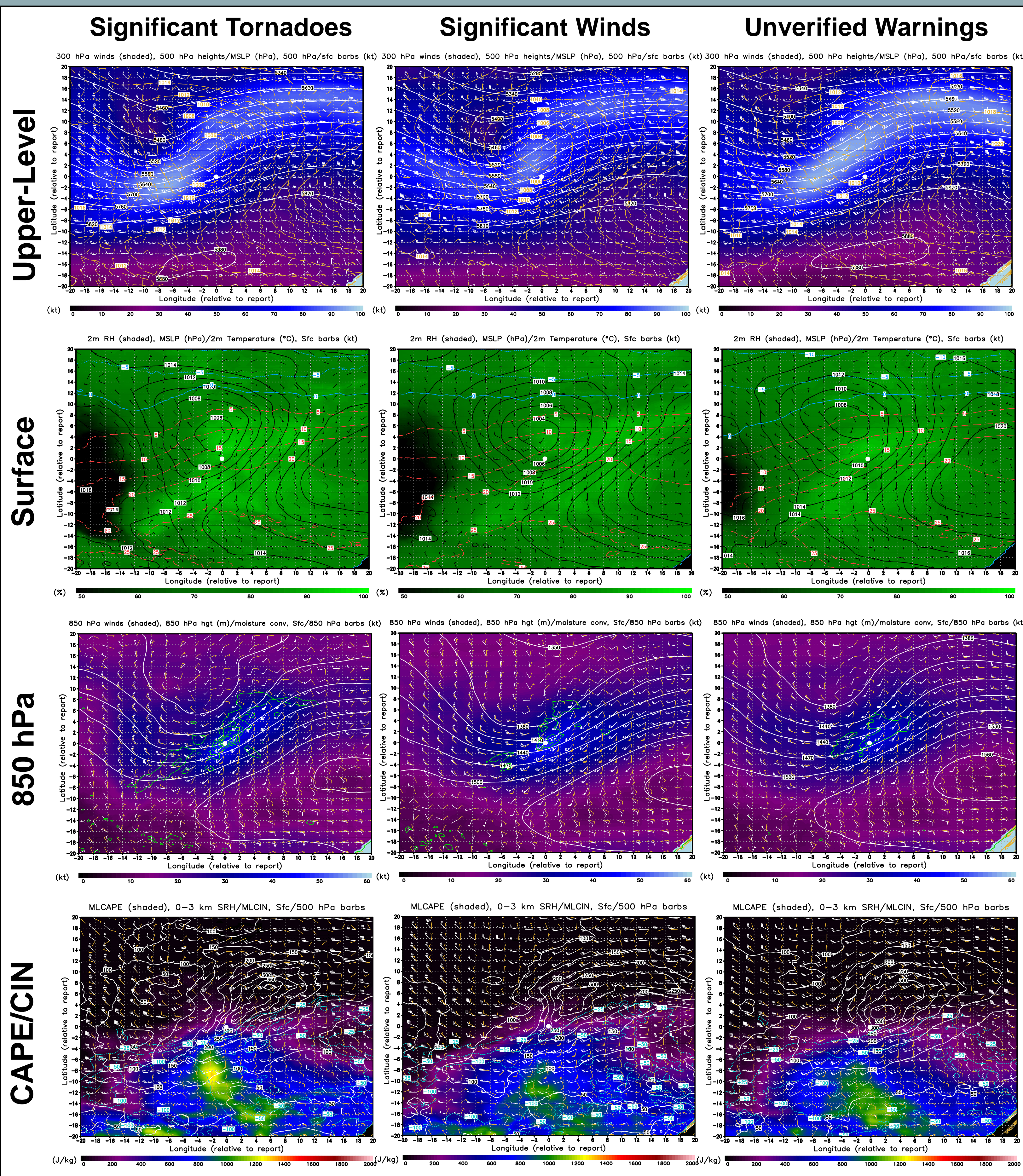
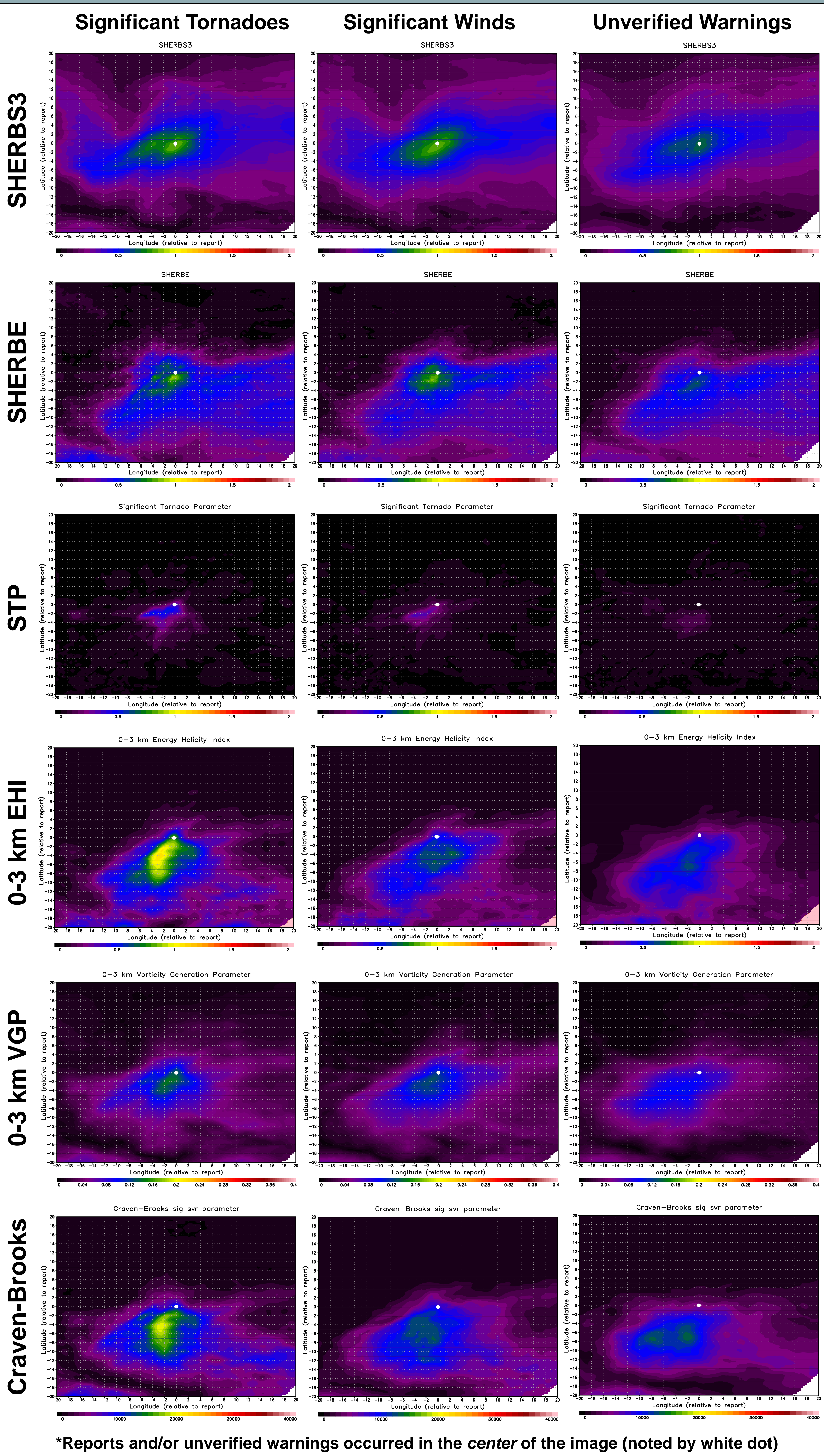
### WINDS

- Upper jet streak focused just northwest of reports
- Surface cyclone stronger
- Enhanced SHERB

*All differences are minor, suggesting need for additional tools*

### TORNADOES

- Upper jet streak focused upstream of reports
- Strongest moisture convergence and LLJ
- Enhanced values of CAPE-dependent composite parameters, especially south



## Synthesis and conclusions

- Report-relative, synoptic-scale composites corroborate previous HSLC case studies, showing that significantly severe (and non-severe) HSLC events are characterized by strong upper-level troughs, nearby surface lows and cold fronts, intense low-level jets, and abundant low-level moisture. Any differences between significant severe composites and non-severe composites are subtle.

- CAPE-dependent parameter values are maximized to the south of report locations, with reports tending to occur on the nose of enhanced values. At the composite report locations, traditional composite parameters tend to be well below their conventional thresholds.

- SHERBS3 and SHERBE values are maximized near the reports and unverified warnings, with values closer to 1 in the significantly severe cases.

## Acknowledgements

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