Further Analysis and Verification of 1300 UTC Storm Prediction Center Convective Outlooks

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Introduction

Marion and Frame (2014) subjectively analyzed 1300 UTC Storm Prediction Center (SPC) Convective Outlooks to determine general reasons why outlooks with a high (> 10%) tornado risk did not verify. Further analysis was conducted to determine any key differences or trends between days on which forecasts verified and days on which forecasts did not verify. The goal of this project is to suggest future research areas that may be most beneficial to the continued improvement of tornado forecasting.

Methodology

All SPC Moderate and High Risk Outlooks, along with Slight and Enhanced Risk Outlooks with a 10% or greater tornado probability issued at 1300 UTC between 3 March 2006 and 3 March 2016 were subjectively analyzed to determine whether the tornado reports corresponded to the highest tornado risk area in the SPC Outlook.

Marion and Frame (2014) determined four primary reasons as to why the outlooks did not verify: The development of linear convection (LC), non-tornadic supercellular convection (NTSC), or non-severe convection (NSC) and lack of convection initiation (LCI).

All outlooks were analyzed using archived radar data, WPC surface maps, and SPC mesoanalysis. Some of the data collected included the type of initiating boundary, lifting condensation level (LCL) height, storm relative helicity (SRH), and 0-6 km shear vector orientation with respect to the initiating boundary. The data from cases that verified was compared with that from cases that did not verify to determine if any key differences exist.

Results: Month of Year and Boundary Type

February and December were the months in which the highest percentage of cases verified (Fig. 1). The next highest verification percentages came in months typically associated with severe weather: March, April, and May. January and August verified at the lowest percentage. Aside from 2015, there has been a steady increase in percentage of verified outlooks each year since 2012 (Fig. 2).

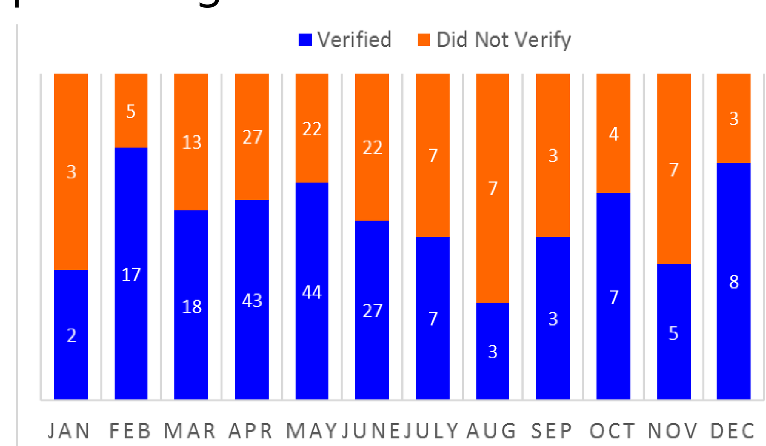

Fig. 1: Verification percentage by month

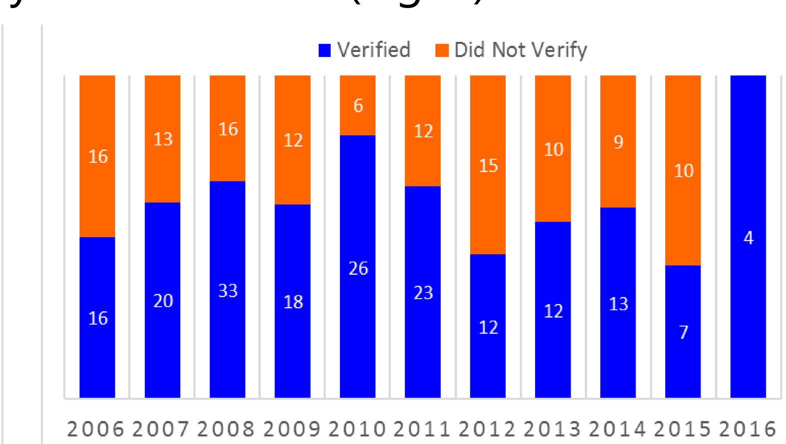

Fig. 2: Verification percentage by year

Cold Fronts were the most common initiating boundary (57%; Fig. 3), but warm fronts and drylines were the boundaries for which forecasts verified most often (Fig. 4) Cases of cold fronts and no initiating boundary verified at a lower percentage, with no boundary cases verifying the least. The verification percentage for cases involving no front has not improved with time. After a few years in which all cases involving warm fronts verified, the percentage of verified warm front cases has decreased recently (Fig. 5).

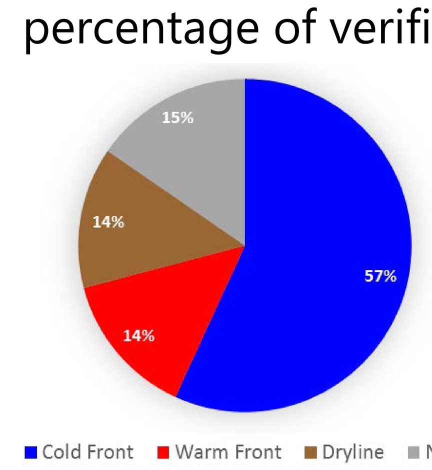

Fig. 3: Frontal type, all cases

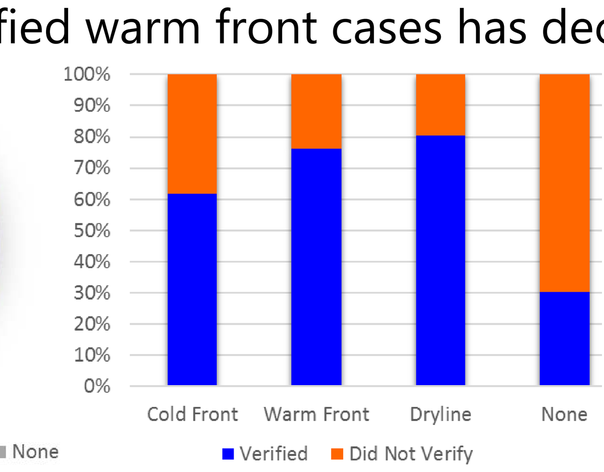

Fig. 4: Verification percentage by frontal type

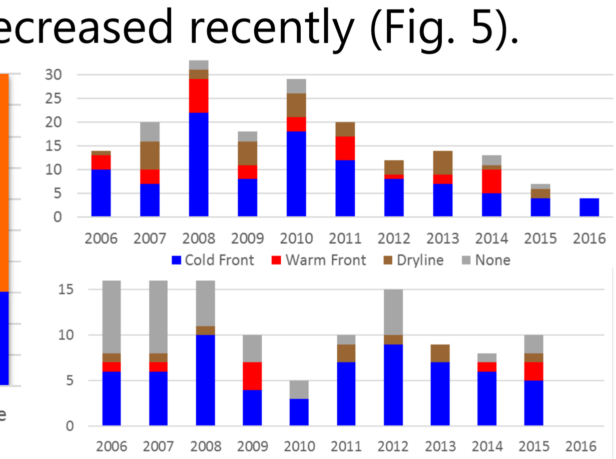

Fig. 5: Breakdown by frontal type and year (Top: Verified, Bottom: Did not verify)

Results: Shear Vector Orientation

0-6 km shear vector orientation with respect to the initiating boundary was separated into three bins: 0-30°, 30-60°, and 60-90°. The crossing angle was most commonly less than 60°. Somewhat surprisingly, the shear vector orientation with respect to the boundaries was similar between cases that did not verify (Fig. 6) and cases that did verify (Fig. 7).

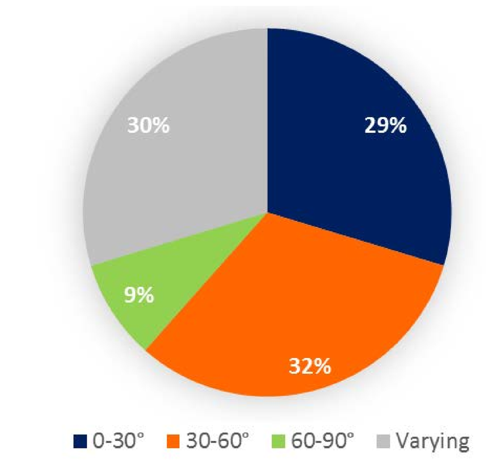

Fig. 6: Shear vector angle orientation ranges for cases that did not verify

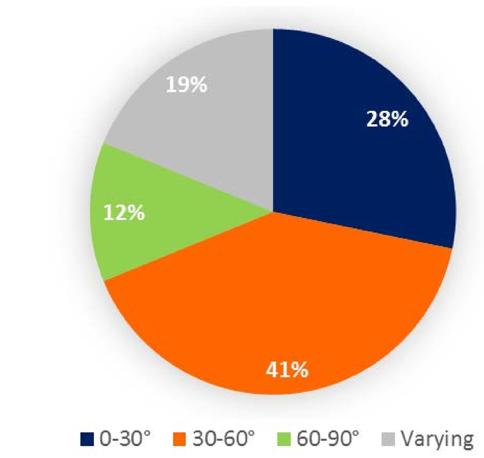

Fig. 7: Shear vector angle orientation ranges for cases that verified

Since 2012, the percentage of nearly-parallel shear vector cases that did not verify has decreased each year (Fig. 8). Comparing before 2010 to after 2010 shows that there has been an increase in the percentage of nearly perpendicular shear vector cases that verified (Fig. 9). There is no discernable trend among cases that varied between bins.

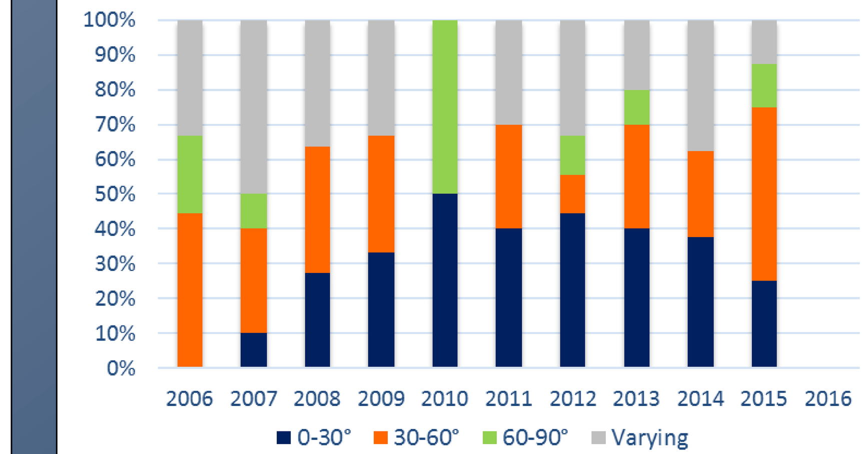

Fig. 8: Percentage of each shear vector orientation by year for cases that did not verify

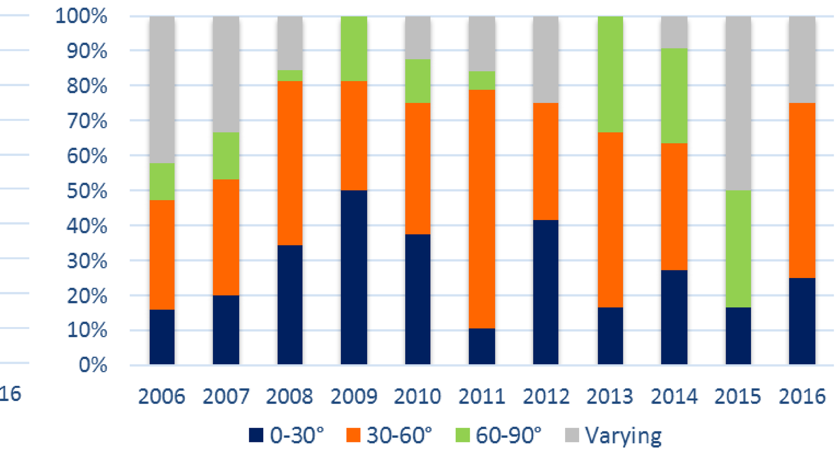

Fig. 9: Percentage of each shear vector orientation by year for cases that verified

Results: Parameters

The environment on days on which outlooks did not verify was suboptimal compared to days on which outlooks did verify. Values of 0-1 km SRH, LCL height, and surface-based convective available potential energy (CAPE) were generally more supportive of tornado development on days that verified (Fig. 10).

On days in which outlooks did not verify, at least one of the three aforementioned variables was typically not at a value supportive of tornado development (Fig. 11). Days that did verify were much more likely to have a combination of high 0-1 km SRH and low LCL heights (82% of verified outlooks vs. 57% of outlooks that did not verify).

Analysis of the Significant Tornado Parameter (STP) reinforces the point that one variable was usually missing on days on which outlooks did not verify; on 25% of such days, the maximum STP value was less than one (Fig. 12).

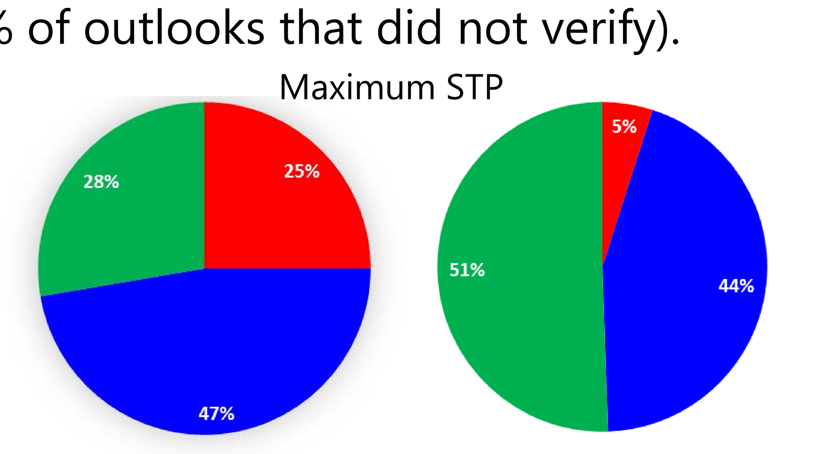

Fig. 12: Maximum STP values for cases that did not verify (left) and cases that did verify (right)

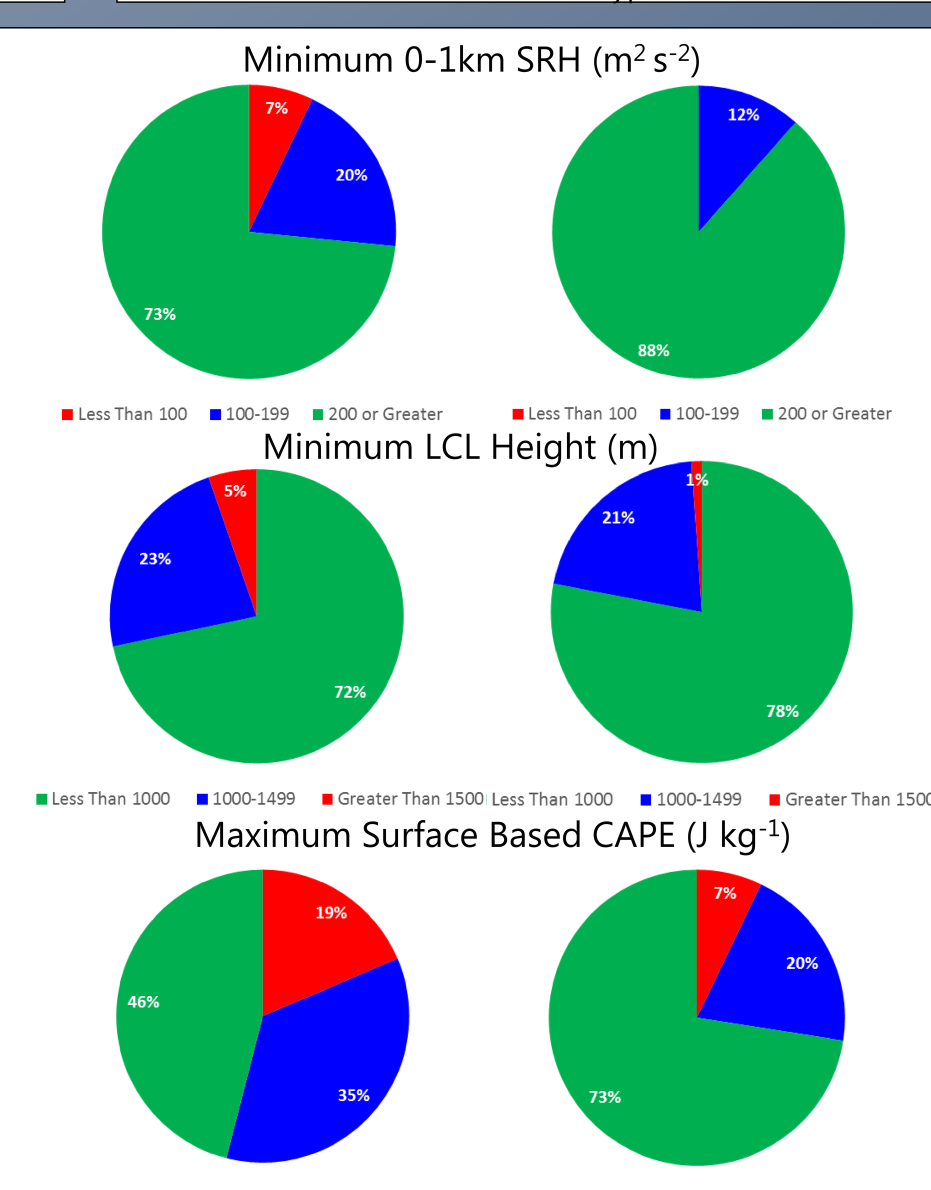

Fig. 10: Examination of variables commonly associated with tornado development for cases that did not verify (left) and cases that did verify (right).

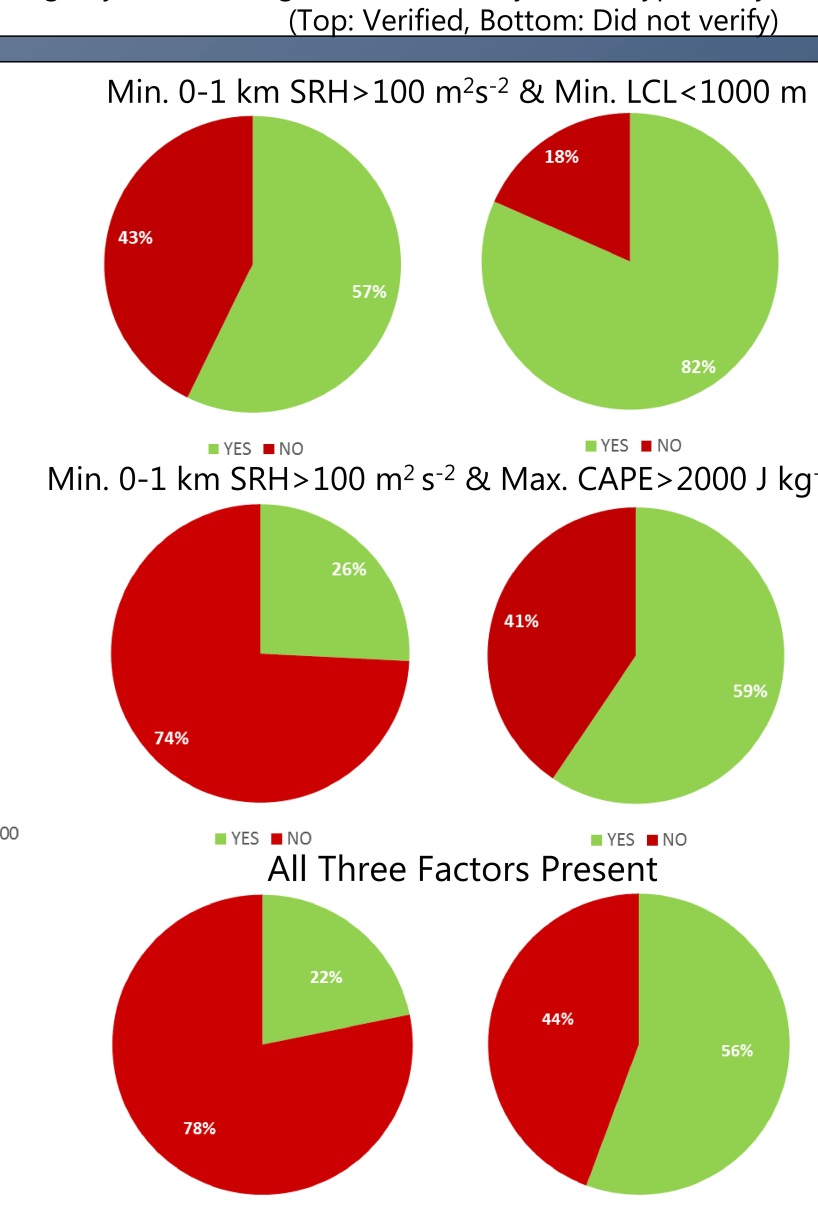

Fig. 11: Comparison of the percentage of cases that did not verify (left) or verified (right) for the criteria listed above each pair of graphs.

Conclusions and Further Analysis

- Cases on which a frontal boundary was not present verified at a far lower percentage than cases with a frontal boundary. Cases involving warm fronts and drylines verified at a higher percentage than those involving cold fronts.
- December and February verified at high percentages, meaning that it is not necessarily cold-season setups that give forecasters the most difficulty.
- There is not a huge difference between shear vector orientation ranges between cases that verified and those that did not verify.
- Values of 0-1 km SRH, LCL Height, and CAPE were typically less favorable for tornado development for cases that did not verify.
- At least one or more of these variables were often missing on days when outlooks did not verify.
- Further analysis of specific cases is necessary to discern specific causes of the failed production of tornadoes on certain days.

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