28th Conference on Radar Meteorology, 1997

P3.7 REGIONAL ADAPTATION OF NEXRAD MESOCYCLONE AND TVS ALGORITHMS

Robert R. Lee*[1]

[1] WSR-88D Operational Support Facility (OSF), Norman, Oklahoma

1. ABSTRACT

Work is now underway at the Operational Support Facility (OSF) and at many National Weather Service (NWS) field sites to fine-tune default adaptable parameters and to optimize algorithm performance for diverse climatological
and local environmental conditions. The OSF has provided recommendations to NWS field sites for modifying adaptable parameters in two algorithms, Mesocyclone (1995) and TVS (1996). Tuning and optimizing capabilities are especially important for sites not in Great Plains environments.

2. BACKGROUND

The Mesocyclone and Tornado Vortex Signature (TVS) Algorithms were originally designed to identify severe weather characteristics in Great Plains supercells. As a result of field reports and other investigations, the OSF and algorithm source scientists believe that algorithm adaptation data is too strict for optimal performance in other severe weather events such as bow echos, comma heads, gust fronts, squall lines, and mini-supercells. (Burgess *et. al.* 1995, Grant and Prentice 1996) These suspicions were confirmed by OSF researchers who analyzed Level II data collected from various sites around the country and calculated Mesocyclone and TVS Algorithm performance using different combinations of adaptable parameters. Unpublished, internal, adaptable parameter studies resulted in specific recommendations for operational sites to change one Mesocyclone Algorithm parameter and one TVS parameter to improve algorithm performance. The first recommendation, given in 1995, authorized and encouraged field sites to change the Mesocyclone Algorithm parameter, Threshold Pattern Vector (TPV) number, from the default value of 10 to values as low as 6. This change allows the Mesocyclone Algorithm to recognize smaller two- dimensional features. The second recommendation, given in 1996, lets sites lower the TVS parameter Threshold TVS Shear (TTS) from the default value 72 hr-1 down to as low as 18 hr-1. This change allows the TVS Algorithm to detect circulations with smaller shear values.

* *Corresponding author address:* Robert R. Lee, WSR-88D Operational Support Facility, 1200 Westheimer Drive Norman, OK 73069; e-mail: rlee@osf.noaa.gov

3. FIELD SURVEY

After the OSF recommended that field sites change Mesocyclone and TVS parameters, Application Branch personnel distributed a survey to determine which sites changed parameters, what new parameters were being used, and what were forecaster perceptions of algorithm performance after the changes had been made.

A total of 136 surveys were mailed out and 92 sites returned the form.
A total of 19 sites modified the Mesocyclone TPV parameter and 18 sites modified the TVS TTS parameter. Most of the WSR-88D focal points reported a lack of storm events to be able to comment on perceived algorithm changes. Some radar focal points were interested in studying the problem of algorithm optimization for themselves before applying OSF recommendations.

Survey responses suggested that forecasters in the Great Plains preferred to use default parameter values. Figure 1 shows survey results from other forecasters who felt they had enough data to comment and reported a change in algorithm performance after modifying the parameters.

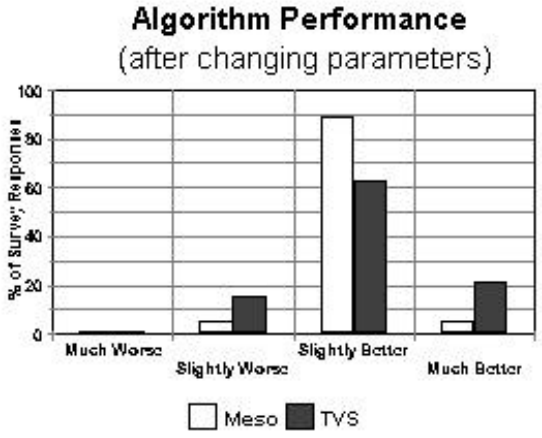

Figure 1. Perceived algorithm performance after modifying Meso and TVS adaptable parameters.

Figures 2 and 3 show TPV and TTS parameter values that were modified from default settings and the resulting perceived algorithm performance change.

Forecast offices have confirmed expectations of an increased number of algorithm detections and some have

modified their severe weather warning procedures to use Meso and TVS Algorithm as circulation detectors. Current algorithms can not accurately differentiate between severe and non-severe circulations or forecast the formation of tornadoes given the presence of 3D rotational signatures or shear zones.

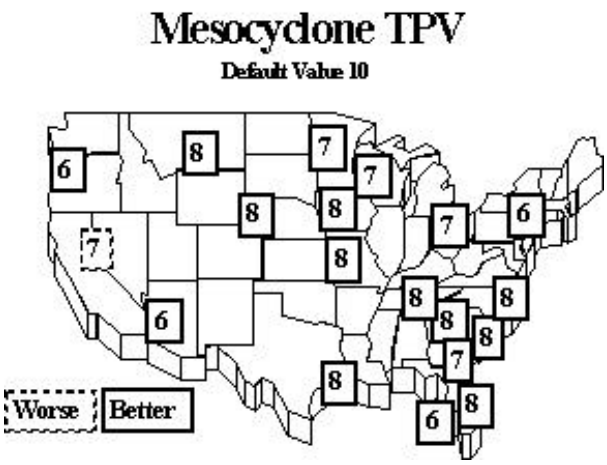

Figure 2. Perceived performance and modified TPV values.

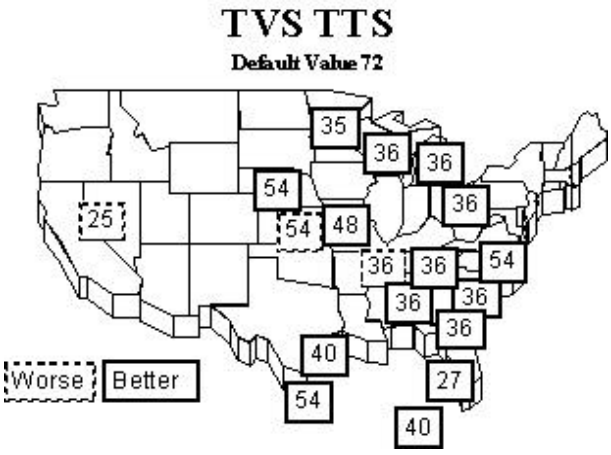

Figure 3. Perceived performance and modified TTS values.

4. RECOMMENDATION AND DISCUSSION

The proposed solution for identifying tornadic circulations from bow echos, comma heads, gust fronts, squall lines, and mini-supercells is to increase algorithm sensitivity by reducing default adaptable parameters to detect smaller, weaker circulations. A potential problem exists with this approach. Unpublished studies performed at the OSF and forecaster field experience have shown that when the Mesocyclone and TVS Algorithms are tuned to detect these non-traditional, damage causing circulations, all smaller, weaker circulations, tornadic and non-tornadic, are detected by the algorithms.

Algorithm functional design, radar sampling limitations, poor ground truth, and lack of knowledge about tornado formation and life cycle contribute to the a perception of too many algorithm detections. Current Mesocyclone and TVS Algorithms only detect three dimensional rotational velocity features. There is no guarantee that detected features will cause damage or even reach the ground. Between 50 and 70 percent of all mesocyclones do not produce tornadoes. (Burgess *et. al.* 1993) Algorithm detections in areas where ground damage can not be later identified are not necessarily false alarms. Rather, algorithms perform as designed; but, no damage occurs. True algorithm false alarms may be caused by velocity dealiasing errors, ground clutter contamination, or environmental flow around updraft or downdraft obstacles.

Therefore, until improved algorithms are fielded, forecasters should use the Mesocyclone and TVS Algorithms as circulation detectors. Adaptable parameters should be set to detect non-traditional circulations to avoid missing important circulations. Let the algorithms find more circulations and forecasters consider age, depth, rotational velocity, shear, reflectivity structure, divergence, convergence, and environment to issue tornado warnings. Forecasters need to assess circulation and storm structure evolution when algorithms locate areas of concern.

4. REFERENCES

Burgess, D.W., R.J. Donaldson, and P.R. Desrochers, 1993: Tornado Detection and Warning by Radar. The Tornado: Its Structure, Dynamics, Predictions and Hazards, Geophys. Monogr., C. Chruch, ed., No. 79, Amer. Geophys. Union, 203-221.

, R.R. Lee, S.S. Parker, D.L. Floyd, D.L. Andra Jr. 1995: A Study of Mini Supercells Observed by WSR-88D Radars. Preprints, *27th Conf. on Radar Meteorology*, Vale, CO, Amer. Meteor. Soc., 4-6.

Grant, B., R. Prentice, 1996: Mesocyclone Characteristics of Mini-Supercell Thunderstorms. Preprints, *15th Conference on Weather and Forecasting*, Norfolk, Va, Amer. Meteor. Soc., 362-365.