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The New Tornadic Vortex Signature Detection Algorithm (TDA) for Build 10

or

A New Spin on Tornado Detection

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The OSF's Applications Branch has coded the National Severe Storms Laboratory's (NSSL) Tornado Detection Algorithm (TDA) for inclusion in the WSR-88D Build 10 software release. (Field sites that have used either NSSL's WDSS or WATADS software may already have some familiarity with the TDA.) Here we briefly describe some of the major differences between TDA and the old TVS algorithm, TDA's operation and skill, and some ongoing work within the branch and elsewhere to fine-tune TDA's performance. (Note: the TVS nomenclature has been retained.)

For starters, the new TDA is no longer part of the mesocyclone algorithm. Build 10 software may detect a TVS without a mesocyclone also being detected. Second, the new algorithm may identify more TVS's. The overall skill will increase, compared to the old algorithm, but there will also be an increase in the number of false alarms. OSF and NSSL algorithm developers will be providing users with guidance on tuning the performance through adaptable parameter studies. Third, the TVS product may display an open inverted red triangle in addition to the more familiar solid red triangle. The inverted open triangle indicates a TVS signature aloft and is called an elevated TVS or ETVS. The red triangles are also slightly larger than before. Fourth, the algorithm attempts to match all TVSs or ETVSs to the nearest storm. However, if there is no storm within 20 km, two questionmarks ""??"" are displayed for the storm Id. Fifth, the new TDA uses 30 adaptable parameters instead of just two.

With the default adaptable parameter settings, the new TDA algorithm systematically searches all velocity data within 100 km of the radar and below 10 km height AGL for moderate gate-to- gate velocity differences (11 m/s) between adjacent radials that lie in regions of reflectivity that are greater than 0 dBZ. The velocity differences (pattern vectors) must have an implied cyclonic rotation. At least three pattern vectors in close proximity are required to form two-dimensional features. At least three two-dimensional features must correlate vertically in order to have a three-dimensional feature. Finally, the three-dimensional features are tested against thresholds of velocity differences, height, and depth to determine if any are either TVSs or ETVSs.

Applications Branch personnel, NSSL algorithm developers, and some field forecasters are now in the process of developing alternate sets of adaptable parameters from studies on a large, geographically diverse data set of tornadic events. These adaptable parameter sets will allow URC's to tailor the sensitivity of the TDA algorithm to station preferences and regional storm types. This is important because the new tornado algorithm contains 30 adaptable parameters and it is imperative that algorithm developers provide as much information as possible about TDA's performance so that field personnel can choose which adaptable parameter set will best satisfy operational needs of URC committee members.

Currently, developers have defined a Default Set which optimizes overall algorithm performance and a Minimized Set which will make the TDA perform similarly to the old TVS Algorithm. It is anticipated that more sets will be available in time for the release of Build 10, including a set for Tropical Cyclone/Low-topped Convection, a set for Mini-SuperCells, and a Middle-Ground set which will lower the False Alarm Rate at the expense of some overall performance.

During TDA's development, algorithm performance and default parameters were considered optimized when the Critical Success Index (CSI) was highest. Using default values, Mitchell (1998, Weather and Forecasting, in press) showed TDA to have a POD = 43, an FAR = 48, and a CSI = 31. Other comparison studies by Mitchell (1997, AMS Radar Conference) show that the old TVS Algorithm has a POD = 3, an FAR = 0, and a CSI = 3. Obviously, there will be a major change in the operational approach to using the TDA versus the old TVS Algorithm. For the old TVS Algorithm, the algorithm rarely identified a TVS (i.e. low POD), but if a TVS was identified, then the circulation was likely tornadic or about to be (i.e. extremely low FAR). Using default adaptable parameters, the new TDA algorithm may identify several TVSs in one volume scan during severe weather events. The user should then use other information (e.g. knowledge of environment, other algorithms, and spotter information) to discriminate between those which are actually producing or about to produce a tornado.