P20.8 ROTATIONAL SHEAR NOMOGRAM FOR TORNADOES

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1. INTRODUCTION

Operational meteorologists commonly use a mesocyclone recognition nomogram (Fig. 1) developed by Andra (1997), which relates rotational velocity and range from the WSR-88D, to mesocyclone strength, for issuing tornado and severe thunderstorm warnings.

This mesocyclone recognition nomogram has had good success, but it also has a major limitation. Unfortunately, it does not take into account the diameter of a mesocyclone, which may be an important factor in determining mesocyclone intensity (NSSL, 1997). An example of this limitation is the mini supercell, which is noted to have a mesocyclone diameter of about 2 nm (Burgess et al, 1995). The original nomogram was not applicable for this type of thunderstorm. In order to aid forecasters with this type of storm, a second nomogram was needed.

Since mesocyclone diameter may be an important part of mesocyclone intensity, we developed a rotational shear nomogram to help improve tornado warning decision making. We used rotational shear because it takes into account both the rotational velocity and the diameter of a mesocyclone, and it is readily available to the operational forecaster using the WSR-88D. To make the tornado warning decision process easier for forecasters, areas on the nomogram were labeled as minimal mesocyclone, tornado possible, tornado probable, and tornado likely.

Forecasters in Shreveport, LA have been using this rotational shear nomogram and have shown improved tornado warning verification results.

2. DATABASE

Data was gathered on 50 mesocyclones, most occurring in the NWSO Shreveport county warning area (CWA), but a few outside the Shreveport CWA. These mesocyclones were detected in the lower levels of the storms. All mesocyclones in this study occurred over the south central and southeast United States. The data covered a 5 year time period from 1994 through 1998, although the data in the first 2 years of the study was sparse due to the lack of available WSR-88D radars. Of the 50 mesocyclones in the database, 32 produced verified tornadoes and 18 did not produce a tornado.

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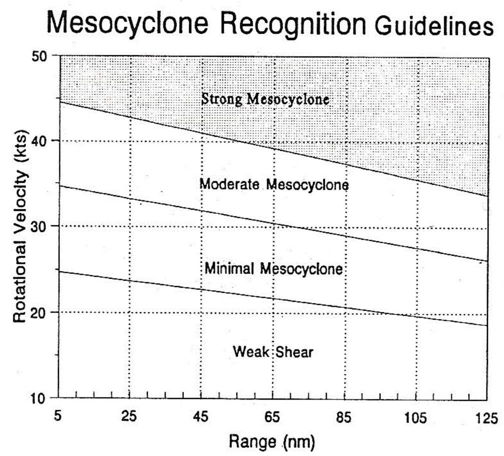

Figure 1. Mesocyclone recognition nomogram (Andra, 1997).

For those events in the Shreveport CWA, we made a concentrated effort to verify whether or not a tornado occurred by sending staff members to the area where a mesocyclone occurred to do a storm survey. Several times in heavily wooded rural areas, where a tornado was not previously reported to the office, we found a tornado track as a result of a storm survey.

In order to calculate rotational shear, we must first determine rotational velocity. The equation for rotational velocity (Vr) is:

$$Vr = \frac{|Vi| + |Vo|}{2} \quad (1)$$

where Vi and Vo are the maximum inbound and outbound winds in a mesocyclone as determined by the WSR-88D (Andra, 1997).

The VR shear function on the WSR-88D display was used to calculate rotational shear (Sr) on each mesocyclone in the database. Rotational shear is a relationship between rotational velocity and diameter of a mesocyclone, and is calculated by:

$$Sr = \frac{2\,Vr}{D} \quad (2)$$

where Sr is rotational shear in s^{-1}, Vr is rotational velocity in m/s, and D is mesocyclone diameter in m (NSSL, 1997).

Figure 2 shows the data plotted on a graph of rotational shear (Sr) vs range from the radar of each mesocyclone.