

The tornadic thunderstorm events during the 1998-1999 South African summer

E de Coning* and BF Adam

Weather Forecasting Research Programme, South African Weather Bureau, Private Bag X097, Pretoria 0001, South Africa

Abstract

Due to the occurrence of several tornadoes in the summer of 1998/99 it was decided to research the occurrence of tornadic events over South Africa. A general overview of tornadoes is given along with a way to classify the intensity of these events. This is followed by a section on the frequency, occurrence and location of tornadoes over South Africa. Severe weather and/or tornado events can be expected when certain atmospheric conditions prevail. These are defined and indications of threshold values for severe weather are given. Three tornadic events which occurred in 1998/99 in South Africa are then discussed by means of these parameters. The first is the Harrismith tornado in November 1998 which was classified as an F3 tornado by the Fujita-Pearson (FP) classification. The tornado which occurred in Mount Ayliff in January 1999 was seemingly the most severe ever reported - FP classification F4 - and was the next case considered. Finally a short summary on the Umtata event of December 1998 is given. The aim with these case studies was to see which synoptic, mesoscale, model and radar characteristics could be identified to indicate severe weather and/or tornado possibilities. Knowledge of these indicators can help operational forecasters to know what to look for in future severe weather events in order to forecast with greater accuracy. Reasonable success was achieved through the use of model data fields to "see" tornado signatures or at the very least indicators of severe weather conditions. With the aid of real-time radar to monitor the development of the severe storms (in two of the cases) it was possible to identify the tornado cloud structure. Without radar coverage not much can be said about these kinds of events.

Introduction

A tornado is defined as a violently rotating column of air with small diameter extending from a thunderstorm to the ground (Goliger et al., 1997). Tornadoes are small-scale by-products of thunderstorms, with less than 1% of thunderstorms producing tornadoes. Tornadoes occur in many parts of the world, but are most frequently found in the United States of America east of the Rocky Mountains during the spring and summer months (NOAA Pamphlet, 1995).

Despite all the research into the origin and prediction of tornadoes (mainly in the USA), this phenomenon is still not fully understood or predictable (Goliger et al., 1997). Until the middle of 1998 a general public perception prevailed that tornadoes do not occur in South Africa, but occur almost exclusively in the USA. This perception seems to have changed during the 1998-1999 summer season, with tornadoes accompanying several severe storms over the eastern escarpment, generating widespread interest through extensive news media coverage. Severe storms associated with extensive wind damage can, however, be erroneously reported as tornadic storms.

An important point to remember is that a tornado's size is not necessarily an indication of its intensity. Large tornadoes can be weak, and small tornadoes can be violent and *vice versa*. The life cycle of the tornado should also be taken into consideration. A "small" tornado may have been larger at one stage but is at the "shrinking" stage of its life cycle. The Fujita-Pearson (FP) scale is based on damage and not the appearance of the funnel, and is shown in the **Appendix** (Fujita, 1973a; b). Damage varies from F0 to F5, with increasing numbers indicating increasing damage and therefore increasing intensity. Storm observers often try to estimate the

intensity of a tornado, basing their judgement on the rotational speed and amount of debris being generated as well as the width of the tornado. However, the official estimate (in the USA as well as South Africa) is only made after the tornado has passed. The FP scale is, however, subjective and varies according to the degree of experience of the surveyor.

During the 1998/99 summer season seven "tornadoes" were reported in the Eastern Cape of which only three have conclusively been identified as tornadoes (Van Niekerk and Sampson, 1999). One of these, which occurred in Mount Ayliff, was confirmed as an F4 tornado. This event seems to be the most severe ever reported and will, along with the Harrismith event, be discussed in this paper.

Summary of South African tornado history

The CSIR maintains a database of tornadic activity (Goliger et al., 1997), which currently contains nearly 200 events dating from 1905 to 1996. A map of the tornado events over the eastern parts of South Africa up to 1997 (unfortunately excluding the 1998/1999 season) is given in Fig. 1. Most tornadoes have been observed over the eastern escarpment areas of the subcontinent.

Classification of tornadoes in Southern Africa was based on an assessment of the damage, with less emphasis placed on the path length and width (Goliger et al., 1997). Where insufficient information was available for positive classification, the tendency was towards a lower FP-scale intensity. Confirmation of tornadic events remains a challenge in South Africa. The authors are aware of more than 20 severe storm events during 1989 to 1998, which were not surveyed for damage and/or evidence of tornadoes. There exists a need to carry out damage surveys within two days of a severe event.

The tornadoes documented by Goliger et al. (1997) had the following characteristics: They occur over a broad spectrum of

* To whom all correspondence should be addressed.

☎(012) 309-3081; fax (012) 323-4518 e-mail: estelle@cirrus.sawb.gov.za

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