Your Tornado Information and Safety Manual

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Index

Foreword

As we all should know by now, our weather has changed and tornadoes are not only in the US anymore, but in South Africa as well.

I am an EF4 tornado survivor and over the years tornadoes in South Africa has increased yearly.

We even had two tornadoes on the same day in two different provinces, which has happened again since then.

As we do not have the advanced warning systems in place which the US have, I have decided to write a manual for South Africans containing information on tornadoes so that we can educate ourselves on the signs and safety advise to help us and our loved ones to stay save in the event of a tornado.

Zac Cronje

Introduction

South Africa witnesses several supercell thunderstorms each year with the inclusion of isolated tornadoes. On most occasions these tornadoes occur in open farmlands and rarely cause damage to property, as such many of the tornadoes which do occur in South Africa are not reported. The majority of supercells develop in the central, northern, and north eastern parts of the country. The Free State, Gauteng, and Kwazulu Natal are typically the provinces where these storms are most commonly experienced, though supercell activity is most certainly not limited to these provinces. On occasion, hail reaches sizes in excess of golf balls, and tornadoes, though rare, also occur.

On the 6 May 2009 a well-defined hook echo was noticed on local South African radars, along with satellite imagery this supported the presence of a strong supercell storm. Reports from the area indicated heavy rains, winds and large hail.

On Sunday October 2, 2011 2 devastating tornadoes tore through two separate parts of South Africa on the same day, hours apart from each other. The first, classified as an EF 2 hit Meqheleng, the informal settlement outside Ficksburg, Free State which devastated shacks and homes, uprooted trees, and killed one small child. The second, which hit the informal settlement of Duduza, Nigel in the Gauteng province, also classified as EF2 hit hours apart from the one that struck Ficksburg. This tornado completely devastated parts of the informal settlement and killed two children, destroying shacks and RDP homes.

Tornado Basics

What is a tornado?

A tornado is "a violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud." Literally, in order for a vortex to be classified as a tornado, it must be in contact with the ground and the cloud base. Weather scientists haven't found it so simple in practice, however, to classify and define tornadoes. For example, the difference is unclear between an strong mesocyclone (parent thunderstorm circulation) on the ground, and a large, weak tornado. There is also disagreement as to whether separate touchdowns of the same funnel constitute separate tornadoes. It is well-known that a tornado may not have a visible funnel. Also, at what wind speed of the cloud-to-ground vortex does a tornado begin? How close must two or more different tornadic circulations become to qualify as a one multiple-vortex tornado, instead of separate tornadoes? There are no firm answers.

How do tornadoes form?

“warm moist air meets cold air and dry air "--is a gross oversimplification. Many thunderstorms form under those conditions (near warm fronts, cold fronts and drylines respectively), which never even come close to producing tornadoes. Even when the large-scale environment is extremely favorable for tornadic thunderstorms, as in an SPC "High Risk" outlook, not every thunderstorm spawns a tornado. The truth is that we don't fully understand. The most destructive and deadly tornadoes occur from supercells--which are rotating thunderstorms with a well-defined radar circulation called a mesocyclone. [Supercells can also produce damaging hail, severe non-tornadic winds, unusually frequent lightning, and flash floods.] Tornado formation is believed to be dictated mainly by things which happen on the storm scale, in and around the mesocyclone. Recent theories and results from the VORTEX program suggest that once a mesocyclone is underway, tornado development is related to the temperature differences across the edge of downdraft air wrapping around the mesocyclone (the occlusion downdraft).

What direction do tornadoes come from?

Tornadoes can appear from any direction. Most move from southwest to northeast, or west to east. Some tornadoes have changed direction amid path, or even backtracked. A tornado can double back suddenly, for example, when its bottom is hit by outflow winds from a thunderstorm's core.

Does hail always come before the tornado?

Rain? Lightning? Utter silence? Not necessarily, for any of those. Rain, wind, lightning, and hail characteristics vary from storm to storm, from one hour to the next, and even with the direction the storm is moving with respect to the observer. While large hail can indicate the presence of an unusually dangerous thunderstorm, and can happen before a tornado, don't depend on it. Hail, or any particular pattern of rain, lightning or calmness, is not a reliable predictor of tornado threat.

How do tornadoes dissipate?

The details are still debated by tornado scientists. We do know tornadoes need a source of instability (heat, moisture, etc.) and a larger-scale property of rotation (vorticity) to keep going. There are a lot of processes around a thunderstorm which can possibly rob the area around a tornado of either instability or vorticity. One is relatively cold outflow--the flow of wind out of the precipitation area of a shower or thunderstorm. Many tornadoes have been observed to go away soon after being hit by outflow. For decades, storm observers have documented the death of numerous tornadoes when their parent circulations (mesocyclones) weaken after they become wrapped in outflow air--either from the same thunderstorm or a different one. The irony is that some kinds of thunderstorm outflow may help to cause tornadoes, while other forms of outflow may kill tornadoes.

Do tornadoes really skip?

Not in a literal sense, despite what you may have read in many older references, news stories, or even damage survey reports. By definition (above), a tornado must be in contact with the ground. There is disagreement in meteorology over whether or not multiple touchdowns of the same vortex or funnel cloud mean different tornadoes (a strict interpretation). In either event, stories of skipping tornadoes usually mean

There was continuous contact between vortex and ground in the path, but it was too weak to do damage; Multiple tornadoes happened; but there was no survey done to precisely separate their paths (very common before the 1970s); or There were multiple tornadoes with only short separation, but the survey erroneously classified them as one tornado.

What happens when two tornadoes come together?

That is more unusual than it seems, because most video that seems to show tornadoes merging actually involves either one tornado, or one among multiple subvortices, going behind another. On those very rare occasions when tornadoes do merge, it usually involves a larger and stronger tornado that simply draws in and absorbs the lesser circulation, then keeps on going.

How long does a tornado last?

Tornadoes can last from several seconds to more than an hour. The longest-lived tornado in history is really unknown, because so many of the long-lived tornadoes reported from the early-mid 1900s and before are believed to be tornado series instead. Most tornadoes last less than 10 minutes.

How close to a tornado does the barometer drop? & how far does it drop ?

It varies. A barometer can start dropping many hours or even days in advance of a tornado if there is low pressure on a broad scale moving into the area. Strong pressure falls will often happen as the mesocyclone (parent circulation in the thunderstorm) moves overhead or nearby. The biggest drop will be in the tornado itself, of course. It is very hard to measure pressure in tornadoes since most weather instruments can't survive. A few low-lying, armored probes called "turtles" have been placed successfully in tornadoes.

What is a waterspout?

A waterspout is a tornado over water--usually meaning non-supercell tornadoes over water. Although waterspouts are always tornadoes by definition; they don't officially count in tornado records unless they hit land. They are smaller and weaker than the most intense Great Plains tornadoes, but still can be quite dangerous. Waterspouts can overturn boats, damage larger ships, do significant damage when hitting land, and kill people

How are tornadoes in the northern hemisphere different from tornadoes in the southern hemisphere?

The sense of rotation is usually the opposite. Most tornadoes (but not all!) rotate cyclonically, which is counterclockwise in the northern hemisphere and clockwise south of the equator. Anticyclonic tornadoes (clockwise-spinning in the northern hemisphere) have been observed, however--usually in the form of waterspouts, non-supercell land tornadoes, or anticyclonic whirls around the rim of a supercell's mesocyclone. There have been several documented cases of cyclonic and anticyclonic tornadoes under the same thunderstorm at the same time.

What is a multivortex tornado?

Multivortex (a.k.a. multiple-vortex) tornadoes contain two or more small, intense subvortices orbiting the center of the larger tornado circulation. When a tornado doesn't contain too much dust and debris, they can sometimes be spectacularly visible. These vortices may form and die within a few seconds, sometimes appearing to train through the same part of the tornado

one after another. They can happen in all sorts of tornado sizes, from huge "wedge" tornadoes to narrow "rope" tornadoes. Subvortices are the cause of most of the narrow, short, extreme swaths of damage that sometimes arc through tornado tracks. From the air, they can preferentially mow down crops and stack the stubble, leaving cycloidal marks in fields. Multivortex tornadoes are the source of most of the old stories from newspapers and other media before the late 20th century which told of several tornadoes seen together at once.

What is the original F-scale?

Dr. T. Theodore Fujita developed a damage scale (Fujita 1971, Fujita and Pearson 1973) for winds, including tornadoes, which was supposed to relate the degree of damage to the intensity of the wind. This scale was the result. The original F-scale should not be used anymore, because it has been replaced by an enhanced version. Tornado wind speeds are still largely unknown; and the wind speeds on the original F-scale have never been scientifically tested and proven. Different winds may be needed to cause the same damage depending on how well-built a structure is, wind direction, wind duration, battering by flying debris, and a bunch of other factors. Also, the process of rating the damage itself is largely a judgment call--quite inconsistent and arbitrary (Doswell and Burgess, 1988). Even meteorologists and engineers highly experienced in damage survey techniques often came up with different F-scale ratings for the same damage. Even with all its flaws, the original F-scale was the only widely used tornado rating method for over three decades. The enhanced F-scale takes effect 1 February 2007.

What is the Enhanced F-scale?

The Enhanced F-scale (simple table or detailed 95 page PDF) is a much more precise and robust way to assess tornado damage than the original. It classifies F0-F5 damage as calibrated by engineers and meteorologists across 28 different types of damage indicators (mainly various kinds of buildings, but also a few other structures as well as trees). The idea is that a "one size fits all" approach just doesn't work in rating tornado damage, and that a tornado scale needs to take into account the typical strengths and weaknesses of different types of construction. This is because the same wind does different things to different kinds of structures. In the Enhanced F-scale, there will be different, customized standards for assigning any given F rating to a well built, well anchored wood-frame house compared to a garage, school, skyscraper, unanchored house, barn, factory, utility pole or other type of structure. In a real-life tornado track, these ratings can be mapped together more smoothly to make a damage analysis. Of course, there still will be gaps and weaknesses on a track where there was little or nothing to damage, but such problems will be less common than under the original F-scale. As with the original F-scale, the enhanced version will rate the tornado as a whole based on most intense damage within the path. There are no plans to systematically re-evaluate historical tornadoes using the Enhanced F-scale. A full PDF document on the Enhanced F-scale is online.

So if the original F-scale winds were just guesses, why were they so specific?

Excellent question. Original F-scale winds were attached arbitrarily to the damage scale based on 12-step mathematical interpolation between the hurricane criteria of the Beaufort wind scale, and the threshold for Mach 1 (738 mph). Though the F-scale actually peaked at F12 (Mach 1), only F1 through F5 were used in practice, with F0 attached for tornadoes of winds weaker than hurricane force. The newer EF-Scale wind groupings were rooted in engineering study of wind effects, with the 3-second gust thresholds rounded to the nearest values that are divisible by 5.

I heard the Oklahoma City tornado was almost "F6." Is that a real level on the original F-scale? Is there such a thing as EF-6?

For the original F-Scale, Fujita plotted hypothetical winds higher than F5; but as mentioned in the previous answer above, they were only guesses. Even if the winds measured by portable Doppler radar (32 meters above ground level, roughly 302 mph) had been over 318 mph, the tornado still would have been rated "only" F5, since that is the most intense possible damage level. On the Enhanced F-scale, there is no such thing as "EF6" or higher. Damage--no matter how "incredible" or how strong the wind--maxes out at EF-5.

What is a "significant" tornado?

A tornado is considered "significant" if it was rated EF2 or greater on the Enhanced F scale, or at least F2 on the old F-scale. Grazulis (1993) also included killer tornadoes of any damage rating in his significant tornado database. It is important to know that those definitions are arbitrary, mainly for parsing out more intense tornadoes in scientific research. No tornado is necessarily insignificant. Any tornado can kill or cause damage; and some tornadoes rated less than EF2 in open areas probably could do EF2 or greater damage if they hit a sufficiently well-constructed target.

Big fat tornadoes are the strongest ones, right?

Not necessarily. There is a statistical trend (as documented by NSSL's Harold Brooks) toward wide tornadoes having higher damage ratings. This could be related to greater tornado strength, more opportunity for targets to damage, or some blend of both. However, the size or shape of any particular tornado does not say anything conclusive about its strength. Some small "rope" tornadoes still can cause violent damage of EF4 or EF5; and some very large

tornadoes over a quarter-mile wide have produced only weak damage equivalent to EF0 to EF1.

Can't we weaken or destroy tornadoes somehow, like by bombing them or sucking out their heat with a bunch of dry ice?

The main problem with deploying anything packing enough energy to realistically stand a chance at affecting a tornado (e.g., hydrogen bomb) is that it would be even more deadly and destructive than the tornado itself. Lesser things (like huge piles of dry ice or smaller conventional weaponry) would be too hard to deploy in the right place fast enough, and would likely not have enough impact to affect the tornado much anyway. Imagine the legal problems one would face, too, by trying to bomb or ice a tornado, then inadvertently hurting someone or destroying private property in the process. In short--bad idea!

How does cloud seeding affect tornadoes?

Nobody knows, for certain. There is no proof that seeding can or cannot change tornado potential in a thunderstorm. This is because there is no way to know that the things a thunderstorm does after seeding would not have happened anyway. This includes any presence or lack of rain, hail, wind gusts or tornadoes. Because the effects of seeding are impossible to prove or disprove, there is a great deal of controversy in meteorology about whether it works, and if so, under what conditions, and to what extent.

What does a tornado sound like?

That depends on what it is hitting, its size, intensity, closeness and other factors. The most common tornado sound is a continuous rumble, like a nearby train. Sometimes a tornado produces a loud whooshing sound, smilar to a waterfall, or the noise of open car windows while driving very fast. Tornadoes which are tearing through densely populated areas may be producing all kinds of loud noises at once, which collectively may make a tremendous roar. Just because you may have heard a loud roar during a damaging storm does not necessarily mean it was a tornado. Any intense thunderstorm wind can produce damage and cause a roar.

Do tropical cyclones produce waterspouts?

Yes. Waterspouts--tornadoes over water--have been observed in tropical systems. We don't know how many of them happen in tropical cyclones, but a majority probably are from supercells. The similarity in Doppler radar velocity signatures over water to tornado-producing cells in landfalling hurricanes suggests that it may be common, and yet another good reason for ships to steer well clear of tropical cyclones.

Does tropical cyclone strength or size matter for tornadoes?

Often, but not always. Relatively weak hurricanes like Danny (1985) have spawned significant supercell tornadoes well inland, as have larger, more intense storms like Beulah (1967) and Ivan (2004). In general, the bigger and stronger the wind fields are with a tropical cyclone, the bigger the area of favourable wind shear for supercells and tornadoes. But supercell tornadoes (whether or not in tropical cyclones) also depend on instability, lift and moisture. Surface moisture isn't lacking in a tropical cyclone, but sometimes instability and lift are too weak. This is why tropical systems tend to produce more tornadoes in the daytime and near any fronts that may get involved in the cyclone circulation. It is also why SPC won't always have tornado watches out for every instance of a tropical cyclone affecting land.

Tornadoes in Africa

Event	Date	Area	Tornadoes	Casualties	Notes
Johannesburg - Pretoria, South Africa tornado	26 November 1948	Highveld,South Africa	-	6 fatalities, 100 injuries	64 km track crossed major urban areas
Albertynesville, South Africa tornado	30 November 1952	South Africa	-	20 fatalities, 400 injuries	
Paynesville, South Africa tornado	2 December 1952	South Africa	-	11 fatalities	
Trompsburg, South Africa tornado	5 November 1976	Karoo, South Africa	-	5+ fatalities	Longest path ever measured in SA, 175 km, mostly through desert
Senekal, South Africa tornado	15 September 1988	South Africa	-	2 fatalities	Long track event

Welkom, South Africa tornado	20 March 1990	Free State,South Africa	-	destroying 4000 homes	Multi-vortex tornado races through the suburbs of Welkom with a 240 km long severe storm front and a width of up to 1.7 km. Proved to be the most devastating (in monetary terms) in South Africa's history.
Harrismith tornado	15 November 1998	Free State,South Africa	1	0 fatality, 14 injuries	F2 according to Weather Service. Several houses and three airplane hangers were damaged or destroyed
Mthatha, South Africa tornado [2]	15 December 1998	South Africa	-	15 fatalities, 100 injuries	Tornado tracked through major urban area
Umtata tornado	11 January 1999	Eastern Cape, South Africa	1	11 fatality, 150 injuries	Category unknown. Large amounts of damage was caused including damage to the hospital. Nelson Mandela, previous president of South Africa was in a pharmacy when the tornado hit, and was

					protected by his bodyguards while lying on the floor. The pharmacy was also damaged, but Mandela was not injured.
Mount Ayliff, South Africa tornado [3]	18 January 1999	South Africa	-	25 fatalities, 500 injuries	120 km long track F4
Heidelberg, South Africa tornado [4]	21 October 1999	South Africa	-	20 injuries	100+ km path narrowly missed Johannesburg
Centurion tornado	21 October 1999	Gauteng,South Africa	1	unknown fatality, unknown injuries	F1 according to Weather Service. Damage was caused.
Mpumalanga, South Africa tornado outbreak	9 September 2002	Mpumalanga,South Africa	4	2 fatalities	Strong line of storms. Some buildings completely flattened
Dullstroom tornado	1 August 2006	Mpumalanga,South Africa	1	0 fatalities, 9 injuries	Several homes damaged, roof a high school completely removed. Estimated to be strong F1, possibly F2
Vryheid tornado	20 October	KwaZulu-	1	0	Rural huts destroyed on a

	2006	Natal, South Africa			farm 15 km east of the town. Child almost 'taken up' into tornado. Path estimated to be 4 km long. Estimated F1
Klerksdorp tornado	4 March 2007	North West,South Africa	1	1 fatality, 3 injuries	F0 (South African Weather Bureah classified it as a "mini tornado"). 200 houses and other buildings damaged.
Molweni tornado	14 November 2008	KwaZulu-Natal, South Africa	1	8 fatalities, 200 injuries	Crossed an urban area. Cars rolled some distance and shipping containers hurled through the air over 200m. Mud huts completely scoured away. Brick houses levelled. Path estimated to be 10 km long. Estimated EF3-4
Bulwer tornado	6 November 2009	KwaZulu-Natal, South Africa	1	1 fatality, 30 injuries	F3 according to Weather Service. Cars thrown and cinder brick homes flattened
Ficksburg tornado	3 October 2011	Free State,South Africa	1	1 fatality, 42 injuries	F2 according to Weather Service. 122

					houses and shacks destroyed.
Duduza tornado	3 October 2011	Gauteng,South Africa	1	1 fatality, 166 injuries	F2 according to Weather Service. 150 houses destroyed
Bronkhorstspruit tornado	13 November 2011	Mpumalanga,South Africa	1	0 fatality, 0 injuries	Category unknown. Minimal damage due touching down in open fields.
Bethlehem tornado	23 June 2012	Free State,South Africa	1	8 fatality, 27 injuries	F2. Several houses was destroyed in Bethlehem and Kestell areas

Since June 2012 we had some severe weather due to lack of spotters and photos most of them are seen as strong wind and not tornadoes. Only once one makes proof available do they change their mind on whether it was strong wind or a tornado.

Tornadoes in South Africa Causes

by **Globerover** on March 29, 2010 in **South Africa**

Interested in the causes of tornadoes in South Africa? Learn more about South African tornado causes...

The majority of reports that originate from Africa regarding tornadoes refer to events that have occurred in South Africa. There are many causes for the tornadoes in South Africa. Very few reports of tornadoes are available from other regions in the continent but this in no way implies that other regions do not suffer from tornadoes. A hit by a tornadic storm event can become a deadly and devastating event for any region.

Tornadoes in South Africa

There are different causes of South African tornadoes, which are generally created with exceptionally hot air masses accompanied by severe thunderstorms. The majority of the tornadoes occurring in South Africa are actually underreported. An F3 tornado event in 1999

occurred close to the South African metropolis and almost went unreported. The South African Weather Service reports that the majority of the tornadoes have occurred in the Free State, Gauteng, KwaZulu-Natal and the north end of the area formerly known as Transkei.

Build-up of a Tornado

A tornado is a whirling funnel that starts from what appears to be a tube, which starts from a cloud and which eventually touches the ground. The bottom often has translucent dust, which the strong winds pick up and can be accurately described as a violent rotating column of air. Tornadoes are extremely dangerous and powerful storms. The column of whirling air is connected to a cloud on top that is usually a cumulonimbus cloud and rarely may also be the base of an a cumulus cloud. These look like condensation funnels. A waterspout tornado, when it occurs in Africa, occurs in tropical regions that are close to the equator. They are not commonly seen at higher altitudes.

Season for Tornadoes in South Africa

In the main, tornados occur during mid-summer, which is from November to January in the southern hemisphere, where South Africa is. A few tornadoes have also been noticed in summer, which is September and October; while others have sporadically hit different areas during late summer and occasionally in autumn in February till May.

Tornadoes usually occur in the late afternoon or early evening from 4 p.m. to 7 p.m. and 65% of the tornadoes fall into the category of F0 – F1 on the Fujita Scale. These are categorized as light damage tornadoes. Approximately 25% of the tornadoes can be classified as the F2 storms, which cause considerable damage.

There are few tornadoes that have gone above the F3 level. One such event was the Ayliff tornado, which afflicted the Eastern Cape region in 1999 and was classified as an F4 tornado. There have been at least seven killer tornadoes in the last 60 years that hit South Africa and the Ayliff tornado was one of them. It killed 25 individuals and injured more than 500 people. The tornado created havoc along a 25 mile path. After that,, in 1952, Albertynesville, South Africa suffered a devastating tornado that killed 20 citizens and injured 400 residents of that region.

Signs of An Approaching Tornado

A man watching a nearby tornado

Learn to spot a tornado before it is too late.

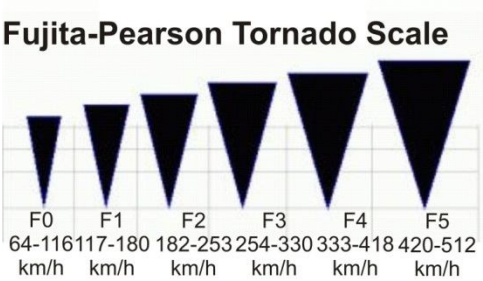
Signs of an approaching tornado include:

- the sky turning to a greenish black color
- debris drops from the sky
- sounds similar to a waterfall or rushing air.
- A funnel-shaped cloud appears with other clouds moving quickly towards it.

The Tornado Scale

The Fujita-Pearson scale or more popularly known as the F scale is used to measure the intensity of a tornado based on the amount of damage done by a passing tornado over an area.

The F scale rates a tornado from F0 all the way to F5 with a F5 tornado having the fastest wind speeds and causing the most damage.



An F0 Tornado

- Have wind speeds between 64-116 km/h
- Causes light damage.
- Branches break off of trees and pushes over smaller trees.

An F1 Tornado

- Have wind speeds between 117-180 km/h
- Causes moderate damage.

- Tiles break off of roofs. Cars and trailers gets pushed

An F2 Tornado

- Have wind speeds between 182-253 km/h
- Causes considerable damage.
- Roofs get torn off. Big trees get toppled. Mobile homes are destroyed. Heavy cars are lifted and thrown.

An F3 Tornado

- Have wind speeds between 254–330 km/h
- Causes Severe Damage.
- Roofs torn off even on the well-constructed structures. Trains are overturned.

An F4 Tornado

- Have wind speeds between 333-418 km/h
- Causes Catastrophic Damage
- Well-constructed structures are levelled. Structures with weak foundations are blown away.

An F5 Tornado

- Have wind speeds between 420–512 km/h
- Causes Total Damage
- Few if any structures are left standing. Cars become missiles flying in the air.

Tornado Safety

What should I do in case of a tornado?

That depends on where you are. This list of tornado safety tips covers most situations.

What is a tornado watch?

A tornado watch defines an area shaped like a parallelogram, where tornadoes and other kinds of severe weather are possible in the next several hours. It does not mean tornadoes are imminent, just that you need to be alert, and to be prepared to go to safe shelter if tornadoes do happen or a warning is issued. This is the time to turn on local TV or radio, turn on and set the alarm switch on your weather radio, make sure you have ready access to safe shelter, and