

Tornadoes in a Nutshell

A guide for journalists produced by the Science Media Centre of Canada

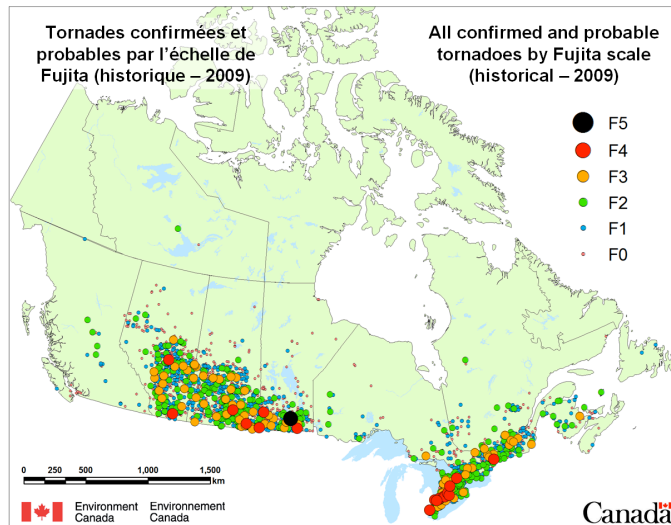
This is part of the Science Backgrounder series produced by the SMCC. It offers a simple explanation of the science of tornadoes.

What is a tornado?

A tornado is a vortex of violently circulating winds that extends from the base of a cloud (often a *supercell* storm, see below) to the surface. A funnel cloud often accompanies a tornado. It is sometimes only partly visible, or not seen at all, and dust and debris (or spray over water) near the surface are the only indication that a tornado is occurring.

The strongest tornadoes often develop with *supercell* storms, which have a large area of strong wind rotation within the cloud called a *mesocyclone*. The mesocyclone is created by wind shear (wind speed increasing with height) and strong updrafts in the storm. The wind shear causes air near the surface to spin horizontally, like a rolling pin. This spin is then tilted to a more or less vertical axis and stretched by strong updrafts, intensifying the rotation. Strong downdrafts then wrap around the rear of the storm help to bring the rotation down to the surface. And if conditions are just right, a tornado forms at the boundary between the strong updrafts and downdrafts.

The average speed of a tornado moving along the ground is 50 km/h and the average width is about 100 metres, though it can range from 10–2000 metres. A tornado usually lasts about 15 minutes, but can endure for up to several hours. Warning signs include severe thunderstorms with very large hail, a deep whistling sound like a jet engine or a roar like a train, and the characteristic vertical funnel cloud.



Tornadoes in Canada and the U.S.

Canada reports the second-largest number of tornadoes in the world, about 60 annually, although many more go unreported since large areas of Canada have low population densities. Most reported tornadoes occur in southern Ontario, central Alberta, southwestern Quebec, and southern Saskatchewan to Manitoba. Western New Brunswick reports occasional tornadoes. Canada's tornado season runs from April to October, peaking in June and July. The U.S. claims the most reported tornadoes, with about 1,000 annually. The U.S. 'tornado alley' has nearly perfect conditions for creating supercell storms, – warm, dry air moving east across the Rocky Mountains lies over hot, humid air moving north from the Gulf of Mexico, creating unstable conditions. If a low pressure system then creates strong wind shear, conditions are just right for supercell storm formation.

Tornado Strength

In Canada, the strength of a tornado is measured using a standard scale called the Fujita (F) scale. It does not directly measure wind speed, but estimates wind speed inside the tornado, based on observed damage. As of 2007, the U.S. uses an enhanced Fujita (EF) scale that includes additional damage guidelines.

F number	Estimated wind speed (km/h)	Damage	Occurrence in Canada (%)
F0–light	60–110	Pushes over shallow-rooted trees, some damage to chimneys, signs	66.3
F1–moderate	120–170	Moving vehicles pushed off road, some damage to mobile homes	25.8
F2–considerable	180–240	Roofs torn off houses, large trees snapped or uprooted, heavy cars lifted off ground	6.3
F3–severe	250–320	Roofs and some walls torn off houses, most trees uprooted, and heavy cars lifted off ground and thrown	1.3
F4–devastating	330–410	Well-constructed houses leveled, cars and large objects thrown	0.2
F5–incredible	420–510	Strong frame houses lifted off foundations, vehicles thrown at least 100 m, trees uprooted and transported large distances.	0.05

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Canada's Deadliest Tornadoes

Regina, Saskatchewan: 1912. 28 dead, hundreds injured. Rated F4.

Edmonton, Alberta: 1987. 27 dead, hundreds injured. Rated F4.

Windsor to Tecumseh, Ontario: 1946. 17 dead, hundreds injured. Rated F4.

Pine Lake, Alberta: 2000. 12 dead, 140 injured. Rated F3.

Can we forecast tornadoes?

Meteorologists study storm development to determine the likelihood of a tornado. Tornadoes form so quickly that it is impossible to forecast them far in advance. Doppler radar is the most useful tool for forecasting tornadoes. It displays cloud-level winds toward and away from the radar, enabling meteorologists to observe changes in wind speeds and directions and to locate areas that might lead to tornado development. Using radar, they can also look for a characteristic shape called a *hook echo* in a storm, caused by downdrafts wrapping rain and hail around the back side of the storm cloud. This shape indicates that strong rotation associated with a mesocyclone is present.

What to do in a tornado:

Inside: Go to the basement or lowest building level and stay in the centre of a small room away from windows, doors and outside walls. Lie close to the ground, preferably under a heavy table or desk and use your arms to protect your head. Large buildings with wide-span roofs (such as gyms, churches and stadiums) may collapse if a tornado hits so if possible, find shelter in another building. More than half of all deaths from tornadoes happen in mobile homes, so these should be abandoned.

In a car: Never try to outrun a tornado in urban areas. Stop, get out and find shelter elsewhere, preferably in a building with a strong foundation.

Outside: If shelter is not nearby, lie flat in a ditch or depression, being wary of potential flooding. Do not go under an overpass or bridge.

Research in Canada

David Sills of Environment Canada participates in VORTEX2, a U.S. project with some international participation. Often referred to as 'storm chasers', the scientists seek to determine how and when tornadoes form, their structure, and what sort of damage they create. <http://www.nssl.noaa.gov/projects/vortex2/>

At McGill University, Peter Yau's team is studying how tornadoes form when different winds intersect. The goal of this study is to help meteorologists better forecast high-winds like hurricanes and tornadoes.

http://www.mcgill.ca/meteo/faculty_staff/faculty/yau/

Gregory Kopp of the University of Western Ontario is one of the leading scientists for the Three Little Pigs Project. The group looks at the impact of strong winds on full-size homes, to develop better structures that can withstand high winds, like tornadoes, at affordable prices. <http://www.eng.uwo.ca/irlbh/>

For more information:

Environment Canada, Tornadoes: <http://www.ec.gc.ca/meteo-weather/default.asp?lang=En&n=6C5D4990-1>

Government of Canada, Get prepared: Tornadoes in Canada: <http://www.getprepared.gc.ca/knw/ris/trn-eng.aspx>

The National Severe Storms Laboratory: <http://www.nssl.noaa.gov/edu/safety/tornadoguide.html>

The Weather Channel: http://www.weather.com/outlook/weather-news/severe-weather/articles/tornado_2010-03-30

Storm Prediction Center at NOAA: <http://www.spc.noaa.gov/faq/tornado/index.html#The%20Basics>

http://www.weather.gov/os/brochures/adv_spotters.pdf

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