

Scientists use seismic waves to measure tornado intensity

October 25 2017, by Joseph Cariz



Tornado with dust and debris cloud forming at surface. Credit: NOAA Photo Library/Flickr

Seismic waves generated by tornadoes when they touch down could be used to measure a twister's intensity, according to a new study.

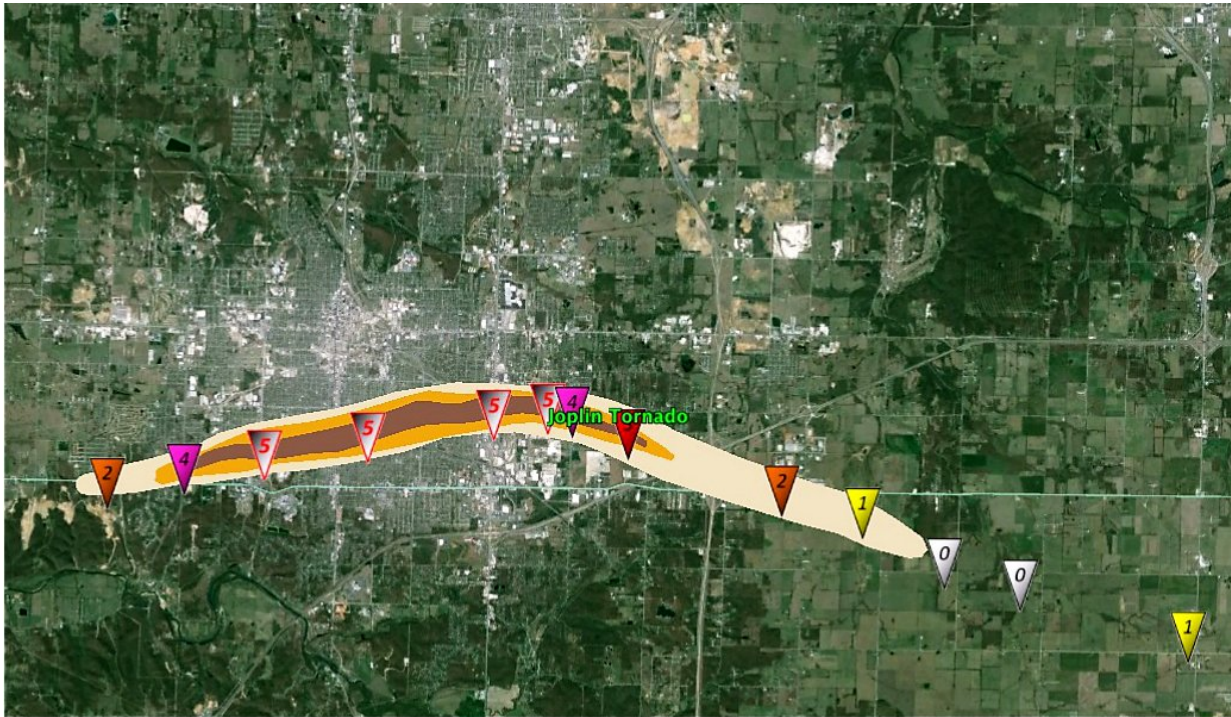
The new research examined a catastrophic tornado that struck Joplin, Missouri in May 2011 and revealed the size of seismic waves produced by the tornado on the ground correlated with its strength.

The results suggest researchers can estimate a large tornado's strength by measuring the seismic waves it creates, a finding that could open the door to devising more accurate methods to study [tornadoes](#) from the ground, according to the authors of the new study published in *Geophysical Research Letters*, a journal of the American Geophysical Union.

Weather authorities currently forecast the locations of tornadoes using surface weather stations and Doppler radar. But they still rely on storm chasers and spotters to find out when a tornado touches down. There is also no way to directly measure a tornado's wind speed, so authorities rely on damage reports to indirectly judge its intensity.

"Our results have applications for developing a more quantitative measure of a tornado's strength," said Anne Valovcin, a graduate student in the Earth science department at the University of California in Santa Barbara and lead author of the new study. "Also, we only see the [seismic signals](#) when it touches the ground, so that could provide a new way to directly determine when a tornado has touched down."

A new way to monitor twisters



Map of the full path of the Joplin tornado on May 22, 2011. Darker colors indicate more severe damage. The numbered points give the recorded intensity of the tornado on the Enhanced Fujita Scale at that location. Credit: NOAA/NWS

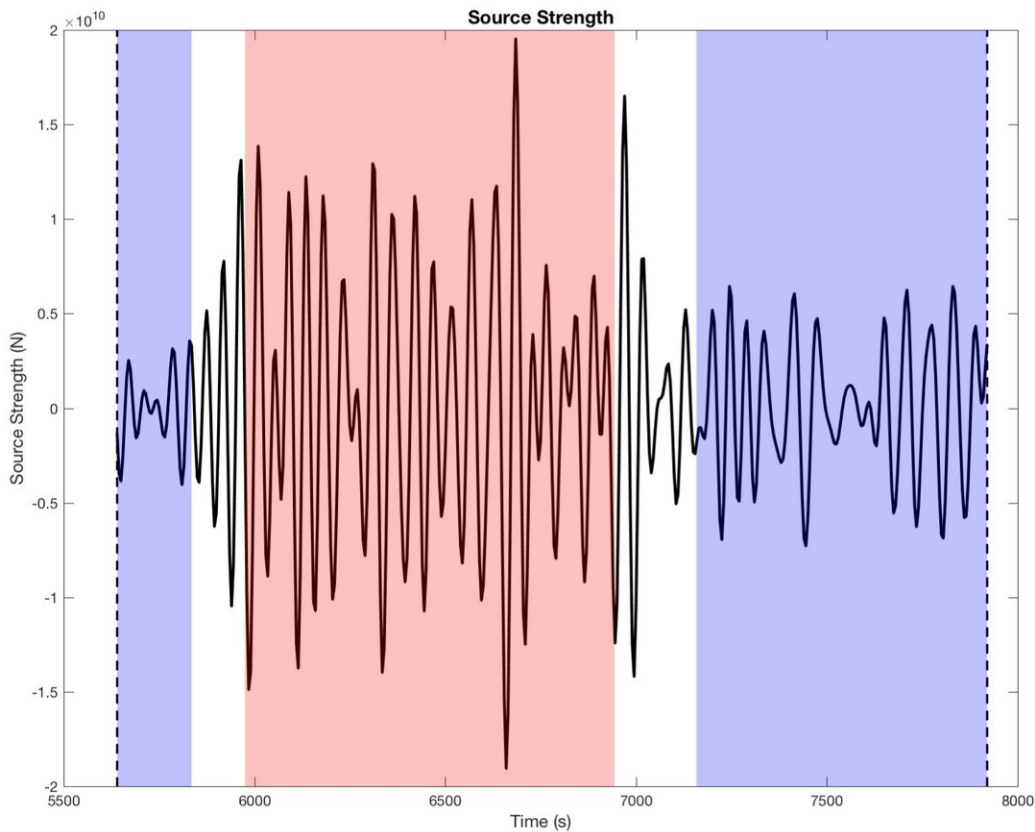
Seismic waves are vibrations in the Earth created when the ground shakes, usually felt during earthquakes, volcanic eruptions or large explosions. Tornadoes also generate small seismic waves when they travel over the ground, but scientists know little about how these waves vary with storm strength.

In the new study, Valovcin and her colleagues analyzed seismic waves generated by the May 22, 2011 Joplin tornado to characterize the relationship between the size of these waves and the tornado's strength. The Joplin twister clocked in as a powerful EF5 on the Enhanced Fujita Scale, a scale that rates the intensity of tornadoes by how much damage

they cause. It killed 158 people and resulted in \$2.8 billion in damage, making it the costliest single tornado in U.S. history.

The study's authors hypothesized that if the tornado touched the ground close enough to a [seismic station](#), the instruments could pick up those signals. "We wanted to see if we could detect these ground signals, then work backwards and create a model for the seismic waves generated by the tornado along its entire path," Valovcin said.

The researchers collected data from a network of stations built to detect small earthquakes and map Earth's interior under North America. These stations are equipped with seismometers and barometers that measure seismic signals and changes in air pressure. The measurements for the new study came from one station close enough to the Joplin tornado to detect its seismic signals.



A chart comparing the size of the seismic waves to the recorded strength of the Joplin tornado through its lifetime. The red section indicates when the Joplin tornado was recorded as EF4-5 intensity, and the blue section is when the tornado was recorded as a weaker EF0-2. Credit: Valovcin et al.

The authors divided the tornado's path on land into hundreds of individual points and calculated the size of the [seismic wave](#) generated at each point. They then correlated the size of the seismic waves at each stage in the tornado's lifetime with the tornado's intensity at that time.

The results show the size of the seismic waves correlated well with the tornado's EF rating. EF ratings range from EF0 to EF5, with EF5 being

the most destructive category. The Joplin tornado went from an EF1-2 to an EF4-5 in fewer than 10 minutes, and stayed at that intensity for approximately 15 minutes before beginning to lose its strength. As the twister got stronger and then weaker, the size of the seismic waves it generated increased and decreased accordingly.

Measuring a tornado's seismic signals could provide a better way for researchers to measure a tornado's strength and could help determine exactly when a twister touches down, according to the study's authors. But they cautioned the new method is largely preliminary and has several limitations.

For example, the technique requires measuring the air pressure at the time of the tornado to eliminate seismic interference from the turbulent air surrounding the twister. Seismic stations therefore need to be located next to functioning barometers to provide usable data.

Additionally, seismic waves generated by tornadoes are very small, and can't be felt by a person without equipment. They don't propagate far from their source, unlike seismic waves generated by earthquakes, which are often larger and can travel long distances. Detecting tornadoes in real-time with this method would require building a much denser network of seismic stations and barometers than currently exists, Valovcin said.

More information: Anne Valovcin et al. Modeling the Excitation of Seismic Waves by the Joplin Tornado, *Geophysical Research Letters* (2017). [DOI: 10.1002/2017GL074185](https://doi.org/10.1002/2017GL074185)

This story is republished courtesy of AGU Blogs (<http://blogs.agu.org>), a community of Earth and space science blogs, hosted by the American Geophysical Union. Read the original story [here](#).

Provided by American Geophysical Union

Citation: Scientists use seismic waves to measure tornado intensity (2017, October 25) retrieved 20 June 2024 from <https://phys.org/news/2017-10-scientists-seismic-tornado-intensity.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.