

Scaling the dangers of dust storms

ASU-led team develops first large-scale ranking system to raise awareness about the dangers of Phoenix dust storms

By Dolores Tropiano, ASU News
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Dust storms can be dramatic and even breathtaking events that sweep across the desert at high speeds during the Phoenix monsoon season.

But they can also be dangerous. Dust storm events are the third deadliest weather hazard in Arizona, behind flooding and temperature extremes.

And until now, there was no way to quantify that danger.

That changes in June with the launch of the [Phoenix Dust Storm \(PHX-DUST\) scale](#), the first standardized ranking system for Phoenix dust storms.

The scale was created by a coalition led, in part, by Arizona State University researchers, and its launch coincides with the beginning of the monsoon season.

“It's not like we're the first to implement dust scales,” said [Randy Cervený](#), President's Professor in the [School of Geographical Sciences and Urban Planning](#). “But we're the biggest. We're the first to do it on such a big scale for a big population area.”

The severity scale is designed to raise awareness of the dangers of dust storms and improve public safety, forecasting and research.

“The idea behind the Phoenix dust storm scale was to create a way to monitor air quality with regards to intense dust events that we have in the Phoenix Valley,” said [Ryan Heintzman](#), an assistant teaching professor in the School of Geographical Sciences and Urban Planning. “But also to provide a way for the public to understand and look at the actual intensity of these events.”

Cervený said that researchers intentionally made the scale easy to understand.

“It's aligned with other extreme weather scales,” he said. “Having more awareness of the dust events in the area is going to help people make more informed decisions.”

“It would be similar to the day after a tornado,” he added. “... It puts what happened in perspective and brings awareness; and that's absolutely a critical thing.”

Highlighting the dangers

Unlike hurricanes or tornadoes — classified by well-established scales that clearly signal their severity — dust storms have long lacked a standardized way to measure and communicate their intensity. That absence has made it harder to fully understand the risks they pose.

So just how dangerous are dust storms?

That depends on many things, including particle size and the duration of the storm.

Although a single spot of dust can be smaller than the width of a strand of hair, when gathered together and whisked up into a large dust storm, they can pose risks that run the gamut from minor eye irritation for most people to serious respiratory complications for those with underlying health conditions.

Dust storms can increase cardiovascular problems because inhaling fine dust can irritate sensitive lung tissue, causing airways to swell and constrict. Dust particles often carry trapped allergens, mold spores and pollutants that can trigger allergic reactions or severe asthma flare-ups.

Over time, repeated or acute exposure may reduce lung capacity and increase the risk of lower respiratory tract infections, particularly among vulnerable populations such as children and older adults.

Beyond that, dust storms impact traffic and airport safety. They can bring down power systems and even public infrastructure.

“When dust storms move through the Phoenix Valley, they can lower visibility, and in the past, they have led to serious car accidents, multicar pileups,” Heintzman said. “During some of these events, we’ve seen the closure of Phoenix Sky Harbor (International Airport).”

Scientists believe that the new dust storm category scale will bring greater understanding of these dangers.

A category 5 collaboration

PHX-DUST scale is the result of a collaboration among nearly every major weather organization in the region, from television meteorologists to air quality experts and public agencies.

“It was 22 people that were interested in the project,” Heintzman said. “Dr. Randy Cervený tried to pull a lot of these stakeholders together.”

The scale ranks dust storms from Category 1–5 based on objective measurements such as dust concentrations, wind speeds, duration and geographic coverage.

“We don’t really know the exact scale until we have the full collection of data from our monitors,” Heintzman said. “So right now, it’s really just looking at a post-event, kind of like the enhanced Fujita scale or tornado scale.”

The benchmark for the system is the historic July 5, 2011 dust storm, one of the most severe events ever recorded in Phoenix.

The scale is based on every thousand micrograms per cubic meter.

“Category one is a thousand micrograms per cubic meter of dust,” Heintzman said. “Category five is 5,000 micrograms per cubic meter of dust.”

The scale also includes subcategories. The international news-making dust storm of 2011 was a “Category 5, Widespread, Long-Duration High-Gust” dust storm.

“Imagine a cubic box,” Cervený said. “And it continually gets more and more dust. So a thousand little micrograms per cubic meter would create a dim haze while more than 5,000 is basically opaque.”

Phoenix first

Researchers say Phoenix is uniquely positioned to create this kind of scale.

The area’s dust storms are often driven by collapsing thunderstorms rather than the frontal systems and broader dust indexes used in other parts of the world.

“The most common way that we have dust storms around Phoenix is through convective events,” Heintzman said. “Basically, when a thunderstorm is really strong, it has a powerful cold downdraft. When that downdraft hits the surface, which is covered in dust, it pushes it forward and generates our dust storm.”

Phoenix also has the data and infrastructure to support the PHX-DUST scale.

The metropolitan area has unusually dense environmental monitoring networks. That includes 22 air-quality monitors and 11 wind-monitoring stations that will collect the data.

Most cities do not have this level of data coverage.

“The reason we did this here is we have the data,” Cervený said. “We have all the instrumentation. This is really tailored to Phoenix, and the type of storms we get are different from places like California or the Middle East.”

That local focus is part of what makes the scale unique. While other regions have developed dust metrics, they often track long-term trends rather than individual events.

Here, researchers can classify a single storm.

From research to real-world use

The goal is for the scale to move beyond research and into everyday use.

Meteorologists could use it to describe storms to the public, much like tornado or hurricane ratings. Agencies such as the ADEQ could use it to assess air quality impacts, while utilities like SRP could

monitor how dust affects infrastructure.

“We wanted to create some scale that could be used not just for air quality specialists, but that might be useful for all the different agencies around Phoenix, including local news,” Heintzman said. “We even had astronomers that contributed some input because they're interested in dust that might get in the way at night (and compromise stargazing).”

The scale may also help policymakers better understand long-term trends — such as whether severe dust storms are becoming more frequent — and inform decisions about land use and development.

Beyond Phoenix, the scale could serve as a model for other regions.

While it was designed for the Valley's unique conditions, researchers say the framework could be adapted elsewhere — particularly in areas where dust storms pose growing risks.

“This absolutely could be used in places beyond Phoenix,” Heintzman said. “It would have to be looked at more to see the concerns of that local place. But we see air pollution concerns and dust not just in Phoenix, but all over the United States and all over the world.”

This story originally appeared on [ASU News](#).

Main image



Researchers have created the first scientific post-event classification tool designed to measure and rank the severity of dust storms in the Phoenix metropolitan area. Photo by Charlie Leight/ASU Now

Text image(s)



Randy Cervený, President's Professor in the School of Geographical Sciences and Urban Planning, is one of the researchers who worked on the PHX-DUST scale. Photo by Deanna Dent/Arizona State University



Assistant Teaching Professor Ryan Heintzman, of the School of Geographical Sciences and Urban Planning, who worked on the PHX-DUST scale, poses with a weather station device in the Laboratory for Urban Climate Instrumentation on ASU's Tempe campus. Photo by Charlie Leight/ASU News