



# NOAA NATIONAL SEVERE STORMS LABORATORY



# 2025 IN A FLASH

A Year of NSSL Innovation in Severe Storm Science



## National Severe Storms Laboratory



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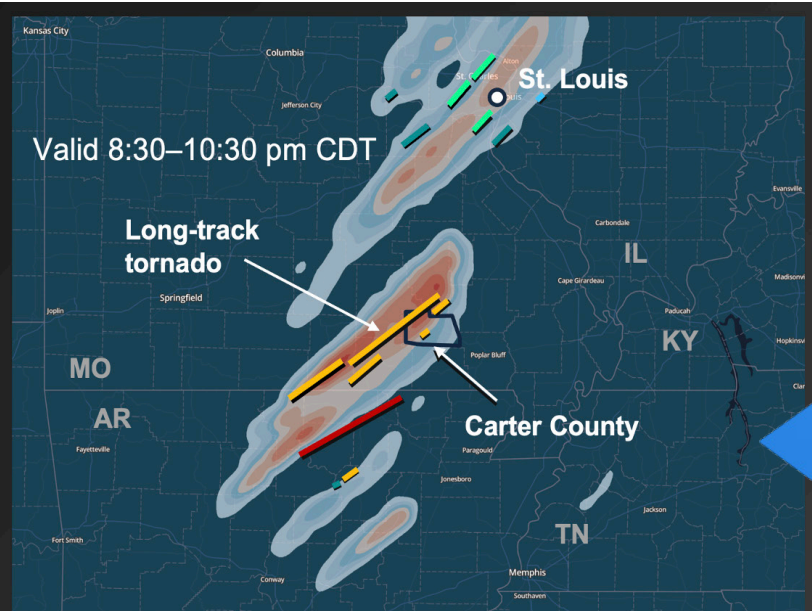
## WARN-ON-FORECAST SYSTEM (WOF5)

The Warn-on-Forecast System is a paradigm shift in tornado forecasting and warning that has already proven capable of yielding lead time of up to two hours.

In 2025, WoFS transitioned to the National Weather Service in a demonstration capacity, a key step toward being fully operational. This transition will result in much more frequent use of WoFS through 2026.

This March in Carter County Missouri, NWS forecasters armed with WoFS model info, alerted local first responders more than two hours ahead of a strong EF3 tornado. This allowed the local community to seek shelter and take necessary precautions, potentially saving dozens of lives.

But Warn-on-Forecast does more than just tornadoes. This summer in Utah, NWS forecasters used WoFS to help identify potential areas of downbursts, high winds and wildfire danger, issuing safety messaging for a local airport as well as an outdoor concert. These safety messages give those in harms way the time and information they need to protect themselves or seek shelter.



WoFS ensemble 90th percentile of near-ground rotation intensity (0–2 km updraft helicity)



### THE TORNADO THAT DIDN'T SURPRISE: WOF5 YIELDS 2-HOUR TORNADO ALERT



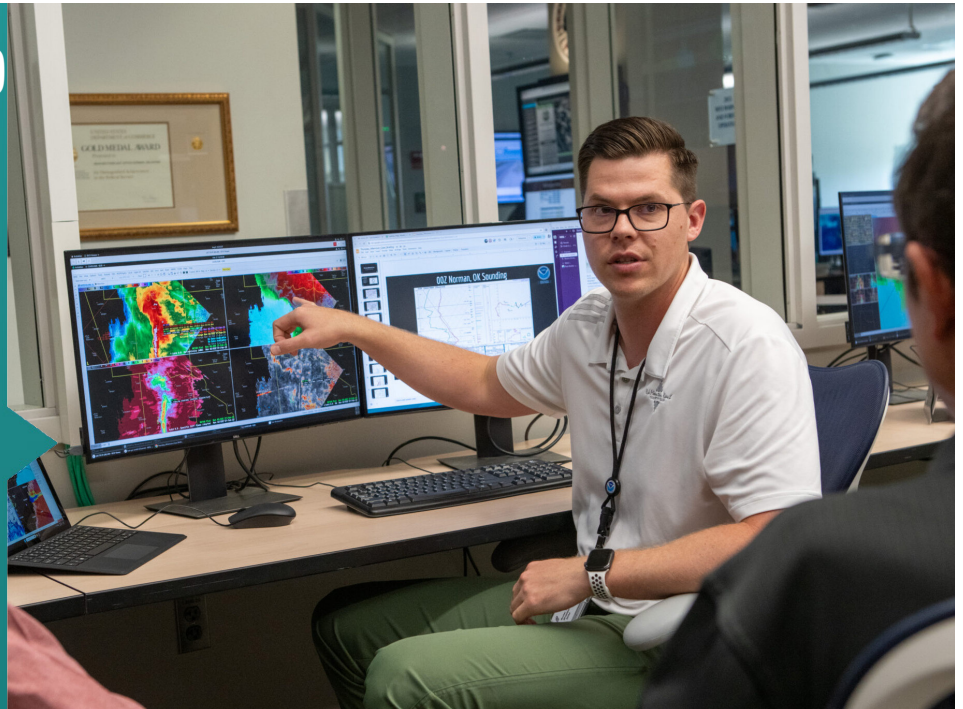
Scan to watch and learn how the Warn-on-Forecast System is pushing warning lead times for tornadoes and severe weather to up to two hours.

## PHASED ARRAY RADAR (PAR)

NSSL is the pioneer of weather radar technology and we have been innovating and improving on it for decades.

This year, NSSL captured more than 175 hours of meteorological data on various modes of weather events, giving a robust range of cases for evaluation. This data is crucial to moving PAR technology forward in its development as a potential solution for the National Weather Service's Radar Next program.

This year NSSL processed and sent near real-time PAR data to the National Weather Service forecast office in Norman, Oklahoma to help aid warning forecasters during severe weather. Adaptive scanning techniques were heavily utilized during operations to improve update rate and maximize coverage of storms.



### A CLEAR VISION: PHASED ARRAY RADAR INNOVATING FOR THE FUTURE



Scan to watch and learn how NSSL is innovating and developing the radar technology of the future.

## VORTEX-USA

Getting out in the field to study tornadoes has been at the heart of our mission for more than 60 years. Much of that work falls under the VORTEX-USA program.

This year, VORTEX-USA researchers collected data from 13 severe weather events in the Plains, including—for the first time—low-level scans of several tornadoes with the NSSL Doppler wind LiDAR. NSSL also put its new HailCam instrument in the field, capturing never-before-seen, hi-res images of hail in free fall.

These large-scale experiments put dozens of scientists and a wide range of vehicles, computing and instrumentation out into the field to study tornadoes up close. Gathering these observations and ground truths are an essential part of nearly all the research that happens at the lab.



## FAR AFIELD: RESEARCHERS SEEK OUT AND STUDY TORNADOES



Scan to watch and learn how NSSL researchers take to the field to study tornadoes and severe weather up close and personal.



## SOCIAL AND BEHAVIORAL SCIENCE PROGRAM

Over the years, NSSL has continued to push the boundaries of scientific understanding of tornadoes and severe weather. These efforts have led to cutting edge technologies that have improved forecasts and lead time. Yet we also know this information is only useful if it is accessible and easily understood by the people who need it.

NSSL's Social Science Research Team (SSRT) works to find ways to make severe weather information more effective for the end user. This year more than 480 survey responses were collected after tornadoes to assess how people receive, understand, trust, and respond during severe weather events.

This feedback, as well as interviews with NWS forecasters and emergency managers, is used to improve warning and safety messaging to maximize effectiveness and accessibility for the public.



## TORNADO TALES: HOW DO PEOPLE INTERACT WITH WARNINGS?



Scan to watch and learn how the NSSL's Social Science Research Team is gathering data on how people receive and respond to severe weather alerts.

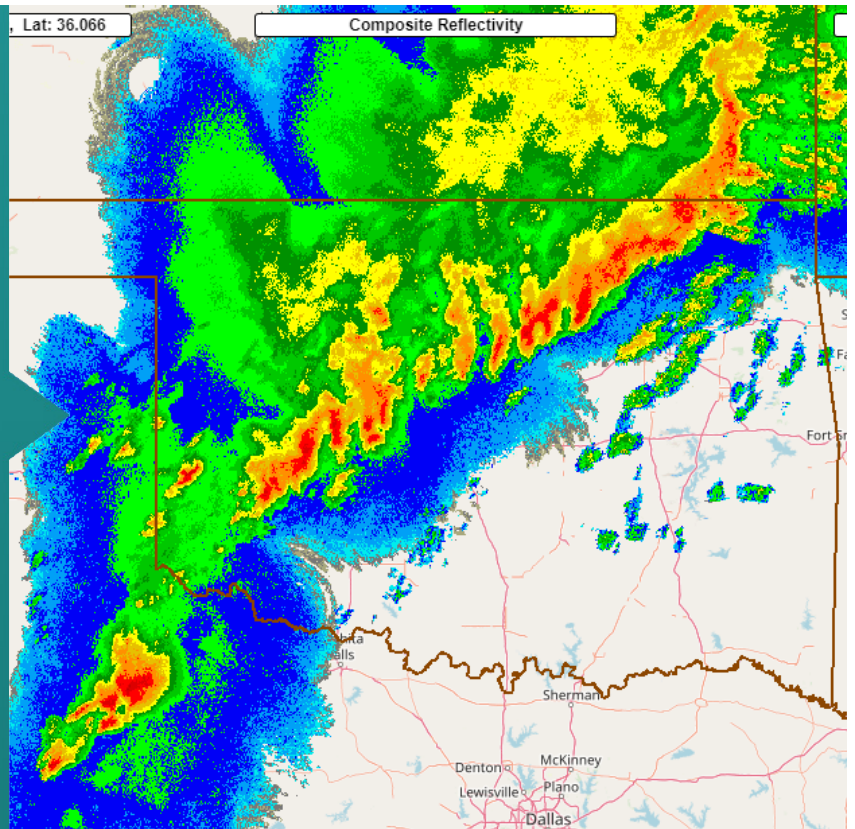


## MRMS

While perhaps less understood than more obvious tornado and severe weather tools, MRMS is a foundational element of the weather enterprise that is a cornerstone to our ability to issue forecasts and warnings.

In 2025, the Multi-Radar/Multi-Sensor system continued to deliver state-of-the-art radar analyses to both the National Weather Service and the public 24 hours a day and seven days a week. Every two minutes, MRMS generates roughly 500 new products, and this year, NSSL's MRMS public website recorded more than 600,000 views.

In fact users looked at nearly two million different MRMS products, including the nation's gold standard precipitation estimates, tools that help forecasters identify tornado tracks and severe hail storms, tools used to issue lifesaving flash flood warnings and aviation safety tools like echo tops that help pilots avoid danger.



## AI AND MACHINE LEARNING

AI and machine learning are changing the world as we know it and that includes the world of science and weather. NSSL is harnessing these new tools to enhance the capabilities of our researchers.

WoFSCast is an AI-powered model that seeks to improve on the Warn-on-Forecast System by matching or exceeding the forecast skill of numerical weather prediction models but more quickly (up to 10x faster) and with less computing power needed.

In 2025, WoFSCast earned similar accuracy ratings to Warn-on-Forecast in Hazardous Weather Testbest experiments, was cited as a success story by NOAA's Weather Program Office, and was featured as a research highlight by EOS Magazine.

As this technology continues to develop, NSSL remains on the cutting edge, pushing the boundaries of what is possible.



### WOFSCAST: HARNESSING THE POWER OF AI AND MACHINE LEARNING

Scan to watch and learn how the WoFSCast is harnessing the power of AI to revolutionize severe weather forecasting.



## QUICK NUMBERS

**83** Total publications, exceeding our annual goal by 28%.

**175** The ATD operated and collected 175 hours of data in 2025

**2** WoFS predicted strong tornado probability two hours in advance of Carter County EF3.

**13** Field work deployments, covering six states and >100 total participants

NOAA HAZARADOUS WEATHER TESTBED

**233** Total participants **5** Total experiments **4** Countries **26** Weeks