NOAA National Severe Storms Laboratory

# Multi-function phased array radar

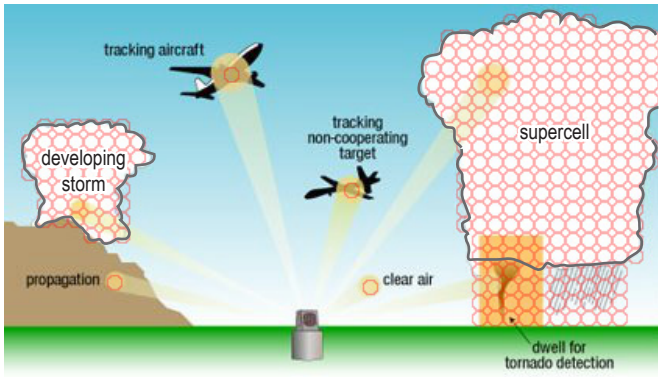
**Phased array radar can scan for severe weather in less than a minute**

## Weather radar of the future

Phased array radar technology can scan the entire sky for severe weather in less than a minute, five times faster than current weather radars. Rapidly updating phased array radar can capture developing tornadoes, microbursts, and other severe weather before they impact communities. Phased array radar has the potential to provide revolutionary improvements in NOAA National Weather Service (NWS) tornado, severe storm and flash flood warning lead times and accuracy, reducing false alarms. Since 2003, NOAA's National Severe Storms Laboratory (NSSL) has led the effort to evaluate this technology with the National Weather Radar Testbed phased array research radar. NSSL researchers and engineers believe phased array radar could be the weather radar of the future.

## A multi-function radar

By 2020, more than 350 FAA radars and by 2025, nearly 150 of the nation's Doppler weather radars will need to be either replaced or have their service life extended. Phased array radars have been used by the military for many years to track aircraft. NSSL's Multi-function Phased Array Radar (MPAR) program is investigating the potential to determine if both the aircraft surveillance and weather surveillance functions can be combined into one radar. Combining the operational requirements of these various radar systems with a single technology solution would result in an estimated savings to the nation of $4.8 billion in acquisition and maintenance costs. Services could improve



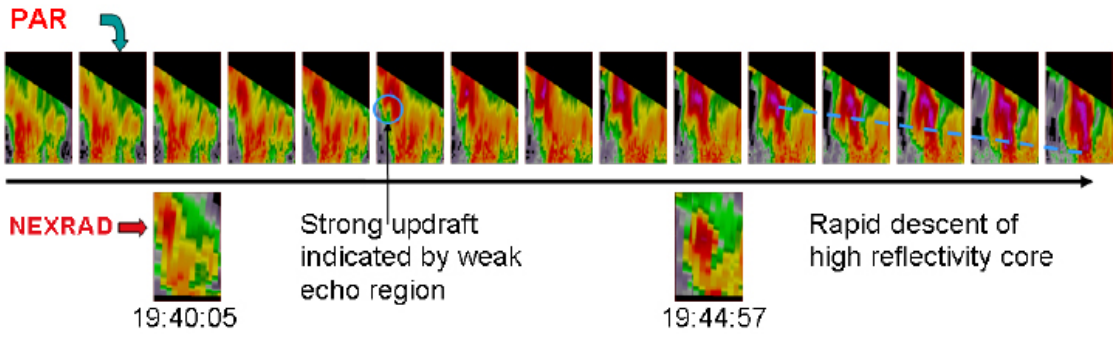

dramatically despite being able to reduce the number of radars by 35 percent.

## Electronic steering

A phased array radar has a unique flat panel antenna that remains stationary. Current weather radars mechanically rotate and tilt the radar dish to sample different parts of the atmosphere. Phased array radar can be steered electronically, giving users the ability to control how, when and where the radar scans. This means the radar can be directed to focus its beam only where storms are detected. Focused observations of storms lead to faster updates since the radar does not waste time scanning clear-air regions.

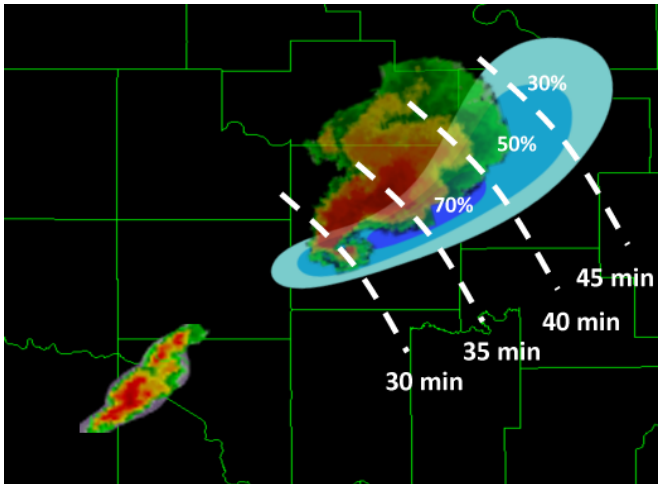
## Fast updates

Phased array radar has strong potential to aid the NWS in the forecast and warning decision process by providing new radar data more quickly. Developing severe




*Phased array radar captures 15 clear images of a descending microburst during the time it takes NEXRAD for 2.*

weather will be easier to detect, and important changes in the strength of the storm will be revealed. National Weather Service forecasters have already been evaluating how rapidly updating phased array radar data impacts the warning decision-making process. In one simulated case, forecasters saw a tornado signature embedded in a tropical storm and were able to issue a tornado warning 21 minutes before it actually touched down. This is a significant increase over the current 14-minute national average tornado warning lead time.




*A model predicts the path of a potentially tornadic supercell over the next hour. The confidence level that the tornado will follow the centerline track is highlighted in shades of blue. White dashed lines indicate forecast times.*

## Warn-on-Forecast

NOAA's Warn-on Forecast research project aims to use phased array radar data to create computer forecasts that accurately predict when and where severe weather will occur in the next hour. Every time the Warn-on-Forecast models receive a new radar scan from phased array radar the forecasts will be re-computed. Eventually these models will be able to predict what the weather will do over individual neighborhoods every few minutes up to an hour in advance.

## Looking ahead

NSSL's MPAR research team will continue to explore new capabilities to address 21st century weather forecast and warning needs. New scanning strategies and techniques are demonstrated, tested and evaluated each spring to minimize the amount of time MPAR takes to scan a storm without losing data quality. And, in collaboration with our partners, engineers are working to add dual-polarization to MPAR and are preparing aircraft tracking techniques for testing.

## Research Partnerships

A unique federal, private, state and academic partnership is developing MPAR technology. Participants include NOAA's National Severe Storms Laboratory and National Weather Service Radar Operations Center, Lockheed Martin, Department of Defense including U.S. Navy and U.S. Air Force, University of Oklahoma's School of Meteorology, School of Electrical and Computer Engineering, and Atmospheric Radar Research Center, Oklahoma State Regents for Higher Education, the Federal Aviation Administration, Department of Homeland Security, Basic Commerce and Industries, and the Office of the Federal Coordinator for Meteorology.

## Benefits of MPAR include:

- Improvements in detecting and tracking tornadoes, strong wind gusts, hail, and locally heavy rains that cause flash floods and mudslides.
- Severe weather warning lead times extended from the current 14 minutes and false alarm rates reduced from the current 75 percent.
- More accurate weather forecasts based on better data
- More precise hazardous weather information to make better flight safety and airspace capacity decisions, increasing economic efficiency for domestic aviation and surface transportation systems.
- Improved wildfire monitoring and prediction from more detailed data provided by MPAR.
- Better modeling of chemical, biological or radiological hazard tracks with MPAR's detailed wind fields.
- MPAR's capability to track aircraft not responding to air traffic control in U.S. airspace will benefit homeland security and commercial aviation.
- Estimated $4.8 billion in savings to the taxpayer: $1.8 billion with single radars having multi-function capability, $3 billion in life-cycle costs projected over 30 years.

**http://www.nssl.noaa.gov/projects/pardemo/**