Weather Radar Research

National Severe Storms Laboratory
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Radar is one of the most valuable tools available to a forecaster. For more than 40 years NSSL has led the nation with ingenuity and creativity to push radar technology to the edge. From the original WSR-57 research project to Doppler radar, NEXRAD, and now polarized and phased array radars, NSSL's radar research has truly changed the face of weather forecasting.

Doppler radar

NSSL scientists helped develop the WSR-88D radars, also known as NEXRAD. Doppler radars send out horizontal pulses, providing information about snow, ice pellets, hail, and rain particles. These radars also tell which direction the wind is moving – they can "see" rotation and other severe weather patterns as they develop in the atmosphere. The information provided by Doppler radars has reduced fatalities by 45 percent by giving a "heads-up" to severe weather.

NSSL's radar facilities include the WSR-88D KOUN dual polarimetric radar (left) and phased array radar testbed.

Gold medal performance

NSSL's participation in the successful deployment of the national network of WSR-88D radars was the cornerstone of the modernization of the National Weather Service. In 1997, NSSL received a Gold Medal from the Department of Commerce for work leading up to and support of the national NEXRAD deployment.

CRAFT

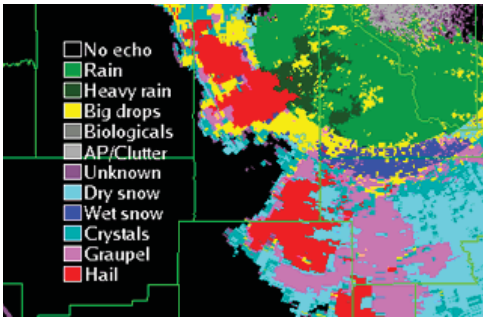
The Collaborative Radar Acquisition Field Test (CRAFT) was another milestone, as researchers from NSSL and other organizations joined together to make high-resolution radar data from the national NEXRAD network available over the Internet in real-time to government, university and private sector users. The NOAA group transferred the successful CRAFT prototype to operations and received the 2004 NOAA Technology Transfer Award for their accomplishment.

Making radars faster and better

NSSL engineers work to make evolutionary and radical improvements in computing and signal processing and evaluate them to determine if they are suitable to be included in the network of NWS radars. Faster, cleaner, better signal processing reduces costs and improves the WSR-88D's ability to detect hazards.

Dual-polarization technology

NSSL continues to develop dual-polarimetric radar technology. Dual-polarized radars transmit radio wave pulses with both horizontal and vertical orientations to more accurately measure cloud particles and precipitation size, shape and density. This additional information results in improved estimates of rain and snow rates, better detection of large hail location in summer storms, and improved identification of rain/snow transition regions in winter storms. The WSR-88D radars in the NEXRAD network will be upgraded with polarimetric technology beginning in 2010, extending their functionality and effectiveness.



Dual-polarization technology ,when added to the WSR-88D radar network, will help forecasters identify different types of precipitation within radar data.

CASA

NSSL is participating in the Collaborative Adaptive Sensing of the Atmosphere (CASA) program to explore monitoring the lower atmosphere with a network of many short-wavelength (3cm) radars. Because these small and less expensive radars are spaced closer together, they complement the NEXRAD network, by providing data in the lowest 1km of the atmosphere where the curvature of the earth creates blind spots. NSSL's researchers want to develop useful algorithms that will lead to a higher probability of detection, lower false alarm rate, and increased lead time for severe weather events.

Mobile Doppler research radar

NSSL and its partners, the University of Oklahoma, Texas A&M and Texas Tech, developed and are using Shared Mobile Atmospheric Research and Teaching Radars (also known as "SMART-Radars"). SMART-Radars are mobile Doppler radars that can be placed in position as a storm is developing to rapidly scan the atmosphere at low levels, below the beam of NEXRAD radars. SMART-R's have already been used to study tornadoes, hurricanes and other weather phenomena across the country. In areas where mountains block the beams of standard radars, mobile radars have been shown to be helpful in providing extra rainfall data to determine the threat of flash floods and debris flows. Recently, a new mobile radar with dual-polarization capabilities was added to the fleet. Researchers were able to position this radar to scan a hurricane eyewall with dual-polarization for the first time as Hurricane Ike made landfall.

One of the mobile 5-cm SMART-Rs was recently modified to perform simultaneous transmit/receive dual-polarization measurements. As a research radar, the SMART-R can transmit real-time data products back to the Hazardous Weather Testbed in Norman, OK, where researchers and forecasters are testing new techniques.

Phased array radar technology

NSSL is leading radar technology into the future with a facility dedicated to phased array radar research and testing in Norman, OK. Phased array radar uses electronically controlled multiple beams and frequencies transmitted from a fixed flat plate antenna (instead of a rotating parabolic or bowl-shaped antenna), which reduces the scan time of weather systems from four to five minutes using current radar technology to less than one minute. Phased array radar can scan the atmosphere at lower levels more effectively and has the capability to quickly re-scan areas with the most severe weather — potentially increasing forecasters' warning lead-times. Data from phased array radar will also be used to initialize computer models to improve forecasts. It is expected to take 10-15 years to move from research and development to technology transfer and deployment.

Multi-mission Phased Array Radar (MPAR)

NSSL is also exploring ways to transition from maintaining a number of single-function radar systems, used for aircraft surveillance and weather observations, to a single multi-mission, phased array radar network. MPAR would expand our current weather surveillance network, replace the nation's aging air traffic surveillance radars, and meet homeland security and defense requirements for identifying and tracking non-cooperative aircraft over the U.S. One network of MPAR units, each capable of performing multiple functions, could theoretically replace seven aging, single-function conventional radar networks.

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On the web: http://www.nssl.noaa.gov/research/radar/
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