Revolutionizing our ability to observe, understand, predict, and respond to hazardous weather events

National Science Foundation
Engineering Research Center for
Collaborative Adaptive Sensing of the Atmosphere

The Challenge: Sensing Gaps
Because of the Earth's curvature, current radars cannot observe the lower atmosphere. In fact, 72% of the atmosphere below 1km does not have radar coverage in the United States, even though most severe weather forms at these low altitudes.

The CASA Solution
By filling these sensing gaps with densely spaced networks of low-power, X-band radars, the CASA solution provides:
- Low-level coverage to 250m above ground level
- Rapid updates as fast as 20 seconds
- High spatial resolution averaging 250m
- Overlapping radar coverage for better views of wind fields (vector winds)
- Collaborative adaptive radar control optimizes sector surveillance and multi-Doppler scans to deliver the best data to users
CASA radar networks operate as an integrated system, delivering information optimized for user decision-making. The system software analyzes incoming meteorological data and reconfigures network scanning patterns in response to changing weather and diverse user needs every 60 seconds.

**User-Driven System Design**

**Observe**

CASA network targets a tornadic storm cell with multi-radar sector scans providing volumetric data from 250m to 9km.

**Understand**

Frequent, high resolution, low altitude radar observations provide geographically specific detections that can map weather hazards with street level precision. CASA radars also feed analysis and assimilation systems for hazardous weather forecasts and nowcasts ranging from minutes to hours. Ongoing user feedback on weather products and scanning strategies is incorporated into CASA's iterative research and design process.

**Predict**

Using CASA low-level wind data, the Advanced Regional Prediction System (ARPS) forecasts an area of rotation (vorticity) in advance of an EF2 tornado, paving the way toward "warn-on-forecast."

**Respond**

CASA's 4-radar network in Oklahoma, showing overlapping 40km range coverage.
CASA is a multi-sector partnership among academia, industry and government that is creating a new paradigm for weather observation based on low cost, densely spaced networks of X-band radars for improved warning and response.

High resolution view of a tornado in progress with wind direction (multi-Doppler wind) and storm intensity (reflectivity) captured in CASA's Oklahoma test bed.

End-to-End Test Bed
CASA operates prototype test beds in Massachusetts, Oklahoma, and Puerto Rico to research and validate the CASA concept. The Oklahoma test bed is a network of four agile, adaptive X-band radars that disseminates data in real time to National Weather Service forecasters and local emergency managers for evaluation and feedback.

A Multi-Sector Partnership
CASA is a consortium of academic, government, and industry partners, including:

**Academic Partners**
- University of Massachusetts Amherst (lead organization)
- University of Oklahoma
- Colorado State University
- University of Puerto Rico Mayaguez
- University of Delaware
- University of Virginia
- McGill University
- Indiana University of Pennsylvania
- University of Colorado at Colorado Springs

**Government and Industry Partners**
- NOAA/National Weather Service, OSHRE/OneNet,
- Raytheon Company, Vaisala, Inc., EWR WeatherRadar,
- WeatherNews, Inc., ITT Corporation, Environment Canada, KWTV NEWS 9, Japan National Research Institute for Earth Science and Disaster Prevention (NIED)

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First generation dual-pol, Doppler radars with novel real-time signal processing features including dual-PRF, second trip echo suppression, velocity unfolding, clutter filtering, and attenuation correction.

Educating the Next Generation
CASA is educating the next generation of system-savvy engineers, meteorologists, social and computer scientists.

Collaborate with CASA
We invite universities, government organizations and industry to discuss using our data archives, test beds, and technology for research and development.

Projects may include: determining capabilities of networks of small radars for winter weather, flooding, or non-weather targets; new implementations of adaptive scanning strategies and radar network control; product development for weather sensitive industries such as utilities, transportation, or broadcast media; research in weather information and human behavior; exploration of innovative radar deployment strategies leading to federal, state, local, or private use of CASA radars; or sponsored research on technology development.

On the Horizon...

A new generation of solid state X-band radars are in development. Pictured left: 1 x .5m low-power, low-cost e-scan panel (phase-tilt). Contact CASA to learn more.