Weather

Airborne Phased Array Radar (APAR): Next-generation radar for weather research

Spring 2013

I. Description

Airborne radar is a critical tool for studying weather and related hazards, especially over rugged terrain or the open ocean, where other tools can have major limitations. For the last two decades, the nation’s leading airborne Doppler research radar has been ELDORA, the Electra Doppler Radar jointly built by NCAR and French scientists. Now, major advances in radar technology have paved the way for a “phased array” successor to ELDORA, being designed by NCAR for installation on the NSF/NCAR C-130 aircraft. This airborne phased array radar (APAR) will provide far more detail from within severe thunderstorms, hurricanes, winter storms, and other hazardous, difficult-to-study types of weather.

In a phased array system, a standard radar dish is replaced by a few dozen to thousands of transmitters and receivers, all spread across a rectangular plate. Like many radars in one, phased array systems allow researchers to sample the atmosphere far more frequently. Compared to ELDORA, APAR will double the amount of detail that can be gathered along the plane’s flight track, with greatly reduced signal loss in heavy precipitation. APAR will also permit dual-polarization capability that can distinguish raindrops, ice crystals, and snowflakes from each other, helping improve observations and predictions of dangerous heavy rain and snow events.

II. Stage of Research

The APAR project is divided into three phases:

- Build a prototype radar transmitter/receiver (late 2014)
- Build a full-size prototype for ground testing (late 2016)
- Develop the complete APAR system for C-130 installation (late 2020)
III. Advantages

- State-of-the-art airborne radar, with unique capabilities and auxiliary instruments aboard the C-130 aircraft.
- The ability to significantly improve our understanding of processes involving raindrops and ice crystals, leading to better estimates of heavy precipitation and potential impacts.
- Design adaptable to other C-130 aircraft operated by many agencies in the United States and other nations, including the U.S. Air Force for hurricane reconnaissance and research.

IV. Applications

APAR will gather new levels of detail from within storms, with the potential for significant improvements in tracking and forecasting many types of weather, including:

- Tropical cyclones (hurricane genesis, track, intensity change, landfall location, and impacts)
- Severe weather (tornadoes, supercells, squall lines, derechoes, etc.)
- Mountain-related precipitation and flooding
- Winter storms and fronts (blizzards, ice storms, etc.)
- Oceanic showers and thunderstorms
- Climate processes that connect the ocean and atmosphere (El Niño, La Niña, etc.)

V. Funding and IP Status

Primary: NSF (base funding and American Reinvestment and Recovery Act)
Seeking additional funding for APAR development

VI. Research Partners

MIT/Lincoln Laboratory
Seeking additional collaborators

---

Contacts

Scott Rayder, UCAR Senior Advisor for Development and Partnerships
303-497-1673, rayder@ucar.edu