NCAR | EARTH OBSERVING LABORATORY

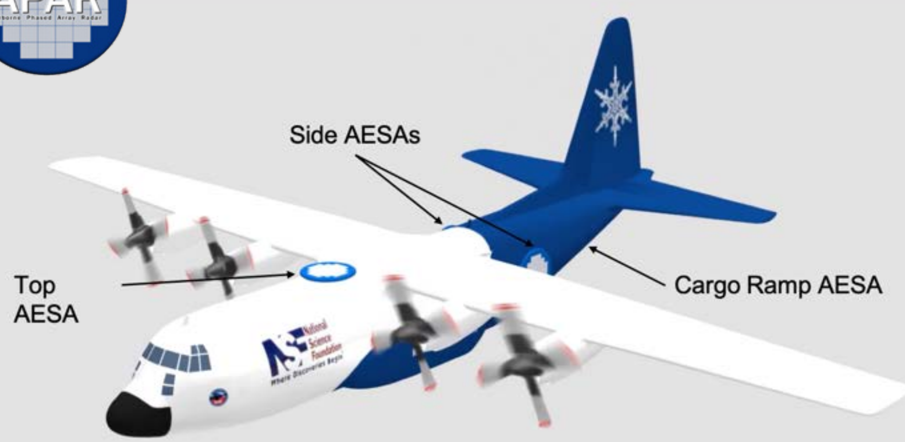
development • deployment • *data* • discovery

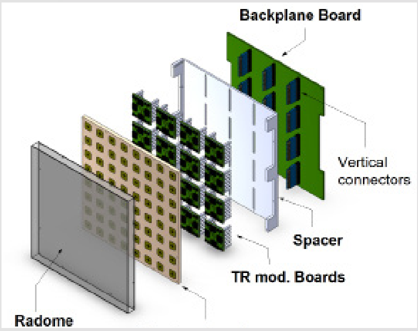
Airborne Phased Array Radar (APAR)

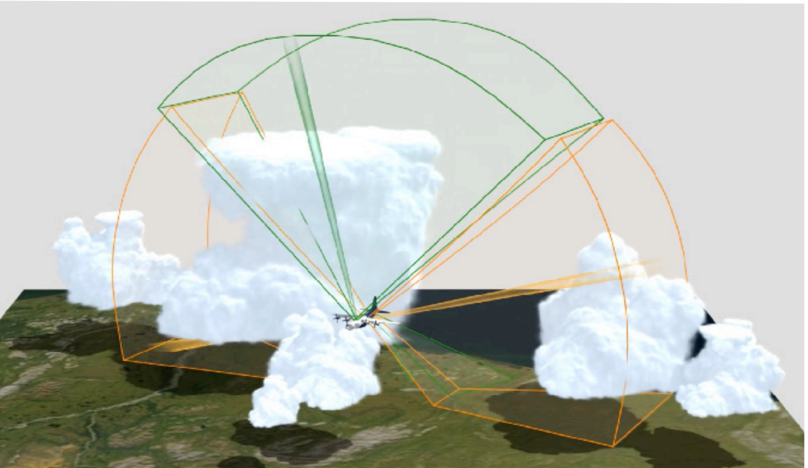
An airborne Doppler radar is a critical tool for studying Earth Systems Science and high-impact weather systems, especially in hard to reach areas such as open ocean and in complex terrain where the operation of ground-based radars is impossible or challenging. Major advances in radar technology have paved the way for developing an Airborne Phased Array Radar (APAR) system that can provide unprecedented detailed concurrent observations of the dynamics and microphysics of high-impact storms, such as hurricanes and mesoscale convective systems.

APAR, currently under design by NCAR/EOL, consists of four removable C-band Active Electronically Scanned Arrays (AESA) mounted on the top, both sides, and the cargo ramp of the NSF/NCAR C-130 aircraft. Each AESA is approximately 1.8 m x 1.8 m in size and is made up of ~2,400 transmitting/receiving antenna elements with dual-polarimetric capabilities. The dual-polarimetric capabilities of APAR, in addition to inherent beam agility associated with electronic steering, will provide more flexible scanning strategies and enhanced measurement capabilities.

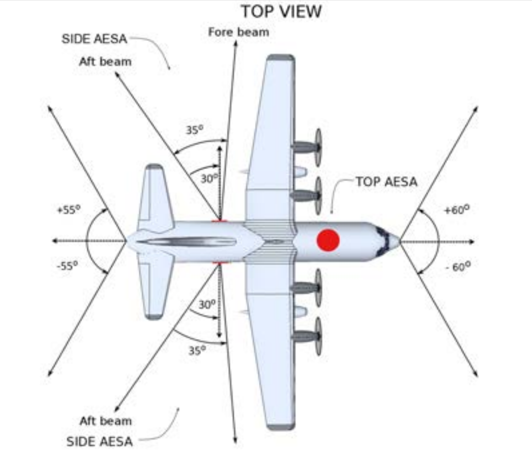
APAR's unique capabilities will open new research frontiers in Earth Systems Sciences and high-impact weather events. APAR will enable scientists to advance knowledge about the formation and evolution of societally disruptive weather and environmental conditions leading to it. The transformative remote sensing concept of the APAR will enable improved prediction and predictability, via assimilation of APAR data into numerical weather models, ultimately leading to improved weather alerts to the public.

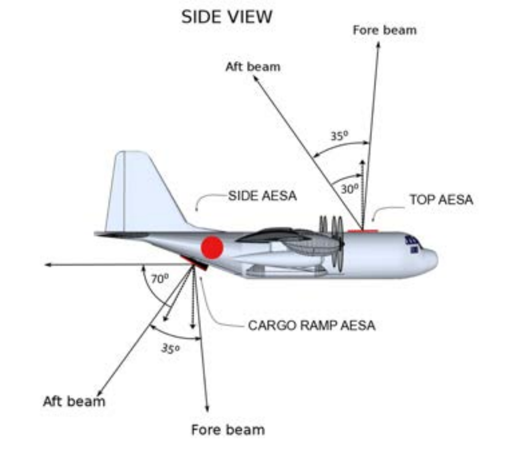






DEVELOPMENT PROJECT





Technical Specifications

- Frequency: 5.35 GHz – 5.45 GHz
- Total Elements per AESA: ~2400
- Beamwidth (El/Az): <2.2°
- Hybrid Digital Beamforming
- Antenna Gain: ~38 dB
- Min. Detectable Reflectivity @ 10 km: -11 dBZ
- Peak Transmit Power: ~28 kW
- Polarization: Dual Linear
- Typical Boresight Sampling Volume (Radial x Along Track x Cross Track): 150 m x 395 m x 380 m @ 10 km
- Along Track Spacing: <= 300 m (Aircraft Speed 120 ms^{-1})

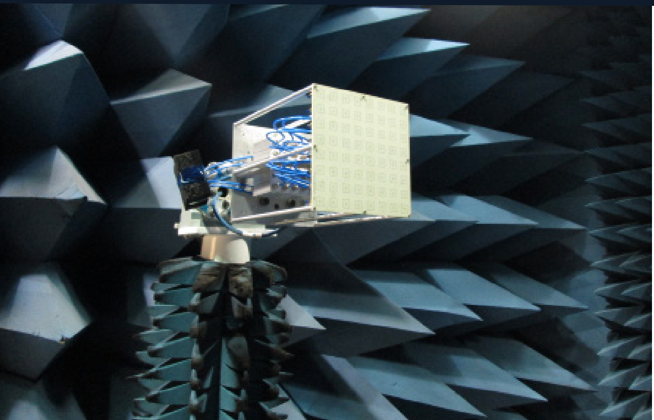
About APAR

The proposed APAR system consists of the radar front and back end subsystems. The radar front end consists of the four AESAs mounted to the exterior of the aircraft. The radar back end resides inside the aircraft and contains the hardware and software required to control the AESAs and to process, display and archive the data. The NSF/NCAR C-130 nose surveillance radar data combined with the APAR surveillance mode reflectivity will provide enhanced situational awareness to contribute to safe aircraft operations during extreme weather. The 3D volume-scan data will help guide real-time radar operations and provide the basis for improved analysis of the phenomenon of interest. The APAR system will be a significant addition to the existing NSF/NCAR C-130 instrumentation suite, providing new insights and context to weather observations from the platform.

Advantages of APAR

The APAR system will be a state-of-the-art airborne weather radar with the following unique/advantageous features:

- Dual-Doppler capability and rapid scanning to observe the 3D kinematics of storm structures.
- Dual-polarimetric capability allowing observations of storm microphysics and significantly improving our understanding of in-cloud mixed phase microphysical processes which will in turn lead to better estimates of heavy precipitation and potential impacts.
- C-band transmit frequency that penetrates deeper into heavy precipitation due to less attenuation than the extant X-band airborne radars.
- The ability to form multiple, simultaneous beams using digital beamforming techniques that allows for fast scanning and interrogation of rapidly developing weather systems such as tornadoes.
- An airborne radar mounted on a long duration aircraft to allow sampling of weather in remote locations.



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www.eol.ucar.edu/instruments/airborne-phased-array-radar-apar

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