Development and Preliminary Results of the Airborne Phased Array Radar (APAR) Observation Simulator (AOS)

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The National Center for Atmospheric Research (NCAR) is partnering with the National Science Foundation and National Oceanic and Atmospheric Administration, as well as university and industry collaborators, to develop the Airborne Phased Array Radar (APAR) to be deployed in the NSF/NCAR C-130 research aircraft. The APAR design is for four phased array radar (PAR) faces operating at C-band with dual-polarimetric capability. This system on a long-duration C-130 aircraft offers a substantial advance in airborne research radar technology and capability and will be a unique and valuable tool for studying many high impact weather phenomena, e.g. tropical cyclones, winter storms, severe convection, and heavy rainfall events.

One of the key advantages of PAR technology is the two-dimensional agile electronic scanning of the Active Electronically Scanned Arrays (AESA) compared to mechanically scanning radar antenna implemented in the current airborne tail Doppler radars. On the NSF/C-130, this will facilitate scanning the same volume with different look-angles as the aircraft flies by, thus enabling 3-D dual-Doppler wind retrievals. At the same time, rapid scanning of the cloud volumes and surveillance scanning are enabled. Furthermore, it is possible to enhance the time resolution of important regions of the storm by returning the electronically steered beam to features of interest more frequently. This new radar flexibility in combination with the aircraft flight patterns enables new sampling strategies for sampling storms. It is therefore desirable to explore the trade-offs of different sampling strategies of various weather research scenarios and develop the next generation APAR data processing capabilities (exchange format, quality control, archival, analysis, and display) before fielding the radar.

To this end the APAR Observation Simulator (AOS) prototype system is being developed. The AOS will produce synthetic radar output from numerical weather prediction models that will facilitate the development of optimal flight patterns and scan strategies for APAR. The Weather Research and Forecasting (WRF) and Cloud Model 1 (CM1) models have been run to simulate different weather scenarios for which the AOS is being used to generate simulated APAR data under various scanning strategies and flight patterns that are representative of both idealized and real flight conditions.

In this paper we will present preliminary dual-Doppler analyses, tradeoffs from different scanning strategies, and results of the analysis of uncertainties using data generated from the AOS prototype. Future development plans of second generation AOS will be discussed toward the goal that the AOS can be a resource for both APAR developers and future PI’s planning field programs.