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The Next Generation Airborne Polarimetric Doppler Radar

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NCAR's Electra Doppler radar (ELDORA) with a dual-beam slotted waveguide array using dual-transmitter, dual-beam, rapid scan and step-chirped waveform significantly improved the spatial scale to 300m (Hildebrand et al. 1996). However, ELDORA X-band radar's penetration into precipitation is limited by attenuation and is not designed to collect polarimetric measurements to remotely estimate microphysics. ELDORA has been placed on dormancy because its airborne platform (P3 587) was retired in January 2013. The US research community has strongly voiced the need to continue measurement capability similar to the ELDORA.

A critical weather research area is quantitative precipitation estimation/forecasting (QPE/QPF). In recent years, hurricane intensity change involving eye-eyewall interactions has drawn research attention (Montgomery et al., 2006; Bell and Montgomery, 2006). In the case of convective precipitation, two issues, namely, (1) when and where convection will be initiated, and (2) determining the organization and structure of ensuing convection, are key for QPF. Therefore collocated measurements of 3-D winds and precipitation microphysics are required for achieving significant skills in QPF and QPE. Multiple radars in dual-Doppler configuration with polarization capability estimate dynamical and microphysical characteristics of clouds and precipitation are mostly available over land. However, storms over complex terrain, the ocean and in forest regions are not observable by ground-based radars (Bluestein and Wakimoto, 2003).

NCAR/EOL is investigating potential configurations for the next generation airborne radar that is capable of retrieving dynamic and microphysical characteristics of clouds and precipitation. ELDORA's slotted waveguide array radar is not compatible for dual-polarization measurements. Therefore, the new design has to address both dual-polarization capability and platform requirements to replace the ELDORA system. NCAR maintains a C-130 aircraft in its fleet for airborne atmospheric measurements, including dropsonde, and in situ sampling and remote sensing of clouds, chemistry and aerosols. Therefore, the addition of a precipitation radar to the NSF/NCAR C-130 platform will produce transformational change in its mission. This new design can be cloned for C-130s operated by a number of agencies, including NOAA and the Air Force hurricane reconnaissance fleet.

This paper presents a possible configuration of a novel, airborne phased array radar (APAR) to be installed on the NSF/NCAR C-130 aircraft with improved spatial resolution and polarimetric capability to meet or exceed that of ELDORA. The preliminary design, an update of the APAR project, and a future plan will be presented.

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