NASA D3R Radar Upgrade: Enhancing Sensitivity And Spatial Resolution

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The NASA dual-frequency, dual-polarization, Doppler radar (D3R) is an important ground validation tool for the global precipitation measurement (GPM) mission's dual-frequency precipitation radar (DPR). The D3R has undergone extensive field trials starting in 2011 and continues to provide observations that enhance our scientific knowledge. To further enhance its capabilities, the digital receiver and waveform generation subsystems are being upgraded. Due to the new, more flexible architecture, this upgrade enables more research frontiers to be explored with enhanced performance.

The D3R's solid state transmitters allow for phase and amplitude control of the radar's transmitted signal. Coupled with a reconfigurable digital receiver, the radar's transmitted waveform and receiver filters can be dynamically controlled. An additional benefit is the new hardware couples the transmitter and receiver logic (previously these were two separate systems) enabling synchronous, pulse-by-pulse, changes between the transmit waveform and receive filters.

With pulse-by-pulse phase and frequency control, and the ability to use time or frequency multiplexed waveforms is available and better range overlay suppression can be obtained. With frequency diverse sub-pulses, more independent samples of the precipitation volume are available, increasing the accuracy of the polarimetric moments for a given observation period. These new waveform designs also enable better simultaneous cross-polarization isolation (for more accurate estimation of differential reflectivity and copolar correlation) and can enable measurements of cross-polar echo power (e.g., linear depolarization ratio).

One of the primary motivations for this upgrade is to enable enhanced radar sensitivity and increase range resolution to 30 meters. In this work, the D3R system's upgrade will be discussed with a focus on the hardware modifications and system's sensitivity. The performance of the pulse compression waveforms will be presented and compared to simulated results. Finally, initial observations of the D3R's Ku-band radar will be discussed in context of the upgrade's additional capabilities.