Beam multiplexing and clutter filtering for the Phased Array Weather Radar

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Ways to increase volume coverage speed for phased array polarimetric weather radar are explored. To that end, beam multiplexing is suggested for the upper elevations where range ambiguities are not present. The principal constraint on collecting data at the upper elevations is that the requirements for the velocity and reflectivity errors of the WSR-88D are met. The tradeoff space consisting of frequency, dwell time, and power are examined keeping in mind the practical limits of each. It is shown that a single beam system can achieve about a fourfold reduction in the time to scan the top five elevations if the average transmitted power is increased six times. Because measurements at the top elevations are made at ranges less than about 100 km where signal to noise ratios are larger compared to further ranges, we revisit the SNR requirement for these elevations. The effects of clutter filtering are also considered in terms of the reduction in dwell time and issues associated with non-uniform sample sequences. Characteristics of clutter are obtained from the research phased array radar in Norman. Some simple filtering techniques such as DC removal, fitting of a Gaussian autocorrelation to the clutter signals, and polynomial fit via regression are compared. The best choice is a regression filter, and its performance over a wide velocity range and for specified clutter-to-signal ratios and weather spectrum widths is evaluated and will be shown. It is demonstrated that a phased array radar with four simultaneous beams could cover the top five elevations in 3 to 9 s while meeting the WSR-88D requirements for errors in velocity and radar reflectivity.