Obtaining the full scattering matrix with simultaneous H&V transmission radar

*Valery V Melnikov[1]

1. Oklahoma University

Polarimetric weather radars with simultaneous transmission and reception of orthogonally polarized waves (SHV design) are most popular at this time. SHV radars are capable of measuring ZDR, the differential phase P_{dp}, and correlation coefficient R_{hv}, but are not capable of measuring linear depolarization ratio LDR, the cross-polar differential phase P_{xh}, and cross-polar correlation coefficient R_{xh}. The latter three variables deliver valuable information about hail, the melting layer, cloud ice crystals, and strong in-cloud electric fields. LDR, P_{xh}, and R_{xh} can be measured with alternate polarization radars (AHV design), which switch wave polarizations from pulse to pulse. In terms of scattering matrix elements S_{hh}, S_{vv}, and S_{hv}, SHV radar measures S_{hh} and S_{vv} elements, whereas AHV radar is capable of measuring all three matrix elements, i.e., S_{hh}, S_{vv}, and S_{hv}.

A method of measuring all three matrix elements of the scattering matrix with SHV radar having variable phase between H- and V-polarized waves upon transmission is proposed. An implementation of this method with SHV radar having pulse compression is discussed. Possibilities of implementing of this method with the phased array multifunction radar being developed in the US are also considered. Measurements of the full scattering matrix can significantly increase the capability of SHV radars in weather observations and in detection of airplanes, i.e., in two major modes of operations of the multifunction phased array radar.

Keywords: scattering matrix, simultaneous transmit weather radar, phased array weather radar