THREE BODY SCATERRING AND HAIL SIZE

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In radar meteorology three body scattering signature refers to an appendage seen in weather radar displays of reflectivity behind hail bearing storm cells. It is caused by multiple scattering between hydrometeors and ground. Transmitted EM wave is scattered by large hydrometeors towards the ground. The ground backscatters the wave to the hydrometeors which in turn scatter it back to the radar antenna. Hence the name "three body scattering". We reexamine the radar equation for this phenomenon and point out that a coherent wave component produces 6 dB more power then previously reported (D.S. Zrnic, Radio Sci., 22, 76-86, 1987). Furthermore, we explore the possibility to gauge hail size that could cause this phenomena. A model of forward scattering by spherical hail together with accepted values of ground backscattering cross sections is used in our attempt to reconcile the reflectivity in this signature with observations. The Doppler velocities in the three body signatures are caused by the change of phased path length between the radar, hail, and the ground. Advection and vertical motion of hail within the 3 body resolution volume are responsible for this change. Therefore, an attempt is made to estimate the size by separating advection from vertical motion; this seems possible because the advection part causes Doppler shift of the backscattered fields at locations of the storm cell not affected by the three body interaction. Time series of polarimetric radar data have been collected in few cases of observed three body interaction. Doppler spectra in the signatures are examined, and reveal wide distribution of velocities. Polarimetric signatures including co-polar cross correlation coefficients and spectral densities of polarimetric variables are also analyzed and examples are presented.