Meteor Trail Observations Collected with the Penn State VHF Radar

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In this paper, we use radar observations from the new Penn State VHF radar interferometer installed near Penn State campus, University Park, Pennsylvania (77.97°W, 40.70°N), to study the variability of specular as well as non-specular meteor trails in the E-region ionosphere. The radar operates almost continously since January 2013. The antenna beam is pointed to the north in the magnetic meridian plane. In azimuth the half-power beam-width is about 3.4^o, while in elevation the gain pattern peaked in the direction perpendicular to the geomagnetic field at E-region heights at about 18^o elevation angle. The system uses two phased sub-arrays of four 24-element COCO strings with an east-west separation of 50 m. On transmission both sub-arrays are excited simultaneously and oriented perpendicular to the Earth's geomagnetic field lines at E-region heights. On reception each sub-array is sampled independently for interferometric detection of the scattering regions. This paper presents comparisons of meteor occurrence statistics for at least two types of echoes from meteor trails: (1) Specular reflections from trails oriented perpendicular to the radar beam, and (2) scattering, or, non-specular reflections, from trails deposited with arbitrary orientations. We examine and compare the diurnal and seasonal variability of echoes from specular and non-specular returns observed with the Penn State radar. We also discuss how observed meteor trail variability, both specular and non-specular reflect the background state of the atmosphere and ionosphere as well as the properties of the meteor input function (MIF) that define the incoming meteoric particles. Count rates suggest that the specular meteor radar systems (SMR) observe particles that are in a similar size range to existing SMR systems and approximately two orders of magnitude larger in size than other high power large aperture (HPLA) systems based on the configuration and transmit power of the Penn State radar system.