VHF Passive Bistatic Radar Observations of Meteor Trails

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The Manastash Ridge Radar is a completely passive bistatic VHF radar designed to observe the scatter of commercial FM broadcasts from ionospheric E-region irregularities. The altitude of these irregularities is comparable to that of meteor decay, and meteor trail scattering cross sections are frequently large enough to be observed with this 100 MHz instrument. Our radar is not sufficiently sensitive to detect head echoes.

At 100 MHz we expect that the meteor trails are primarily underdense, and that the scattering cross section is enhanced by coherent scatter from field-aligned meter-scale plasma irregularities (Dyrud *et. al.*, GRL v28 p2775, 2001). We can determine the slant range ($\Delta r \sim 1.5$ km) and Doppler spectrum ($\Delta v \sim 2$ m/s). We also have interferometric capability, which produces an angular resolution of about 0.1° for strong meteor echoes. Meteor targets are moderately overspread at 100 MHz, however the radar detection algorithm is based upon time series analysis rather than correlation-based estimates. The useful sample rate for these time series is approximately 500 Hz, so that the temporal resolution is a few milliseconds.

We will present a variety of examples of meteor detections, including range-Doppler observations, high time-resolution observations, time series, and interferometric observations. The Doppler and interferometric information are consistent with the notion of the meteor trail formed in the midst of a thick mesospheric wind field which creates shears that distort the observed trails. Although the overall Doppler width may be large (about 100 m/s), the interferometric information suggests that the Doppler spectra are narrow at a particular location along the trail, and the overall Doppler velocities are consistent with the expected winds in the mesosphere. In other words, the plasma waves which are presumably responsible for the VHF scatter apparently have relatively little phase velocity with respect to the plasma column on which they form.