Determining Atmospheric Properties with HPLA Meteor Observations

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High-power, large-aperture (HPLA) radars such as the Jicamarca Radio Observatory (JRO) in Peru provide accurate measurements of meteoroid velocities, trajectories, and signal strengths by detecting the head echo formed by a meteoroid as it travels through the atmosphere. Using these observations, researchers have inferred meteoroid mass from the deceleration and, more recently, from the signal strength. The calculation of meteoroid mass from deceleration is sensitive to atmospheric density, which is generally not known with great accuracy. In this presentation, we examine the possibility of improving estimates of the atmospheric density and scale height by using meteor head echo observations with HPLA radars.

To achieve this, we fit velocity and range measurements from a large sample of head echoes to the meteor ablation model outlined in Lebedinets et al. 1973 and Rogers et al. 2005. The meteors were observed within a period of less than an hour using the 50 MHz radar at JRO after sunrise on July 17, 2007. When fitting the model results to the observations, we allowed the atmospheric density, n, and scale height, h, to become free parameters. Thus, the model not only fit to a meteoroid velocity and mass, but to n and h as well. Then we determined whether there was a common fitted n and h for multiple head echoes. We investigate the limitations of such an approach and develop criteria for which head echoes should be used in fitting to the model. Finally, we discuss whether this would be a realistic method of remotely sensing neutral atmospheric properties.