Dual-Frequency Radar Determination of Meteor Masses Using FDTD Simulations

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Meteor mass estimates vary greatly depending on the method of measurement. Even estimates made using two radar systems operating at different frequencies might not agree. This leads to a discrepancy of several orders of magnitude in determinations of the total meteor mass flux (see Table 1 of Plane 2012). Each measurement technique has associated biases and constraints that might limit observations to a portion of the total mass distribution. In particular, radar estimates require assumptions about the ionization efficiency of the meteoroid, and are subject to velocity and mass biases.

Marshall and Close (2015) introduced a finite difference time domain (FDTD) model that simulates a radar echo bouncing off of a meteor head plasma. We use this model to construct tables of the radar cross section a radar would observe for a meteor of a given size and density. Using these tables, we estimate the masses of a set of coincident meteor observations from the MAARSY (53.5 MHz) and EISCAT (931 MHz) radars in Norway. The data set contains more than 400 meteors observed simultaneously by both radars, which allows us to estimate the mass without making assumptions about the size of the meteor. In the future we hope to apply this technique to independently observed meteors.

References:

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