The Importance of Earth as a Meteor Detector

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In order to understand the complex meteoroid environment that threatens spacecraft in near Earth space, ground based observational techniques provide us with an effective option for evaluating the important parameters of flux, speed, mass, density and directionality. While no observational method (in-situ or ground based detectors) provides bias free measurements of direct quantities, there are several benefits to using the Earth as a detector for calibrating meteoroid models that extend to the inner Solar System and beyond Earth's orbit. The Earth constantly interacts with meteoritic particles from comets and asteroids as they evolve from their parent objects through dynamical processes. Modeling these dynamical processes with a physics-based approach can help reveal the causes of observational features but developing those models involves constraining sequences of poorly defined parameters. These parameters must be tuned to a particular detector that offers direct or indirect measurements of mass, density, flux and speed – the quantities used in evaluating penetration risk.

The following topics will be discussed:

- Consistency between ground based and in-situ measurements of flux in Earth orbit
- Consistency between radar and electro-optical speed determinations and agreement of these with dynamical studies
- The fact that there are six sporadic sources which cannot be determined by integrated line of sight emissivity
    - Observations using IRAS or COBE cannot give you all important directionality needed for risk evaluations
- The large collecting area of the Earth's atmosphere compared to in-situ detectors gives better number statistics in the threat regime

The NASA Meteoroid Environment Office utilizes ground based radar and electro-optical measurements to calibrate the Meteoroid Engineering Model (MEM). As MEM is an engineering design model our main emphasis is on threat size particle, speed, flux and directionality. However, MEM has acknowledged limitations particularly with regard to source strength as a function of mass and work is proceeding with improved distributions that will rectify many of these shortcomings.