Modeling the Altitude Distribution of Meteor Head Echoes Observed with HPLA Radars: Implications for the Radar Detectability of Meteoroid Populations

N. Swarnalingam, **D. Janches**, J. D. Carrillo-Sanchez, P. Pokorny, J. M. C. Plane, Z. Sternovsky and D. Nesvorny

The altitude distribution of meteors detected by a radar is sensitive to the instrument's response function and can thus provide insight into the physical processes involved in radar measurements. This, in turn, can be used to determine the rate of ablation and ionization of the meteoroids and ultimately the input flux on Earth. In this work, we model the radar meteor head echo altitude distribution for three High Power and Large Aperture radar systems, by considering meteoroid populations from the main cometary family sources. In this simulation, we first use the results of a dynamical model of small meteoroids impacting Earth's upper atmosphere to model the incoming mass, velocity, and entry angular distributions. We then combine these with the Chemical Ablation Model and establish the meteoroid ionization rates as a function of mass, velocity, and entry angle in order to determine the altitude at which these radars should detect the produced meteors and the portion of produced meteors from each population that are detected by these radars. We explore different sizes of head plasma as well as the possible effects on radar scattering of the head echo aspect sensitivity. We find that the modeled altitude distributions are generally in good agreement with measurements, particularly for ultra-high-frequency radars. In addition, our results indicate that the number of particles from Jupiter Family Comets (JFCs) required to fit the observations is lower than predicted by astronomical models. It is not clear yet if this discrepancy is due to the overprediction of JFC meteoroids by dynamical models or due to unaccounted physical processes in the treatment of ablation, ionization, and detections of meteoroids as they pass through Earth's atmosphere.