Determination of Meteoroid Flux from Meteor Data Debiased by Numerical Simulation

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Deployment of multi-station all-sky video meteor networks presents an opportunity to measure the total flux of meteoroids impinging on the surface of the Earth. However, direct measurement of particle flux is not possible since observed meteoroid populations are invariably distorted by selection bias. Most detection systems, including human observers, favour meteors that are brighter and closer to the centre of the field of view. We present a method for debiasing the data using a numerical simulation of meteoroid particles entering the Earth's atmosphere.

A population of virtual meteoroid particles is generated and their atmospheric entry is simulated. The trajectory of each virtual meteoroid is tracked and its peak magnitude is determined as seen by predefined ground-based observers. After application of bias-generating effects the resulting meteor is marked as either recorded or missed. Once a sufficiently large dataset is obtained, the sample is statistically processed and distributions of various properties, such as apparent magnitude or altitude, are compared to equivalent statistics computed from observational data. Finally, the parameters of the population and selection bias are gradually adjusted and the entire procedure is repeated until the best possible agreement with observational data is found. The final set of parameters is then used as a model of the actual meteoroid population.

We used the simulation in an analysis of the 2016 Perseids observed by a single AMOS camera during two nights of maximal activity. The simulation shows there is a marked difference between values of mass index s before and after correcting the observations for selection bias and that commonly reported values of s are likely underestimated. The developed method can be easily adapted to any observational method or existing meteor sighting database and used to measure and understand the sources of selection bias distorting meteor observation statistics.