Meteoroids at the Moon

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We use a dynamical model to characterize the monthly and yearly variations of the lunar meteoroid environment for meteoroids originating from short and long-period comets and the main-belt asteroids. Our results show that if we assume the meteoroid mass flux of 43.3 tons per day at Earth, inferred from previous works, the mass flux of meteoroids impacting the Moon is 30 times smaller, approximately 1.4 tons per day, and shows variations of the order of 10% over a year. The mass flux difference is due to the combined effect of the smaller cross-section of the Moon (factor of 13.46) and Earth's larger gravitational focusing (factor of 2-2.5).

The lunar surface is vaporized by these impactors at an average impact vaporization flux of 11.6×10^{-16} $g \cdot cm^{-2} \cdot s^{-1}$, providing a significant source for the rarefied lunar exosphere. Our model predicts acceptable vaporization rates and reproduces the local time dependence of observations of the dust ejecta cloud, measured by the Lunar Dust Experiment on board NASA's Lunar Atmosphere and Dust Environment (LADEE) satellite. However, the predicted density of the lunar ejecta cloud is four orders of magnitude larger than reported values by LADEE. This discrepancy might be attributed to a much lower yield from meteoroid impacts on fluffy lunar regolith and/or a lower detection efficiency of the LADEE dust detector. We suggest an upper limit of 30 cm per million years for the soil gardening rate from small meteoroids.