MODELING OF WATER EVENTS IN THE LUNAR EXOSPHERE RESULTING FROM METEOROID IMPACTS. C. Knez¹, D. M. Hurley¹, and M. Benna². ¹Johns Hopkins University Applied Physics Laboratory (Claudia.Knez@jhuapl.edu), ²NASA Goddard Space Flight Center.

Introduction: The presence of water on the surface and exosphere of the Moon has been the subject of much research. Enhancements of water and other volatiles are known to occur in permanently shadowed regions (PSR) near the lunar poles (e.g., [1]) and are likely ancient deposits. Additionally, there is evidence of diurnal variability of water [2] that is consistent with contributions of water from an ongoing source.

High speed meteoroids impacting the lunar surface are an exogenous source of water on the Moon since the meteoroids are partially composed of hydrated minerals and other volatile species [3]. The Lunar Atmosphere and Dust Environment Explorer (LADEE) spacecraft used the Neutral Mass Spectrometer (NMS) to measure and correlate the occurrence rate of sporadic water events with meteoroid flux in the range of masses likely to produce detectable plumes [4]. Due to LADEE’s short duration and the coarse resolution of NMS, there were <1000 observations of water.

Simulations: There are multiple properties of meteoroid released water that we will examine, including: variability in the number flux of impactors important on short timescales, e.g., meteoroid streams; variability in the average impact velocity; and variability induced by phase effects from the Moon’s orbital velocity. Each one of these factors can introduce an increase by a factor of a few in the expected density of water observed.

In order to simulate a varying meteoroid number flux, various functions were used for the number of impacts occurring during the simulation. The previous work used the average sporadic impactor flux to seed the Poisson distribution of number of impacts in a given impactor mass range. This work uses a linear function. The linear function is constructed such that the maximum value corresponds to the peak meteoroid flux during a Geminid stream [4].

Each simulation consisted of 10,000 orbits to produce a statistically significant set of outcomes. The cumulative distribution function of those 10,000 simulated orbits was then normalized to compare to the LADEE observations.

Results: The simulations were performed for a mass function with iteratively smaller minimum values (e.g., $10^{-2}$, $10^{-1}$, and $10^{-6}$ g) and compared to the observations collected by LADEE NMS. Figure 1 shows the results of the various minima for the mass function assuming water comprises 1% of the ejecta. Where the Continuous Probability Function for water is above 50%, the curve corresponding to $10^{-6}$ g (black) closely follows the LADEE NMS observations.

Conclusions: The simulations show that small impactors potentially play a large role in the release of water. Including the full range of expected impactors reduces the amount of water release per incident mass to 1%, which is a very reasonable assumption. As this work progresses, the variability in the sporadic background meteoroid streams will be used to compare with the data.

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