Characterizing Lunar Dust Impact Plumes. E. Bernardoni[1,2], M. Horanyi[1,2], and J. Szalay[3], [1]Laboratory of Atmospheric and Space Physics, Boulder, Colorado, USA, [2]Department of Physics, University of Colorado Boulder, Boulder, Colorado, USA, [3]Department of Astrophysical Sciences, Princeton University, New Jersey, USA.

Introduction: The Lunar Dust Experiment (LDEX) on-board the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission observed from 9/2014 to 4/2015 a dynamic and permanently present dust cloud around the Moon produced by continual meteoroid bombardment. Through the implementation of a forward modeling approach using a two-dimensional single plume ejecta model, Szalay and Horányi revealed that this dust environment is sensitive to meteoroid showers [1,2,3]. The sporadic background contribution to the impacting dust flux is dominated by helion (HE), apex (AP), and antihelion (AH) sources oscillating with lunar phase. An estimate for the flux ratio of HE to AH sources was derived as well as the initial mass, speed, and angle from surface normal distributions of the ejecta. The speed distribution, however, was recently improved to account for the correlation between local time and altitude of the sampling [2]. By implementing these improved distributions into a three-dimensional self-consistent multiple ejecta plume model fitted to LDEX data, we will provide a correction to the angular distribution fit (See Figure 1).

Model Corrections: In addition to implementing the new ejecta speed distribution, this project introduces another parameter to chi-squared minimization fit. The new parameter relates to the perpendicular offset of the spacecraft's trajectory to the center of the ejecta plume labeled as y_1 in Figure 1. In the two-dimensional model fit performed by Szalay and Horányi, the spacecraft was assumed to have flown through the center of each ejecta plume. Under this assumption, several plume fits produce unusually narrow ejecta angular distributions [1,2,4]. As these narrow angular distribution fits may be due to the spacecraft trajectory clipping the edge of the dust plume, an offset parameter is introduced to remove the previous assumption. With a full three-dimensional model of lunar impact eject plumes fitted to LDEX data, an estimate of the meteoroid flux at 1 AU source can then be attempted via random sampling of the three-dimensional plume model per source. To perform this fit, the values of average impactor mass and speed must be fixed or sampled from a known distribution. These values are set based on models from previous literature.

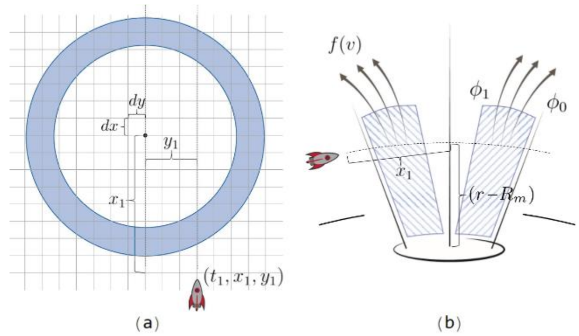

Figure 1. Illustration of the simulated plume and flight path. The blue ring represents the generated plume while the dotted line represents the a simulated flight path. **(a)** shows the top view of the plume model labeled with the starting point of the simulated flight path (t_1,x_1,y_1) as well as grid steps dx and dy used for binning the simulated impact rates. **(b)** shows the side view of the plume model labeled with inner and outer cone angles φ_1 and φ_0 respectively.

Conclusion: The correction to the eject velocity distribution and the inclusion of an addition offset parameter provide an improved model for lunar impact ejecta plumes observed by LDEX. This new fit reduces the number of outlying fits and shows that the distributions are independent of altitude and impact location. The angular distribution of these lunar impact ejecta plumes were found to be surprisingly narrow with an average exterior angle, labeled as φ_0 in Figure 1, of $8 \pm 3^{\circ}$.

References:

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