Erratum: Role of collisions in erosion of regolith during a lunar landing [Phys. Rev. E 87, 022205 (2013)]

Kyle J. Berger, Anshu Anand, Philip T. Metzger, and Christine M. Hrenya

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The density and viscosity used in the simulations presented in the original paper and stated in Table II are representative of Earth's atmospheric conditions, rather than the intended lunar conditions. The correct values of density and viscosity for 6 m from impingement are 1.64×10^{-9} g/cm^3 and 9.57×10^{-2} cP, respectively. We reran the simulations at the lunar conditions of density and viscosity, and we must revise some of our conclusions accordingly. It is important to note that none of our previous conclusions were incorrect for the parameters used, but rather they were not representative of lunar conditions.

In order to observe significant erosion at the correct lunar conditions, it is necessary to change the base particle size to 50 μm and the distance from impingement to 1 m (gas density $\rho = 1.49 \times 10^{-3}$ g/cm^3, viscosity $\mu = 9.57 \times 10^{-2}$ cP). In addition, all other geometrical parameters (box size $= 0.05 \times 1 \times 0.025$ cm^3, bed height $= 0.07$ cm, anchoring plane height $= 0.05$ cm, erosion plane height $= 0.075$ cm) and time step have similarly been reduced to reflect the changed particle size without changing the total number of particles.

Figure 1 shows the updated cumulative erosion number, or total number of particles eroded, as a function of time for cases of no collisions, nondissipative collisions, and dissipative collisions (Fig. 8 in the original paper). Unlike previous results, no regions of negative slope, or sedimentation, appear in the cumulative erosion number when collisions are present; this change is caused by a reduced collision frequency above the surface and therefore fewer particles returning to the surface.

The average fractional collision number, which is the averaged fraction of eroded particles engaged in a collision at a given time, was found to be 0.2% (rather than the 20% in original paper, Fig. 6). This reduction in collisional frequency is traced to the reduced particle size considered here; namely, close-but-not-touching particles experience a more similar drag force than two larger particles oriented similarly relative to the gas velocity gradient. The reduced collisional frequency results in fewer particles returning to the surface as evidenced by the absence of segments of negative slope in the cumulative erosion number in Fig. 1. The reduced frequency of collisions between particles results in collisions having a reduced effect on the erosion flux. Other results, which will be published in another paper, show that collisions above the surface become more important when more than one particle size is introduced.

All sensitivity studies from the original paper have also been reperformed, and only differences with previous observations are noted here. (i) First, significantly increasing the erosion plane height now results in a reduction of the erosion flux, which previously caused no change in the erosion flux (Fig. 10 in original paper). This change is caused by the reduced gas forces, which were previously orders of magnitude larger than gravity but are now no longer sufficient to cause particles to reach a relatively high erosion plane. However, small changes in the erosion plane do not change the erosion flux. (ii) Second, the particle spring constant k no longer has an effect on the erosion flux. This change can be explained by the decreased number of collisions between eroded particles, which were likely the cause of the previous sensitivity to the spring constant. (iii) Finally, previously the coefficient of friction had a significant effect on the erosion flux, and the coefficient of restitution had a minor effect on the erosion flux. The coefficient of friction now has only a minor effect on the erosion flux, although the qualitative nature of trend is the same as before. In addition, the erosion flux is now nearly independent of coefficient of restitution. This change can be explained by the reduced collision frequency between eroded particles.

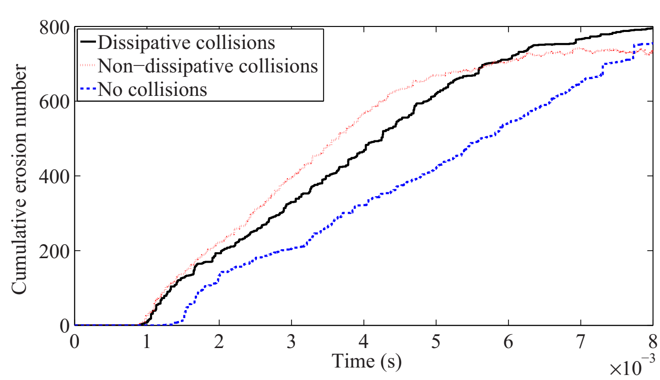

FIG. 1. (Color online) Cumulative erosion number for no collisions, nondissipative collisions, and dissipative collisions as a function of time.

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