Title: Numerical Simulations of Landslides Calibrated Against Laboratory Experiments for Application to Asteroid Surface Processes

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Abstract

Spacecraft images of asteroids show evidence of low-gravity granular flows. Interpretation of these flows requires numerical modeling, which in turn requires code validation at laboratory scales. We have implemented a soft-sphere discrete element method (SSDEM) for modeling granular flows in our numerical code (Schwartz et al. 2012, Granular Matter 14, 363). Here we present results from a study to calibrate our code against controlled landslide experiments in order to determine the SSDEM parameters that best match real materials, to see how changes in those parameters affect the flow, and to mimic effects such as those due to irregular particle shapes. The apparatus, designed at University of Braunschweig, is a 0.6 × 0.8 m enclosed bed with a surface comprised of 10 mm diameter glass spheres glued into precisely drilled holes in a metal plate. The exact positions and depths of each of these glued spheres are input to the simulations. The experiments consist of filling the apparatus with loose glass beads (also 10 mm diameter) up to a set depth then gradually tilting the bed to note the angle of landslide initiation and the characteristics of the resulting flow. We reproduce this procedure in simulations, which we find are quite sensitive to the adopted SSDEM parameters, e.g., rolling friction and tangential damping delay landslide onset, while higher particle elasticity gives rise to faster, shorter-duration landslides. Preliminary results show a best match to the experiments (landslide initiation around 25 degrees) when adopting low static friction and no rolling friction in the simulations, but more experiments are in process. In future work, we will perform simulations in low-gravity environments representative of asteroid surfaces. This work is supported in part by grant NNX08AM39G from the NASA Office of Space Science. This study resulted from International Team collaboration #202 sponsored by ISSI in Switzerland.