Using RAMMS (RApid Mass Movement Simulation) to simulate rapid gravity mass flows in martian gullies

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ABSTRACT

Martian gullies are young alcove-channel-fan systems, some of which are geomorphologically active today. The present-day flows in gullies are generally more mobile and deposit on substantially lower slopes than would dry grainflows. Yet, these flows have been observed to form in the absence of liquid water and are generally believed to be triggered and fluidized by CO_2 sublimation. However, initiation and flow conditions are currently unknown. We employ the RAMMS (RApid Mass Movement Simulation) debris flow and avalanche model to back-calculate and infer initial and flow conditions of recent flows in three gullies in Hale Crater on Mars. We infer minimum release depths of 1.0–1.5 m and initial release volumes of 100–200 m^3. Entrainment leads to final flow volumes that are 2.5–5.5 times larger than initially released, and this bulking is necessary to match the observed flow deposits. Back-calculated dry-coulomb friction ranges from 0.1 to 0.25 and viscous-turbulent friction between 100–200 m s^{-2}, similar to debris flows on Earth. This suggests that CO_2 sublimation fluidizes recent flows in gullies to a similar degree as water in terrestrial granular debris flows.