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High resolution topographic analysis and numerical simulations of landslides on Mars

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Landslides on Mars have been studied since the Mariner missions in the 1970s. These landslides were found to be exceptionally large by terrestrial standards and were also found to be abnormally mobile. Here we study three martian landslides that have a more terrestrial scale (1.1-3.2 km long) with the aim of discovering if these smaller landslides obey the same rules as their larger cousins. By virtue of their size and through the size-frequency of superposed impact craters we know that these three landslides must be younger than the larger landslides included in previous studies. Hence, this gives us a vision as to whether conditions for landsliding (possibly related to activity of water in the crust, through alteration or the hydrosphere) have changed over Mars' history. Because of their more manageable size we are able to take advantage of stereo images taken by NASA's High Resolution Imaging Science Experiment (HiRISE) to reconstruct their topography at 2 m/pix horizontal resolution, with a vertical accuracy of $\sim$0.5 cm. This enables us to accurately reconstruct their volumes, which range between 4.5 x 106 and 9.5 x 108 m3, but also enables us to simulate their dynamics. We do this by making a best-guess estimation of the initial topography and the release area and then run the model SHALTOP. This model can simulate gravity-driven dry granular flow using different friction laws. We vary the density, the friction coefficient and the friction law calculation (Coulomb or Pouliquen) in the model and "good" solutions are those where the spatial distribution of deposition thickness and deposit morphology most closely match those measured from our elevation data. Our preliminary results suggest that these three martian landslides do not have the same friction coefficient. Morphological similarity with mudflows in one case suggests fluid may have been involved in its formation.