Granular crater collapse in two dimensions

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ABSTRACT

A numerical investigation is performed using discrete element method simulations to study the collapse of a two-dimensional granular crater. Several initial shapes of cavities for different aspect ratios are tested, and the final shape of the crater is given as a function of its initial geometry and the model parameters. We follow the evolution of the free surface profiles and calculate the kinetic and potential energies as well as the velocity fields from the initiation of the collapse flow up until the relaxation of the crater, when the final metastable state is reached, and compare our numerical results with a continuum model of the Saint-Venant equations for a shallow flowing layer. Depending on the geometrical shape of the initial cavity, the crater relaxation may undergo a similar evolution as the collapse process of two independent granular steps. From the energetic viewpoint, we establish clear criteria under which the collapse flow will generate a granular jet, which is associated with the evolution of kinetic energy during the collapse. Finally, the effects of the collapse time and the sample size of the system were characterized upon the above predictions.

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