# Fly By Numbers: Using Mercury-DPM to explore the in-flight particle-particle interactions of 'ballistic' volcanic blocks

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Particles ejected in Strombolian-type eruptions typically follow ballistic trajectories through the atmosphere before coming to rest at the Earth's surface. However, Vanderkluysen et al. (2012) have observed particles colliding mid-air, resulting in deviations from standard ballistic trajectories that, in some instances, allow particles to exceed the maximum distances attainable by their previously assumed ballistic trajectories.

Mercury-DPM, a code for discrete element simulations, is here used to investigate the prevalence and effects of particle collisions numerically. Once particle parameters (e.g. size, density), exit conditions (e.g. ejection angle, ejection speed), external body forces (e.g. gravity, air drag), and particle-particle interactions (elastic, plastic, viscous, frictional) are defined, Mercury computes the translational and rotational evolution of particles by solving Newton's second law. Thus it is an ideal tool for exploring the reltionships between the exit conditions of particles, including the concentrations of particles within eruptive bursts and the time periods between bursts, and how these factors affect both the prevalence of particle collisions and the resultant translations of the particles involved. By exploring the range of scenarios documented for actual eruptions, we are able to quantify the anticipated effects of particle-particle interactions due to Strombolian-type volcanic activity.