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A numerical model of the formation and growth of a basal granular avalanche from a hot ash cloud. The first stage in the development of a two layer pyroclastic flow model.

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The majority of existing numerical pyroclastic flow models utilise the same governing equations and physics to describe the flow throughout its depth. High concentrations at the base of the flow result in a collapse of any dilute cloud assumptions, due to a change in the governing physics for this more granular regime. Thus uniform bulk continuum models can not accurately replicate this region. To answer this issue, other studies have developed two-layer pyroclastic flow models, similar to that seen in the sedimentology literature in reference to turbidity currents. In these models, two sets of governing equations are solved, describing separately the physics of the hot ash cloud and the basal granular avalanche. Some of these models include the growth of the ash cloud from the granular avalanche due to dome collapse, as seen in block and ash flows; for example at the Soufriere Hills Volcano, Montserrat.

In this study we use a two layered approach to develop a model for the formation of a basal granular avalanche due to sedimentation from the ash cloud, as observed during an eruption column collapse. We will present the first stage in construction of the full two layer pyroclastic flow model, describing the development and validation of a model for the formation, growth and subsequent collapse of a depth averaged granular avalanche. The governing physics is described by depth averaged bulk continuum conservation equations, while the avalanche is assumed to be isothermal with a constant density. These equations are solved using the Finite Volume Method, with approximate Riemann solvers to first order accuracy utilising the Godunov method.

The sedimenting source from the ash cloud is applied using the two-stage TRBDF2 method, maintaining stability in our results. Our model successfully illustrates the formation, growth and subsequent stopping phase of a granular avalanche. Further observations of the behaviour of the flows along slopes and over a change in gradient will be presented. These results are an important step in developing an accurate pyroclastic flow model, which replicates both the physics and run-out of the natural phenomena, vital for any hazard and risk assessment.