Retrogressive failure of a layer of granular material on an inclined plane

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ABSTRACT

The flow of granular materials down an inclined plane is closely related to many natural hazards, such as landslides and avalanches, which can cause serious damage to life and property. Avalanches can be triggered by many different factors, such as human activities, new material falling, wind or earthquakes. When an avalanche is triggered by a local disturbance, it is not only material downstream of this disturbance that is dislodged. Material upslope of the disturbance may also collapse, through an upwards propagating erosion wave through the granular layer, or 'retrogressive failure', which separates the regions of flowing and static material. This retrogressive failure is critically dependent on physics beyond the μ(I)-rheology and, despite being one of the basic waves in granular flow, has not been modelled in detail before. Retrogressive failure increases the mass of material in an avalanche, and so understanding this process is crucial for improving predictions of runout distances and flow paths, and consequently reducing the associated risks. We use small scale lab experiments, novel theory and numerical simulations to model retrogressive failure, and apply our results to both geophysical and industrial contexts.

REFERENCES

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