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Experiments on the Non-Boussinesq Flow of Self-Igniting Suspension Currents on a Steep Open Slope

J. N. McElwaine and B. Turnbull
DAMTP, University of Cambridge and SLF, WSL, Davos

Pyroclastic flows from volcanoes, dust storms in the desert, and sumarine turbidity currents are all gravity currents of particles in suspension occuring in nature. Powder snow avalanches are one such flow where the density difference between the suspended particles and the interstitial air is high and the particles carry a significant proportion of the flow's momentum. This means that the Boussinesq approximation is not valid. Aspects of such flows, such as their internal structure and the transition from a dense flow to a suspension current are not well understood. Repeatable laboratory experiments are necessary for a better understanding of the underlying physics. Up to now, an experiment has not been designed with the correct similarity criteria for modelling powder snow avalanches. In this work, we have designed, carried out, and analysed the results from a new experimental model of powder snow avalanches. These experiments had three novel features. Fine, dry snow was used to form suspension currents in air. The high density ratio of powder snow avalanches was preserved so that the currents are non-Boussinesq. Our experiments started with a dense current that then self-ignited, undergoing the transition to a suspension current. The shape and position of the current was tracked with two video cameras, and the air flow measured with a high frequency response pressure transducer mounted in the base.