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Thermomechanical modelling of mixed rock/ice avalanches

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In this presentation we apply a thermomechanical avalanche dynamics model to simulate the motion of three recent catastrophic mixed rock/ice avalanches. These are (1) the 2015 seismic induced rock/ice avalanche that destroyed the village of Langtang, Nepal (2) the 2016 Lamplugh (Alaska) rock/ice avalanche and (3) the 2017 Piz Cengalo (Switzerland) avalanche. These events are similar in that they all involve the entrainment of either glacier ice or significant amounts of snow. Of interest is the fact that in both Langtang and Piz Cengalo the flow of rock and ice was accompanied by a fast moving cloud of suspended ice and soil particles. In Langtang the air-blast of the cloud overran the village and caused the primary damage. This was not the case at Piz Cengalo where the rock/ice flow transformed into a series of debris flows that overflowed the existing retention basin. Here the primary problem is to identify the amount of meltwater that can be generated by dissipative heating and to understand how water transforms the frictional properties of the flow. Modelling rock/ice avalanche flow therefore requires a thermomechanical model capable of accounting for the behaviour of different avalanche flow regimes with varying thermomechanical properties. We present such a model but underscore the problems of application including the specification of the thermal initial and boundary conditions for the entrained glacier ice and snowcover.