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The use of a proforma approach in the modelling and mitigation of channelised debris flows

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Debris flows in mountainous terrain are hazardous to both centres of population and the infrastructure connecting them. Critical to any form of mathematical or physical modelling approach to assess the hazard posed in such environments is the quality of the field data from which they are derived. Inherent to the accurate field documentation of debris flows is the development of a suitable system to record the pertinent data and identify key variables. Detailed information is required in three identified regions of a debris flow: the source zone; the zone of entrainment, if any; and the zone of deposition. Methods of remote sensing, traditionally aerial photograph interpretation, can provide important spatial and temporal patterns in a regional to national scale context, but their use in the context of debris-flow deposits can be restricted by the environmental and geomorphological characteristics of mountainous terrain. The resolution and range of data that can be collected by individual site visits, although time consuming, is often far superior.

A proforma approach in conjunction with detailed mapping, developed after the consideration of debris-flow deposit properties and bounding conditions from an engineering geomorphological perspective, is presented. The proforma specifically targets the necessary dataset to begin deterministic modelling in a GIS framework after identification of the controlling variables. The final output is expected to produce a model capable of calculating the runout of a channelised debris flow based on topographic constraints and provide a measure of impact force at specified points. This impact force is the necessary information required to assess the hazard posed by channelised debris flows to life and infrastructure and constrain design for construction of suitable mitigatory measures.

Preliminary data collected from channelised debris flows deposits in the Bhutan Himalaya using the proforma are presented. Debris flows sourced either high above the only road to traverse the country from east to west, or directly below the road surface, are a continual threat to both life and infrastructure. As a result the road is often closed at several points simultaneously. The debris flow hazard is considered high in the country due to the combination of steep relief, near tropical weathering of bedrock, and strong monsoonal precipitation input.