ASSESSMENT OF DEBRIS-FLOW HAZARD IN NW SLOVENIA

FIELD WORK IN HEADWATERS OF THE UPPER SAVA RIVER AND INVESTIGATIONS ON FAN SEDIMENTS

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Among different natural hazards (i.e. snow avalanches, landslides, rock falls, floods), debris flow hazard in Slovenia has been relatively poorly investigated since now. The conditions in Slovenia (cases such as the Stože debris flow with over 1 million m^3 in 2000 in the village of Log pod Mangartom, over 20 small debris flows in 2002 in the village of Koseč) as well as in the Alpine environment in recent years provide enough evidence that the debris-flow hazard is rising.

In Slovenia, in the last years we have successfully used 1- and 2-D mathematical modelling of debris flows to produce local hazard maps in devastated areas (Log pod Mangartom, Koseč) and to help planning structural mitigation measures. The two main problems associated with such a modelling are the assessment of a realistic debris-flow scenario (i.e. magnitude, rheology), and the validation of the model using field data. In Slovenia, the debris-flow cadastre is practically an empty file and not many historical studies have been done so far.

For this reason, selected methods for estimation of debris flow magnitudes have been applied in selected torrential watersheds (Sodnik & Mikoš, 2006). Some of the methods gave reasonable estimations for the few known field situations (i.e. Koseč or Log pod Mangartom). For further work in assessing debris flow hazard, we started field work in the headwaters of the Upper Sava River in NW Slovenia. One of the aims of this study is to select appropriate methods for estimation of debris-flow magnitudes using field data and hydrologic modelling.

FIELD WORK IN HEADWATERS OF THE UPPER SAVA RIVER

In the Upper Sava River valley between Rateče (border to Italy) and Jesenice, out of many torrential fans, 4 fans have been selected for the study (Trebiža, Suhelj, Presušnik, and Koroška Bela). Since December 2006, one or two sedimentological trenches reaching from 4 m to over 5 m in depth were excavated in the distal or/and in the proximal part of each of the selected fans. For the selected layers, sediment samples were taken and are now under investigation in a geotechnical lab to determine their soil properties, especially their rheological properties to be used for parameterisation in mathematical modelling.

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For some of the torrential fans under investigation, several distinct debris-flow events were recognized within the sediment profile, while the importance and meaning of further internal stratification was also analyzed in situ. Generally, a typical sedimentary sequence of each of the recognized debris-flow events comprises of a succession of fining-upward non-sorted coarse gravel diamicton that gradually passes into better sorted stream sediments (gravel and/or sand and/or silt). The sequences are separated by erosion surfaces of which none show signs of significant pedogenesis. Furthermore, sediment samples were taken for laboratory lithological analyses and some more samples for OSL age dating (e.g. from the silt-rich layer, see Fig. 1), as the main aim of this field work was to get evidence of historical debris-flow events and to try to estimate the time of their occurrence.

Fig. 1 The OSL age-dating sampling detail within the stream sediment portion of the sequence in the proximal trench on the Trebiža torrential fan.

The age and the thickness of sediment layers recognised as debris-flow deposits helped to recognise debris-flow prone fans. In some cases the age of debris-flow deposits was dated back more than 10,000 years i.e. close to the last glacial period in the area, with significant pedogenesis on top of them. Especially the Koroška Bela fan with three much younger debris-flow layers was recognised as the most threatened fan of all under investigation. Firstly, there is a historical record of a major debris-flow event on November 13, 1789 that covered some 40 to 50 houses on this fan.

Secondly, in 2007, geological-morphological analysis of the torrential watersheds of the investigated fans has been executed in order to determine potential sediment sources for initiation of debris flows, and especially the torrential watershed of Koroška Bela proved to be landslide active with a large potential to develop debris flows.

The results gained through this field and laboratory work are currently used for two-dimensional mathematical modelling of debris flows on torrential fans. In order to determine hazard maps on these fans, a digital elevation model (5 x 5 m) has been used together with the two-dimensional mathematical model Flo-2D (see preliminary results on Fig. 2).

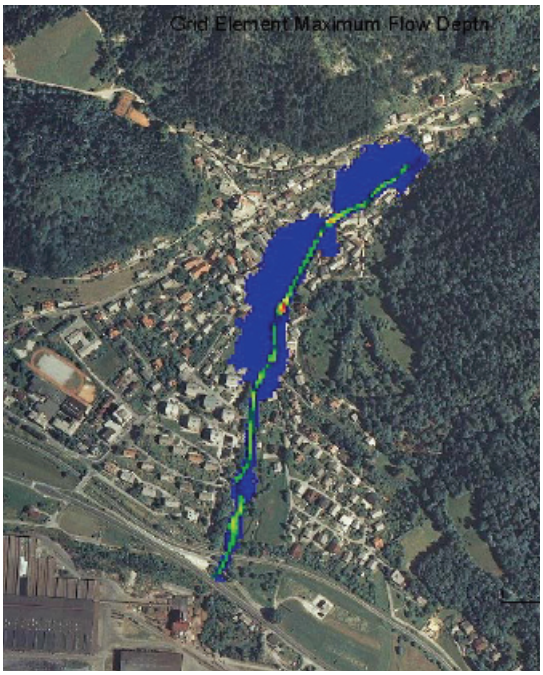

Fig. 2 Maximum flow depths for clear water hydrograph with the return period of 100 years on the Koroška Bela fan, using Flo2D mathematical model.

REFERENCES

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