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Evaluating the use of high-resolution numerical weather forecast for debris flow prediction.

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The sudden occurrence combined with the high destructive power of debris flows pose a significant threat to human life and infrastructures. Therefore, developing early warning procedures for the mitigation of debris flows risk is of great economical and societal importance. Given that rainfall is the predominant factor controlling debris flow triggering, it is indisputable that development of effective debris flows warning procedures requires accurate knowledge of the properties (e.g. duration, intensity) of the triggering rainfall. Moreover, efficient and timely response of emergency operations depends highly on the lead-time provided by the warning systems. Currently, the majority of early warning systems for debris flows are based on nowcasting procedures. While the latter may be successful in predicting the hazard, they provide warnings with a relatively short lead-time ($\sim$6h). Increasing the lead-time is necessary in order to improve the pre-incident operations and communication of the emergency, thus coupling warning systems with weather forecasting is essential for advancing early warning procedures.

In this work we evaluate the potential of using high-resolution (1km) rainfall fields forecasted with a state-of-the-art numerical weather prediction model (RAMS/ICLAMS), in order to predict the occurrence of debris flows. Analysis is focused over the Upper Adige region, Northeast Italy, an area where debris flows are frequent. Seven storm events that generated a large number (>80) of debris flows during the period 2007-2012 are analyzed. Radar-based rainfall estimates, available from the operational C-band radar located at Mt Macaion, are used as the reference to evaluate the forecasted rainfall fields. Evaluation is mainly focused on assessing the error in forecasted rainfall properties (magnitude, duration) and the correlation in space and time with the reference field. Results show that the forecasted rainfall fields captured very well the magnitude and dynamics of rainfall in most of the cases, which reveals a great potential in using high-resolution weather forecast for advancing debris flow warning systems.