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Estimating runoff and maximum flood on dtm by the Raindrop program for the Bátaapáti nuclear waste repository, Hungary

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Bátaapáti, a small village in South Hungary became well-known because of the planned Final Disposal Facility for low and intermediate level radioactive waste of the Paks Nuclear Power Plant. The facility is expected to be operated for some 600 years to let the radiation of the waste reduce to a harmless level. For such a long lifetime all the possible natural hazards affecting the selected facility site should be assessed. With the increased variability of the weather in the last decade the meteorological effects, like catastrophic flash floods, are considered as potential endangering factors. In this paper a forecasting is given about the expected magnitude of flash floods in Nagymórágy Valley, the trunk channel dewatering the area. The simulation of the event is based on a minute-stepping algorithm running on a high-resolution digital terrain model (DTM). The model integrates the objects of reality from the point of view of runoff circumstances. It is based on a 1-meter resolution digital elevation model (DEM), integrating the drainage network up to the gullies deeper than 30 centimetres. Land use data were added to the DTM from the maps of recent military surveys. A worst scenario for flood events is envisaged as simultaneous apperance of the following factors: (1) completely burn forest; (2) maximum downpour of rain ever registered within 50 km radius (26.4 mm within 20 minutes). The modelled rainfall event potentially responsible for the flash flood is based on historical sources. The worst-case scenario is supposed, so that the actual runoff can be maximal with negligible infiltration, due to, for example, former rainfalls saturating the soil, or frozen soil in spring or forests. The duration of flowing of the individual water-bodies on the pixels is calculated by Manning equation (Hessel et al., 2003). The high-resolution

model provides a clear physical approximation for the timing of accumulation. The different versions with different rainfall events, land covers, such as forest burnt down or 100% forested catchment area, or different terrains. The maximum discharge (500-700 m^3/min) appears ca. at 30 min. after the starting of the rainfall. The entire flash flood ends within 3 hours. In case of burnt-down forest the maximum discharge is 200 m^3/min higher than if the topography is 100% forest-covered. The peak discharge occurs 10 min. earlier. Consequently, the time for any possible countermeasures decreases to ca. 20 min. If we take into account that the global warming increases the intensity and frequency the modelled catastrophic rainfalls, two factors increase the severity of such events: (1) the flash discharges will increase further and (2) the time frame of any action to reduce the catastrophic outcome is expected to decrease.

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Hessel, R., Jetten, V., Guanghui, Z., 2003. Estimating Manning's n for steep slopes, Catena 54, 77-91.