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Modeling debris flow triggered by snow melting in the Barsemdara river valley, Tajikistan

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Debris flow is one of the most hazardous events that occur in all mountain regions. Direct debris flow damage includes loss of human life, destruction of houses and facilities, damage to roads, rail lines and pipelines, vehicle accidents, and many other losses that are difficult to quantify. In July 2015, in the valley of the Barsemdara River (Gorno-Badakhshan Autonomous Region, Tajikistan), plenty of debris flows were observed. As a result, residential areas, social facilities, and infrastructure in Barsem village and neighboring settlements were destroyed and flooded. Besides, debris flow deposits blocked the Gunt River with the subsequent formation of a dammed lake with a maximum volume of 4.0 million m^3.

The aim of this study was to obtain hydrographs of debris flow waves in the source and detailed zoning of the Barsemdara river valley. For the debris flow source, we applied transport-shift model. Equations of this model were developed by Yu.B. Vinogradov basing on Chemolgan experiments of artificial debris flows descending. Previously, the model characteristics were compared with the observational data of the Chemolgan experiments, and the results were found to be satisfactory [Vinogradova, Vinogradov, 2017]. Based on the equations, a computer program was created in the programming language Python. Besides, we improved the model by adding flow velocity calculations, and eventually it became possible to obtain hydrographs. To investigate quantitative characteristics of the debris flow in the river valley we implied a two-dimensional (2D) model called FLO-2D PRO. It is based on the numerical methods for solving the system of Saint-Venant equations. Besides, in this model, it is assumed that debris flows move like a Bingham fluid (viscoplastic fluid) [O'Brien et al., 1993]. The input information for modeling was digital elevation model (DEM) and previously obtained hydrographs. The output information included flow depth, velocity distribution and hazard level of the territory. The results of the study will be reported.

1. Vinogradova T.A., Vinogradov A.Y. The Experimental Debris Flows in the Chemolgan River Basin // Natural Hazards. – 2017. – V. 88. – P. 189-198.

2. O'Brien J. S., Julien P.Y., Fullerton W.T. Two-dimensional water flood and mudflow simulation //Journal of hydraulic engineering. – 1993. – V. 119, No 2. – P. 244-261.