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Largest ever man-made debris flow experiments in the Chemolgan River basin (USSR, 1972-1978)

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Debris flows are one of the most dangerous and common hydrological phenomena in mountainous regions of the world. The problem of calculation and forecasting the mudflows still remains intractable. This situation is primarily due to a shortage of reliable observational data on the characteristics of past debris flows. In this connection, the data obtained as a result of the direct observation of the phenomenon is very important.
In this presentation we would like to talk about (and show the short movie describing) the largest ever man-made debris flow experiments which were conducted in 1972-1978 at Zailiyskiy Alatau mountains near Alma-Ata (currently Kazakhstan) under supervision of Russian hydrologist Prof. Yu.B. Vinogradov (Vinogradova & Vinogradov, 2017).
Lake reservoir located at an altitude of over 2900 m was closed by a dam unit with spillways designed to create water releases with a maximum flow rate of 100 m3/s. The useful volume of the reservoir was 73 000 m3. In the lower part of the debris flow channel in 1.7 km from the dam unit a control debris flow measurement section line was equipped. Measuring devices were continuously developed and modified from one experiment to another.
On the whole there were five experiments in 1972, 1973, 1975, 1976 and 1978. The mud-stone flow of 1975 was the largest of the experimental debris flows. Vinogradov (1980) described its movement: "Great was the front wave of the second stream: in the vanguard of the huge piles of boulders a stone block, a large sevenmeter axis of which coincided with the direction of the flow movement, was rushing like a battering ram." In the wide valley of the Chemolgan river the front of the flow was gradually released from large boulders and had the average velocity on the upper 5-km stretch 4.0 m/s, on the lower one 18 km 1.9 m/s and maximum debris flow discharge was 380 m3/s.
The experiments on the Chemolgan river have greatly extended knowledge of debris flow processes. On the basis of the observed differences in the development and course of the transport, transport-shift and shift debris flow process it became possible to make the separation of debris flow phenomena into flows of low and high density.
As a result of processing the data of experiments on the Chemolgan polygon the information about the character of dependence of the eroding debris flow mixture ability on its density and composition of the solid phase was obtained for the first time.
Developed mathematical model of transport-shear debris flow process by Vinogradov (1980) is consistent with the actual observed characteristics of mudflow processes and thus can be used for engineering calculations and forecasts.
This experiment is unique in scale and similar studies have not been carried out in the world. The experiments on the Chemolgan debris flow polygon allowed us to see and measure something that previously was only possible to guess about or to build speculative models which are not always representative.