Creation of a Program for Calculating the Dynamic State of Sediment in the Event of Heavy Rain

(Research Period: 2015 – 2016)

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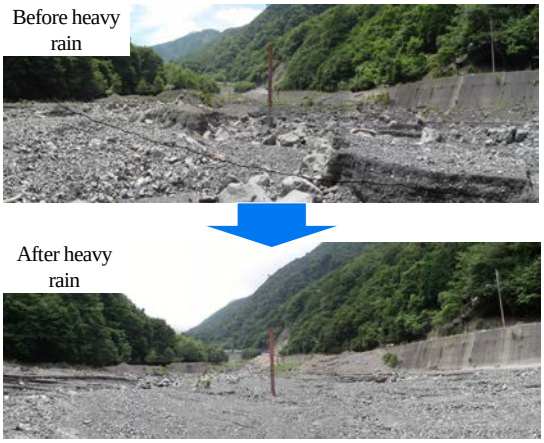
Keywords: Numerical calculation program, dynamic state of sediment, grain size, mountainous river

1. Introduction

Analyzing the dynamic state of the sediment of mountainous rivers is one of the most basic technologies to prevent and mitigate disasters caused by sediment movement. On the other hand, mountainous rivers have many characteristics different from those of downstream rivers such as the following:

(1) The sediment may flow in the state of debris flow in steep slope sections.
(2) The riverbed fluctuation is significant, and the shape of river channels and grain sizes of riverbed materials vary widely depending on the time and place.
(3) The grain sizes of riverbed materials are large (see the photo above).
(4) On the other hand, in the event of heavy rain, sediment, including sediment that is small in grain size, may be produced on an extremely large scale due to landslide or debris flow even though the frequency is low (See the photo below).

Although many riverbed fluctuation calculations have been conducted for the purpose of analyzing the dynamic state of sediment, it is hard to say that a method of analysis in which the characteristics of mountainous rivers described above are sufficiently reflected has been established. Therefore, the Sabo Planning Division of NILIM created a numerical calculation program for analyzing the dynamic state of the sediment of mountainous rivers in the event of heavy rain, based on previous analysis methods and experimental results.



Photos: The situation of riverbed materials before and after heavy rain

2. Outline of the model created

The program was created to enable unified analyses ranging from debris flows in steeply sloped river channels to bed load sediments generated in river channels that are relatively mild in slope as shown in the figure. In addition, in order to continuously analyze boulders to fine-grained sediments, it enabled the analysis of quicksand forms of the following simultaneously:

(1) Coarse-grained soil and stone flowing in laminar form
(2) Suspended sediment flowing in the turbulence state in the pore fluid between coarse-grained soil and stone flowing in laminar form
(3) Suspended sediment flowing in the turbulence state in the current bed above the bed where sediment is flowing in laminar form

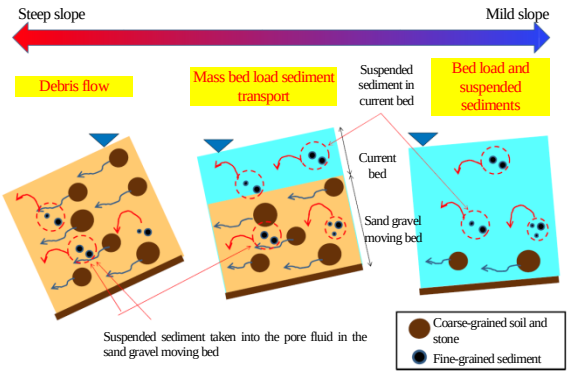


Figure: Outline of the model created

3. For utilization

The creation of this program is considered to have enabled the analysis of the dynamic state of sediment in the event of heavy rain to a certain level of accuracy. It is hard to say that the dynamic sediment state analysis technologies have been sufficiently utilized in practical operations, such as the creation of facility placement plans so far. Although it is, of course, important to continuously improve analysis technologies, we are expecting the numerical calculation program we created this time and similar analysis technologies to be increasingly utilized in practical operations.

☞For details, refer to the following:

1) Document No. 874 of NILIM
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0874.htm