Efforts for Flood Hazard Mapping of Small- and Medium-sized Rivers

(Research period: FY 2017 -)

NAKAMURA Kento, Researcher, ITAGAKI Osamu, Head
Flood Disaster Prevention Division, River Department,

key words: *small- and medium-sized rivers, flood hazard map, airborne laser profiler data*

1. Introduction

Heavy rains and floods unlike those experienced in the past have now become a frequent occurrence, and devastating flood damage has continued to occur at rivers throughout Japan. Although river improvement works and other structural measures are essential for preventing these disasters, in addition, disaster prevention/mitigation by promoting non-structural measures such as timely evacuation is also important. For promoting non-structural measures , flood hazard maps, which illustrate possible flooded areas and depths, are necessary, but have not been provided for many small- and medium-sized rivers. Swift elimination of these no--risk-information areas has become an issue.

In Japan, there are approximately 21,000 rivers under the administration of prefectural government (as of April 2018), and flood forecasting or water level reporting is legally required at only about 2,000 rivers nationwide (as of October 2019; hereinafter, "flood forecasting or reporting river"). At a flood forecasting or reporting river, river administrator is also legally required to specify the possible flooded areas and depths with assuming the largest flood scale. Specification of these areas has been completed at all of the approximately 400 rivers administered by the central government, and about 1,700 rivers, in which approximately 1,600 rivers with the assumed largest flood scale, under prefectural government (as of July 2020). On the other hand, among remaining approximately 19,000 rivers, i.e. the rivers not designated as flood forecasting or water level reporting river (as of October 2020; hereinafter, "small- and medium-sized rivers"), flood hazard maps with the assumed largest flood scale have been provided for only about 4,000 of these rivers (as of June 2020), or fewer than one-in-four of all small- and medium-sized rivers.

Based on these circumstances, the Flood Disaster Prevention Division has conducted research on techniques for preparing flood hazard maps for small- and medium-sized rivers by utilizing airborne laser profiler (hereinafter, LP) data in cooperation with the Water and Disaster Management Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). A technical review committee (Chair: Prof. IKEUCHI Koji, University of Tokyo Graduate School) was organized in the Bureau in January of 2020, and "Guide to flood hazard mapping for small- and medium-sized rivers" (hereinafter, "Guide") was released in June of 2020 (**Table**)[1].

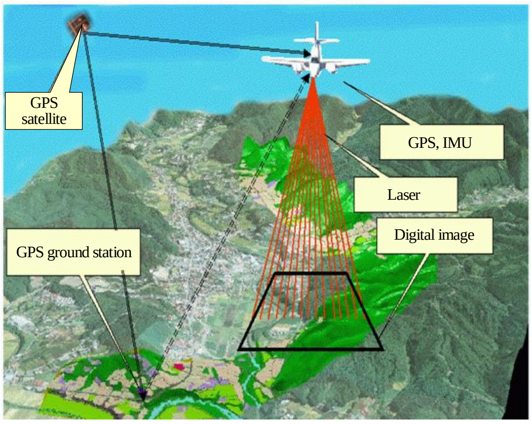

Fig.-1 Airborne laser profiler

Table Chronology of discussions in Technical Review Committee

Date	Main agenda
1st Session January 7, 2020	Background of study Results of survey of prefectural needs Simpler flood hazard assessment method
2nd Session March 25, 2020	Secretariat's response to items pointed out at 1st Session Guide (preliminary draft)
3rd Session May 25, 2020	Secretariat's response to items pointed out at 2nd Session Guide (draft)

Besides, it is planned to increase the number of rivers where the possible flooded areas and depths are specified, from approximately 2,000 rivers in FY 2020 to approximately 17,000 rivers in FY 2025, following the revision of the law in 2021.

2. Features of Guide

To prepare flood hazard maps quickly for the enormous number/ length of small- and medium-sized rivers, the Guide adopts new analysis techniques as follows:

(1) Setting the river channel and flood plain cross section based on available LP data and Digital Elevation Model.

(2) Adopting rational formula where the flood run off analysis has not yet been conducted for reducing the flood run off analysis

workload.

(3)Adopting one-dimensional non-uniform flow calculation technique without assuming levee breaching for reducing the possible flooded areas and depths analysis workload.

The following points were also mentioned as remaining technical challenges in the Guide.

- Setting appropriate interval of the cross sections of the river sections for one-dimensional non-uniform flow calculation.
- Developing a method to consider the large content of sediments in flood where complex disaster of sediment and flood is concerned.
- Clarifying conditions for avoiding remarkable under estimation of the possible flooded areas and depths without considering levee breaching.
- Setting the appropriate boundary river water level at the lower end of the river for one-dimensional non-uniform flow calculation.
- Developing a method for estimating the possible flooded areas and depths at river sections with mixture of multiple types of flood flow, such as parallel-flow-type, diffusion-flow-type, and storage-type.
- Judging river sections where the proposed analysis technique is applicable based on available information such as LP data.

3. Trial application of Guide

Together with collecting and analyzing examples of the application of the Guide, which are necessary in study to solve the above-mentioned technical challenges, NILIM is also promoting trial application of the Guide in order to support quick elimination of no-risk-information areas throughout Japan. Due to budget limitations and other reasons, trial applications are limited to the parallel-flow-type river sections. It should also be noted that this work has been greatly delayed under the condition of the strengthening of infection prevention countermeasures against the novel coronavirus.

4. Current status of trial application

The following work is being carried out for approximately 8,000 rivers (with a total length of approximately 40,000 km) based on the available LP data.

(1) Screening rivers for the trial application based on request from prefectural government and LP data availability information.

(2) Borrowing the LP data from the Geospatial Information Authority of Japan.

(3) Checking whether the LP data cover the target river.

(4) Dividing the target river into river sections with roughly the same peak flood discharge.

(5) Collecting the necessary data for calculating the peak flood discharge in each river section.

(6) Identification of river sections which are considered to have the parallel-flow-type flooding during assumed maximum flood scale based on topographic data (and peak flood discharge).

Fig.-2 shows an example of identification of a river section with parallel-flow-type flooding.

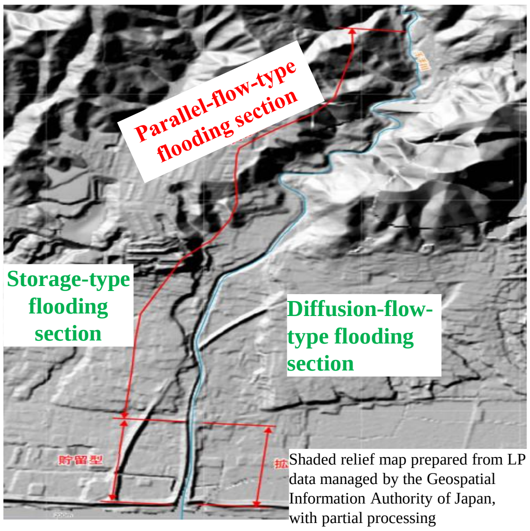

Fig.-2 Example of identification of parallel-flow-type flooding section

5. Conclusion

Through ongoing trial applications, the Flood Disaster Prevention Division continues the studies to validate the proposed analysis technique, and to solve the technical challenges of the Guide, together with facilitating the elimination of no-risk information areas at small- and medium-sized rivers.

☞For more information:

1) Flood Risk Reduction Policy Planning Office, River Environment Division, Water and Disaster Management Bureau, MLIT, and Flood Disaster Prevention Division, River Department, NILIM: "Guide to flood hazard mapping for small- and medium-sized rivers"
https://www.mlit.go.jp/river/shinngikai_blog/tyusyokasen/pdf/manual.pdf (in Japanese)