Research Trend & Results

Establishment of River Level and Inundation Forecast Approaches for Appropriate Evacuation and Flood Control Activities

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Key words: River level forecast, inundation forecast, SIP

1. Introduction

In recent years, torrential rain and local heavy rain (so-called "torrential downpour") are increasing, and flood disasters have occurred frequently. In order to strengthen the monitoring of such flood disasters that are suddenly caused by rapid development of cumulonimbus clouds, the Ministry of Land, Infrastructure and Transport (MLIT) has allocated 38 units of X-band MP radar across the country and is distributing almost real-time precipitation information on spatial and temporal resolutions to be updated every one minute with 250m mesh. In order to ensure more secure disaster prevention / mitigation, it is desired to provide real-time information / warning appropriate for location that "triggers evacuation" by translating such precipitation information etc. into inundation forecast information, using ICT. Then, the River Department, participating in "Strengthening resilient disaster prevention / mitigation functions" in SIP (Cross-ministerial Strategic Innovation Promotion Program), which started in fiscal 2014, has been studying for development and social implementation of new technologies concerning observation / forecast / analysis to ensure secure disaster prevention / mitigation against flood disasters resulting from heavy rain etc. in collaboration with the National Institute of Information and Communications Technology ("NICT"), the National Research Institute for Earth Science and Disaster Prevention ("NIED"), etc. (Figure 1).

In this study, research and development as well as system construction are conducted in order to translate the precipitation information from the next-generation radar developed by the NICT and the precipitation forecast information developed by the NIED and into practical river level forecast and inundation forecast information and provide the information in real time. Accordingly, we plan to introduce techniques for assimilation of river level and inundation monitoring data and examine optimization of algorithm, etc. to enhance the accuracy and speed of the river level and inundation forecast, and establish a prototype system in fiscal 2016 based on results of such activities. We also aim to complete this system through feasibility tests in and after fiscal 2017.

2. Outline of inundation forecast and river level forecast systems

As the result of discussion with the organizations concerned about needs and practical use of inundation forecast and river level forecast systems, we have decided to establish an inundation forecast system for the basins of Kanda River and Shakujii River and a river level forecast system for the basin of Arakawa River, and therefore created an inundation forecast model and a river level forecast model. The inundation forecast model integrated the river, sewerage hydraulic analysis, and flood analysis models so that inland flood and river flood can be treated in an integrated manner. In the river level forecast model, dependence on flush volume was eliminated to the extent possible by using the distribution pattern runoff model and the one-dimensional unsteady flow model. We improved the accuracy of this model by incorporating the data assimilation technique using a granular filter.

3. Future study

For the inundation forecast, in addition to improvement of resolution focused on the important points and their peripheral areas, such as underground shopping center and subway entrance, and to enhancement of the accuracy and computing speed by parallelization of algorithm, etc., we plan to examine inundation monitoring in order to improve monitoring of inundation phenomenon and forecast accuracy by assimilation of inundation monitoring data.

For the river level forecast, in addition to improvements including expansion of modeling areas, we will also examine visualization of computation results from the viewpoint of users and, based on such examination, establish a real-time computation / display system for inundation forecast and river level forecast and identify issues for establishment of prototype system.
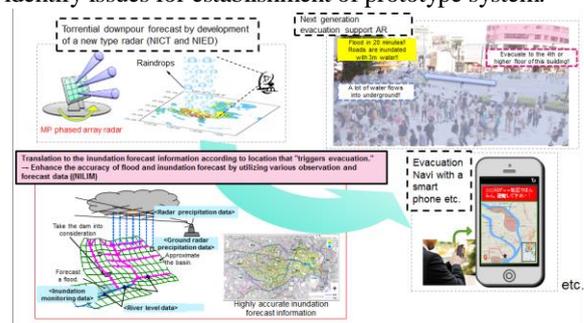

Figure 1. Concept of Collaboration in Technical Development for the Observation, Analysis, and Forecast of Flood Disasters