# Hydrologic Predictions in Sparsely Gauged River Basins for Flood Disaster Reduction

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## INTRODUCTION

Southeast Asia is one of the most vulnerable regions in flood and sediment disasters. Under the pressure of increasing population and fast economic development, the regions are facing many water-related issues such as flood, drought, water shortage, soil loss, water pollution and degradation of ecosystem. Among these, to establish countermeasures for flood disasters is urgent task. Early flood warning, preparedness and risk managements are the key to the reduction of flood disaster damages and they are highly dependent on flood prediction ability. DPRI, Disaster Prevention Research Institute, Kyoto University promotes the research to advance flood forecasting ability and disseminates the research products and information to reduce flood disasters.

## NEED OF FLOOD PREDICTIONS IN SPARSELY GAUGED RIVER BASINS

In 2004, severe rainfall fronts and ten typhoons hit Japan caused heavy rainfall disasters with 232 casualties. In 2005 and 2006, the seasonal rain fronts and typhoons brought severe damages to the east and the southwest part of the Kyushu region in Japan. These rainfall disasters mainly occurred at tributary catchments with several hundreds square km in mountainous areas. River managements of these river catchments are not well maintained, and hydrologic observations, especially river discharge observations are inadequate. Most of river catchments in the Southeast Asian regions also have quite insufficient hydrologic observation systems. These sparsely gauged or ungauged basins suffer from flood disaster damages because of limited flood predictions and flood preparedness.

The problem is that flood predictions are essential measures to reduce flood disasters while most of river basins which need flood predictions do not have enough hydrologic data to construct rainfall-runoff models to make flood predictions. Therefore, hydrologic predictions and reduction of prediction uncertainty in ungauged basins is one of the principle research themes to reduce flood disasters.

The research theme includes a development of innovative flood prediction systems which are applicable at sparsely gauged river basins. Some flood prediction systems developed at DPRI, Kyoto University and application results listed below are introduced at the presentation:

- A transferable flood simulation model over different climate regions and different spatiotemporal scales is an essential tool to realize flood predictions in ungauged basins. A hydrologic model with spatial scale invariant consideration applied at some catchments in Thailand, Nepal and Japan shows a possibility as

one of transferable hydrologic models.

- An innovative physically based distributed hydrologic prediction system developed at the Yodo River basin in Japan is introduced. The model incorporates radar rainfall observation technology and numerical geographic information such as detailed topography and land use. The hydrologic model also includes dam reservoir operations to analyze human-nature interactions. The system is extended to a real-time flood forecasting system using best available data, which demonstrates the forecasting results through web pages. The prediction system is also utilized to analyze the flood risk at the Yodo River basin under global warming with the outputs of an atmospheric climate model.
- A macro-scale hydrologic simulation model applied at the Huaihe River basin in China (132,350km$^2$) and the Chao Phraya River basin in Thailand (110,000km$^2$) are presented. A flood prediction result at the Huaihe River basin with the outputs by an atmospheric simulation system is provided and the possibility to predict floods in any catchment on the globe is demonstrated.

## RESEARCH NETWORK FOR PREDICTIONS IN UNGAUGED BASINS

The importance of hydrologic predictions in ungauged basins is internationally recognized. The International Association of Hydrological Sciences (IAHS) initiated a global ten-year initiative: Predictions in Ungauged Basins (PUB) in 2003. The PUB initiative aims at achieving major advances in the capacity to make reliable predictions in ungauged basins. In Asian countries, China, Japan, Nepal, Sri Lanka and Thailand have organized national working groups and promoted the PUB research to solve their problems in hydrology and water resources cooperatively. The research group at DPRI, Kyoto University is actively involved in the PUB research, which is partially supported by the 21COE research program at DPRI.

## CV

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TACHIKAWA Yasuto is an Associate Professor of Disaster Prevention Research Institute at Kyoto University. He received Dr. Eng. from Kyoto University in 1996. He was a Monbusho Visiting Fellow at University of Oklahoma (1998-99). His major is flood prediction, hydrology and water resources engineering. He is a science steering group member of PUB (Predictions in Ungauged Basins), which is a global ten-year initiative under the International Association of Hydrological Sciences (IAHS). He is a coeditor of IAHS Red Books, no. 282 "*Weather Radar Information and Distributed Hydrological Modeling*" in 2003, no. 301 "*Predictions in Ungauged Basins: International Perspectives on the State of the Art and Pathways Forward*" in 2005, and no. 303 "*Predictions in Ungauged Basins: Promise and Progress*" in 2006. Recent his research papers include "A downscaling method of topographic index distribution for matching the scales of model application and parameter identification (coauthor)" in *Hydrological Processes* (20) in 2006, and "Input data resolution analysis for distributed hydrological modeling (coauthor) in *Journal of Hydrology* (319) in 2006. Email: tachikawa@flood.dpri.kyoto-u.ac.jp