FLOOD PREDICTIONS IN JAPAN AND PUB, PREDICTIONS IN UNGAUGED BASINS

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Abstract:
Flood and sediment disasters are quite common in Japan. To establish countermeasures for flood and sedimentation disasters, the roles of rainfall-runoff models are significant. Various kinds of rainfall-runoff models have been developed and applied in Japan; however their comparative evaluations are still not well performed, especially from the view point of predictive uncertainties. A sound evaluation of rainfall-runoff models is indispensable to reduce the prediction uncertainties and to enhance the prediction accuracy. In 2003 the International Association of Hydrological Sciences (IAHS) initiated a global ten-year initiative: Predictions in Ungauged Basins (PUB). The PUB initiative (see www.iahs.info for details) aims at achieving major advances in the capacity to make reliable predictions in ungauged basins. Recently a PUB secretariat has been launched at the International Water Management Institute (IWMI) in Colombo, Sri Lanka. The thematic working groups (TWGs) and the national working groups (NWGs) are formed under the science steering committee of PUB. Japan, China, Korea, Nepal, and Thailand have actively promoted the PUB research to solve their problems in hydrology and water resources cooperatively. One of the PUB research topics in Japan is to develop a model evaluation method that accesses model performances and prediction uncertainties. This is a base to establish a rainfall-runoff modeling guideline to recommend a suitable hydrologic model in gauged and ungauged basins. The presentation includes flood disasters and flood runoff modeling in Japan, fundamental research issues to establish a hydrologic modeling guideline, and PUB activities especially in Asian countries.

Flood runoff modeling in Japan
Pioneering works for flood runoff modeling in Japan include the physically based hydrologic modeling by Ishihara and Takasao (1959, 1962), who achieved the theoretical development of the kinematic wave model for hillslope rainfall-runoff phenomena and proposed a variable sources area concept. Kimura (1960) proposed the storage function method, which is a simple nonlinear reservoir model. This model is still widely used for estimating design floods in Japanese river basins. The tank model proposed by Sugawara (1972, 1995) is another widely used model in Japan. In the last two decades, many studies have been conducted to analyze the relations between runoff and catchment properties such as topography, land use, soil types and so on. The relations between lumped and distributed hydrologic modeling structure have also been a major research topic. Physically based distributed models have been constructed and applied together with the development of numerical geographic information and radar rainfall observation technology. These models are extended to include dam reservoir operations to analyze human-nature interactions. To apply hydrologic models to continental scale basins with atmospheric general circulation models is also actively conducted to access water resources in global scale.

Need of model evaluation method and modeling guideline
To wisely apply hydrologic models, we need a modeling guideline that suggests a suitable model with settings such as model resolution, input data resolutions, parameter identifications and so on. The storage function method is still widely used in practical engineering works in Japan, though many models having more physically-based hydrologic background have been proposed. One of the reasons for not applying newly developed models in engineering purposes is that there exist no well-defined methods or indices that can intercompare the performances and predictive uncertainties among different models. The well defined evaluation method is also important to understand the insufficiency of existing models, which leads to develop an innovative next generation hydrologic model.

Fundamental research issues for establishing modeling guideline
The results of a hydrological model depend on many factors, including the forcing inputs, process descriptions, parameters and landscapes. It is not easy to define their importance and compare their influences in the modeling. Accurate descriptions of forcing inputs, process description, parameters and landscapes are practically impossible because of their heterogeneity in space and time. However, existing knowledge in hydrology has already identified important processes and their limitations in describing the rainfall runoff processes. In addition, scales and scaling effect are also significant in hydrological modeling. There exist certain thresholds in forcing inputs, parameter distributions, process recognitions and the landscapes that provides an acceptable accuracy in the modeling results. It is necessary to investigate these issues in detail and to identify the thresholds that define the appropriate scale of observation, process description, parameters and landscapes for establishing the modeling guideline.