C-06

Probabilistic short-term flood stage prediction using a distributed rainfall-runoff model

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1. Introduction

A procedure for probabilistic forecasting of watershed flood stage conditions considering rainfall at a fine spatial and temporal resolution, and using a distributed physical rainfall-runoff model, is introduced. Additionally, in order to achieve an accurate real-time flood stage forecast, a distributed adaptive updating procedure is developed to utilize observed discharge data in real time.

2. Probabilistic flood stage forecasting

A probabilistic short-term forecast of the flood stage throughout a watershed is proposed, based on a rainfall translation model and a distributed rainfall-runoff model. Consideration is given to the effects of uncertainty in the rainfall forecast, as well as hydrological uncertainties.

3. Precipitation uncertainty: Monte Carlo simulation

A translation vector model for analysis of rainfall pattern movement is extended to include a time series analysis of observed pattern translation to allow for stochastic generation of future rainfall patterns. Autoregressive integrated moving average (ARIMA) models are fitted to the translation model parameters and a simulation is conducted to generate future rainfall patterns. These rainfall patterns are input into a distributed rainfall-runoff model, resulting in a distributed ensemble forecast of flood stage.

4. Hydrological uncertainty: adaptive updating

Real-time discharge observations are used together with the distributed rainfall-runoff model to improve the ability of the model to forecast future discharge rates. A recursive updating algorithm that uses discharge observations at a limited number of observation points in a watershed is developed to update the state of the rainfall-runoff model's surface and subsurface discharge.

5. Application

The flow routing map for the Nagara River watershed, Japan, is shown in Figure 1.

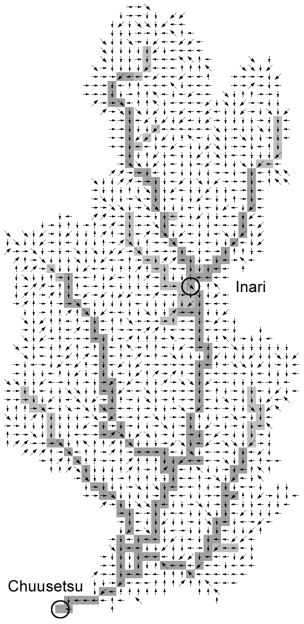

Figure 1: Nagara River flow routing map

An ensemble forecast example for the watershed mouth located at Chusetsu for a 6-hour period commencing at 11/9/2000 20:00 is shown in Figure 2.

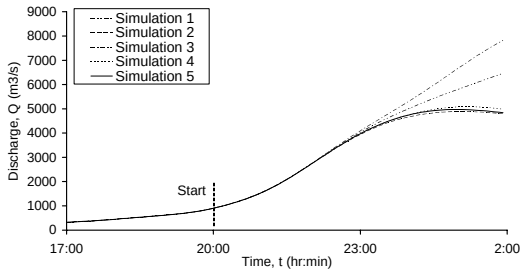

Figure 2: Simulated future discharge for Inari

6. Conclusion

The probabilistic forecast of the distributed flood stage within a watershed is of value when making decisions regarding flood mitigation and warning, considering risk on both a temporal and spatial scale.