P-39

Flood Prediction System with Weather Radar and Distribute Hydrologic Model – Case Study for Typhoon Rusa, 2002

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1. Introduction

A deterministic flood forecast specifies a point estimate of the predicted values, such as precipitations and river stages/discharges. On the other hand, a probabilistic forecast specifies a certain probability distribution function of the predicted values. The predictive probability in a probabilistic forecast is a numerical measure of the certitude degree about the intensity of a flood event, based on all meteorological and hydrological information utilized in the forecasting process. Recent trend of flood forecast is away from the conventional simple deterministic forecasts of hydrographs toward offering probabilistic forecasts, which include its prediction uncertainty.

2. Methodology

This study presents a real-time flood forecast algorithm in probabilistic way with radar image extrapolation model and distributed hydrologic model.

First, new attempt of ensemble rainfall prediction is presented with radar rainfall prediction and spatial random error field simulation. The extrapolation model gives deterministic rainfall prediction, and its prediction error structure is analyzed by comparing with the observed rainfall fields. With the analyzed error characteristics, spatial random error fields are simulated using covariance matrix decomposition method. The simulated random error fields, which successfully keep the analyzed error structure, improve the accuracy of the deterministic rainfall prediction. Then, the random error fields with the deterministic fields are given to a distributed hydrologic model to achieve an ensemble runoff prediction.

Second, the Kalman filter theory is coupled with a distributed hydrologic model to update spatially distributed state variables and to incorporate the uncertainty in the rainfall forecast data. At this moment, rather than direct implementation of conventional Kalman filter concept into a distributed model, this study suggests several techniques, such as (1) using a ratio of simulation and observation results to update spatially distributed state variables efficiently and (2) Monte Carlo simulation of state variables and its error covariance. A distributed model coupled with the Kalman filter gives improved forecasting accuracy.

The real-time forecasting algorithm is applied to Gam-cheon basin, South Korea with Typhoon Rusa flood events, which was one of the most disastrous floods in 2002.

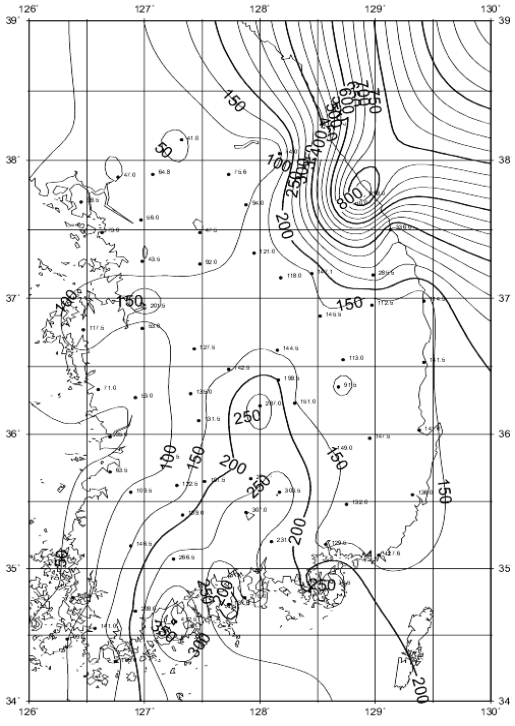

Fig. 1 Isohyetal map of Korea Peninsula during Typhoon Rusa (Aug. 31 ~ Sep. 1, 2002)