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1. Introduction

To get a good rainfall-runoff simulation result, not only to set model parameters precisely but also to give proper initial state variables is important. Furthermore, if there is a big difference between simulated discharge and observed discharge in real time simulation, updating parameters or state variables is unavoidable. State variables in most distributed hydrological models are defined as storage amount all over a basin and its spatial distribution.

Updating state variables gives much effect on a simulation result, especially when the model is a distributed one. Because considerable amount of storage is already distributed all over the basin and it is almost impossible to measure that. Thus, when we use a distributed model for real-time flood prediction, how to update the spatially distributed state variables is a quite important issue to obtain accurate prediction.

This study introduces an efficient method to update state variables in a distributed model during simulation. The variables updating is an essential fore-step for data assimilation or filtering in real time simulation.

The grid-cell based distributed runoff model [1] is used for this study, which is developed at Flood Disaster Research Laboratory, DPRI of Kyoto University. Program downloading is available at <http://fmd.dpri.Kyoto-u.ac.jp/~flood/cellModel/cellModel.html>. The model is applied to the Kamishiiba Dam basin (area: 211.0km²) of Kyushu area for two flood events; Event 1 (97/9/15~9/19) and Event 2 (99/6/24 ~7/3).

2. State variables updating

This research tested two kinds of method to update state variables. Here, the state variables are water depth at all computational nodes by the specified state-discharge relationship incorporating saturated-unsaturated flow mechanism [2].

One method is to update the water depth of every cell using steady state condition, which means

setting the depth proportionally according to the upper cell number of each cell. This method is named as steady-state method.

The other method uses the simulation result right before the updating. Under an assumption of similarity, the ratio calculated from observed discharge and simulated discharge is multiplied to all the states variables of each cell.

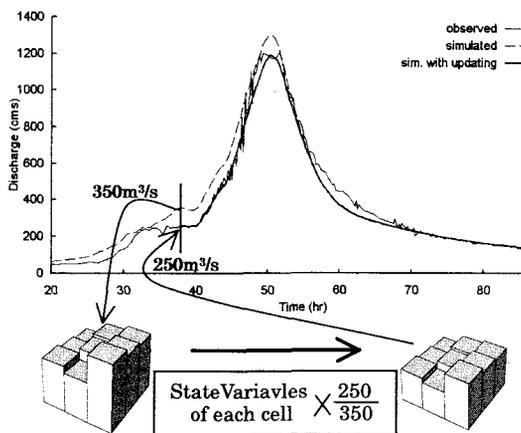


Fig. 1 Reset the storage of each cell with the ratio

As for example in Fig.1, the simulated discharge at 38th hrs is 350m³/s and observed one is 250 m³/s. The ratio 250/350 is multiplied to all the discharge of each cell at 38th hrs, then, it is converted to the water depth. And, the simulation starts again using the updated water depth as an initial condition. This method is named as ratio method.

According to the testing results (Figs.2 and 3), the steady-state method does not show good updating results; also it makes a big discrepancy at the peak. On the other hand, the state variables are successfully updated with the ratio method. When the variables are updated properly, better simulation results can be obtained than when the variables are not updated.

Updating time point of Event 1 does not make much difference in the result. But, results from Event 2 show some effect on updating point choice. Several reasons could be considered;

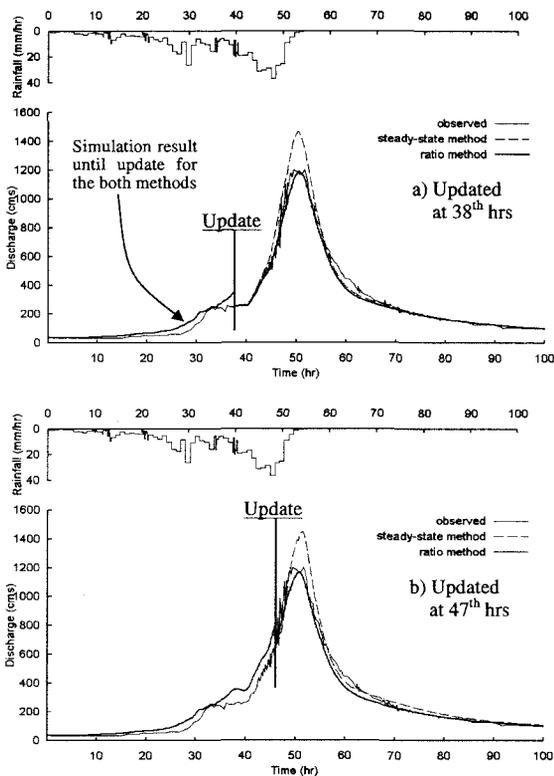


Fig. 2 Reset the state variables of Event 1

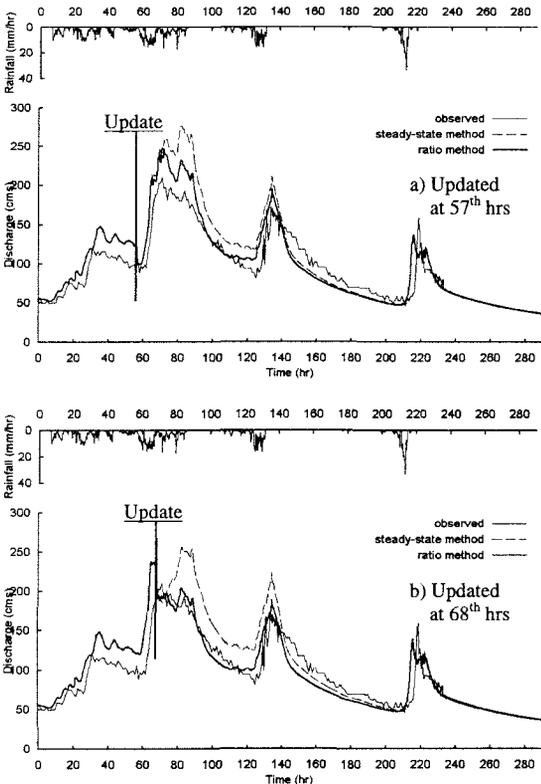


Fig. 3 Reset the state variables of Event 2

1) the difference between simulated and observed discharge at the updating point, 2) the type of flood event; whether it has one peak or multi-peak. Several steps of updating can solve the difficulty to choose appropriate updating point.

3. Summary

It is possible to improve real-time forecasting accuracy if the updating method introduced here is conjoined with some data assimilation, and if new observed data is available for the several steps of updating. Figure 4 shows improved forecasting accuracy by three steps of updating with observed data. This case may be regarded as one type of data assimilation when the observed data are believed as accurate.

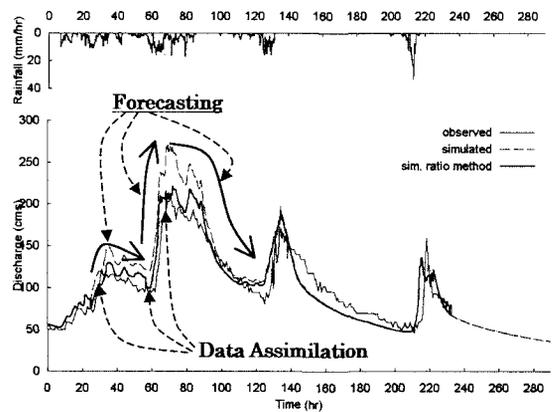


Fig. 4 Expected result from data assimilation

To carry out appropriate data assimilation, uncertainty of observed data should be considered, and Kalman filter could be a good method to carry out that. Data assimilation with Kalman filter to the grid-cell based distributed runoff model is under way.

4. References

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