APPLICABILITY OF RADAR DATA TO FLOOD FORECASTING: A STUDY OF THE JINZU RIVER BASIN, JAPAN

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1. Introduction

Radar data offers a preference method over ground-based rainfall in the capturing rainfall which allowed real-time data and high spatial resolution information. Kim *et al.* (2006)[1)] concluded that using radar rainfall data give fine-resolution input to a distributed hydrologic model. This study is designed to evaluate performance of utilizing C-Band and XRAIN datasets for flood forecasting in a river basin with distributed hydrologic model, Integrated Flood Analysis System (IFAS).

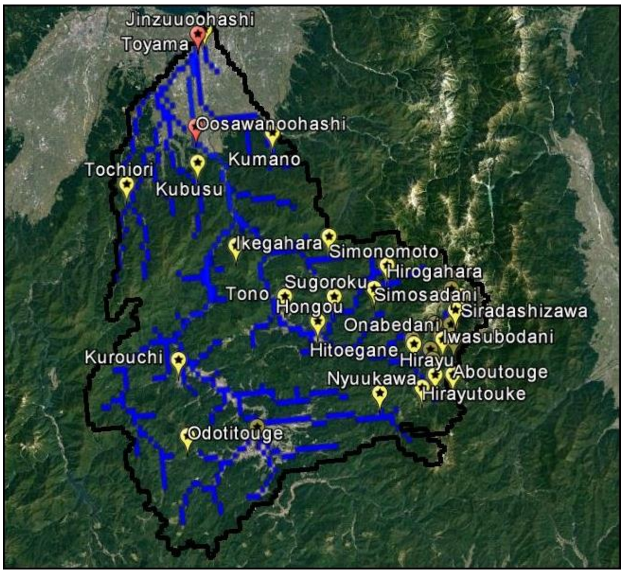

Fig.1 The Jinzu River Basin. (Copyright Google Earth)

2. Study Area

The Jinzu River was selected for this study according to history of flooding. The Jinzu River is the longest river in Toyama Prefecture which has approximately 120 km long and 2,720 km^2 of catchment area. The upper river basin is mostly occupied by natural forest and some parts are herbaceous with sparse vegetation, while residential areas, paddy field, and cropland stretching from the foot of the mountains to river mouth. The Ministry of Land, Infrastructure and Tourism (MLIT) has 29 ground gauges and two measurement discharge stations (Jinzuuohashi and Oosawanoohashi) as watershed management and disaster prevention tools in the Jinzu River.

3. Methodology

IFAS was developed by International Center for Water Hazard and Risk Management (ICHARM) for flood forecasting using a geographic information system. This program uses a modified tank model, the PWRI distributed model, as the basis for modeling. The model is divided into surface, groundwater, and river channel model that have to be calibrated.

4. Data

The digital elevation model (DEM) and land use data are derived from Global Map which is created by the International Steering Committee for Global Mapping (ISCGM). For both the DEM and land use, the Global Map datasets have a horizontal grid (1 km mesh) spacing 30-arch seconds. Three types of rainfall data were used as inputs to the IFAS model: ground-based, C-Band, and XRAIN datasets. Since XRAIN which have been installed in purpose of heavy rain disaster prevention belong to the latest datasets, the availability is limited from 2011. Hence, representative sample was taken from 2011 to 2014. Total ten cases were considered in this study with the provisions of peak discharge above 900 m3/s.

5. Objective Function

According to the Japan Institute of Construction Engineering (JICE), the performance of a hydrology model can be evaluated based on three errors indicators: the wave shape error (E_w), volume error (E_v), and peak discharge error (E_p).

6. Result and Discussion

The performance of the radar datasets was determined by comparing its results with the rainfall amount as observed by ground gauges. C-Band datasets as well as ground-based data cover whole of The Jinzu River Basin. However, there was small segment of mountainous area that could not be reached by XRAIN radar. This is probably related to the detection range of XRAIN radar is limited and shorter than typical range of C-Band radar. Both observations made by C-Band and XRAIN datasets show high degree of agreement and accuracy in term of spatial rainfall distribution. C-Band datasets has tendency of overestimated rainfall value in almost cases. On the contrary, XRAIN datasets provide underestimated rainfall intensities in mostly cases compared to ground-based rainfall. Average rainfall in the whole of river basin was also analyzed. XRAIN datasets present large difference of total rainfall in almost area river basin, mainly faraway places from XRAIN radar. Furthermore, it failed to catch heavy rainfall. Ground-based, XRAIN and C-Band datasets were imported in the hydrologic model and it was calibrated manually using the observed discharge. The simulated river discharges were evaluated using the observed discharge to estimate the applicability of radar datasets regarding to flood forecasting. The IFAS model simulations using ground-based data matched in many cases. Well relationship with the observed discharge was expressed by C-Band and XRAIN simulations in some cases as well. However, C-Band runoff model tends to generate overestimated discharge. In other hand, IFAS model simulations using XRAIN datasets seem to be an underestimate value particularly for peak of discharge due to extremely difference of rainfall intensities by attenuation.

7. Conclusion

The achieved of this study are listed below.

1. The C-Band and XRAIN datasets has well agreement with ground-based data in term of distribution rainfall. However, C-Band datasets has tendency to give overestimated rainfall while, XRAIN datasets provide underestimate rainfall intensities when those are compared to the ground-based data.
2. IFAS Simulation using ground-based data fairly produced good results in almost cases. C-Band and XRAIN datasets also give considerably well simulation results in several cases.
3. C-Band in combination with XRAIN datasets might can be an alternative data for flood forecasting in The Jinzu River.

8. References

1. Kim, S., Tachikawa, Y., Takara, K. : Flood forecasting system using weather data and a distributed hydrologic model, *Annuals of Disaster Prevention Research Institution, Kyoto University*, No. 49 B, 2006.

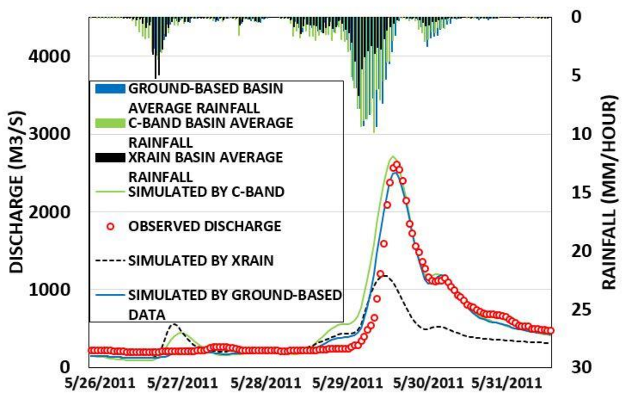

Fig.2 Simulation for Jinzuuoohashi station in case 1.

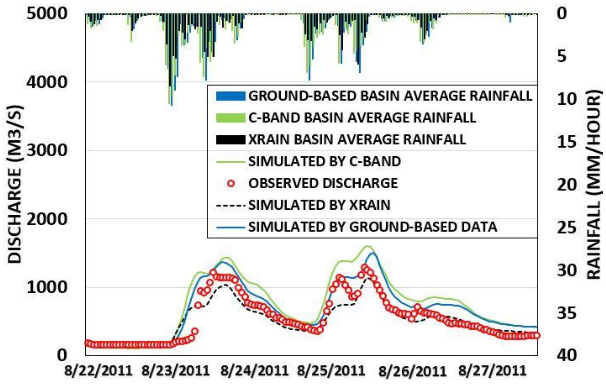

Fig.3 Simulation for Jinzuuoohashi station in case 3.

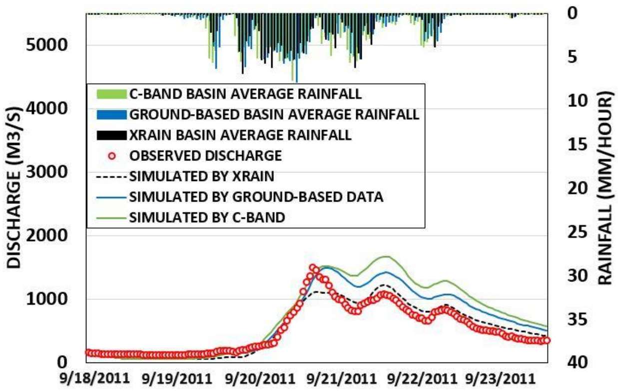

Fig.4 Simulation for Jinzuuoohashi station in case 4.

Table 1 Simulation result

Data	Case	Ew	Ev	Ep
Ground	1	0.07	0.01	-0.04
	3	0.16	-0.21	0.15
	4	0.17	-0.23	-0.007
C-band	1	0.27	-0.08	0.03
	3	0.34	-0.35	0.24
	4	0.27	0.29	0.11
XRAIN	1	0.24	0.31	-0.54
	3	0.10	0.07	-0.12
	4	0.11	-0.008	-0.18