Ⅱ－25　SEASONAL SNOWMELT RUNOFF PREDICTION BY USING REMOTE SENSING DATA AND TANK MODEL

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ABSTRACT: Runoff of the large basin which is covered by snow during winter time was analyzed for the period of early spring to late summer. Such analyzing process requires only daily precipitation, temperature and remaining snowcover area. The remaining snowcover area was estimated by utilizing NOAA-AVHRR. Snowmelt runoff at the dam site was predicted by tank model which its parameters can be obtained by optimization technique for one year and using to predict runoff of another year.
Keywords: runoff, snowcover, NOAA-AVHRR, snowmelt, tank model

INTRODUCTION

Snowmelt runoff of the large basin is the significant input for hydropower and irrigation purposes, planning must take care of this time series runoff closely during spring season. Among various models used to predict that runoff, one of the most popular model is tank model which was developed by **Sugawara**(see also **Sugawara** et al.,1984), the model shows some superiors such as the model structure is less complex and the model can be applied for all basin sizes efficiently.

STUDY BASIN AND METEOROLOGICAL DATA

Tadami river basin at Taki dam, catchment area 1991.4km^2, was selected to prove the usage of snowcover area from NOAA for runoff model. The basin is the headwaters of Agano river(see **Fig.1**), which locates in Fukushima Prefecture, within the basin, there are six dams, nine intake dams and one diversion point. The meteorological data data of the basin is observed at four stations and daily runoff is observed at six dam sites. The basin representative data input to the model is calculated among these stations.

EMBEDDING SNOWCOVER AREA TO TANK MODEL

The basin is divided into four subbasins by contour lines as shown by **Fig.2**, the snowmelt component of tank model is modified by inserting the ratio of snowcover area to subbasin area and is expressed hereunder:

$$QSMZ_j = SCRZ_j \times TZ_j \times (CSM_j + P/80) \qquad \text{if } TZ_j \geq 0$$

$$= 0 \qquad \text{if } TZ_j \leq 0$$

where $QSMZ_j$, $SCRZ_j$, TZ_j, CSM_j are snowmelt, ratio of snowcover area from NOAA data, air temperature and snowmelt factor of zone j respectively, P is precipitation which is assumed constant over the basin. The air temperature of each zone is obtained by adjusting observed data with lapse rate curves. Snowmelt from all zones are combined through zonal area-weighted average and put into the top tank together with precipitation(see **Fig.3**). Evapotranspiration from the top tank is the average value between **Thornthwaite**'s method and **Hamon**'s method, the distribution of evapotranspiration between zones is also considered.

MODEL CALIBRATION AND PREDICTION

There are totally twenty model parameters and suitable values are obtained by Powell's conjugate direction method(**Powell**,1964), the result from calibration for daily runoff of water year 1988 is shown in **Fig.4**.
Calibrated parameters are verified through the predicting stage of runoff of water year 1989 and 1990, **Fig.5** and **6** show these results.
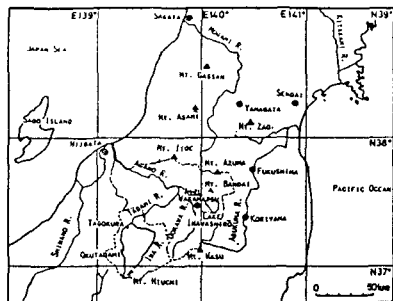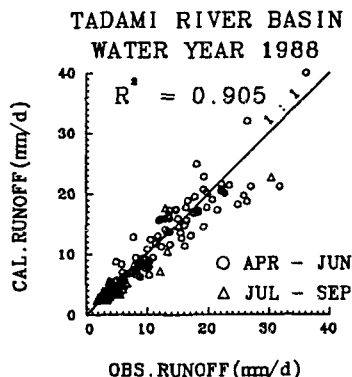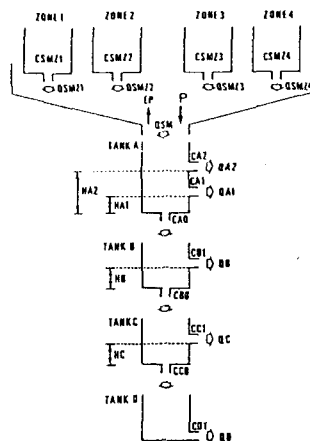
Fig.1 Location of basin

Legend: -700m, 1100m-1500m, 700m-1100m, 1500m-

Fig.2 Zonal subbasins

Fig.3 Tank model

TADAMI RIVER BASIN WATER YEAR 1988

$R^2 = 0.905$

CAL.RUNOFF (mm/d) vs OBS.RUNOFF (mm/d)

O APR – JUN
△ JUL – SEP

Fig.4 Model calibration

TADAMI RIVER BASIN WATER YEAR 1989

$R^2 = 0.793$

PRED.RUNOFF (mm/d) vs OBS.RUNOFF (mm/d)

O APR – JUN
△ JUL – SEP

Fig.5 Model prediction

TADAMI RIVER BASIN WATER YEAR 1990

$R^2 = 0.694$

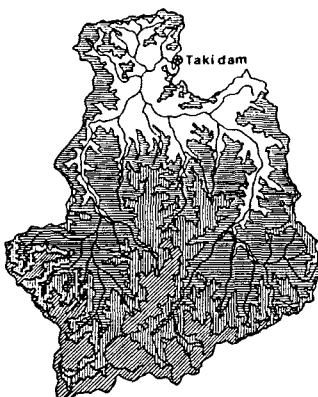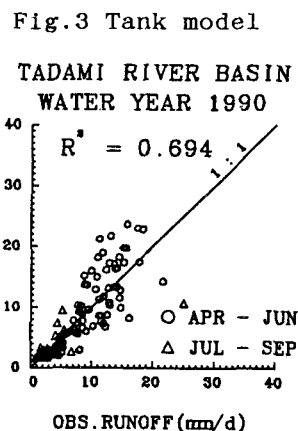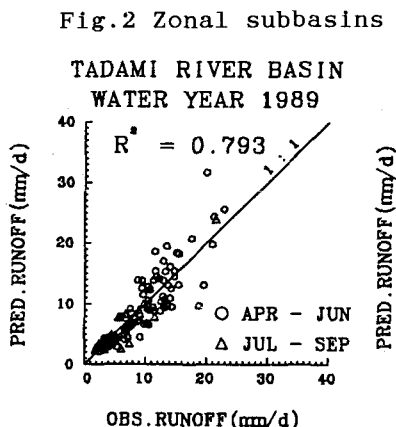PRED.RUNOFF (mm/d) vs OBS.RUNOFF (mm/d)

O APR – JUN
△ JUL – SEP

Fig.6 Model prediction

RESULT AND DISCUSSION

Result from calibration of water year 1988 reveals that the snowcover area evaluated from NOAA data can be used as basin data base for evaluating seasonal snowmelt runoff of large basin at some level of accuracies. Even prediction mode of the model shows some deficiencies ,especially, for water year 1990 the runoff of early spring is overestimated because the drastic decreasing runoff to about 66% in 1990 but the seasonal amount is in agreement.

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