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Automatic calibration of Sugawara's tank model works?-Yes,it works!

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I. PURPOSE

This paper shows that Sugawara's tank model and his automatic calibration method work well to describe the precipitaion-runoff system in Honduras.

II. DESCRIPTION OF DATA.

The study area is a sub-basin of the Humuya river, located in the central region of Honduras with 1932.60 km^2 of area and elevations ranging from 200 m to 2744 m. The following hydrological information of the study area was obtained through the Department of Hydro-climatology of the Honduran Water Resources Bureau.:

Data Name	Location	Station #	Available Period	Data Type
Rainfall	Humuya Basin	3	1970 - 1981	DailY
Streamflow	Humuya Basin	2	1968 - 1982	Daily
Evapotranspiration	Humuya Basin	1	----	Mean Monthly

III. METHOD.

The tank model of four tanks was used to describe the precipitation-runoff system in a sub-basin of the Humuya River. The tank model parameters were determined automatically using the following procedure[1].

At first, the computed hydrograph resulting from an initial model sugested by Sugawara was divided into sub-periods according to the ratio of individual discharge components. After that, the volumes of the calculated and observed discharges in each sub-period were compared using the following criteria:

$$RQ(I)=\sum_{I} QE(J)/\sum_{I} Q(J) \quad \ldots\ldots\ldots\ldots \quad (I=1,2,\ldots\ldots.) \qquad (1)$$

$$RD(I)=\frac{\sum_{I}'(\log QE(J-1)-\log QE(J))}{\sum_{I}'(\log Q(J-1)-\log Q(J))} \quad \ldots\ldots\ldots \quad (I=2,3,4) \qquad (2)$$

where: I= Index number of the sub-period ; J= Day Number
Q,QE = Are the Observed and Estimated Diacharges
$\sum_I$ = Sum over the J days belonging to the sub-period I
$\sum_I'$= Sum over the J days belonging to the sub-period I for which QE(J-1)-QE(J) is positive.

Then, the runoff and infiltration coefficients of tanks were adjusted using feedback formulae including RD and RQ values. For example, the feedback formulae for the first tank are as follows:

$$A0'=(A0+A1+A2)/(RD(2)*(1+A+B)),$$
$$A1'=B*A0, \quad A2'=A*A0, \quad \text{when } A=(A2/A0)/RQ(1),\ B=(A1/A0)/RQ(2). \qquad (3)$$

where, A0,A1,A2: old parameters, A0',A1',A2': adjusted parameters. The selected parameters are the ones that made the following criterion CR minimum :

$$CR = (MSEQ+MSELQ)/2 \qquad (4)$$

where: MSEQ = Mean square error of discharge.
MSELQ =Mean square error of logarithms of discharge.

IV. RESULTS AND DISCUSSIONS.

Fig.1 shows the observed and estimated discharges with the selected tank parameters. The CR value of the initial tank was 0.4869, while that of automatically calibrated tank was improved to 0.2478 after 8 iterative process. From this graph, it was found that this method is applicable to simulate the precipitation-runoff system in small river basin, where streamflow data is scarce. Due to the lack of local soil moisture information, this factor was not considered. The consideration of this factor would improve the adjustment.

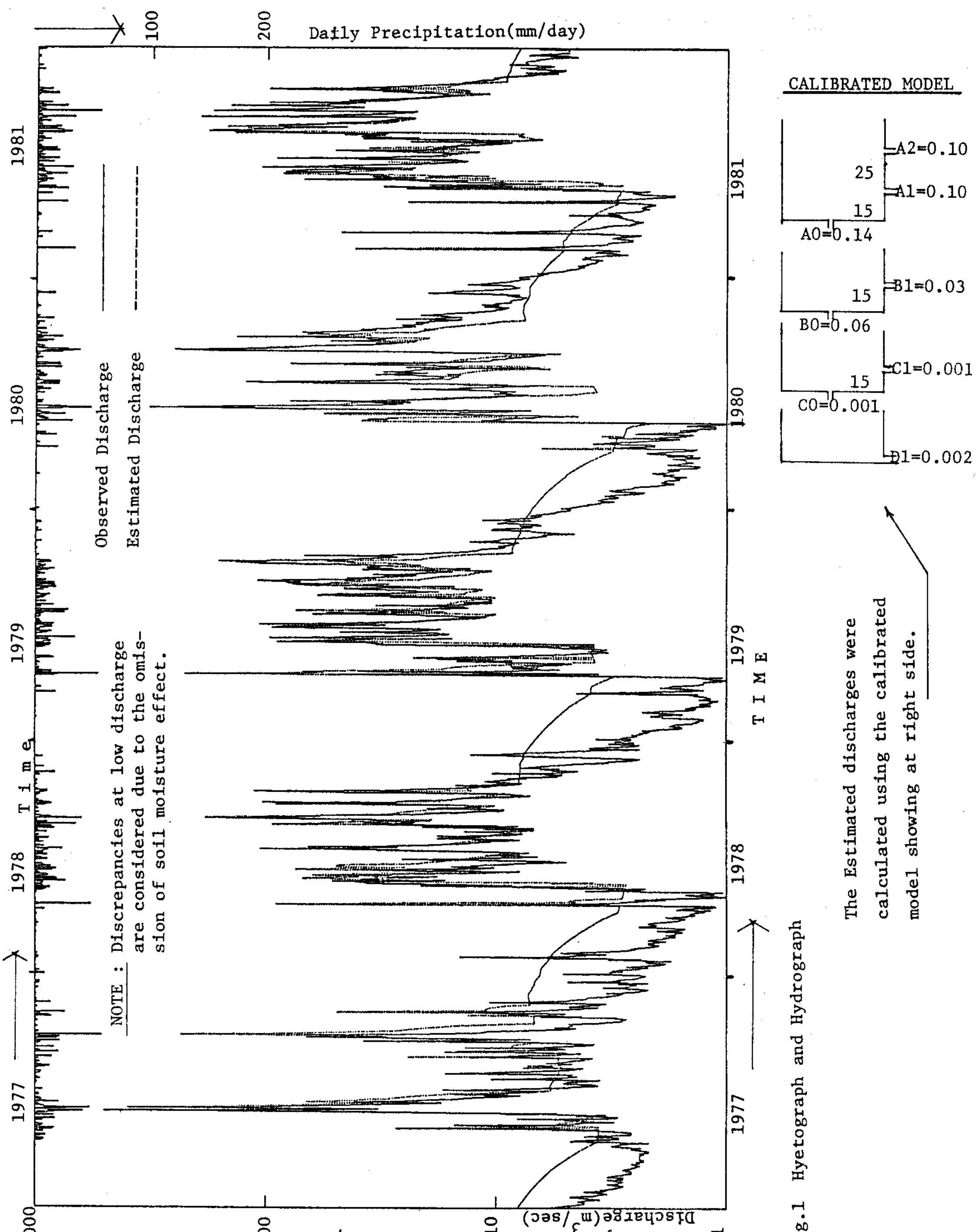

Fig.1 Hyetograph and Hydrograph

V. REFERENCES.

1. M.Sugawara, I.Watanabe, E.Ozaki and Y.Katsuyama :Research notes of the Japanese National Research Center for Disaster Prevention. NO.65, Japan, November 1984.