DETERMINATION OF TEMPORAL OCCURRENCE OF RAINFALL IN UNGAUGED BASINS (CASE STUDY: ORUMIEH-IRAN)

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Nowadays there are several rainfall-runoff models which are used for flood hydrograph simulation. Due to the lack of rain gauges inside area of the many of the small basins, the nearest gauges data is used as the basin hyetograph. To simplify the model in most of the studies, it is assumed that the shower storm arrives over the watershed area quickly and stays there stationary (Lima, 2003). This assumption cause temporal difference between observed and simulated hydrographs which may be covered by other temporal parameters such as time of concentration (t_c) and lag time (t_l).

For this purpose the mathematical models were simulated using HEC-HMS and the parameters of the model calibrated using the recorded rainfall-runoff events of the nearest gauging station. In the study area there are no recording gauges so the time of rainfalls were not defined (Figure 1) so the temporal occurrence of rainfall in the sub-basins was determined by the following steps:

 – Time of Gravity Center of hyetograph (TGCH) was determined by using the HYGC program for each event at stations surrounding the study area (Figure 2).
 – Plate equations that are passing through the TRGC of stations were determined for the events (Figure 3).
 – The centroid measures of sub-basins were placed in the above equations to determine the TGCH of sub-basins.
 – The hyetograph of the nearest station was shifted as its gravity center conformed to sub-basins centroid (Figure 4).

The flood hydrographs of sub-basins were simulated using both shifted and non shifted hyetographs. The peak discharges of simulated hydrographs were compared with the recorded hydrographs (Figure 5).

There were 12 recorded hydrograph for 7 events in 3 station gauges. The results of 9 hydrograph showed that shifted hyetograph leading to better estimation, 2 hydrograph non-shifted hyetograph were better and in one hydrograph there was no difference between them (Table).

The lack of rain gauges inside area of the many of the small basins is one of the errors sources to peak discharge estimation. By using our proposed approach in this study, the temporal occurrence of rainfall could be estimated and the runoff simulation could reach more accurate.
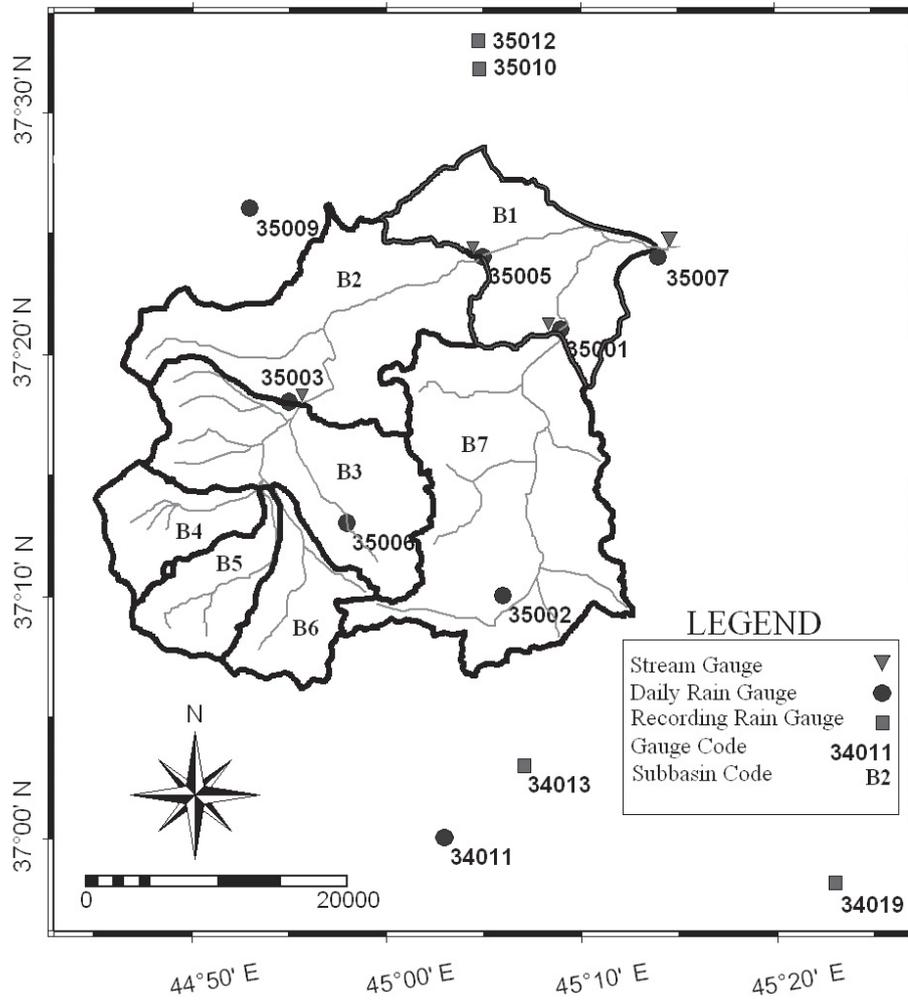
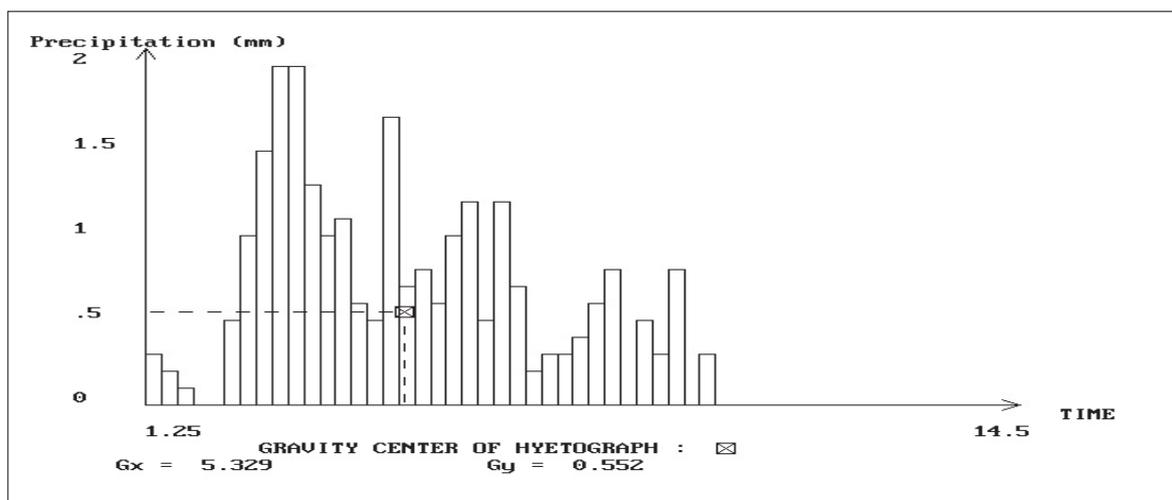Figure 1. The study area in north east of Iran and its gauges

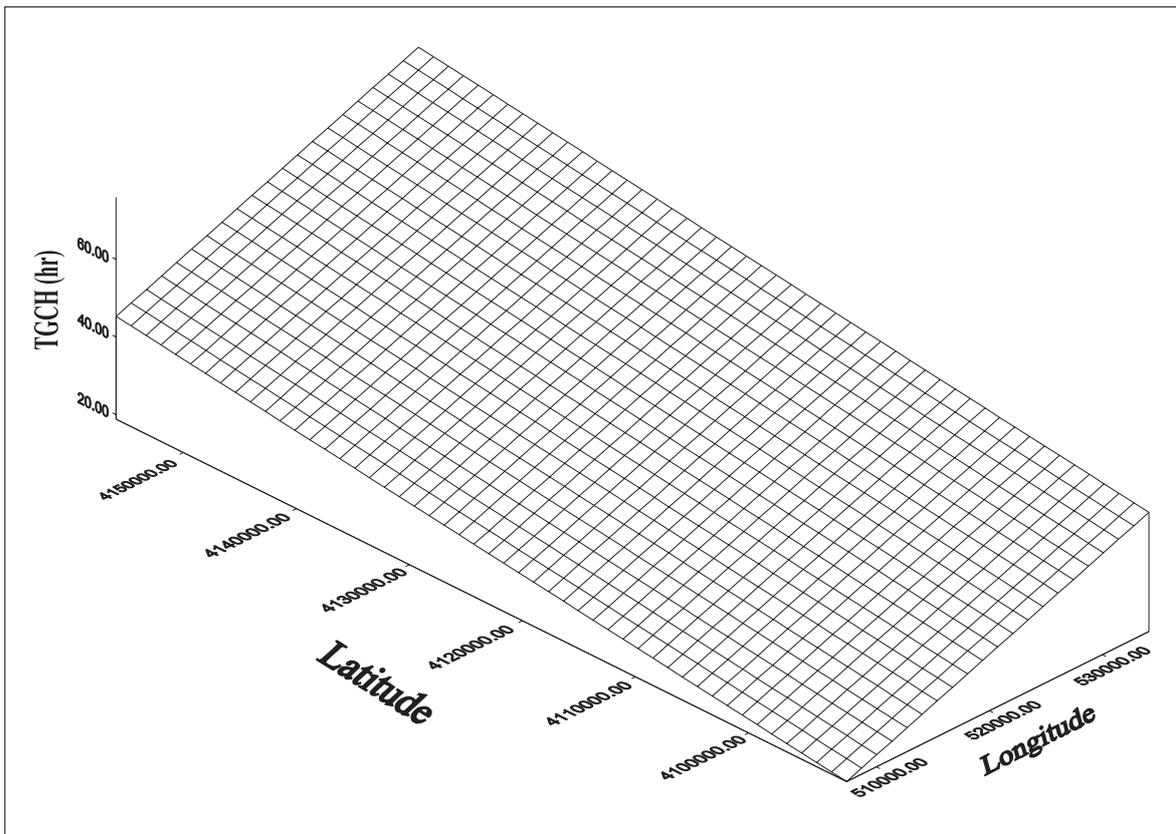Figure 2. Determination of gravity center of hyetograph

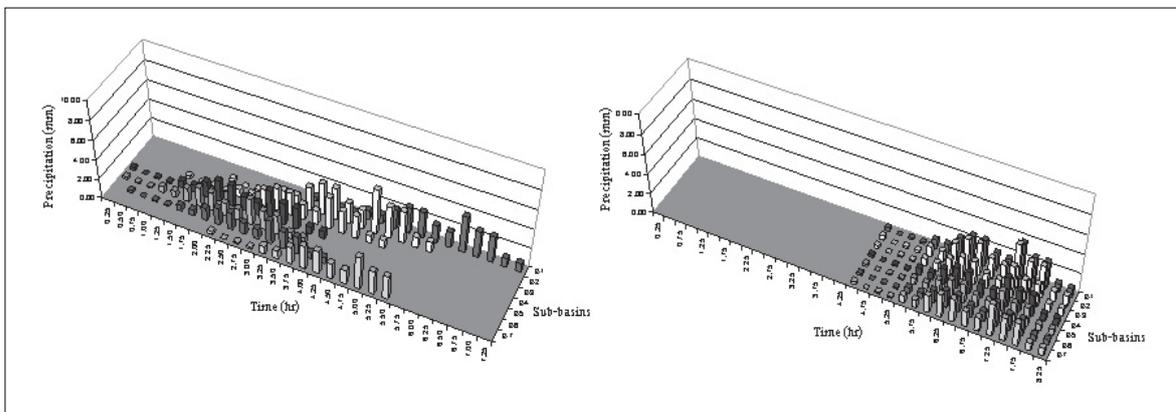Figure 3. Plate of time of occurrence of rainfall gravity center

Figure 4. Hyetograph of sub-basins before shift (right) and after shift (left)
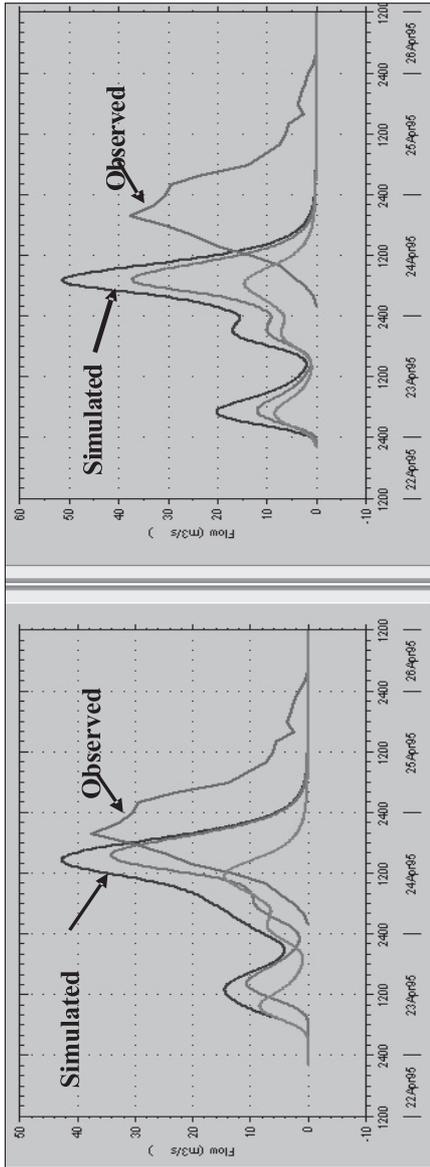
Figure 5. Simulated hydrograph before hyetograph shift (right) and after hyetograph shift (left) at Dizaj station (1995/04/22)

Table 1. Comparison of simulated and observed peak discharge resulted of two type of hyetographs

Date	Gauge name	Dizaj				Bibakran				Ghasemloo			
	Hyetograph type	non shifted		shifted		non shifted		shifted		non shifted		shifted	
	hydrograph	Qp	Diff. (%)	Qp	Diff. (%)	Qp	Diff. (%)	Qp	Diff. (%)	Qp	Diff. (%)	Qp	Diff. (%)
1995/04/22	Observed	37.45		37.45									
	Simulated	51.2	-36.7	42.58	-13.7*								
1995/04/18	Observed	96.15		96.15		85.4		85.4					
	Simulated	100.5	-4.5	100.13	-4.1*	93.8	-9.8	93.57	-9.6*				
1995/04/03	Observed	20.1		20.1									
	Simulated	20.4	-1.5	20.3	-1*								
1993/05/12	Observed	188.6		188.6									
	Simulated	221.6	-17.5	220.1	-16.7*								
1993/04/07	Observed	61.4		61.4		51.9		51.9					
	Simulated	70.15	-14.3	65.6	-6.8*	65.16	-25.5	63.4	-22.2*				
1992/04/21	Observed	65.9		65.9		24.3		24.3					
	Simulated	42.9	34.9*	41.6	36.9	28.8	-18.5	26.1	-7.4*				
1992/04/13	Observed	189.9		189.9		113.2		113.2		83		83	
	Simulated	212	-11.6*	213.3	-12.3	127.7	-12.8	127.3	-12.5*	83.3	-0.4	83.3	-0.4