Developing a Quasi-Temporal GIS For Prediction Time of Concentration in Flood Hazard Modeling

Kambiz BORNA, MohamadReza RAJABI, Ali MANSOURIAN, Majid HAMRAH, Islamic Republic of IRAN

Keywords : Geographic phenomena, Temporal GIS, Flood, Time of Concentration

SUMMARY

When dealing with geographic phenomena we usually are trying to represent some part of the real world with a static nature for them as it is, as it was, or perhaps as we think it will be. Beside spatial, aspatial and topological properties, geographic phenomena also change overtime. And for many applications, as prediction flood, it is this change that is quite Often the most interesting aspect to study. This paper investigates the principal concepts of temporal GIS and flood relevant parameters. Focusing on Time of Concentration that is one of the most important Parameters for prediction flood modeling approaches. Moreover, development of a prototype quasi-temporal GIS could be led to a new model of Time of Concentration. The main advantages of the mentioned model is about increasing the precise of Concentration time evaluattion. As well it could be effectively used for improving flood modeling and decreasing damage to human and infrastructure.

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1 – INTRODUCTION

A lot of research work on data model Spatio-Temporal in the past years has been done. However modeling phenomena Spatio-Temporal Considering the large variety of phenomena and the existence and possibility of change in the real world is a lot of complexity.
Considering the importance that the application of time as one of the pillars of determining the geographic phenomenon must be treated with it as the place component symptoms are treated. In this research the concept of time as a component of the phenomenon of geographic emphasis is to understand the features and models, spatial-temporal and use it for a research project in the field is to examine the flood.

Flood Flows in addition to temporary and non-production waste waters used for people residing around the basin, due to lack of passing and matching crop season and the high volume and short time base for other reasons, first and second cause of soil erosion are in many cases cause damage to agricultural lands and products it is. On the other hand dry and desert areas with low rainfall, to maintain control and descending currents resulting from climate vital to find. Different parameters on the occurrence of floods, which affects one of the important Time of Concentration is.

2. TIME OF CONCENTRATION

Time of Concentration, part of the most important factors affecting the psychological status of water flow and flood peak is the watershed basin. The Time of Concentration of surface currents derived from primary rain outer most basin to allow output location. Time of Concentration, basin depends on the amount and severity of rainfall, length and canal slope, vegetation and previous soil moisture and other characteristics of hydraulic flow path. Not so constant as the Time of Concentration, will provide the basin. So between the various formulas presented in this field has been calculated for the Time of Concentration, basin have broader application of that formula is used. Kirpich,(1940) related the Equation (1) to calculate the Time of Concentration has suggested:

$$T_c = 0.00032 * (\frac{L}{S}) \quad (1)$$

T_c: Time of Concentration (Hours)

L: length of main river (m)

S: slope across the main river (m/m)

River or stream, that all mental water produced in the basin through the basin is discharged, main river or canal is called length and is usually highest. After being identified main canal basin canal network map study, longitudinal profile and slope of the net and gross plot was determined.

3. STUDY AREA

Basin class BOJNOURD two to four degrees below the basin names CHHARKHARVAR and FIROZEH-GRYVAN is. The main way water basin FIROZEH-GRYVAN is. River CHHARKHARVAR the village PAKTEL head of the source and origin of the probe CHENARAN AND ASFYDAN coming to this river. River Firozeh the village ASDLY and started passing the source of GRYVAN and FIROZEH high water and near the park BABAAMAN river CHHARKHARVAR and then joins the station location Hydrometric BABAAMAN in near the village QARLQ and QAREH KHANBANDI river ATRAK River is current. River FIROZEH-GRYVAN part of downtown BOJNOURD and 500 m intervals up to a kilometer from the city to password. Basin CHHARKHARVAR (CHENARAN) area, the environment, the average slope and length of the main road about respectively 275/74 km, 98 km, 7/5 % and 39 km of the basin area that is approximately 22/5 percent of the total Basin area BOJNOURD is. The average height of the basin-scale map 1/50000 is about 1627 meters. Rain with the regression equation Height – rainfall presented the weather report, is 32 mm.

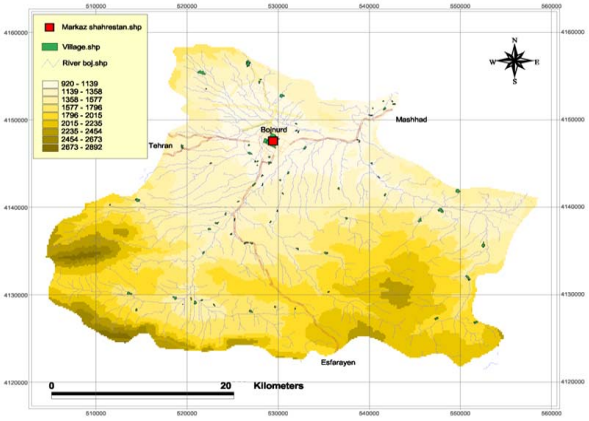

Figure1 : Bojnurd Basin Area

4 . DATA COLLECTION AND PREPARATION

Kirpich formula based on Time of Concentration .the formula proposed for a basin obtained during different time of year that have different modes of rainfall severity and soil moisture is, some will be fixed. While the expected time for a basin that takes raw surface currents derived from the extreme rainfall basin output place to be during different years, has various values. Because the amount of soil moisture, surface evaporation and precipitation in each year when a section values are different. Thus, by collecting data related to your Basin Watershed BOJNOURD this case the problem was investigated. The following position in all stations in the Basin is shown BOJNOURD .

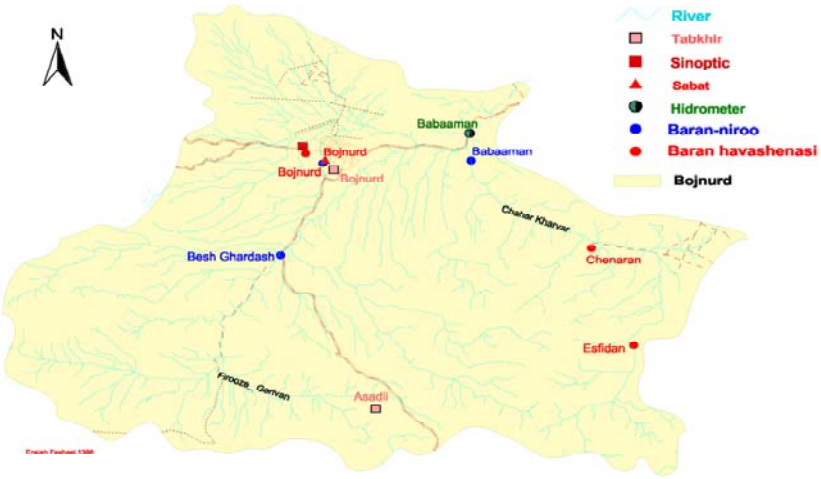

Figure2 : Bojnurd Basin Stations

Rain or snow (Precipitation) include all climate descending like rain and snow and sleet, Hydraulic input cycle in one area is the most important factors that should be studied.

Information about the 23 rain measurement station North KHORASAN Province stations, including location and amount of your monthly precipitation was collected was.

ST	X	Y	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
AlMohammad	554525	4176008	0	24	0	0	108	105	19	52	74	18	27	14
barzoo	585485	4161743	0	1.5	23	17.5	102	101.5	21	41.5	39.5	47	51.5	14
inche-olia	447653	4164188	1	12.5	6	0	28.5	69	13	20	26.5	21	13	14
khartoot	470159	4197568	8	4	0	14	8.5	29	4	15.5	46	17	45	42.5
baba-aman	538644	4147632	0	6.5	6	2.5	103.5	105	17.5	23	38.5	20.5	35	5
ghezelghan	537000	4167000	0	18	20.5	0	75	108	24.5	36	18	10.5	27.5	14
ghatlish	526992	4185123	1.5	2.5	1	1.5	56.5	82	21	18.5	36	16	23	10.5
hese-gah	503132	4168808	22	24	25	0	80	40	100	35	86	25	32	21
darkesh	477596	4144120	8	11	28	60	103	45	80	96	62	41	89	12
gholaman	512801	4211894	3	28	6.5	12	27.5	11	14	5.5	19	13.5	3	10.5
yeke-sood	470376	4225703	2	52	3	19.5	20	17	33	39	26.5	38.5	22	7
ghareghatloo	476826	4233894	9	6	2	5	55	55.5	20	30	38.5	30	33	27
tesh-ghardesh	525209	4140405	0	2	5	1	62.5	80	13.5	16.5	21	10	37	7
chandir-ayrghaye	444440	4225128	13	29	18	1	56.5	61.5	31	40	42	17	32	15
garmikhan	541650	4153273	0	7	4	2	86	99	14	32	31	30	43	8
tarooj	608250	4121587	0	0	15	6.5	53	54.5	12	29	22	53.5	35	2
namenloo	598614	4170344	17.5	11.5	0	66.5	67.5	75	77.5	47	46	39.5	31.5	2
shoorak	561793	4136772	0	0	12.5	5	63	83.5	7	21	16	23	34	7
ashkhaane	492940	4157017	0	4	24.5	9.5	74.5	146	11.5	23.5	10.5	62.5	14.5	22.5
ghale-barbar	516315	4176165	0	15	4	0	72	99	35	30	57	32	38	14
sankhaast	484731	4122788	0	5	3	1.5	45.5	111.5	12	19	22.5	21.5	8	3
khosh			0	0	0	20	35.5	44.5	64.5	42.5	52	25	0	0.5
nooshirvan			0	2	1.5	2.5	88.5	100.5	33	36	21.5	51.5	24	1

Table 1: table of Rain Data in 12 months of year 2008

Figure below, each region rainfall measurement stations in your study of rain in January shows.

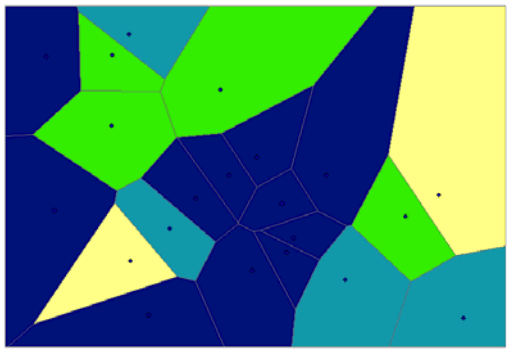

Figure 3 : Voronoi map for Rain Stations

Images following lines aligned position and rain sensing stations in the Basin rain BOJNOURD is displayed.

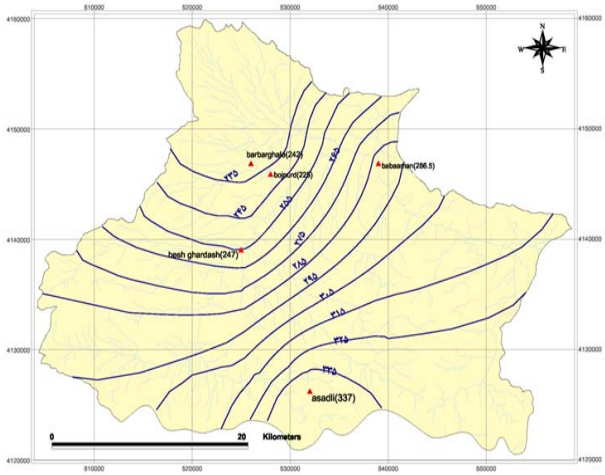

Figure 4 : Contour lines for Rain Data

In the continued process of data collection, evaporation measurement stations in the province of North KHORASAN information on water surface evaporation in a twelve-month period of years brought achieved. Process of converting water vapor to liquid evaporation say. Vaporization may be released from the surface water level or soil moisture as evaporation and transpiration of plants occur in the surface. Evaporation of important phenomena in nature is water flow. Since this phenomenon is the waste of water, dry and semi-arid areas of special importance has . Evaporation measurement stations usually measure evaporation by the Ministry of Energy is done. The aim of the study to estimate evaporation and transpiration evaporation of real places is desired.

For the most accurate method to estimate actual evaporation and transpiration using LAYSYMTR is. By using this cost and time spent on the many, thus its implementation is not possible everywhere. Therefore, various scientific bodies for various experimental methods to estimate actual evaporation and transpiration can

have suggested using meteorological data and methods of utilizing the proposed amount be calculated and estimated.

FID	Shape *	Id	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
0	Point	0	350.	391.8	405.9	331.1	174.1	151.1	102.1	39.500000	25.4	49.6	96.5	164.3
1	Point	0	207.	286.9	255.7	199.3	91.5	86.2	81.9	38.500000	51.1	54.8	62.5	118.1
2	Point	0	286.	352.3	322.7	305.1	122.7	153.2	100.2	53.500000	49.1	67.7	115.4	210.8
3	Point	0	287	365.2	356.4	273.9	125.2	147.3	92.3	32.700000	42.3	45	102.3	185.4
4	Point	0	232	283.1	290.9	242.4	109.3	107	72	30.000000	56.2	63.6	80.3	134.9
5	Point	0	249.	305.9	293.1	248.4	127.9	105.6	64.2	20.800000	27	47.5	65.1	166.7

Table 2: table for Evaporation data in 12 months of year 2008

Considering that the soil absorption rate of mental speed in water affects therefore collect information relative humidity of soil was done. Because the relative humidity levels in the earth time is different in different years as a result of information that we try to twelve months of the year to bring the denotative obtained.

FID	Shape *	Id	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12
0	Point	0	38	37	36	35	52	54	51	70	63	48	42	44
1	Point	0	48	43	34	38	51	52	52	62	57	55	51	48
2	Point	0	42	37	41	41	67	62	55	68	70	64	55	43
3	Point	0	33	31	37	43	75	65	59	80	72	60	48	45
4	Point	0	56	54	51	52	73	76	71	82	81	72	52	44
5	Point	0	43	39	41	50	68	66	61	77	71	66	61	53

Table 3: table for Soil Absorption Rate data in 12 months of year 2008

Continue with your studies was determined that the Time of Concentration with the severity of rainfall will be related. Severity rainfall, the height ratio between changes in precipitation changes is time. When determining the dimensions of many structures such as dams, urban sewage channels, bridges, river engineering works, home matches and Watershed Management, designed to harmonize them with the severity of the floodwater from the password will be most important as it is in turn proportional with the severity of rain is considered.
Calculate the rainfall severity, whatever the time is shorter by rainfall severity increased. On the other hand, a shower soon return period is longer than the more severe it will be. Relations severity - time shower with their frequency of occurrence varies in different regions. Basically, the exact analysis of shower rain gauge short-term help is possible for the Study of Israel and durable shower less than 24 hours need statistics rain gauge is fixed. Such measurements in a small number of rain gauge stations of the Ministry of Energy is measured and recorded. Therefore access to these views and do statistical analysis on them is not possible everywhere. Severity rainfall amounts in the table below the base station in the Back of course shows.

T Back						time
100	50	25	10	5	2	minute
121.47	108.27	94.94	76.92	62.59	40.95	15
97.03	86.48	75.84	61.45	49.99	32.71	20
81.75	72.86	63.89	51.77	42.12	27.56	25
71.2	63.45	55.65	45.08	36.68	24	30
63.43	56.53	49.57	40.16	32.68	21.38	35
57.44	51.19	44.89	36.37	29.59	19.37	40
52.67	46.94	41.16	33.35	27.13	17.76	45
48.76	43.46	38.11	30.88	25.12	16.44	50
45.5	40.56	35.56	28.81	23.44	15.34	55
42.73	38.09	33.4	27.06	22.02	14.41	60

Table 4: table for Rainfall Severity data in past 2, 5, 10, 25, 100 years for specified minutes in Bojnurd Basin

5 – INVESTIGATION

Review data with rainfall, humidity and soil surface evaporation and using the empirical formula Kirpich separately for each month of the year realized that the above formula for a basin can not be your latrine universality and separated slope of the main figures and gross water path length is dependent on other parameters. In this research affiliation parameter Time of Concentration with rainfall, relative humidity of soil, surface evaporation rate and severity of precipitation any time of the year was reviewed.

The results of this analysis suggested revisions will be given the change in formula Kirpich using new factors can predict precisely the Time of Concentration. A parameter K to the same formula to this we add to the overall impact of three factors at the Time of Concentration the desired we calculate.

$$T_c = K * 0.00032 * (\frac{L}{S}) \quad (2)$$

Studies that Time of Concentration of year that rainfall in most months in, the rate of evaporation rate and lower relative humidity more soil is reduced. Time of Concentration with in the soil moisture and rainfall and evaporation of photos direct relation to the surface. K so that the formula providing that the following equations (3,4,5,6,7) suggested .

$$K = (R * W * P * T^{-1}) / 2 \qquad (3)$$

$$R = \frac{\sum_{i=1to30} R_i / 30}{\sum_{i=1to12} R_i / 12} \quad (4),\ W = \frac{\sum_{i=1to30} W_i / 30}{\sum_{i=1to12} W_i / 12} \quad (5),\ R = \frac{\sum_{i=1to30} T_i / 30}{\sum_{i=1to12} T_i / 12} \quad (6),\ P = \frac{P_i}{\sum_{i=1to12} P_i} \quad (7)$$

Where R is the monthly average precipitation divided by mean annual rainfall, W is the average monthly humidity divided by average annual humidity, T is equal to the average monthly evaporation and average annual evaporation in the end even with the severity of rainfall is equal to P divided by monthly average annual rainfall severity. Only the amount of annual rainfall average in one study for the behavior and distribution does not suffice basin time monthly rainfall during the year naturally of special importance in studies of different climate parameters has.
With investigations carried out on the curve severity, duration and frequency, several empirical relationships can be presented to the rainfall severity return period when various basic and gained one of these relationships, Mr. Benson is a close relationship by Dr. GHAHRMAN for Iran, which is recommended in Equation (8) that has been used.

$$P_T^t = \left[0.4524 + 0.2471 \ln(T - 0.6)\right]\left(0.3710 + 0.6184 t^{0.4484}\right) P_{10}^{60} \qquad (8)$$

t: Calculated based on rainfall for minutes

T : According to the period

P_{10}^{60} : Amount of rain an hour with 10-year period Back

P_T^t : Amount of rain t minutes with the desired course of T Back

Much is achieved by the following equation.

$$P_{10}^{60} = e^{0/8153} X_1^{1/1374} X_2^{-0/3072} \qquad (9)$$

X_1 : Average maximum 24 hour precipitation (daily maximum)

X_2 : Average annual rainfall in mm by

Values obtained with the rainfall severity and times desired course different Back is achieved. Chart Severity - Time frequency ASDLY Station Below is shown.

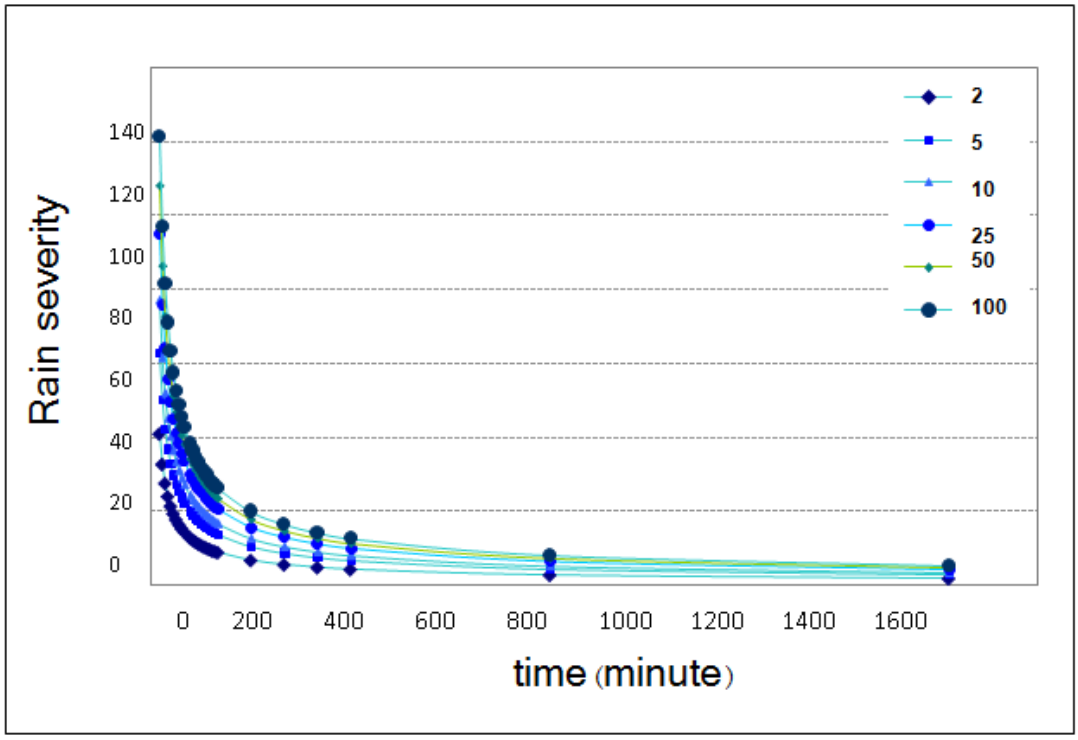

Figure 5 : diagram of Rain Severity for bojnurd basin

6-CONCLUSION

In this research, using the concept of time in GIS and review various parameters Precipitation, evaporation, soil moisture and relative severity of rainfall in different times of the year was shown that the parameter Time of Concentration phenomenon closely related to time and not be fixed as a parameter to express the water basin.
Thus, by studying a number of parameters influence a new formula for calculating Time of Concentration was suggested. Considering the results of empirical data derived from reviews of various stations North KHORASAN Province of Iran, relation with the factors considered Time of Concentration and were determined using the monthly average of the annual formula focus time to was. However, the Severity of Rainfall parameters slightly different topic, because it was applied using a recommended formula for the amount of severity of rainfall per month with a return period of ten years for each of the stations was achieved. Then the annual monthly average ratio was placed.
Assumption that the beginning of this research was considered, All natural phenomena in terms of influence on the Time of Concentration are identical. The issue discussed and future research will be more reviews. Of course, this formula with the proposed revisions influence other factors such as vegetation, climate impact, etc. will provide more accurate .

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CONTACTS

Kambiz BORNA
ISLAMIC AZAD UNIVERSITY Branch of bojnurd
Tel. +98915-584-2179
Email: kambizborna@ymail.com

MohamadReza RAJABI
Faculty of Geodesy and Geomatics Eng. K.N.Toosi University of Technology
No 1346, Mirdamad cross, Valiasr st., Tehran, IRAN 19967-15433
Tel: +98911-343-6025
Email: mreza.rajabi@gmail.com

Dr. Ali MANSOURIAN
Faculty of Geodesy and Geomatics Eng. K.N.Toosi University of Technology
No 1346, Mirdamad cross, Valiasr st., Tehran, IRAN 19967-15433
Email: alimansourian@yahoo.com

Dr. Majid Hamrah
Faculty of Geodesy and Geomatics Eng. K.N.Toosi University of Technology
No 1346, Mirdamad cross, Valiasr st., Tehran, IRAN 19967-15433
Email: hamrah@kntu.ac.ir