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Fractal Analysis of Dynamism of Relative Humidity in the Geomorphic Domain in Fars Province, Iran

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Abstract: *Contrary to Euclidean geometrical figures, fractals are chaotic and randomly generated. These figures are chaotic in all parts and this chaos is similar in all scales. The current study is aimed to investigate relative humidity using fractal dynamism of geomorphic filed of Shiraz Province. Then, climate elements are analyzed to separate the geomorphic filed of the whole region. Ultimately, algebraic analysis tries to examine tension between geoclimatic elements including temperature, humidity, and precipitation. at the mentioned stage, the effect of tension on relative humidity is evaluated since 40-year statistics have shown that any of the mentioned elements have the ability to combined spin. Therefore, structures of the mentioned elements help climatic indices to stay in thermodynamic equilibrium. Results have shown that fractal changes of humidity in cybernetics along with geomorphic condition of Shiraz district may distort Bakhtegan geomorphic balance. On the other hand, according to fractal status of relative humidity in terms of material and energy balance, the mentioned domain may get unbalanced under the effect of Fasa geomorphic domain and then move towards Persian Gulf base-level.*

Keywords: *Fractal, Relative humidity, Domain, Shiraz geomorphic domain*

1. INTRODUCTION

Fractal theory refers to the study of chaotic dynamic geoclimatic systems. Fractal systems are nonlinear geoclimatic dynamic systems which are seriously sensitive to their initial condition. Trivial changes in their initial condition may lead to great changes in future. Cybernetic behavior of geoclimatic systems are seemed to be random. However, it is not necessary to have randomness included in fractal behaviors. Definite dynamic systems including geoclimatic processes are able to show fractal behaviors. It is obvious that minimum of three state variables can be the vital prerequisite for fractal behavior of time-independent dynamic systems. As for time-discrete systems, one state variable is sufficient. Climatic elements of Shiraz geomorphic domain including temperature, precipitation and relative humidity as well as pressure are deemed as dynamic elements. Dynamic system is a system which really does exist. On the other hand, the mentioned elements are enforced specifically on every domain including Shiraz geomorphic domain. On the other hand, balance between humidity and temperature of Shiraz domain is of significant importance. It can be said that humidity or heat of Shiraz domain cannot be determined based on precipitation or temperature.

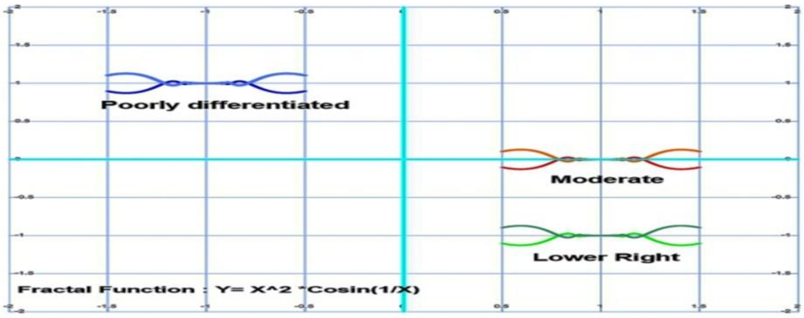

Figure1. *Schematic representation of fractal*

All in all, fractal dynamic can be studied in three intervals: unbalanced interval for which vector resultant at two points is zero. This is the lowest fractal structure. If the two-dimensional vector resultant of complex arrays is zero at only and only one point, then fractal dynamic moves towards balanced state. However, if arrays have imaginary interval, input dynamic goes towards unbalanced state. Function calculations have shown that points inside the interval approaching infinity while the interval itself is finite. The behavior is of chaotic nature. Sirpinski triangle and Koch snakeskin are two known fractals. As for Koch snakeskin, it can be said that the mentioned fractal has finite area but infinite parameters. It is possible to measure the self-similar area of fractals using a new concept which is based on the number of copies of elf-similar sets and magnitude of each set. It means that fractal dimension of a set is determined by logarithmic division of the number of copies by magnitude. In cybernetic point of view, some geoclimatic systems are nonlinear complex dynamic systems which show chaotic, random and unpredictable behaviors. Theory of chaos in geomorphology tries to study these nonlinear systems which are sensitive to their initial condition. Geomorphic systems have the ability of self-arrangement while they are fractal in nature. The mentioned feature is possible to see in the majority of flow systems including mass flows, soil system and coastal humid fields. According to theory of chaos, it is possible to have a relationship between form (fractal dimension) and process (self-arrangement). Theory of chaos is a great help to understand, analyze and predict geomorphic systems. Complexity of geomorphic systems and their chaotic state is too high to use basic mathematical operations and laws of physics to deal with them [1]. Consequently, new trends and viewpoints try to analyze and simulate complex behaviors of these nonlinear systems in geomorphology based on simple and small-scale laws of mathematics and physics in the form of autonomous cell models. Results have sown that climatic changes of Shiraz geomorphic domain can be drawn as algebraic nonlinear function. On the other hand, such variables as temperature, humidity, pressure and height of domain cannot be deemed as linear combined set of independent elements. The mentioned feature is indicating the dynamism of this domain.

2. Materials and Methods

Shiraz geomorphic domain is of 52 degrees and 13 minutes and 53 seconds to 53 degrees and 28 minutes and 59 seconds east longitude and of 15 minutes and 29 degrees and 55 minutes and 59 seconds east latitude. It is of 1500-meter height whose area is 10689 km^2. Extracting information and quantitative data along with statistical algebra based on decimal interpretation and double definition as well as trigonal descriptions are used to determine stable states and balance of stable domains. Results were compared to GES observations. Then, results were leveled based on comparison to field observations in order to provide scientific and practical approaches for domain management. Fractals are seen in the majority of structures such as snowflakes, mountains, clouds, etc. fractals are also used to describe, interpret and predict phenomena. The most important data mining methods for Shiraz geomorphic domain indicate algorithm explorations which lead to classical algebraic geoclimatic structures as suitable grounds for investigation of sustainability and balance of independent and discriminated geoclimatic domains. Additionally, it is emphasized that the mentioned domain has joint east hydro morphologic boundary with independent domains such as Kor river [2]. Geomorphologic gradient of Kor domain implies that sustainability of Shiraz geomorphic domain as a fractal element should be under the effect of hierarchy [3] or should affect it. On the other hand, Shiraz geomorphic domain is of relative hierarchical nature which affect Fasa geomorphic domain as one of its elements [4].

2.1. Horizontal Distribution of Relative Humidity on the Surface of Shiraz Geomorphic Domain

Based on the data mentioned in fourth and eighth columns od table 1, spatial composition of the elements are attached to geographical information system for Shiraz domain. Information are interpreted in macro scale means. As shown in the figure, the region is of 40% to 46% humidity. On the east-north part of Shiraz geomorphic domain, relative humidity is of 46% to 52%. It seems that relative humidity streams on the central and east-northern geomorphic domain are developed due to Doroudzan dam. However, two limited streams are also seen on western and west-southern geomorphic domain origin of which is debated.

Table1. *Internal mediating of long-term relative humidity of Fars province*

Row	Analog Longitude	Latitude Analog	Relative Humidity to Percent	Row	Analog Longitude	Latitude Analog	Relative Humidity to Percent
1	52.09304845	30.46134195	33.71184554	21	52.95524948	29.33627475	44.39723703
2	51.9248141	30.2931076	35.02323226	22	53.3863999	28.87363029	43.72215161
3	51.84069691	30.09332931	38.61626984	23	53.69127475	28.56870554	42.80784705
4	51.9458434	29.7148020	44.55246422	24	53.71230402	28.16914893	44.53176975
5	52.21922421	29.34678993	43.27060334	25	52.67135402	29.76737526	44.16914832
6	5238745856	29.11546717	43.39659346	26	52.29282674	29.76737526	44.16914832
7	52.4715753	28.95774747	43.77059618	27	52.76598584	29.93560961	48.4638503
8	52.7134126	28.42150048	44.45378306	28	53.27068888	29.60965556	43.51895532
9	52.97627877	28.15863432	44.86568413	29	53.75436263	29.19958434	40.979102
10	53.6807601	27.84319492	44.796467	30	54.12237526	28.74745453	41.04326371
11	54.60604901	28.00091462	43.39357122	31	54.40627072	28.28481008	4347222928
12	54.3569749	28.57922019	42.10014446	32	54.63759295	27.8852535	43.18575493
13	53.6807601	29.35730404	41.16850237	33	53.74384798	27.85370956	4474401107
14	53.40737929	29.94612426	41.48714061	34	53.11296918	28.23223684	45.26584201
15	53.08142524	30.50340053	38.21315657	35	52.51363432	28.66333736	43.85319848
16	52.77650048	30.90295711	35.48802438	36	51.93532875	29.34678939	44.9051092
17	52.67135402	30.94501569	35.20514089	37	51.63040399	29.70428738	42.86676756
18	52.3979732	30.51391518	37.43413551	38	52.0825338	30.20899042	40.6307475
19	52.44003179	30.21950507	44.93935102	39	52.19819294	30.66112023	31.43763104
20	52.72392725	29.75686062	46.21601768	40	52.32558725	287.62232155	100.1920847

It is concluded that surface geopotential of the mentioned domain is under the effect of latitude and longitude and latitude which cybernetic ally control synoptic condition of the domain.

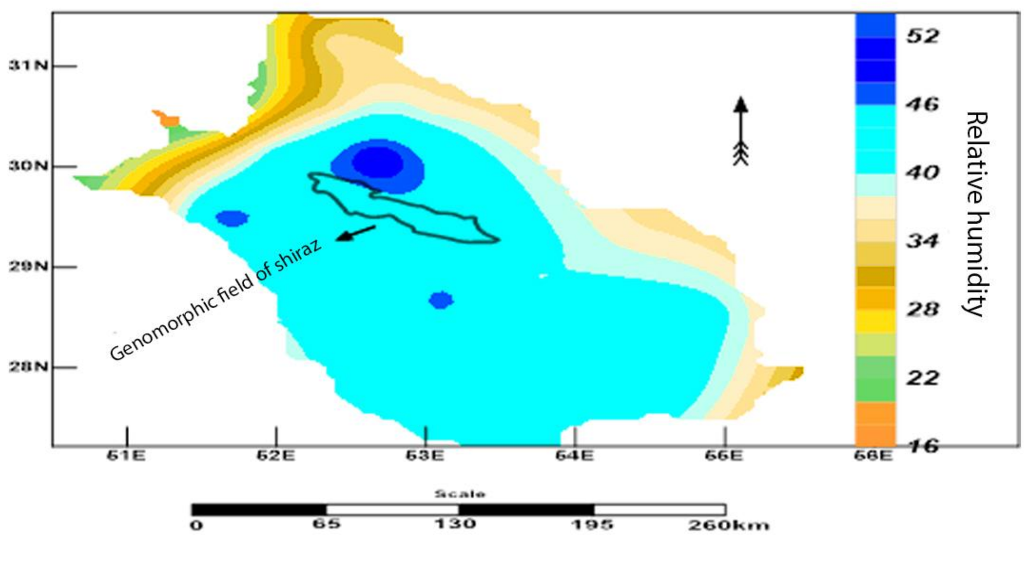

Figure2. *Geographical position of Shiraz geomorphic on relative humidity map of Fars province*

Nevertheless, algebraic calculation of pressure requires a certain physical structure which is beyond the current study, since criteria have to be transformed into relational structures in order to determine pressure structure enforced in the domain.

2.2. Changes of Relative Humidity of Shiraz Geoclimatic Domain

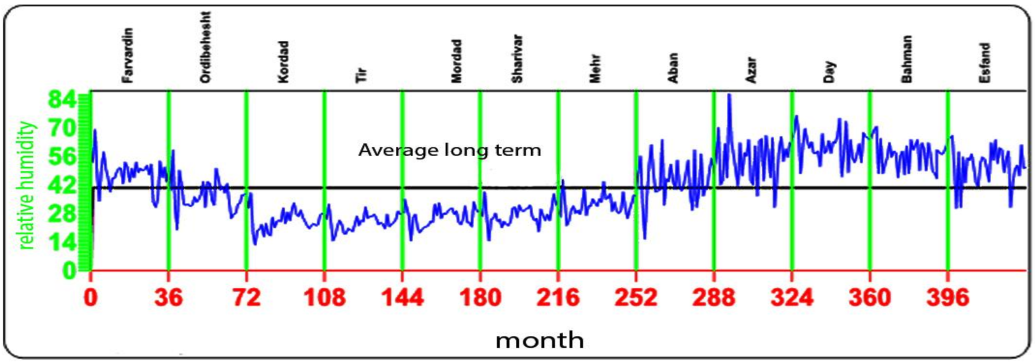

Figure3. *Changes of relative humidity in Shiraz geomorphic domain based on 30-year statistics*

The given figure is divided into 12 parts each of which indicates a month. It is worth noting that each month is an integrated part of the figure. The above mentioned figure shows changes of relative humidity of Shiraz geomorphic domain for one given month during 30 years. Figure 3 shows the changes trend of relative humidity for Shiraz Domain. Based on the given figure, for Farvardin, for example, there are 30 pulses. This figure clearly shows humidity changes of 4 GisGraphers during 30 years. To vividly imagine changes trend, figure 4 shows pulses of each month in spatial dimension. As a matter of fact, vertical rectangular indicate relative humidity of each month. It is obvious that measurement is done for all months during 30 years. Additionally, those fluctuations are the most highlighted ones that change extremely. Consequently, weaker changes are translated into two-dimensional statements. One of the most unique features of figure 3 is that researchers can determine fluctuation trends in addition to changes trend of Shiraz geomorphic domain. It means that researcher can see humidity changes three-dimensionally in the form of square while rectangular form wavy shape together. It is worth noting that humidity fluctuations of Shiraz geomorphic domain can be vividly imagined. Figure 4 shows spatial form of figure 4 which is the representation of changes and fluctuations. Based on figures 3 and 4, it is concluded that fluctuation of relative humidity can be calculated by classical algebra while changes of relative humidity are not as rule-governed as fluctuations. As a matter of fact, changes of relative humidity are affected by chaotic trends. This chaotic structure can be elicited based on three-dimensional squares of the matrix showing relative humidity fluctuations. An important issue in dealing with climatic trends is calculation of chaotic state or chaos of climatic elements which is explained in the following sections [5-19].

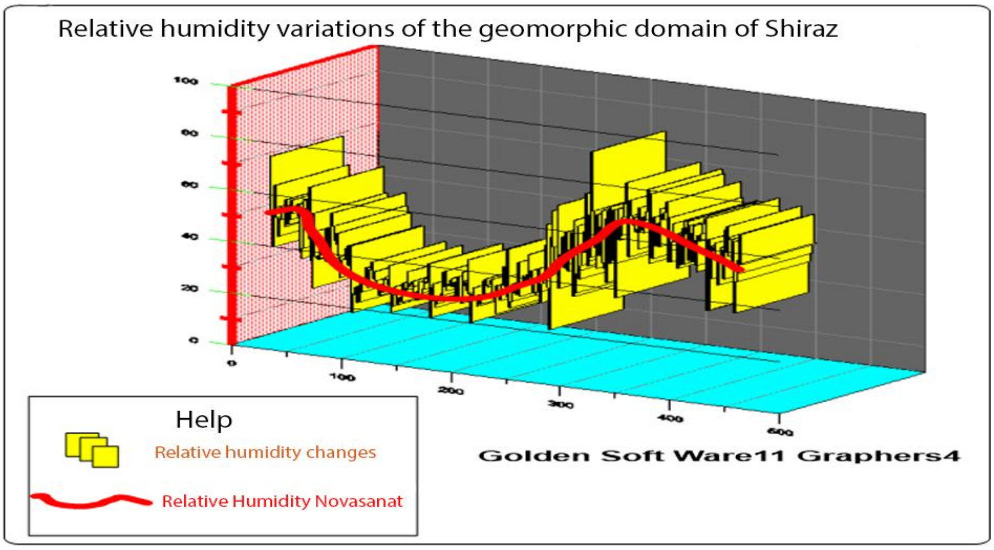

Figure4. *Spatial structure of changes and fluctuations of average long-term relative humidity for Shiraz geomorphic domain*

2.3. Changes and Fluctuations of Relative Humidity of Shiraz Geoclimatic Domain

Changes and fluctuations of relative humidity of Shiraz geoclimatic domain can be of different types. Figure 4 shows that relative humidity for 47-month sample is 17.5% or less while the given value for 132-month sample is 17.5%. cumulative frequency is 27.5%. table 2 introduces relationship between relative humidity and cumulative frequency:

$$Fc = 0.026Rh^{2.36}$$

Table2. *Percentage frequency of relative humidity of Shiraz geomorphic domain*

Relative humidity	Frequency	Cumulative frequency
17.5	47	47
27.5	132	179
38	71	250
48.5	74	324
58.5	78	402
68.5	28	430
78.5	2	432

Rh is calculated based on the above mentioned criterion:

$$Rh = e^{(0.462*(Ln38.462Fc))}$$

These criteria indicate fractals in fluctuating relative humidity of Shiraz geomorphic domain. Humidity is calculated as 14.63% and 14.64% based on the mentioned criteria. On the other hand, relative humidity of 14.63% or less makes fractal functions ambiguous by directing them towards negative infinity while the value of 14.64% or higher directs them towards positive infinity. Accordingly, relative humidity fluctuations in Shiraz geomorphic domain show fractal behavior [20-34].

2.4. Fractal Structure of Relative Humidity Changes of Shiraz Geomorphic Domain

As for Fractal structure of relative humidity changes of Shiraz geomorphic domain, it is worth noting that if criteria 1 and 2 which were mentioned in the previous sections to say that inputs of system rotate around the same central point have classical resultant considering cybernetic action and reaction resulted from changes and fluctuations of relative humidity of Shiraz morphologic domain, the given function rotates around a central point. On the other hand, if an input or output function of a climatic element can make all positive and negative values to rotate around a central point ad then arrange them in descending or ascending order so that they will not be ambiguous, its performance will be of chaotic nature. Having received inputs greater than 14.64%, Criteria 1 and 2 direct elements towards positive infinity while inputs of 14.63% or less may direct elements towards negative infinity. It is worth noting that movement towards infinity is acceptable while there is a distance from central point so that outputs are meaningful before infinity. To have a realistic imagination, look at pictures 5 and 6. Figure 5 shows the input and output structures of nonlinear system. It is possible to imagine and draw fitness level. If a spatial fractal structure is taken as a three dimensional form, figure 3 shows the iteration of pulses. These iterations are so useful that iteration format is of dynamic nature. The dynamic can show the replacement point and economic and community dynamic. By comparison figures 5 and 6 and 3, it is obvious that changes and fluctuations of relative humidity of Shiraz geomorphic domain is of fractal nature. As for temperature, temperature changes and fluctuations of Shiraz geomorphic domain is of chaotic cybernetic nature [35-48].

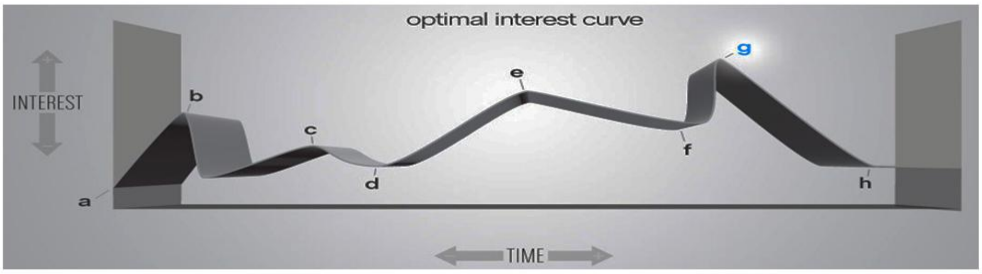

Figure5. *Classic structure od algebraic series of spatial inputs and outputs (source:google)*

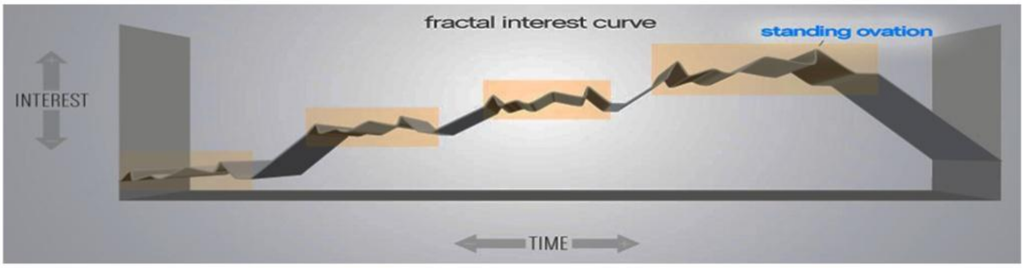

Figure6. *Classic structure of spatial fractals (source: google)*

According to figure 6, iteration of pulses is fitted. Longitudinal and sectional coordination of waves are under the effect of dynamism. If these structures are compared to figure 3, fractal behavior of changes and fluctuations of relative humidity of Shiraz geomorphic domain is proved. If spatial information of figure 6 is shown in parallel to criteria 1 and 2 and drawn in two-dimensional curve, it is possible to imagine cybernetic fractal of dynamic performance of relative humidity of Shiraz geomorphic domain. It is sufficient to feed information about relative humidity into criteria 1 and 2 in Graferz software in order to draw it automatically. It is worth noting that criteria 1 and 2 represent nonlinearity of 30-year trend of relative humidity [49-104].

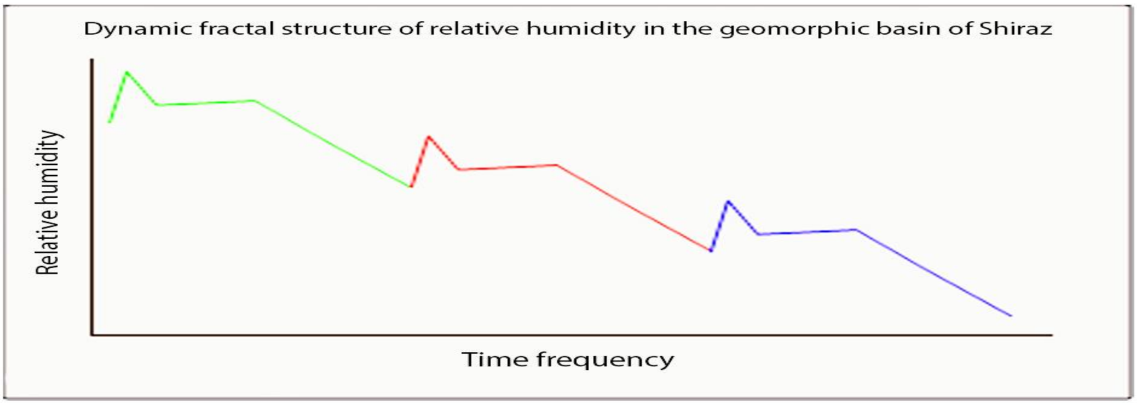

Figure7. T*wo-dimensional blanket of relative humidity of Shiraz geomorphic humidity*

3. RESULTS

Contrary to precipitation, vaporization and temperature obey fractal trend in terms of climatic changes and fluctuations. On the other hand, there is a central point relative humidity of which is 14.63% to 14.63%. As a matter of fact, relative humidity of Shiraz geomorphic domain approaches zero to make sure that fluctuations are repeated in the form of waves. According to the fact that Shiraz morphologic domain is one of the most unique Zagros domains which is of 2000 m height and 1500 m, it is in harmony with Shiraz climatic domain. The mentioned harmony is important since climatic area is wider than geomorphic area. It is worth noting that if Shiraz climatic domain is of hierarchical nature, Shiraz geomorphic domain is a holon of that hierarchy. From the geomorphic point of view, Shiraz geomorphic domain (rounded coefficient of 1.72, Classical length of 167 km, classical width of 23 km, area of 3985 and perimeter of 380 km) is really flexible to flood crisis management. The flexibility is bifurcation coefficient of 3.99. the domain is of 1950 average height. According to length of the domain, slop of Shiraz geomorphic domain is 1.1% or .66% which is equal to 40 minutes and 8 seconds. Incident radiation in the case of changes and fluctuations of Shiraz geomorphic domain is 29.5. the mentioned value is equal to 7.62^{e26}J and 7.62^{e19} cal. On the other hand, annual precipitation is 7.62^{e26}. Although energy balance of Shiraz geomorphic domain is in equilibrium in the case of climatic changes and fluctuations, it cannot be neglected. According to basic rules, balance id not f geopotential and geoclimatic nature but is of practical basis. According to geomorphologic and cybernetic results, annual potential energy is 1^{e27}. Crisis management of relative humidity should follow fractal criterion.

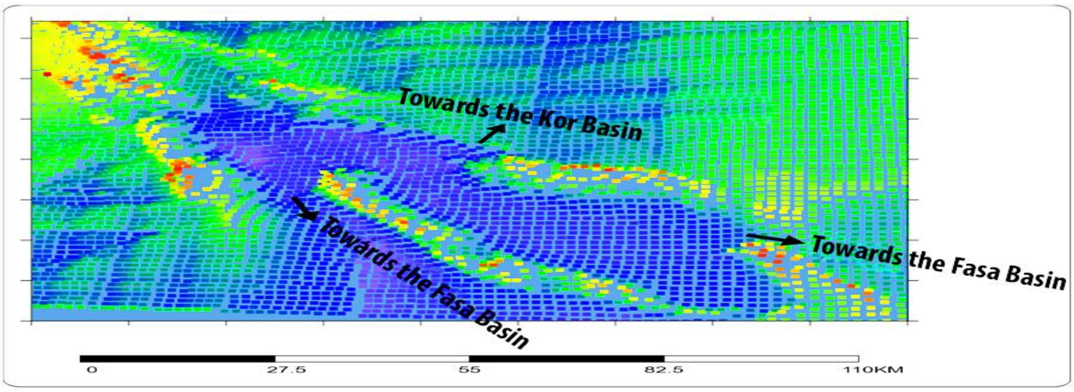

Figure8. *Balance state of Shiraz domain in cybernetic with Kor and Fasa reservoirs*

Fractal criterion is of algebraic nature which approaches positive and negative infinity. Consequently, the main trend goes towards unbalanced state. Domain view of physical resultant of chaotic changes of temperature, precipitation and fractal changes of relative humidity of Shira domain is in cybernetic with Shiraz geomorphic domain. Consequently, Baktegan geomorphic domain is going to unbalanced state. On the other hand, according to fractal performance of relative humidity in terms of material and energy balance is severely under the effect of Fasa geomorphic domain. Accordingly, it is unbalanced and moves towards Persian Gulf base-level. Physical resultant of chaotic changes of temperature, precipitation and fractal changes of relative humidity of Shiraz domain is in cybernetic with geomorphic state of Shiraz domain. It makes Baktegan geomorphic domain unbalanced. On the other hand, regarding fractal performance of relative humidity in terms of material and energy balance, the domain is severely affected by Fasa geomorphic domain. Fasa domain is unbalanced in terms of physical resultant and moves towards Persian Gulf base-level.

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