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Assess circulation pattern of drought periods using SPI (case study: central Iran)

Kamal Omidvar [a], Mehran Fatemi , Mahdi Narangifard* [b], Khodakaram Hatami Bahman Beiglou [c]

Professor of Climatology in Yazd University, Yazd, Iran [a]
Ph. D Student of Climatology in Yazd University, Yazd, Iran [b]
Ph. D Student of Climatology in Isfahan University, Isfahan, Iran[c]

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Abstract

Drought is a natural hazard that have in arid and semiarid areas more frequency. So the study and identify synoptic patterns affecting this phenomenon seems to be necessary. by using peripheral circulation approach, drought periods during the 30-year (2011-1982) in the six synoptic stations provinces of Kerman, Yazd and Isfahan, which have a long-term cooperative period were calculated with using the standardized (SPI). Then use Principal-component analysis (PCA) method with the correlation matrix method and Rotation that in the Varimax method on 500 pressure level data to identify the basic elements of the atmospheric currents. Then By using cluster analysis with Ward method on Component amounts, circulation patterns causing drought were identified. The study showed that more than 42% of the variance component analysis of 500 geo-potential height level by extending the sub-polar low in to the Low latitudes that led to high flow like Siberian high become southern and high pressure level on researched area is formed ,So domination of high pressure center on the region cause falling air cold, stable & No cloudiness weather that Show there is not Instability in the region, which climbed moisture in the atmosphere and cause little precipitation and drought events.

*Corresponding author. Tel.:+989177097454
E-mail address: Mahdi.narangifard@gmail.com

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Introduction

Climate conditions of each region are determined by repetition and cumulative effects of weather systems which pass over that region. Repetition, variation or continuations of weather systems of each place have important roles in determining and identifying the climate of that place. Continuation or variation of systems are identified by classification process or determining the atmosphere circulation patterns and air types. Therefore, classification of air systems is one the main objectives of synoptic climatology (Huth, 1996). Drought is one of the natural hazards which occur in most parts of the world, but it is more apparent in arid and semi-arid regions. Drought is one of the natural hazards that can affect human inversely more that any other hazard, and it occurs in almost all weather regions (Khosh Akhlagh et al., 2012). Drought is a hazard that among all the natural hazards is the most complicated, but it is the least known phenomenon, and can affect more people than other hazards (Ahmadi, et al., 2013). From climatology point of view which is concerned, when the precipitation received in a region at a given time period is less that average long term precipitation in that region, we are faced with drought. Therefore, the threshold of drought event is a geographic quantity, and it is different in the temporal and spatial scales (Parvin, 2011).

Atmosphere circulation patterns play the main role in occurrence of environmental phenomena, especially in temperate regions, and dry and wet periods events are about repetition of synoptic systems and air types. Investigating climatology variables like precipitation and temperature in a given place and time shows that these variables are severely under the influence of atmosphere circulation patterns. Therefore, meteorological variables like precipitation and temperature and related phenomena like flood, drought, glaciation, etc. are related to special kinds of atmosphere circulation patterns. Without identifying air type temporal frequency, explaining and treating environmental issues are very hard because each air type causes its special environmental conditions. By identifying atmosphere circulation patterns, we can explore the variations, frequency, intensity and spatial distribution of climatic variations like precipitation, and we can explain its physical causes. Therefore, many attempts have been done for developing atmosphere circulation patterns classification methods and investigating their role and effects on precipitation variables (Fatahi and Bahmanyar, 2011). According to the close relationship among atmosphere circulation patterns and climatic elements, extreme weather like flood, drought or dry and wet periods can also be attributed to atmosphere circulation patterns variation, and in this respect, the role of atmosphere circulation patterns in establishment and control of short term drought and flood can be investigated by using indexes that are developed based on precipitation variable variations. Studies show that flood and drought are under the influence of atmosphere circulation patterns (Bardossy and plate, 2013; Bogardi et al. 2015).

The probability of drought event is considered as the main properties of Iran weather, which is seen in both humid weather and dry weather domain. This situation is established as the consequence of sever fluctuations in weather in different temporal scales. Drought properties in Iran show that in general none of the regions of Iran is unaffected by this phenomenon, and based on their natural location, may experience its detrimental effects. Southern, Eastern and central parts of Iran are more vulnerable because of more fluctuation in precipitation amounts (Farajzade, 2007). At present, the most important problem in front of development and progress of provinces Isfahan, Kerman and Yazd, in central Iran is the problem of pervasive droughts and critical condition of water resources and challenges of natural and human life in this area. Today in drought management in order to minimize the adverse effects, conveying crisis management to risk management is considered as an inevitable issue. In this respect, monitoring is one of the most effective tools in realization of this kind of management, especially in its closest form to real time, and it is obvious that without identifying atmosphere circulation patterns, explaining and solving the environmental problems are very hard. About atmosphere circulation patterns during drought periods, many studies have been conducted all around the world and also Iran, among which the following can be mentioned:

Littman (2000) classified the data of pressure and geo-potential height of 500 HPa by cluster analysis, and investigated the relation of the obtained air types with precipitation in Mediterranean area. Studies showed that negative

steps of NAO pattern caused winter precipitation increase and temperature decrease, and its positive step caused precipitation reduction, temperature increase and winter drought across Turkey. Girardin and Tardif (2006) studied the variations of summer drought in Boreal, Canada in relation to atmosphere scale synoptic circulation. Results showed that Eastern boreal is under the penetration of two big components of atmosphere named zonal and meridian.

Yetemen and Yalcin (2009) investigated the relationship between monthly average temperature in Afyon, Turkey with remote linkage pattern index of North sea-Mazandaran, and showed that in the positive step of remote linkage pattern of North sea-Mazandaran, the air temperature in Afyon mountain area had increased, and provided a proper condition from weather convenience point of view for tourists in the above-mentioned area. Buntgen et al. (2010) investigated summer drought in Germany and stated that from synoptic view point, the presence of a high pressure in the atmosphere middle level above North Sea, and the presence of a low pressure on Southeast of Europe had caused summer drought. Parry et al. (2010) studied the spatial and temporal development and properties of Europe big scale drought by Standard precipitation Index method (SPI) and synoptic exploring, and the results showed that in the first period, the presence of a high pressure system across North of Atlantic and its Blocking in the direction of western winds caused deviation of systems causing precipitation towards southern Mediterranean, and this situation caused drought event in Europe. Croitoru et al. (2011) investigated drought event in central plain of Romania and regarded Blocking of air in the direction of advection of tropical humid air mass as the reason of this event. Kutiel (2011) studied remote linkage pattern effects of North sea-Mazandaran on Middle East precipitation and temperature systems, and concluded that Middle East temperature system is sensitive to different steps of remote linkage patterns of North sea-Mazandaran, and this sensitivity is more sever in negative step and lead to temperature increase in Middle East. Rimkus et al. (2013) investigated the atmospheric patterns during drought periods in Lithuania. Results showed that drought intensity is related to atmosphere circulation patterns in Baltic area. Negative phases of NAO/AO caused sever drought in the area. Zhaoliang et al. (2014) investigated the probability of seasonal precipitation in China by using Atmosphere-ocean big scale indexes monthly. Results showed that water level temperature index in West of Pacific Ocean and Indian Ocean used Southern oscillation El-Niño Index for more effective predictions.

Several studied have been conducted in Iran on this field which is briefly explained in the following paragraphs:

Sadeghi (2008) investigated Khorasan province drought by synoptic method. He knows the delay in sub-tropical high pressure withdrawal and weakening of East Mediterranean trough as the main reasons of drought in this area. Atayi (2009) showed that at the time of ridge patterns and high pressure establishment, Iran experienced low precipitation and drought.

Fatahi (2010) investigated atmosphere circulation patterns effective on pervasive drought in Chagar-Mahal and Bakhtiyari Province, Iran, and identified drought causing and precipitation causing air types by investigation wet and dry periods and the frequency of atmosphere circulation patterns events. Falah Ghalhari et al. (2010) investigated the relationship between climate big scale synoptic patterns with precipitation in Khorasan Razavi province, Iran by using comparative neural-phase inference system. Parvin (2011) showed that when the most severe drought occurs in Urmia lake watershed, four synoptic patterns are dominant on the region. Moosavi Baygi (2011) investigated the synoptic patterns leading to autumn and winter droughts in Khorasan Razavi, Iran, and stated that in all months of autumn and winter because of Siberia high pressure interaction with Azor high pressure systems, and strengthening of Siberia high pressure, and therefore its complete dominance on the area, severe, acute and average droughts occur in the researched area.

Khosh Akhlagh et al. (2012) stated that trough axis spatial situation of Mediterranean Sea when approaching more and more toward the east of the sea, and orient as WestNorth-EastSouth, precipitation will increase, and far distance of trough from East Mediterranean and its orientation as EastNorth-WestSouth is usually accompanied with low precipitation and drought event. Mohammadi et al. (2013) investigated the effect of Mediterranean systems on droughts of West of Iran, and pointed out that in dry years of west of Iran, increase in pressure annual average

and reduction in frequency of cyclones of most cyclone causing centers are seen. Mofidi et al. (2013) investigated the atmosphere circulation patterns during wet and dry periods in southern coast of Caspian sea, and showed that sea level pressure variation in Black sea area can be used as a proper index for explaining the spatial-temporal variation of precipitation in southern coast of Caspian sea, and during the dry period, reduction of anticyclone activity in northern corridor is accompanied with noticeable increase of anticyclone activity in this region.

Materials and Methods

The researched area includes 6 synoptic stations in Kashan, Isfahan, Isfahan east, Yazd, Kerman and Bam which are located in Isfahan, Yazd and Kerman provinces. The geographic location of the researched area is shown in figure 1. Central Iran is a steppe-like plateau characterized by extremely wet climate in the Northern regions, arid and semi-arid conditions surrounded by

Despite all the investigations conducted on this topic, there is not enough knowledge about zonal structure of atmosphere circulation when precipitation occurs in Central Iran, it seems necessary to conduct a research which investigate the situation dominant on drought period event, and analysis the atmosphere circulation structure on the area in a special way. Therefore, the aim of this study is to develop and use a synoptic model for defining and determining the atmosphere circulation patterns groups and identify the drought causing patterns on central Iran (Isfahan, Kerman and Yazd provinces).

desert with no recorded rainfall for years and mountains (Zagros on the west and Alborz on the north). According to the climatological conditions in Iran, four different seasons are distinguished including spring (from March to the end of May), summer (from June to the end of August), autumn (from September to the end of November) and winter (from December to the end of February) (Shahabfar et al., 2012).

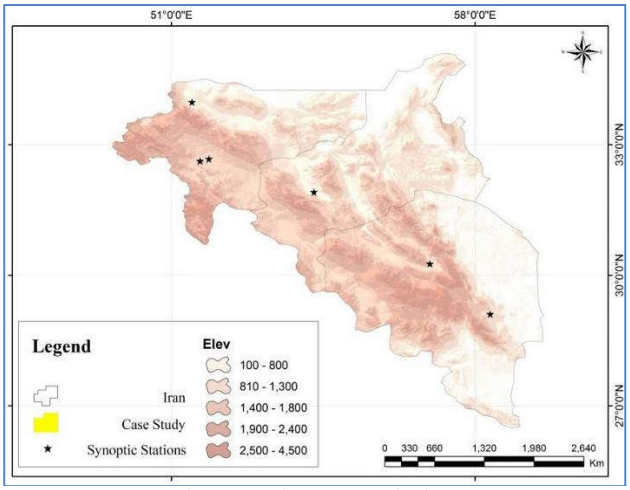

Fig 1: Study Area and Elev

In this study, the precipitation data obtained from six synoptic stations on a daily and monthly basis over a 30-year statistical period (1982-2011) were used. The Standardized Precipitation Index (SPI) is one of the most commonly used indicators of meteorological drought monitoring that has been used extensively in the literature (Rahmani et al., 2015). Among all drought indices, SPI is the most popular one which is widely used throughout the world for the purpose of drought analysis (e.g. Hayes et al., 1999; Raziei et al., 2009; Ibrahim et al., 2010; Mirabbasi et al., 2013; Fatemi et al., 2015; Mozafari and Narangifard, 2016). The Standard Precipitation Index (SPI) was used for identifying dry periods and statistical analysis (Eq. 1). This index was developed by Mckee et al (1993) based on the following equation.

$$SPI = \frac{P_i - \overline{P}}{SD}$$

Where, Pi is precipitation in year i, $\overline{P}$ is the average precipitation during statistical period, SD is the set standard deviation of precipitation.

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Positive amounts of index show precipitation more than median and negative amounts show different intensities of drought (table 1).

Table 1: Different intensities of drought based on Standard Precipitation Index

Standard precipitation index	Index value
2 and more	Very severe wet years
1.5 to 1.99	Severe wet years
1 to 1.49	Middle wet years
-0.99 to 0.99	Normal
-1 to -1.49	Middle drought
-1.5 to -1.99	Severe drought
-2 and less	Very strong drought

Then by using standard precipitation index (SPI), drought, wet and normal periods of the region were identified by spatial occurrence condition of more than 50 percent, which included weak, average and severe drought, and weak, average and sever wet period. After identifying the drought and wet years by using SPI index, 38 months were wet, 11 months were dry and other months were identified as normal. Then by studying approach as peripheral circulation for identifying drought circulation patterns, daily data of 500 HPa geo-potential height level in the given months were exploited from classified data. Then by conducting the principal component analysis by correlation method and components rotation by Varimax, effective components were identified. Then by cluster analysis and calculating Euclidean distance and Ward method on component amounts, data of 500 geo-potential height level was classified, and in each cluster or category one day was chosen and investigated as the key or pattern day.

RESULTS AND DISSCUSION

For obtaining drought patterns by using SPI index, 11 months were identified in statistical period in the researched area, then daily data of 500 HPa geo-potential height level related to dry months were extracted from NASA classified data, and this data set was made ready for analyzing the principal components and cluster analysis. Based on the principal component analysis, for classification of map patterns, correlation matrix and Varimax rotation were used and 12 components were identified which explained 92 percent of data diffraction. Therefore, rotation components were converted to map in order to reveal its map patterns, although we can not identify the way of component patterns arrangement in drought event decisively.

Exploring the principal components of drought periods

Based on the diffraction array of principal component exploring, the explained percentage by each of the components of geo-potential height data of 500 HPa were calculated (Figure 2) to (Figure 7). Therefore, by 12 components we can explain 92 percent of data variation in geo-potential height. In order to prevent from elongation of the topics, interpretation of components with low percentage is abandoned, and in each analysis just 6 components will be investigated. Based on the obtained components, the first 6 components which explained 78 percent of data diffraction were chosen for analysis. In map exploring of each component, there are negative and positive values which can show the dominant atmosphere systems, so load fields should be investigated and interpreted with regard to both positive phases and negative phases.

Table 2: Component percentages estimated from principal component analysis

Components	1th	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th

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Expression percentage	27.8	3.2	11.6	10.4	8	6.4	4.8	3.2	2.3	1.8	1.4	1.1
Eigenvalues(e^{-14})	-7.39	-3.33	-2.58	-2.23	-1.97	-1.89	-1.8	-1.53	-1.41	-1.23	-1.01	-9.61

The first component explains 27.8 percent data diffraction of 500 HPa geo-potential height level in periods without precipitation (dry). Spatial pattern of this component shows that there are several cow-eye patterns with negative and positive phases in the researched area, but positive phase of the North of Caspian sea shows sub-polar low pressure which moves towards lower latitudes by its formation, and cause extension of high pressures to lower latitudes, and on the researched area the positive phase shows high elevation center which encounter air stability and not ascendance of the air (Figure 2). The second component explains 13.2 percent of data diffraction of 500 HPa geo-potential height level in periods without precipitation (dry). Spatial pattern of the second component shows that cow-eye patterns which are formed show several high elevation and low elevation centers which show multi-polarity of phases, and the positive phase that penetrates Iran from Northeast can be Siberia high elevation which affects the area (Figure 3). The third component explains 11.6 percent of data diffraction of 500 geo-potential height level. Spatial pattern of the third component shows that several centers with different phases are formed. The most important center that affects the researched region is the positive phase that can show high elevation center of West and Northwest of Europe which cause drought (Figure 4). The fourth component explains 10.4 percent of data diffraction of 500 HPa geo-potential height level. Spatial pattern of the fourth component shows that a high elevation center is formed on the Mediterranean Sea and the Black sea, and affects the researched area which causes the stability and air descend and the area faces lack of humidity and no precipitation (Figure 5). The fifth component explains 8 percent of data diffraction of 500 HPa geo-potential height level in periods lacking precipitation (dry). The spatial pattern of the fifth component shows that a high elevation center with positive phase is formed on the north of Aral lake, and another center is extended towards Iran from East Europe which has negative phase, therefore, this pattern can show a low elevation center that causes the falling of cold air to Iran (Figure 6). The sixth component explains 6.4 percent of data diffraction of 500 HPa geo-potential height level in periods without precipitation (dry). Spatial pattern of the sixth component shows that it is a sub-polar low elevation or, by changing its phase, is a high elevation which is formed in Northern or central Europe, and directs other systems entering the researched area by its opposite phases (Figure 7).

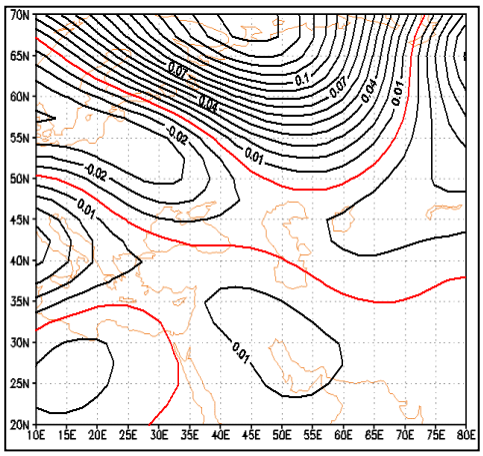

Fig 2: The first component of 500 HPa

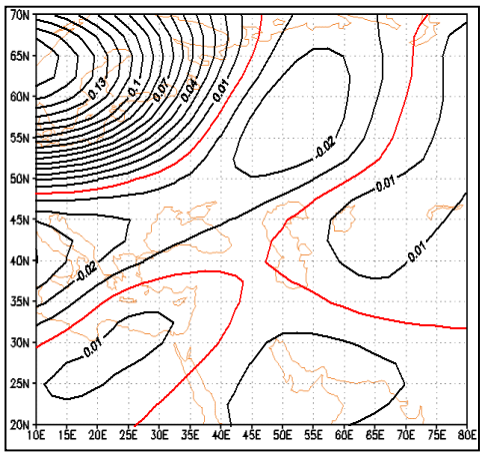

Fig 3: The second component of 500 HPa

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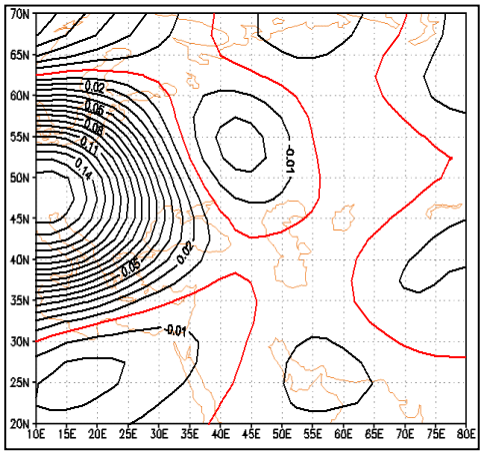

Fig 4: The third component of 500 HPa

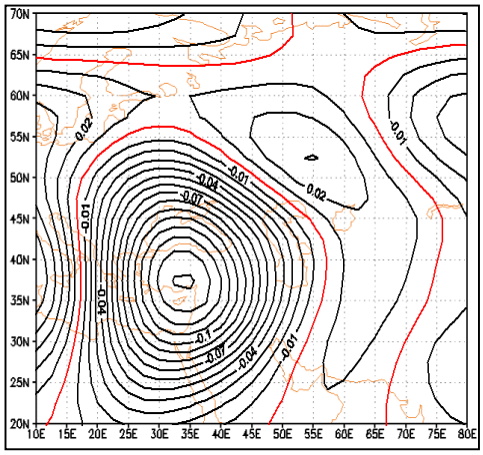

Fig 5: The forth component of 500 HPa

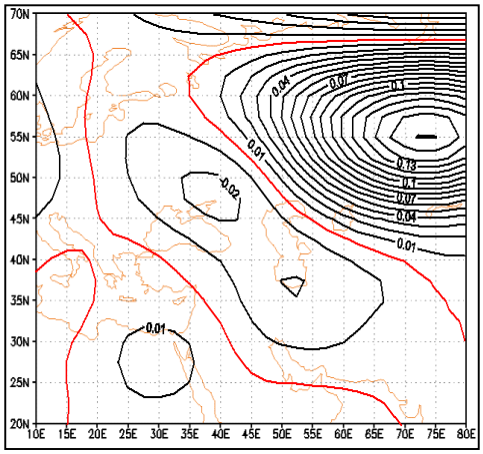

Fig 6: The fifth component of 500 HPa

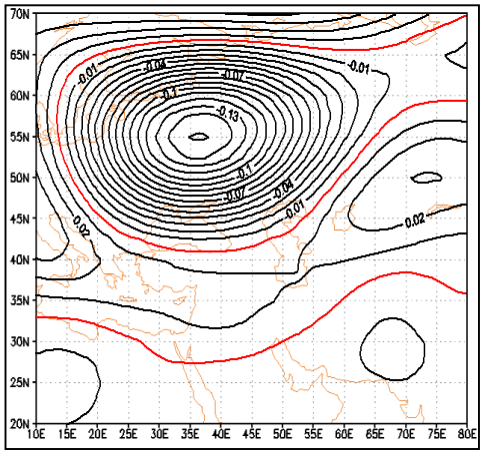

Fig 7: The sixth component of 500 HPa

Cluster investigation of drought periods

After conducting the principal component analysis, agent scores obtained from the analysis process were prepared for cluster analysis, which was done by calculating Euclidean distance and Ward linkage on component amounts for identifying map patterns of drought periods. Therefore in each cluster, one day was chosen as representative day or circular pattern based on the most intra-group correlation. Then, the map of representative day or circulation pattern was extracted in the coordinate frame introduced and it was processed and explored.

Table 3: Representative days in each cluster and their properties

day	month	year	Frequency percent	Intra-group correlation	Correlation of representative day	pattern
1	3	2008	26	0.90271	0.93832	A
11	12	1993	30	0.87214	0.91763	B
4	12	1988	15	0.89136	0.92317	C
27	1	1987	2	0.96543	0.97541	D
15	4	2001	18	0.82012	0.87655	E
11	2	1997	9	0.93275	0.94833	F

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Pattern A

This pattern has 26 percent frequency which is dominant in winter and early spring, and plays an important role in drought event. 1 March 2008 was chosen as the representative day or circulation pattern of this cluster on the basis of correlation analysis.

The Map pattern of 500 HPa level shows that a high elevation center with a closed contour 580 geo-potential decameter (anticyclone system) is formed in the West of Spain in eastern region of Atlantic Ocean. Moreover, a trough is formed with focus on east Mediterranean sea and North West of Egypt, and the research area is located in the direction of weak ridge axis of central Iran, and generally the arrangement of geo-potential height curves on the area do not have much agreement with trough and atmosphere waves ridge (Figure 8). Map pattern of sea level pressure shows that there is a high pressure center with closed contour 1020 HPa on Northwest of Iran, and the researched area is under the influence of this high pressure. Moreover, two relatively strong high pressure systems are present on Tibet and eastern parts of Atlantic Ocean with closed contour 1030 HPa lower than geographical latitude of 45 degree north which affect the area. In Northwest of this high pressure low pressure sub-polar has large extension to lower latitudes (Figure 9). Based in the map pattern, it can be concluded that in the sea level there is a high pressure center on the researched area which is dominant and leads to the stability in this area, and at the 500 HPa geo-potential a weak ridge is formed on the west of Persian Gulf which is extended to the researched area. The atmosphere arrangement in this pattern shows the stability and not ascendance in the area which is so effective in drought event.

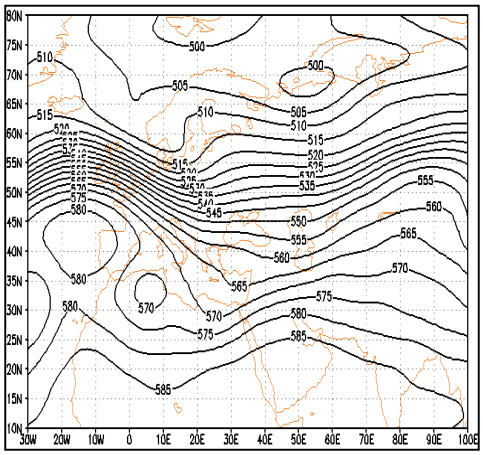

Fig 8: 500 HPa geo-potential height level map

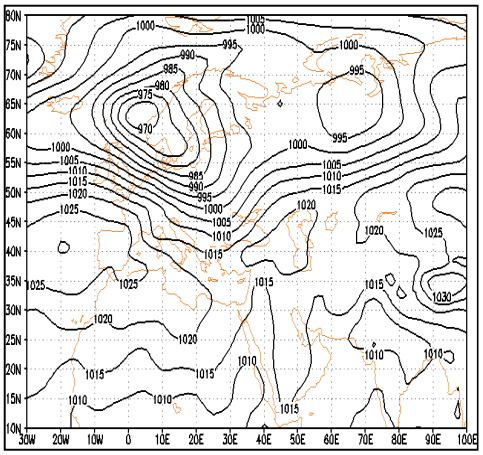

Figure 9: Sea level pressure map

Pattern B

This pattern has 30 percent frequency which is dominant in winter and early spring, and is important in drought event. This pattern is similar to the first pattern in terms of time, but in terms of intensity, it is weaker than the first pattern. 11 December 1993 was chosen as the representative day or circulation pattern of this cluster based on correlation analysis. Map pattern of 500 HPa geo-potential height level shows that weak atmosphere currents are dominant on Iran, and the researched area is under the upper convergence of east ridge, and the penetration intensity of trough and ridge of upper latitudes reaches the 40 degree North geographical latitude, and its axis is in the Northwest of the Persian Gulf, and the researched area is not under the influence of a trough with focus on east axis of Mediterranean sea and Northern Africa (Figure 10). Map pattern of sea level pressure shows that sub-polar low pressure tongue is extended to north of Mediterranean sea, and a tongue from high pressure center of north east of Baikal lake with closed contour 1040 HPa is extended on the researched area, and a high pressure center in Northwest of Iran with closed contour 1025 HPa can be seen in this pattern (Figure 11). Therefore, surface divergence and upper convergence in this pattern makes the condition of no cloudiness and no precipitation in

the area and provides the condition of drought event.

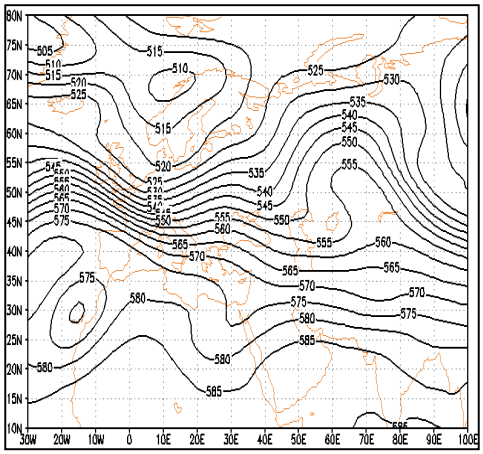

Fig 10: 500 HPa geo-potential height level map

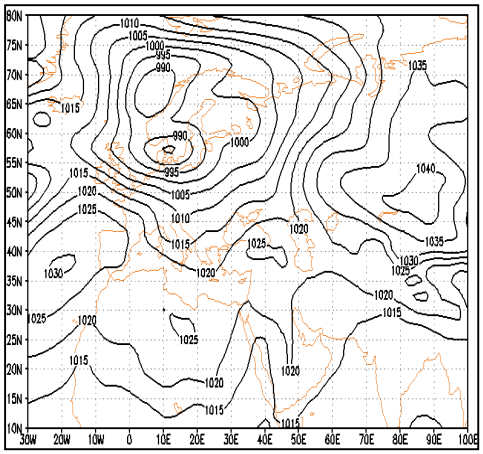

Fig 11: Sea level pressure map

Pattern C

This pattern has 15 percent frequency, which has the highest frequency in January. 4 December 1998 was chosen as the representative day or circulation pattern of this cluster based on correlation analysis. Map pattern of 500 HPa geo-potential height level shows that a barrier in meridian 40 degree east causes a change in the direction of atmosphere currents, and two directions of trough and ridge are produced, and the researched area is located in the direction of lower latitudes currents and in east ridge or under the upper convergence region (Figure 12). Map pattern of sea level pressure shows that a strong high pressure in North of the Caspian sea (40 degree east long, 55 degree north width) with closed contour 1030 HPa is formed, and slow movement of this system in 500 HPa level causes two directions in atmosphere currents, and this high pressure tongue is extended to Iran and the researched area (Figure 13). This pattern in 500 HPa level shows a trough which is located in the east of the researched area, and directs the fall of cold air of upper latitudes on the region, and at sea level, Eastern Europe high pressure tongue is extended on the region, so in this pattern the condition of moisture entrance and ascending is not provided and at the time of its dominance, brings the condition of drought in January.

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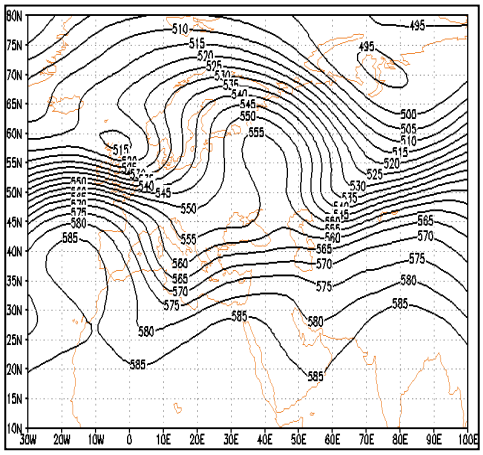

Fig 12: 500 HPa geo-potential height level map

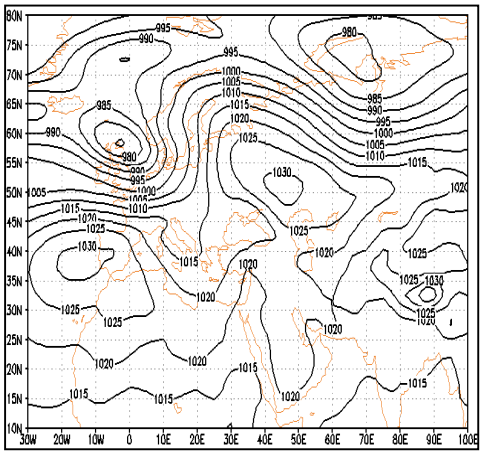

Fig 13: Sea level pressure map

Pattern D

This pattern has 2 percent frequency which appears in January-February. 27 January 1987 was chosen as the representative day or circulation pattern in this cluster based on correlation analysis. Map pattern of 500 HPa geo-potential height level shows that sub-polar low elevation causes a trough formation with the focus on the Black sea, and in the lower latitudes, atmosphere currents make a ridge on the west of Mediterranean sea and a trough in the east of Mediterranean sea and Black sea causes a situation that locates the area in the east of trough (Figure 14). Map pattern of sea level pressure shows that sub-polar low pressure is extended towards lower latitudes to Black sea, and in the Northeast of Africa a strong high pressure is formed and its tongue penetrates the researched area (Figure 15). A high elevation in Southeast of Saudi Arabia peninsula is seen with closed contour of 590 geo-potential decameter. Based on the above-mentioned two levels it can be concluded that this pattern with 2 percent frequency has the ability of causing precipitation, and the moisture of Mediterranean Sea, Black sea and Red sea penetrate this area, and based on the atmosphere arrangement cause precipitation event.

Pattern E

This pattern has the frequency of 18 percent which is dominant in spring and is effective in drought event. 15 April 2001 was chosen as the representative day or circulation pattern of this cluster based on correlation analysis. Map pattern of 500 HPa geo-potential height level shows that a deep trough with focus on central part of Mediterranean sea and a ridge with focus on west of Persian Gulf and Caspian sea are formed, and the researched area is located in the east of the ridge (Figure 16). Moreover, a high elevation system (Saudi Arabia anticyclone) is seen in the south of Saudi Arabia peninsula with closed contour of 590 geo-potential decameter. Map pattern of sea level pressure shows that a high pressure center with pressure 1015 HPa is formed on the region and by producing a clockwise current prevents the surface moisture from ascending (Figure 17). Therefore, upper convergence strengthens the surface divergence that leads to more permanence of this system, and leads to no precipitation and cloudlessness. The absence of upward movements is one of the main reasons of stable condition dominance in the region.

Pattern F

This pattern has 9 percent frequency which has the most condition of occurrence in late January, February and early March. 11 February 1997 was chosen as the representative day or circulation pattern of this cluster based on the correlation analysis. Map pattern of 500 HPa geo-potential height level shows that atmosphere currents cause trough and ridge in two directions and the researched area is located in the East of trough under the upper divergence (Figure 18). Map pattern of sea level pressure shows that a high pressure tongue of eastern Atlantic Ocean with closed contour 1030 HPa is extended on the researched area which has a surface divergence (Figure 19). Therefore, surface divergence with upper divergence weakens the instability.

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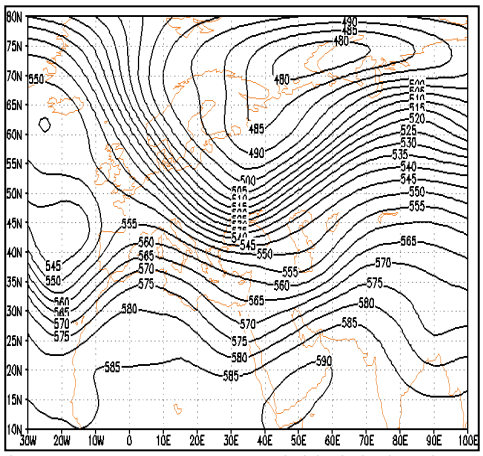

Fig 14: 500 HPa geo-potential height level map

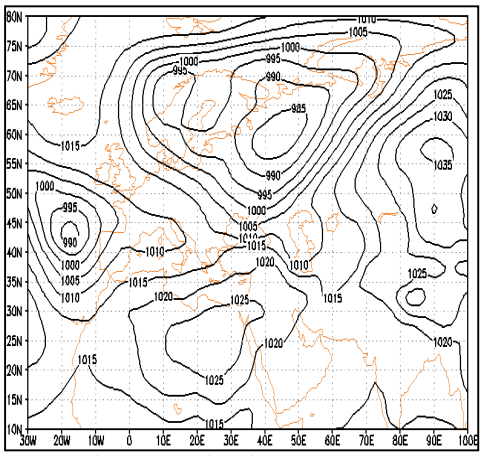

Fig 15: Sea level pressure map

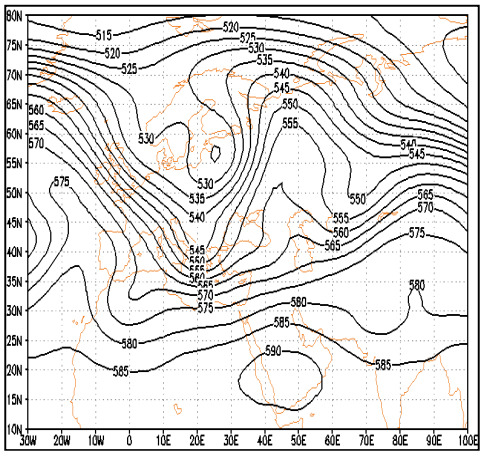

Fig 16: 500 HPa geo-potential height level map

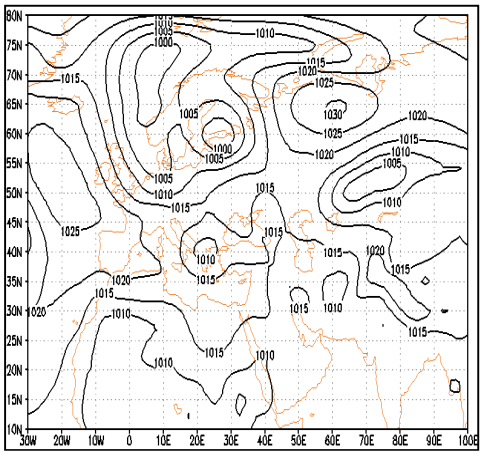

Fig 17: Sea level pressure map

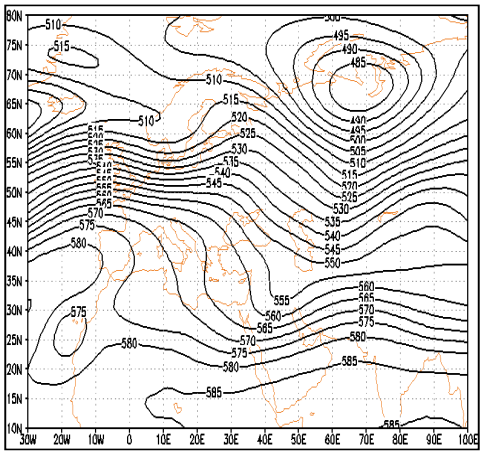

Fig 18: 500 HPa geo-potential height level map

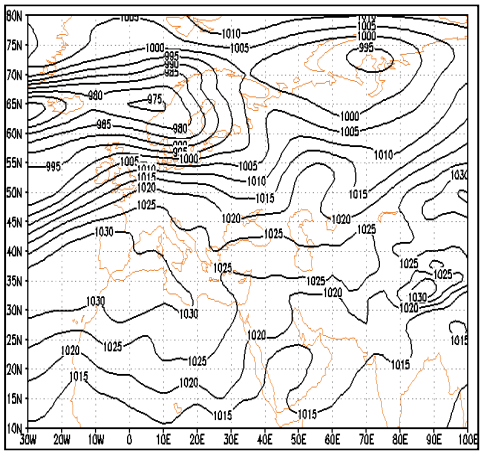

Fig 19: Sea level pressure map

CONCLUSION

Drought is one of the extreme weather and natural hazards. This phenomenon has higher frequency in arid and semi-arid regions. Drought is considered as one the important natural disasters which has a calm, gradual and creeping occurrence and has affected different aspects of life. This disaster is a catastrophic weather phenomenon which affects societies directly by limiting the accessibility of water resources, and has huge economical, social and environmental costs (Ebrahimi et al., 2010: 60). In this study, investigating the obtained components from principal component exploring shows that more than 42 percent of variation in 500 HPa geo-potential height level data is accompanied with the extension of sub-tropical low elevation to lower latitudes that leads to high flow like Siberian high become southern and a high elevation or high pressure tongue is formed on the researched area. Therefore, the dominance of high elevation cores on the area which encounter cold air falling, cloudlessness and clear sky and shows that there is no instability in the area which causes ascendance of the present moisture and leads to low precipitation and drought event.

Drought is one of the important and frequent phenomena in Central Iran and the researched area, although expectation for drought event in this area is much less that wet years based on SPI index because monthly long term precipitations is very low in this region, and with little precipitation in each month, the researched area exits from climatic drought based on this index, and wet period or normal condition would occur. Therefore, based on the selected dry months, circulation patterns of 500 HPa level and sea level were extracted, and the results showed that:

The arrangement of contour and isobar pattern in drought event has a stable atmosphere, and more than 90 percent of the time in sea level pressure, high tongues of North West and West or North and North East enter the region and create trough at the middle levels, and the research area is in the West of the trough in upper converged descend air and have the condition of air falling and prevent high humidity rise from lower levels and cause drought condition and this arrangement of atmosphere patterns in most of the times prevents precipitation and causes drought event.

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