J. Appl. Environ. Biol. Sci., 4(2)39-50, 2014

ISSN: 2090-4274
Journal of Applied Environmental and Biological Sciences
www.textroad.com

Gradual Changes of Climate in the West of Iran Based on Frequency of Air Masses Presence in Winter

Ramin Beedle

[1]Scientific Member of Researches Center of Agriculture and Natural Resources, Kermanshah, Iran & PhD Student of Climatology, Esfahan University, Esfahan, Iran

Received: November 5 2013
Accepted: December 25 2013

ABSTRACT

Significant repetition of daily dominance of definite air mass in each region that requires good condition of meteorological conditions creates a definite climate. In this research, winter air masses were studied in 5 synoptic stations in the west of Iran including Kermanshah, Ilam, Khoram Abad, Nozhe and Sannadaj in period 1961-2004. 3 kinds of winter air mass being identified by Spatial Synoptic Classification of Islamic Republic of Iran (SSCIRI), annual and monthly distribution and daily share of each of them in each month were evaluated in terms of historical and climatic changes. The west of Iran in a brief look and from temperature aspect is divided into the stations including Kermanshah, Nozheh of Hamedan and Sanandaj as being cold and Khoram Abad and Ilam stations inclined to southwest and are hot. The calculations of monthly and annual evaluation of air masses frequency based on Kermanshah station was done as relative representation of the west of Iran. Totally and according to the studies, it is concluded that winter in Kermanshah station and for west of Iran had hot condition and winter period with its historical characteristics in which coldness and snowfall are its main components, had less occurred and it is getting short and spring condition is more and more visible namely in March.

KEYWORDS: Iran; Climate change; air masses; presence frequency; trend; Kermanshah; SSC

INTRODUCTION

Daily dominance of different air masses based on geographical conditions of each location can created special condition in terms of meteorological aspects; in other words, meteorological stations being distributed in the surface of one region at presence time of an air mass show different behaviors based on geographical characteristics, topography, being far or near the humidity resource. Due to this fact one station seems colder and more humid than the other station. Indeed, air mass is like a thermal and humidity umbrella and the regions affected by it attain their share based on the mentioned characteristics. Thus, one of the ways to recognize climate and review its change during the time is identification of air masses as the most important factors in formation of atmosphere systems. Until now, climate change issue was studied from different angles and it had some results but evaluation of climate changes based on recognition of air masses and their frequency creating special meteorological condtions at ground level and is considered less and it is necessary that a research is carried out by this as surface climate in a region is completely influenced by some conditions created by repetition of air masses presence and the least benefits of these researches are the possibility of comparing the results of common methods of studying climate change by this method forming new view.

Different researches are done about circulation patterns, air masses, and climate as the followings:

A new method in Spatial Synoptic Classification of air masses was executed based on determination of seed days in a project in the southeast of USA. In this plan by statistical analysis and discriminant function, statistical period's days 1960-1990 were classified and were attributed to one of 6 defined air masses. By evaluating synoptic maps of USA by human being, the result was that the concepts of Berjeron air masses doesn't meet the demands of synoptic studies namely in the eastern zone of USA, so new classification of air masses were recommended and 6 kinds of air masses were identified and introduced for winter and summer seasons. By this method, air masses frequency and each one permutation were defined in the above period. The weak point of this design in determining seed days is only for summer and winter seasons (Kalkstein et al, 1996).

Spatial Synoptic Classification was used in north of America and 327 stations since 1948 for most of states and since 1953 to 1993 it was used for most of Canada stations. In this paper, sliding seed days facilitated year-round applicability and spatial continuity of air types were improved. 6 air masses and one transitional mass were determined and by evaluating frequency average and change of air type characteristics, a better understanding of America climate was achieved and the role of natural barriers including Sierra Nevada Mountains and other natural factors including big plain of the north of America being effective in reduction of air masses were more obvious (Sheridan, 2002).

Corresponding author: Ramin Beedle, Scientific Member of Researches Center of Agriculture and Natural Resources, Kermanshah, Iran & PhD Student of Climatology, Esfahan University, Esfahan, Iran. Email: ramin.bidel@gmail.com

Spatial Synoptic Classification plan was carried out in Western Europe by 6 variables in 48 stations including temperature, Dew point temperature, sea level pressure average, speed and direction of wind and cloudiness by 4 times daily observation in period of 1974-2000, by climatic zoning of the studied region based on 9 meteorological elements applied by Sheridan (2002), 7 climatic regions were determined separately for winter, spring and fall and 6 climatic zones were designated for summer. By selecting 6-week windows in each season, climatic seasons were identified and then by analyzing main components and obtaing 9 modes with S mode and hierarchical cluster analysis (AHC) and then k-means clustering, air types in each station were defined according to 6 types of America air mass. By determining central station in each climatic region and defining 5 rules of selecting seed day for each air mass including cloudiness, saturation deficit, maximum temperature, minimum temperature and maximum of Change daily dew point, seed days were identified in each central station and by sliding curve technique, transfer of seed day of other station in each climatic region was carried out based on Euclidean distance , then in each season and region and in each station, 6 kinds of air masses were identified (Bower et al , 2007) .

In order to evaluate climatic changes by synoptic classification system, a research was carried out in Texas. This research activity was done in 30 stations in Texas states in summer in 1961-1990 periods. Classification was based on identifying the days designating 6 kinds of air mass and then Discriminant analysis was done by using 6 elements of temperature, dew point, pressure, cloudiness, zonal and Meridional components of wind. In summer, there kinds of air masses including DM, DT and MT were dominant in Texas that dedicated totally 84% of the days and the remaining masses had 10% share. According to statistical analysis, significance trend was not observed in temperature average of each air mass in each station but it was proved that average Dew Mass point DM was increased. In the final conclusion of the research is stated that average Dew mass point DM has indicated increase in all western parts of Texas that can not be due to land use change, also DM mass frequency in central Texas was reduced in some of the stations in the report of 3 decades ago. At chapter-to-chapter comparison level, air mass frequency indicated good correlation with total precipitation (Sheridan, 1997).

The evaluation of air mass characteristics changes was done between urban and rural areas. In this paper, besides using Spatial Synoptic Classification plan being applied for more than 300 stations in USA and its record since 50 years ago, daily maximum and minimum temperature was compared between urban and rural stations in the east of USA. For each of various urban regions, pair stations were selected one in a city and the other in village. The results show that night temperature between urban and rural areas for most of air masses, show greater difference in summer in comparison with winter. Three dry air masses including DP, DM, DT have temperature differences with lowest degree in winter (1 to 3 degree) that increases to 2 to 5 degree in summer and remains at this level in fall. On the other hand, wet air masses (MM, MP, MT) have completely complex pattern as MT mass acts as dry masses, with greater magnitude. This mass in winter is with windy and cloudy condition reducing temperature differences and vice versa in summer, with less cloudiness and mild wind, temperature difference in urban and rural areas is more obvious. MM air mass is uniform in most of the regions and heat island difference is summer and winter is less than 1°C.finally in 4 great cities of USA, minimum temperature difference of dry air masses is more than wet masses between urban and rural areas and this is more evident in summer than winter (Sheridan et al, 1999).

By Spatial Synoptic Classification, characteristics changes and air masses frequency in 100 cities in USA in 1948-1993 periods were studied. The issues of climate change in a long period were done by air separation and the type of air mass. In winter and summer, north-south frequency of DP air mass is with the defined slope for both seasons and winter frequency of transitional air mass in the center of city reduced considerably and this is due to the increasing conversion of Upper troposphere circulations from zonal condition to meridional condition. Frequency reduction of MT winter air mass in the southeast of USA and frequency increase at the same time in mp air mass and significant increase of MT summer air mass to 2 to 4 percent in a 10-year period is obvious and it is due to the sudden reduction of DM air mass. The other findings of this research and most important parts of them is taking into attention the considerable increase of cloudiness in most of air masses namely, DM, MM and MT and cloudiness increase of afternoon that is dedicated to tree types of dry air mass. Increasing summer minimum temperature is restricted only to wet masses namely MT air mass increased approximately 0.3°C in 10-year period (Kalkstein et al, 1998).

Frequency of weather types and Teleconnection indexes for Northern America were studied. In this research, Spatial Synoptic Classification plan of every day in statistical period of 330 stations in USA and Canada were classified in terms of execution thermal and moisture classifications in every day in one of 7 groups of weather type and then the relationship between weather type frequencies and Teleconnection patterns PNA, NAO were defined and DP, MT types in all over the continent have great changes and in the west with winter months and positive phase PNA, DP mass days were seen rarely and marine air was circulating considerable into the farms but MT mass was reduced significantly in PNA positive phase. In PNA negative phase, DT mass penetrated uncommonly from the east to Texas while, in winters with PNA^{+}, western penetration to California is very common. Also in non-cold seasons for example in August and in

PNA positive phase, DM mass were present for 13 days and polar masses MP, DP were present for 9 days, while in negative phase and at the same month, averagely 22 days were dedicated to polar masses and only 4 days were dedicated to DM mass and obviously shows definite change in penetration from west to north (Sheridan, 2003).

Air masses changes to reveal climate changes and evaluation of frequency reduction of the coldest air mass and increasing frequency of the hottest air mass in polar region of northern America were investigated (Kalkstein et al, 1990).

Grouping the days based on analysis of air passing route and thermal and humidity characteristics 850 hPa caused that reduction is obtained in the number of the coldest days of winter and increase in hot and humid days of spring and summer in the northern center of USA during 1958-1992 (Schwartz, 1995).

Time series of unique climatic variables such as air temperature and precipitation was used to study climate change. To classify surface variables of meteorology to separate classes and identification of air masses, spatial synoptic classification (SSC) method was used and then frequency changes frequency of air masses was investigated during 1948-2005 in USA. The results showed that hot and humid masses are increased more in comparison with dry and cold masses and this caused increase in green gas concentration (Knight et al, 2008).

The probability of linkage of ground level air masses with upper atmosphere circulation models and the subject of the effects of climate change on human health, mortality caused by heat wave and increasing demand of electricity energy in California was studied. In this research, at first, dominant circulation daily patterns on the north of America were identified by re-analysis ERA-40 Geopotential height 500, 700 hPa and temperature 850hPa. Then 12 patterns were obtained by clustering objective analysis and it was compared with circulation historical patterns being simulated by NCAR-CCSM3. Two cases of these models were related to air mass conditions of coastal cities in winter and transitional months and 3 cases were related with air mass of non-coastal cities in summer (Sheridan, et al, 2009).

METHODOLOGY

In this research winter air masses in Iran were identified by the following calculation process and data of 63 first-degree synoptic stations (Fig.1) and in 1961-2004 period based on Spatial Synoptic Classification method and then evaluation of frequency changes of the presence of winter masses in 5 synoptic stations in the west of Iran including Kermanshah, Ilam, Khoram Abad, Nozhe and Sanandaj totally were studied as the following calculation process. 1) Organizing matrices of winter data of the stations by p mode 2) using 9 climatic variables including sea level pressure, Dew point temperature, minimum temperature, maximum temperature, minimum and maximum deficit of daily saturation, cloudiness, daily range temperature and daily range of dew point (Bower et al, 2007) 3) Calculation of Temporal Synoptic Index (TSI) in winter in stations by principal components analysis (PCA) and then cluster analysis (CA) in order to identify surface weather types 4) grouping the obtained weather types by stable variable of Virtual Potential Temperature (VPT) for primary identification of air masses 5) Determining primary seed days of each air mass based on 5 variables including maximum and minimum temperature, the maximum daily change of dew point, daily cloudiness, saturation deficit and then by considering numbers range as a higher and lower standard deviation of data mean as criterion (Bower et al, 2007), and selecting 10 days with the minimum value of RMSE 6) Interpreting atmospheric maps of primary seed days related to seal level pressure- geopotential height of 850 and 500 hPa-temperature of 1000, 925, 850, 700 and 500 hPa- zonal and Meridional components of wind (u,v) , 300, 250 hPa- mixing ratio 700 hPa for final approving of seed days of seasonal air masses. 7) Discriminant analysis of winter data in the stations based on Virtual Potential Temperature (VPT) of final seed days 8) Determining the days dedicated to each air mass in winter calendar of each station 9) Determining annual and monthly presence frequency of air masses and daily changes in winter months during statistical period of each station. This evaluation is including daily changes in each month and then monthly changes during studies period.

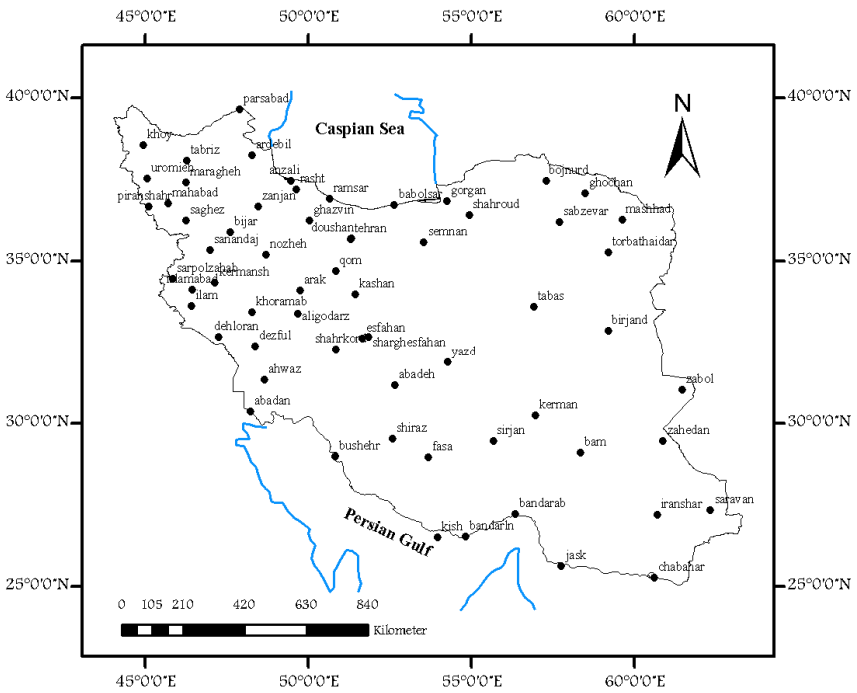

Fig. 1 The stations used in the research

RESULTS

Identification and classification of winter masses in Iran are based on Spatial Synoptic Classification (SSC) method that were done by some modification in the selection method of seed days and three air masses with distinctive meteorological characteristics and temporal and spatial domains. General characteristics of these masses in Iran (63 stations) are presented in table (1) and in selected station are presented respectively in tables (2) to (6).

Table 1- Total average of meteorological characteristics of winter masses in Iran (The stations together)

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	5.9	6.5	63.7	6.9	15.2	3.4	12.2	1.3	3.7
2 Winter	5.5	12.3	51.8	10.8	22.3	3.2	18.2	6	4.5
3 Winter	6.1	1.7	76.6	3.9	7	4.1	6.5	-2.5	3.3

Table 2- Characteristics of winter air masses in Kermanshah station

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	6.5	3.7	69.2	5.9	15.1	4.2	10	-1.7	3.9
2 Winter	6.8	9.1	57	9.3	20.9	4.7	15.6	2.7	4.4
3 Winter	4.6	-3.1	76.9	3.8	7.8	3.5	2.9	-8.2	4.6

Table 3- Characteristics of winter air masses in Ilam station

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	9.1	3.8	66.3	6.3	15.6	3.6	2.8	0.2	4
2 Winter	10.9	9.2	53.5	9.9	21.3	3.7	14	4.6	4.6
3 Winter	8.3	-1.7	71	5.1	9.9	3.2	2.7	-5	4.5

Table 4- Characteristics of winter air masses in Khorma Abad station

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	7.7	5.5	68.2	5.9	15.3	3.8	11.7	0.3	3.4
2 Winter	6.7	11	57.7	8.4	21.3	4	17.4	4.9	3.9
3 Winter	6	0.4	70	5.2	9.8	2.5	7	-4.6	4

Table 5- Characteristics of winter air masses in Nozheh of Hamedan station

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	4.7	0.1	74.1	4.6	15.1	4.4	6.4	-5.5	4.1
2 Winter	4.6	5.6	61.3	8	21.2	4.6	12.5	-0.9	4.8
3 Winter	4	-8.7	79.2	3.2	5.5	3.9	-1.8	-14.9	5.3

Table 6- Characteristics of winter air masses in Sanandaj station

Characteristics Air masses	Rainfall mm	Daily average temperature C	Relative humidity %	Daily average Saturation deficit C	Potential Temperature C	Daily average cloudiness octaz	Max temperature C	Min Temperature C	Max daily change Dew point C
1 Winter	6.6	2.9	68.1	5.6	15.1	4.5	8.7	-2.6	**3.6**
2 Winter	6.4	8.2	56.4	8.7	21	4.7	14.2	1.3	**4.3**
3 Winter	**4.1**	**-4.5**	**73.3**	**4.3**	**7.1**	**3.8**	**1.4**	**-10.2**	**4.1**

As it is shown in these tables, the coldest air mass with considerable relative humidity was air mass(3) and in all over Iran and in each of the stations, this characteristics is observed but according to the geographical condition of stations, By considering their thermal and humidity variables they are different but reflect similar characteristics. Thus, air mass(3) can be called cold and humid. The hottest air mass is air mass (2) with less relative humidity and these conditions exist in all over Iran and each of the stations and are considered hot and dry mass. Air mass(1) is moderate and a little cold mass with suitable relative humidity. In terms of average precipitation in rainy days, in all over Iran air masses (3),(1) and (2) respectively are located in grades 1 to 3. This condition is different in stations as the highest rainfall air mass is in Kermanshah, Ilam stations; air mass (2) (The hottest) and in other stations air mass(1) is (Moderate). Although rainfall amount difference of air masses(1) and (2) is not very much, air mass(3) has undoubtedly the lowest rainfall air mass among west region stations.

Frequency of winter masses

After doing discriminant analysis on data of each station, their daily membership to each of 3 kinds of air mass was determined then, by organizing the obtained information of this stage, presence frequency of winter masses were defined as seasonal separated by January, February and March months. This evaluation shows that seasonal frequency of air mass(1) among the selected stations is the highest while air mass(2) in Ilam, Khoramabad stations and air mass(3) in Kermanshah, Nozheh and Sanandaj in new priorities have the highest frequency value. Considering air masses meteorological characteristics (table 1), we find that southern section of west region from khoramabad to the south of Iran have experience moderate and hot masses and from Kermanshah to northwest of Iran, moderate and cold masses had the highest presence. Thus, approximately the west of Iran can be separated in terms of temperature and humidity. The details of these data are presented in table (7).

Table 7- Presence frequency percent of winter air masses in the west of Iran

	Air mass 1	Air mass 2	Air mass 3
Kermanshah	56.6	21.2	**22.2**
Ilam	52.2	42	**5.8**
Khormabad	58.3	30.9	**10.8**
Nozhe of Hamedan	45.3	22.6	**32.1**
Sanandaj	**51.6**	**19.8**	**28.6**

Temporal distribution of air masses method in each months of winter was evaluated for better revelation of temporal dominance. The results indicated that air mass(1) except Ilam station has the highest frequency in January in

other stations. However there is little difference with February and it means that the first month of winter had experienced moderate air mass more and in February and March these conditions gradually had less presence.

Air mass(2) winter that is totally hot, has the highest presence in March and then in February and January, slope of presence was less with the exception that in Ilam station, this air mass has the second priority in January.

Air mass(3) with its cold nature shows the highest frequency in February with little difference in comparison with January month, except Khoram Abad that has the highest presence in January with little difference from February.

Thus, by ignoring little difference between January and February, it can be said that air mass(1) of winter in all stations of west of Iran has the highest frequency in January and February and air mass(2) with the highest frequency in March and air mass 3 has the highest frequency in January and February months. Climatic condition of winter in the west of Iran based on the obtained frequencies has moderate condition in January and cold condition in February and hot condition in March. After doing discriminant analysis on station data and defining daily membership to air masses in winter, to avoid lengthy explanation, the related results only in Kermanshah station are provide as the centrality of the west of Iran and to some extent its representation as the charts of each month in winter.

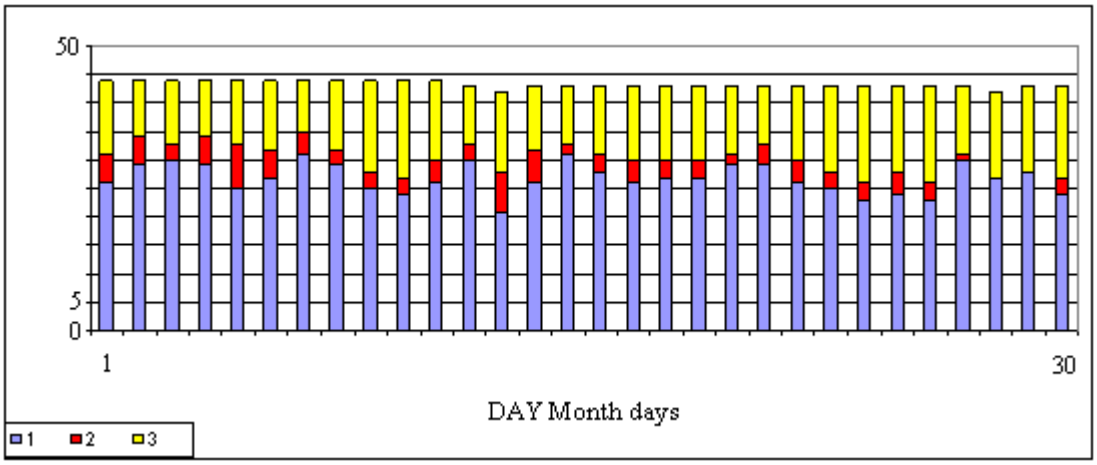

Figure 2- temporal distribution of presence frequency of winter masses in January month in Kermanshah station

As it is shown the number of presence days of each air masses in each days of January month during statistical period are presented. This chart indicates considerable presence of air mass(1) with moderate nature. Air mass(2) has the least presence and it is fluctuating during January month. Air mass(3) as the coldest one has fluctuating presence and is considered in second grade. So, it can be said that January month in Kermanshah station has moderate and a little cold nature. The evaluation of frequency change of daily presence shows increasing presence of air mass(3) and decreasing presence of air masses(1) and (2) that is indicating gradual dominance of colder conditions from the beginning of this month to the end of it. In other words, as we approach the end of January, colder condition presence is getting more Fig (3).

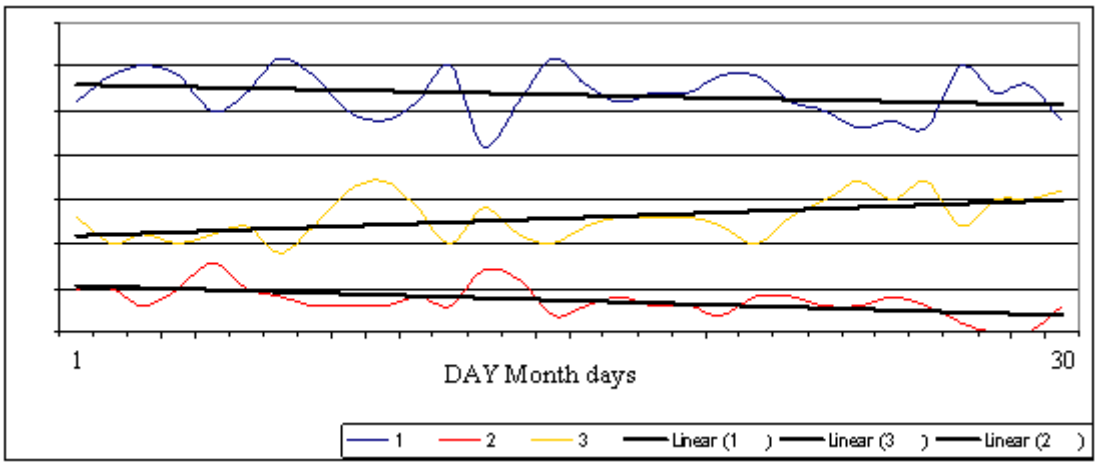

Figure 3- linear trend of winter masses presence changes in January month in Kermanshah station

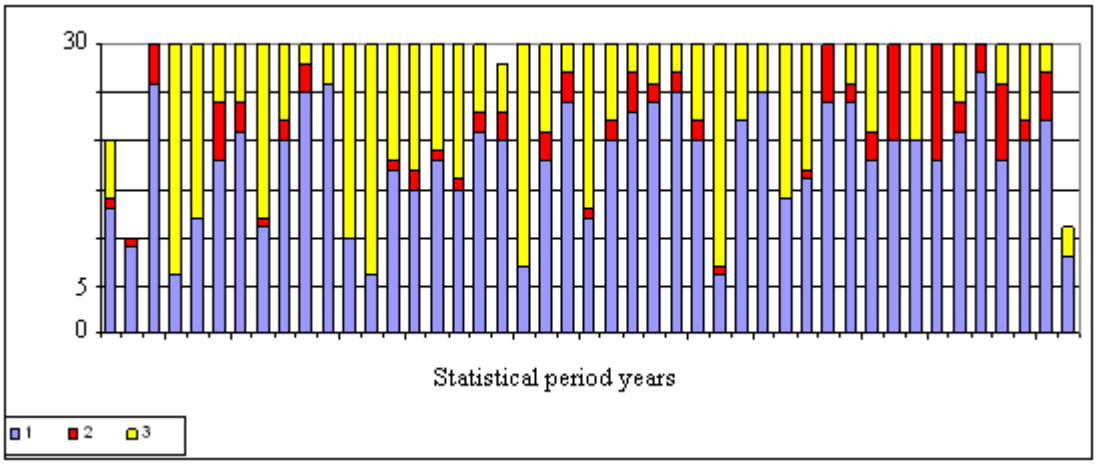

Figure 4- temporal distribution of winter masses presence frequency in January of different years in Kermanshah station.

In figure (5) the changes of air masses presence in January of different years are presented. When we look at air masses presence from this view, we find that during statistical period, mass 1(moderate) has increased its presence while, air mass(3)(The coldest) has decreased its presence and air mass(2) (The hottest) had increasing presence in recent years. Linear trend of these changes presented in figure (3) shows that climatic condtions of January in studies period considering the frequency of air masses are inclined toward moderate and hotter condition.

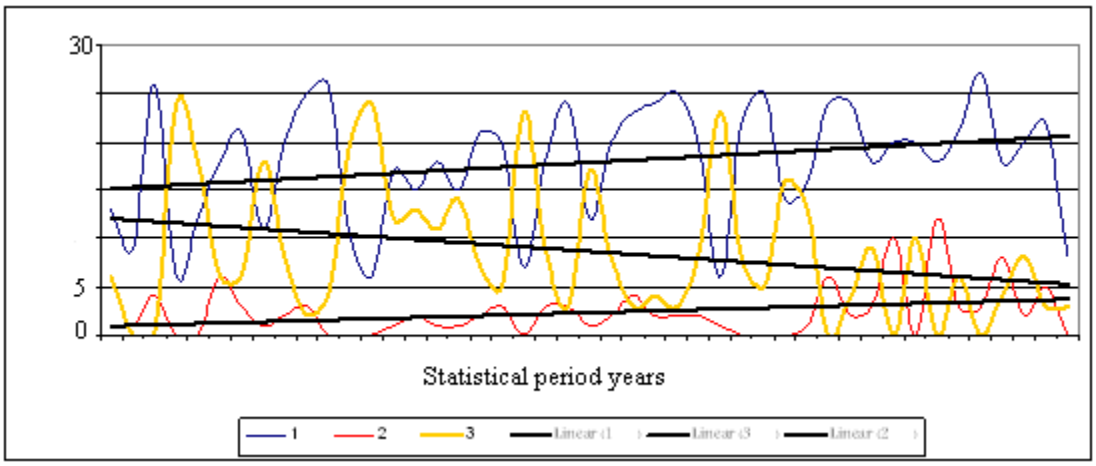

Figure 5- annual changes trend of air masses presence in January in Kermanshah station

Frequency changes of masses presence in each of February days are presented in figure (6). As it is seen, air mass(1) has the highest presence in all the days of this month and as we approach the end of the mount, the number of these air masses presence is increased in each of the days. Thus, in February the dominance of moderate air mass is completely obvious. Air mass2 (The hottest) increased its presence from the beginning days to the end of the month and it has dedicated the share of air mass 3 days (The coldest). As air mass(3) presence in the first half of February is more than the days of second half. It means that air coldness and colder conditions are gradually reduced in the second half of February. These changes trend are in figure (7) shows that air masses(1) and (2) are increasing and air mass3 (The coldest) has decreased with greater slope.

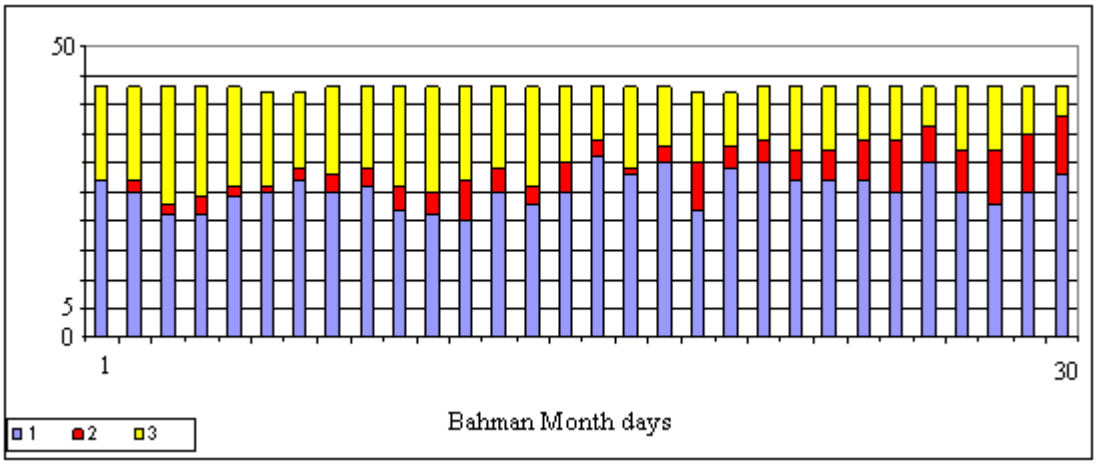

Figure 6- Temporal distribution of presence frequency in February days in Kermanshah station

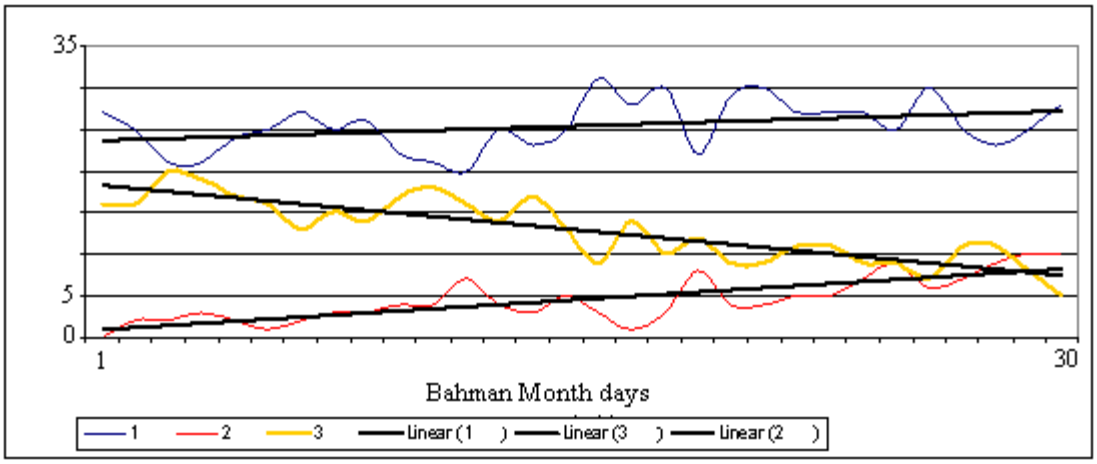

Figure 7- Linear trend of presence of winter masses change in February days in Kermanshah station

This condition is supported completely during studies period. Figure (8) well indicates that air mass(1) has increased its presence gradually to the recent years and air mass3 (The coldest) has considerable presence in two time sections but as we approached to recent years, its presence is decreased. Air mass(2) at the beginning of its presence has shown itself less and gradually by fluctuations these days. The important point in the lack of presence of air masses(2) and(3) in February while air mass(1) has kept its presence even for some days or for ever. Annual changes trend in figure () shows that air mass(1) has increased its presence with a relative high slope while, air mass(3) has decreased its presence. Air mass(2) during its presence studies period is with littler changes and its increasing trend shows mild slope. Thus, February climatic condition according to this information is inclined to moderate condition. However, air mass(1) with moderate condition has better rainfall in comparison with air mass 3 but its temperature condition provide rainfall formation in the form of snow less and it is problematic issue in this region.

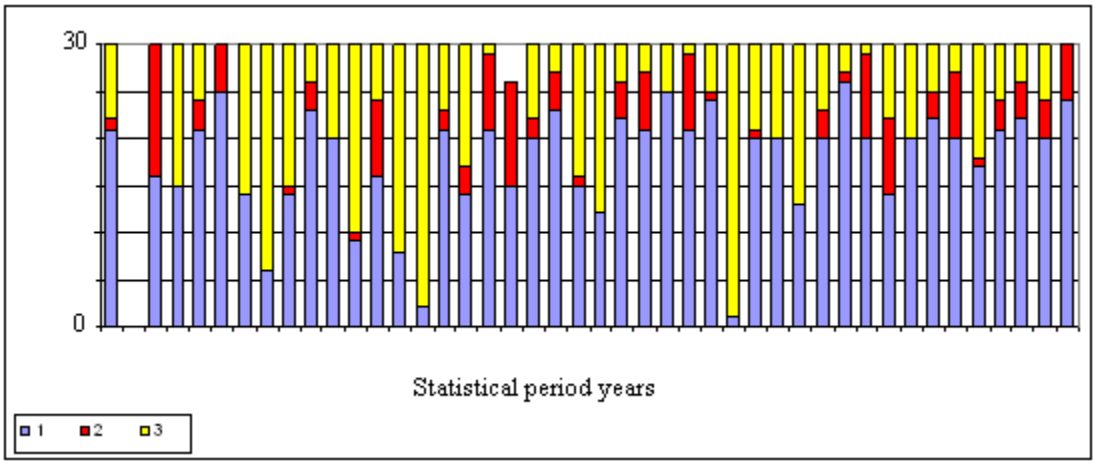

Figure 8- Temporal distribution of presence frequency in February days in different years of Kermanshah station

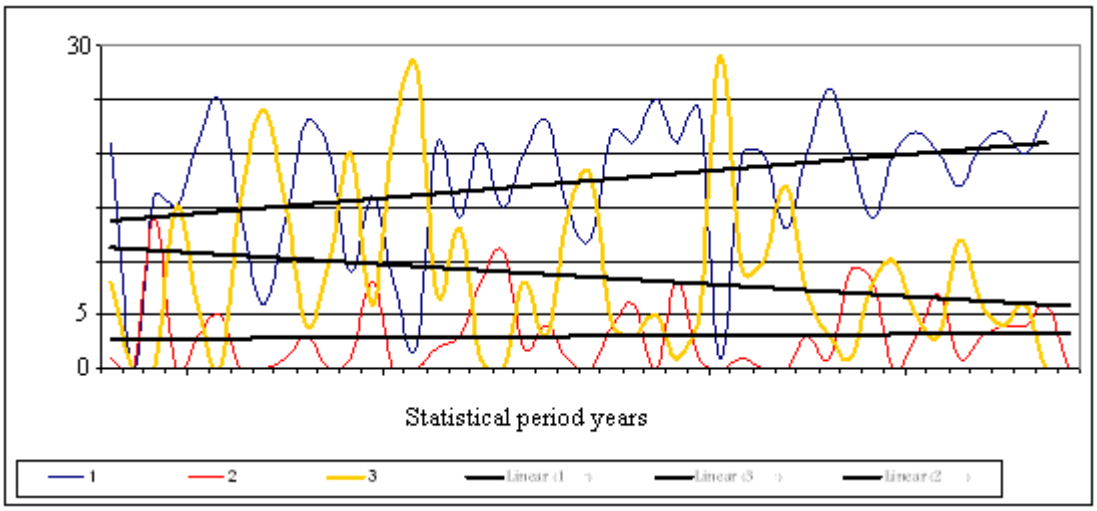

Figure 9- Annual changes trend of air mass presence in February days in Kermanshah station

March is considered movement month of meteorological conditions and it has different condition with January and February months. The presence of air masses in each of March days figure (10) during studies period shows that to the first 10 days of this month mass1(moderate) has maximum presence and gradually are replaced by mass2 (The hottest) as mass 2 from the beginning of March to the end of it, increased its presence and masses(1) and (3) are getting less and even mass3 (The coldest) in the final week is without presence. Daily changes trend of this presence is presented in figure (11) and it well shows decreasing trend of moderate cold masses and increasing trend of hotter trend.

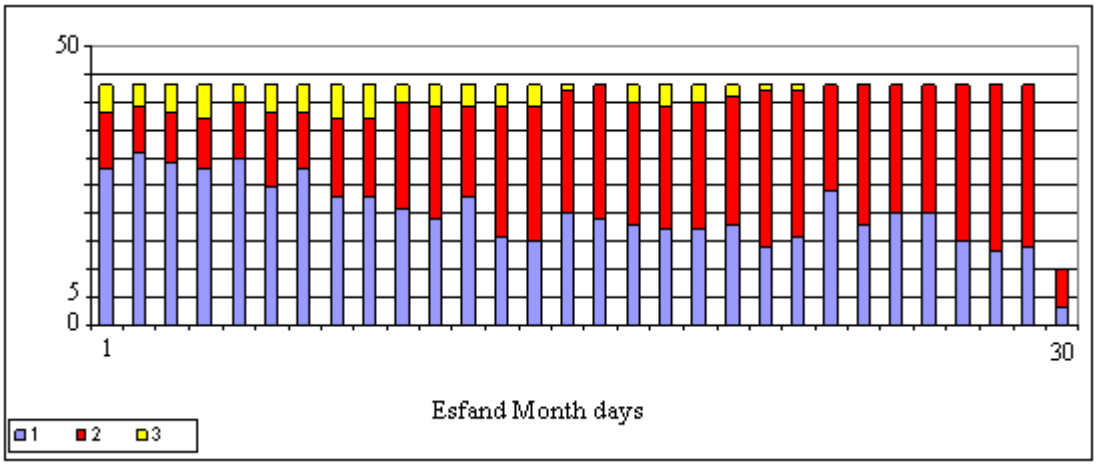

Figure 10- Temporal distribution of winter masses presence in March days in Kermanshah station

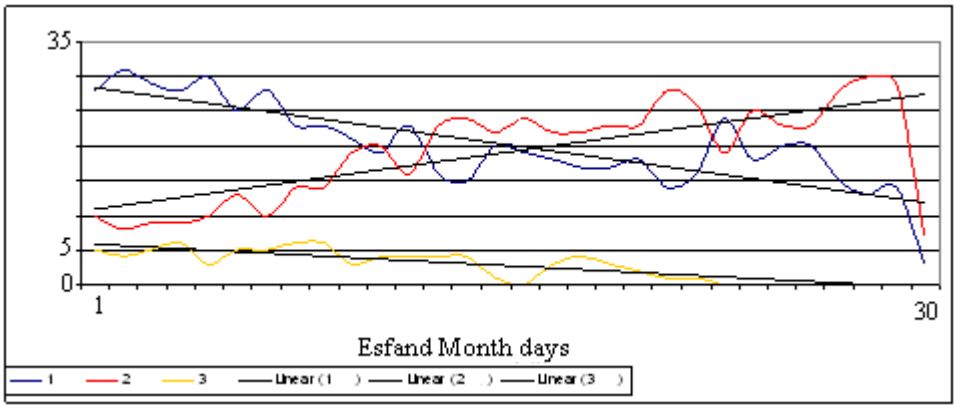

Figure 11- Linear trend of presence of winter masses change in March days in Kermanshah station.

Air masses presence in annual scale shown in figure (12) indicates the increase in the number of presence days of air mass(2) in final years of studies period and fluctuation changes of air mass 1 and decreasing the presence days of air mass(3). Annual changes trend in figure (13) shows gradual presence increase of air mass2 (The hottest) in comparison with air mass1 (Moderate) and uniform trend of air mass(3). The obtained results indicate the climatic conditions change in March toward hotter condition and this movement between moderate air masses with air mass(2) as hotter is occurred.

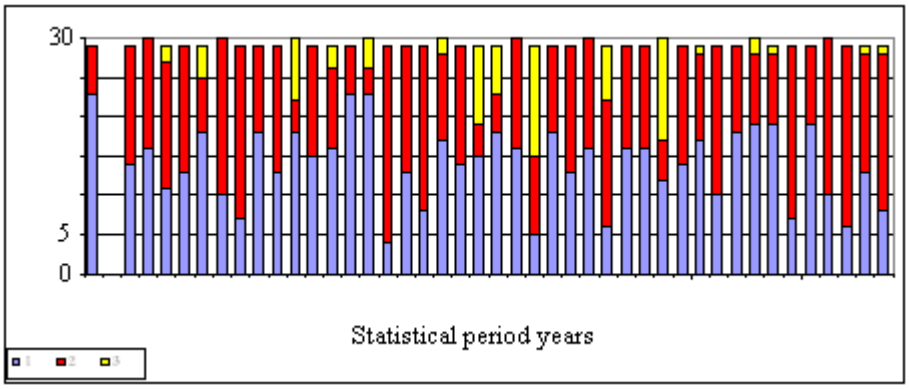

Figure 12- Temporal distribution winter masses frequency presence in March days in Kermanshah station

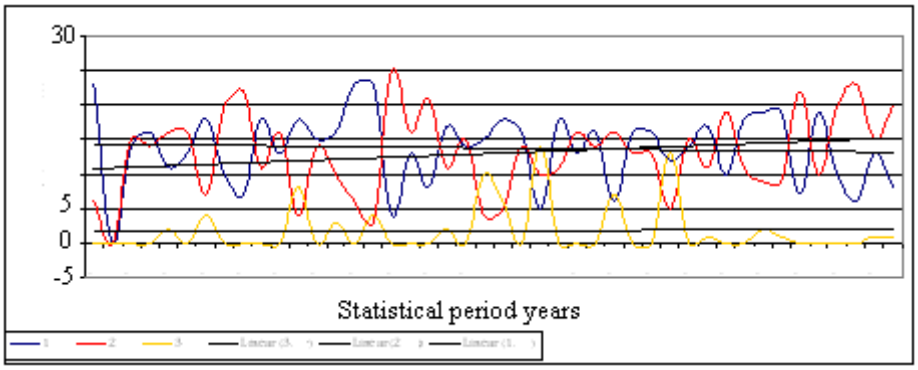

Figure 13- Annual changes trend of air masses presence in March days in Kermanshah station

Conclusion

The researches based on air masses besides creating different capabilities in the studied filed, are encountered with special problems. The existing review literatures about air masses support this issue. In this research due to the lack of good review of literature about air masses in the studied region, in the selected methodology besides using Spatial Synoptic Classification method framework (Sheridan, 2002) and (Bower et al, 2007) some modifications were done in accordance with region condition in Iran in identification of primary masses and selection of seed days.

The focus of the subject of this research in the west of Iran consisting of 5 synoptic meteorological stations and then Kermanshah station as the relative representation of the region, is on probable changes of climatic condtions based on frequency changes of air masses presence each with unique meteorological characteristics.

This study showed that in winter, there are 3 different air mass in Iran and they are divided in terms of meteorological conditions, respectively to moderate (relative humid)- hottest (semi-humid) and coldest (Rather humid). The presence of these air masses in winter showed that in the west of Iran air mass (1)as moderate and rather humid has great presence frequency among the stations. While air mass2 (The hottest) in Khoram Abad, Ilam stations and air mass3 (The coldest) in Kermanshah stations; Nozhe and Sanandaj are in the next grades of frequency.

According to this and generally west of Iran is divided into two parts in terms of temperature. First section: Kermanshah, Nozheh of Hamedan and Sanandaj stations are cold and section 2: KhoramAbad and Ilam inclining toward southwest of Iran are hot. In the monthly and annual investigation of air masses frequency, Kermanshah station is selected as relative representation of the west of Iran and the related calculations were done based on it.

Air masses frequency changes occurring during the days of each month of winter and during studies period, showed that in January, the highest recurring daily presence was respectively including air masses 1, 3 and 2 and the trend of these changes from the beginning to the end of it is as masses 1 and 2 have decreasing trend and mass 3 as the coldest shows increasing trend. In other words, by moving to the end of this month, moderate and cold condition is created. But annual changes trend of air masses presence in this month during studies period (1961-2004) considering equal to climate change indicates decreasing trend of air mass(3) and increase in air masses(1) and (2). Thus, January month is inclined toward moderate and hot condition. The evaluations in February showed that recurrent presence of air masses(1) and (2) at the beginning of this month to the end and in each days are increased and it shows that as we approach the final days of this month, we will have moderate and hot condition and its coldness is reduced. But changes trend of air masses presence in February and during studies period showed that air mass (1) had increasing movement and air mass(3)had decreasing movement and air mass(2) was almost uniform thus, climatic condtions of this month by decreasing presence of the coldest air mass will be more moderate and this can change rainfall form and considering the snowfall experience in this month, snow is observed less. This caused early evacuation of rainfall by rivers during winter and its negative effects are revealed in the lack of good feeding of underground water levels and increasing water in seasonal springs in spring and the beginning of summer. Production of agricultural products and environmental balance namely beside the rivers are the first things being damaged by these changes. In March different condition is observed as recurrent presence of moderate and cold masses in each days of this month is descending and for hotter mass is ascending. Thus, as we approach the final days of this month, the hot condition is more dominant. On the other hand, the trend of air masses presence changes in March during statistical period showed that climate of this month is based on air masses presence; indicated decreasing moderate condtions and increasing hot condition and uniform condition of cold condition. So, hot trend of March is obtained from this evaluation. Totally and according to the studies, it is concluded that winter in Kermanshah station and for west of Iran had hot condition and winter period with its historical characteristics in which coldness and snowfall are its main components, had less occurred and it is getting short and

spring condition is more and more visible namely in March. The main results of continuing this condition is rapid evacuation of precipitation and its change, less use of underground wall level and vulnerability of natural ecosystems.

Acknowledgment

The authors declare that they have no conflicts of interest in the research.

REFERENCES

Bower D, Mc Gregor GR, Hannah DM, Sheridan SC (2007) Development of a spatial synoptic classification scheme for Western Europe. Int Journal of Climatology 27:2017-2040.

Kalkstein L S, Nichols M C, Barthel C D, Greene JS (1996) A new spatial synoptic classification: application to air-mass analysis. International Journal of Climatology, 16 : 938-1004.

Kalkstein LS, Sheridan S C, Graybeal D Y (1998) A determination of character and frequency changes in air masses using a spatial synoptic classification. International Journal of Climatology 18:1223-1236.

Sheridan SC (1997) Using a synoptic classification system to assess climate trends and variability in Texas. Proceeding, 10th conference on applied climatology, American Meteorological Society, 287-289.

Sheridan SC (2002) The redevelopment of a weather-type classification scheme for North America. International Journal of Climatology 22:51-68.

Sheridan SC (2003) North American Weather-Type Frequency and Teleconnection Indices. International Journal of Climatology 23:27-45.

Sheridan SC, Kalkstein L S, Scott J M(1999) An evaluation of the variability of air mass charter between urban and rural areas. Proceeding, 15th International congress of Biometeorology and International conference on urban climatology, International Society of Biometeorology, 5pp.

Kalkstein, L. S., P. C. Dunne, and R. S. Vose (1990), Detection of climate change in the western North American Arctic using a synoptic climatological approach, J. Clim., 3, 1153– 1167.

Schwartz, M. D. (1995), Detecting structural climate change: An air massbased

approach in the north central United States, 1958 – 1992, Ann. Assoc. Am. Geogr., 85, 553– 568.

Knight, D. B., et al. (2008), Increasing frequencies of warm and humid air masses over the conterminous United States from 1948 to 2005, Geophys. Res. Lett., 35, L10702, doi:10.1029/ 2008GL033697.

Sheridan SC, Hayhoe K, Kalkstein L. (2009) ESTIMATING CLIMATE CHANGE IMPACTS FROM ATMOSPHERIC CIRCULATION PATTERNS AND AIR MASSES. California Climate Change Center. CEC-500-2009-031-D.