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The frequency of severe storms Zab Basin in Iran and their relationship with large-scale atmospheric patterns

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ABSTRACT

Storm severe turbulence and severe atmospheric air pressure caused by the collision of two cold and warm fronts occur. Storms often with strong winds, torrential rains and is causing deforestation, the destruction of buildings and breaking windows. In this study, given the scale of temporal and spatial distribution, wind speed and comprehensiveness of the three threshold size and calculate the 90th percentile wind speed, Forty days pervasive and severe storms were selected. Sea level pressure data and the elevation data of 500hp level were extracted from the database NCEP/NCAR. Matrix was formed that storm was on the rows and elevation data middle levels of the atmosphere, was on the columns. And principal components that explain the variation in height level pressure hp500 were identified. The results showed that the most frequent storms at the thermal equator. April was the most prevalent (33%) and July and August had the lowest number of storm. Five synoptic pattern of atmospheric middle level, in the form of three major causes of severe storms in the Zab River Basin: Cut off low pattern, Shallow trough pattern of long wave and deep trough pattern of short wave. Because of the special arrangement of relatively strong and contrasting surface synoptic, the pressure gradient and energy exchange at its maximum reached compression Isobaric lines and as a result, Strong winds in the catchment area level has been created. The results from the scale distribution of days in each cluster showed that 52% of days with deep traffic rule synoptic pattern happened in May and November (a total of 12 storms) and 26% more in December, January and February (each of the two storms) is assigned. The most frequent traffic synoptic pattern of a synoptic pattern of middle levels and 60% of the patterns assigned to itself, causing severe storms in the Zab River Basin.

***Keyword*:** Frequency; Seasonal Distribution; Storm; Zab Basin

1. INTRODUCTION

Storm is a natural phenomenon that can happen in any country. Storm severe turbulence and severe atmospheric air pressure caused by the collision of two cold and warm fronts occur. The extreme weather conditions, including natural disasters, which sometimes impose financial heavy losses and casualties in areas under their control.

Monitoring systems and the arrival time of severe storms basically, one of the main requirements of crisis and natural disasters in the region. If the economic terms of the size and scope of the consequences of severe storms (direct and indirect) to be evaluated, they certainly vacuum Study finds increased importance. The main part of a severe storm warning system, is the model prediction and forecasting in time, and with the risk of potential losses sure, will decrease. Classification of types of atmospheric circulation patterns or extreme changes in climate weather useful tool and are the most important method of identification (Prudhomme and Genevier, 2010: 1180). Given that almost all climate disasters are directly or indirectly associated with high levels of atmospheric circulation patterns, therefore, examine the synoptic weather pattern associated with violent storms Cut Off Low Zab catchment area would be inevitable. Therefore, the main objective of this research is to identify and categorize atmospheric circulation patterns associated with the occurrence of severe storms Zab basin using advanced statistical methods and their synoptic interpretation. In addition, the main purpose of the survey, the frequency of severe storms Zab basin Iran and their relationship with large-scale atmospheric patterns.

The first task of counting hydro-meteorological events and distribution of atmospheric and climate disasters. So far the researchers have done several studies on severe storms. Including the valuable work of the late Raheli Salimi (1382), Zahedi (1384), Jahanghir and et al (1384), Alamdary and et al (1390) Asadi and et al. (1392) Rezaei Banafshah and et al (1393) pointed to the potential for wind energy assessment. Other researchers have studied such Hussein Zadeh (1376), Zulfikar (1383), Kamijani and et al (1391), halabyan and Hussein Ali Pvrjzy (1393) statistical and quantitative and qualitative climate winds.

Weber and Forger (2001: 821) after generating patterns of day and night winds Alpine region (Switzerland) 16 model air flow near the surface were identified. Another consequence is that the direction of prevailing winds in the storm-prone region of the South West and West and north-western Alps and in combination with wind currents and vice versa mountain valley winds may reach their maximum. In another study clinics (2015: 4) identify and classify statistical process more than 2 meters per second wind speed and wind seasonal patterns in the coastal area of the United States of America.

2. MATERIALS AND METHODS

Little Zab River Basin is located in the south-west of West Azerbaijan province, including the cities of Piranshahr, Sardasht, Baneh and the three urban centers of approximately 370 thousand people in its place. Determine the scope of the study due to system synoptic showing different levels of the atmosphere that create waves sweeping across the province. (Figure 1).

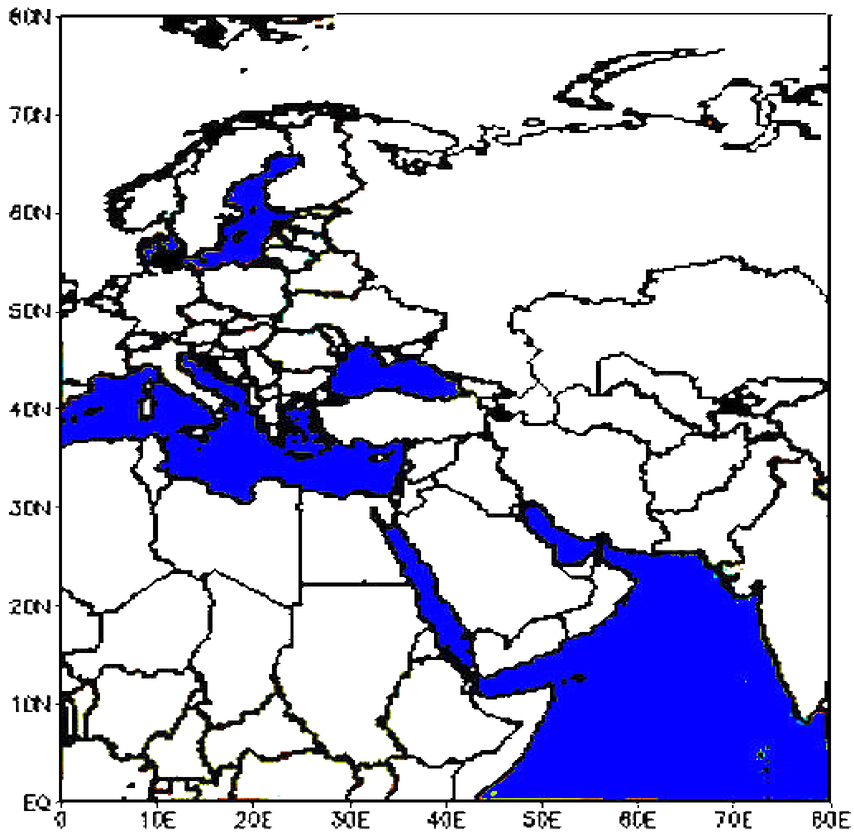

Fig. 1. Geographic network intersection map data restored NCEP / NCAR.

So, according to the topography of the area and taking the maximum probability of occurrence of severe storms, the number of stations that have long-term data were used. In addition, the choice of these stations was considered a close distance and proximity to places astray storm.

Overall, in this study severe storms with environmental approach to circulation was investigated. In this study, four categories of data are required: the data stream low level three stations Piranshahr, Sardasht, Baneh include:

1. sea level pressure (slp),
2. The data of wind speed (m/s),
3. The direction of the wind,
4. High levels of atmospheric data including geo-potential height (hgt) in meters Zab is in the catchment area.

In view of the scale spatiotemporal distribution, 40 severe storms catchment area were selected. Then, the daily pressure of 500 hPa height on the ground and gusty stations located in the range of 0 to 80 degrees East longitude and latitude 0 to 80 degrees north of the website were taken *www.esrl.noaa.gov.* Above 864 cells will be in the range of distances between each cell in 2.5*2.5 degrees. In the above-mentioned range, cell 864 is a distance between 2.5 and 2.5 degrees per cell. Then, the method used descriptive statistics, factor analysis and hierarchical clustering techniques "enter" to classify synoptic patterns of the severe storms studied area. According to the index of the storm, the storm was forty days. The selection and elevation data were extracted on study (Table 1).

Table 1. Selected storm days in the catchment area Zab.

20040515	19931113	19890327	19860101
20050319	19950403	19890408	19861221
20050323	19951003	19890410	19861222
20050330	19960425	19890412	19861226
20070131	19971208	19890415	19870131
20070416	19980820	19890505	19870420
20070419	20000314	19891118	19870425
20070407	20030425	19891208	19870602
20050519	20031029	19891210	19880131
20111128	20040305	19930419	19890101

In total, for the identification and classification of synoptic patterns following steps:

In the first stage, according to the study of climatology appropriate data in the form of a combination of an element (pressure) a few places (network crosses NCEP/NCAR) and several times (during a storm) is used. In the second step data matrix taking into account the aim of this study was set in S mode and S-mode.

Thus, a matrix of 40 rows of data (stormy day) in 864 column or variable (height at 500 hPa) is set. The third phase was the matrix of correlations between data. Then, the covariance matrix of correlations were calculated.

The fourth stage is calculated based on Initial Eigenvalues matrix, the number of operating results was selected. In the fifth stage, in order to identify severe storms producing 500 hPa synoptic patterns, based on six factors were obtained from factor analysis, windy days with minimum Euclidean distance formula based on the equation (1), and the cluster analysis.

$$e_{jk} = \sqrt{\sum_{i=1}^{n} (x_{ij} - x_{ik})^2}$$

Relation (1)

In this formula, e_{jk} the distance between the observation j and k in a set of observations. x_{ij} The variable I on j member and x_{ik} is the member variable I on k and n is the number of variables for each member. Finally, each cluster was drawn ink drawings. But in order to better interpret the map, finally, one day in each cluster having the highest correlation with the other members of the cluster was elected as a representative to analyze the synoptic.

Then, investigated the frequency of severe storms Zab basin Iran and their relationship with large-scale atmospheric patterns

3. RESULTS AND DISCUSSION

Time scale distribution storms

Overview of the frequency of occurrence of severe storms Zab catchment area showed the highest frequency of storms in the vernal and autumnal equinoxes. April, July and September, with 33% of the highest frequency and storm had the lowest (Fig. 2).

During the seasons pass, wave's westerly winds become oriented to the meridional mode and is often associated with cold fronts passing cyclones and turbulent weather. In fact, more than 80 percent after the storm, the air basin delayed a day or two and is ultimately unsustainable.

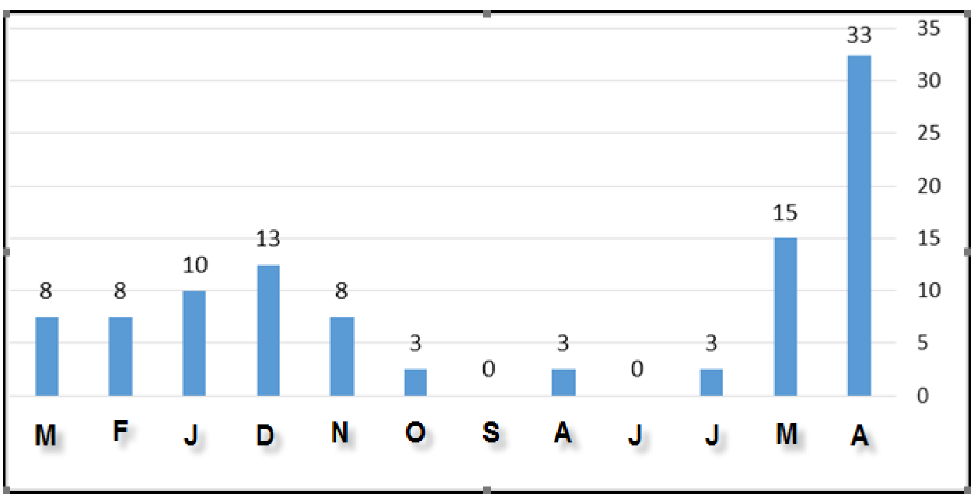

Fig. 2. monthly distribution frequency of severe storms Zab catchment area.

After analyzing data from a height of 500 hPa days of severe storms Zab catchment area, using the technique of principal components analysis and hierarchical clustering into five synoptic pattern of the hurricane area, Overview resulting patterns suggests that, these patterns can be classified in three groups as follows:

- The first group of Cut off low upper atmosphere
- The second group of Shallow trough pattern of long wave southern Mediterranean
- The third group of deep trough pattern of short wave northeastern Africa

All top-level disturbances (synoptic patterns) in the short and long wave trough of westerly winds have formed. Details of each of the patterns in more detail in the following five states. The results from the scale distribution of days in each cluster showed that 42 percent of the days with the rule of synoptic upper atmosphere Cut off low happened in May and December and 32 percent is assigned in April and February. Synoptic pattern of a Shallow trough pattern of long wave of the southern Mediterranean percent surge in March to just 56 percent. The distribution for the traffic pattern in the East Mediterranean deep trough pattern of short wave northeastern Africa was 45%. And distribution of synoptic patterns in both groups showed that, the most abundant atmospheric Cut off low synoptic pattern of middle levels and the allocation of 47.5 per cent of the patterns, causes violent storms in the Zab River Basin. Group traffic pattern shallow long wave and short wave pattern deep trough of 27.5 and 25 percent respectively in the next rankings are. Synoptic patterns identified separately named storm days according the weather conditions prevailing on selected days in middle levels are listed in Table 2.

Table 2. Monthly distribution of synoptic patterns of storm days per cluster.

Group	**synoptic pattern**	**M**	**F**	**AP**	**M**	**J**	**A**	**O**	**N**	**D**	**J**	**F**	**M**	**%**
First	Cut off low of east Turkey	0	1	1	0	0	0	0	1	2	1	1	0	15
Second	deep trough of East European_center Turkey	0	0	1	2	1	1	1	0	0	0	0	0	15
	deep trough of East Russia-East Turkey	0	2	1	2	0	0	0	0	2	0	2	0	17.5
	deep trough of West European traffic Greece	2	0	5	1	0	0	0	1	0	1	0	2	27.5
Third	shallow trough of southern Mediterranean	1	0	5	1	0	0	0	1	1	2	0	1	25
Total		3	3	13	6	1	1	1	3	5	4	3	3	40
% Frequency Monthly		7.5	7.5	32.5	15	2.5	2.5	2.5	7.5	12.5	10	7.5	7.5	100

It is clear that, in all three synoptic pattern has been identified, the formation of intense meridional wind wave's westerly winds and currents deep middle levels is quite clear and obvious. Although there are similarities between some of the practices identified in the appellation, but large differences can be seen in atmospheric conditions governing them went on to explain that they are paid.

4. CONCLUSIONS AND RECOMMENDATIONS

The aim of this study is to identify and analyze severe storms Synoptic Basin during the period 01/01/1364 to 12/29/1390 Zab (9861 days) approach to the working environment. The three threshold, size and comprehensiveness of wind speed and wind speed to calculate the 90th percentile, 40 days was the most comprehensive and the most severe storms, the basin of these storms were observed during the whole year except summer.

After getting lower and middle levels of the atmosphere and collect elevation data from the US National Oceanic and Atmospheric on the middle level altitude barley matrix of covariate data, principal component analysis was performed and 6 factors explained 97.4 percent of the atmosphere's pressure elevation changes. To identify synoptic patterns, cluster analysis was performed on these components are integrated into the procedure. Finally, five synoptic pattern affecting the storms were identified.

The result of this study is a useful value (1383) is consistent. Utah became aware of the strong winds. Overall, the study concluded that, on April the highest rate of 33% and 52% of the maximum number of storm days with traffic rule synoptic pattern deep in the May and November happened. On the other hand, accounted for 60% of total group Deep traffic patterns, the most common of synoptic pattern that causes violent storms in the middle levels of the Zab River Basin.

Because of anomalies polar vortex movement and position of the jet stream and storm bands is more than usual for energy transfer from high latitudes to lower latitudes and therefore the domains of activity and predominance of westerly The study area is increased and after the three synoptic pattern deep traffic, and traffic Srdchal shallow upper atmospheric formed. In the vast majority of the synoptic patterns, very low-lying and relatively strong language from polar latitudes directly or diagonally to the circuit towards lower latitudes up to 60 degrees around the circuit 50 is penetrated and the tabs for High-latitude cold deep waves backward down the front side of low latitudes warm up leads. As a result, the surface pressure and low pressure systems on both sides of the wave is formed between the two pressure gradient due to heat intense conflict reaches its maximum level.

Since these descriptions, 47.5% of annual storms does in April and May Zab River Basin, and this time of year with the peak blooming trees thus providing basic strategies from the perspective of various disciplines in the inevitable. With this description, from the perspective of synoptic climatology in order to prevent or reduce financial damage and even death due to the severe storm that one of the natural threats to the inhabitants of the region, it is recommended that the following items are considered:

-To reduce the speed of winds and protect towns and villages of damage caused by severe storms.

Appropriate government policies imposed by municipalities and agriculture in the form of green belt.

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