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## The spatial distribution of atmospheric conditions, severe storms Zab basin in Iran (A case study of Cut Off Low synoptic pattern)<sup>1</sup>

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**Keyword:** Spatial Distribution, Storm, Cut Off Low, Zab Basin.

**ABSTRACT.** Atmospheric circulation patterns is the most important method of identification of environmental change that, it is useful For purposes such as weather forecasting, predict natural events (air pollution, floods, drought, etc). The aim of this study is to analyze the synoptic conditions of severe storms is Zab basin . Daily data of wind speed over the period 1364/01/01 to 1390/12/29 of three synoptic stations was taken from the department of meteorology. Given the scale of temporal and spatial distribution, wind speed and comprehensiveness of the three threshold size and calculate the 90th percentile wind speed, 40 days pervasive and severe storms were selected . Sea level pressure data on the network with a size 5.2°\*5.2° that was located on Cornell 0-80 degrees east longitude and 0-80 degrees northern latitude from the database NCEP/NCAR were extracted. Matrix was formed in the dimensions of 40\*864 with storm was on the rows and elevation data middle levels of the atmosphere, was on the columns. A principal component analysis was performed on data matrix elevation and six factors were identified that about 97.4% of the Pressure elevation changes of 500hp level was explained . To identify synoptic patterns, cluster analysis integration "ward's" was performed on these components.

The results showed that, Cut off low synoptic pattern of the upper atmosphere with an abundance of 47.5% in May and December had the highest frequency. Irregularities in the movement and position of the polar vortex caused the jet stream and storm paths meridional winds greater control and troughs are driven towards the low latitudes deeper. As a result, the pressure gradient and energy exchange at its maximum reached compression Isobaric lines and Strong winds in the catchment area level has been created. All patterns are identified for the winds mainly from the west and southwest.

### 1. INTRODUCTION

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.

Research studies on Violent storms have done a number of synoptic method. Including valuable things worth noting: Barati and Fleetwood (1386: 72), hopes and Nekounam (1390), Alijani and president Poor (1390), Omidvar. (1393), Abatzvglvs et al (2013: 704), clinics (2015: 4) and Pena et al (2011 :153).

Oltmanns et al (2014: 992) plateau fjord cyclone caused Big East Greenland shelf is the presence of strong cyclones and severe cold weather and dry wind the ice sheet plateau. He realized the important role the leeward slopes and valleys fjord beaches in wind speeds increase due to strong pressure gradient.

## 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 (Figure 1).

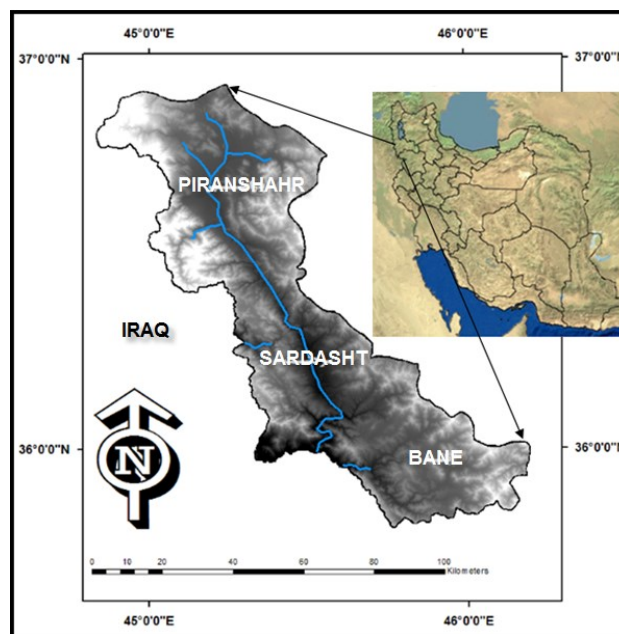


Fig. 1. Location map of the catchment area Zab political divisions' map

Overall, in this study severe storms with environmental approach to circulation was investigated. In this study, two data sets are needed: a low level of atmospheric data, including sea level pressure (slp), the wind speed (m/s) and wind direction and other weather data Zab catchment area of upper level includes: geopotential (hgt) in meters (table 1).

Table 1 Geographic View weather stations Zab catchment area

Station	Latitude	Longitude	Altitude (m)
Piranshahr	'40° 36	'08° 45	1455
Sardasht	'09° 36	'30° 45	1670
Bane	'00° 36	'54° 45	1600

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.

Then, factor analysis and hierarchical clustering techniques "imported" was used to classify severe storms synoptic patterns of the studied area. In summary, in this study, factor analysis formula (1) can be written as:

$$Y_i = \mu_i + \lambda_{i1}F_1 + \lambda_{i2}F_2 + \dots + \lambda_{i6}F_6 + e_i \quad i=1,2,\dots,864 \quad \text{Relation (1)}$$

Which  $e_i \approx N(0, \sigma_i^2)$  are assumed to be errors. Variable height of 500 hPa level (meeting)  $\mu_i$  is average height of 500 hPa meeting is for 40 days with thunderstorms. Its coefficient of the  $i$  confluence with the  $j$  factor, factor influencing variables (crosses) are. The error terms are assumed to be independent from each other and from existing operating (Parvin, 2013: 3059). In total, for the identification and classification of synoptic patterns were following steps:

In the first stage is used 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 the time (days storm). In the second step the data matrix was prepared taking into account the study on the S or S-mode. Thus, the matrix of the data set of 40 rows (stormy day) in 864 column or variable (height at 500 hPa). The third phase was the matrix of correlations between data. Then, the covariance matrix of correlations were calculated as follows relation (2).

$$CO_{xy} = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{N} \quad \text{Relation (2)}$$

The fourth stage is calculated based on initial eigenvalues matrix, the number of operating results was selected. In the fifth step, the cluster analysis to identify synoptic patterns 500 hPa producing severe storms, based on six factors were obtained from factor analysis, windy days with minimum Euclidean distance. In this formula, the distance between the observation  $j$  and  $k$  in a set of observations. The variable  $i$ , on  $j$  member and the member variable  $i$   $k$  and  $n$  is the number of variables for each member. At the end of each cluster was drawn ink drawings. But in order to better interpret the map, then select one of the days in each cluster having the highest correlation with the other members of the cluster as a representative synoptic analysis.

### 3. RESULTS AND DISCUSSION

#### Cut off Low synoptic pattern of East Turkey

The results from the scale distribution of days in each cluster showed that the synoptic pattern of atmospheric Srdchal East in December was only 33%. Obviously, the arrangement of intense meridional wind waves westerly winds and currents deep middle levels is quite clear and obvious. Because of the number of days, to the interpretation of synoptic storm days in each cluster, based on the correlation between changes in the balance between the atmosphere of days in each cluster, the cluster average in Table 2. The choice of the closest date possible each cluster as a representative average day. As can be seen highly significant correlation (99%) of each cluster there most days. So then, weather conditions on the basis of the analysis will be synoptic.

Table 2. The correlation changes representative of each pattern with a height of 500 hPa Day Average

synoptic pattern	First	Second	Third	Fourth	Fifth
	depth	Cut off Low	depth	shallow	depth
Representative Day	03/10/1995	29/10/2003	31/01/2007	30/03/2005	26/12/1986
Correlation with average pattern	0.96**	0.95**	0.97**	0.97**	0.92**
The interclass correlation	0.87	0.87	0.87	0.86	0.86

The results of the planning data matrix and principal component analysis on 500 hPa height variance matrix of days with severe storms Zab catchment area showed that the calculated output value is equal to zero and correlation matrix determinant reviews Overview of the extracted

correlation matrix table also indicates the lack of association between them and complete independence from the other factors (Table 3), so factor analysis was appropriate. The results of principal component analysis obtained with 6 components suggests possible explanation of 97.4% of the atmosphere in terms of pressure elevation changes (Table 4).

Table 3 Covariance matrix of factors

factors	First	Second	Third	Fourth	Fifth	Sixth
First	1	0	0	0	0	0
Second	0	1	0	0	0	0
Third	0	0	1	0	0	0
Fourth	0	0	0	1	0	0
Fifth	0	0	0	0	1	0
Sixth	0	0	0	0	0	1

Since the first component alone 45.2% of the variation of hp500, the model was accepted. The cluster analysis integration "into" the matrix component scores 6 days with severe storms in five different clusters of separate Euclidean distance 14 respectively (Figure 2).

Table 4. The percentage of variance explained by the factors of balance hp 500 days of severe storms

factors	First	Second	Third	Fourth	Fifth	Sixth
Explanation of diffraction	45.2	24	15.2	8.6	2.7	1.7
The cumulative percentage of variance explained	45.2	69.2	84.4	93	95.7	97.4

Conditions governing the synoptic pattern is such that, along the orbit of 35 degrees latitude, low-elevation tab from the center of the polar vortex has penetrated into the lower latitudes to the northeast coast of the Mediterranean Sea. Low package height of cut as it meanders along the westerly winds waves. Jet stream associated with it is placed on the top of the Turkish center-south region of the Black Sea

As is clear from the map of the day 10/29/2003, the maximum height of 500 hPa for low-lying holes and the broad masses of cold air is about 5450 meters from the ground. In such circumstances, the subtropical high altitude and south-eastern Iran dominates the southern half and the middle levels there appears to 5850 meters altitude. Thus, due to the drop in the minimum height for dynamic full of atmosphere.

The review will be concluded waves westerly winds a couple of days before that, an intense meridional wind westerly winds have caused in East Europe traffic is relatively deep diagonal form along the meridian of nearby Eastern European countries to Greece 40-25 ° East. Since Zab basin is located in the front of the Srdchalha ie, below the upper divergence (half-right (east) Cut off Low) is located, for a long time benefited from the instability caused by the synoptic system. For durability and maintenance of the system over time cyclonic circulation in the area, long-term and severe instabilities leading to the front (Figure 3).

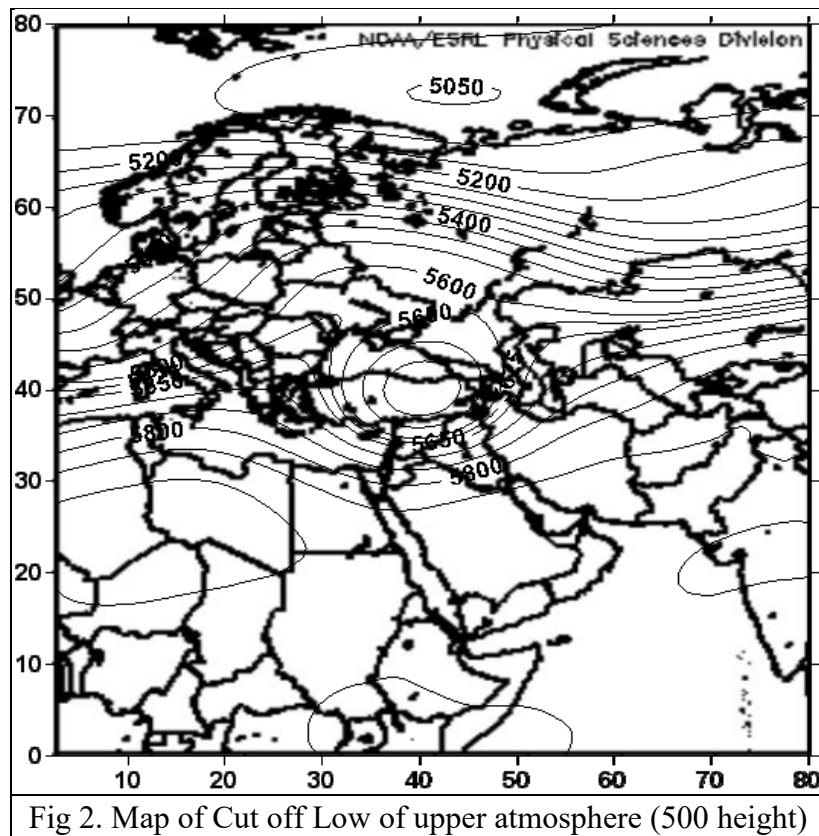
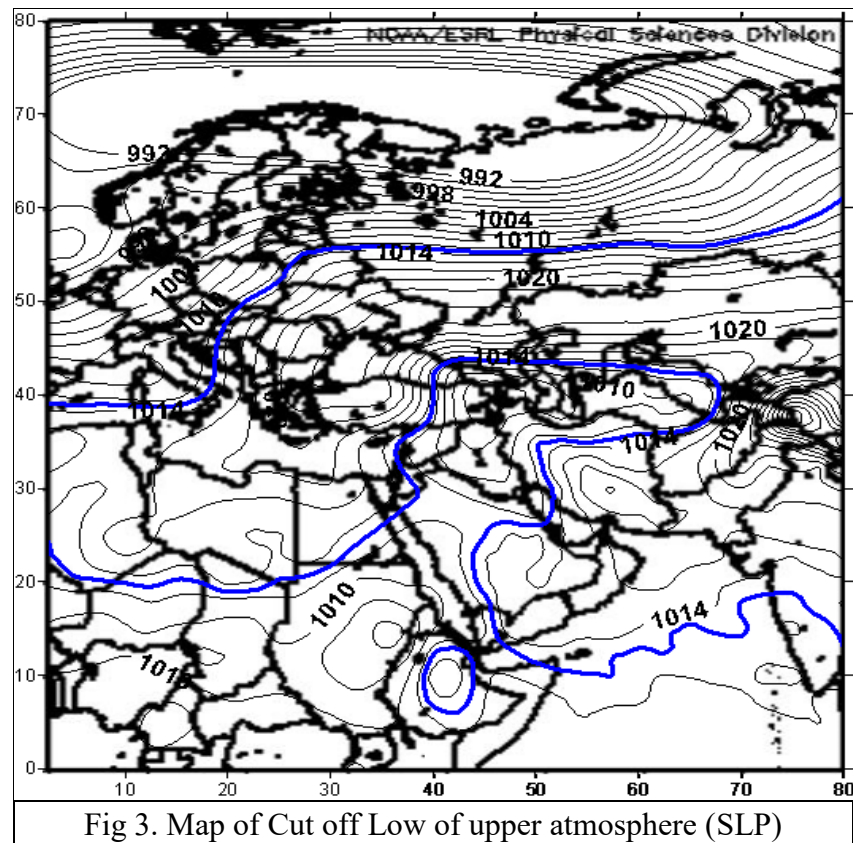


Fig 2. Map of Cut off Low of upper atmosphere (500 height)

As is evident from the composite map of sea level pressure, a relatively strong thermal pressure of about 1040 mbar pressure core is strong pressure on the Tibetan Plateau and its bilingual drawn to the southeast of Iran and one in the circuit  $45^\circ$  latitude in the form of an arc around the northern Iran, the neighboring countries and east Europe to Egypt and Libya. However, a strong low pressure system about 1000 mbar can be seen on the far north-western Iran with a low pressure system to the south-western to north-eastern Sudan are interconnected. The relatively strong position of the two systems arrangement is such that, in line with diagonal lines at the border Isobaric they are compressed, causing severe gradients of power. Then, at about 32 meters per second wind from the south-east of the West in the catchment Zab is blown.



#### 4. CONCLUSIONS AND RECOMMENDATIONS

The results of this study with the valuable work Harnack and others (1997) is similar, he realized that the impact of landing near balance between the atmosphere and the formation of strong winds Utah. Based on the results, in order to prevent or reduce financial damage and even death due to severe storm, which has a natural threats to the inhabitants of the region it is recommended that the following guidelines should be considered:

- With regard to the distribution of time, location and size of the potential damage and to prevent or reduce the damage hurricanes, storm early warning system designed to be installed on the Zab River Basin. To view a synoptic pattern approach similar to the one identified five patterns

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