

## *Identification of Synoptic Climate Types in Sistan Area (Zabol Station)*

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### **Extended Abstract**

#### **Introduction**

Within a synoptic weather, the classification of ambient weather conditions into categories is a useful tool for numerous climate impact applications.

Air mass is a large and homogeneous volume of air which is adequately located over a certain area and captured properties of its below area. In order to form air masses, it is necessary that air remains stable in an area for a long period of time. Ultimately, general flows of air make them move. While moving and passing different regions, characteristics of air masses are changed, modified and also transformed into another air. A location's climate follows air masses entering to that region and, reflects geographical conditions of that location. One of the objectives of synoptic climatology is to carry out synoptic categorization or to determine dominant air types (climate) in a location in a year. Air masses are generally categorized based on potential temperature and humidity. However, other criteria are considered as bases for their categorization.

The Sistan basin is located in a arid zone with less than 60mm precipitation. This region in the east of Iran and northern regions of Sistan and Baluchistan Province has special climate that is affected by severe winds and dusty air. This climate distinguishes this region from others in Iran. The region depends on Hirmand river and its embranchments inflows that import more than billions cubic meter waters and can support the survival of Hamoon international wetland and the populations of region.

The occurrence of periodic fluctuations in water inflows and potential climatic, geomorphologic and hydrologic conditions cause the surface to be exposed in winds flows. In Sistan region winds are blown throughout the year, but during the June to September the direction, frequency and intensity of wind blows are more pronounced. This wind is distinguished as 120 days winds and is one of the most famous moderate scale wind systems in the northern hemisphere.

Identifying effective air masses on this region is of considerable importance in order to better plan and make use of available resources in this region. It is because of the fact that by the analysis of its effects on the surface phenomena (e.g. dust), environmental planners would be able to find better ways for decreasing environmental problems. Finally recognizing these relationships allows us to predict many environmental accidents in order to, at least, decrease

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their harmful effects by these predictions.

### Methodology

In this paper, to identify the prevailing air masses in the North of Sistan and Baluchestan province (East of Iran), daily data of 14 climatic variables of Zabol weather station were used. The data were considered against atmospheric variables and utilized as a P matrix from 21/03/1975 till 20/03/2005. At first, to explore the major source of variance in climatic variables in the region, a Principle Component Analysis (PCA) was applied to the Z scores of primary data in a 10825\*14 cells matrix. Findings showed that three principle components (Thermal-humidity, Wind and precipitation) could account for 87 percent of data variances and were selected as the most effective factors. Then, the principle components matrix was used as input variables in a cluster analysis for identifying prevailing climatic conditions of the region. Principal Component Analysis (PCA) involves a mathematical procedure that transforms a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principal components. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. To obtain classes from a PCA, the component scores can be grouped via cluster analysis. A common procedure involves hierarchical clustering. HCA is a technique of choice for exploring and visualizing large data sets. HCA consists in calculating the dissimilarity, usually called the distance, between the individuals with one individual corresponding generally to one column of the data matrix.

### Results and Discussion

The Hierarchical Clustering Analysis (HCA) with sequential combination methods have been applied to components scores and findings showed six various air masses in climatic regimes of region. These air masses are:

- a) warm, without precipitation and relatively quiet;
- b) dry, warm, no precipitation and windy;
- c) cold, dry and windy air mass;
- d) high precipitation, temperate and relatively windy;
- e) very warm, dry, no precipitation and severe windy air mass;
- f) very cold, quiet and less precipitation air mass.

Characteristics of air masses and their comparison with each other showed that precipitation and cooling in the region were heavily concentrated and the period of their activities were very limited. On the other hand, warm and dry air masses controlled a large part of times in a year.

### Conclusion

The study of characteristics of Zabol weather showed that precipitation and cooling in regional climatic condition of Sistan area are highly concentrated and the period of their activities is very

limited. On the other hand, the warm and dry weather types prevail during the large part of the year. The analysis of annual trends of air masses occurrence indicated that the frequency of very cold events was reduced while the recurrence of cold air masses increased. In addition, the warm and dry air masses frequency was limited by dominating the very warm and dry air masses. Consequently, the climatic seasons in the North of Sistan and Baluchistan Province was changing and shifting and the duration of very warm and dry period was increasing.

The four major patterns of sea level pressure are controlled by the interactions and characteristics of Sistan region weather types.

**Keywords:** *Air Mass, Principal Component Analysis, Cluster Analysis, Sistan, Iran.*

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