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Analyzing Synoptic Pattern of Cold Dust Occurrences in Khuzestan Province

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Extended Abstract

Introduction: In recent years, dust storms have turned into a serious problem in Khuzestan province during the cold season. Therefore, this study sought to investigate and analyze the sweeping dusts' synoptic pattern in Khuzestan province during the cold season.

Materials and methods: In order to study and analyze the synoptic pattern of dust in Khuzestan province in the cold period of the year, two databases were used, and the dust codes were extracted, according to which an all-out dust was defined as a situation in which the dust covers at least 50 percent of the spatial area and lasts for two days. After identifying the all-out dust days, the corresponding pressure data of such days were extracted. These data included ground pressure data, geopolitical altitude, moisture depletion, and atmospheric precipitation for 100 to 500 hp_a levels, obtained from NCEP / NCAR. The data's spatial resolution was 2.5*2.5 arc degrees.

According to the research topic and in order to fully display the effective systems involved in creating dusts within the study range, atmospheric systems were determined from -10 degrees west longitude to 100 degrees east longitude, and from 10 to 70 degrees north latitude. This stud attempted to identify and analyze the effective patterns involved in creating dusts in Khuzestan province by using a Perimeter Environmental approach. In the next step, the dust days' pattern was identified, administering a cluster analysis on the corresponding pressure data of such days. Following the extraction of the corresponding pressure data regarding those days, cluster analysis was used for identifying Khuzestan province's dust patterns.

Then, to classify the ground surface pressure data and identify the representative days, cluster analysis was performed on the data. Cluster analysis is a method in which variables are classified into specific groups based on their characteristics so that real representative groups are identified and the data volume is reduced. In other words, cluster analysis seeks to reduce the number of identified groups, with similar cases being grouped in the same category where intra-group variance is minimum and inter-group variance is maximum. In this method, grouping is made based on group's similarity or interval. There are different methods for measuring the distance among the data, a most commonly-used of which is the Euclidean Distance method.

To select the representative days of the groups obtained from the classification of dust-related data, the Lund correlation method was used. The correlation coefficient in such cases typically varies between 0.5 and 0.7. Therefore, the representative days were extracted based on 0.5 threshold. So, the day with correlation coefficient of 0.5 with more days was selected as the representative day.

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Results: After identifying the dusty days and performing cluster analysis on pressure data, four synoptic patterns were identified, including 1) Caspian Sea low pressure – Siberian high pressure, European high pressure pattern, 2) European-Mediterranean Integral high Pressure- Sudan low Pressure, North Caspian low Pressure pattern, 3) The Arabian Sea low pressure and North African high pressure pattern, and 4) Siberian high pressure - Sudan low pressure, and low Mediterranean pressure pattern, with the first pattern having the highest frequency.

Discussion and Conclusion: According to the study's findings, in latitudes over 20 degrees, Iraq, northern Saudi Arabia, and eastern Syria are the main sources of dust formation in the region, that, together with western winds emanating from those areas of the Middle East which are prone to dust generation, including the Sahara Desert in northern Africa exacerbate the situation. Environmental conditions along with increasing temperature, low humidity, wind speed, soil particles' lack of complete adhesion, and atmospheric factors that develops instability in these areas, are also fully involved in the occurrence of such a phenomenon.
The Sudan's low-temperature thermal tabs that are stretched to higher ranges, the dynamic change in their nature when the Mediterranean or Red Sea pressures land in the deserts of Saudi Arabia and Africa, and the deep pressure dust formed in the eastern Mediterranean within the troposphere's middle layer are the main generators of dust in south-west Iran and Khuzestan province. Therefore, it could be argued that when a deep landing in the eastern Mediterranean is created, the flows of the east side coincide with the North African currents which will eventually merge with the high divergence in the southwestern part of Iran, provided that environmental conditions are provided. The ground level instability due to the low sea-level pressures on the great deserts of the Middle East will lead to the phenomenon of dust in Khuzestan province.

Keywords: Dust, Moisture advection, Atmospheric Vorticity, Cold period.