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Identification of Heat Waves in Khuzestan Province and Synoptic Analysis of Saudi Arabia's High-pressure Role in Their Creation

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Abstract
Heat waves are a major manifestation of climat chanqe and of natural disasters and climat.The abundance and durability of heat waves in Khuzestan province has become a climate threat .The aim of the present study is to identify the hot waves of Khuzestan over an 18-year(2017-2000) period of time and synoptic analysis of Saudi Arabias anticyclone coherent role in their creation. For this, heat waves were first selected based on three criteria: maximum daily temperature of over ۴۰°C, permanence and endurance of the waves for three days or more in the region, and spread of the wave at ۸ stations or higher across the province. Thus, the number of ۶۷ three-day heat waves and ۲۵ or higher four-day heat waves were determined. Then, a pressure map and the topography of these waves at low and middle levels of Vardsepehr were prepared and outlined in the GrADS environment. Upon visual inspection of the maps, a dominant synoptic pattern was determined. In the end, as for the synoptic analysis of the dominant pattern, the heat wave of ۲۸-۳۰ June ۲۰۱۷ as the representative of the summer heat waves of Khuzestan was analyzed. As for the synoptic pattern analyses leading to heat waves, climatic data were extracted from selected days as demonstrated by the Nova and Skewti Site of Wyoming University. Results indicated that in almost all heat waves, in the low layers of the Vardsepehr, cyclone tongues of Pakistan and Saudi Arabia as the most important systems affecting conformity with the regional topographic pattern (southern Zagros highlands) and the rotating pattern of the system had caused the hot advection of the radiant temperature of the hot deserts of Lut and those of Saudi Arabia on the province of Khuzestan, with the low layers of Vardsepehr entering the Khuzestan plain from the southeast to the northwest by passing through the southern foothills of Zagros, and extending to the north of Iraq and eastern coasts of the Mediterranean. However, synoptic conditions were changed at ۷۰۰ and ۵۰۰ hPa levels as, with the dominance of the summer rotating pattern in the region, Saudi Arabia's anticyclone gradually evolved from the ۷۰۰ hPa level, thus becoming the dominant pattern of the region.

Keywords: Heat Waves, Province of Khuzestan, Saudi Arabia's Subtropical High Pressure, Synoptic Analysis

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Extended Abstract

Introduction

Heatwaves are among the most detrimental atmospheric events and are a prominent effect of climate change. Currently, climate change is one of the most significant environmental challenges facing the country. In fact, heatwaves represent a stable atmospheric condition characterized by a generally descending movement on a large scale. Although there is no universally accepted definition of a heatwave, it can be considered as positive oscillations with high frequencies above the average of daily maximum temperatures that persist over specific geographical areas for days (sometimes weeks or months). Heatwaves are among the most dangerous climate threats associated with global warming, impacting society, the economy, and the environment. The effects of heatwaves can lead to regional hazards, such as increased illness and mortality, as well as increased demand for electricity and water. Heatwaves significantly affect climatic comfort, which is a crucial condition for human life and activity.

Data and Method

To investigate heatwaves in this province, daily maximum temperature data from 12 synoptic stations in Khuzestan province over a 19-year statistical period (2000-2017) were utilized. The selection of stations was based on geographical latitude and the need for a common time period to analyze a larger number of stations, hence the choice of a 19-year period.

Results and Discussion

Today, summer heatwaves have become a social and environmental issue in Khuzestan province. As observed in the statistical analysis of heatwaves, due to Khuzestan's location in the subtropical region, the warm season in this province starts earlier and ends later compared to other parts of Iran. The number of summer heatwaves has been increasing in recent years. Each year, during the warm season, the arrival of severe and persistent heatwaves causes unusually high temperatures in the province, leading to significant economic and biological damages. The abnormal increase in temperature, often accompanied by high humidity, severely impacts the electricity network, disrupts transportation, and causes industries and related facilities to shut down. More importantly, the health and comfort of a large number of people are jeopardized, resulting in numerous fatalities. For example, the heatwave from June 28 to June 30, 2017, was one of the most unprecedented heatwaves in Khuzestan province, as reported by Kayhan News Agency (the severe and unprecedented heat in Khuzestan and the provincial capital is the main cause of citizens' aggression during hot days, and with the temperature of these days in Ahvaz, heat-related illnesses have also become widespread). The aim of this research was initially to identify heatwaves in Khuzestan province and then to analyze the synoptic role of the high-pressure system from Saudi Arabia in their formation.

Conclusion

Based on the results, a total of 67 three-day heatwaves and 25 four-day or longer heatwaves were identified during the statistical period. The analysis of synoptic maps indicated that the dominant and main factor of these heatwaves in the lower troposphere is a combination of the influences of two cyclonic systems from saudi arabia and pakistan, while in the middle and upper layers, the core and ridge of the arabian cyclone play a significant role. The prevailing synoptic pattern of heatwaves is such that in the lower layers of the troposphere, the tongues of cyclonic

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systems from pakistan and saudi arabia are the most influential systems, aligning with the topographic pattern of the region (the southern Zagros heights) and the rotational pattern of the system, leading to the advection of warm radiative temperatures from the hot lut and arabian deserts over Khuzestan province. In the lower troposphere, a tongue extends from the southeast to the northwest, entering the Khuzestan plain from the southern slopes of the Zagros and spreading to northern Iraq and the eastern Mediterranean coast. However, at the 700 and 500 hPa levels, the synoptic conditions change completely, and with the dominance of the summer rotational pattern over the region, the Arabian cyclone gradually develops at the 700 hPa level and becomes the dominant factor in the area.

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