The Effect of the Siberian Air Altitude on the Characteristics of the Climate of the Northern Arabian Peninsula

Sura Mohammed Baqer Mohammed Jawad, Dr. Ali Abdel Zahra Al-Waeli, Dr. Osamah Khazal Alsharifi

University of Baghdad, College of Education/ Ibn Rushd for Human Sciences, Department of Geography, Iraq.
Email: sura.m@ircoedu.uobaghdad.edu.iq

Abstracts

The field of climatic geography focuses on the study of the Earth's surrounding atmosphere, particularly the lower (surface) part close to the Earth's surface. This field examines the interactions within the atmosphere resulting from the solar radiation that reaches the Earth and the subsequent distribution of atmospheric pressure. Consequently, certain surface pressure systems, both high and low, emerge and vary in their temporal and spatial impacts on the climate of the Arabian Peninsula. Therefore, it is essential to conduct a comprehensive and detailed study to understand the causes, development, movement, geographical distribution, and monthly and seasonal recurrence of these pressure systems. For this purpose, a minor climatic cycle spanning eleven years (2007/2008 to 2021/2022) was selected. The study relied on analysing weather maps at the 1000 millibar pressure level to analyse the recurrence of the Siberian high-pressure system over the study area, using observations at both 00:00 and 12:00 during the study period.

Keywords: Siberian High (Siberian Anticyclone), Recurrence, Duration of Persistence, Arabian Peninsula.

Introduction

The following question determines the research problem:

Is there a seasonal variation in the rates of recurrence and number of days of residence of the Siberian High Pressure that the Arabian Peninsula is exposed to? Do the frequencies and number of days of residence of the Siberian High Pressure vary temporally over the Arabian Peninsula?

It is a preliminary solution to the problem presented by the researcher, which is as follows:

Is there a seasonal variation in the rates of recurrence and number of days of residence of the Siberian High Pressure that the Arabian Peninsula is exposed to? How do the frequencies and number of days of residence of the Siberian High pressure vary over the Arabian Peninsula?

The importance of the research lies in determining the impact of the Siberian High Pressure on the climate of the northern region of the Arabian Peninsula, by analysing the monthly averages of the frequencies and number of days the Siberian High Pressure remains, and knowing the nature of the area covered by the high pressure and the period it takes, whether monthly or annual, and its duration is eleven. A year starting from the year (2009/2010) until the end of the year (2021/2022), which is equivalent to a microclimatic cycle.

The Arabian Peninsula is located within the tropical latitudes. It extends north towards the middle latitudes, where it is exposed to several types of atmospheric highlands, including the subtropical, Siberian, and European highlands, whose centres are outside the Arabian Peninsula, and the highlands of the Arabian Peninsula, which have internal centres, in addition to being exposed to several types of lowlands. Frontal depressions, such as the Mediterranean depression and the thermal depressions, including the Sudanese and Indian depressions, whose centres are outside the borders of the region, and the Arabian Peninsula depressions, which have internal centres, in addition to the influence of the Arabian Peninsula by merging depressions with multiple centres, so it is important to know the extent to which the movement of these pressure systems controls the climate the Arabian Peninsula.

1- Spatial dimension:

The spatial dimension is represented by the geographical borders of the Arabian Peninsula, which is located within the southwestern part of the continent of Asia, between two circles of latitude (12.50¯°32) north and two arcs of longitude (35°60°) east and known as the geographical distributions of the surface frequencies of the Siberian high pressure affecting the climate of the peninsula. Arabic: The northern region of the Arabian Peninsula was determined (this division was made because the northern region overlaps with the central latitudes and the southern region is adjacent to the equatorial region, which helped diversify the pressure systems on the Arabian Peninsula), which is located north of the circle of latitude (23.5°), which represents the Tropic of Cancer. And the southern region, which is located south of the Tropic of Cancer.

To clarify the effect of dynamic geographical factors represented by temperature, air humidity, and atmospheric pressure, (five) climate stations were chosen and distributed over the study area, which is (Arar, Kuwait, Tabuk, Al-Ahsa, and Al-Madinah), Table (1) and the map (1).

Table (1): Locations of study stations and their height above sea level

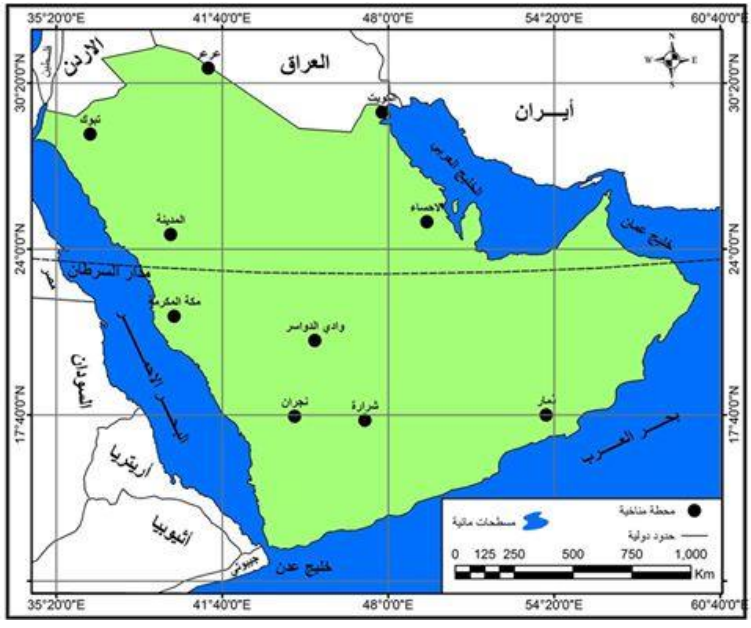
Altitude above sea level(m)	Location relative to the arcs of Meridians east	Location relative to latitudes	Climatic stations	Region
555	41 13¯°	°30 9¯	juniper	Northern
55	47 98¯°	29 21¯°	Kuwait	
778	°36 63¯	°28 38¯	Tabuk	
179	49 48¯°	25 3¯°	Al-Ahsa	
654	39 7¯°	24 55¯°	City	

Source : www.tutiempo.net.climat.Asia

2- The temporal dimension:

A small climate cycle with a duration of (11) years was chosen to study the recurrences and the number of days of survival of the high-pressure system affecting the climate of the Arabian Peninsula, which begins with the year (2009/2010) and ends with the year (2021/2022). The research will depend on studying temporal variations depending on the monthly average of recurrences. The number of days of survival and a study of the spatial variation of the frequencies and the number of days of survival of the Siberian High Pressure for the northern region of the Arabian Peninsula only, based on the seasonal average.

Map (1) Locations of selected climate stations for the study area



Source: Based on Majid Hamoud and Kamal Hamoud, The Geographical Atlas of the Islamic World Aleppo, Dar Al-Radwan Printing House, Syrian Arab Republic, 2015, p. 5.

3- The qualitative dimension:

It explains the study of the occurrences of the Siberian High Pressure affecting the climate of the Arabian Peninsula, based on the analysis of synoptic maps of the study area and source areas.

The frequency and number of days the Siberian high altitude remains

A- Night monitoring:

It is clear from Table (2) that the seasonal sum of the Siberian high altitude for frequency and number of days of residence reached (34.7, and 23.9) high altitude/day respectively, as the Siberian high air high, as indicated by the data in Table (2) and Figures (1, 2), began to extend

over the northern region. From the Arabian Peninsula in October, extending through Iraq and then northern Arabia,

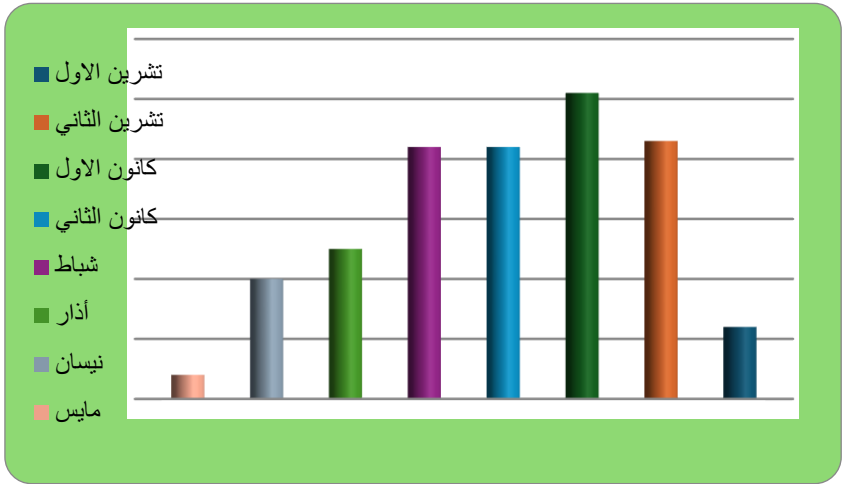
Table (2): Monthly average, seasonal total, and percentages of frequency and number of days the Siberian high altitude remains over the Arabian Peninsula for the period (2010/2009 - 2021/2022) according to observations (00)

Data	Average number of days stay	Rate %	Repetition rate	Rate %
October	2.7	5	1.2	7.8
November	6.9	18	4.3	19.9
December	7.2	21	5.1	20.7
January	6.5	17.6	4.2	18.7
February	5.4	17.6	4.2	15.6
March	3.1	10.5	2.5	8.9
April	2.5	8.4	2.0	7.2
May	0.4	1.7	0.4	1.2
Total	34.7	100	23.9	100

Source: The researcher analysed weather maps for the pressure level of 1000 millibars, based on maps of the Middle East region published on the website: https://www.google.com/search?q=vertical+plymouth+climate+maps

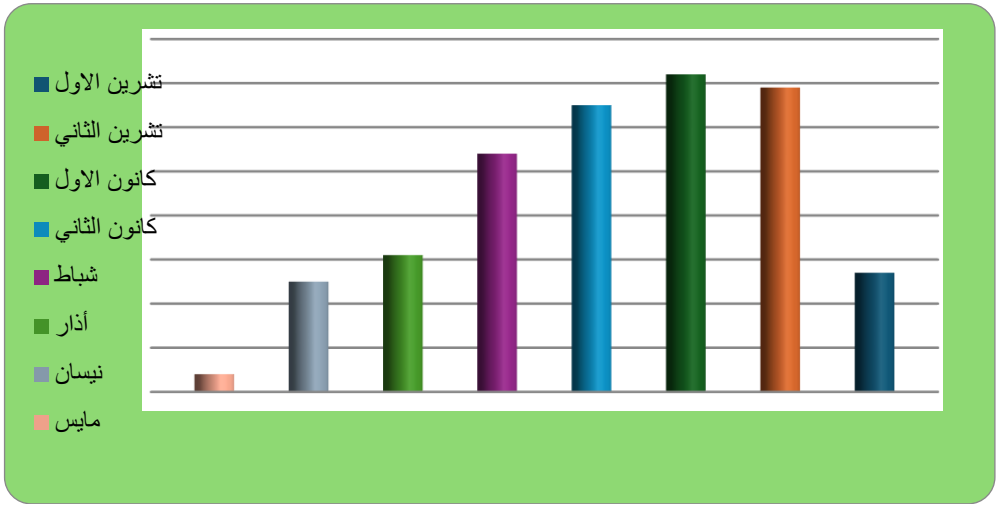
The average frequency recorded was 1.2 highs and 2.7 days, with percentages of 7.8% and 5%, respectively, of the total seasonal frequency and the number of days of persistence. The appearance of the high-pressure system in this month is due to the relative decrease in temperatures following the apparent movement of the sun to the southern hemisphere after September 23. The continuous drop in temperatures increases the chances of the Siberian high-pressure system advancing towards the region because these climatic conditions contribute to the weakening and eventual dissipation of most low-pressure thermal systems. Thus, the climate becomes more favourable for the advancement of high-pressure systems. This phenomenon is evident in November, as shown in Map (2), which recorded an average frequency of 4.3 highs and 6.9 days, representing percentages of 19.9% and 18%, respectively. This shows a significant increase compared to October, with a difference of 3.1 highs in frequency and 4.2 days in the number of days of persistence. Refer to Figures (1 and 2).

Figure (1) Monthly average frequency of the Siberian high above the peninsula Arabic for the period (2010/2009 - 2021/2022) according to balance (00)



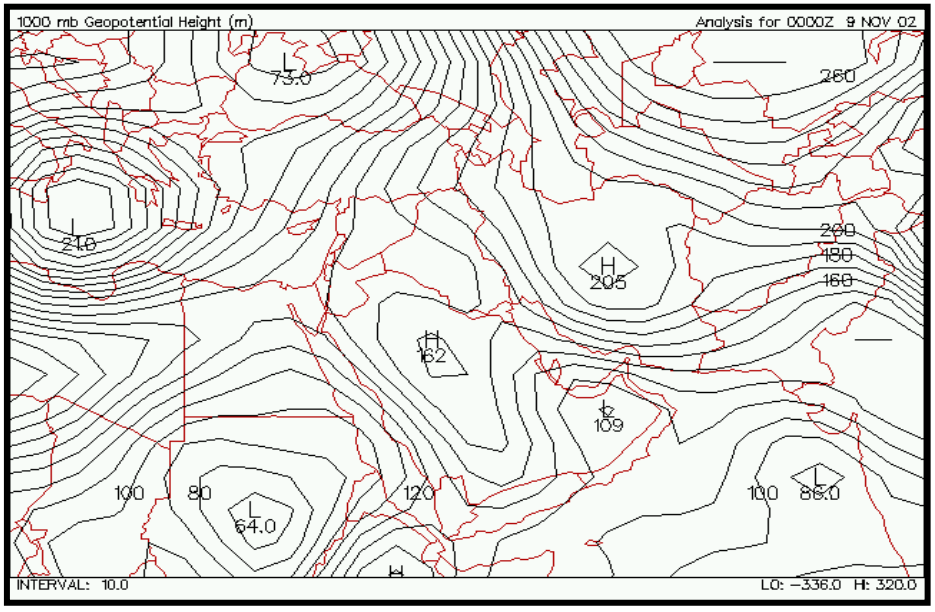
Source: Table (2)

Figure (2) Monthly average number of days the Siberian high altitude stays over the peninsula Arabic for the period (2010/2009-2022/2021) according to balance (00).



Source: Table (2)

Map (2) The progress of the Siberian high altitude towards the Arabian Peninsula

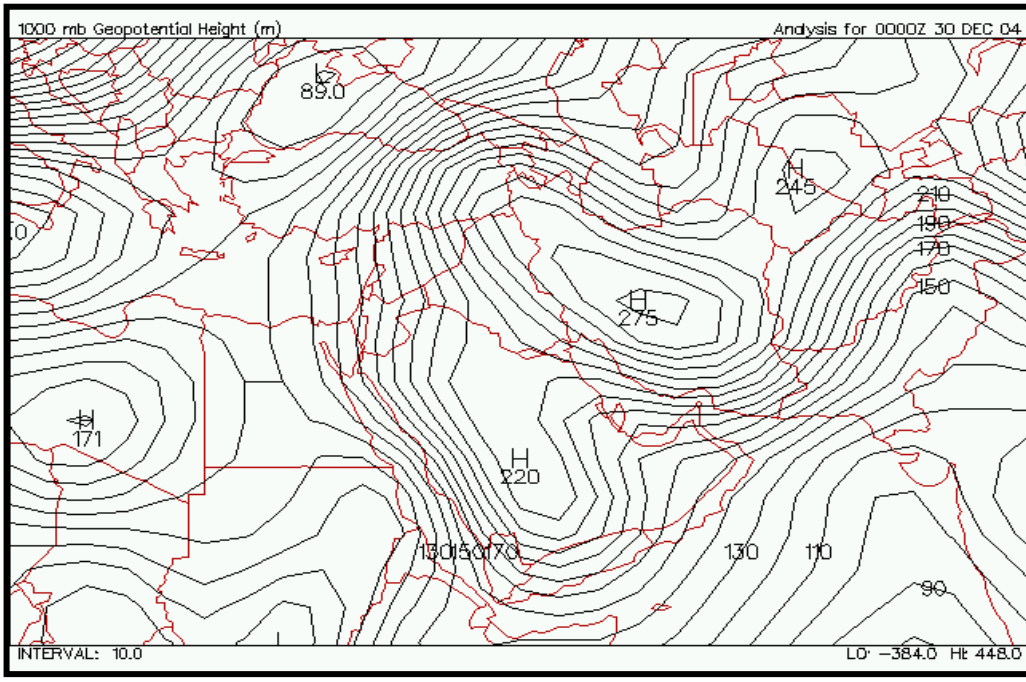


Source: Maps of the Middle East region published on the website: http://.vortexplymouth.edu

In December, the Arabian Peninsula was exposed to the advancement of the Siberian high-pressure system, which showed distinct centres over the Iranian plateau and other areas over the Arabian Peninsula, as illustrated in Map (3). This month recorded the highest average frequency and number of days of persistence over the northern part of the Arabian Peninsula, reaching 7.2 highs and 5.1 days, with the highest percentages of 20.7% and 21%, respectively. However, the average frequency and number of days of persistence of the Siberian high-pressure system decreased in January compared to December, with an average frequency of 4.2 highs and 6.5 days, representing 18.7% and 17.6% of the seasonal total, respectively.

This decrease is attributed to the increased advancement of the subtropical high-pressure system towards the Arabian Peninsula from its western parts, influenced by the continuous Mediterranean frontal lows over Iraq during this month, which increased the frequency of the subtropical system at the expense of the Siberian high. In February, there is no difference from January in the average frequency, which remains at 4.2 highs, but its surface deepening is less than in January, with 5.4 days, accounting for 15.6% and 17.6%, respectively. The northward advancement of the Sudanese low-pressure system west of the Red Sea also plays a role.

Map (3) Illustrates the Dominance of the Siberian High-Pressure System Over the Study Area.

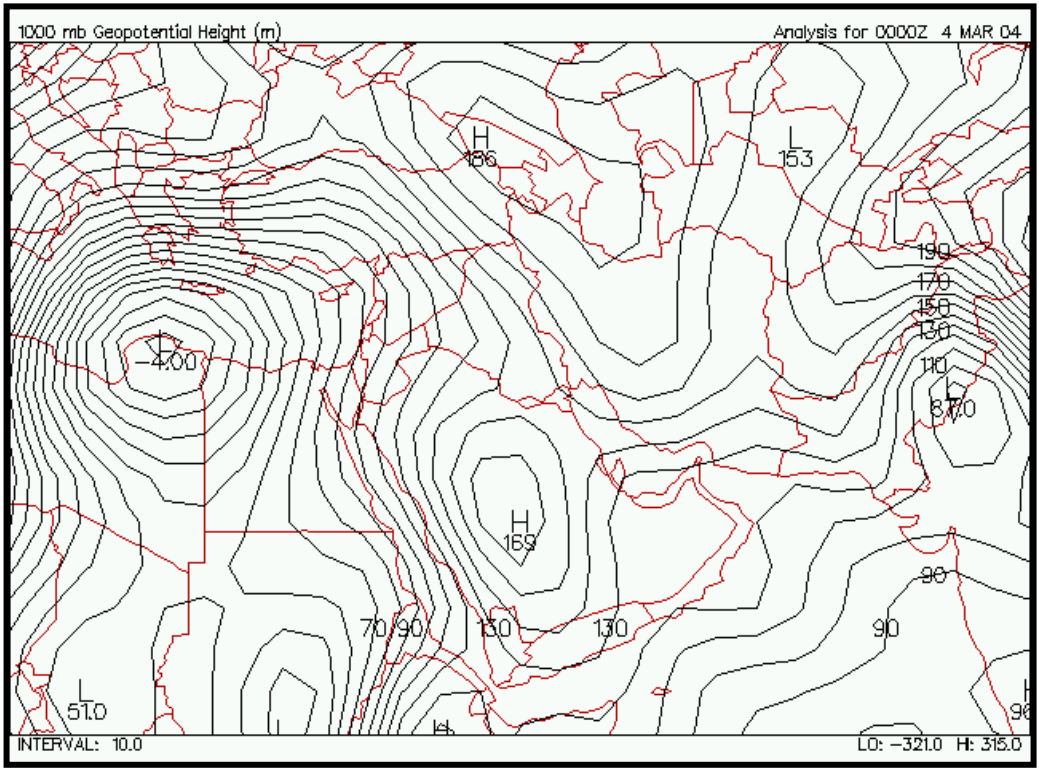


Source: Maps of the Middle East published on the website: http://.vortexplymouth.edu//

In March, the Siberian high-pressure system continues to advance towards the Arabian Peninsula, driven towards the Sudanese low-pressure system, as shown in Map (4). However, the frequencies are lower, with an average of 2.5 highs and 3.1 days of persistence, representing 8.9% and 10.5%, respectively. This decrease is due to the rising temperatures in this month, which weaken the Siberian system, causing it to shift northward. Consequently, there is also a decrease in April, with an average frequency and number of days of persistence of 2.5 highs and 2.0 days, respectively, accounting for 7.2% and 8.4% of the seasonal total of the Siberian high-pressure system over the northern region.

The declining trend continues in May, with an average frequency and number of days of persistence of 0.4 each, and the lowest percentages of 1.2% and 1.7%, respectively. This decline is due to the appearance of thermal low-pressure systems, both those advancing from outside the Arabian Peninsula and those forming over it. Additionally, the possibility of merging these low-pressure systems increases as temperatures rise this month.

Map (4) Illustrates the Advancement of the Siberian High-Pressure System Towards the Southern Region.



Source: Maps of the Middle East published on the website: http://.vortexplymouth.edu//

B - Daytime monitoring:

The seasonal total for the frequency and the number of days the Siberian high-pressure system persisted in this observation was recorded at 31.3 occurrences and 21.2 days, respectively. This is detailed in the analysis results of the weather maps in Table (3). The data from this table, along with Figures (4) and (3), indicate that the Siberian high-pressure system appeared over the northern region in October with an average frequency of 2.0 occurrences and 2.7 days, representing 9% and 9.4% respectively of the seasonal average. This is due to the weakening of the Indian monsoon system during this month, resulting from the apparent movement of the sun towards the south, which reduced the contrast between land and sea, thereby decreasing the advancement of the Indian low-pressure system that had dominated during June, July, August, and September. This allowed the Siberian high-pressure system to advance, strengthened by the continued decrease in temperatures. Consequently, its extensions towards the Arabian Peninsula increased in November, as shown in Map (4), resulting in higher frequencies of 6.3 occurrences and 4.3 days for this month.

Table (3): Monthly average, seasonal total, and percentage frequency and number of days the Siberian high-pressure system persisted over the Arabian Peninsula for the period (2009/2010 - 2021/2022) according to the (12) observation.

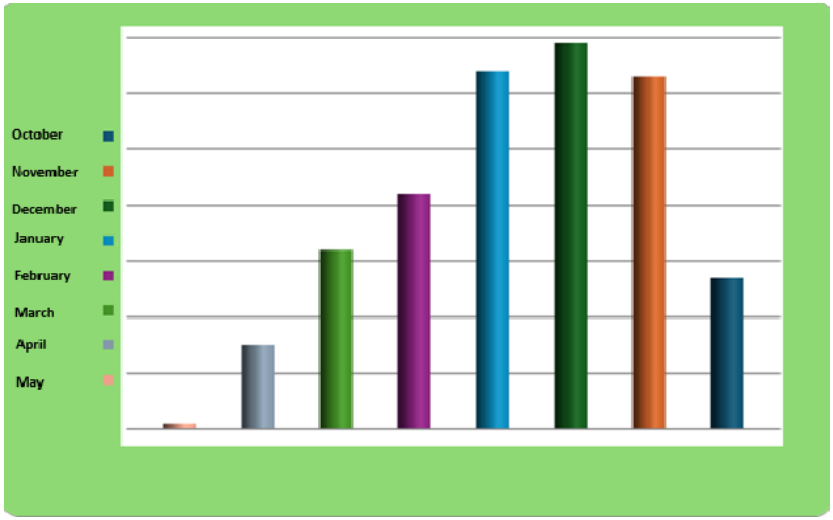
Rate %	Average number of days stay	Rate %	Repetition rate	Data
9	2.7	9.4	2.0	October
20.1	6.3	20.3	4.3	November
22	6.9	17.9	3.8	December
20	6.4	16.5	3.5	January
13.4	4.2	13.2	2.8	February
10.2	3.2	15.1	3.2	March
4.8	1.5	7.1	1.5	April
0.3	0.1	0.5	0.1	May
100	31.3	100	21.2	Total

Source: The researcher analysed weather maps for the pressure level of 1000 millibars, based on maps of the Middle East region published on the website: Tht://Vortex.pIymouth.edu//

The frequency and duration of the Siberian high-pressure system recorded for the nighttime observation were 20.1% and 20.3% respectively, for the same reasons identified in the nighttime observation. In December, the highest frequency of the Siberian high-pressure system during the daytime observation was recorded at 3.8 occurrences, accounting for 17.9% of the seasonal total frequency over the northern region for this observation period. The average number of days it persisted was 6.9, which is 22%. Due to the increased frequency of the subtropical high-pressure system and the continuous appearance of the Sudan low-pressure system moving towards the Mediterranean low-pressure systems to the north and northeast of the Arabian Peninsula, the frequency of the Siberian high-pressure system decreased in January compared to December, recording an average of 6.4 occurrences and 3.5 days, representing 20% and 16.5% respectively, as shown in Figures (3, 4) and Map (5).

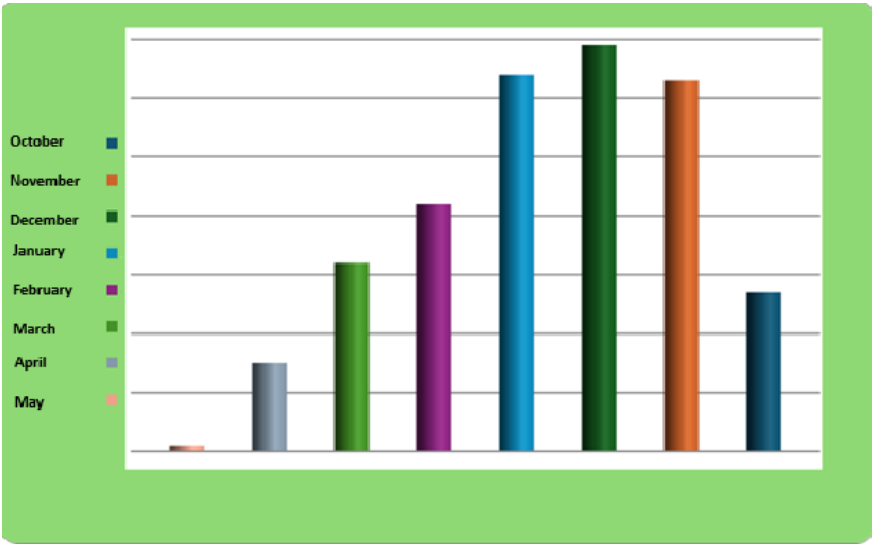
The dominance of the Siberian high-pressure system over the northern region during the daytime observation decreased in February to 4.2 occurrences and 2.8 days, with a difference of 2.2 and 0.7 respectively, representing 13.4% and 13.2% of the frequency and duration from the seasonal total for this observation period. This reduction is attributed to the retreat of high-pressure systems during the day the transition to warmer conditions, especially in the second half of February, and the increasing influence of low-pressure systems.

Figure (3) shows the monthly average frequency of the Siberian high-pressure system over the Arabian Peninsula for the period (2009/2010 - 2021/2022) according to the (12) observation.



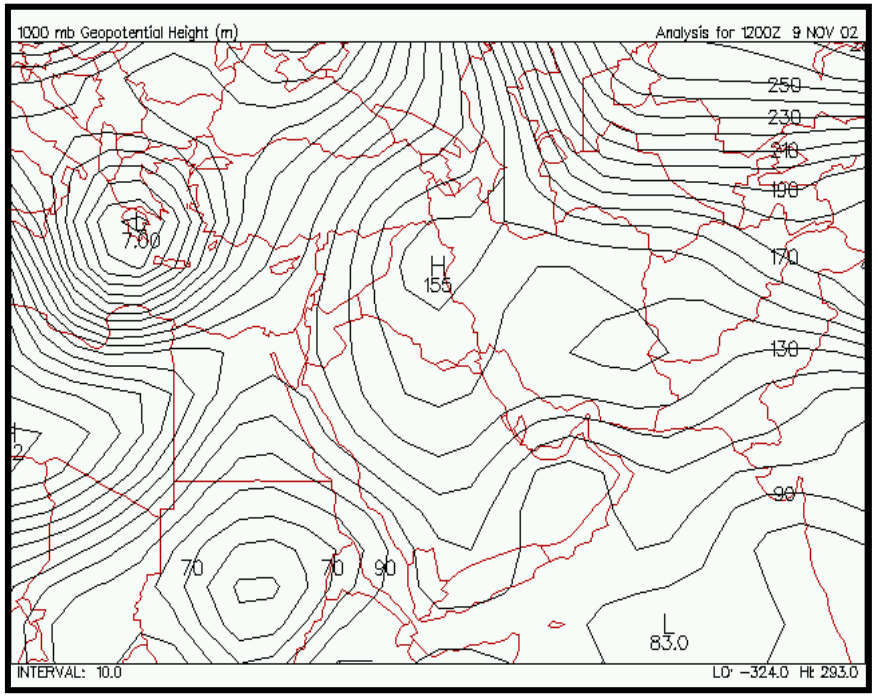
Source: Table (3)

Figure (4): Monthly average number of days the Siberian high altitude remains over the peninsula Arabic for the period (2010/2009 _ 2022/2021) according to the monitoring (12)



Source: Table (3)

Map (5) The control of the Siberian high altitude over the Arabian Peninsula



Source: Maps of the Middle East published on the website: http://.vortexplymouth.edu//

The most important of which is the Sudanese depression and the growing chances of merging between the thermal depressions.

Despite the increased frequency of the Siberian high-pressure system in March compared to February, which recorded an average frequency of 3.2 occurrences with a percentage reaching 15.1%, it did not persist for long. The number of days it remained was equal to the number of occurrences (3.2 days), representing 10.2%. This is due to the rising temperatures, the weakening of the Siberian high-pressure system, and its fluctuating control. These climatic conditions allow for longer dominance by thermal low-pressure systems such as the Sudan low and the seasonal Indian low, and the appearance of thermal lows during the day. This is also evident in April. Despite the extension of the Siberian high-pressure system, its frequency and duration did not exceed 1.5 for both frequency and duration, recording percentages of 4.8% and 7.1% respectively from the daytime observation over northern Arabia. In May, the frequency dropped to 0.1 occurrences per day for both frequency and duration, with the lowest percentage reaching 0.3% and 0.5% respectively. The nighttime observation recorded higher seasonal averages for frequency and duration compared to the daytime observation, due to the significant drop in nighttime temperatures which facilitates the expansion of the Siberian high-pressure system.

Results:

1. The geographical and astronomical location of the Arabian Peninsula, the variation in topographical features across its parts, and the surrounding water bodies are the most important factors in the formation and advancement of high-pressure systems affecting the region's climate. The dynamic controls have a greater impact on the high and low-pressure systems influencing the climate of the Arabian Peninsula than the static controls.

2. The Arabian Peninsula is affected by more than one high-pressure system during the season, some of which are polar, such as the Siberian high-pressure system entering from the north, northeast, and southeast, and the European high-pressure system entering from the north and northwest.

3. The subtropical high-pressure system recorded the highest seasonal total frequency and duration over the northern region, with 45.3 occurrences and 28.4 days in the 00 observations, and 39.1 occurrences and 29.5 days in the 12 observations.

4. The Siberian high-pressure system recorded the highest seasonal averages for frequency and duration in December, reaching 7.2 occurrences and 5.1 days respectively for both observations. The northern region recorded the highest monthly average for the Siberian high-pressure system in November with 4.3 occurrences and 6.9 days in December for the 12 observations.

WORKS CITED

Majid Hamoud and Kamal Hamoud, The Geographical Atlas of the Islamic World, Aleppo, Al-Ridwan Publishing House, Syrian Arab Republic, 2015.

www.tutiempo.net.climat.

Weather maps for the 1000 millibar pressure level based on maps of the Middle East published on the website: http://vortexplymouth.edu.

Maps of the Middle East published on the website: http://vortexplymouth.edu.