EVALUATION AND FORECASTING OF HOT DAYS IN THE ZAHEDAN CITY

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Abstract: As the frequency of hot days increases, heat stresses in cities will increase and this will be one of the most important challenges of the coming decades. A large part of the vulnerability of the population in urban areas is caused by urban heat waves, which creates emergency conditions and mortality due to hot day in these areas. The Zahedan city with 660,575 people is the largest point population in the southeast of the Iran, and also faces with this challenge. The purpose of this study is to investigate the hot day of the Zahedan and predict them for future periods. In this study, long-term statistics (1981-2020) of the Zahedan station were used and data were simulated with LARS-WG model. Then, the maximum temperature data were selected using the temperature threshold percentile method and after programming in Matlab environment, the Zahedan hot days were extracted for future periods. The findings of this study showed that hot days will reach 6000 days by 2099 and winter hot day will increase. Also, short heat waves have become more frequent and long-term heat waves will occur more than in previous periods, this event provides the conditions for creating thermal stresses and public health challenges for citizens.

Keywords: hot days, Zahedan, simulation, LARS-WG model

1 INTRODUCTION

Climate behavior indicates a tangible change in the environment. This change occurs in the form of extreme phenomena. Increased hot days in summer, lands temperate, heavy rainfall, reduced snow, and huge droughts are among the changes that have occurred in the climate. One of these behaviors that is used on the planet and experiences all its regions and human health occurs especially in urban areas, is heat waves. We have little knowledge about the climatic behavior of heat waves. In particular, the answer to the question of whether intense waves and the frequency of heat waves are changing? It is also possible to use this as a failure to change global climate change and its consequences (Delworth and Mann, 2000). Global warming has extremely changed the climate in recent years, increasing the probability and intensity of meteorological and climatic hazards (Peduzzi, 2019). Research on heat waves is a newly emerging research topic within the field of climate change research with high relevance for the whole of society (Marx et al., 2021) Heat waves and hot days have most implications for human health, particularly in urban areas where enhanced vulnerability to high temperature and humidity over the last few decades (Lijielin et al., 2018).

There are three main factors in the development and description of heat waves as the main obstacle: lack of a regional definition of heat waves, lack of a simple measurement of meteorological elements to show the complex relationship between the human body and ambient temperature, lack of appropriate time series for meteorological variables that should probably be included. According to a simple definition, a heat wave is an unexpected period of annoying atmospheric heat and heat stress that causes temporary changes in people's lifestyles and threatens their health.

Thus, although the heat wave is a meteorological event, it cannot be assessed without its human consequences. The combination of meteorological elements associated with human sensitivities to heat should be used. To combine high daily and low night values, a specific threshold must be set so that the climatic variables of an area can be related to it. At the same time, continuity must be considered. There are approaches that suggest two important aspects of heat waves. These aspects are physiological and sociological. Living in the past and present conditions of a particular climate and limited events can affect human beings. (Kalkstein, 1993). Heat waves are unusual periods of hot air that affect human health and increase heat stress, thus exacerbating the conditions for cardiovascular, cerebrovascular and respiratory diseases (Kyselý, 2004; Kovats and Ebi, 2006). Although there are many environmental hazards in human groups and threaten all kinds of hazards in human society, but in relation to heat waves, the criteria of age, income level, level of social isolation, working in an unventilated environment and living in the upper floors of apartments are possible. Is to increase diseases and heat stress (Hughes and McMichael, 2011). According to UN research, the urban population will increase in the next decade (UN, 2010). The World Meteorological Organization has not been able to provide a comprehensive and clear definition of heat waves because the intensity, frequency and characteristics of heat wave events vary in geographical locations (Kyselý and Kim, 2009), although some researchers believe that these events are Local temperature thresholds cover different areas.

There are two approaches to temperature thresholds for defining heat waves:

– Increasing absolute values that first affect and limit human physiological activities and create conditions that prevent human comfort and create problems for human health (Kyselý, 2004).
– Deviation from normal, which emphasizes the sociological aspects and adaptation to the prevailing climate in a given place, and the physiological aspects that can take into account the processes of temperature regulation with the human body and determining its thresholds' human body and determining its thresholds. The Health Consequences of Hot days one of your emerging concerns. Recent heatwave events, particularly in Europe in 2003 with 80,000 casualties (Robine et al., 2008) and in Russia in 2010 with approximately

5,400 deaths (Revich, 2011), have highlighted these problems across continental Europe. (Kosatsky, 2005). Some researchers believe that this event is an example of what is called “a form of the future to come” (Beniston and Díaz, 2004). This perspective should be considered in decision-making for planning based on extreme temperature events and applied to warning systems to maintain public health (WHO, 2003; Kovats and Ebi, 2006; Kalkstein and Sheridan, 2007). Numerous studies have been conducted on hot daysaround the world.

Ding et al. (2010) based on maximum daily temperature data collected at 512 stations in the period 1961-2007. Geographical patterns and temporary changes in hot days and heat waves (including Study duration 3 to 5 days) in China (Ding et al., 2020). Wolf et al. (2010) examined the appropriate definition of heat waves in UK. A specific threshold for the whole country cannot be provided because different environmental and physiological conditions prevail in different regions. As global warming and urban populations increase, heat stress in cities will increase, and this will be one of the major challenges of the coming decades. And today there is extensive research on concerns about increased heat stress in large cities, especially hot days and climate events that lead to death in cities and nearby areas. Therefore, it is important to study the specific patterns of heat stress and their health risk for the urban population. The Zahedan city with 660,575 people is the most populous population point in the southeast of the country, and also faces this challenge. Reduction of water resources, increase of heat stresses simultaneously with the occurrence of hot days can cause serious damage to the urban population and the environment of this city, so understanding the behavior of hot days in future periods of Zahedan will help planners to map the future of the city. The purpose of this study is to assessment the hot days of the Zahedan and predict them for future periods.

2 STUDY AREA

Zahedan city is the center of Sistan and Baluchestan province in eastern Iran and close to the border between Iran and Afghanistan and Pakistan (Figure 1). This city is one of the most important administrative, political, commercial and military centers in southeastern Iran. Zahedan city with 660,575 people is the most populous population point in the southeast of the country. The altitude of the city is 1378 m. this city has warm and dry climate. The average annual temperature in Zahedan is 21.06 C° and the warmest month of June with an average daily temperature of 28 C° and the coldest month of January with an average daily temperature of 7.45 C°.

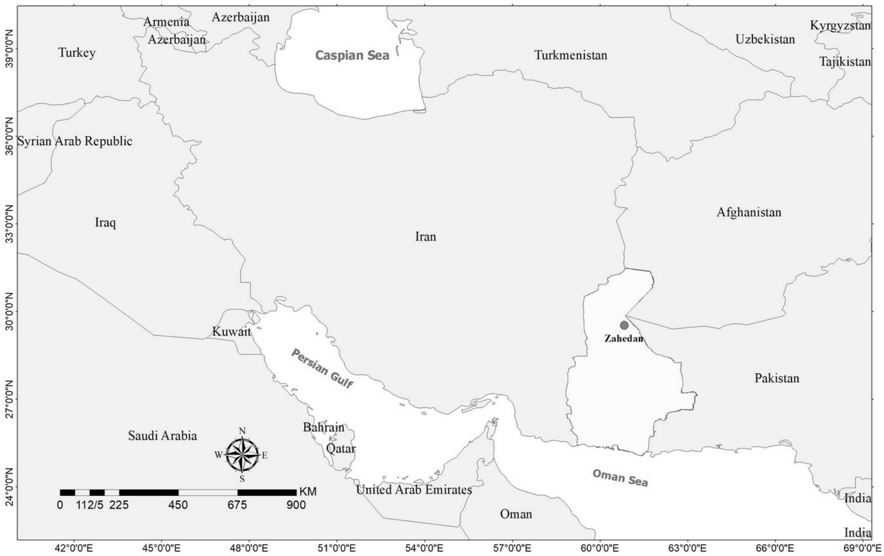

Figure 1 Location of the Zahedan city in the Middle East

3 MATERIAL AND METHODS

Accurate and consistent meteorological data are the main inputs of climate models. Observations (such as wetlands and droughts (climatic information of at least 30 years as the baseline period) as observations (for semen events and droughts) are considered (Semenov and Barrow, 2002). In this study, the long-term statistics of Zahedan station were processed as a base period. In this study, maximum temperature data of Zahedan station to study and classify heat waves, data of minimum and maximum temperature, precipitation and sunny hours have been used to predict and model the incoming hot days of the model. This statistic is for the period (1981-2020) there are several ways to define a heat wave (Rafael at al., 2009). The method of percentiles, which can be calculated for all observations, the method of deviation from the standard for the average daily temperature, the application of absolute values for the daily average, etc., most of which have been studied in Europe and North America. (Karl and Knight, 1997; Kyselý, 2004; Diaz et al., 2002; Meehl and Tebaldi, 2004; Kovats and Ebi, 2006). For study heat waves, used Matlab software, a program was written to extract heat waves. Then, after programming in Matlab software, the days when the 90th percentile was above the set threshold (36.5) and lasted at least 2 days were separated from the maximum temperature matrix of Zahedan station by this program and were introduced as Zahedan heat waves and hot days. In this program, days from sequence of 2 days to 15 days and deviation of +2 were defined.

Formula 1:

$$Q_p = x(n+1)p$$

Q – the percentile, p – the desired percentile, x – the maximum temperature, n – the number of temperature data.

Here is how to define a heat wave:

$$HT(i), HT(i+1), \ldots HT(i+p-1) \geq 2, HT(i-1), HT(i+p) \leq 2$$

Then, LARS-WG model was evaluated by comparing statistical period data and data produced by the model using statistical tests and comparative graphs. For this purpose, the baseline scenario was prepared for the statistical period of 1981-2020 and the model was implemented for the mentioned base period. To evaluate the outputs of the LARS-WG model, monitoring and modeled data were prepared for 4 climatic elements of maximum and minimum temperature, precipitation and radiation, as well as their statistical characteristics including monthly average, etc., and the model's ability to create past climates. Zahedan station was processed. Statistical tests were used to compare monitoring data and data generated by the model. Comparison of these data for existing elements was performed using correlation test. The results showed that the ability of LARS-WG model in modeling the maximum temperatures of the period under study is good. The results of Pearson correlation for maximum temperature showed that the correlation between these model data and real data is 0.87. Pearson correlation values between modeling and observational values are accepted at the level of 0.01. The LARS-WG thumbnail model was implemented for the base period, thus calibrating the model. Due to the fact that the results of climate models have the necessary validity only in the test areas, the test and validation of the model was appropriate to the data of the study area. In order to ensure the accuracy of the model, first a baseline scenario that does not apply any climate change for the study area in 1981-2020 was developed for the statistical period and by re-implementing its power model in reproducing the data of the observational statistical period was evaluated. Then the output of the model including minimum temperature, maximum temperature and precipitation as well as their standard deviation were compared with 39-year observational data of the study area. The evaluation of LARS-WG model was done by comparing the base period data and the data produced by the model using comparative diagrams and RMSE (Root Mean Square Error), MAE (Mean Absolute Error), BIAS, NSE (Nash-Sutcliffe Efficiency) error parameters (Formul 2).

The value of the NSE parameter is between minus infinity and one variable, and the closer this value is to one, the higher the accuracy of the model. The MAE and RMSE parameters show the model error and the lower values of these two criteria indicate better model performance. The fact that the BIAS parameter is close to zero also indicates that the model is more accurate in the simulation. In these relationships, S represents the values simulated by the model, O represents the actual values, the index of the months of the year, and N represents the number of months of the year. K-S statistical tests were used to compare the frequency distribution and T-test was used to compare the means and F-test was used to compare the standard deviation of the observed and modeled data. The mentioned statistical tests are based on the assumption of zero:

H0 – the difference between observational and pseudo-simulated data is not significant.

H1 – the difference between observational and simulated data is significant. If the p-value is less than 0.01, the null hypothesis is rejected and the null hypothesis is accepted.

Formul 2:

$$NSE = 1 - \frac{\sum_{i=1}^{n} (s_i - o_i)^2}{\sum_{i=1}^{n} (s_i - \bar{o}_i)^2}$$

$$BIAS = \frac{1}{n} \sum_{i=1}^{n} (s_i - o_i)$$

$$MAE = \frac{\sum_{i=1}^{n} o_i - s_i}{n}$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (o_i - s_i)^2}{n}}$$

After ensuring the capability of the LARS-WG model in producing climate data, this model was implemented to downscaling the output of the HadCM3 atmospheric circulation model and to produce artificial data to predict the climate of the periods 2030-2011 and 2065-2046.

4 DISCUSSION

In LARS-WG model, precipitation modeling and its probability of occurrence is done by quasi-experimental distribution method and Markov chain and radiation modeling is performed based on quasi-experimental distribution and temperature modeling using Fourier series (Semenov and Barrow, 2002). According to the T-test, the model has the ability to simulate the maximum temperature in all months and the correlation values are accepted in all months (Table 1) at the confidence level of 0.01. Figure 2 shows a comparison of the monthly average and the standard deviation of the observed and simulated maximum temperatures. According to Figure 3, it can be said that the values related to the maximum temperature produced by the LARS-WG model have a very good fit with the observed values.

Table 1 Observed and simulated values of maximum temperature

	jan	feb	mar	apr	may	jun	jul	agu	sep	oct	nov	des
observations	23.42	29.98	34.1	36.84	36.76	35.13	31.45	26.12	19.88	15.98	14.79	18.34
Simulated	23.67	29.66	34.05	36.61	36.63	34.95	31.35	26.22	20.15	16.04	15.23	18.7

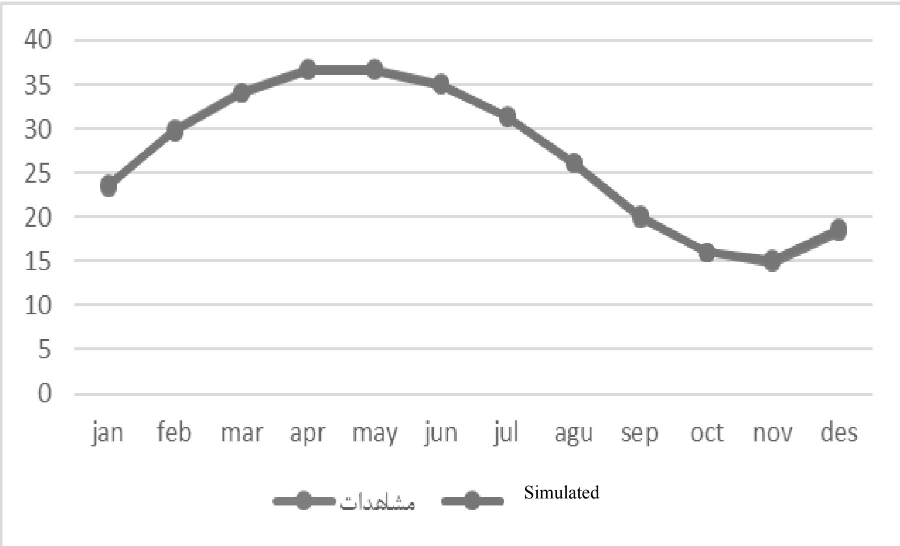

Figure 2 Maximum observational and simulated temperature of the base period

The values of RMSE, MAE, BIAS and NSE parameters related to each of the climatic parameters are presented in Table 2. High values of NSE parameter Low values of MAE error index and near zero BIAS index indicate the high efficiency of LARS-WG model in simulating climatic parameters of Zahedan station. This indicates the greater power of LARS-WG in modeling temperature data than precipitation, which is the result of similar studies such as Babaian and Najafi Nik (2011). This is due to the nature of the temperature parameter which is a continuous element.

After ensuring the accuracy and efficiency of the LARS-WG model in simulating the climatic parameters of Zahedan station, the output of the HadCM3 model under scenarios A2 and B1 for the period 2030-2011 and 2065-2046 is scaled and the maximum temperature values are predicted with their values in The base period was compared. Then the hot days of Zahedan city for the future periods were extracted from the simulated maximum temperature data.

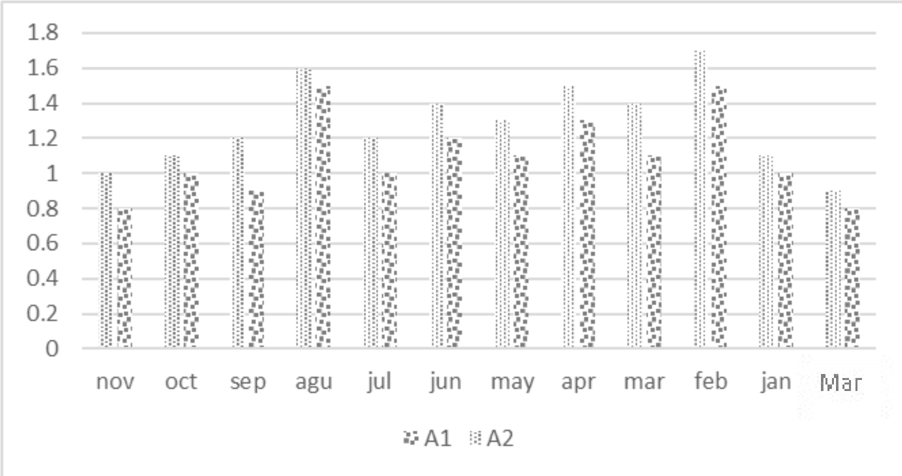

Figure 3 Changes in the average temperature of the maximum period 2030-2015 under scenarios A2 and B1

Table 2 Error values for the maximum temperature of Zahedan

Maximum Temperature			
RMSE	MAE	NSE	BIAS
0.23	0.03	0.99	0.03

The near future 2030-2011

HadCM3 shows, that under both scenarios studied, predicts a maximum temperature increase for all seasons (Figure 3). By comparing the maximum temperature of the base period and the 2020s, the maximum increase in the maximum temperature will occur in March by 1.7 to 1.3 degrees Celsius (Figure 4). The lowest increase in January will be 0.5 to 0.4 degrees Celsius (Figure 5). Scenario A2 predicts a greater increase in temperature. Some scholars believe that these events are examples of "a form of the future to come" (Beniston and Díaz, 2004) and should be considered when deciding on heat-related planning (Figure 6).

Far future: 2046 -2065

The average maximum monthly temperature of Zahedan in the 2050s will increase compared to the base period in all months. The highest increases in scenarios A2 and B1 are 3.9 and 3.5, respectively, and are related to July and June. In the cold months of the year, the largest increase occurs in March and December, which leads to a shorter cold period. The lowest temperature increase is forecasted at 1.1 to 2.1 degrees Celsius in January (Figure 7) According to the HadCM3 model, for both scenarios, the maximum temperature increase is predicted for all seasons and months.

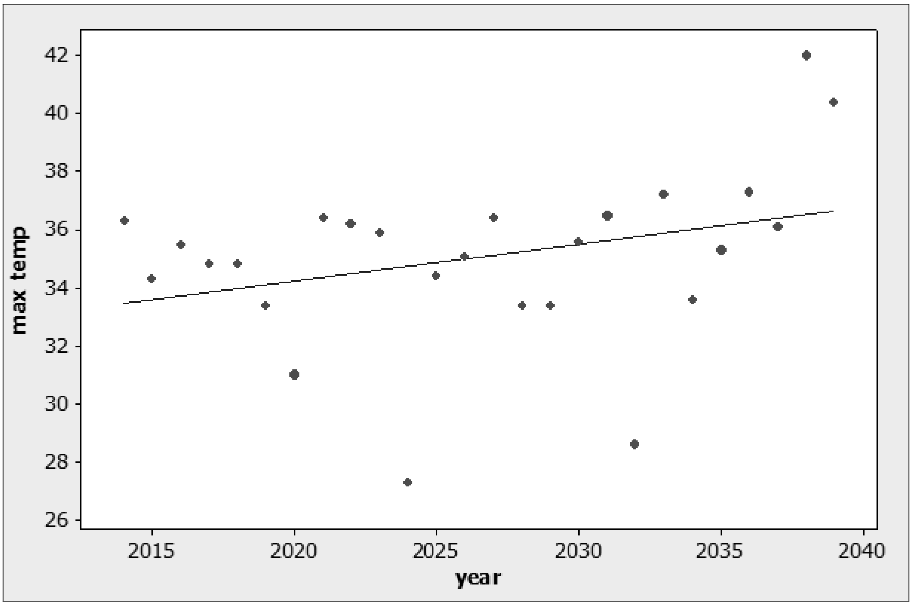

Figure 4 Simulated maximum temperature for the period 2015-2039

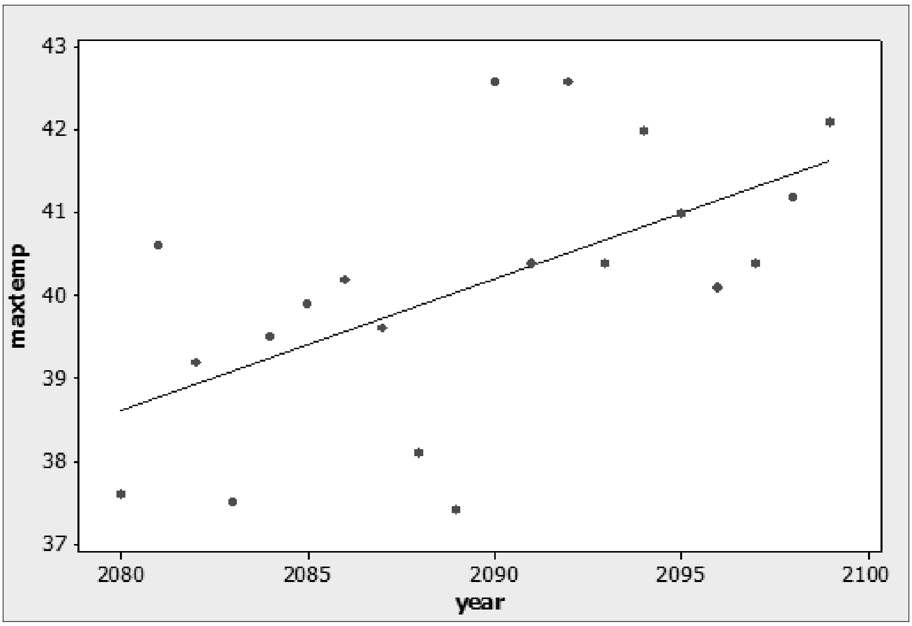

Figure 5 Simulated maximum temperature for the period 2080-2010

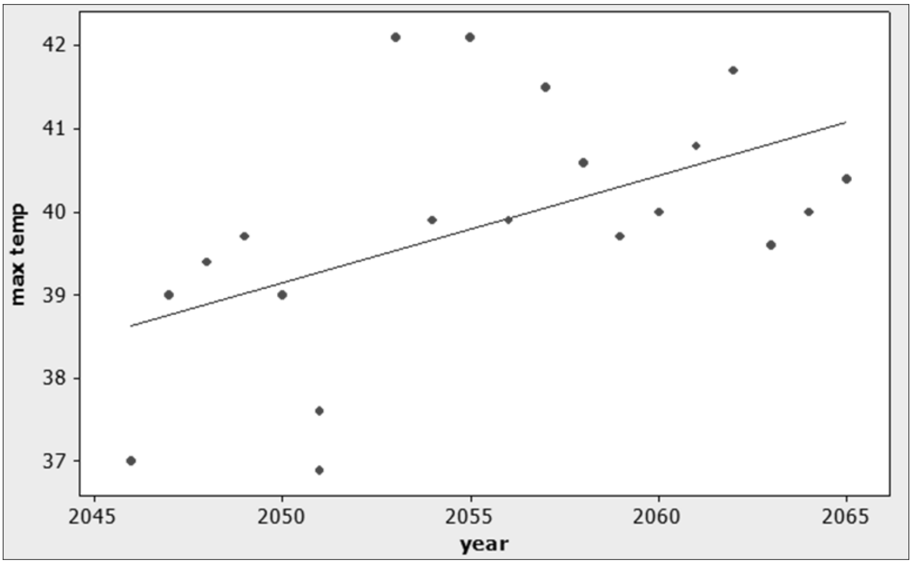

Figure 6 Simulated maximum temperature for the period 2046-2065

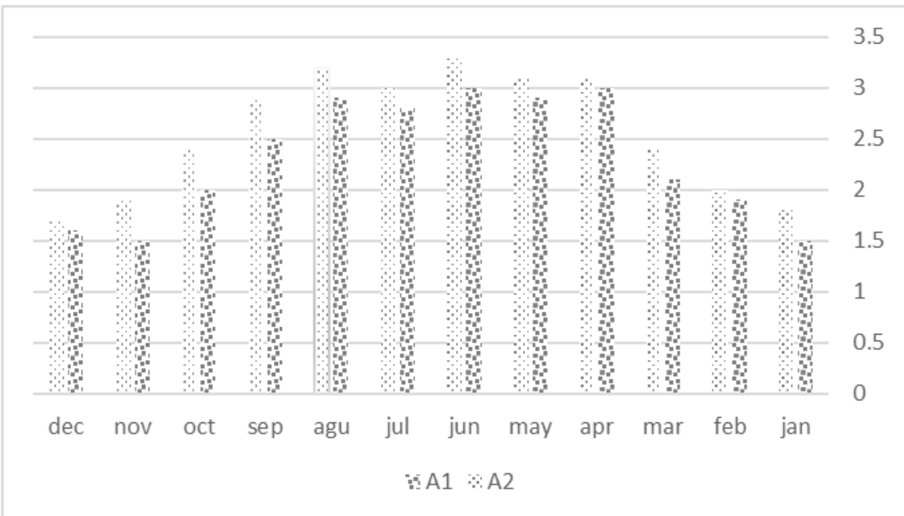

Figure 7 The mean temperature changes of the maximum period 2065-2046 under scenarios A2 and B1

Identifying and detecting the characteristics of hot days and limit temperature events is different from other environmental hazard assessments. It is the variability and variability of the climate that determines the somewhat different temperatures from place to place and from time to time, and complicates our understanding of heat waves. Therefore, in this study, Zahedan hot days are divided into cold period hot days and warm period hot days based on the month and the calendar season.

The total number of hot period waves in Zahedan is 174 hot days and 177 cold period heat waves are 2 to 15 days. The maximum frequency was two-day and short continuous waves and the minimum frequency was continuous waves. As shown in Table 3, winter heat waves are also abundant. Warm periods are increasing in Zahedan with winters having hot nights.

Table 3 Frequency of heat waves in Zahedan in observational data (days)

Warm	waves	two	three	four	five	six	seven	eight	nine	ten	eleven	twelve	thirteen	fourteen	fifteen
Warm	period	32	28	27	22	21	17	12	4	3	1	0	1	2	1
Cold	period	39	31	29	23	19	20	10	4	1	0	1	0	0	0

The heat waves of the period 2030-2011 are also shown in Table 4. Statistics show that the occurrence of heat waves in the near future is increasing. Heat waves increase in the warm period compared to the observation period. In the cold period, heat waves have also increased. Continuous waves will also occur during this period, indicating the occurrence of long warm periods. The heat waves of the hot period will reach 199 heat waves, which will be 25 more heat waves than the base period.

Table 4 Frequency of heat waves in Zahedan in the data of 2030-2011

Warm	waves	two	three	four	five	six	seven	eight	nine	ten	eleven	twelve	thirteen	fourteen	fifteen
Warm	period	37	25	29	23	23	19	18	8	3	1	2	2	1	1
Cold	period	40	41	36	27	20	21	12	6	3	1	2	1	1	1

Statistical analysis of the heat waves of the future mid-period shows that the heat waves have increased by 19% (Table 5). Short heat waves have become more frequent and long-term heat waves will occur more than in previous periods. The number of heat waves in the hot period compared to the base period was 27 waves and in the cold period it was 44 heat waves. This statistic shows that the cold period in Zahedan is moderate and in the future the cold period of Zahedan will be shorter. Over the past fifty years, hot days, hot nights, and heat waves have become more prevalent, which can affect the health of millions of people in some parts of the world, especially in areas with lower adaptation capacity (IPCC, 2007).

Table 5 Frequency of heat waves in Zahedan in the data of 2065-2046

Warm waves	two	three	four	five	six	seven	eight	nine	ten	eleven	twelve	thirteen	fourteen	fifteen
Warm period	38	25	30	25	21	20	18	5	3	2	2	1	2	1
Cold period	41	40	39	26	22	20	17	7	4	2	1	0	1	1

Due to the fact that the hot days of the next period will reach more than 6000 days, so the heat waves will also increase. This increase in heat waves in the period 2099-2088 will occur in the hot and cold period, and the data show that longer heat waves will occur more (Table 6). In a future warmer climate, as the average temperature rises, it appears that the heat waves will be wider, longer, and more abundant (Folland et al., 2001).

Table 6 Frequency of heat waves in Zahedan in the data of the period 2099-2088

Warm waves	two	three	four	five	six	seven	eight	nine	ten	eleven	twelve	thirteen	fourteen	fifteen
Warm period	40	28	31	22	2	23	18	5	4	2	1	2	2	2
Cold period	44	41	39	29	23	24	19	8	6	4	2	1	2	2

The average maximum temperature of Zahedan is 26.3 and according to modeling and simulation of data, this value will increase by about 1.5 degrees Celsius in the period 2030-2011, which is directly related to the occurrence of heat waves. The heat waves of these hot months will reach 192 and the cold months will reach 212 heat waves. Heat waves will become more frequent and intense in the coming period. In recent years, the intensity of heat waves has increased in a number of regions of the world. Warm days increased by 2.18 days per decade for the statistical period of 1948-2006 in the Northern Hemisphere (Feng at al., 2005). The number of hot days in the statistical period of Zahedan until 1394 reaches 1467, which is the criterion for selecting hot days 36.3, which is obtained from the 90th percentile. In the initial period, ie 2030, it will reach 3470 days. This amount will reach 4600 hot days for 2065 and more than 6000 hot days for 2099. The average maximum temperature will reach 28.47 degrees Celsius in 2065 and 29.21 degrees Celsius in 2099. (Table 7) The heat waves of the distant future will also increase and reach 244 heat waves in the cold period. Unfortunately, climatic models, if heating the global summer average for 2050 is set to be above 90 degrees Fahrenheit on most days (National Wildlife Federation, 2010).

Table 7 Features maximum temperatures and hot days observations and future periods

Frequency Of HW	Average Maximum Temperature	Frequency of Hot Days	Frequency of HW	
			Warm Period	Cold Period
Observation period	26,3	1467	171	177
2030-2011	27,46	3470	192	212
2065-2046	28,47	4600	193	221
2099-2088	29,21	5293	203	244

5 CONCLUSION

Today, extreme temperatures are among the climatic events that have caused acute climatic hazards in the environment. The persistence of extreme temperatures creates heat waves that, as the most important climatic hazard, have severe human and environmental consequences. Heat waves are part of extreme weather events that have hazards and negative effects on human life and well-being. In recent years, the intensity of heat waves has increased in a number of regions of the world. Therefore, knowing the behavior of this climatic event in any geographical location can help in land use planning. The city of Zahedan, as the most populous point in the southeast of the country, has intense heat waves. In this study, heat waves of Zahedan were studied and their behavior in the future was predicted. First, the maximum temperature was modeled with the LARS-WG model and then identified and classified using heat wave programming. The maximum temperature in the city of Zahedan has been simulated in disturbed periods from 2019 to 2099, which shows the increase in temperature, especially in the cold months. Heat waves also become more frequent during these periods. This increase is more significant in the cold period, which indicates the temperate temperature in winter, and will increase the warm period in this geographical point. The average maximum temperature of Zahedan is 26.3 and according to modeling and simulation of data, this value will increase by about 1.5 degrees Celsius in the period 2030-2011, which is directly related to the occurrence of heat waves.

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Hodnotenie a predpoveď horúcich dní v meste Zahedan

Súhrn

Je zrejmé, že dnes už „klimatické správanie“ jasne naznačuje hmatateľnú zmenu v životnom prostredí. Táto zmena nastáva vo forme extrémnych javov. Zvýšený počet horúcich dní v lete, teploty Zeme, silné zrážky, znížené množstvo snehu a obrovské suchá patria medzi zmeny, ku ktorým došlo v klíme v posledných desiatkach rokov. Jednou z týchto zmien spôsobov správania, ktoré zažívame na planéte a zažívajú ju všetky jej regióny s výrazným vplyvom na ľudské zdravie a ktorá sa vyskytuje najmä v mestských oblastiach, sú vlny horúčav. O klimatickom správaní sa vĺn horúčav máme málo vedomostí. Dôležitá je najmä odpoveď na otázku, či sa menia intenzita týchto horúčav a frekvencia vĺn horúčav? Je možné zmeny intenzity a frekvencie horúčav v meste považovať za zlyhanie ľudskej spoločnosti pri reakcii na globálnu zmeny klímy a jej dôsledkov. Globálne otepľovanie v posledných rokoch extrémne zmenilo klímu, čím sa zvýšila pravdepodobnosť a intenzita meteorologických a klimatických rizík. Výskum vĺn horúčav je novovznikajúca výskumná téma v oblasti výskumu klimatických zmien s veľkým významom pre celú spoločnosť. Vlny horúčav a horúce dni majú najväčší vplyv na ľudské zdravie, najmä v spomínaných mestských oblastiach, kde sa za posledných niekoľko desaťročí výrazne zvýšila zraniteľnosť spoločnosti voči vysokým teplotám a vlhkosti. Preto je dôležité študovať špecifické vzorce tepelného stresu a ich zdravotné riziko pre mestskú populáciu. Mesto Zahedan so 660 575 obyvateľmi je najľudnatejším miestom na juhovýchode Iránu a takisto čelí tejto výzve. Úbytok vodných zdrojov, zvýšenie tepelných stresov súčasne s výskytom horúcich dní, môže spôsobiť vážne škody mestskému obyvateľstvu a životnému prostrediu tohto mesta, takže pochopenie „správania sa“ horúcich dní v budúcich obdobiach pomôže plánovačom Zahedanu zmapovať riziká a navrhnúť zlepšenia pre budúcnosť mesta. Účelom tejto štúdie je zhodnotiť horúce dni Zahedanu a predpovedať ich pre budúce obdobia. Ako sme uviedli extrémne teploty dnes patria medzi klimatické javy, ktoré spôsobili akútne klimatické ohrozenia životného prostredia. Pretrvávanie extrémnych teplôt

vytvára vlny horúčav, ktoré ako najdôležitejšie klimatické nebezpečenstvo majú vážne dôsledky pre ľudí a životné prostredie. Vlny horúčav sú súčasťou extrémnych poveternostných udalostí, ktoré predstavujú nielen nebezpečenstvo, ale už aj priame negatívne účinky na ľudský život a pohodu človeka. V posledných rokoch sa intenzita vĺn horúčav zvýšila v mnohých regiónoch sveta. Preto poznanie správania sa tejto klimatickej udalosti v akejkoľvek geografickej makropolohe a aj mikropolohe môže pomôcť pri diskusiách a ďalšom rozvoji miest Mesto Zahedan ako „najľudnatejší bod“ na juhovýchode Iránu zažíva veľmi intenzívne horúčavy už takmer 20 rokov. V tejto štúdii boli študované vlny horúčav Zahedanu a boli urobené modely, ktoré predpovedajú „správanie týchto vĺn horúčav“ v budúcnosti. Najprv sa modelovala maximálna teplota pomocou modelu LARS-WG a potom sa maximálna teplota identifikovala a klasifikovala pomocou programovania vĺn horúčav. Maximálna teplota v meste Zahedan bola simulovaná v jednotlivých obdobiach od roku 2019 do roku 2099. Simulácie ukázali očakávaný nárast teploty najmä v chladných mesiacoch. Uvádzaný nárast a zvýšená frekvencia horúcich dní v týchto chladných obdobiach sa zdajú „nevyhnutné“ pre túto oblasť. To, že tento nárast horúcich dní je výraznejší v chladnom období naznačuje zmiernenie teplôt v zime a zvýšenie teplôt v letných mesiacoch v tejto geografickej oblasti. Priemerná maximálna teplota Zahedanu je dnes 26,3 stupňa Celzia a podľa modelovania a simulácie údajov sa táto hodnota v období rokov 2011 – 2030 zvýši asi o 1,5 stupňa.