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THE ANALYSIS OF TEMPERATURE BASED ON INTERDECADAL VARIABILITY OF REGIONAL TEMPERATURE IN PAKISTAN: CASE OF FEBRUARY OVER THE PERIOD OF 1950S-2000S

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ABSTRACT

In this paper, an attempt has been made to observe the regional spatial variability of temperature in the month of February based on ground observed data. The month of February shows explicit temperature anomalies in the entire country at decadal level with some most prominent patches in the north, northwestern rugged parts of the country as well as in Balochistan and its coastal areas. The February obviously indicates warming in most parts of the country but surprisingly shows some cooling impression partly in different decades like in the northeastern parts of the country as well as in areas dominated by Kirthar ranges in the decade of 1960s. In most cases the Balochistan shows prominent warming trend but not in the decades of 1980s and 1970s. The 1980s, 1990s, and 2000s support the warming tendency in the study period.

KEY WORDS: Pakistan, February, Temperature anomalies, decadal scale, spatial distribution.

INTRODUCTION

The climate change and variability is a complex phenomenon and has relationship with atmospheric circulation as well as sea surface temperature (Ahmad et al 2014(a)). Though if temperature variability is at global scale or at national scale has link with atmospheric teleconnections (Ahmad et al 2014(b)). Pakistan is not big contributor to the emission of green house gases due to its subsistent agricultural economy but it is encouraging effort that Pakistan has joined the global efforts for climate change and became member of United Nations Framework Convention on Climate Change (UNFCCC) on June 13, 1992. However, the country has limited research in this respect and the awareness is increasing that the developing society of Pakistan needs better understanding of climate and its impacts on agriculture and society where the fast growing population faces climatic hazards like floods, drought and flood (Ahmad et al. 2011; Pachauri, 2009).

Pakistan is located with substantial north south extension in the subtropical region with most part dominated by arid and semi arid climate in the south and generally temperate climate in the north. It is an agricultural country with highest densities of population living in the Indus Flood Plains (IFP). The agricultural sector is the most sensitive quarter in term of response to climate variation and change. Living in an agricultural country with climate change scenario is highly pertinent to understand the spatial distribution of temperatures and its interdecadal shift at regional scale and monthly perspective is highly required in agriculture sector. In this paper, we put forward spatial distribution of temperature anomalies in the month of February which is a winter month in Pakistan.

So far the winter and summer months are concerned in climate variability scenario, they have characterized differently by cooling or warming trends (Ahmad et al, 2014 (c)). The Himalayas, Karakoram and Hindukush (HKH) are nurturing rivers of South Asia including river Indus and river Kabul. The temperature variability definitely exerts influence on glacial melting in Himalayas will affect the downstream flow (Barnett et al. 2005; Fowler and Archer, 2006). The variability in surface air temperature and changes in snow cover are interlinked in northern Pakistan (Butt et al. 2008; Gardelle et al. 2012). Some studies (e.g Chung et al. 2004) documented that the warming trend is higher over the urban morphology. In this way, the Pakistani cities may not be exception where the change from rural to urban way of life has increased the urban landscape and induced the urban heat island impact (Sajjad et al. 2009). Thus in the above said scenario the paper addresses the complications associated with spatial distribution of temperature variability.

MATERIAL AND METHOD

The monthly data were obtained from Pakistan Meteorological Department (PMD) for 54 selected stations which almost cover the whole country. In next stage, monthly averages were calculated. The study period was divided into six decades and the calculation were done separately for each decade. The spatial distribution of mean monthly temperature was depicted with the help of isothermal maps. The temperature coefficient was mapped and the results are mainly based on simulated Figures. For each decade the ten February months were treated as continuous series. Interpolation with spatial resolution of 0.5×0.5 lat and long is performed to improve the quality of data and fill the data voids especially in remote and rugged national territories of the country. For detail of methodology read Ahmad et al (2010).

RESULTS AND DISCUSSION

For all the decades of the study period, the isothermal map is shown on the left while temperature anomalies are given on the right side of all subsequent figures.

The decade of 1950 (Figure 1) in February the coastal areas are warmer and characterized by 18 ^{o}C and above by proceeding northward the average temperatures are declining until reaching the temperature well below freezing in HKH zone north of Peshawar valley. The second aspect of average temperature is apparently decreasing with approach from eastern plains towards western mountains of the country.

The anomalies of temperature are not as simple as we found in case of distribution of average temperatures. In the decade of 1950, the warming of February is obvious but the lofty northeastern corner of the country was an exception in the Himalayas. The maximum warming occurred in the Peshawar valley and surroundings that was ranging between 0.5 and 2 temperature coefficient values. The impact of landforms is not as obvious as we usually noticed.

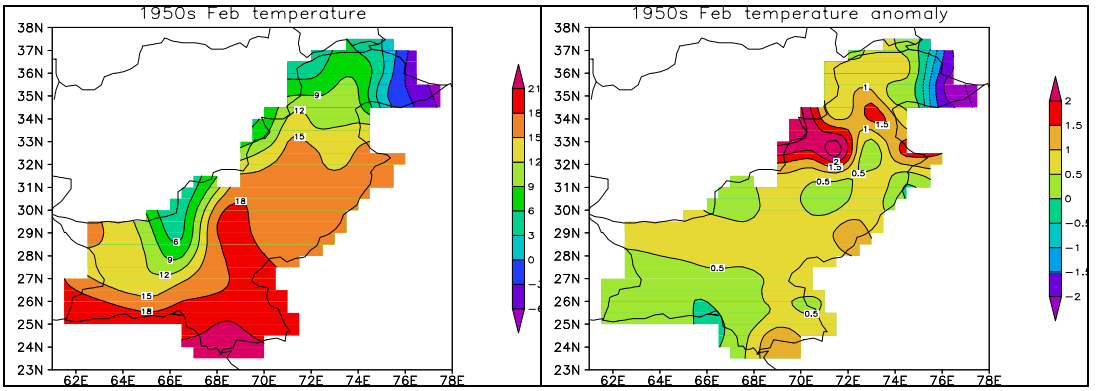

Figure 1. The decade of 1950

In the decade of 1960, (Figure 2) the 18 °C isotherm has been slightly shifted northward and is the indication of high temperatures than 1950s. the Peshawar valley with surroundings and HKH region was more or less the same as in the previous decade the same is true for Balochistan except the Quetta-Ziarat axis where little changes has occurred in surface average temperatures.

The anomalous pattern of temperature found in 1960s seems complex than the previous decade. Balochistan became warmer, the plains and piedmonts also configured warming trend. The temperatures in Sulaiman ranges lob area were located below average in February. The decade is evident that the western border regions with Afghanistan were above average especially along the Tribal areas border furthermore the HKH zone also faced warming.

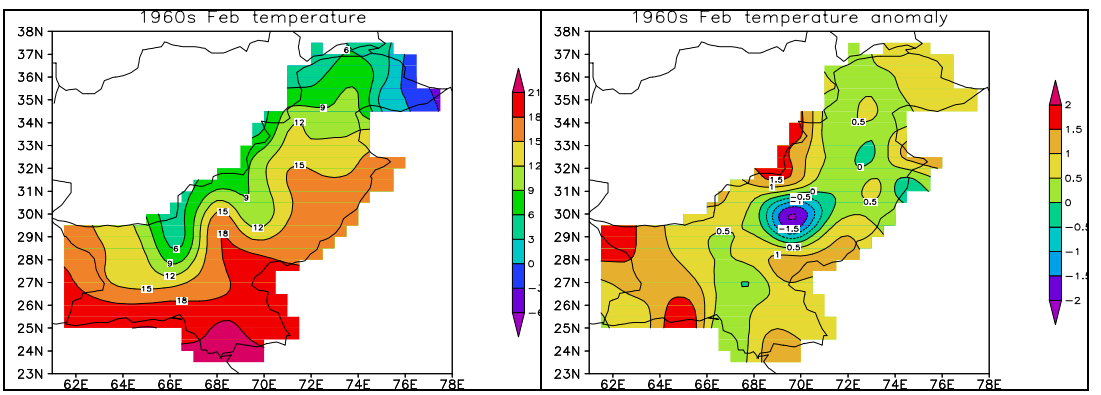

Figure 2. The decade of 1960

Refers to the decade of 1970 (Figure 3) the belt of 18 °C has been pushed southward in northwestern Sindh and the geometry of the area between 18 °C and 15 °C has also been changed if compared with previous decade indicating the dynamics of average temperature changes in the plains and piedmonts. The area between 15 °C and 12 °C

also has been changed but little southward shift is obvious the same belt has become wide in the province of Balochistan in 1970s.

Unexpectedly the February in 1970s was the coolest amongst all decades where temperatures were mostly below reference, the lowest temperature was located in Kharan and Noshki area, however the Balochistan coastal areas remained as exceptions.

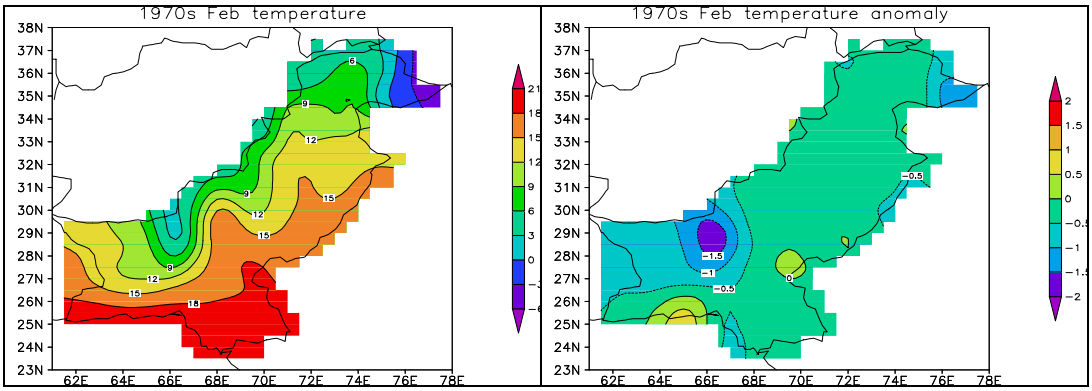

Figure 3. The decade of 1970

The decade of 1980 (Figure 4) show little changes in averages with reference to previous decade furthermore the Potwar Plateau region also did not register any substantial difference in temperature. The area extended between 9 °C and 6 °C in Swat valley become slightly narrow in 1980s. After 1970s, the warm belt appeared in northern Punjab, Peshawar valley and surroundings, coastal areas of Balochistan, parts of Kirthar ranges and parts of north eastern Gilgit-Baltistan, the rest of the country was slightly below average temperature, that was 0 °C to -0.5 °C.

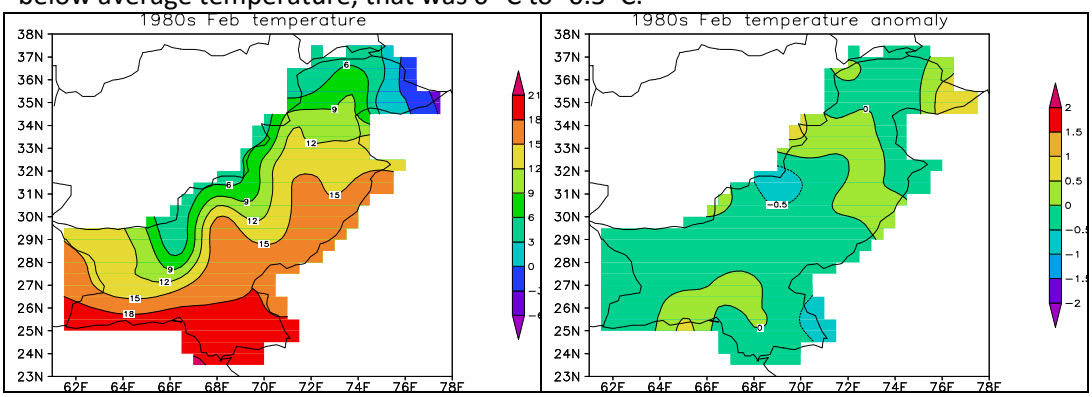

Figure 4. The decade of 1980

The decade of 1990 (Figure 5) experienced obvious change in the southern part of the country dominated by 18 °C and above. The geometry between isotherms of 18 °C and 15 °C was found highly dynamic almost in all decades. In 1990s, the northward shift of isotherms was an indication of increasing averages (warming) in Pakistan and supports the global warming.

The 1990s were warmer than the previous decade and less warm than the 2000s. However, Balochistan and southern Sindh were warmer than the coastal Balochistan, Punjab, KPK and most of HKH.

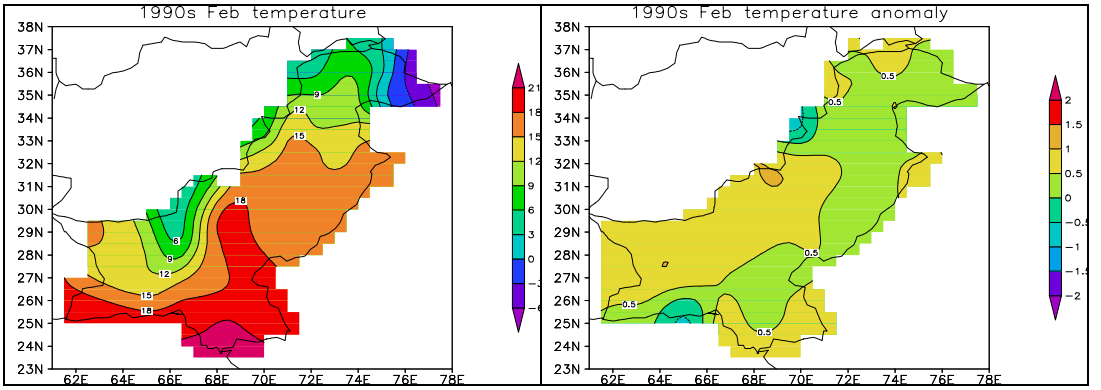

Figure 5. The decade of 1990s

The decade of 2000, (Figure 6) was warmer than all decades and the intrusion of 21 ^{o}C farther in southern Sindh was the signature of increase in average temperatures. The temperature in HKH has also been raised if compared with previous decades. The real warming has been noticed in 2000s where Balochistan and HKH zone were subjected to temperature well above average. The piedmonts were warmer than the plains. The coastal belts were not as warm as interior of the country. Based on temperature coefficient in different parts of the country the gradient of warming was increasing from 1980s to 1990s and 2000s in the study period.

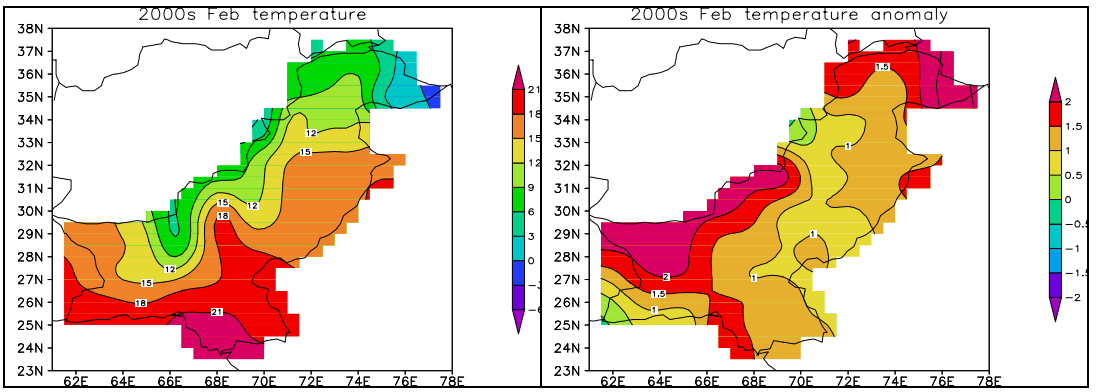

Figure 6. The decade of 2000

CONCLUSION

The temperature averages were found dynamic in February especially in southern national territories and along the piedmonts. The temperature variability varies from decade to decade, region to region and basin to basin in the study area at decadal level.

It was observed that geometry between isotherms of 18 ^{o}C and 15 ^{o}C was found highly dynamic in almost all decades. In 1990s, the northward shift of isotherm was an indication of increasing averages (warming) in Pakistan and supports the global warming to some extent. The observed temperature variability was complex in early decades, the study period does not support totally that February is warming in all decades however 1950s, 1980s 1990s and 2000s were observed with leading warming tendency in Pakistan.

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