Pakistan Geographical Review, Vol. 69, No.2, December 2014, PP 62-67

INTERDECADAL VARIABILITY OF TEMPERATURE IN PAKISTAN OVER THE PERIOD OF 1950S-2000S: A CASE STUDY OF APRIL

IFTIKHAR AHMAD*, ROMANA AMBREEN*, SHAHZAD SULTAN**, AHMAD SAEED* & MUHAMMAD FAHIM AHMAD**

*Department of Geography, University of Balochistan, Quetta

** Pakistan Meteorological Department, Islamabad

ABSTRACT

In the climate change scenario, it is highly pertinent to study, the temperature averages and their spatial anomalies at interdecadal scale. In this paper we analyze the month of April from 1950s-2000s based on the surface air temperature. Based on observed monthly temperature data the spatial distribution and variation of decadal isotherms are indicative of complex temperature variability throughout the country especially in the mountainous, pediments and coastal regions. The spatial distribution of temperature also reflects indelible impact of landforms on spacing and distribution of temperature in the complex terrain of Pakistan. In this study, geographical approach has been adopted to depict the spatial variation of temperature in Pakistan over the study period. The warmest decade was 2000s in the study period.

KEY WORDS: Temperature variability; spatial distribution; decadal anomalies; April; Pakistan.

INTRODUCTION

Drought and water shortage is the most serious threat to Asian community (Christensen et al 2007; Cruz, 2007. The food security of poor community and climate change got deep relationship (Lal et al. 2001; Barlow et al, 2002). Pakistan is facing temperature variability that triggers events like heat waves, drought and floods (UNFCCC, 2007; Pachauri, 2009). Climate variability can not be understood without understanding of regional temperature variability (Ahmad et al 2010). The temperature variability in complex mountain system is the prime concern of searchers contemporarily in climate sciences, also the Himalayan region in Pakistan has shown increase in average temperature.(Mahrt, 2006; Hussain and Mudasser 2007; Rasul et al 2008). The monthly temperature anomalies are the most important tool that helps climate change diagnostic (Buhairi, 2010) as well as in formulating climate policy (Nordhaus, 2007). The paper is focused on the surface temperature anomalies observed in different parts of the country in April over the decades of 1950s-2000s.

MATERIAL AND METHOD

The temperatures of the selected stations throughout Pakistan have been obtained from Pakistan Meteorological Department (PMD) then averages were calculated at decadal scale. In next stage the anomalies based on temperature coefficient were mapped For further detail of methodology read, Ahmad et al, (2014); Ambreen et al (2014). The describe results are based on simulated results (Figure 1).

RESULTS AND DISCUSSION

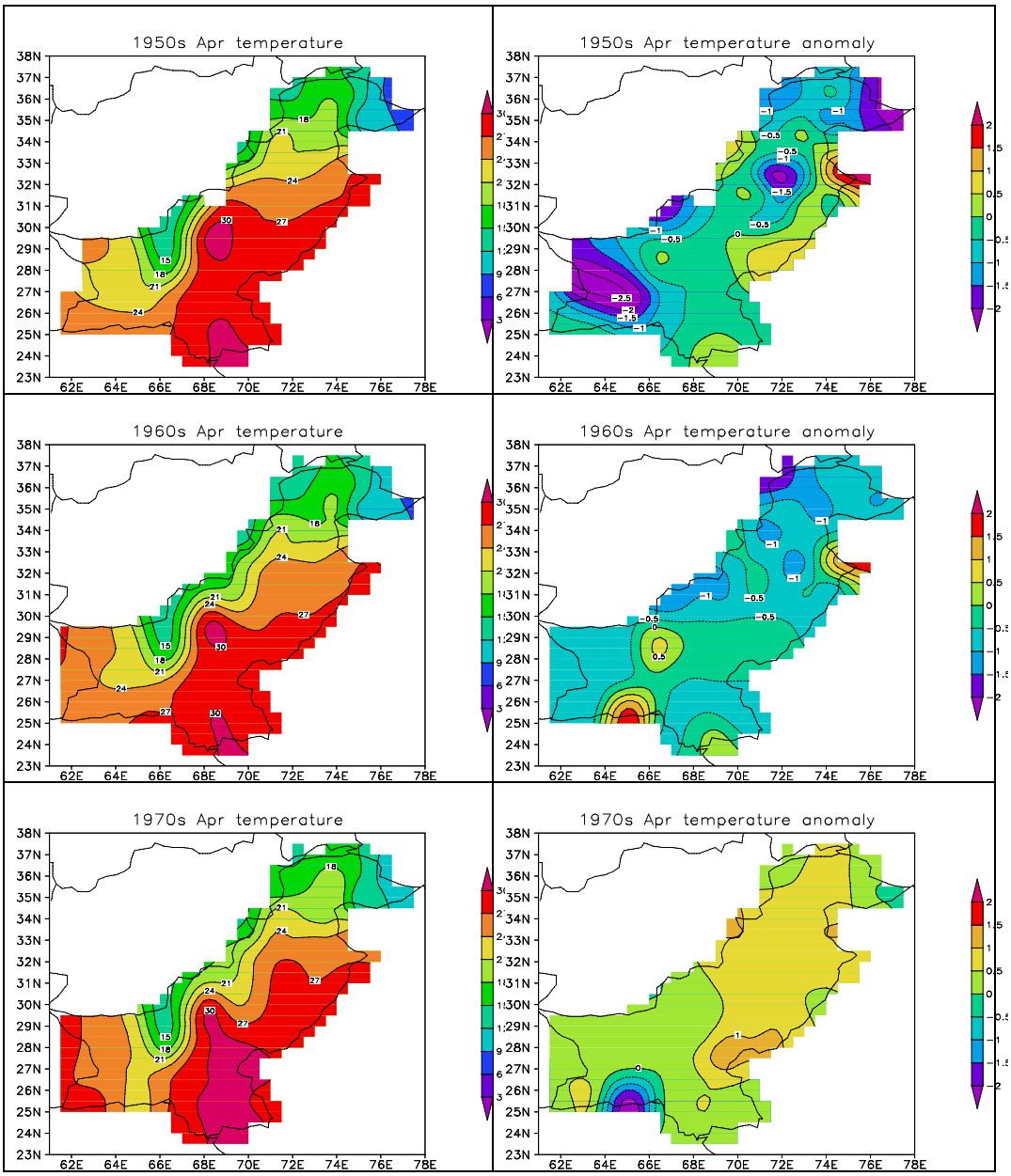
In 1950s, the Indus plains are quite hot in Sindh and lower Punjab where the temperature ranges between 27 ^{o}C and 32 ^{o}C and the averages temperature declines as one proceeds towards northern parts of the country. The temperature decline is obvious from costal Balochistan with approach towards northern parts of the province. An indelible impact of landforms and latitude is quite clear on the average surface air temperatures of Pakistan. Based on temperature anomalies interior Balochistan was cooler than the adjacent areas with Sindh. The same is true for interior Punjab but its eastern parts close to Indian borders experienced warming trend, Azad Kashmir and Muree Hills shown maximum warming trend in the decade. The decade experienced temperature coefficient values from 1.5 (warm) to -2.5 (cool).

In 1960s, the observations show more or less the same pattern of average temperatures but the isotherms of 24 ^{o}C, 21 ^{o}C, and 18 ^{o}C in northern Pakistan seems to be shifted further north. The anomalies examination shows that the coastal areas of Balochistan, Kharan and areas centered over the Muree Hills have acknowledged warming temperatures. The temperature remained cool (below average) in most of the national territories. The range of variability remained between 2 and -2 temperature coefficient.

In 1970s, the area of above 30 ^{o}C has increased in spatial extent, northward push of isotherm is slightly continued. The anomalies condition is custodian of warming and thus the decade was found warmer than the previous one. The coastal areas explicates cooling temperatures (below average) while the rest of the national territories were clearly found above the reference temperature. Obvious warming has been recorded in the Punjab and upper Sindh, KPK, parts of Hindu Kush and Karakoram.

In 1980s, surprisingly the area characterized by above 30 ^{o}C has been reduced in spatial extent and the shift of average temperature towards north in the country was not obvious. The coastal areas of Blochitan again were above average temperature except few areas centered over the Noshki in Balochistan and Kohi Safed and surrounding areas in Tribal areas, the rest of Pakistan knowledgeable temperature slightly below average.

In 1990s, based on observations the situation was more or less analogous with the temperature situation found in 1980s except southern Sindh where the temperature above 30 ^{o}C has been registered. April was cooler rather in 1990s, except Balochistan coast, Quetta Valley and surroundings. Based on the isothermal map, the geography of the temperature for the decade of 2000s highlight that the decade was the warmest than any other decade of the study period where Sindh, Punjab, central and western Balochistan were found warmer as indicated by surface distribution of temperatures. Sindh was the warmest region in the decade. The coefficient values were between 0.5 and 2 that held temperature well above average.


1950s Apr temperature
1950s Apr temperature anomaly
1960s Apr temperature
1960s Apr temperature anomaly
1970s Apr temperature
1970s Apr temperature anomaly

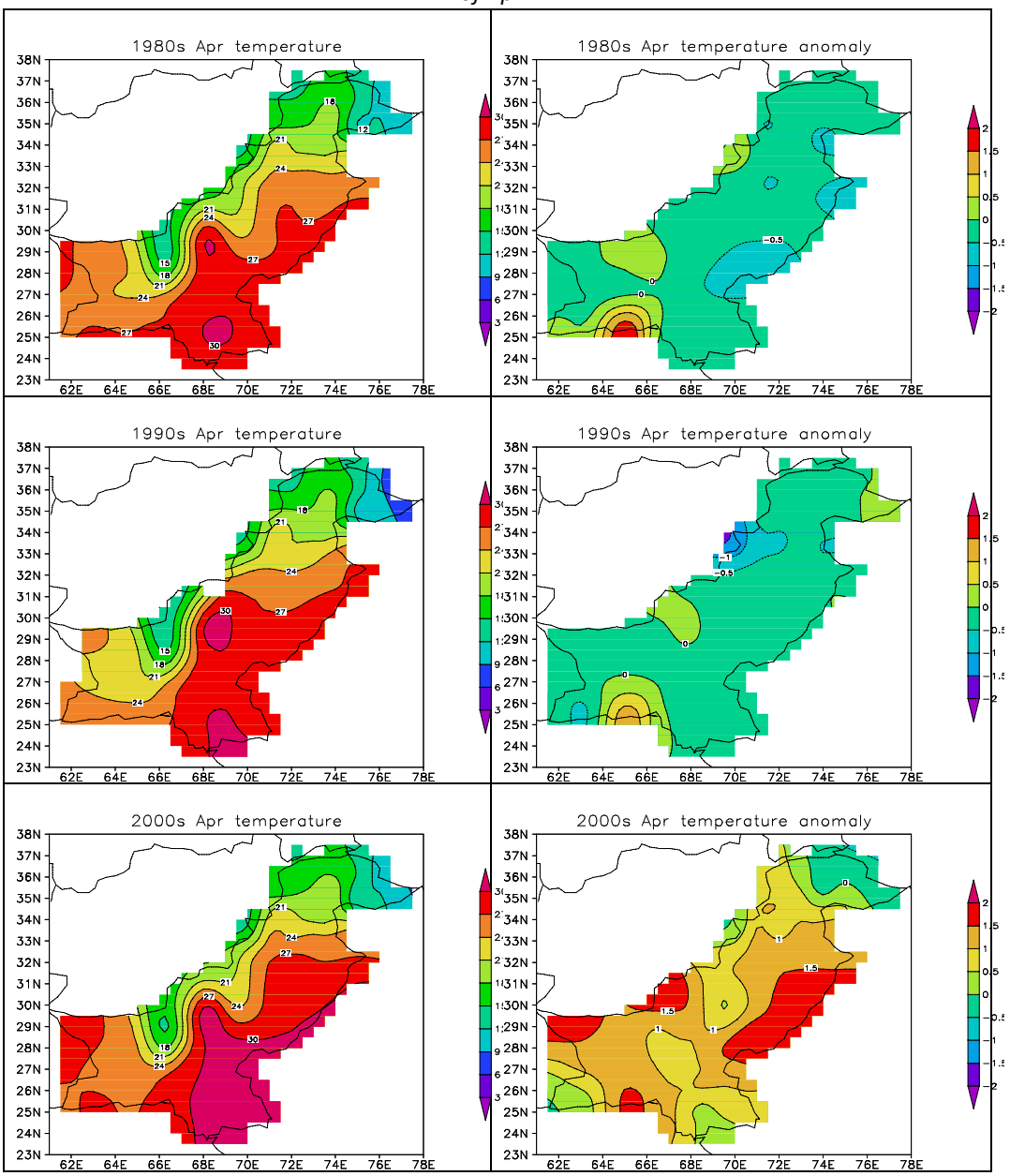


Figure 4: In April, the spatial distribution of decadal average temperature (left column) and spatial distribution of their respective decadal temperature anomalies (right column) in Pakistan over the study period.

CONCLUSION

Examination of temperature anomalies in all decades except 2000s of the study period give the impression that the temperature were not above the average temperature

except few cases .Therefore, the individual decadal temperature anomalous results for April do not strongly hold the warming doctrine in the study locus. To be kept in view April is almost a transitional month between the cool and warm seasons in Pakistan. The cooling and warming in the coastal areas of Balochistan below average and above average respectively might be the result of impact of change in sea surface temperature (SST) in Arabian Sea.

The warmest decade was 2000s in the study period where the astern Punjab and western Balochistan plus its coastal area were the warmest areas. The piedmonts and plains were above average throughout the country. The enclosed valleys all over Pakistan were also warmer. This decade was truly custodian of the global warming doctrine.

Acknowledgement

The temperature data used in this paper was obtained from PMD therefore, the authors are very grateful. Paper is part of the series where we seek out the temperature and precipitation variability in Pakistan with geographical perspective.

REFERNCES

Christensen, J.H., Hewitson, B., Busuioc., A, Chen, A., Gao, X., Held, I., Jones, R., Kolli, R.K, Kwon, W-T., Laprise, R., Magaña, R.V., Mearns, L., Menéndez, C.G., Räisänen, J., Rinke, A., Sarr, A. and Whetton, P. (2007) Regional Climate Projections. In: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L., Eds., *Climate Change* 2007: *The Physical Science Basis*. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, United Kingdom and New York, USA.

Cruz, R.V., Harasawa, H., Lal. M., Wu, S., Anokhin, Y., Punsalmaa, B., Honda, Y., Jafari, M., Li, C. and Huu, N.N. (2007) Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E., Eds., *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 469-506.

Lal, M., Harasawa, H., Murdiyarso, D., Adger, W.N., Adhikary, S., Ando, M., Anokhin, Y., Cruz, R.V., *et al.* (2001) Asia. Climate Change 2001: Impacts, Adaptation, and Vulnerability. In: McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S.., Eds., *Contribution of Working Group II to the Third Assessment Report of the Intergovernmental*

Panel on Climate Change, Cambridge University Press, Cambridge, 533-590.

Barlow, M., Cullen, H. and Lyon, B. (2002) Drought in Central and Southwest Asia: La Niña, the Warm Pool, and Indian Ocean Precipitation. *Journal of Climate*, 15, 697-700. http://dx.doi.org/10.1175/1520-0442(2002)015<0697:DICASA>2.0.CO;2

UNFCCC, Climate Change (2007) Impacts, Vulnerabilities and Adaptation in Developing Countries. http://unfccc.int/resource/docs/publications/impacts

Pachauri, RK. (2009) Regional Conference on "Climate Change: Challenges and Opportunities for South Asia", 13-14 January 2009, Islamabad.

Ahmad Iftikhar., Sun Z., Deng W., Ambreen R. 2010: Trend Analysis of January Temperature in Pakistan over the. Period of 1961-2006: Geographical Perspective. *Pakistan Journal of Meteorology*, 7(13), 11-22.

Mahrt, L. (2006) Variation of Surface Air Temperature in Complex Terrain. *Journal of Applied Meteorology and Climatology*,45, 1481-1493. http://dx.doi.org/10.1175/JAM2419.1

Hussain, S.S. and Mudasser, M. (2007) Prospects for Wheat Production under Changing Climate in Mountain Areas of Pakistan—An Econometric Analysis. *Agricultural Systems*, 94, 494-501. http://dx.doi.org/10.1016/j.agsy.2006.12.001

Rasul, G., Qin, D. and Chaudhry, Q.Z. (2008) Global Warming and Melting Glaciers along Southern Slopes of HKH Ranges. *Pakistan Journal of Meteorology*, 1, 63-76.

Buhairi, M. (2010) Analysis of Monthly, Seasonal and Annual Air Temperature Variability and Trends in Taiz City -Republic of Yemen. *Journal of Environmental Protection*, 1, 401-409. http://dx.doi.org/10.4236/jep.2010.14046.

Nordhaus, W.D. (2007) A Review of the "Stern Review on the Economics of Climate Change". *Journal of Economic Literature*, 45, 686-702. http://dx.doi.org/10.1257/jel.45.3.686

Ahmad, I., Ambreen, R., Sultan, S., Sun, Z. and Nawaz, M. (2014) Regional Characteristics of Temperature Anomalies in Pakistan with Emphasis on Spatial Distribution at Decadal Scale: A Case Study of August (1950s-2000s). *Atmospheric and Climate Sciences*, 4, 721-726. doi: 10.4236/acs.2014.44065.

Romana Ambreen, Iftikhar Ahmad, Shahzad Sultan, Sun Zhaobo, Muhammad Nawaz, 2014. A study of Decadal December Temperature Variability in Pakistan, American Journal of Climate Change (AJCC), 3, 429-437.