

Variation in Meteorological Parameters Over Pakistan during April 2014

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Abstract: In this study we investigated the meteorological data comprising temperature, dew point, humidity and mean sea level for four major cities of Pakistan (Karachi, Multan, Lahore and Peshawar) on varying latitudes from 25°N to 34°N. These cities are selected to study the variation of coastal, southern, central and northern parts of Pakistan and different variations are observed in ranges i.e difference between lowest and highest values. A clear variation in ranges of meteorological parameters are investigated for these cities to validate this research. This variation in meteorological parameters is because of climate change due to flow of high moisture laden winds from Arabian sea towards Karachi coast in the south. The results obtained regarding dew point temperature, moisture content and atmospheric pressure in the southern city of Karachi represent low values instead of high. As a result, Karachi has different climatic patterns as a coastal city than other areas which are continental in climatic effects.

Keywords: Meteorological, climate, moisture, dew point, continental.

INTRODUCTION

Climate of Pakistan is classified into different zones such as arid, semi-arid, sub-humid and humid on a broad scale from a drier to wetter. Pakistan is an agricultural country and heavy rains have put the country's agriculture to a great risk [1]. Its economy largely depends on agriculture and therefore it is highly climate sensitive. The country experiences seasonal monsoon rains and hence is highly vulnerable to floods. As a result of global warming, Pakistan is also undergoing climate change. The major area of Pakistan is arid and semi arid having a vast spatial temperature variation [2]. The economic life of Pakistan mainly depends on the flow of River Indus [3] shows that summer runoff in the Kunhar river significantly correlates with the preceding winter snowpack. Climatic variability and change has a major effect on rural areas both at a local and regional scale [3]. Thorough station histories must be inspected prior to establish Meteorological characteristics normally important in the study of climate [4]. Main factors of the urban climate are air temperature and humidity that links with human comfort and discomfort index and are regarded as vital components of a comfortable environment [5].

In Pakistan the hydrological inflows and outflows over the dams and at selected points in the rivers is dependent upon precipitation and snow and ice melt in the Northern Pakistan. The excess in flows which are because of heavy rainfall and snow melt in the upper

catchments of the rivers lead to flooding in Punjab and Sindh resulting in destruction of the standing crops. [6].

A study is conducted to investigate spatial and temporal variation of meteorological parameters in April 2014 over Pakistan using daily weather history and observations. Climatic parameters Temperature °C, Dew Point °C, Humidity % Sea Level Pressure hPa data 2014 were taken for Karachi, Multan, Lahore and Peshawar. Previous large climatic observations over North-West India cover the present Pakistan area. The rainfall distribution patterns relates to environmental variation [7].

Extensive number of studies reveal the elements of global sea level change by examining altimeter records. As for the area, mean sea level is a generally stable surface worth; however, it changes sporadically in the time and space [8]. Surface air temperature is a key aspect of several environmental processes and hence it is important to many research areas e.g. hydrology [9]. The monsoon is a macro-scale process and its absorbing features of the climate attract the meteorologists, oceanographers and geographers. Moreover, correct forecast of the monsoon is particularly important as far the socio-economical factor concerns [10].

Mean relative humidity is almost always lower in cities, and as relative humidity is a function of temperature, its values reach their greater contrast between urban and non-urban surfaces at night and in the winter when the heat-island effect is strongest [11]. Many studies are conducted in recent decades on various climatic trends in particular for precipitation and temperature. Relative humidity relates to

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temperature and absolute water vapor concentration. Dew point temperature has usually been the most frequently used humidity measure. If there is a change in dew point temperature, it will result in a corresponding variation in relative humidity [12]. A study of the modern synoptic climatology delivers an outline to understand the hierarchy of climatic controls that operate at various spatial scales [13].

The total amount of precipitation provides only partial information, which is insufficient to correctly assess local conditions of humidity. Changes in extremes can differ significantly even in neighboring territories as a result of local factors, topography, distance from the sea, etc. [14].

MATERIALS AND METHODS

Meteorological data comprising temperature, dew point, humidity and mean sea level is taken and

analyzed for four major cities of Pakistan (Karachi, Multan, Lahore and Peshawar). These cities are selected to study the variation of coastal, southern, central, and northern parts of Pakistan and following variations are observed in ranges i.e difference between lowest and highest values. Graphs are plotted against meteorological parameters for the four major mentioned cities of Pakistan. On the basis of the plotted graphs general trend is analyzed.

RESULTS AND DISCUSSION

In this research we have analyzed the maximum, minimum and average temperature graphs of four cities of Pakistan, Karachi, Multan, Lahore and Peshawar. For Karachi the graph shows a sharp increase in high temperature onwards April 25, 2014 till April 28, 2014 by 8°C. It is due to the clear weather. Also there is a sharp decrease in temperature from April 07, 2014 till

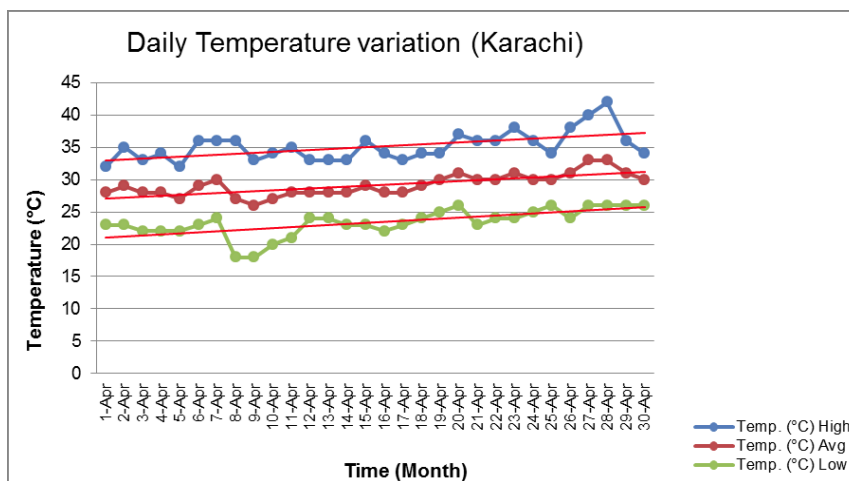


Figure 1: Daily Temperature variation of Karachi during the month of April 2014.

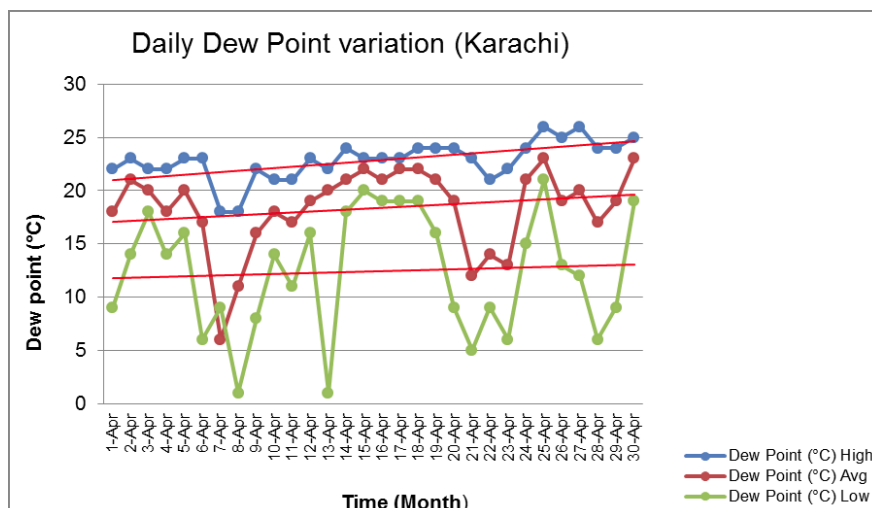


Figure 2: Daily Dew point variation of Karachi during the month of April 2014.

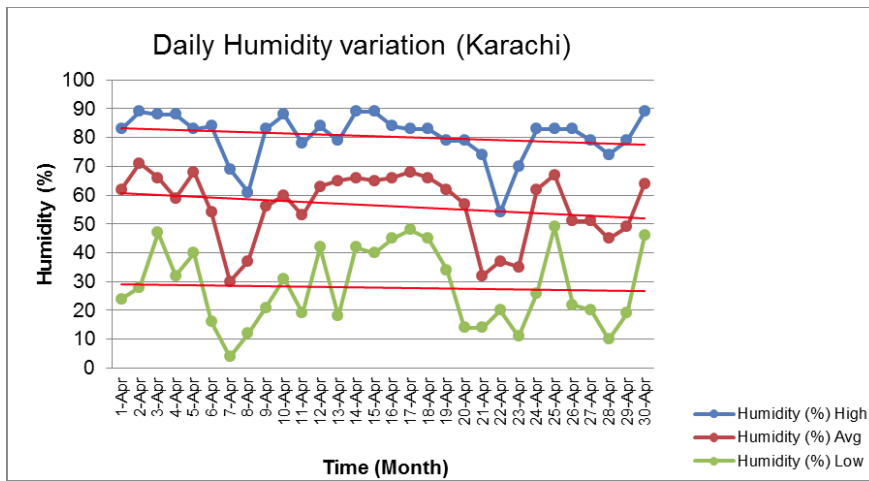


Figure 3: Daily Humidity variation of Karachi during the month of April 2014.

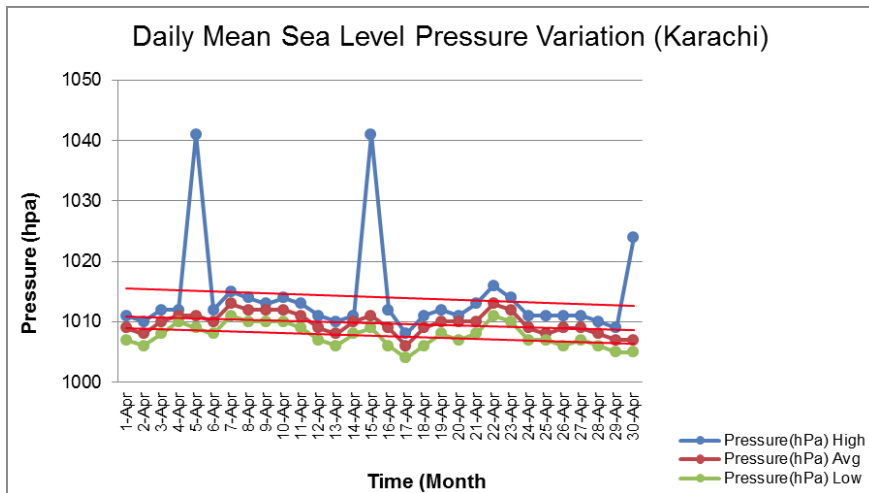


Figure 4: Daily Mean Sea Level Pressure variation of Karachi during the month of April 2014.

April 08, 2014 by 6°C. It is due to low humidity and winds as shown in Figure 1. The dew point graph shows a sharp increase in low dew point temperature from April 23, 2014 till April 25, 2014 by 15°C. It is due to fall in temperature and increase in humidity. The graph also shows two sharp increases first from April 06, 2014 till April 07, 2014, high and then from April 12, 2014 till April 13, 2014, low by 11°C and 12°C respectively due to fall in temperature and increase in humidity as shown in Figure 2. There is sharp decrease in average and low humidity from April 05, 2014 till April 07, 2014 by 38% due to increase in temperature as shown in Figure 3. Two sharp increases in mean sea level pressure by 30 hpa are also observed from April 04, 2014 till April 05, 2014 (due to decrease in temperature) and April 14, 2014 till April 15, 2014 due to high humidity as shown in Figure 4.

The maximum increase in temperature, high of Lahore is by 10°C and 12°C from April 07, 2014 till

April 12, 2014 due to clear weather after rain and from April 17, 2014 till April 26, 2014 respectively as shown in Figure 5. The dew point temperature graphs also show an increasing trend and the maximum increase is in high dew point temperature by 7°C from April 20, 2014 till April 23, 2014 due to clear weather as shown in Figure 6. The humidity curves indicate a decreasing trend in humidity during April 2014. The maximum decrease in humidity (low) is from April 06, 2014 till April 10, 2014 by 25% (due to increase in temperature). Also there is an increase in humidity from April 16, 2014 till April 18, 2014 and the maximum increase is by 33% due to rain as shown in Figure 7. The high, average and low mean sea level pressure graphs show sharp decrease from April 14, 2014 till April 17, 2014 by 5 hpa (due to increase in temperature). Mean sea level pressure shows an increase (high, average, low) from April 22, 2014 till April 24, 2014 by 6 hpa due to increase in temperature as shown in Figure 8.

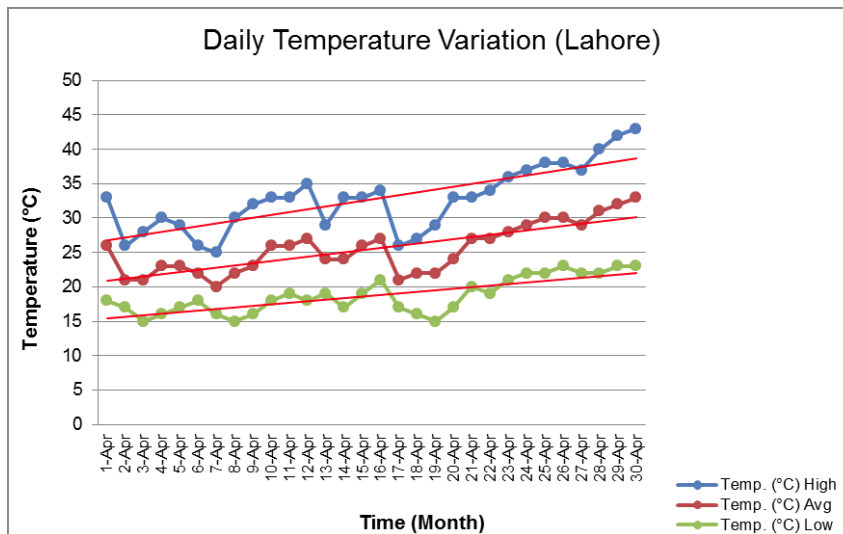


Figure 5: Daily Temperature variation of Lahore during the month of April 2014.

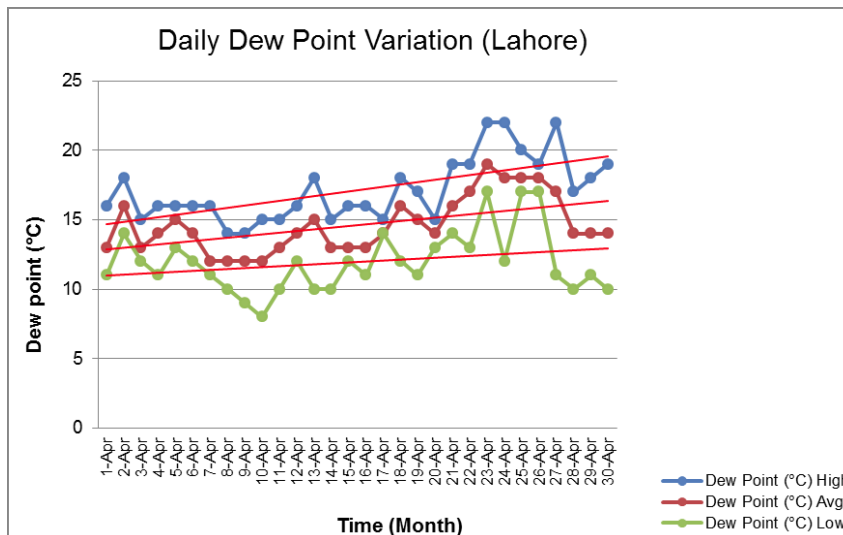


Figure 6: Daily Dew Point variation of Lahore during the month of April 2014.

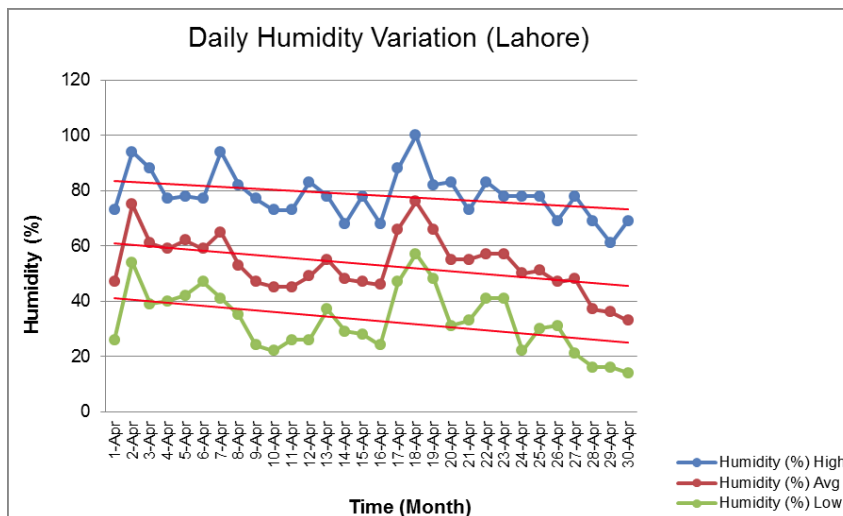


Figure 7: Daily Humidity variation of Lahore during the month of April 2014.

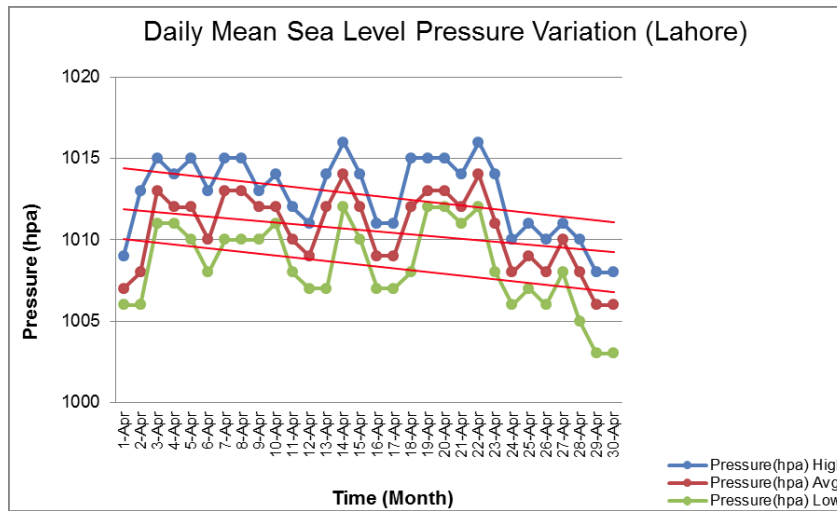


Figure 8: Daily Mean Sea Level variation of Lahore during the month of April 2014.

In Multan the maximum increase in temperature (high) is by 9°C and 10°C from April 06, 2014 till April 12, 2014 (due to clear weather) and from April 21, 2014 till April 24, 2014 due to clear weather after rain as shown in Figure 9 while the dew point temperature graphs also show a decreased trend from April 06, 2014 till April 10, 2014 due to decrease in humidity and the maximum decrease in dew point temperature by 9°C as shown in Figure 10. The humidity curves indicate a decreasing trend in humidity during April 2014. The maximum decrease in humidity (average) is from April 06, 2014 till April 11, 2014 by 35% due to increase in temperature as shown in Figure 11. Here also all of the mean sea level pressure curves indicate a decreasing trend in mean sea level pressure during April 2014. The graph indicates two dips from April 14, 2014 till April 17, 2014 and from April 22, 2014 till April 24, 2014 by 6hpa and 8hpa respectively as shown in Figure 12.

For Peshawar, all the three temperature graphs (high, average, low) show an increased trend in temperature. The maximum increase in temperature (high) is by 11°C and 10°C from April 06, 2014 till April 11, 2014 and from April 18, 2014 till April 22, 2014. It's due to clear weather after rain as shown in Figure 13. The dew point temperature indicates two sharp dips in the graph from April 06, 2014 till April 09, 2014 (due to decrease in humidity) and from April 18, 2014 till April 19, 2014 by 09°C and 11°C respectively due to increase in temperature as shown in Figure 14. Finally the humidity curves indicate a decreasing trend in humidity during April 2014. There are few sharp dips in the graphs but the maximum decrease in humidity is 54% (low) from April 06, 2014 till April 09, 2014 due to increase in temperature as shown in Figure 15. Here high mean sea level pressure curves indicate an increasing trend while mean sea level pressure of average and low is almost constant during April 2014.

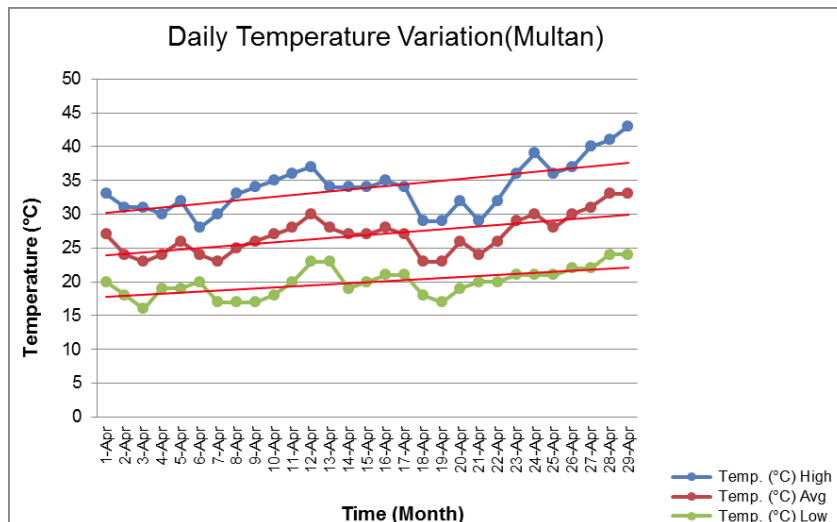


Figure 9: Daily Temperature variation of Multan during the month of April 2014.

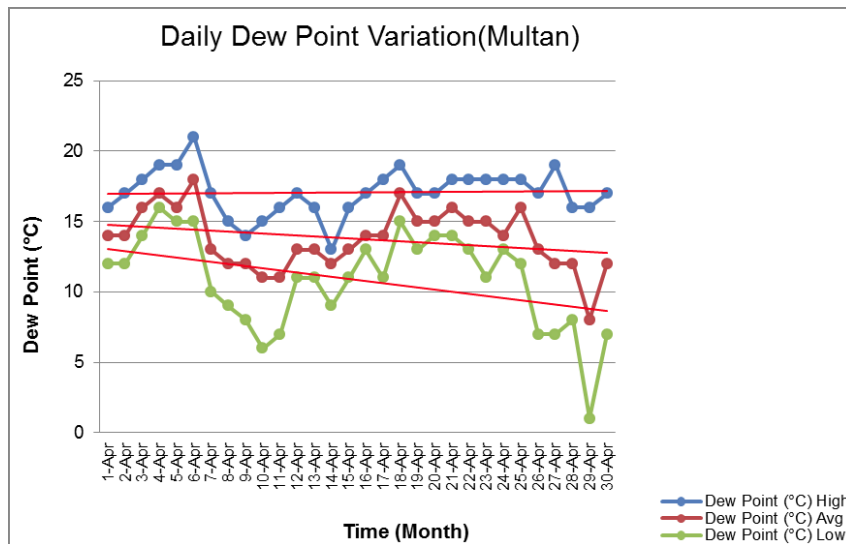


Figure 10: Daily Dew Point Temperature variation of Multan during the month of April 2014.

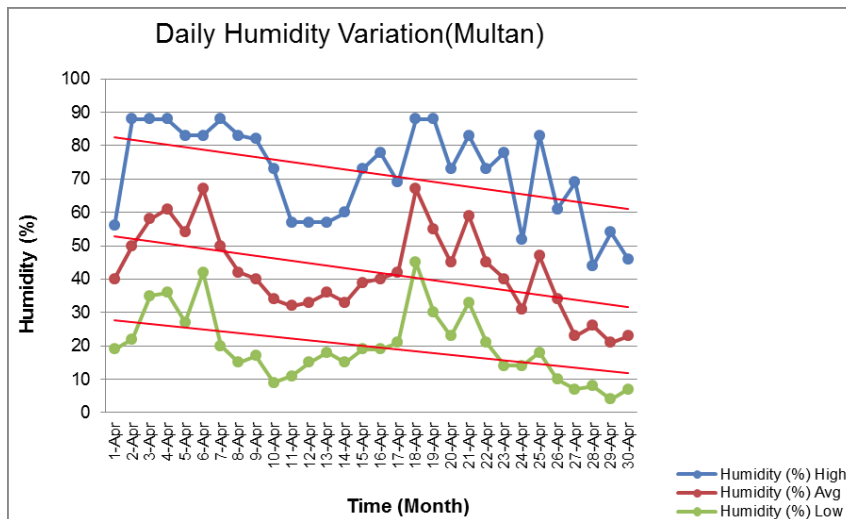


Figure 11: Daily Humidity variation of Multan during the month of April 2014.

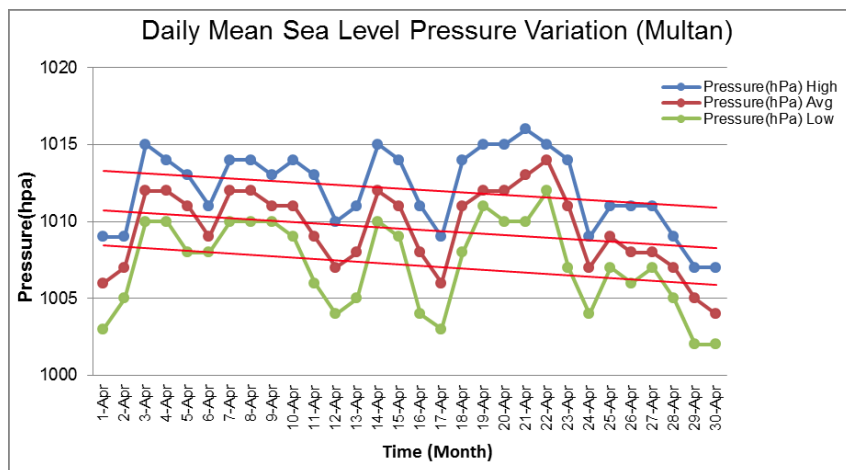


Figure 12: Daily Mean Sea Level Pressure variation of Multan during the month of April 2014.

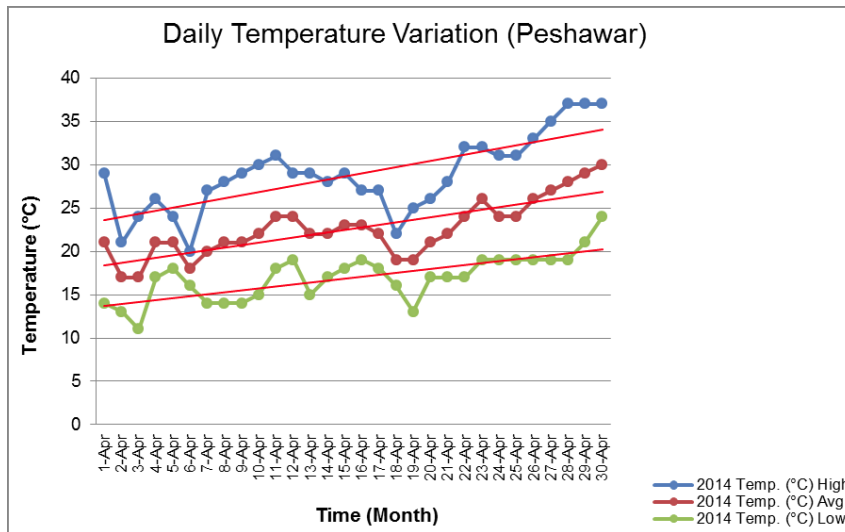


Figure 13: Daily Temperature variation of Peshawar during the month of April 2014.

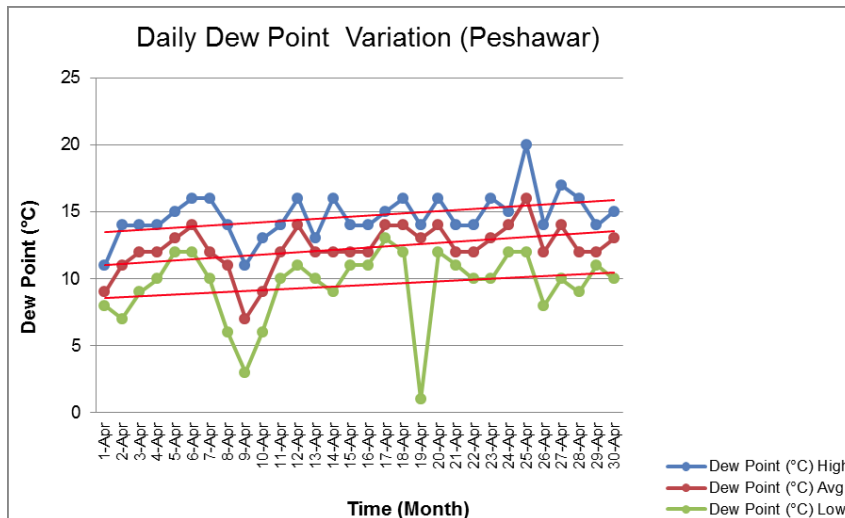


Figure 14: Daily Dew Point variation of Peshawar during the month of April 2014.

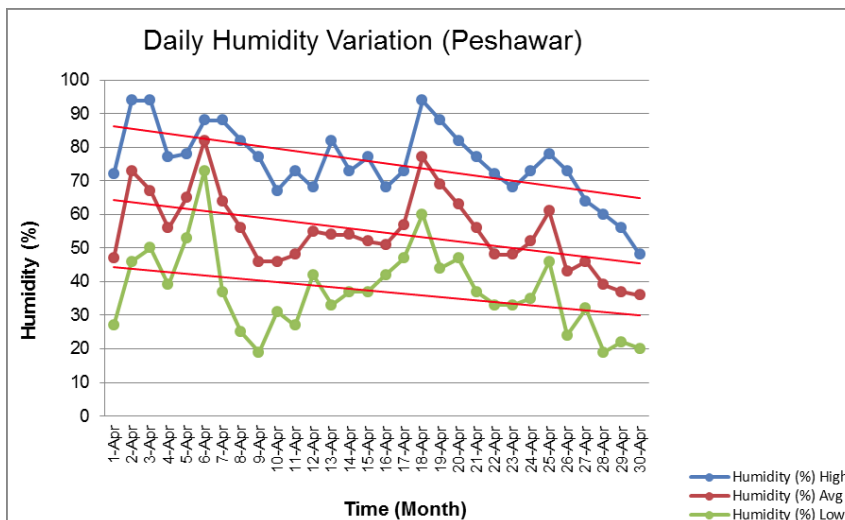


Figure 15: Daily Humidity variation of Peshawar during the month of April 2014.

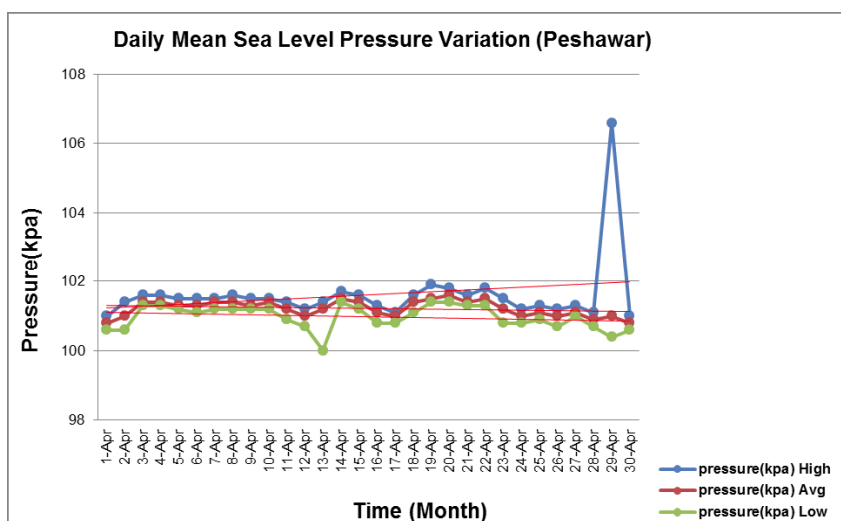


Figure 16: Daily Mean Sea Level Pressure variation of Peshawar during the month of April 2014.

A sharp increase and decrease in mean sea level pressure (high) is observed from April 28, 2014 till April 29, 2014 (due to decrease in dew point) and April 29, 2014 till April 30, 2014 by 55 hpa and 56 hpa (due to increase in dew point) respectively as shown in Figure 16.

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