Warsaw University of Technology

FACULTY OF BUILDING SERVICES,
HYDRO AND ENVIRONMENTAL ENGINEERING

Applied Climatology

The report of Climatological analysis

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Environmental Engineering

Applied Climatology

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TABLE OF CONTENTS

LAB1

1. Explore "monthly climate data" - plot the time series for parameter you wish (different than Tmean or Precipitation):

Firstly, TAISHAN station is selected and use minimum temperature as the parameter: the following graph can be obtained (in figure 1).

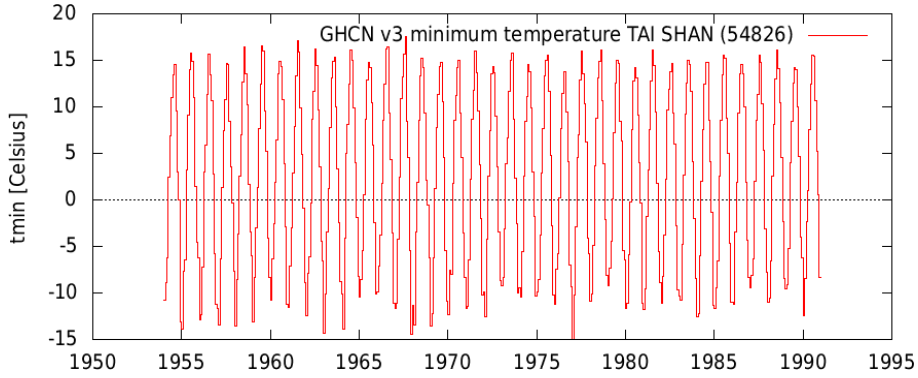

Figure 1 GHCN v3 minimum temperature TAISHAN

What's more, the anomalies can be obtained which showed in the figure 2.

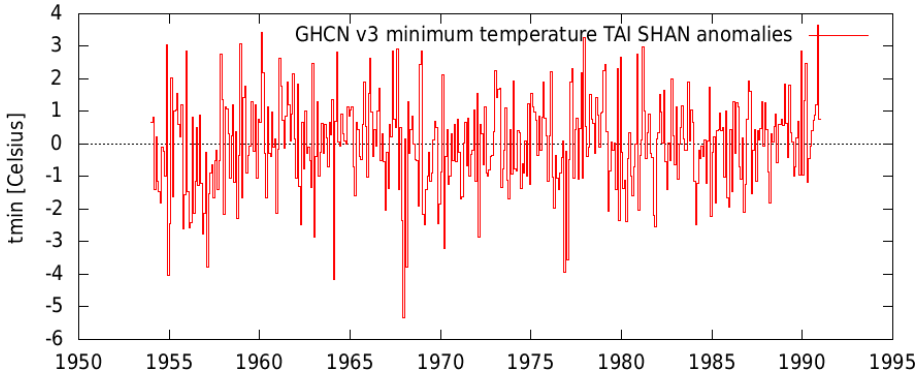

Figure 2 GHCN v3 minimum temperature TAISHAN anomalies

For the annual cycle, computed with all data available, following figures are shown:

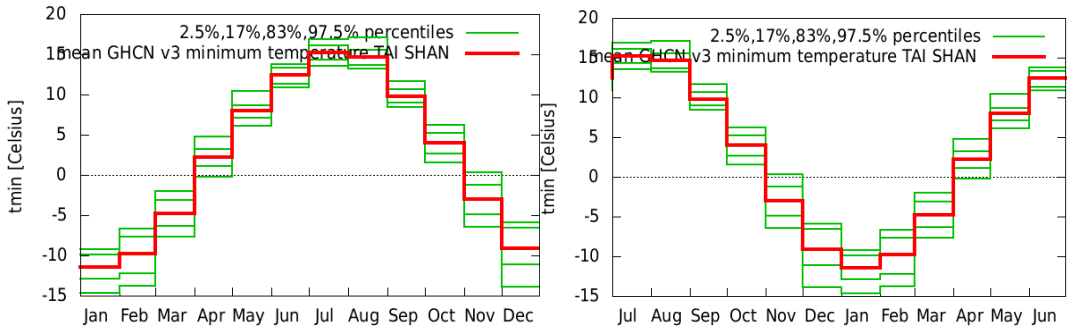

Figure 3 annual cycle for the minimum temperature

However, the shorter time series should be selected, so 10 years was chosen for analyzing. The plots are shown below:

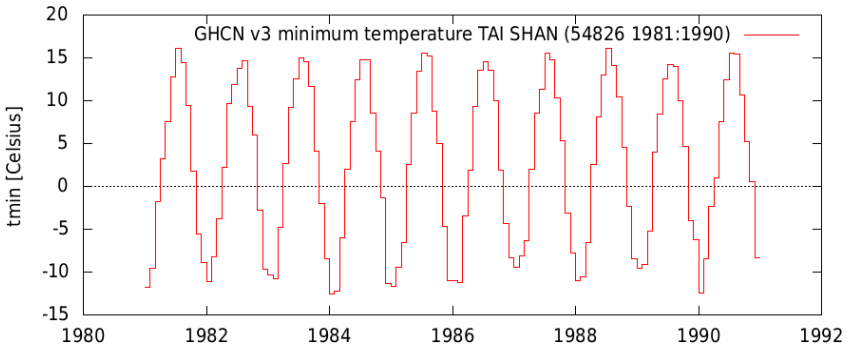

Figure 4 GHCN v3 minimum temperature TAISHAN from 1981 to 1990

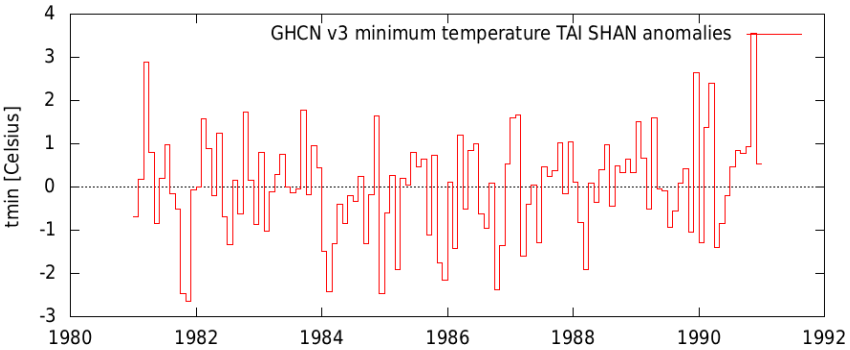

Figure 5 GHCN v3 minimum temperature TAISHAN anomalies from 1981-1990

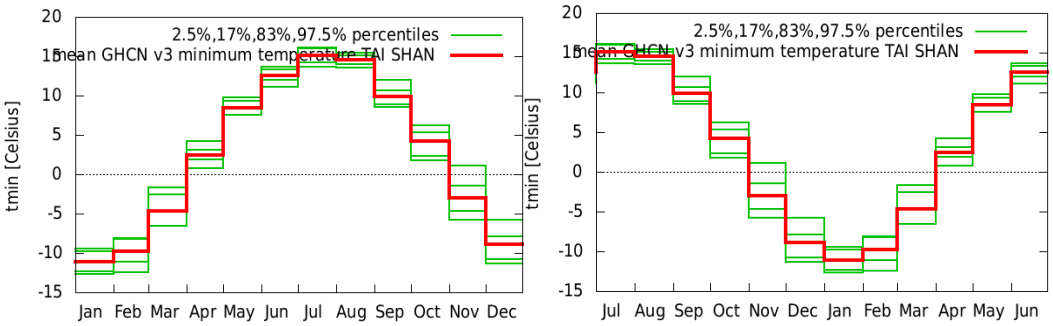

Figure 6 annual cycle for the minimum temperature from 1981-1990

In order to calculate the monthly standard deviation, 31 months values are used, the following figures can get from the website.

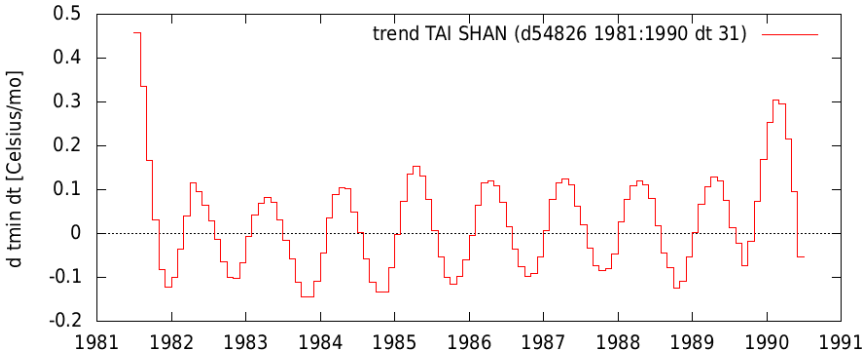

Figure 7 TAISHAN monthly minimum temperature deviation from 1981-1990

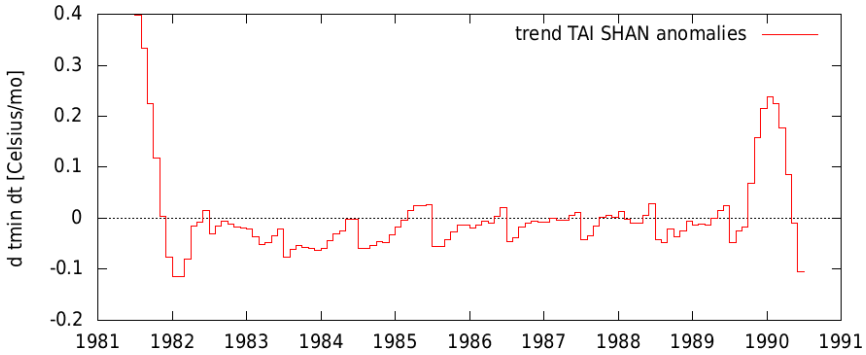

Figure 8 Figure 7 TAISHAN monthly minimum temperature deviation anomalies from 1981-1990

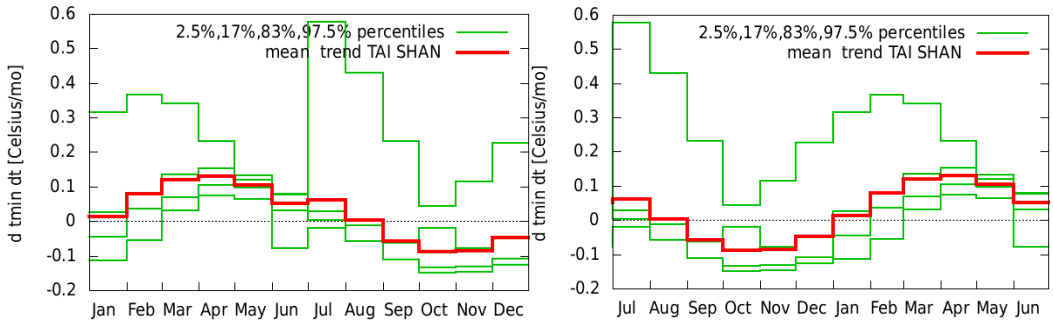

Figure 9 Figure 7 TAISHAN monthly minimum temperature deviation in annual cycle

2. Explore "Select a field"

Firstly, ERA interim is selected and the parameters are temperature and surface. Then the different parameters are put in the following window, the area is near the TAISHAN station:

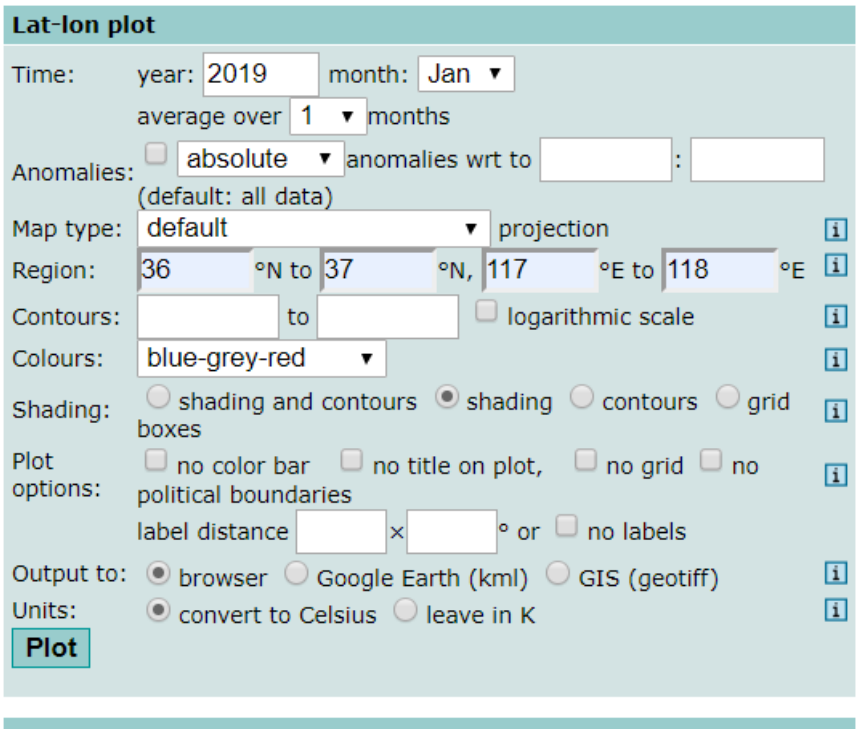

Figure 10 Parameters put for the graph

After all the parameter put, the figure can be plot which is in the figure 11:

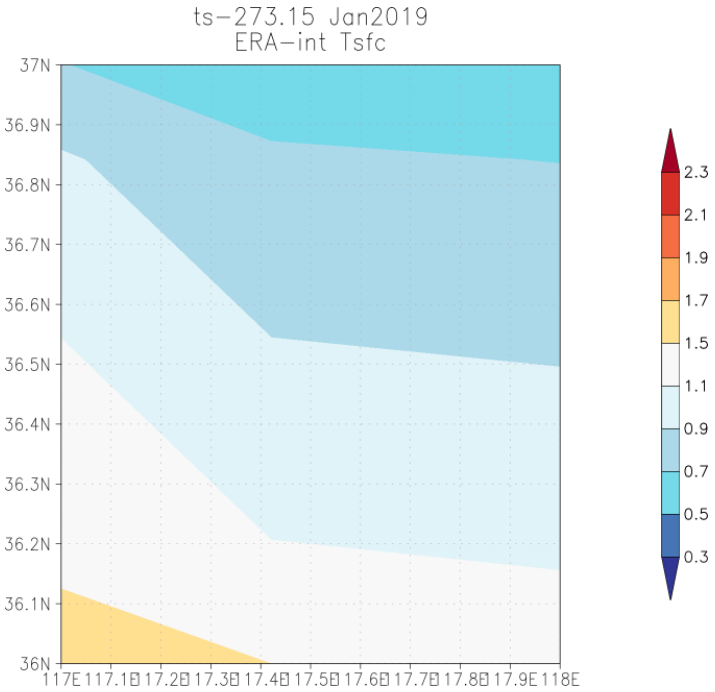

Figure 11 The temperature and surface graph near TAISHAN station in Jan. 2019

ERA-Interim：

ERA-Interim is a global reanalysis data set produced by the European Centre for Medium-Range Weather Forecasts (ECMWF) with a horizontal resolution of approximately 80km x 80km (T255). In degrees (on a regular longitude-latitude grid) this is round about 360 / 255 / 2 =0.7058 degrees, wherefore my demo request uses a 0.75/0.75 degree grid. Retrievals with a higher spatial resolution do not make sense, especially as the true resolution (the resolution of the information content) is 5-10 times rougher than the actual resolution (according to ECMWF).

ECMWF:

The European Centre for Medium-Range Weather Forecasts (ECMWF) is an independent intergovernmental organization supported by most of the nations of Europe and is based at Shinfield Park, Reading, United Kingdom. It operates one of the largest supercomputer complexes in Europe and the world's largest archive of numerical weather prediction data.

NCEP:

The United States National Centers for Environmental Prediction (NCEP) delivers national and global weather, water, climate and space weather guidance, forecasts, warnings and analyses to its Partners and External User Communities. These products and services are based on a service-science legacy and respond to user needs to protect life and property, enhance that nation's economy and support the nation's growing need for environmental information. The centers form part of the National Weather Service.

Global Historical Climatology Network:

The Global Historical Climatology Network (GHCN) is an integrated database of climate summaries from land surface stations across the globe that have been subjected to a common suite of quality assurance reviews. The data are obtained from more than 20 sources. Some data are more than 175 years old while others are less than an hour old.

European Climate Assessment & Dataset:

The European Climate Assessment and Dataset (ECA&D) is a database of daily meteorological station observations across Europe and is gradually being extended to countries in the Middle East and North Africa. ECA&D has attained the status of Regional Climate Centre for high-resolution observation data in World Meteorological Organization Region VI (Europe and the Middle East)].

LAB3

1.Introduction

Purpose:

To present analysis of the variability of the temperature and precipitation during a 20-year period in selected location.

2. basic information concerning XXX station

548260 99999 TAI SHAN CH +36.250 +117.100
+1536.0 19560820 20200109

Latitude

+36.250

Longitude

+117.100

Altitude

+1536.0

Station name (station code)

TAI SHAN (548260 99999)

Station country

China

Station location on Goggle map

3. Source of the data and method of processing

Data were obtained from GSOD database (https://www7.ncdc.noaa.gov/CDO/cdodata.cmd) and processes using R language

4. Make and describe climatograph for your statin

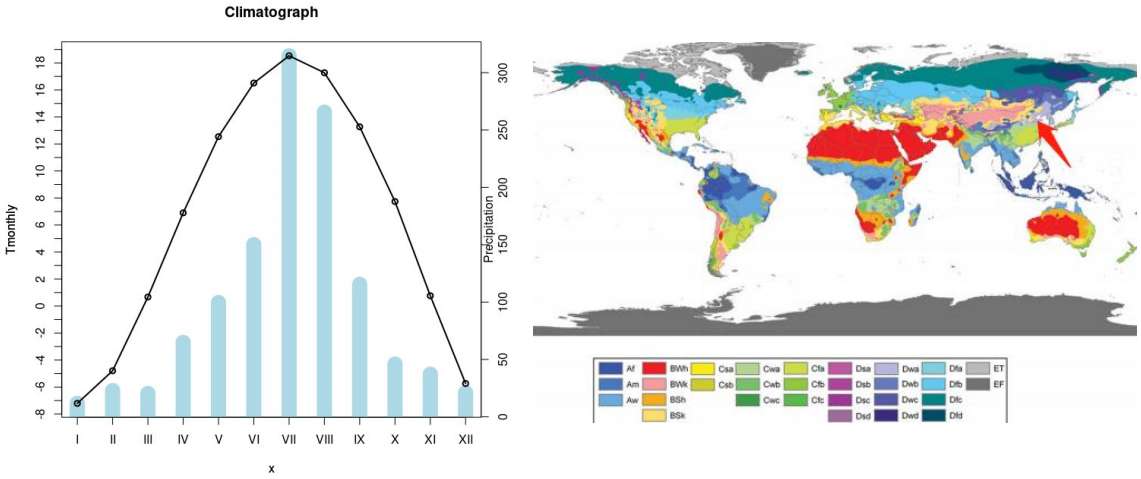

Figure 12 Climatographic of Taishan station(left), koppen scheme(right)

From the figure 1, the average monthly temperatures of the hottest months are always higher than 10 degrees, the average monthly temperatures of the coldest months are always lower than 0 degree as well. Due to this, the climate type in the Taishan station is the D type, according to the Köppen's climatic types.

Next, to figure out the subtype of Taishan station, the precipitation needs to be taken into account. From the figure, it is obvious that January is the driest month, the precipitation is around 20 mm while the most humid month is July, the precipitation is about 300 mm. So, it's not hard to see that this is W type "winter dry season". To the third scale, according to its own characteristics, the high temperature difference between winter and summer, we can finally distinguish its **type as Dwa, which is winter dry season and hot summer.**

Compare to the Koppen Scheme, Taishan station (marked with the red arrow) is in line with the climate of that area.

5. Undertake analysis for the temperature

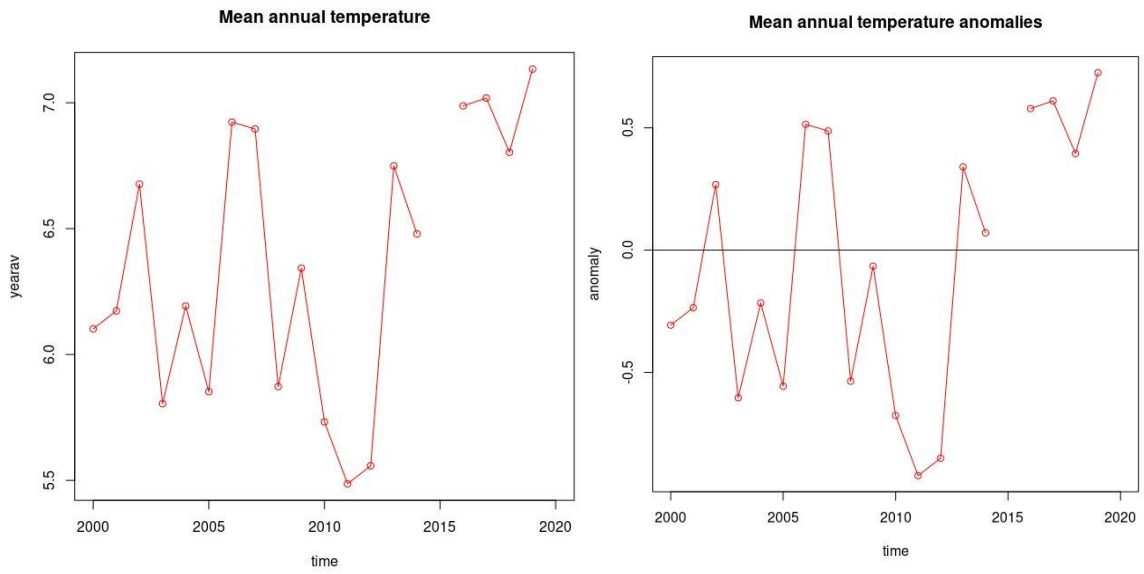

Figure 13,14 The mean annual temperature (left) and anomalies (right) in Taishan

5.1 Mean annual temperature

From the figure above, we can see the annual temperature of Taishan from the period 2000 to 2019, the temperature is not stable and has fluctuate greatly, the difference between the highest average temperature and the lowest average temperature can reach about 1.8 degrees Celsius, the median is about 6.5 degrees Celsius

Even if several sets of data are missing in this graph, we can still conclude that the average temperature of this place has gradually increased over the 20 years since 2000 (except for a cold wave in 2012), especially in recent 2019, it even hit a record high.

Data fluctuates greatly

In my opinion, there are two periods that have data fluctuates greatly. The first stage is that the temperature in 2015 and 2016 is abnormally higher than the years before and after, and the other stage is 2013 to 2014. In 2014, the temperature jumped by 1.3 degrees from 2013, which is the highest difference over these 20 years.

5.2 Temperature extremes

Excluding the missing data for 2015, from 2000 to 2019, the lowest annual temperature is in 2011, which is 5.4 degrees Celsius, and the highest value is the latest 2019, which reached 7.2 degrees Celsius.

The low temperature in 2011 can be interpreted as the cold wave effect in some parts of China, and the annual average temperature has generally risen year after year, consistent with the worldwide temperature rise in recent 10 years.

5.3 Does „extreme temperature days" impact the anomalies in annual mean?

Yes, in the figure 2 and 3, the graph trends of these both figures are quite similar with each other. However, with the bigger amplitude of the annual temperature change, the bigger

anomalies show in the figure 3. As it is known, the annual temperature is highly related with related with the average daily temperature. What's more, the extreme temperature days will affect the annual temperature strongly.

6. Undertake analysis for precipitation

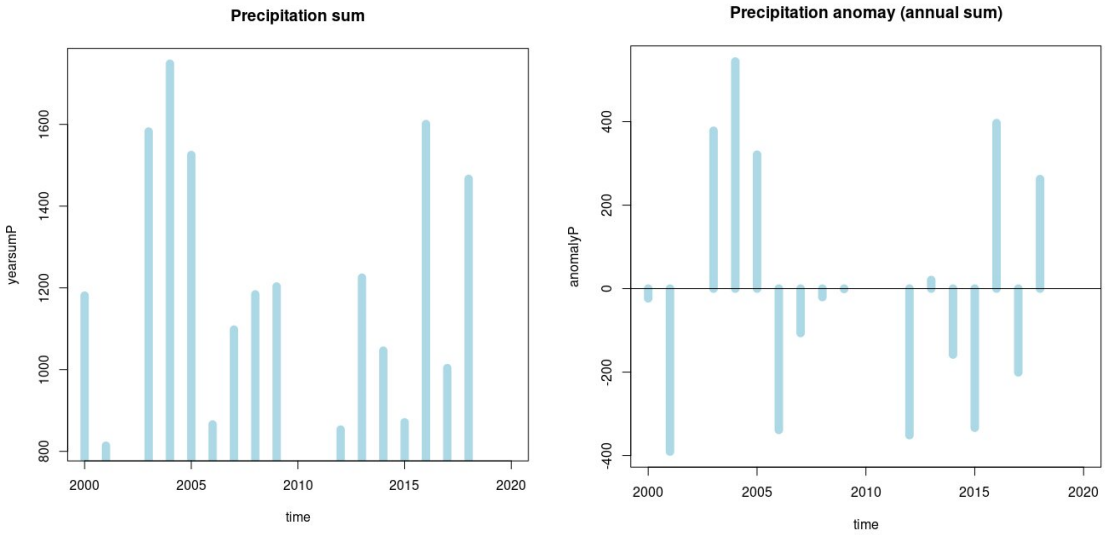

Figure 14,16 Precipitation sum (left) and anomy (annual sum) (right) in Taishan station

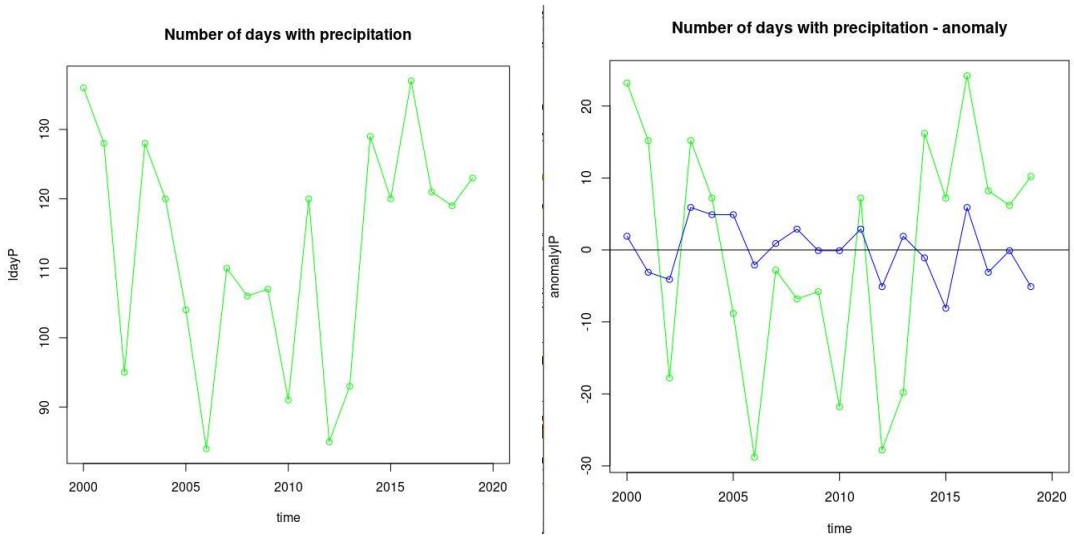

Figure 15 Precipitation days in 20 years in TAISHAN station (left)
Figure 16 Precipitation days with anomaly in TAISHAN station (right)

6.1 annual sum variability

From fig.17, we can conclude that, since the year 2000 to 2019, The annual rainfall data has some fluctuations. The average annual rainfall is about 110mm, this data is consistent with the local climate characteristics. From the data of the past 20 years, there is no obvious regular change in its annual average. It is worth noting that in the three years from 2003 to 2005, the annual rainfall anomaly was relatively high, and at the same time, the average temperature in these three years was much lower.

6.2 extremes

Compared with the overall average, there are two rainfall years with a bias exceeding 20mm and three in the lower years. The highest value occurred in 2016, which exceeded the average by nearly 28cm, and the lowest value occurred in 2006, which was nearly 28mm lower than the average, and the difference between the two extreme values was nearly 55mm. It is worth noting that after 2014, the average annual rainfall in the area was above the average.

6.3 Does “extreme precipitation days” impact the anomalies in annual sum?

Yes, Because the extreme value of a period of time is usually larger than the normal value, resulting in a large deviation of the average value

It is worth noting that after 2014, the average annual rainfall in the area was above the average

7. Number of hot days and cold days

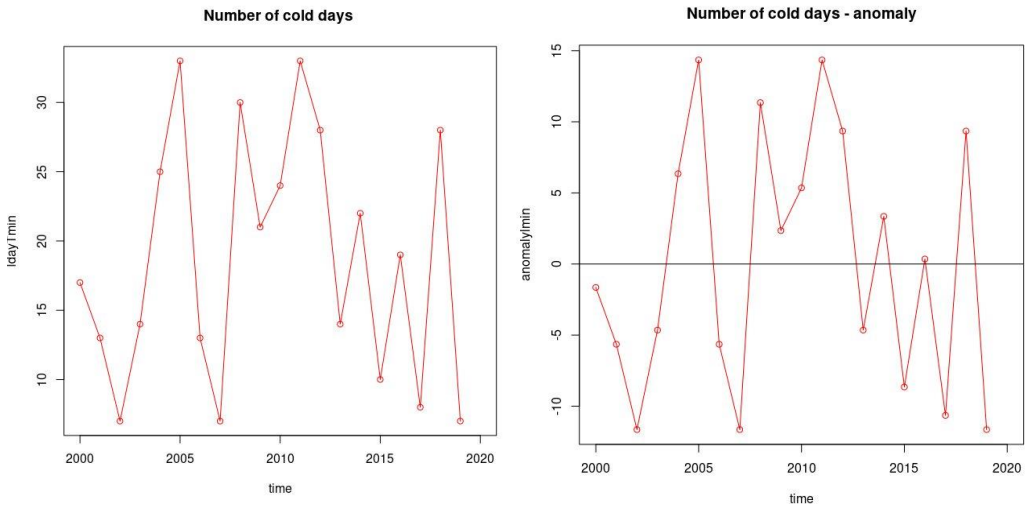

Figure 17 Number of cold days in TAISHAN station

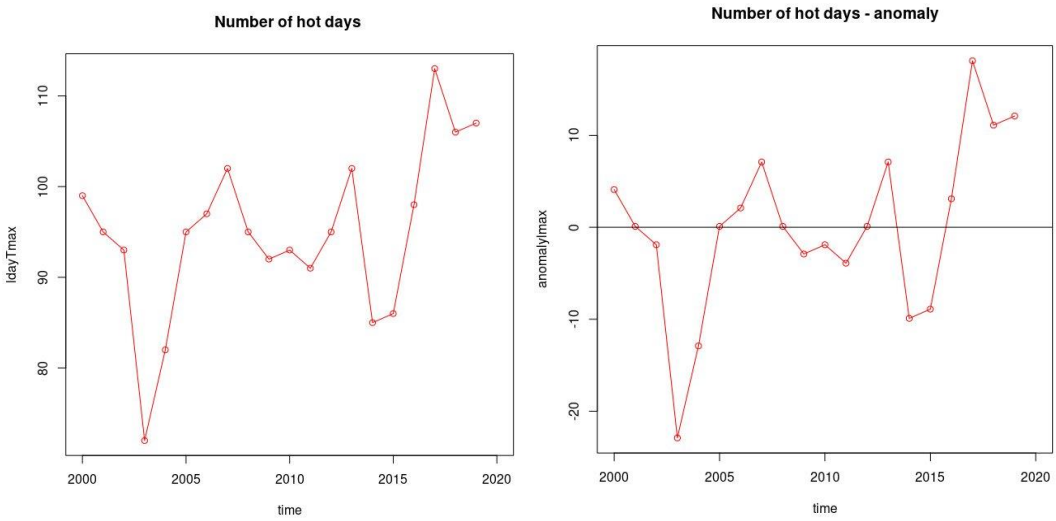

Figure 18 Number of hot days in TAISHAN station

We can see from fig.9 that the years with colder days in the 20 years are probably in a reasonable range, the fluctuation range is not very large, and the difference from the average cold days is within 15 days.

Compared with the number of cold days, the fluctuation range of the hot days is relatively larger, and the largest range can differ by 40 days. Among them, the hot days in 2003 are the least and the hot days in 2017 are the most. The hot days in 2003 were only nearly 70 days, which was about 25 days lower than the average. It is worth noting that the years with more hot days are the last three years.

8. Temperature frequency in 20 years

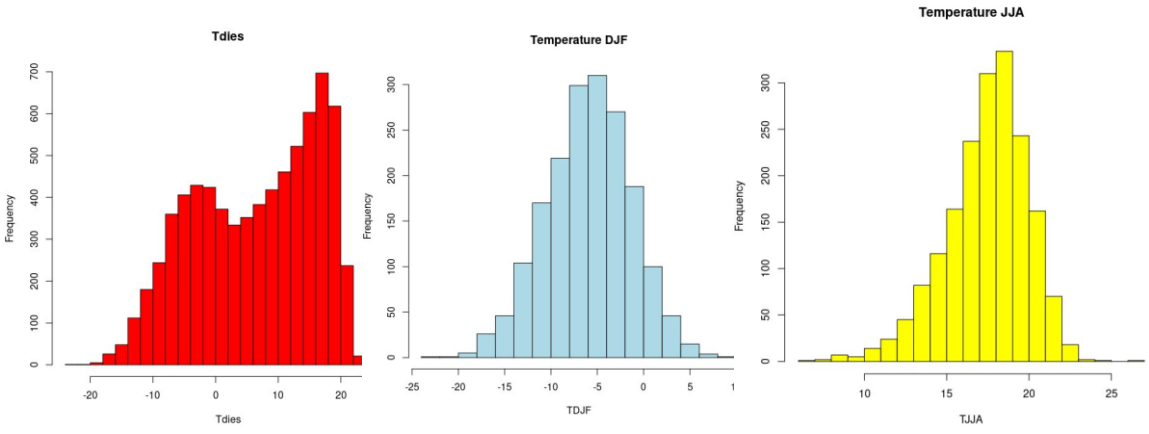

Figure 19 Different temperature frequency in 20 years (left1)

Figure 20 Temperature frequency in Dec. Jan. Feb. Jun. Jul. Aug (left 2,3)

10. Summarize

10.1 Is the temperature variable in terms of year-to-year changes and seasonal variation?

Yes. On the whole, the seasonal changes in temperature are obvious. The cold winter temperature is low, and the hot summer temperature is high. The temperature also fluctuates with the year, but it has not changed much, what's more, the temperature has risen overall in the past 5 years, all higher than the 20-year average value.

10.2 Is there any trend (decreasing / increasing) in the temperature during analyzed period?

During the analyzed period from 2000 to 2019, the annual temperature keeps changing all the time, sometimes it increases and sometimes it decreases. However, overall, the annual temperature in Taishan station is increasing gradually.

10.3 How about temperature extremes

The number of temperature extremes will affect the average temperature and anomalous value of the year. Generally speaking, the number of extreme temperature days each year fluctuates, but it can be concluded from Figure 20 that since 2015, extreme hot weather is significantly higher than in the past 20 years. And there is an increasing trend.

10.4 Is there any long-term trend in the precipitation pattern

From the figure 3, the analyzation of the year sum precipitation in Taishan station can be done. In this figure, it indicated that the precipitation of Taisha station is quite unstable. The precipitations of some years like 2001, 2002, 2006 and 2015 is so less. But compared with the other years the precipitation is so high. It about one time higher than the low precipitation years. In the long term, the year sum precipitation is changing. The difference between highest one and lowest one is smaller.

The overall trend of Mount Tai in the past 20 years according to Figure 17 can be summarized as large local fluctuations. However, since 2014, the overall rainfall has risen higher than the average annual rainfall value, and the fluctuation range is not large. On this basis, It can be predicted that in the next few years, the area will still maintain high rainfall.

10.5 Is annual precipitation sum high?

From the figure 3 and compared with other region, the annual precipitation sum in Taishan station is relatively high. However, for some specific years, the precipitation is not so high. And its precipitation matches the climate type of the region.

10.6 What is major factors influencing temperature and precipitation pattern in your location?

Firstly, its dimension determines its climate, secondly, the atmospheric circulation will also affect its seasonal temperature, and secondly its sea and land location, because Taishan is inland and is greatly affected by land, so its temperature difference is large; Altitude also

affects its temperature. The higher the altitude, the lower the temperature, because it is one of the highest mountains in China. It is higher in altitude and therefore lower in temperature than other regions of the same latitude.
Rainfall is mostly affected by monsoon airflow. The sky over China is basically controlled by westerly airflow. In winter, this area is located in the southeast of Mongolia's cold high pressure, prevailing northerly winds, the climate is cold and dry, and the rainfall is very low. Concentrated season, seasonal precipitation decreases from southeast to northwest

11. Reference

11.1 Figure list

11.2 Literature

[1]https://zh.wikipedia.org/wiki/Template:%E6%B3%B0%E5%B1%B1%E6%B0%94%E5%80%99%E6%95%B0%E6%8D%AE

[2]https://wenku.baidu.com/view/9e5cdcecce2f0066f5332296.html

[3]https://www.zybang.com/question/8167f88c743165f8964a3c045d216680.html