Comprehensive Analysis of U.S. 30-year Climate Normals [1991-2020]

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Introduction

This document provides a comprehensive analysis of the 30-year climate normals data for key weather stations in the United States. The dataset, provided by the National Centers for Environmental Information (NCEI), includes monthly climate normals for temperature and precipitation for the period from 1991 to 2020.

Data Acquisition

The climate normals data were sourced from the NCEI website. The inventory and readme files were downloaded to identify key stations and understand the structure of the dataset. The complete dataset can be accessed here. The inventory file, which contains a list of all stations and their metadata, additional documentation explaining the methodology and data structure is available here.

Key Stations

There are over 15000 stations across the United States and for our convenience of processing this data we identified key stations based on their Global Surface Network (GSN) and Historical Climatology Network (HCN) status.The list of key stations is extracted from the provided inventory file available on the NOAA website.We identified a total of 60 key stations from the inventory file.

Data Cleaning and Aggregation

The inventory data were read and cleaned to extract the relevant information for the key stations. The downloaded CSV files for each station were then read, and the data were aggregated to compute monthly averages for temperature and precipitation. Missing values were handled by removing any incomplete records to ensure data quality.

Data Characteristics

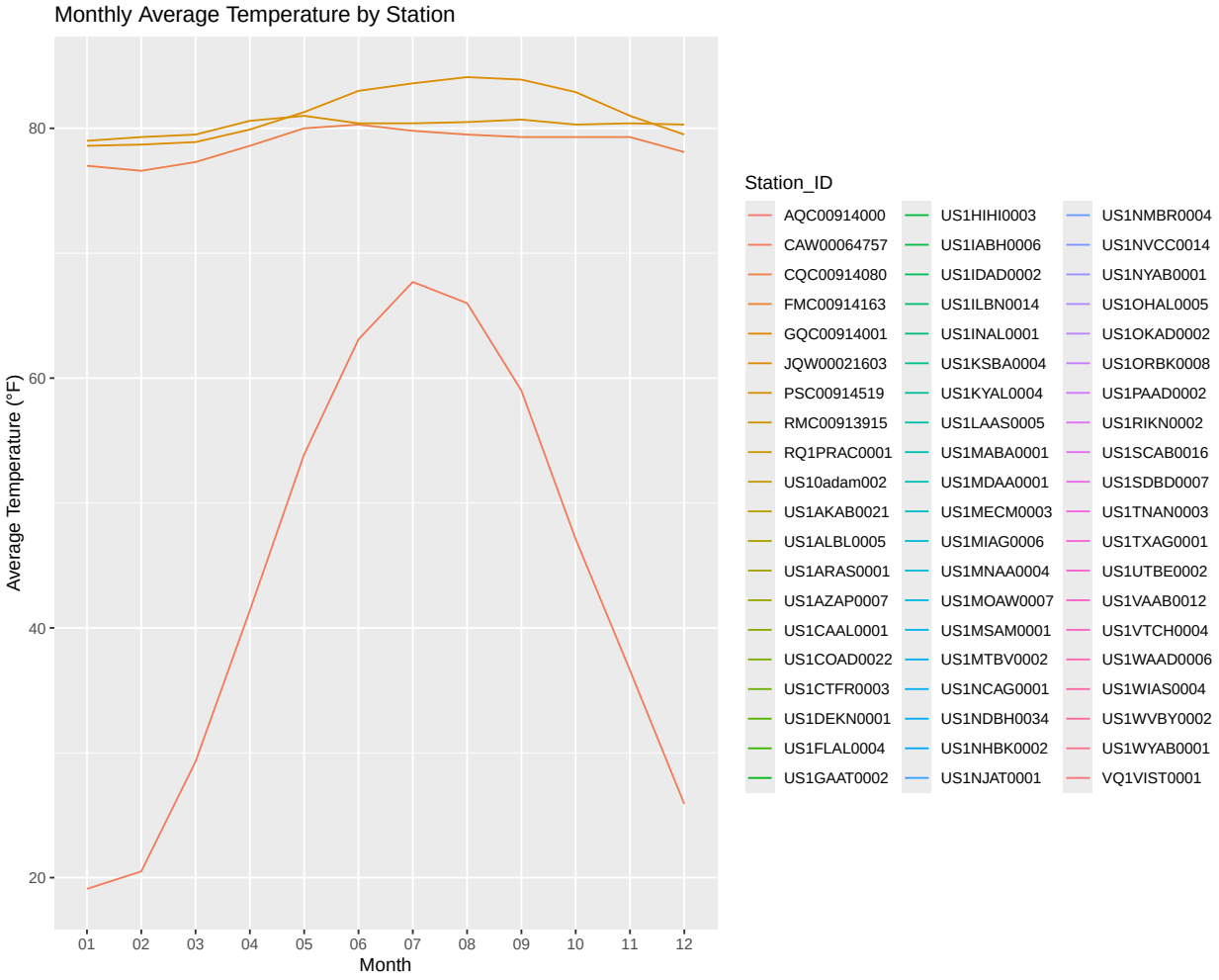
This dataframe has 720 rows and 414 columns. The names of the columns and a brief description of each are in the table below:

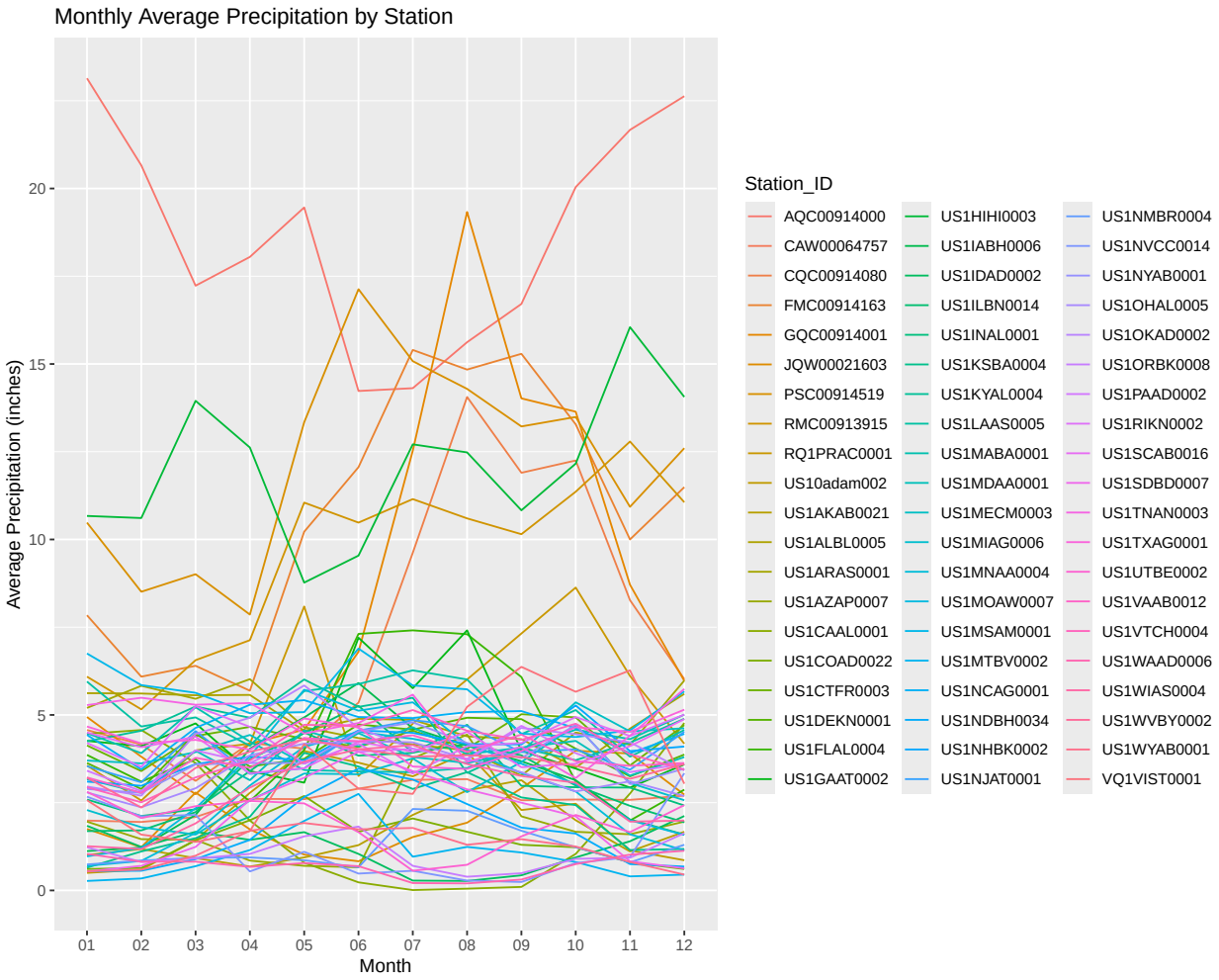
Summary Statistics

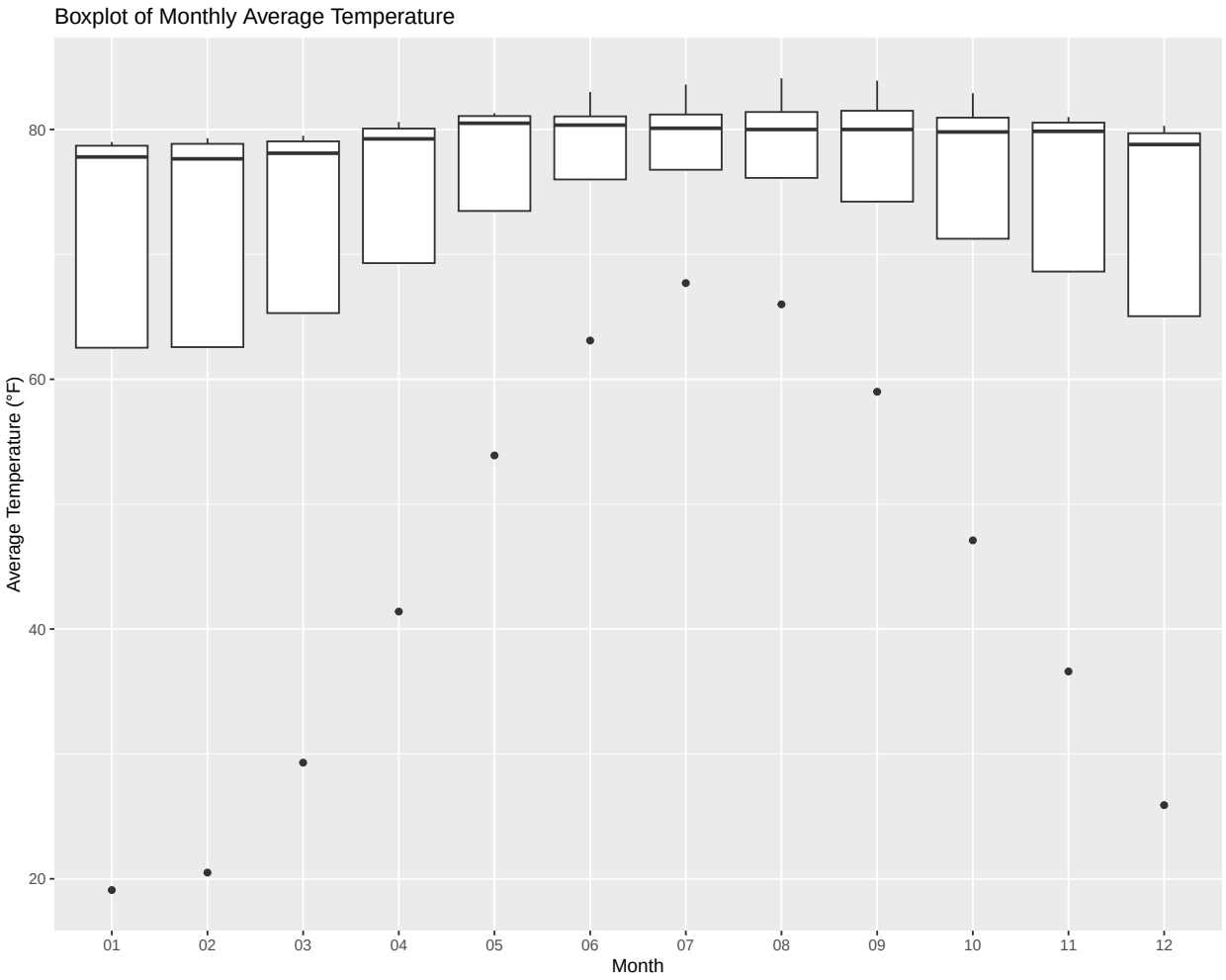
The summary statistics of the cleaned data provide an overview of the distribution of temperature and precipitation values across the key stations. The summary includes measures such as the minimum, maximum, mean, and median values, as well as the first and third quartiles for each variable. These statistics help us understand the central tendency and variability in the climate data.

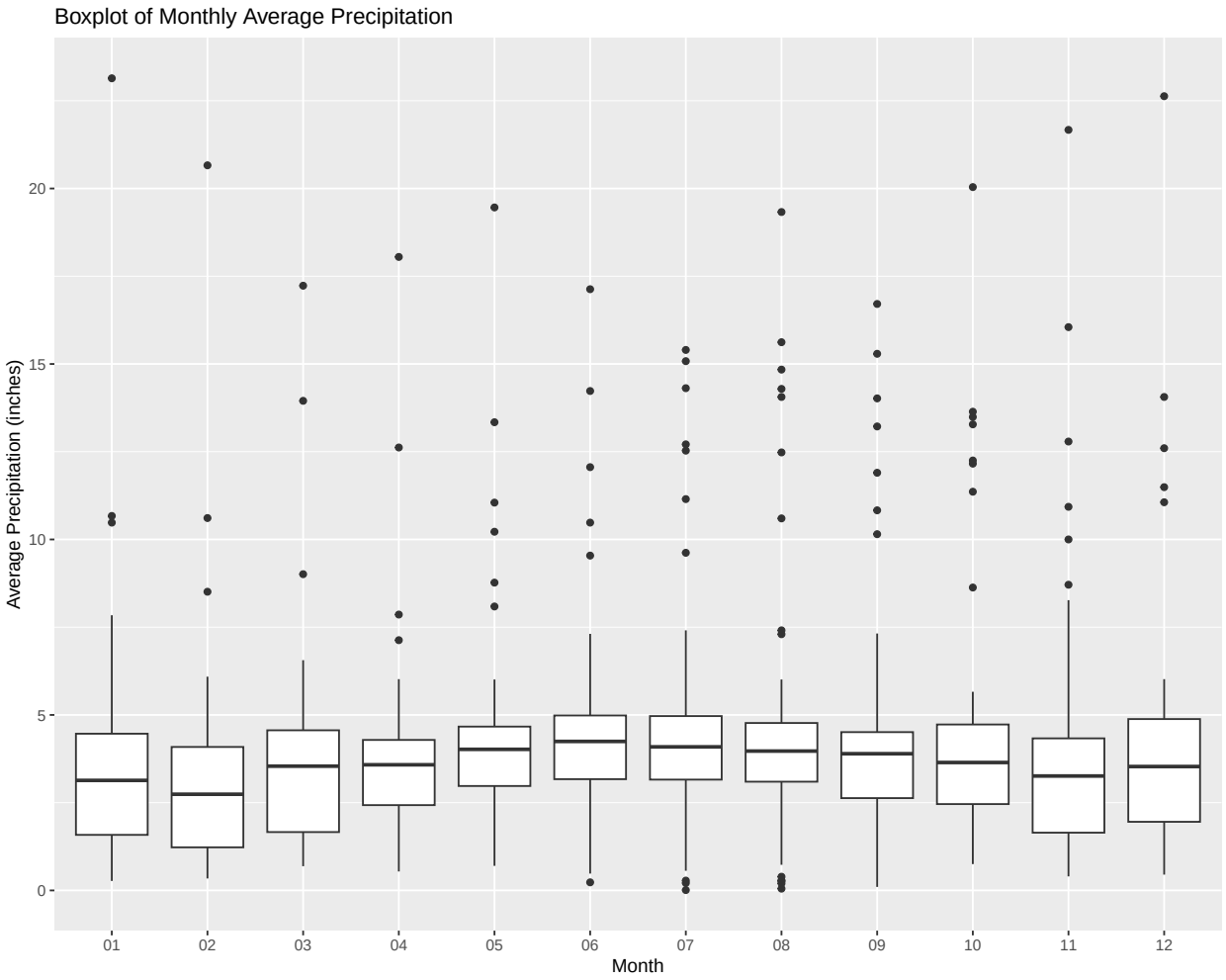
Visualizations

The following plots show the monthly average temperature, monthly average precipitation and the boxplots represent distribution of monthly average temperatures, precipitation to identify seasonal trends, detecting any significant changes across different months. In addition, heat maps illustrate monthly average temperature, precipitation to identify patterns and anomalies.

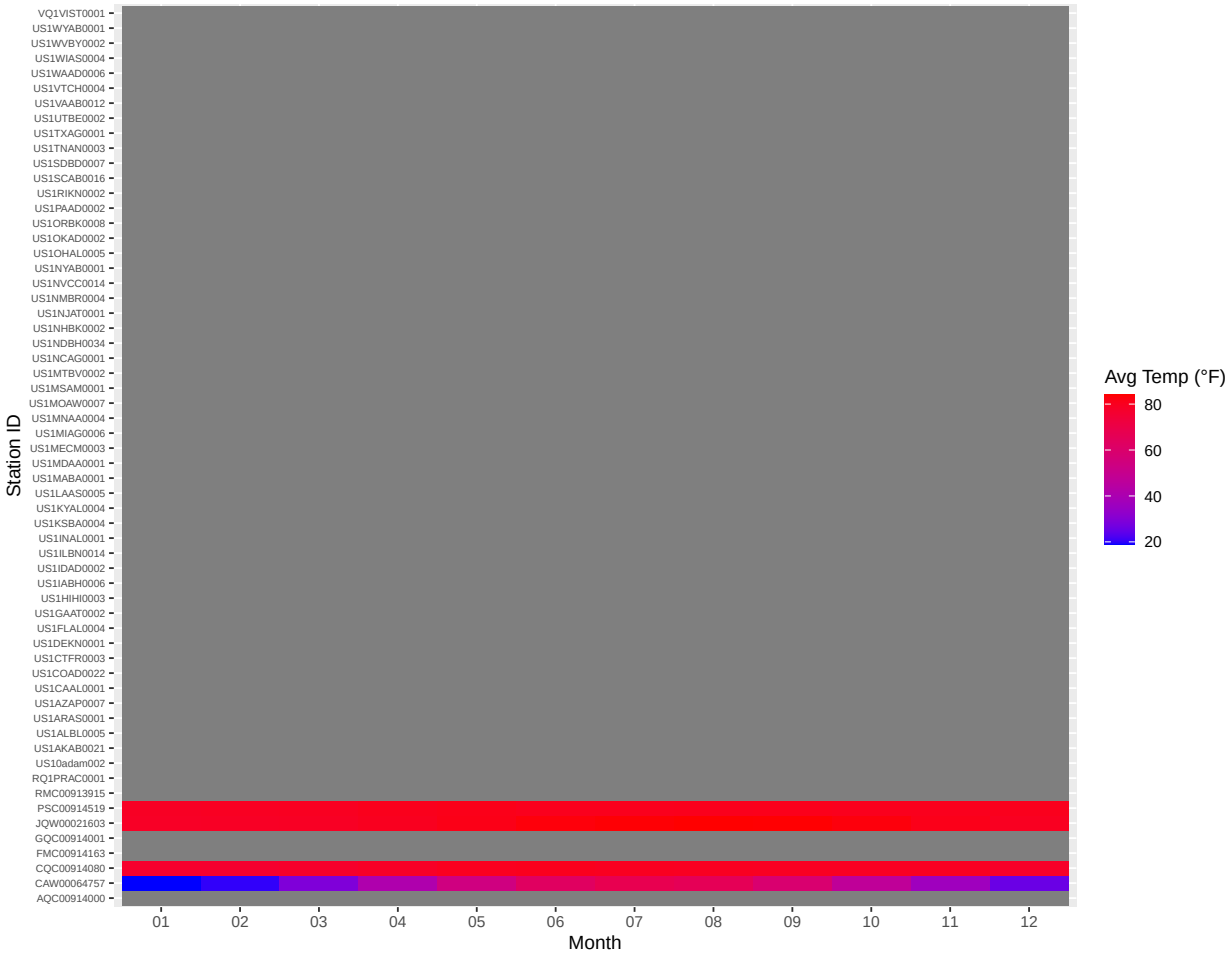


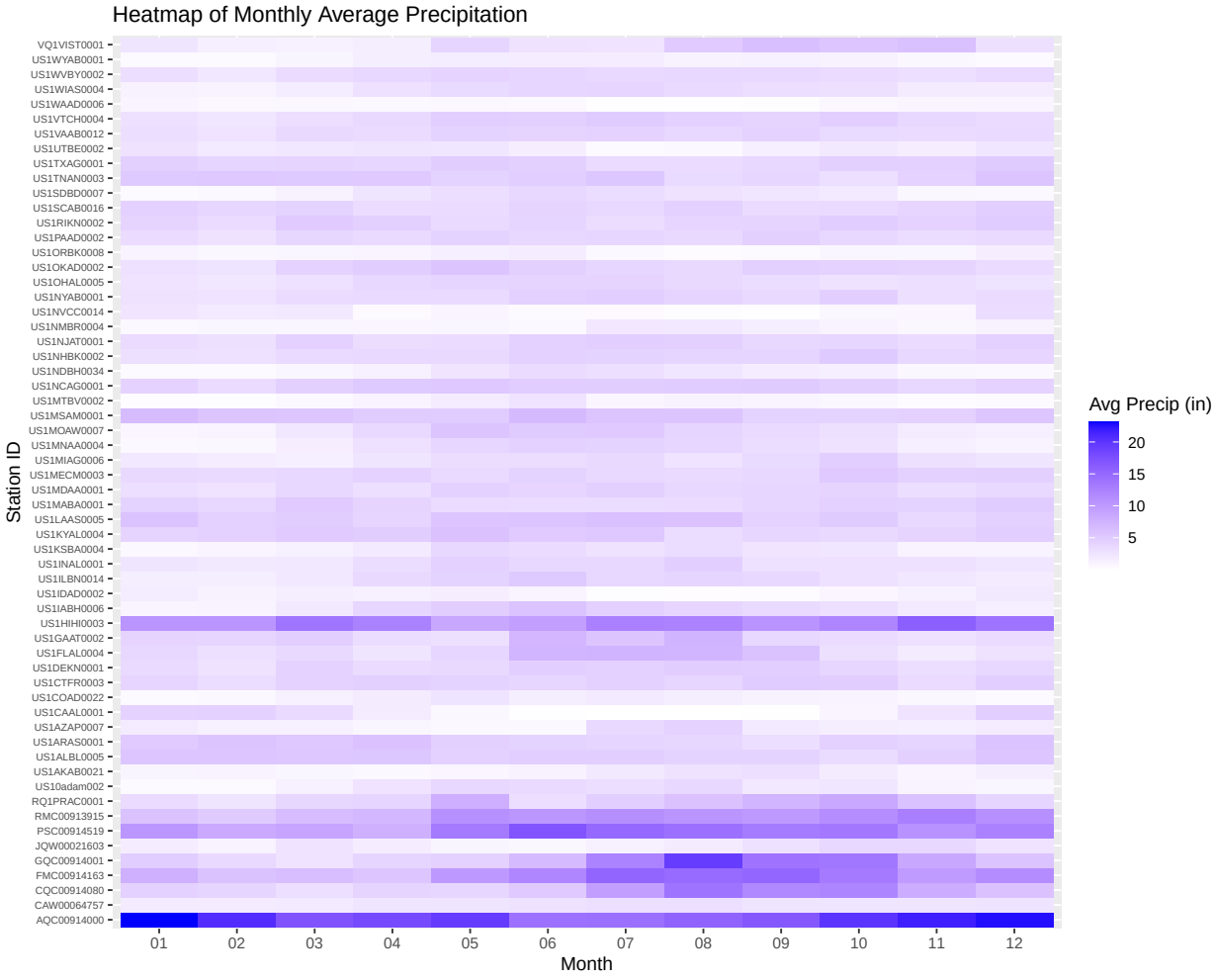

Monthly Average Precipitation by Station
Average Precipitation (inches)
0
5
10
15
20
01
02
03
04
05
06
07
08
09
10
11
12
Month
Station_ID
AQC00914000
CAW00064757
CQC00914080
FMC00914163
GQC00914001
JQW00021603
PSC00914519
RMC00913915
RQ1PRAC0001
US10adam002
US1AKAB0021
US1ALBL0005
US1ARAS0001
US1AZAP0007
US1CAAL0001
US1COAD0022
US1CTFR0003
US1DEKN0001
US1FLAL0004
US1GAAT0002
US1HIHI0003
US1IABH0006
US1IDAD0002
US1ILBN0014
US1INAL0001
US1KSBA0004
US1KYAL0004
US1LAAS0005
US1MABA0001
US1MDAA0001
US1MECM0003
US1MIAG0006
US1MNAA0004
US1MOAW0007
US1MSAM0001
US1MTBV0002
US1NCAG0001
US1NDBH0034
US1NHBK0002
US1NJAT0001
US1NMBR0004
US1NVCC0014
US1NYAB0001
US1OHAL0005
US1OKAD0002
US1ORBK0008
US1PAAD0002
US1RIKN0002
US1SCAB0016
US1SDBD0007
US1TNAN0003
US1TXAG0001
US1UTBE0002
US1VAAB0012
US1VTCH0004
US1WAAD0006
US1WIAS0004
US1WVBY0002
US1WYAB0001
VQ1VIST0001


Boxplot of Monthly Average Temperature
Average Temperature (°F)
80
60
40
20
01
02
03
04
05
06
07
08
09
10
11
12
Month

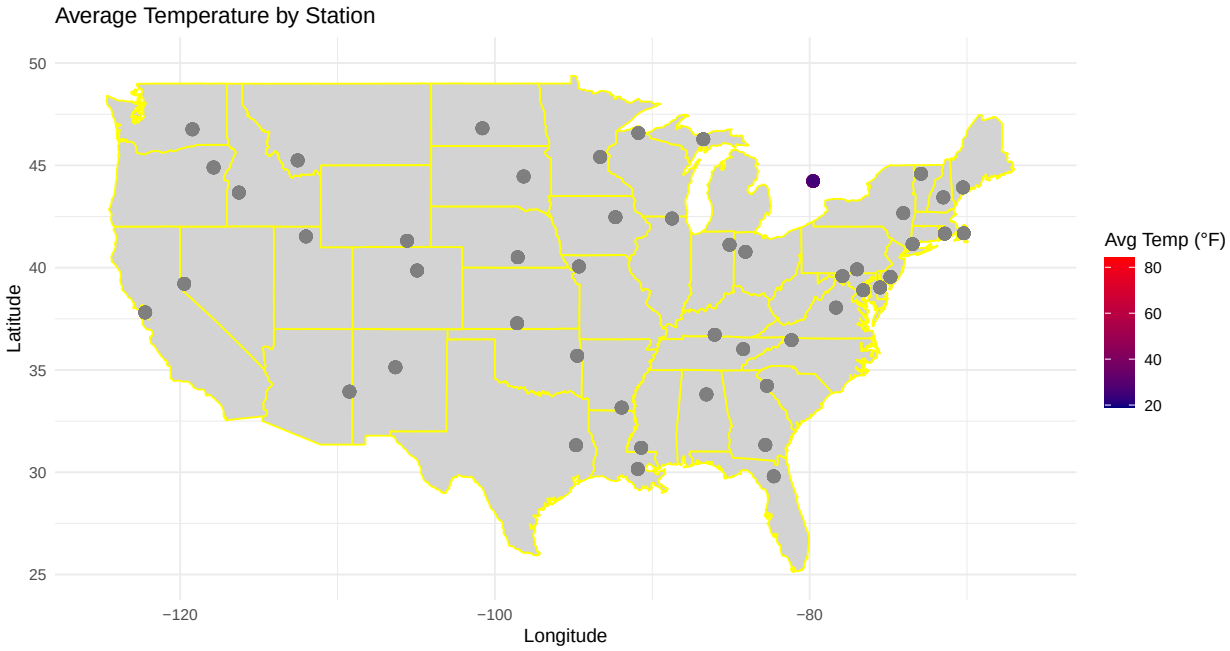

Boxplot of Monthly Average Precipitation
Average Precipitation (inches)
0
5
10
15
20
01
02
03
04
05
06
07
08
09
10
11
12
Month

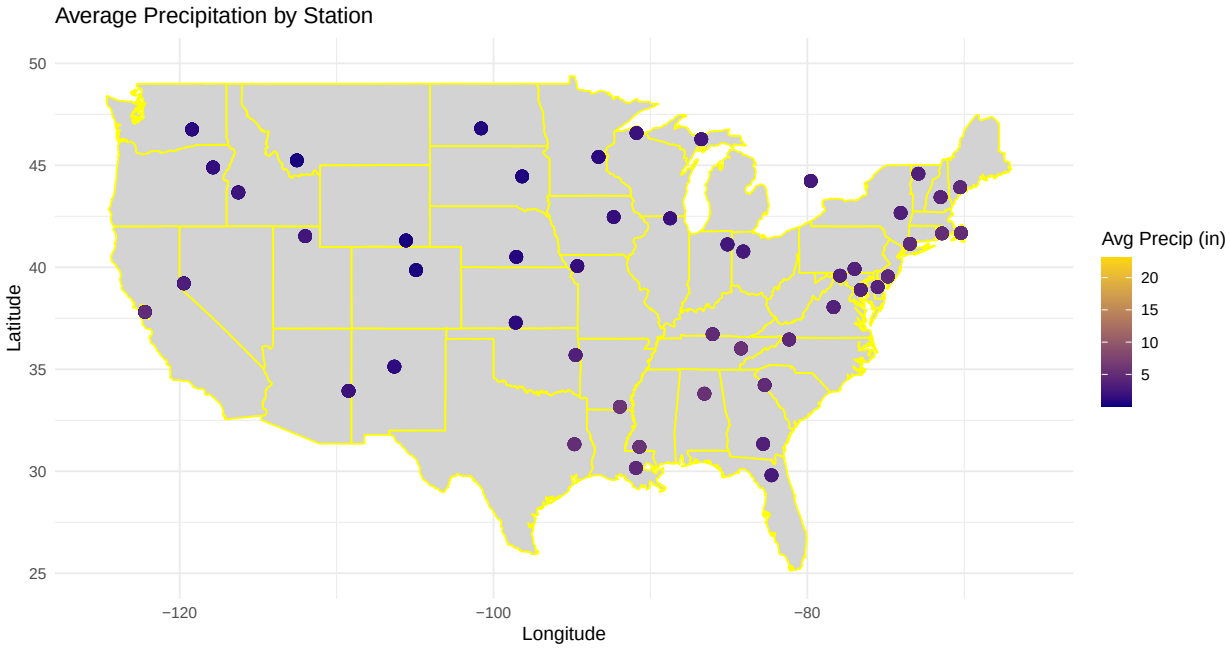
Heatmap of Monthly Average Temperature



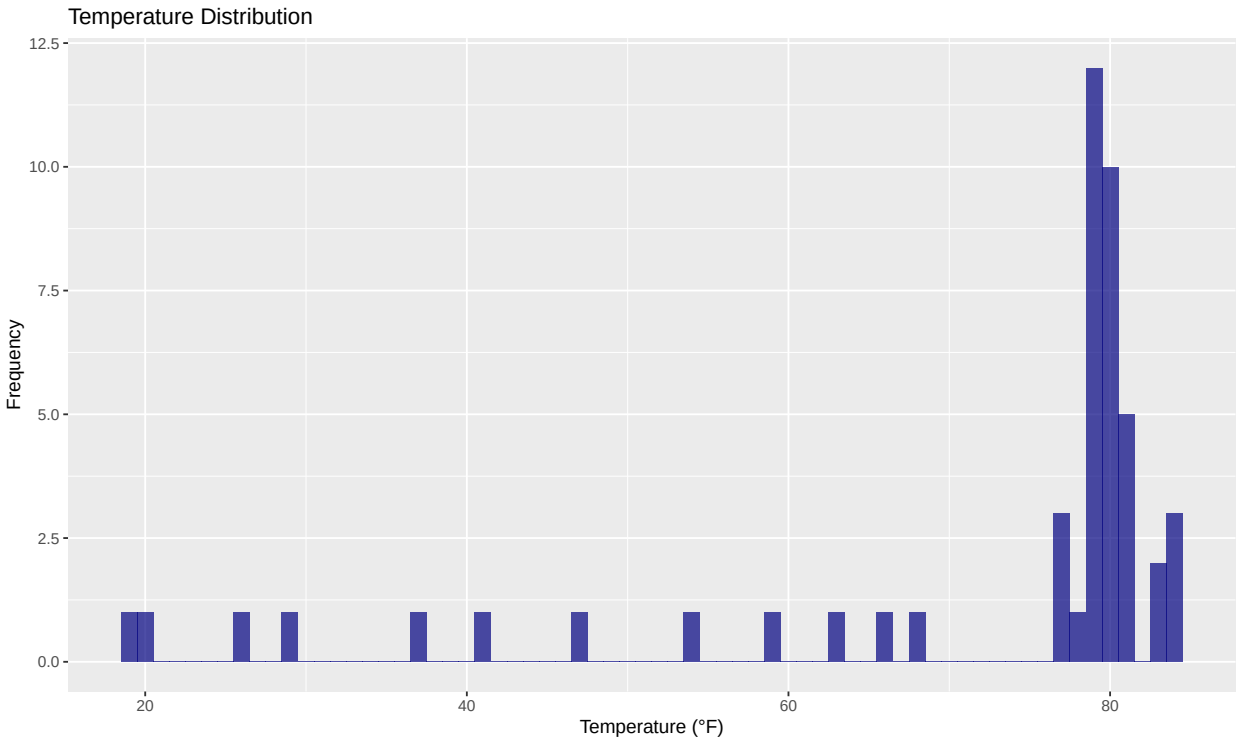


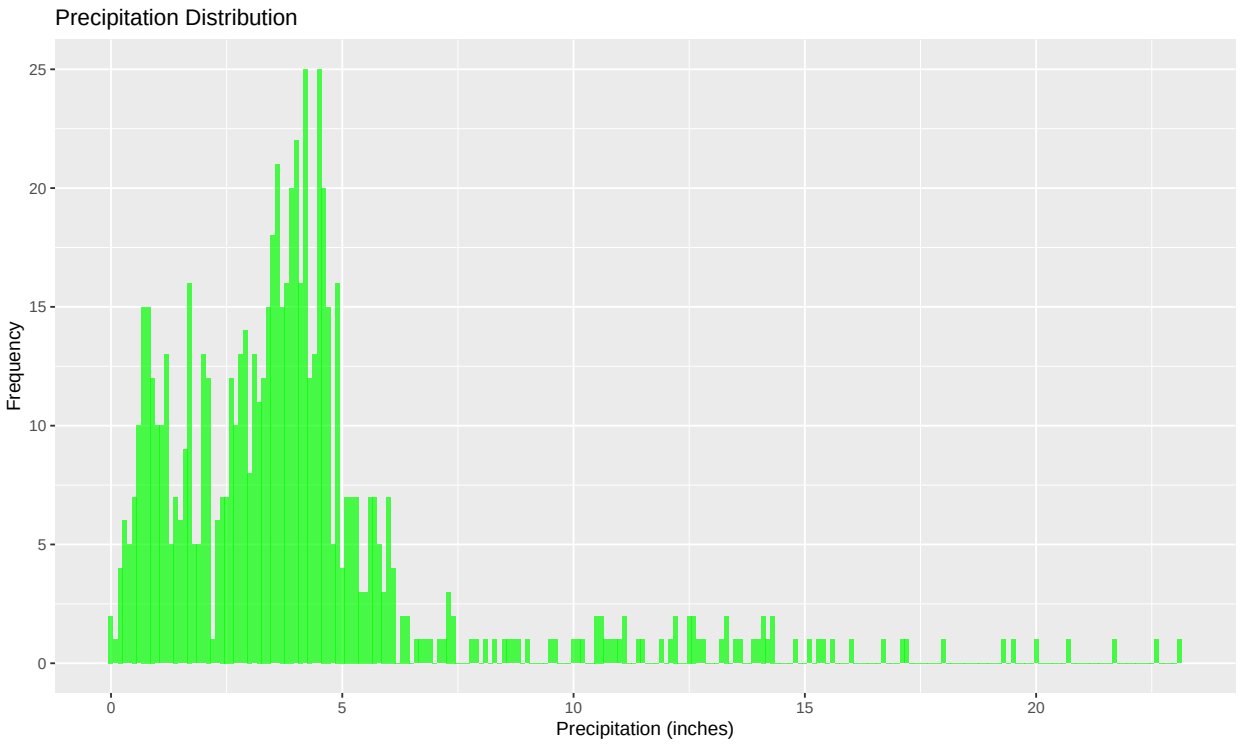
The following maps show the geographical distribution of average temperature and precipitation for each station. These visualizations help in understanding the spatial patterns in the climate data.





The following histograms show the distribution of temperatures, precipitation across all stations to help understand the frequency.


Temperature Distribution
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
20
40
60
80
Temperature (°F)


Precipitation Distribution
Frequency
25
20
15
10
5
0
0
5
10
15
20
Precipitation (inches)