

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](#).

```
# Defining URLs for necessary files
inventory_url <- "https://www.ncei.noaa.gov/data/normals-monthly/1991-2020/doc/inventory_30yr.txt"
readme_url <- "https://www.ncei.noaa.gov/data/normals-monthly/1991-2020/doc/Readme_By-Variable_By-Station"

# Download the inventory file
inventory_file <- tempfile()
GET(inventory_url, write_disk(inventory_file, overwrite = TRUE))
```

```
## Response [https://www.ncei.noaa.gov/data/normals-monthly/1991-2020/doc/inventory_30yr.txt]
##   Date: 2024-06-15 23:14
##   Status: 200
##   Content-Type: text/plain
##   Size: 1.34 MB
## <ON DISK> /var/folders/pr/94_gyf0s7zj7nwbgvvyxkdhz80000gn/T/RtmpJf4NG0/file130d14f290b
```

```
# Read the inventory file with fixed width format
inventory <- read_fwf(inventory_file, fwf_widths(c(11, 9, 10, 7, 3, NA)), show_col_types = FALSE)

# Renaming columns for ease of data transformation
inventory <- inventory %>%
  rename(
    Station_ID = X1,
```

```

Latitude = X2,
Longitude = X3,
Elevation = X4,
State = X5,
Name = X6
)

# Extract key stations, selecting one per state.
key_stations <- inventory %>%
  distinct(State, .keep_all = TRUE)

# Filter and display key stations
key_stations

```

```

## # A tibble: 60 x 6
##   Station_ID Latitude Longitude Elevation State Name
##   <chr>      <dbl>    <dbl>    <dbl> <chr> <chr>
## 1 AQC00914000 -14.3    -171.    408.  AS   AASUFOU
## 2 CAW00064757  44.2     -79.8    246.  ON   EGBERT 1 W
## 3 CQC00914080  15.2     146.    252.  MP   CAPITOL HILL 1
## 4 FMC00914163   9.54    138.    20.1  FM   DUGOR
## 5 GQC00914001  13.4     145.     3.   GU   AGAT
## 6 JQW00021603  16.7    -170.     3.   UM   JOHNSTON ISLAND ~
## 7 PSC00914519   7.45    134.    31.1  PW   NEKKEN FORESTRY
## 8 RMC00913915   7.27    169.     1.8  MH   AILINGLAPALAP ~
## 9 RQ1PRAC0001  18.4    -66.7    29.6  PR   ARECIBO 5.2 ESE
## 10 US10adam002  40.5    -98.5    601.  NE   JUNIATA 6.0 SSW
## # i 50 more rows

```

```
num_key_stations <- nrow(key_stations)
```

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.

```

# Identifying the correct column that contains month information
month_column <- names(climate_data)[grepl("month", tolower(names(climate_data)))] [1]

if (!is.null(month_column)) {
  climate_data <- climate_data %>%
    rename(Month = !!month_column)
} else {

```

```

    stop("The Month column is not found in the data.")
  }

  # Making sure Station_ID column exists and is correctly named
  if (!("Station_ID" %in% names(climate_data))) {
    climate_data <- climate_data %>%
      mutate(Station_ID = rep(key_stations$Station_ID, each = nrow(climate_data) / length(key_stations$St
  })

  # Identifying columns for temperature and precipitation
  temp_column <- names(climate_data)[grepl("tavg", tolower(names(climate_data)))] [1]
  precip_column <- names(climate_data)[grepl("prcp", tolower(names(climate_data)))] [1]

  if (is.null(temp_column) || is.null(precip_column)) {
    stop("Temperature or precipitation columns are not found in the data.")
  }

  # Calculating monthly averages for each station
  monthly_averages <- climate_data %>%
    group_by(Station_ID, Month) %>%
    summarize(
      Avg_Temperature = mean(.data[[temp_column]], na.rm = TRUE),
      Avg_Precipitation = mean(.data[[precip_column]], na.rm = TRUE),
      .groups = 'drop'
    )

  # Merging monthly averages with key stations to include geographical coordinates
  station_averages <- key_stations %>%
    left_join(monthly_averages, by = "Station_ID")

  # Checking summary data structure
  print(head(station_averages))

```

```

## # A tibble: 6 x 9
##   Station_ID Latitude Longitude Elevation State Name      Month Avg_Temperature
##   <chr>         <dbl>    <dbl>    <dbl> <chr> <chr>    <chr>          <dbl>
## 1 AQC00914000 -14.3    -171.    408. AS  AASUFOU 01            NaN
## 2 AQC00914000 -14.3    -171.    408. AS  AASUFOU 02            NaN
## 3 AQC00914000 -14.3    -171.    408. AS  AASUFOU 03            NaN
## 4 AQC00914000 -14.3    -171.    408. AS  AASUFOU 04            NaN
## 5 AQC00914000 -14.3    -171.    408. AS  AASUFOU 05            NaN
## 6 AQC00914000 -14.3    -171.    408. AS  AASUFOU 06            NaN
## # i 1 more variable: Avg_Precipitation <dbl>

```

```

print(head(monthly_averages))

```

```

## # A tibble: 6 x 4
##   Station_ID Month Avg_Temperature Avg_Precipitation
##   <chr>      <chr>          <dbl>          <dbl>
## 1 AQC00914000 01            NaN            23.1
## 2 AQC00914000 02            NaN            20.7
## 3 AQC00914000 03            NaN            17.2

```

```
## 4 AQC00914000 04      NaN      18.0
## 5 AQC00914000 05      NaN      19.5
## 6 AQC00914000 06      NaN      14.2
```

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

```
# Check data structure before summarizing
print(head(climate_data))
```

```
## # A tibble: 6 x 414
##   STATION    DATE  LATITUDE LONGITUDE ELEVATION NAME      Month  day  hour
##   <chr>      <chr>    <dbl>    <dbl>    <dbl> <chr>    <chr> <dbl> <dbl>
## 1 AQC00914000 01      -14.3    -171.     408. AASUFOU, AS ~ 01      99    99
## 2 AQC00914000 02      -14.3    -171.     408. AASUFOU, AS ~ 02      99    99
## 3 AQC00914000 03      -14.3    -171.     408. AASUFOU, AS ~ 03      99    99
## 4 AQC00914000 04      -14.3    -171.     408. AASUFOU, AS ~ 04      99    99
## 5 AQC00914000 05      -14.3    -171.     408. AASUFOU, AS ~ 05      99    99
## 6 AQC00914000 06      -14.3    -171.     408. AASUFOU, AS ~ 06      99    99
## # i 405 more variables: 'MLY-PRCP-NORMAL' <dbl>,
## #   'meas_flag_MLY-PRCP-NORMAL' <lgl>, 'comp_flag_MLY-PRCP-NORMAL' <chr>,
## #   'years_MLY-PRCP-NORMAL' <dbl>, 'MLY-PRCP-AVGNDS-GEO01HI' <dbl>,
## #   'meas_flag_MLY-PRCP-AVGNDS-GEO01HI' <lgl>,
## #   'comp_flag_MLY-PRCP-AVGNDS-GEO01HI' <chr>,
## #   'years_MLY-PRCP-AVGNDS-GEO01HI' <dbl>, 'MLY-PRCP-AVGNDS-GEO10HI' <dbl>,
## #   'meas_flag_MLY-PRCP-AVGNDS-GEO10HI' <lgl>, ...
```

```
summary_stats <- summary(climate_data)
print(head(summary_stats))
```

```
##   STATION      DATE      LATITUDE      LONGITUDE
## Length:720      Length:720      Min.   :-14.32      Min.   :-170.77
## Class :character Class :character 1st Qu.: 32.70      1st Qu.: -101.83
## Mode  :character Mode  :character Median : 39.38      Median : -86.66
##                                     Mean  : 35.24      Mean   : -74.92
##                                     3rd Qu.: 42.52      3rd Qu.: -75.35
##                                     Max.   : 61.31      Max.   : 168.83
##   ELEVATION      NAME      Month      day
## Min.   : 1.80      Length:720      Length:720      Min.   :99
## 1st Qu.: 45.25      Class :character Class :character 1st Qu.:99
## Median : 244.75      Mode  :character Mode  :character Median :99
## Mean   : 410.14                                     Mean   :99
## 3rd Qu.: 402.25                                     3rd Qu.:99
## Max.   :2432.30                                     Max.   :99
##   hour      MLY-PRCP-NORMAL meas_flag_MLY-PRCP-NORMAL
## Min.   :99      Min.   : 0.010      Mode:logical
## 1st Qu.:99      1st Qu.: 2.110      NA's:720
## Median :99      Median : 3.680
```

```

## Mean :99 Mean : 4.153
## 3rd Qu.:99 3rd Qu.: 4.652
## Max. :99 Max. :23.140
## comp_flag_MLY-PRCP-NORMAL years_MLY-PRCP-NORMAL MLY-PRCP-AVGND5-GE001HI
## Length:720 Min. : 2.000 Min. : 2.20
## Class :character 1st Qu.: 5.000 1st Qu.:10.20
## Mode :character Median :10.000 Median :12.90
## Mean : 9.451 Mean :14.05
## 3rd Qu.:12.000 3rd Qu.:17.90
## Max. :25.000 Max. :26.50
## meas_flag_MLY-PRCP-AVGND5-GE001HI comp_flag_MLY-PRCP-AVGND5-GE001HI
## Mode:logical Length:720
## NA's:720 Class :character
## Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE001HI MLY-PRCP-AVGND5-GE010HI
## Min. :11.00 Min. : 0.800
## 1st Qu.:13.00 1st Qu.: 5.700
## Median :14.00 Median : 7.500
## Mean :15.24 Mean : 9.109
## 3rd Qu.:17.00 3rd Qu.:12.075
## Max. :25.00 Max. :21.300
## meas_flag_MLY-PRCP-AVGND5-GE010HI comp_flag_MLY-PRCP-AVGND5-GE010HI
## Mode:logical Length:720
## NA's:720 Class :character
## Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE010HI MLY-PRCP-AVGND5-GE025HI
## Min. :11.00 Min. : 0.200
## 1st Qu.:13.00 1st Qu.: 3.300
## Median :14.00 Median : 4.750
## Mean :15.24 Mean : 6.015
## 3rd Qu.:17.00 3rd Qu.: 7.650
## Max. :25.00 Max. :17.100
## meas_flag_MLY-PRCP-AVGND5-GE025HI comp_flag_MLY-PRCP-AVGND5-GE025HI
## Mode:logical Length:720
## NA's:720 Class :character
## Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE025HI MLY-PRCP-AVGND5-GE050HI
## Min. :11.00 Min. : 0.100
## 1st Qu.:13.00 1st Qu.: 1.600
## Median :14.00 Median : 2.900
## Mean :15.24 Mean : 3.725
## 3rd Qu.:17.00 3rd Qu.: 4.625
## Max. :25.00 Max. :12.700
## meas_flag_MLY-PRCP-AVGND5-GE050HI comp_flag_MLY-PRCP-AVGND5-GE050HI
## Mode:logical Length:720

```

```

## NA's:720                                Class :character
##                                           Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE050HI MLY-PRCP-AVGND5-GE100HI
## Min. :11.00                        Min. :0.000
## 1st Qu.:13.00                      1st Qu.:0.575
## Median :14.00                      Median :1.200
## Mean :15.24                        Mean :1.756
## 3rd Qu.:17.00                      3rd Qu.:2.325
## Max. :25.00                        Max. :7.200
## meas_flag_MLY-PRCP-AVGND5-GE100HI comp_flag_MLY-PRCP-AVGND5-GE100HI
## Mode:logical                      Length:720
## NA's:720                          Class :character
##                                           Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE100HI MLY-PRCP-AVGND5-GE200HI
## Min. :11.00                        Min. :0.0000
## 1st Qu.:13.00                      1st Qu.:0.1000
## Median :14.00                      Median :0.3000
## Mean :15.24                        Mean :0.5446
## 3rd Qu.:17.00                      3rd Qu.:0.7000
## Max. :25.00                        Max. :3.9000
## meas_flag_MLY-PRCP-AVGND5-GE200HI comp_flag_MLY-PRCP-AVGND5-GE200HI
## Mode:logical                      Length:720
## NA's:720                          Class :character
##                                           Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE200HI MLY-PRCP-AVGND5-GE400HI
## Min. :11.00                        Min. :0.0000
## 1st Qu.:13.00                      1st Qu.:0.0000
## Median :14.00                      Median :0.0000
## Mean :15.24                        Mean :0.0922
## 3rd Qu.:17.00                      3rd Qu.:0.1000
## Max. :25.00                        Max. :1.1000
## meas_flag_MLY-PRCP-AVGND5-GE400HI comp_flag_MLY-PRCP-AVGND5-GE400HI
## Length:720                        Length:720
## Class :character                  Class :character
## Mode :character                  Mode :character
##
##
##
## years_MLY-PRCP-AVGND5-GE400HI MLY-PRCP-AVGND5-GE600HI
## Min. :11.00                        Min. :0.0000
## 1st Qu.:13.00                      1st Qu.:0.0000
## Median :14.00                      Median :0.0000
## Mean :15.24                        Mean :0.0235
## 3rd Qu.:17.00                      3rd Qu.:0.0000
## Max. :25.00                        Max. :0.5000

```

```

## meas_flag_MLY-PRCP-AVGNDS-GE600HI comp_flag_MLY-PRCP-AVGNDS-GE600HI
## Length:720 Length:720
## Class :character Class :character
## Mode :character Mode :character
##
##
##
## years_MLY-PRCP-AVGNDS-GE600HI MLY-PRCP-25PTL meas_flag_MLY-PRCP-25PTL
## Min. :11.00 Min. : 0.000 Mode:logical
## 1st Qu.:13.00 1st Qu.: 1.725 NA's:720
## Median :14.00 Median : 2.645
## Mean :15.24 Mean : 4.134
## 3rd Qu.:17.00 3rd Qu.: 4.747
## Max. :25.00 Max. :17.970
## comp_flag_MLY-PRCP-25PTL years_MLY-PRCP-25PTL MLY-PRCP-50PTL
## Length:720 Min. :10.00 Min. : 0.070
## Class :character 1st Qu.:12.00 1st Qu.: 2.620
## Mode :character Median :13.00 Median : 3.810
## Mean :14.53 Mean : 5.634
## 3rd Qu.:17.00 3rd Qu.: 6.478
## Max. :25.00 Max. :21.880
## meas_flag_MLY-PRCP-50PTL comp_flag_MLY-PRCP-50PTL years_MLY-PRCP-50PTL
## Mode:logical Length:720 Min. :10.00
## NA's:720 Class :character 1st Qu.:12.00
## Mode :character Median :13.00
## Mean :14.53
## 3rd Qu.:17.00
## Max. :25.00
## MLY-PRCP-75PTL meas_flag_MLY-PRCP-75PTL comp_flag_MLY-PRCP-75PTL
## Min. : 0.320 Mode:logical Length:720
## 1st Qu.: 3.777 NA's:720 Class :character
## Median : 5.360 Mode :character
## Mean : 7.504
## 3rd Qu.: 8.717
## Max. :30.290
## years_MLY-PRCP-75PTL MLY-PRCP-20PTL meas_flag_MLY-PRCP-20PTL
## Min. :10.00 Min. : 0.000 Mode:logical
## 1st Qu.:12.00 1st Qu.: 1.515 NA's:720
## Median :13.00 Median : 2.375
## Mean :14.53 Mean : 3.849
## 3rd Qu.:17.00 3rd Qu.: 4.545
## Max. :25.00 Max. :17.170
## comp_flag_MLY-PRCP-20PTL years_MLY-PRCP-20PTL MLY-PRCP-40PTL
## Length:720 Min. :10.00 Min. : 0.050
## Class :character 1st Qu.:12.00 1st Qu.: 2.310
## Mode :character Median :13.00 Median : 3.255
## Mean :14.53 Mean : 5.021
## 3rd Qu.:17.00 3rd Qu.: 5.657
## Max. :25.00 Max. :18.780
## meas_flag_MLY-PRCP-40PTL comp_flag_MLY-PRCP-40PTL years_MLY-PRCP-40PTL
## Mode:logical Length:720 Min. :10.00
## NA's:720 Class :character 1st Qu.:12.00
## Mode :character Median :13.00
## Mean :14.53

```

```

##                                     3rd Qu.:17.00
##                                     Max.   :25.00
## MLY-PRCP-60PCTL meas_flag_MLY-PRCP-60PCTL comp_flag_MLY-PRCP-60PCTL
## Min.   : 0.100   Mode:logical           Length:720
## 1st Qu.: 2.993   NA's:720               Class :character
## Median : 4.355           Mode :character
## Mean   : 6.287
## 3rd Qu.: 7.305
## Max.   :27.560
## years_MLY-PRCP-60PCTL MLY-PRCP-80PCTL meas_flag_MLY-PRCP-80PCTL
## Min.   :10.00      Min.   : 0.430   Mode:logical
## 1st Qu.:12.00      1st Qu.: 4.008   NA's:720
## Median :13.00      Median : 5.700
## Mean   :14.53      Mean   : 7.945
## 3rd Qu.:17.00      3rd Qu.: 9.512
## Max.   :25.00      Max.   :31.700
## comp_flag_MLY-PRCP-80PCTL years_MLY-PRCP-80PCTL MLY-PRCP-33PCTL
## Length:720          Min.   :10.00      Min.   : 0.020
## Class :character     1st Qu.:12.00      1st Qu.: 2.135
## Mode  :character     Median :13.00      Median : 3.010
##                      Mean   :14.53      Mean   : 4.635
##                      3rd Qu.:17.00      3rd Qu.: 5.263
##                      Max.   :25.00      Max.   :18.410
## meas_flag_MLY-PRCP-33PCTL comp_flag_MLY-PRCP-33PCTL years_MLY-PRCP-33PCTL
## Mode:logical         Length:720          Min.   :10.00
## NA's:720              Class :character     1st Qu.:12.00
##                      Mode  :character     Median :13.00
##                      Mean   :14.53
##                      3rd Qu.:17.00
##                      Max.   :25.00
## MLY-PRCP-67PCTL meas_flag_MLY-PRCP-67PCTL comp_flag_MLY-PRCP-67PCTL
## Min.   : 0.170   Mode:logical           Length:720
## 1st Qu.: 3.295   NA's:720               Class :character
## Median : 4.685           Mode :character
## Mean   : 6.779
## 3rd Qu.: 8.025
## Max.   :28.500
## years_MLY-PRCP-67PCTL MLY-SNOW-NORMAL meas_flag_MLY-SNOW-NORMAL
## Min.   :10.00      Min.   :0.0000   Length:720
## 1st Qu.:12.00      1st Qu.:0.0000   Class :character
## Median :13.00      Median :0.0000   Mode  :character
## Mean   :14.53      Mean   :0.2542
## 3rd Qu.:17.00      3rd Qu.:0.0000
## Max.   :25.00      Max.   :7.0000
## comp_flag_MLY-SNOW-NORMAL years_MLY-SNOW-NORMAL MLY-SNOW-AVGNDS-GEO01TI
## Length:720          Min.   :11.00      Min.   :0.0000
## Class :character     1st Qu.:12.00      1st Qu.:0.0000
## Mode  :character     Median :14.50      Median :0.0000
##                      Mean   :14.64      Mean   :0.2361
##                      3rd Qu.:16.25      3rd Qu.:0.0000
##                      Max.   :20.00      Max.   :6.3000
## meas_flag_MLY-SNOW-AVGNDS-GEO01TI comp_flag_MLY-SNOW-AVGNDS-GEO01TI
## Mode:logical         Length:720
## NA's:720              Class :character

```



```

##                               Mode :character
##
##
##
## years_MLY-SNOW-AVGNDS-GEO01TI MLY-SNOW-AVGNDS-GEO10TI
## Min.      :11.00              Min.      :0.0000
## 1st Qu.   :12.00              1st Qu.   :0.0000
## Median    :14.50              Median   :0.0000
## Mean      :14.68              Mean     :0.0903
## 3rd Qu.   :16.25              3rd Qu.  :0.0000
## Max.      :20.00              Max.     :2.4000
## meas_flag_MLY-SNOW-AVGNDS-GEO10TI comp_flag_MLY-SNOW-AVGNDS-GEO10TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode :character
##
##
##
## years_MLY-SNOW-AVGNDS-GEO10TI MLY-SNOW-AVGNDS-GEO20TI
## Min.      :11.00              Min.      :0.0000
## 1st Qu.   :12.00              1st Qu.   :0.0000
## Median    :14.50              Median   :0.0000
## Mean      :14.68              Mean     :0.0458
## 3rd Qu.   :16.25              3rd Qu.  :0.0000
## Max.      :20.00              Max.     :1.3000
## meas_flag_MLY-SNOW-AVGNDS-GEO20TI comp_flag_MLY-SNOW-AVGNDS-GEO20TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode :character
##
##
##
## years_MLY-SNOW-AVGNDS-GEO20TI MLY-SNOW-AVGNDS-GEO30TI
## Min.      :11.00              Min.      :0.0000
## 1st Qu.   :12.00              1st Qu.   :0.0000
## Median    :14.50              Median   :0.0000
## Mean      :14.68              Mean     :0.0167
## 3rd Qu.   :16.25              3rd Qu.  :0.0000
## Max.      :20.00              Max.     :0.5000
## meas_flag_MLY-SNOW-AVGNDS-GEO30TI comp_flag_MLY-SNOW-AVGNDS-GEO30TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode :character
##
##
##
## years_MLY-SNOW-AVGNDS-GEO30TI MLY-SNOW-AVGNDS-GEO40TI
## Min.      :11.00              Min.      :0.0000
## 1st Qu.   :12.00              1st Qu.   :0.0000
## Median    :14.50              Median   :0.0000
## Mean      :14.68              Mean     :0.0083
## 3rd Qu.   :16.25              3rd Qu.  :0.0000
## Max.      :20.00              Max.     :0.2000
## meas_flag_MLY-SNOW-AVGNDS-GEO40TI comp_flag_MLY-SNOW-AVGNDS-GEO40TI

```

```

## Mode:logical                      Length:720
## NA's:720                         Class :character
##                                 Mode  :character
##
##
## years_MLY-SNOW-AVGNDS-GE040TI MLY-SNOW-AVGNDS-GE050TI
## Min.      :11.00              Min.      :0.0000
## 1st Qu.:12.00                1st Qu.:0.0000
## Median :14.50                Median :0.0000
## Mean    :14.68                Mean    :0.0042
## 3rd Qu.:16.25                3rd Qu.:0.0000
## Max.     :20.00              Max.      :0.1000
## meas_flag_MLY-SNOW-AVGNDS-GE050TI comp_flag_MLY-SNOW-AVGNDS-GE050TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode  :character
##
##
## years_MLY-SNOW-AVGNDS-GE050TI MLY-SNOW-AVGNDS-GE100TI
## Min.      :11.00              Min.      :0
## 1st Qu.:12.00                1st Qu.:0
## Median :14.50                Median :0
## Mean    :14.68                Mean    :0
## 3rd Qu.:16.25                3rd Qu.:0
## Max.     :20.00              Max.      :0
## meas_flag_MLY-SNOW-AVGNDS-GE100TI comp_flag_MLY-SNOW-AVGNDS-GE100TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode  :character
##
##
## years_MLY-SNOW-AVGNDS-GE100TI MLY-SNOW-AVGNDS-GE200TI
## Min.      :11.00              Min.      :0
## 1st Qu.:12.00                1st Qu.:0
## Median :14.50                Median :0
## Mean    :14.68                Mean    :0
## 3rd Qu.:16.25                3rd Qu.:0
## Max.     :20.00              Max.      :0
## meas_flag_MLY-SNOW-AVGNDS-GE200TI comp_flag_MLY-SNOW-AVGNDS-GE200TI
## Mode:logical                  Length:720
## NA's:720                      Class :character
##                               Mode  :character
##
##
## years_MLY-SNOW-AVGNDS-GE200TI MLY-SNOW-25PCTL meas_flag_MLY-SNOW-25PCTL
## Min.      :11.00              Min.      :0.0000 Mode:logical
## 1st Qu.:12.00                1st Qu.:0.0000 NA's:720
## Median :14.50                Median :0.0000
## Mean    :14.68                Mean    :0.0653
## 3rd Qu.:16.25                3rd Qu.:0.0000

```

```

## Max. :20.00 Max. :2.6000
## comp_flag_MLY-SNOW-25PCTL years_MLY-SNOW-25PCTL MLY-SNOW-50PCTL
## Length:720 Min. :11.00 Min. :0.0000
## Class :character 1st Qu.:12.00 1st Qu.:0.0000
## Mode :character Median :14.50 Median :0.0000
## Mean :14.64 Mean :0.1389
## 3rd Qu.:16.25 3rd Qu.:0.0000
## Max. :20.00 Max. :5.3000
## meas_flag_MLY-SNOW-50PCTL comp_flag_MLY-SNOW-50PCTL years_MLY-SNOW-50PCTL
## Mode:logical Length:720 Min. :11.00
## NA's:720 Class :character 1st Qu.:12.00
## Mode :character Median :14.50
## Mean :14.64
## 3rd Qu.:16.25
## Max. :20.00
## MLY-SNOW-75PCTL meas_flag_MLY-SNOW-75PCTL comp_flag_MLY-SNOW-75PCTL
## Min. :0.0000 Mode:logical Length:720
## 1st Qu.:0.0000 NA's:720 Class :character
## Median :0.0000 Mode :character
## Mean :0.3375
## 3rd Qu.:0.0000
## Max. :9.5000
## years_MLY-SNOW-75PCTL MLY-SNOW-20PCTL meas_flag_MLY-SNOW-20PCTL
## Min. :11.00 Min. :0.0000 Mode:logical
## 1st Qu.:12.00 1st Qu.:0.0000 NA's:720
## Median :14.50 Median :0.0000
## Mean :14.64 Mean :0.0583
## 3rd Qu.:16.25 3rd Qu.:0.0000
## Max. :20.00 Max. :2.5000
## comp_flag_MLY-SNOW-20PCTL years_MLY-SNOW-20PCTL MLY-SNOW-40PCTL
## Length:720 Min. :11.00 Min. :0.0000
## Class :character 1st Qu.:12.00 1st Qu.:0.0000
## Mode :character Median :14.50 Median :0.0000
## Mean :14.64 Mean :0.1222
## 3rd Qu.:16.25 3rd Qu.:0.0000
## Max. :20.00 Max. :5.2000
## meas_flag_MLY-SNOW-40PCTL comp_flag_MLY-SNOW-40PCTL years_MLY-SNOW-40PCTL
## Mode:logical Length:720 Min. :11.00
## NA's:720 Class :character 1st Qu.:12.00
## Mode :character Median :14.50
## Mean :14.64
## 3rd Qu.:16.25
## Max. :20.00
## MLY-SNOW-60PCTL meas_flag_MLY-SNOW-60PCTL comp_flag_MLY-SNOW-60PCTL
## Min. :0.0000 Mode:logical Length:720
## 1st Qu.:0.0000 NA's:720 Class :character
## Median :0.0000 Mode :character
## Mean :0.2139
## 3rd Qu.:0.0000
## Max. :5.8000
## years_MLY-SNOW-60PCTL MLY-SNOW-80PCTL meas_flag_MLY-SNOW-80PCTL
## Min. :11.00 Min. : 0.0000 Mode:logical
## 1st Qu.:12.00 1st Qu.: 0.0000 NA's:720
## Median :14.50 Median : 0.0000

```

```

## Mean      :14.64          Mean      : 0.4097
## 3rd Qu.:16.25          3rd Qu.: 0.0000
## Max.      :20.00          Max.      :10.9000
## comp_flag_MLY-SNOW-80PCTL years_MLY-SNOW-80PCTL MLY-SNOW-33PCTL
## Length:720              Min.       :11.00          Min.       :0.0000
## Class :character        1st Qu.:12.00          1st Qu.:0.0000
## Mode  :character        Median :14.50          Median :0.0000
##                               Mean  :14.64          Mean  :0.1111
##                               3rd Qu.:16.25          3rd Qu.:0.0000
##                               Max.   :20.00          Max.   :5.2000
## meas_flag_MLY-SNOW-33PCTL comp_flag_MLY-SNOW-33PCTL years_MLY-SNOW-33PCTL
## Mode:logical            Length:720              Min.       :11.00
## NA's:720                Class :character        1st Qu.:12.00
##                               Mode  :character        Median :14.50
##                               Mean  :14.64
##                               3rd Qu.:16.25
##                               Max.   :20.00
## MLY-SNOW-67PCTL meas_flag_MLY-SNOW-67PCTL comp_flag_MLY-SNOW-67PCTL
## Min.       :0.0000      Mode:logical            Length:720
## 1st Qu.:0.0000      NA's:720                Class :character
## Median :0.0000                               Mode  :character
## Mean    :0.2458
## 3rd Qu.:0.0000
## Max.    :6.5000
## years_MLY-SNOW-67PCTL MLY-SNWD-AVGND-GE001WI
## Min.       :11.00          Min.       : 0.0000
## 1st Qu.:12.00          1st Qu.: 0.0000
## Median :14.50          Median : 0.0000
## Mean    :14.64          Mean    : 0.3847
## 3rd Qu.:16.25          3rd Qu.: 0.0000
## Max.    :20.00          Max.    :11.7000
## meas_flag_MLY-SNWD-AVGND-GE001WI comp_flag_MLY-SNWD-AVGND-GE001WI
## Mode:logical            Length:720
## NA's:720                Class :character
##                               Mode  :character
##
##
##
## years_MLY-SNWD-AVGND-GE001WI MLY-SNWD-AVGND-GE002WI
## Min.       :10.00          Min.       :0.0000
## 1st Qu.:12.00          1st Qu.:0.0000
## Median :14.50          Median :0.0000
## Mean    :14.61          Mean    :0.2111
## 3rd Qu.:16.25          3rd Qu.:0.0000
## Max.    :20.00          Max.    :6.5000
## meas_flag_MLY-SNWD-AVGND-GE002WI comp_flag_MLY-SNWD-AVGND-GE002WI
## Mode:logical            Length:720
## NA's:720                Class :character
##                               Mode  :character
##
##
##
## years_MLY-SNWD-AVGND-GE002WI MLY-SNWD-AVGND-GE003WI
## Min.       :10.00          Min.       :0.0000

```

```

## 1st Qu.:12.00          1st Qu.:0.0000
## Median :14.50          Median :0.0000
## Mean   :14.61          Mean   :0.1819
## 3rd Qu.:16.25          3rd Qu.:0.0000
## Max.    :20.00          Max.    :5.5000
## meas_flag_MLY-SNWD-AVGND-S-GE003WI comp_flag_MLY-SNWD-AVGND-S-GE003WI
## Mode:logical          Length:720
## NA's:720              Class :character
##                        Mode  :character
##
##
##
## years_MLY-SNWD-AVGND-S-GE003WI MLY-SNWD-AVGND-S-GE004WI
## Min.    :10.00          Min.    :0.0000
## 1st Qu.:12.00          1st Qu.:0.0000
## Median :14.50          Median :0.0000
## Mean   :14.61          Mean   :0.1153
## 3rd Qu.:16.25          3rd Qu.:0.0000
## Max.    :20.00          Max.    :4.2000
## meas_flag_MLY-SNWD-AVGND-S-GE004WI comp_flag_MLY-SNWD-AVGND-S-GE004WI
## Mode:logical          Length:720
## NA's:720              Class :character
##                        Mode  :character
##
##
##
## years_MLY-SNWD-AVGND-S-GE004WI MLY-SNWD-AVGND-S-GE005WI
## Min.    :10.00          Min.    :0.000
## 1st Qu.:12.00          1st Qu.:0.000
## Median :14.50          Median :0.000
## Mean   :14.61          Mean   :0.075
## 3rd Qu.:16.25          3rd Qu.:0.000
## Max.    :20.00          Max.    :2.700
## meas_flag_MLY-SNWD-AVGND-S-GE005WI comp_flag_MLY-SNWD-AVGND-S-GE005WI
## Mode:logical          Length:720
## NA's:720              Class :character
##                        Mode  :character
##
##
##
## years_MLY-SNWD-AVGND-S-GE005WI MLY-SNWD-AVGND-S-GE010WI
## Min.    :10.00          Min.    :0.0000
## 1st Qu.:12.00          1st Qu.:0.0000
## Median :14.50          Median :0.0000
## Mean   :14.61          Mean   :0.0361
## 3rd Qu.:16.25          3rd Qu.:0.0000
## Max.    :20.00          Max.    :2.4000
## meas_flag_MLY-SNWD-AVGND-S-GE010WI comp_flag_MLY-SNWD-AVGND-S-GE010WI
## Mode:logical          Length:720
## NA's:720              Class :character
##                        Mode  :character
##
##
##

```

```

## years_MLY-SNWD-AVGND-S-GEO10WI MLY-SNWD-AVGND-S-GEO20WI
## Min. :10.00 Min. :0
## 1st Qu.:12.00 1st Qu.:0
## Median :14.50 Median :0
## Mean :14.61 Mean :0
## 3rd Qu.:16.25 3rd Qu.:0
## Max. :20.00 Max. :0
## meas_flag_MLY-SNWD-AVGND-S-GEO20WI comp_flag_MLY-SNWD-AVGND-S-GEO20WI
## Mode:logical Length:720
## NA's:720 Class :character
## Mode :character
##
##
## years_MLY-SNWD-AVGND-S-GEO20WI MLY-TAVG-NORMAL meas_flag_MLY-TAVG-NORMAL
## Min. :10.00 Min. :19.10 Mode:logical
## 1st Qu.:12.00 1st Qu.:74.38 NA's:720
## Median :14.50 Median :79.30
## Mean :14.61 Mean :71.09
## 3rd Qu.:16.25 3rd Qu.:80.40
## Max. :20.00 Max. :84.10
## comp_flag_MLY-TAVG-NORMAL years_MLY-TAVG-NORMAL MLY-TMAX-NORMAL
## Length:720 Min. :12.00 Min. :26.60
## Class :character 1st Qu.:13.00 1st Qu.:79.97
## Mode :character Median :16.00 Median :84.45
## Mean :16.75 Mean :77.50
## 3rd Qu.:18.25 3rd Qu.:86.92
## Max. :24.00 Max. :89.90
## meas_flag_MLY-TMAX-NORMAL comp_flag_MLY-TMAX-NORMAL years_MLY-TMAX-NORMAL
## Mode:logical Length:720 Min. :12.00
## NA's:720 Class :character 1st Qu.:13.00
## Mode :character Median :16.00
## Mean :16.94
## 3rd Qu.:18.25
## Max. :24.00
## MLY-TMIN-NORMAL meas_flag_MLY-TMIN-NORMAL comp_flag_MLY-TMIN-NORMAL
## Min. :11.50 Mode:logical Length:720
## 1st Qu.:68.67 NA's:720 Class :character
## Median :73.75 Mode :character
## Mean :64.69
## 3rd Qu.:74.72
## Max. :78.40
## years_MLY-TMIN-NORMAL MLY-DUTR-NORMAL meas_flag_MLY-DUTR-NORMAL
## Min. :12.00 Min. : 7.800 Mode:logical
## 1st Qu.:13.00 1st Qu.: 9.675 NA's:720
## Median :16.00 Median :12.100
## Mean :16.85 Mean :12.812
## 3rd Qu.:18.75 3rd Qu.:13.525
## Max. :24.00 Max. :22.000
## comp_flag_MLY-DUTR-NORMAL years_MLY-DUTR-NORMAL MLY-TAVG-STDDEV
## Length:720 Min. :12.00 Min. :0.600
## Class :character 1st Qu.:13.00 1st Qu.:0.900
## Mode :character Median :16.00 Median :1.100
## Mean :16.75 Mean :1.644

```

```

##          3rd Qu.:18.25          3rd Qu.:1.875
##          Max.    :24.00          Max.    :5.500
## meas_flag_MLY-TAVG-STDDEV comp_flag_MLY-TAVG-STDDEV years_MLY-TAVG-STDDEV
## Mode:logical          Length:720          Min.    :12.00
## NA's:720              Class :character      1st Qu.:13.00
##                      Mode  :character      Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-TMAX-STDDEV meas_flag_MLY-TMAX-STDDEV comp_flag_MLY-TMAX-STDDEV
## Min.    :0.700  Mode:logical          Length:720
## 1st Qu.:1.100  NA's:720              Class :character
## Median :1.300          Mode  :character
## Mean   :1.863
## 3rd Qu.:1.975
## Max.   :4.900
## years_MLY-TMAX-STDDEV MLY-TMIN-STDDEV meas_flag_MLY-TMIN-STDDEV
## Min.    :12.00      Min.    :0.500  Mode:logical
## 1st Qu.:13.00      1st Qu.:0.900  NA's:720
## Median :16.00      Median :1.250
## Mean   :16.94      Mean   :1.773
## 3rd Qu.:18.25      3rd Qu.:2.200
## Max.   :24.00      Max.   :6.800
## comp_flag_MLY-TMIN-STDDEV years_MLY-TMIN-STDDEV MLY-DUTR-STDDEV
## Length:720          Min.    :12.00      Min.    :0.70
## Class :character      1st Qu.:13.00      1st Qu.:1.00
## Mode  :character      Median :16.00      Median :1.30
##                      Mean   :16.85      Mean   :1.55
##                      3rd Qu.:18.75      3rd Qu.:2.10
##                      Max.   :24.00      Max.   :2.90
## meas_flag_MLY-DUTR-STDDEV comp_flag_MLY-DUTR-STDDEV years_MLY-DUTR-STDDEV
## Mode:logical          Length:720          Min.    :12.00
## NA's:720              Class :character      1st Qu.:13.00
##                      Mode  :character      Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-TMIN-AVGND5-LSTH000 meas_flag_MLY-TMIN-AVGND5-LSTH000
## Min.    :0.0          Mode:logical
## 1st Qu.:0.0          NA's:720
## Median :0.0
## Mean   :0.3
## 3rd Qu.:0.0
## Max.   :6.5
## comp_flag_MLY-TMIN-AVGND5-LSTH000 years_MLY-TMIN-AVGND5-LSTH000
## Length:720          Min.    :12.00
## Class :character      1st Qu.:13.00
## Mode  :character      Median :16.00
##                      Mean   :16.85
##                      3rd Qu.:18.75
##                      Max.   :24.00
## MLY-TMIN-AVGND5-LSTH010 meas_flag_MLY-TMIN-AVGND5-LSTH010
## Min.    : 0.0000      Mode:logical
## 1st Qu.: 0.0000      NA's:720

```

```

## Median : 0.0000
## Mean   : 0.7854
## 3rd Qu.: 0.0000
## Max.   :13.8000
## comp_flag_MLY-TMIN-AVGND5-LSTH010 years_MLY-TMIN-AVGND5-LSTH010
## Length:720                      Min.    :12.00
## Class :character                 1st Qu.:13.00
## Mode  :character                 Median :16.00
##                                     Mean    :16.85
##                                     3rd Qu.:18.75
##                                     Max.    :24.00
## MLY-TMIN-AVGND5-LSTH020 meas_flag_MLY-TMIN-AVGND5-LSTH020
## Min.    : 0.000          Mode:logical
## 1st Qu.: 0.000          NA's:720
## Median : 0.000
## Mean    : 1.542
## 3rd Qu.: 0.000
## Max.    :21.100
## comp_flag_MLY-TMIN-AVGND5-LSTH020 years_MLY-TMIN-AVGND5-LSTH020
## Length:720                      Min.    :12.00
## Class :character                 1st Qu.:13.00
## Mode  :character                 Median :16.00
##                                     Mean    :16.85
##                                     3rd Qu.:18.75
##                                     Max.    :24.00
## MLY-TMIN-AVGND5-LSTH032 meas_flag_MLY-TMIN-AVGND5-LSTH032
## Min.    : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean    : 3.26
## 3rd Qu.: 0.00
## Max.    :29.20
## comp_flag_MLY-TMIN-AVGND5-LSTH032 years_MLY-TMIN-AVGND5-LSTH032
## Length:720                      Min.    :12.00
## Class :character                 1st Qu.:13.00
## Mode  :character                 Median :16.00
##                                     Mean    :16.85
##                                     3rd Qu.:18.75
##                                     Max.    :24.00
## MLY-TMIN-AVGND5-LSTH040 meas_flag_MLY-TMIN-AVGND5-LSTH040
## Min.    : 0.000          Mode:logical
## 1st Qu.: 0.000          NA's:720
## Median : 0.000
## Mean    : 4.371
## 3rd Qu.: 0.000
## Max.    :30.900
## comp_flag_MLY-TMIN-AVGND5-LSTH040 years_MLY-TMIN-AVGND5-LSTH040
## Length:720                      Min.    :12.00
## Class :character                 1st Qu.:13.00
## Mode  :character                 Median :16.00
##                                     Mean    :16.85
##                                     3rd Qu.:18.75
##                                     Max.    :24.00
## MLY-TMIN-AVGND5-LSTH050 meas_flag_MLY-TMIN-AVGND5-LSTH050

```



```

## Min.      : 0.000          Mode:logical
## 1st Qu.: 0.000          NA's:720
## Median : 0.000
## Mean      : 5.652
## 3rd Qu.: 1.050
## Max.      :31.000
## comp_flag_MLY-TMIN-AVGND5-LSTH050 years_MLY-TMIN-AVGND5-LSTH050
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                          Mean      :16.85
##                          3rd Qu.:18.75
##                          Max.      :24.00
## MLY-TMIN-AVGND5-LSTH060 meas_flag_MLY-TMIN-AVGND5-LSTH060
## Min.      : 0.000          Mode:logical
## 1st Qu.: 0.000          NA's:720
## Median : 0.000
## Mean      : 7.102
## 3rd Qu.: 5.575
## Max.      :31.000
## comp_flag_MLY-TMIN-AVGND5-LSTH060 years_MLY-TMIN-AVGND5-LSTH060
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                          Mean      :16.85
##                          3rd Qu.:18.75
##                          Max.      :24.00
## MLY-TMIN-AVGND5-LSTH070 meas_flag_MLY-TMIN-AVGND5-LSTH070
## Min.      : 0.000          Length:720
## 1st Qu.: 0.775          Class :character
## Median : 2.150          Mode  :character
## Mean      : 9.144
## 3rd Qu.:14.725
## Max.      :31.000
## comp_flag_MLY-TMIN-AVGND5-LSTH070 years_MLY-TMIN-AVGND5-LSTH070
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                          Mean      :16.85
##                          3rd Qu.:18.75
##                          Max.      :24.00
## MLY-TMAX-AVGND5-GRTH032 meas_flag_MLY-TMAX-AVGND5-GRTH032
## Min.      :10.60          Mode:logical
## 1st Qu.:30.00          NA's:720
## Median :31.00
## Mean      :29.09
## 3rd Qu.:31.00
## Max.      :31.00
## comp_flag_MLY-TMAX-AVGND5-GRTH032 years_MLY-TMAX-AVGND5-GRTH032
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                          Mean      :16.94
##                          3rd Qu.:18.25
##

```

```

##                                     Max.      :24.00
## MLY-TMAX-AVGND5-GRTH040 meas_flag_MLY-TMAX-AVGND5-GRTH040
## Min.      : 3.30          Mode:logical
## 1st Qu.:30.00          NA's:720
## Median :30.55
## Mean    :28.11
## 3rd Qu.:31.00
## Max.    :31.00
## comp_flag_MLY-TMAX-AVGND5-GRTH040 years_MLY-TMAX-AVGND5-GRTH040
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                                     Mean    :16.94
##                                     3rd Qu.:18.25
##                                     Max.    :24.00
## MLY-TMAX-AVGND5-GRTH050 meas_flag_MLY-TMAX-AVGND5-GRTH050
## Min.      : 0.60          Mode:logical
## 1st Qu.:29.98          NA's:720
## Median :30.00
## Mean    :27.12
## 3rd Qu.:31.00
## Max.    :31.00
## comp_flag_MLY-TMAX-AVGND5-GRTH050 years_MLY-TMAX-AVGND5-GRTH050
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                                     Mean    :16.94
##                                     3rd Qu.:18.25
##                                     Max.    :24.00
## MLY-TMAX-AVGND5-GRTH060 meas_flag_MLY-TMAX-AVGND5-GRTH060
## Min.      : 0.00          Mode:logical
## 1st Qu.:28.60          NA's:720
## Median :30.00
## Mean    :26.21
## 3rd Qu.:31.00
## Max.    :31.00
## comp_flag_MLY-TMAX-AVGND5-GRTH060 years_MLY-TMAX-AVGND5-GRTH060
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                                     Mean    :16.94
##                                     3rd Qu.:18.25
##                                     Max.    :24.00
## MLY-TMAX-AVGND5-GRTH070 meas_flag_MLY-TMAX-AVGND5-GRTH070
## Min.      : 0.00          Mode:logical
## 1st Qu.:28.00          NA's:720
## Median :30.00
## Mean    :25.13
## 3rd Qu.:31.00
## Max.    :31.00
## comp_flag_MLY-TMAX-AVGND5-GRTH070 years_MLY-TMAX-AVGND5-GRTH070
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00

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```

##                               Mean   :16.94
##                               3rd Qu.:18.25
##                               Max.   :24.00
## MLY-TMAX-AVGNDS-GRTH080 meas_flag_MLY-TMAX-AVGNDS-GRTH080
## Min.   : 0.00           Mode:logical
## 1st Qu.:19.85           NA's:720
## Median :29.55
## Mean   :22.97
## 3rd Qu.:30.23
## Max.   :31.00
## comp_flag_MLY-TMAX-AVGNDS-GRTH080 years_MLY-TMAX-AVGNDS-GRTH080
## Length:720             Min.   :12.00
## Class :character       1st Qu.:13.00
## Mode  :character       Median :16.00
##                               Mean   :16.94
##                               3rd Qu.:18.25
##                               Max.   :24.00
## MLY-TMAX-AVGNDS-GRTH090 meas_flag_MLY-TMAX-AVGNDS-GRTH090
## Min.   : 0.000         Mode:logical
## 1st Qu.: 0.000         NA's:720
## Median : 0.300
## Mean   : 2.417
## 3rd Qu.: 2.625
## Max.   :17.700
## comp_flag_MLY-TMAX-AVGNDS-GRTH090 years_MLY-TMAX-AVGNDS-GRTH090
## Length:720             Min.   :12.00
## Class :character       1st Qu.:13.00
## Mode  :character       Median :16.00
##                               Mean   :16.94
##                               3rd Qu.:18.25
##                               Max.   :24.00
## MLY-TMAX-AVGNDS-GRTH100 meas_flag_MLY-TMAX-AVGNDS-GRTH100
## Min.   :0.0000         Mode:logical
## 1st Qu.:0.0000         NA's:720
## Median :0.0000
## Mean   :0.0083
## 3rd Qu.:0.0000
## Max.   :0.1000
## comp_flag_MLY-TMAX-AVGNDS-GRTH100 years_MLY-TMAX-AVGNDS-GRTH100
## Length:720             Min.   :12.00
## Class :character       1st Qu.:13.00
## Mode  :character       Median :16.00
##                               Mean   :16.94
##                               3rd Qu.:18.25
##                               Max.   :24.00
## MLY-TMAX-AVGNDS-LSTH032 meas_flag_MLY-TMAX-AVGNDS-LSTH032
## Min.   : 0.000         Mode:logical
## 1st Qu.: 0.000         NA's:720
## Median : 0.000
## Mean   : 1.454
## 3rd Qu.: 0.000
## Max.   :20.100
## comp_flag_MLY-TMAX-AVGNDS-LSTH032 years_MLY-TMAX-AVGNDS-LSTH032
## Length:720             Min.   :12.00

```

```

## Class :character          1st Qu.:13.00
## Mode :character          Median :16.00
##                               Mean  :16.94
##                               3rd Qu.:18.25
##                               Max.   :24.00
## MLY-HTDD-NORMAL meas_flag_MLY-HTDD-NORMAL comp_flag_MLY-HTDD-NORMAL
## Min. : 0.000 Mode:logical Length:720
## 1st Qu.: 0.000 NA's:720 Class :character
## Median : 0.000 Mode :character
## Mean : 164.062
## 3rd Qu.: 8.925
## Max. :1424.200
## years_MLY-HTDD-NORMAL MLY-HTDD-BASE40 meas_flag_MLY-HTDD-BASE40
## Min. :12.00 Min. : 0.00 Length:720
## 1st Qu.:13.00 1st Qu.: 0.00 Class :character
## Median :16.00 Median : 0.00 Mode :character
## Mean :16.75 Mean : 47.41
## 3rd Qu.:18.25 3rd Qu.: 0.00
## Max. :24.00 Max. :651.60
## comp_flag_MLY-HTDD-BASE40 years_MLY-HTDD-BASE40 MLY-HTDD-BASE45
## Length:720 Min. :12.00 Min. : 0.00
## Class :character 1st Qu.:13.00 1st Qu.: 0.00
## Mode :character Median :16.00 Median : 0.00
## Mean :16.75 Mean : 65.01
## 3rd Qu.:18.25 3rd Qu.: 0.00
## Max. :24.00 Max. :804.50
## meas_flag_MLY-HTDD-BASE45 comp_flag_MLY-HTDD-BASE45 years_MLY-HTDD-BASE45
## Mode:logical Length:720 Min. :12.00
## NA's:720 Class :character 1st Qu.:13.00
## Mode :character Median :16.00
## Mean :16.75
## 3rd Qu.:18.25
## Max. :24.00
## MLY-HTDD-BASE50 meas_flag_MLY-HTDD-BASE50 comp_flag_MLY-HTDD-BASE50
## Min. : 0.00 Mode:logical Length:720
## 1st Qu.: 0.00 NA's:720 Class :character
## Median : 0.00 Mode :character
## Mean : 85.35
## 3rd Qu.: 0.00
## Max. :959.10
## years_MLY-HTDD-BASE50 MLY-HTDD-BASE55 meas_flag_MLY-HTDD-BASE55
## Min. :12.00 Min. : 0.000 Mode:logical
## 1st Qu.:13.00 1st Qu.: 0.000 NA's:720
## Median :16.00 Median : 0.000
## Mean :16.75 Mean : 108.329
## 3rd Qu.:18.25 3rd Qu.: 0.025
## Max. :24.00 Max. :1114.200
## comp_flag_MLY-HTDD-BASE55 years_MLY-HTDD-BASE55 MLY-HTDD-BASE57
## Length:720 Min. :12.00 Min. : 0.00
## Class :character 1st Qu.:13.00 1st Qu.: 0.00
## Mode :character Median :16.00 Median : 0.00
## Mean :16.75 Mean : 118.32
## 3rd Qu.:18.25 3rd Qu.: 0.15
## Max. :24.00 Max. :1176.30

```

```

## meas_flag_MLY-HTDD-BASE57 comp_flag_MLY-HTDD-BASE57 years_MLY-HTDD-BASE57
## Mode:logical          Length:720          Min.    :12.00
## NA's:720              Class :character      1st Qu.:13.00
##                      Mode  :character      Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-HTDD-BASE60      meas_flag_MLY-HTDD-BASE60 comp_flag_MLY-HTDD-BASE60
## Min.    : 0.000      Mode:logical          Length:720
## 1st Qu.: 0.000      NA's:720              Class :character
## Median : 0.000      Mode  :character
## Mean   :134.323
## 3rd Qu.: 1.425
## Max.   :1269.100
## years_MLY-HTDD-BASE60 MLY-CLDD-NORMAL meas_flag_MLY-CLDD-NORMAL
## Min.    :12.00      Min.    : 0.0      Mode:logical
## 1st Qu.:13.00      1st Qu.:274.1  NA's:720
## Median :16.00      Median :438.6
## Mean   :16.75      Mean   :350.6
## 3rd Qu.:18.25      3rd Qu.:471.8
## Max.   :24.00      Max.   :593.6
## comp_flag_MLY-CLDD-NORMAL years_MLY-CLDD-NORMAL MLY-CLDD-BASE40
## Length:720          Min.    :12.00      Min.    : 2.4
## Class :character      1st Qu.:13.00      1st Qu.: 983.9
## Mode  :character      Median :16.00      Median :1207.5
##                      Mean   :16.75      Mean   : 994.4
##                      3rd Qu.:18.25      3rd Qu.:1235.0
##                      Max.   :24.00      Max.   :1368.6
## meas_flag_MLY-CLDD-BASE40 comp_flag_MLY-CLDD-BASE40 years_MLY-CLDD-BASE40
## Mode:logical          Length:720          Min.    :12.00
## NA's:720              Class :character      1st Qu.:13.00
##                      Mode  :character      Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-CLDD-BASE45      meas_flag_MLY-CLDD-BASE45 comp_flag_MLY-CLDD-BASE45
## Min.    : 0.5      Mode:logical          Length:720
## 1st Qu.: 840.1      NA's:720              Class :character
## Median :1052.5      Mode  :character
## Mean   : 859.9
## 3rd Qu.:1080.8
## Max.   :1213.6
## years_MLY-CLDD-BASE45 MLY-CLDD-BASE50      meas_flag_MLY-CLDD-BASE50
## Min.    :12.00      Min.    : 0.0      Length:720
## 1st Qu.:13.00      1st Qu.: 696.4      Class :character
## Median :16.00      Median : 898.0      Mode  :character
## Mean   :16.75      Mean   : 728.1
## 3rd Qu.:18.25      3rd Qu.: 928.8
## Max.   :24.00      Max.   :1058.6
## comp_flag_MLY-CLDD-BASE50 years_MLY-CLDD-BASE50 MLY-CLDD-BASE55
## Length:720          Min.    :12.00      Min.    : 0.0
## Class :character      1st Qu.:13.00      1st Qu.:552.6
## Mode  :character      Median :16.00      Median :745.5
##                      Mean   :16.75      Mean   :599.0

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##          3rd Qu.:18.25          3rd Qu.:775.0
##          Max.    :24.00          Max.    :903.6
## meas_flag_MLY-CLDD-BASE55 comp_flag_MLY-CLDD-BASE55 years_MLY-CLDD-BASE55
## Mode:logical          Length:720          Min.    :12.00
## NA's:720              Class :character          1st Qu.:13.00
##                      Mode  :character          Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-CLDD-BASE57 meas_flag_MLY-CLDD-BASE57 comp_flag_MLY-CLDD-BASE57
## Min.    : 0.0 Mode:logical          Length:720
## 1st Qu.:495.3 NA's:720              Class :character
## Median :684.5                      Mode  :character
## Mean   :548.2
## 3rd Qu.:713.5
## Max.   :841.6
## years_MLY-CLDD-BASE57 MLY-CLDD-BASE60 meas_flag_MLY-CLDD-BASE60
## Min.    :12.00          Min.    : 0.0 Mode:logical
## 1st Qu.:13.00          1st Qu.:410.3 NA's:720
## Median :16.00          Median :593.0
## Mean   :16.75          Mean   :473.0
## 3rd Qu.:18.25          3rd Qu.:623.1
## Max.   :24.00          Max.   :748.6
## comp_flag_MLY-CLDD-BASE60 years_MLY-CLDD-BASE60 MLY-CLDD-BASE70
## Length:720          Min.    :12.00          Min.    : 0.0
## Class :character          1st Qu.:13.00          1st Qu.:149.6
## Mode  :character          Median :16.00          Median :283.8
##                      Mean   :16.75          Mean   :232.1
##                      3rd Qu.:18.25          3rd Qu.:319.7
##                      Max.   :24.00          Max.   :438.6
## meas_flag_MLY-CLDD-BASE70 comp_flag_MLY-CLDD-BASE70 years_MLY-CLDD-BASE70
## Length:720          Length:720          Min.    :12.00
## Class :character          Class :character          1st Qu.:13.00
## Mode  :character          Mode  :character          Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-CLDD-BASE72 meas_flag_MLY-CLDD-BASE72 comp_flag_MLY-CLDD-BASE72
## Min.    : 0.0 Length:720          Length:720
## 1st Qu.:103.4 Class :character          Class :character
## Median :222.7 Mode  :character          Mode  :character
## Mean   :185.7
## 3rd Qu.:258.2
## Max.   :376.6
## years_MLY-CLDD-BASE72 MLY-GRDD-BASE65 meas_flag_MLY-GRDD-BASE65
## Min.    :12.00          Min.    : 0.0 Mode:logical
## 1st Qu.:13.00          1st Qu.:274.1 NA's:720
## Median :16.00          Median :438.6
## Mean   :16.75          Mean   :350.6
## 3rd Qu.:18.25          3rd Qu.:471.8
## Max.   :24.00          Max.   :593.6
## comp_flag_MLY-GRDD-BASE65 years_MLY-GRDD-BASE65 MLY-GRDD-BASE40
## Length:720          Min.    :12.00          Min.    : 2.4
## Class :character          1st Qu.:13.00          1st Qu.: 983.9

```

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## Mode :character      Median :16.00      Median :1207.5
##                      Mean :16.75      Mean : 994.4
##                      3rd Qu.:18.25      3rd Qu.:1235.0
##                      Max. :24.00      Max. :1368.6
## meas_flag_MLY-GRDD-BASE40 comp_flag_MLY-GRDD-BASE40 years_MLY-GRDD-BASE40
## Mode:logical      Length:720      Min. :12.00
## NA's:720      Class :character      1st Qu.:13.00
##                      Mode :character      Median :16.00
##                      Mean :16.75
##                      3rd Qu.:18.25
##                      Max. :24.00
## MLY-GRDD-BASE45 meas_flag_MLY-GRDD-BASE45 comp_flag_MLY-GRDD-BASE45
## Min. : 0.5      Mode:logical      Length:720
## 1st Qu.: 840.1      NA's:720      Class :character
## Median :1052.5      Mode :character
## Mean : 859.9
## 3rd Qu.:1080.8
## Max. :1213.6
## years_MLY-GRDD-BASE45 MLY-GRDD-BASE50 meas_flag_MLY-GRDD-BASE50
## Min. :12.00      Min. : 0.0      Length:720
## 1st Qu.:13.00      1st Qu.: 696.4      Class :character
## Median :16.00      Median : 898.0      Mode :character
## Mean :16.75      Mean : 728.1
## 3rd Qu.:18.25      3rd Qu.: 928.8
## Max. :24.00      Max. :1058.6
## comp_flag_MLY-GRDD-BASE50 years_MLY-GRDD-BASE50 MLY-GRDD-BASE55
## Length:720      Min. :12.00      Min. : 0.0
## Class :character      1st Qu.:13.00      1st Qu.:552.6
## Mode :character      Median :16.00      Median :745.5
##                      Mean :16.75      Mean :599.0
##                      3rd Qu.:18.25      3rd Qu.:775.0
##                      Max. :24.00      Max. :903.6
## meas_flag_MLY-GRDD-BASE55 comp_flag_MLY-GRDD-BASE55 years_MLY-GRDD-BASE55
## Mode:logical      Length:720      Min. :12.00
## NA's:720      Class :character      1st Qu.:13.00
##                      Mode :character      Median :16.00
##                      Mean :16.75
##                      3rd Qu.:18.25
##                      Max. :24.00
## MLY-GRDD-BASE57 meas_flag_MLY-GRDD-BASE57 comp_flag_MLY-GRDD-BASE57
## Min. : 0.0      Mode:logical      Length:720
## 1st Qu.:495.3      NA's:720      Class :character
## Median :684.5      Mode :character
## Mean :548.2
## 3rd Qu.:713.5
## Max. :841.6
## years_MLY-GRDD-BASE57 MLY-GRDD-BASE60 meas_flag_MLY-GRDD-BASE60
## Min. :12.00      Min. : 0.0      Mode:logical
## 1st Qu.:13.00      1st Qu.:410.3      NA's:720
## Median :16.00      Median :593.0
## Mean :16.75      Mean :473.0
## 3rd Qu.:18.25      3rd Qu.:623.1
## Max. :24.00      Max. :748.6
## comp_flag_MLY-GRDD-BASE60 years_MLY-GRDD-BASE60 MLY-GRDD-BASE70

```

```

## Length:720          Min.   :12.00          Min.   : 0.0
## Class :character     1st Qu.:13.00          1st Qu.:149.6
## Mode  :character     Median :16.00          Median :283.8
##                      Mean   :16.75          Mean   :232.1
##                      3rd Qu.:18.25          3rd Qu.:319.7
##                      Max.   :24.00          Max.   :438.6
## meas_flag_MLY-GRDD-BASE70 comp_flag_MLY-GRDD-BASE70 years_MLY-GRDD-BASE70
## Length:720          Length:720          Min.   :12.00
## Class :character     Class :character     1st Qu.:13.00
## Mode  :character     Mode  :character     Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-GRDD-BASE72 meas_flag_MLY-GRDD-BASE72 comp_flag_MLY-GRDD-BASE72
## Min.   : 0.0 Length:720          Length:720
## 1st Qu.:103.4 Class :character     Class :character
## Median :222.7 Mode  :character     Mode  :character
## Mean   :185.7
## 3rd Qu.:258.2
## Max.   :376.6
## years_MLY-GRDD-BASE72 MLY-GRDD-TB4886 meas_flag_MLY-GRDD-TB4886
## Min.   :12.00          Min.   : 1.0 Mode:logical
## 1st Qu.:13.00          1st Qu.: 753.0 NA's:720
## Median :16.00          Median : 947.0
## Mean   :16.75          Mean   : 773.6
## 3rd Qu.:18.25          3rd Qu.: 979.1
## Max.   :24.00          Max.   :1059.9
## comp_flag_MLY-GRDD-TB4886 years_MLY-GRDD-TB4886 MLY-GRDD-TB5086
## Length:720          Min.   :12.00          Min.   : 0.6
## Class :character     1st Qu.:13.00          1st Qu.:696.3
## Mode  :character     Median :16.00          Median :886.0
##                      Mean   :16.75          Mean   :721.6
##                      3rd Qu.:18.25          3rd Qu.:918.6
##                      Max.   :24.00          Max.   :997.9
## meas_flag_MLY-GRDD-TB5086 comp_flag_MLY-GRDD-TB5086 years_MLY-GRDD-TB5086
## Mode:logical          Length:720          Min.   :12.00
## NA's:720              Class :character     1st Qu.:13.00
##                      Mode  :character     Median :16.00
##                      Mean   :16.75
##                      3rd Qu.:18.25
##                      Max.   :24.00
## MLY-TMIN-PRBOCC-LSTH016 meas_flag_MLY-TMIN-PRBOCC-LSTH016
## Min.   : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean   : 10.04
## 3rd Qu.: 0.00
## Max.   :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH016 years_MLY-TMIN-PRBOCC-LSTH016
## Length:720          Min.   :12.00
## Class :character     1st Qu.:13.00
## Mode  :character     Median :16.00
##                      Mean   :16.85
##                      3rd Qu.:18.75

```



```

##                                     Max.      :24.00
## MLY-TMIN-PRBOCC-LSTH020 meas_flag_MLY-TMIN-PRBOCC-LSTH020
## Min.      : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean    : 11.42
## 3rd Qu.: 0.00
## Max.    :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH020 years_MLY-TMIN-PRBOCC-LSTH020
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                               Mean    :16.85
##                               3rd Qu.:18.75
##                               Max.    :24.00
## MLY-TMIN-PRBOCC-LSTH024 meas_flag_MLY-TMIN-PRBOCC-LSTH024
## Min.      : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean    : 13.03
## 3rd Qu.: 0.00
## Max.    :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH024 years_MLY-TMIN-PRBOCC-LSTH024
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                               Mean    :16.85
##                               3rd Qu.:18.75
##                               Max.    :24.00
## MLY-TMIN-PRBOCC-LSTH028 meas_flag_MLY-TMIN-PRBOCC-LSTH028
## Min.      : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean    : 14.71
## 3rd Qu.: 0.00
## Max.    :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH028 years_MLY-TMIN-PRBOCC-LSTH028
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                               Mean    :16.85
##                               3rd Qu.:18.75
##                               Max.    :24.00
## MLY-TMIN-PRBOCC-LSTH032 meas_flag_MLY-TMIN-PRBOCC-LSTH032
## Min.      : 0.00          Mode:logical
## 1st Qu.: 0.00          NA's:720
## Median : 0.00
## Mean    : 16.25
## 3rd Qu.: 0.00
## Max.    :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH032 years_MLY-TMIN-PRBOCC-LSTH032
## Length:720              Min.      :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00

```

```

##                               Mean   :16.85
##                               3rd Qu.:18.75
##                               Max.   :24.00
## MLY-TMIN-PRBOCC-LSTH036 meas_flag_MLY-TMIN-PRBOCC-LSTH036
## Min.   : 0.00           Mode:logical
## 1st Qu.: 0.00           NA's:720
## Median : 0.00
## Mean   : 17.91
## 3rd Qu.: 0.00
## Max.   :100.00
## comp_flag_MLY-TMIN-PRBOCC-LSTH036 years_MLY-TMIN-PRBOCC-LSTH036
## Length:720              Min.    :12.00
## Class :character        1st Qu.:13.00
## Mode  :character        Median :16.00
##                               Mean   :16.85
##                               3rd Qu.:18.75
##                               Max.   :24.00
## Station_ID
## Length:720
## Class :character
## Mode  :character
##
##
##

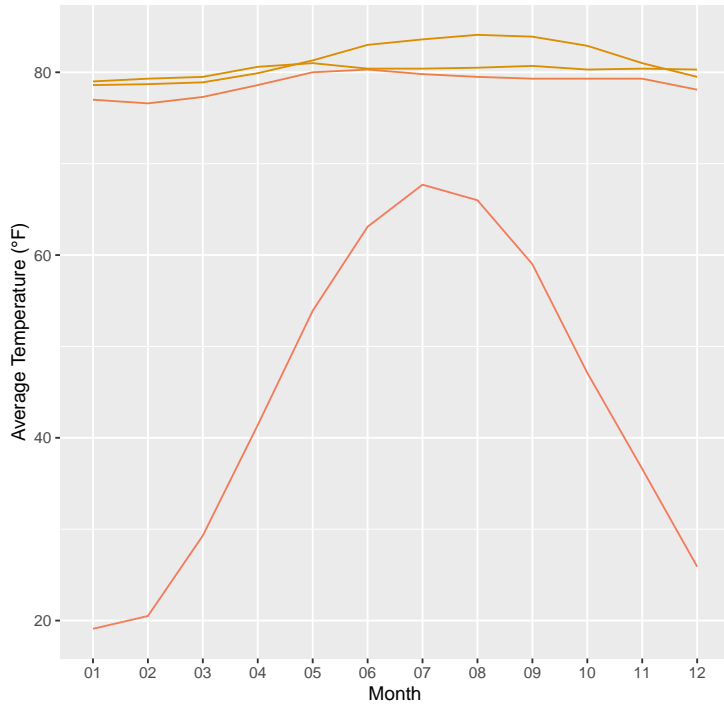
```

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.

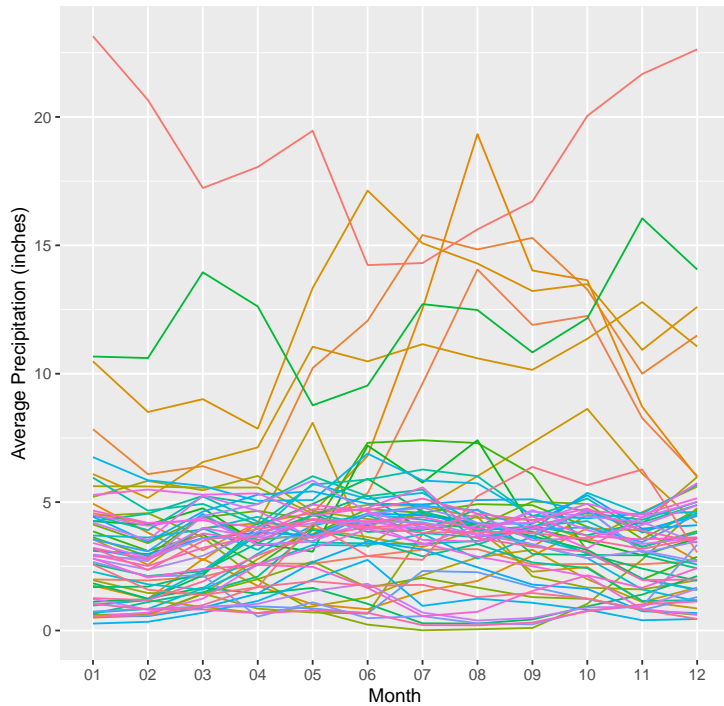
Monthly Average Temperature by Station



Station_ID

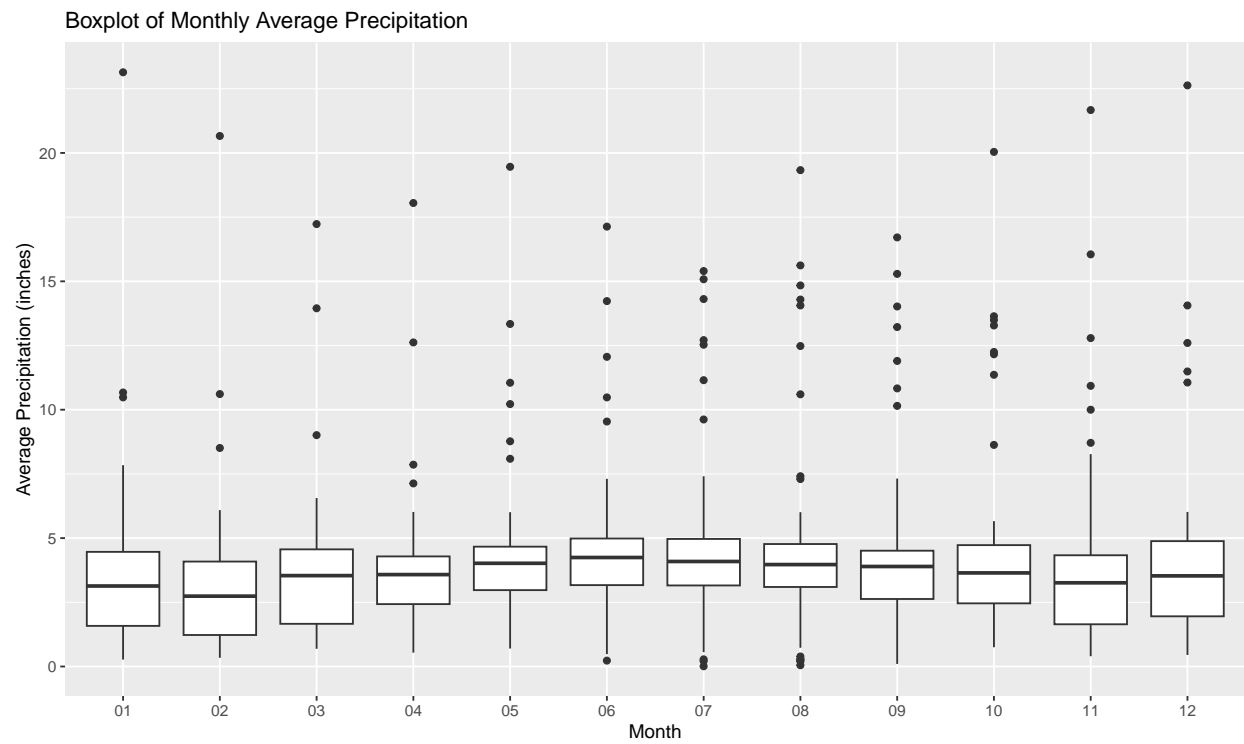
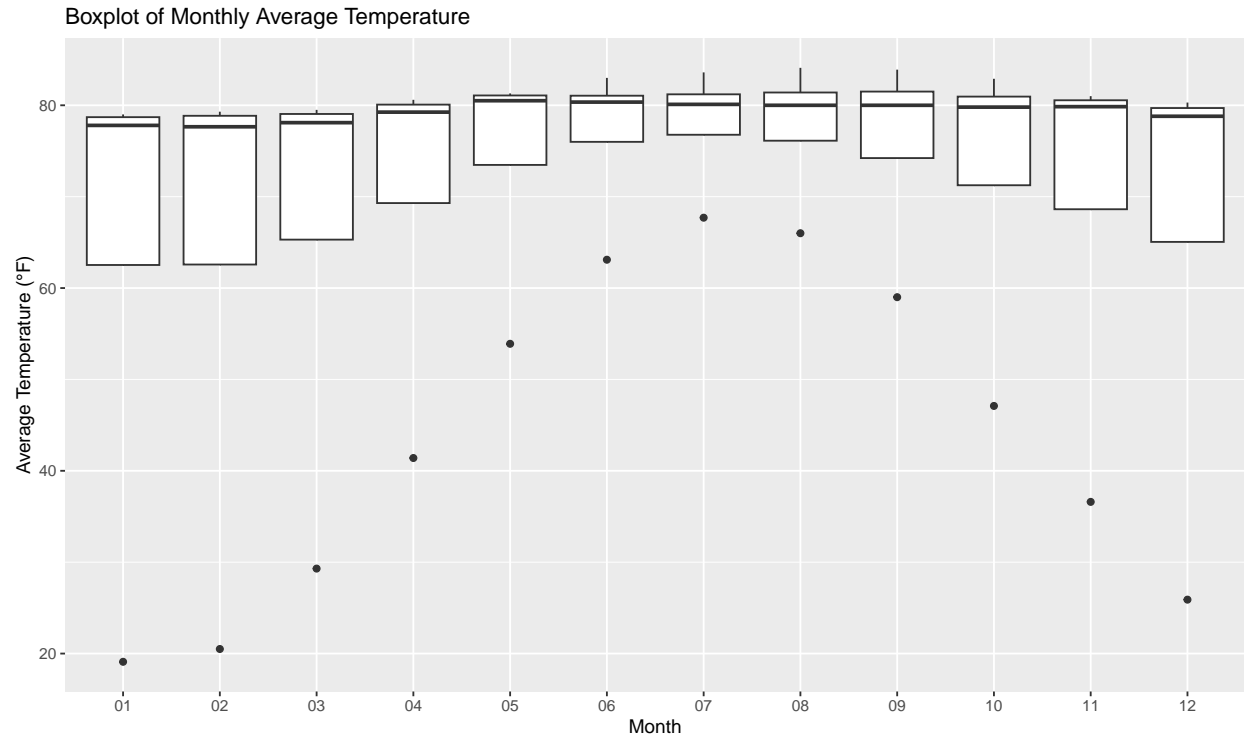
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CQC00914080	US1IDAD0002	US1NYAB0001
FMC00914163	US1ILBN0014	US1OHAL0005
GQC00914001	US1INAL0001	US1OKAD0002
JQW00021603	US1KSBA0004	US1ORBK0008
PSC00914519	US1KYAL0004	US1PAAD0002
RMC00913915	US1LAAS0005	US1RIKN0002
RQ1PRAC0001	US1MABA0001	US1SCAB0016
US10adam002	US1MDAA0001	US1SDBD0007
US1AKAB0021	US1MECM0003	US1TNAN0003
US1ALBL0005	US1MIAG0006	US1TXAG0001
US1ARAS0001	US1MNAA0004	US1UTBE0002
US1AZAP0007	US1MOAW0007	US1VAAB0012
US1CAAL0001	US1MSAM0001	US1VTCH0004
US1COAD0022	US1MTBV0002	US1WAAD0006
US1CTFR0003	US1NCAG0001	US1WIAS0004
US1DEKN0001	US1NDBH0034	US1WVBY0002
US1FLAL0004	US1NHBK0002	US1WYAB0001
US1GAAT0002	US1NJAT0001	VQ1VIST0001

Monthly Average Precipitation by Station

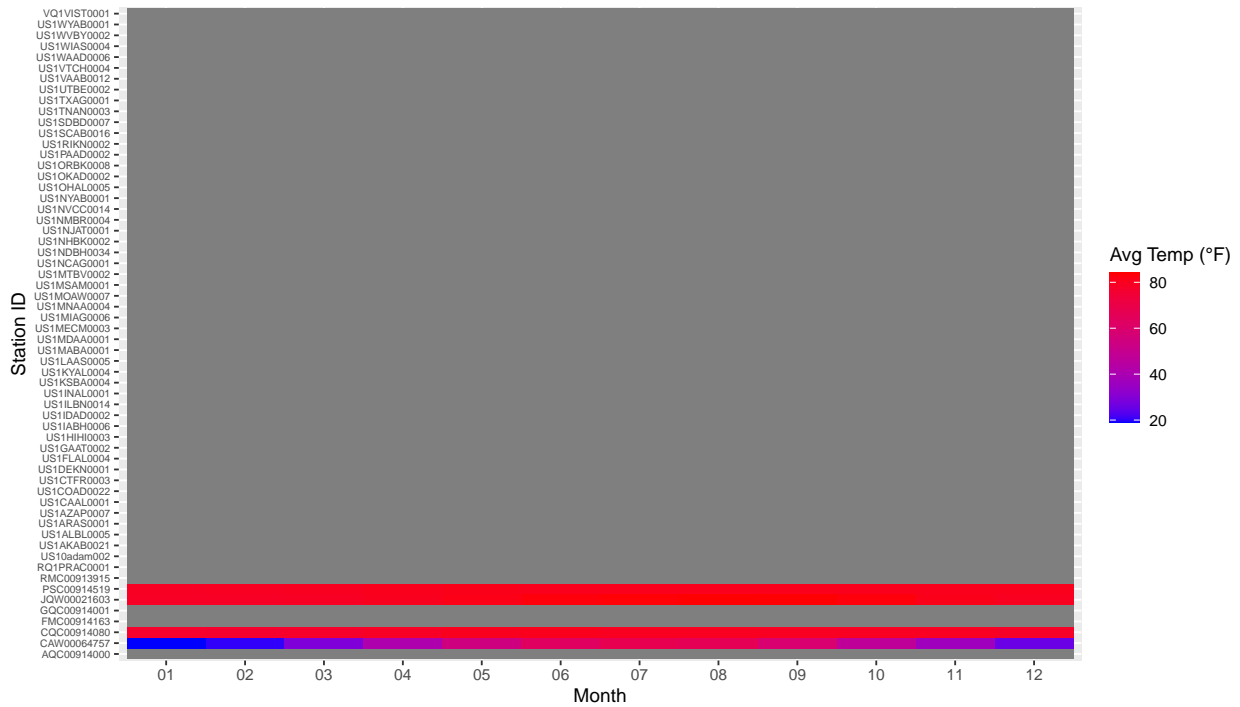


Station_ID

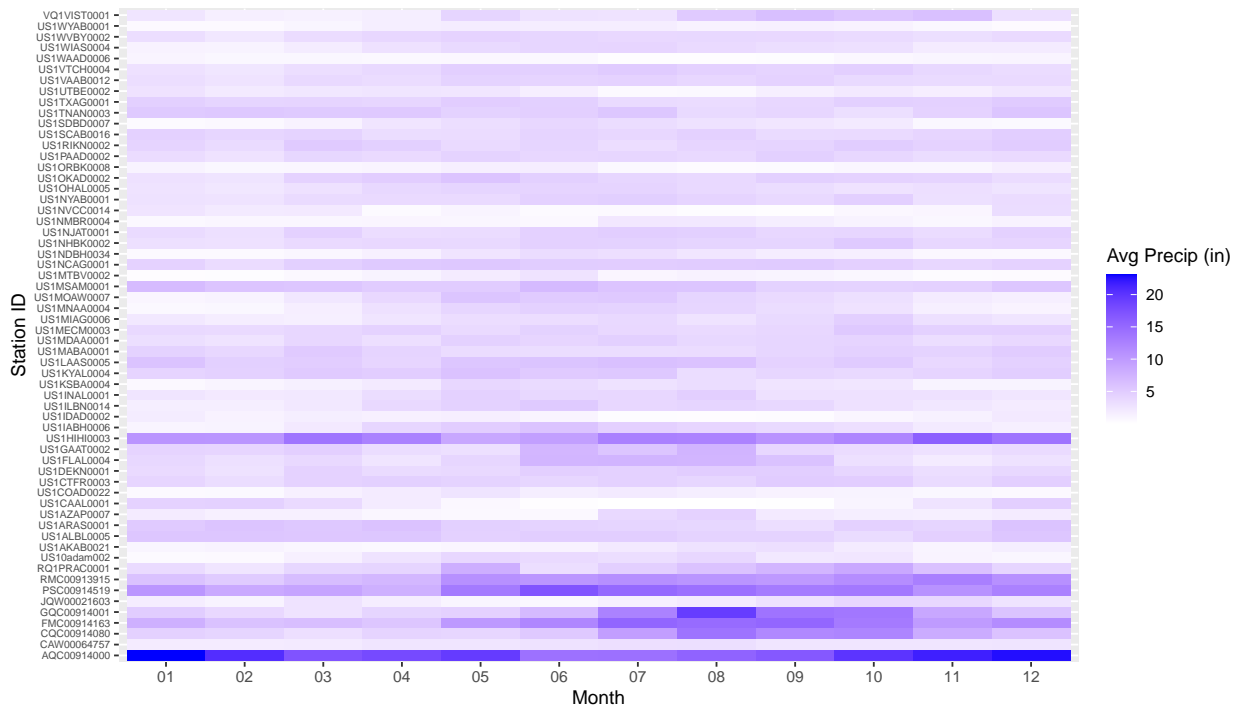
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FMC00914163	US1ILBN0014	US1OHAL0005
GQC00914001	US1INAL0001	US1OKAD0002
JQW00021603	US1KSBA0004	US1ORBK0008
PSC00914519	US1KYAL0004	US1PAAD0002
RMC00913915	US1LAAS0005	US1RIKN0002
RQ1PRAC0001	US1MABA0001	US1SCAB0016
US10adam002	US1MDAA0001	US1SDBD0007
US1AKAB0021	US1MECM0003	US1TNAN0003
US1ALBL0005	US1MIAG0006	US1TXAG0001
US1ARAS0001	US1MNAA0004	US1UTBE0002
US1AZAP0007	US1MOAW0007	US1VAAB0012
US1CAAL0001	US1MSAM0001	US1VTCH0004
US1COAD0022	US1MTBV0002	US1WAAD0006
US1CTFR0003	US1NCAG0001	US1WIAS0004
US1DEKN0001	US1NDBH0034	US1WVBY0002
US1FLAL0004	US1NHBK0002	US1WYAB0001
US1GAAT0002	US1NJAT0001	VQ1VIST0001



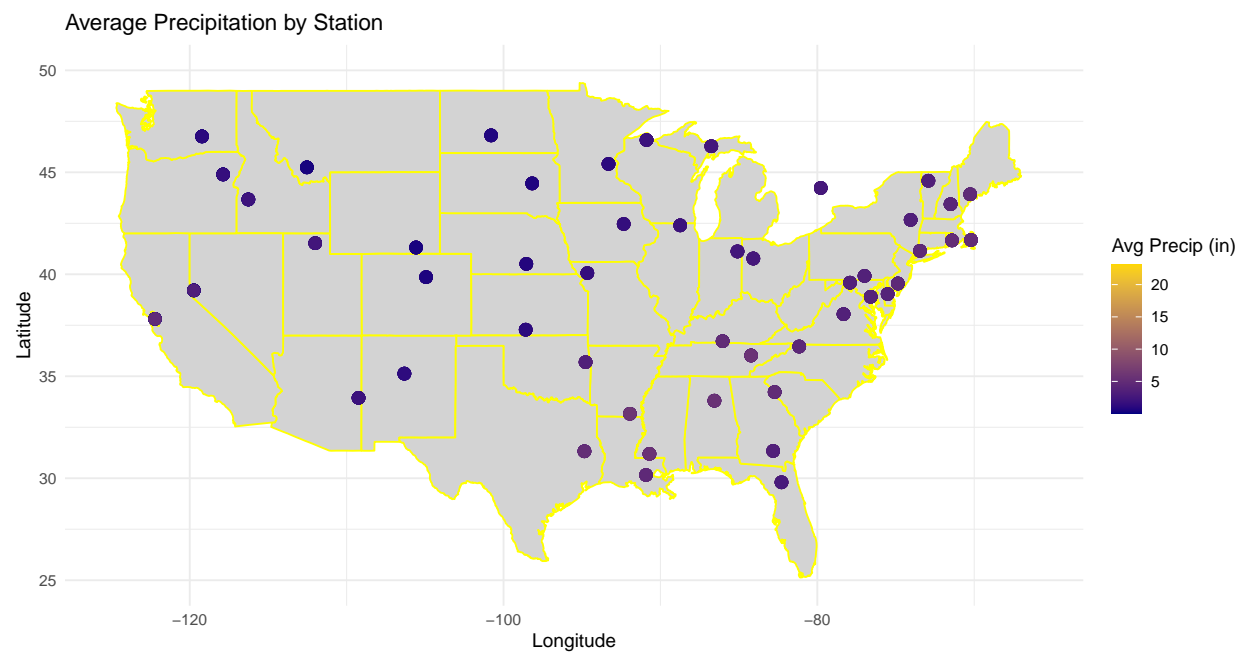
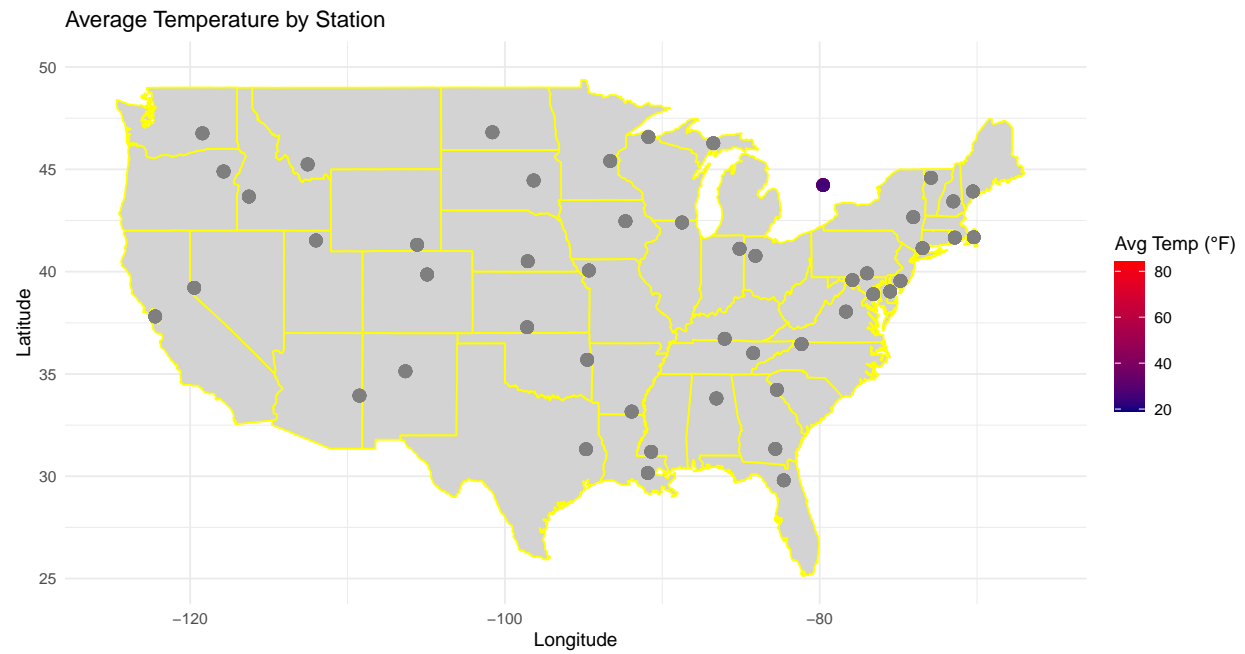
Heatmap of Monthly Average Temperature



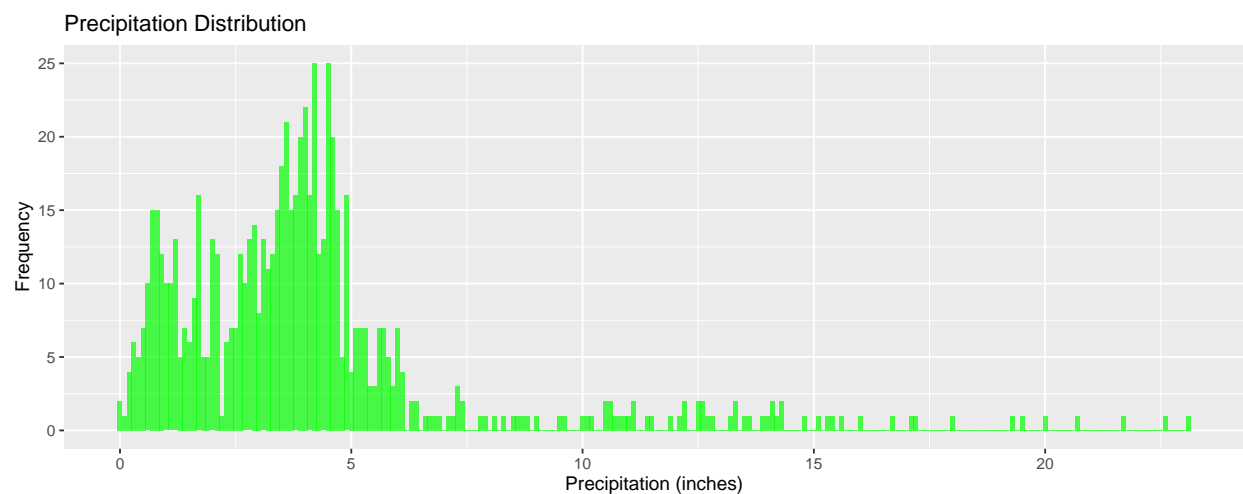
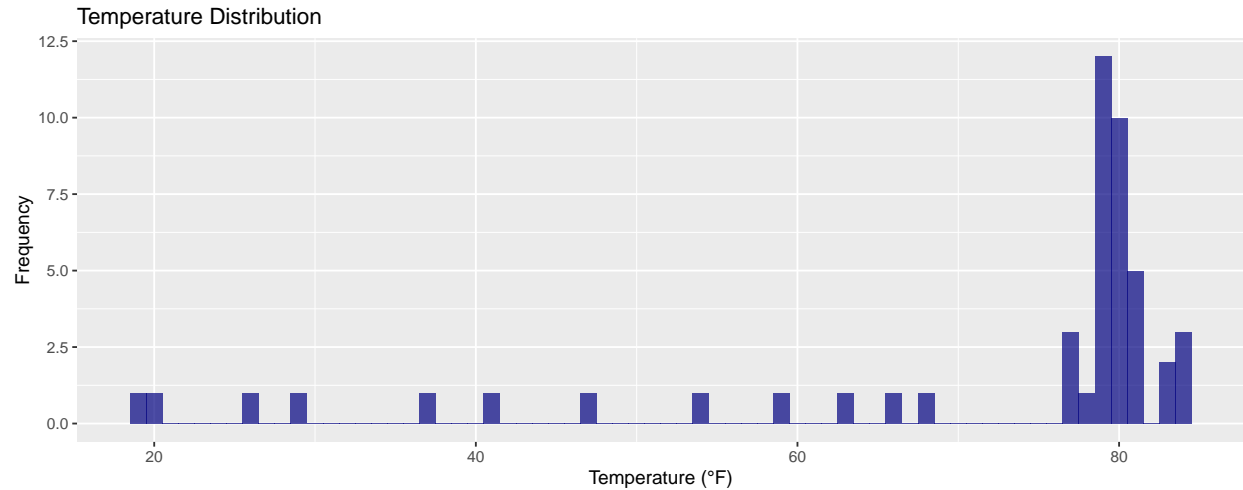
Heatmap of Monthly Average Precipitation



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.



References

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