NASA GISS Surface Temperature Analysis

Nishi Mahato

2/29/2020

Temperature Data Analysis

NASA GISS Surface Temperature Analysis is an estimate of global surface temperature change. Temperature analysis were carried out from 1980 to 2015. Temperature data also shows the northern, southern, and latitudes data. We could able to see the Global Temperature Change from the below plots. The below plots are derived from these two datasets. 1. NASA-GISTEMP-Data 2. NASA-GISTEMP-Data2

```
#install the library
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(tidyr)
library(ggplot2)

#Upload the datasets
gistTemp2<- read.csv("/Users/rajeshkumarpanigrahi/Downloads/NASA GISS Assignment/NASA-GISTEMP-Data2CSV.

head(gistTemp2[1:10])
```

```
##   Year Glob NHem SHem X24N.90N X24S.24N X90S.24S X64N.90N X44N.64N X24N.44N
## 1 1880  -19  -33   -5      -38      -16       -5      -89      -54      -22
## 2 1881  -10  -18   -2      -27       -2       -5      -54      -40      -14
## 3 1882   -9  -17   -1      -21      -10        4     -125      -20       -3
## 4 1883  -19  -30   -8      -34      -22       -2      -28      -57      -20
## 5 1884  -27  -42  -12      -56      -17      -11     -127      -58      -41
## 6 1885  -31  -41  -21      -61      -17      -20     -119      -70      -43
```

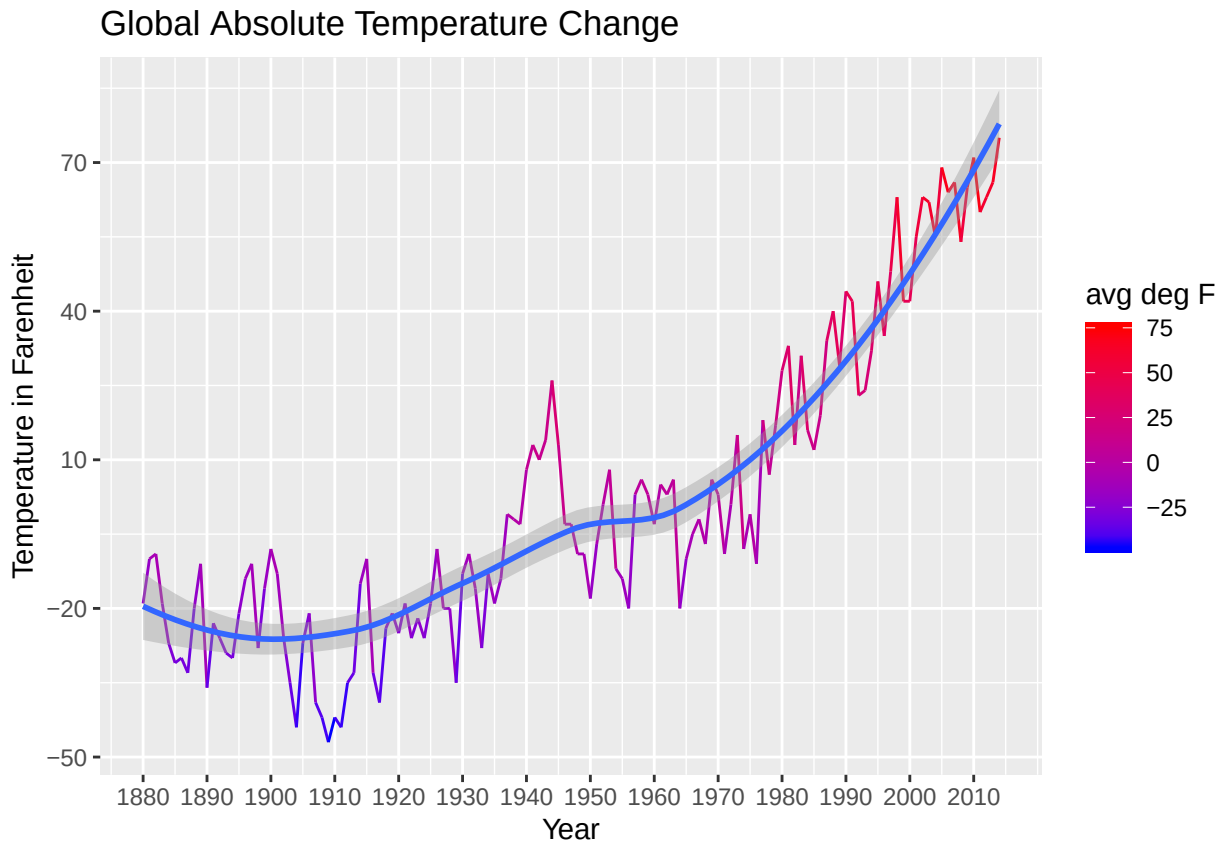
```
gistTemp<- read.csv("/Users/rajeshkumarpanigrahi/Downloads/NASA GISS Assignment/NASA-GISTEMP-DataCSV.csv

head(gistTemp[1:10])
```

```
##   Year Jan Feb Mar Apr May Jun Jul Aug Sep
## 1 1880 -29 -19 -17 -27 -13 -28 -22  -6 -16
## 2 1881  -8 -13   2  -2  -3 -27  -5  -1  -8
## 3 1882  10  10   2 -19 -17 -24  -9   5   0
## 4 1883 -32 -41 -17 -23 -24 -11  -7 -12 -18
## 5 1884 -17 -11 -33 -35 -31 -37 -33 -25 -22
## 6 1885 -64 -29 -23 -44 -41 -50 -28 -27 -19
```

Data Visualization

Plot 1 : The below graph shows the global temperature change from year 1880 to 2015.

```
ggplot(gistTemp2,aes(Year,Glob)) +
  geom_line(aes(color=Glob)) +
  geom_smooth(method="loess") +
  ggtitle("Global Absolute Temperature Change") + xlab("Year") + ylab("Temperature in Farenheit") +
  scale_y_continuous(breaks = seq(-50, 100, by = 30)) + scale_x_continuous(breaks = seq(1880, 2014, by =
  scale_color_gradient(low="blue", high="red", name = "avg deg F")
```

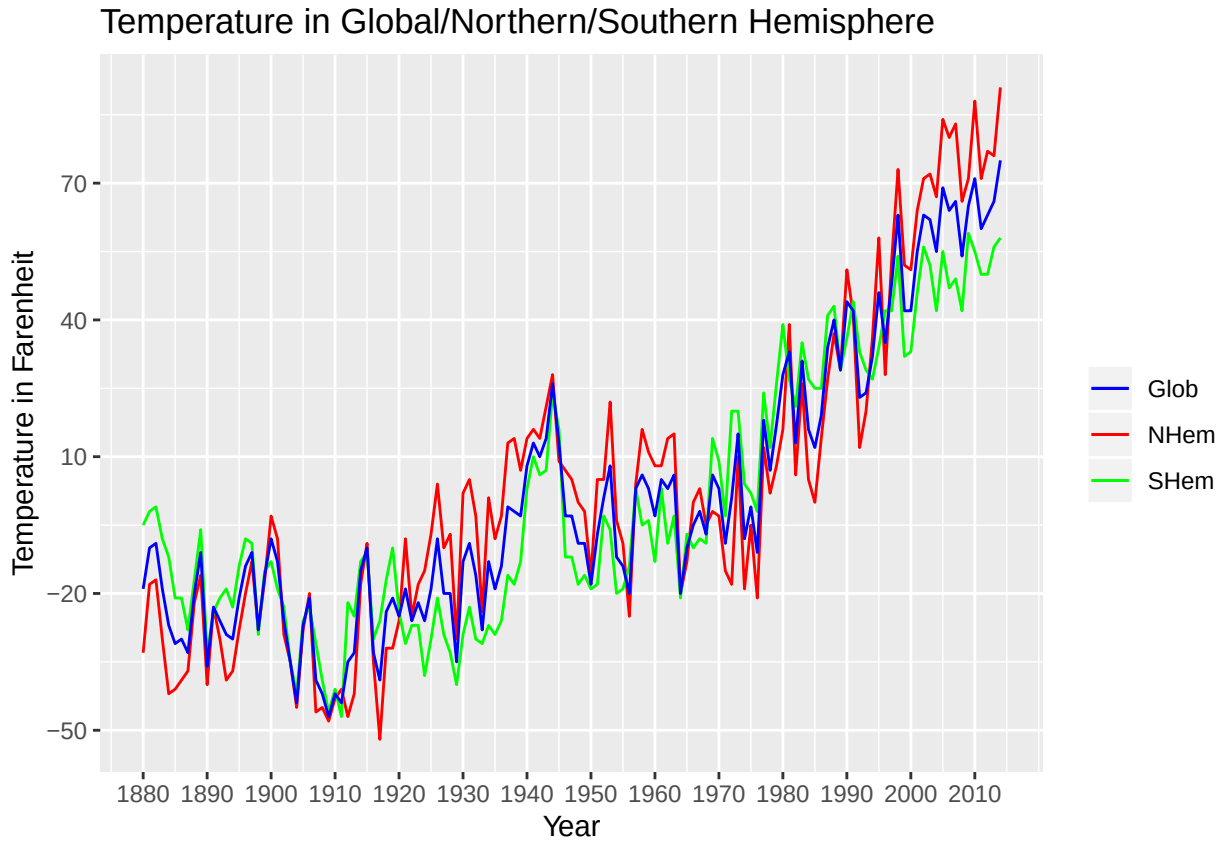


Observation

As we could see from the above graph that temperature is continuously increasing since 1980. There was also a high temperature increase in the year 1944.

Plot 2 : The below graph shows the global, northern and southern hemisphere temperature change from year 1880 to 2015

```
ggplot(gistTemp2,aes(x=Year)) +
  geom_line(aes(y= NHem, col="NHem")) +
  geom_line(aes(y= SHem, col="SHem")) +
  geom_line(aes(y= Glob, col="Glob")) +
  ggtitle("Temperature in Global/Northern/Southern Hemisphere")+xlab("Year") + ylab("Temperature in Far
  scale_y_continuous(breaks = seq(-50, 100, by = 30)) + scale_x_continuous(breaks = seq(1880, 2014, by =
  scale_color_manual(name="", values = c("Glob"= "blue","NHem" = "red", "SHem"= "green"))
```



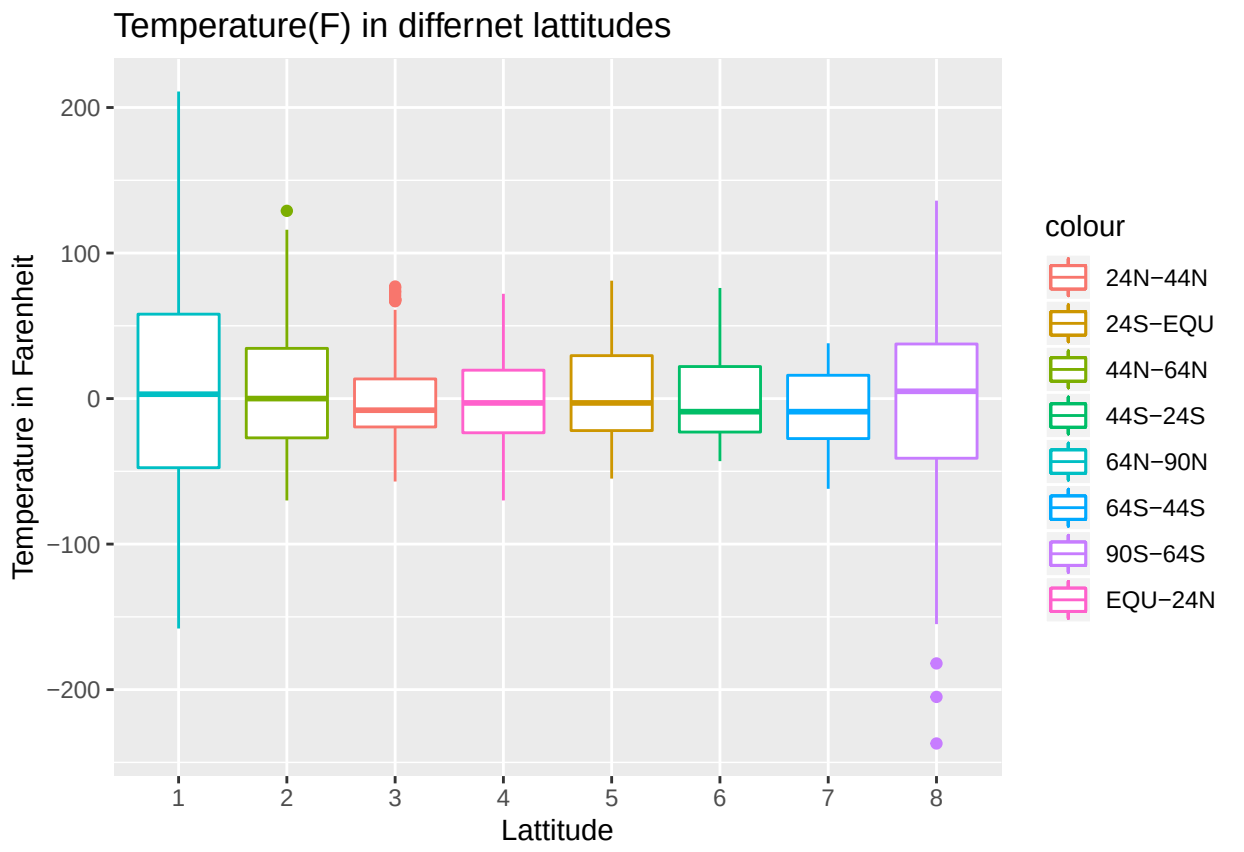
Observation

As we could see from the above plot that the northern hemisphere temperature was lowest in 1980 with compare to southern and global. But, in the year 2015 the northern temperature was highest in comparison with southern and global.

Plot 3 : The below graph shows the tempreature change in different lattitudes.

```
g1 <- gistTemp2
ggplot(g1) +
geom_boxplot(aes(x="1",y =X64N.90N, color="64N-90N")) +
geom_boxplot(aes(x="2",y =X44N.64N, color="44N-64N")) +
geom_boxplot(aes(x="3",y =X24N.44N, color="24N-44N")) +
```

```
geom_boxplot(aes(x="4",y =EQU.24N, color="EQU-24N")) +
geom_boxplot(aes(x="5",y =X24S.EQU, color="24S-EQU")) +
geom_boxplot(aes(x="6",y =X44S.24S, color="44S-24S")) +
geom_boxplot(aes(x="7",y =X64S.44S, color="64S-44S")) +
geom_boxplot(aes(x="8",y =X90S.64S, color="90S-64S")) +
ggtitle("Temperature(F) in differnet lattitudes")+xlab("Lattitude")+ ylab("Temperature in Farenheit")
```



Observation

As we could see from the above graph that maximum and minimum temperature is in north and south pole.

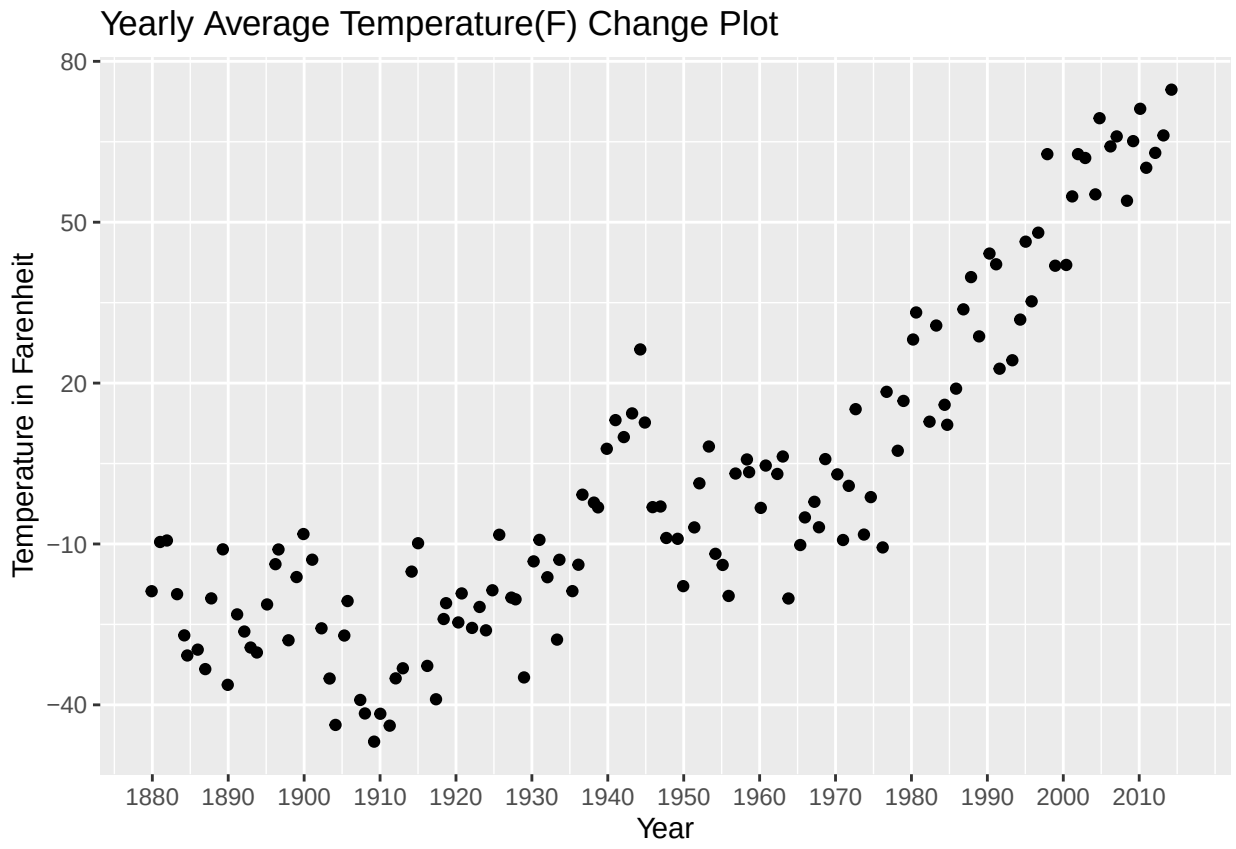
Plot 4 : Monthly temperature change from the year 1980 to 2015

```
#replace missed data with NA
gistTemp <- replace(gistTemp, gistTemp == "***",NA)
gistTemp <- replace(gistTemp, gistTemp == "****",NA)

#change string data to integer
gistTemp$Jul = as.numeric(as.character(gistTemp$Jul))
gistTemp$Aug = as.numeric(as.character(gistTemp$Aug))
gistTemp$Sep = as.numeric(as.character(gistTemp$Sep))
gistTemp$Oct = as.numeric(as.character(gistTemp$Oct))
gistTemp$Nov = as.numeric(as.character(gistTemp$Nov))
gistTemp$Dec = as.numeric(as.character(gistTemp$Dec))
```

```
gistTemp$DJF = as.numeric(as.character(gistTemp$DJF))
gistTemp$MAM = as.numeric(as.character(gistTemp$MAM))
gistTemp$JJA = as.numeric(as.character(gistTemp$JJA))
gistTemp$SON = as.numeric(as.character(gistTemp$SON))
gistTemp$J.D = as.numeric(as.character(gistTemp$J.D))
gistTemp$D.N = as.numeric(as.character(gistTemp$D.N))
```

```
ggplot(gistTemp, aes(Year,J.D)) +
  geom_jitter() +
  scale_y_continuous(breaks = seq(-100, 100, by = 30)) + scale_x_continuous(breaks = seq(1880, 2015, by
  ggtitle("Yearly Average Temperature(F) Change Plot")+xlab("Year")+ ylab("Temperature in Farenheit")
```

```
## Warning: Removed 1 rows containing missing values (geom_point).
```



Observation

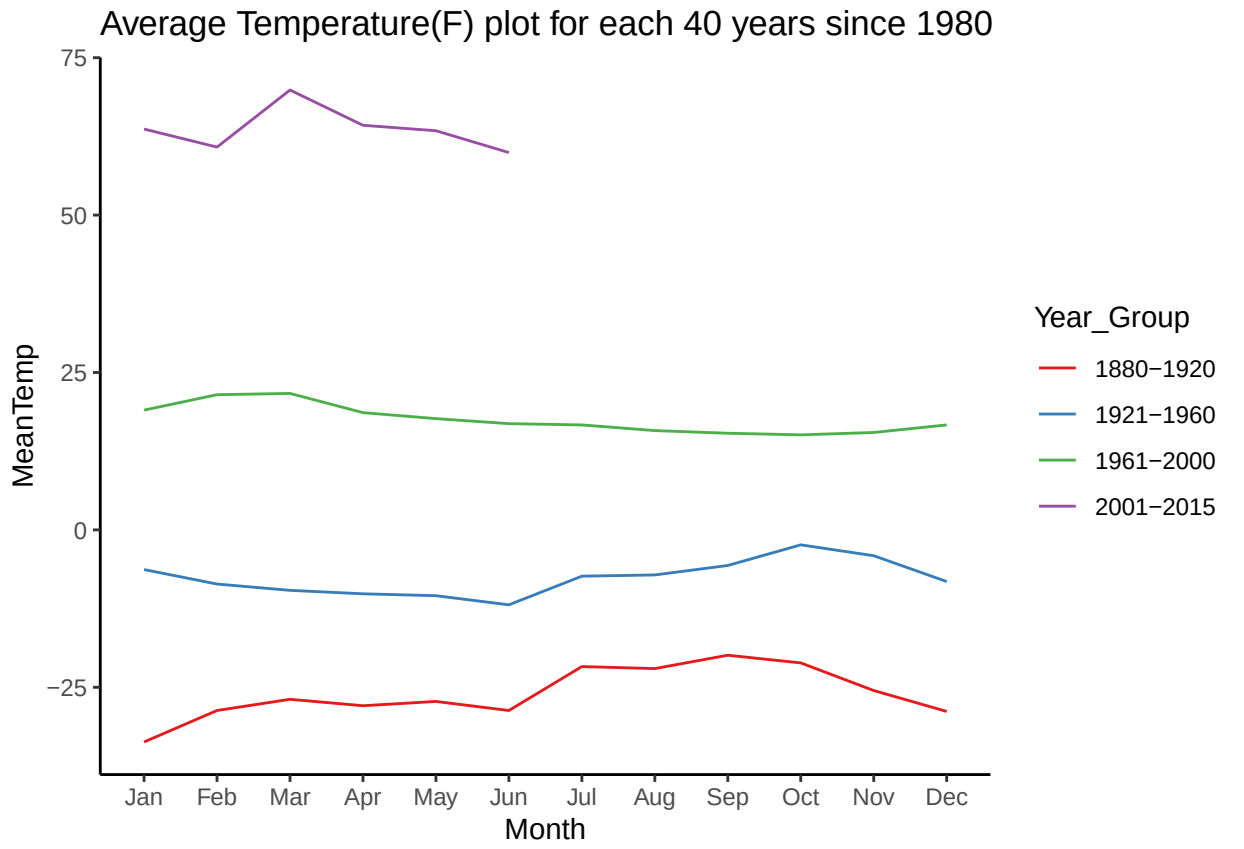
As we could see from the above plot that the temperature has increased since 1980. The temperature is increasing significantly since 1960.

Plot 5 : Average Temperature(F) plot for each 40 years from 1880 to 2015

```
data <- gistTemp[1:13] %>%
gather(Month, MeanTemp, -Year) %>%
```

```r
mutate(Month = factor(Month, month.abb),
Year_Group = case_when(
Year >= 1880 & Year <= 1920    ~"1880-1920",
Year >= 1921 & Year <= 1960    ~"1921-1960",
Year >= 1961 & Year <= 2000    ~"1961-2000",
Year >= 2001 & Year <= 2015    ~"2001-2015"
)) %>%
group_by(Year_Group, Month) %>%
summarise(MeanTemp = mean(MeanTemp))

ggplot(data, aes(x = Month, y = MeanTemp, color = Year_Group, group = Year_Group)) +
geom_line() +
scale_color_brewer(type = "qual", palette = "Set1") +
theme_classic() +
ggtitle("Average Temperature(F) plot for each 40 years since 1980")
```

```
## Warning: Removed 6 rows containing missing values (geom_path).
```



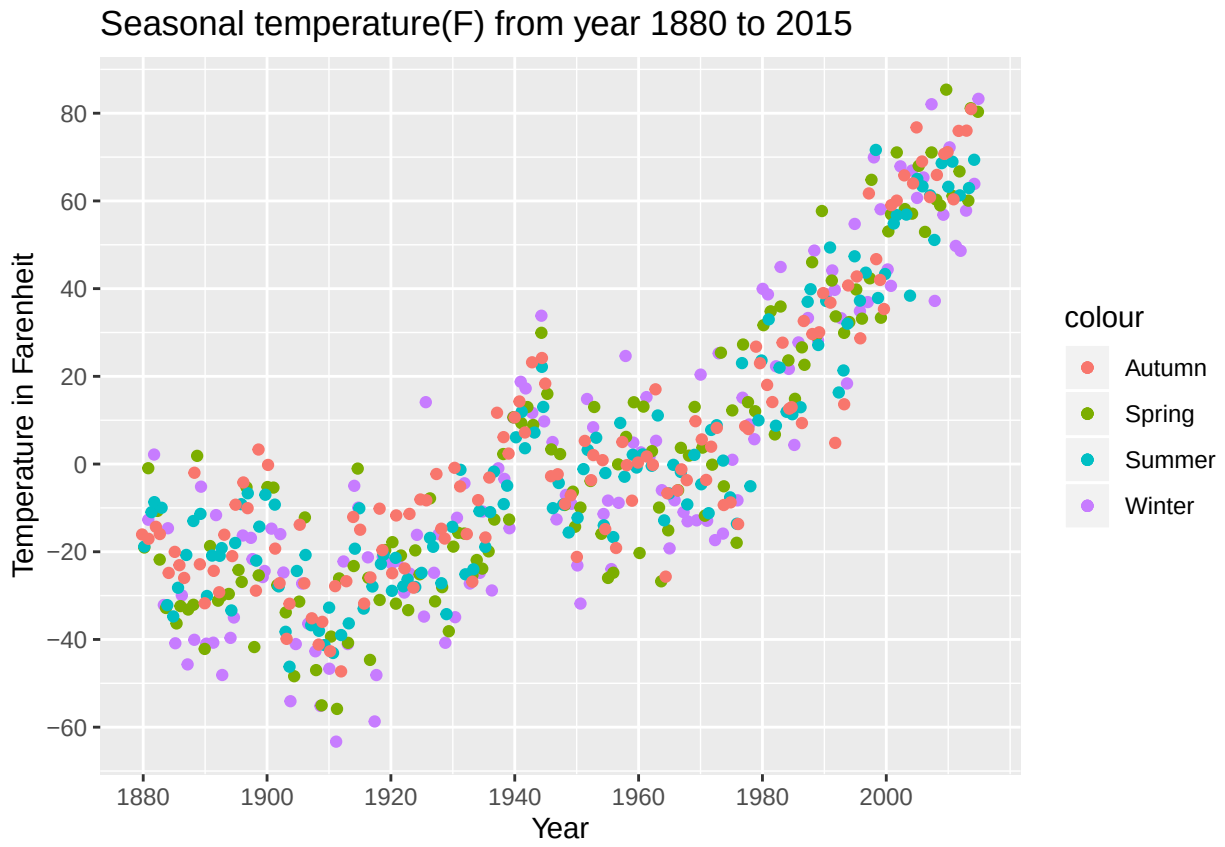
Observation

We could easily see from the above graph that there is a huge increase in temperature every 40 years since 1980.

Plot 6 : Seasonal temperature data since 1980

```r
ggplot(gistTemp,aes(x=Year)) +
  geom_jitter(aes(y= DJF , col="Winter"))+
  geom_jitter(aes(y= MAM, col="Spring")) +
  geom_jitter(aes(y= JJA, col="Summer")) +
  geom_jitter(aes(y= SON, col="Autumn")) +
  scale_y_continuous(breaks = seq(-100, 100, by = 20))+scale_x_continuous(breaks = seq(1880, 2014, by =
  ggtitle("Seasonal temperature(F) from year 1880 to 2015") + ylab("Temperature in Farenheit")
```

```
## Warning: Removed 1 rows containing missing values (geom_point).

## Warning: Removed 1 rows containing missing values (geom_point).

## Warning: Removed 1 rows containing missing values (geom_point).
```



Observation

As we could see from the above graph that most of the highest temperature was in spring & winter and not in summer.

References

- GISTEMP Team, 2020: GISS Surface Temperature Analysis (GISTEMP), version 4. NASA Goddard Institute for Space Studies. Dataset accessed 20YY-MM-DD at https://data.giss.nasa.gov/gistemp/.

- Lenssen, N., G. Schmidt, J. Hansen, M. Menne, A. Persin, R. Ruedy, and D. Zyss, 2019: Improvements in the GISTEMP uncertainty model. J. Geophys. Res. Atmos., 124, no. 12, 6307-6326, doi:10.1029/2018JD029522.