

NASA GISS Surface Temperature Analysis (GISTEMP)

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1. Data Analysis

Data shows the **changes in global temperature** from 1800 to 2014 relative to the mean global temperature(**14°C**) of the base period(1951-1980). Other variables include the temperature changes in the Northern, Southern hemispheres and also in several specific geographical locations (labeled by GPS coordinates).

```
data=read.csv("temp-year.csv", header = TRUE)
head(data[1:9])
```

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

2. Data Processing

All temperature changes are converted to the absolute temperature(celcius)

```
data=read.csv("temp-year.csv", header = TRUE)
data[, 2:15] <- data[, 2:15] / 100+14
names(data) <- gsub('[.]', '-', gsub('X', '', names(data)))
head(data[1:9])
```

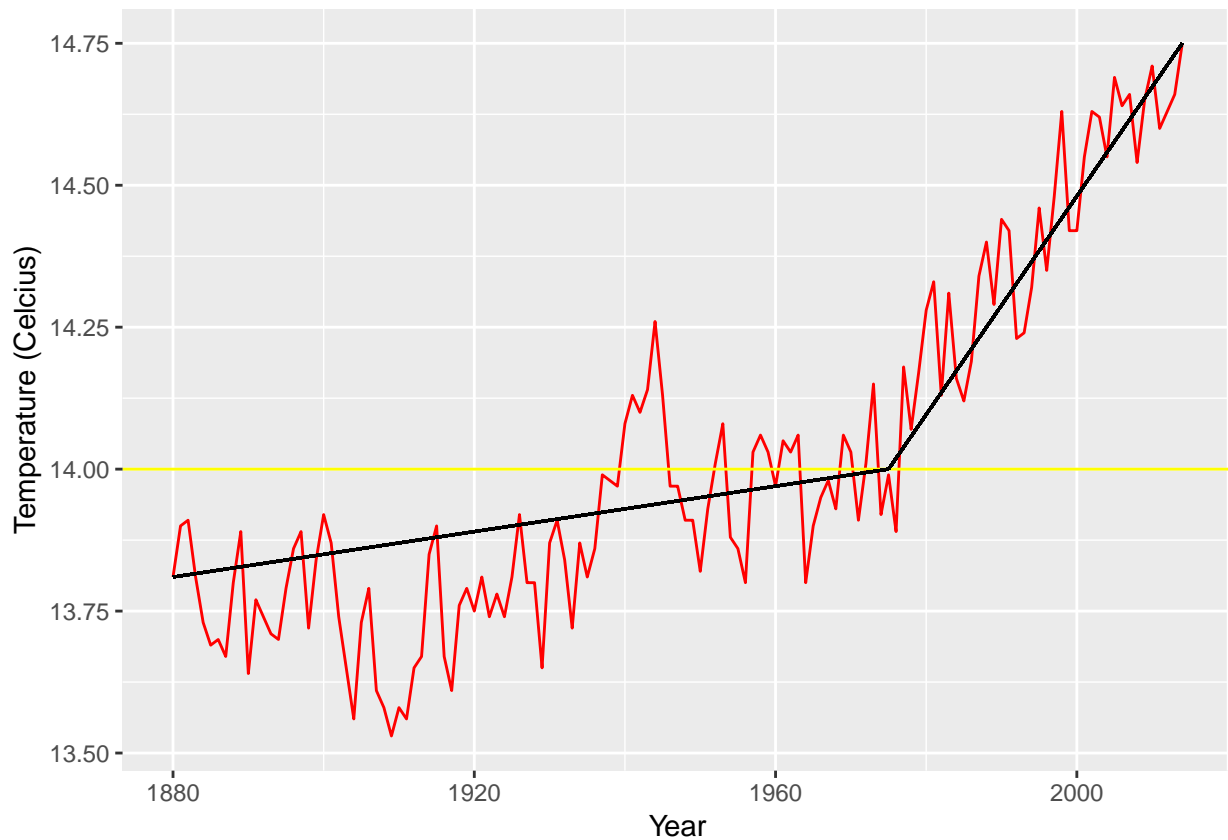
```
##   Year Glob NHem SHem 24N-90N 24S-24N 90S-24S 64N-90N 44N-64N
## 1 1880 13.81 13.67 13.95  13.62  13.84  13.95  13.11  13.46
## 2 1881 13.90 13.82 13.98  13.73  13.98  13.95  13.46  13.60
## 3 1882 13.91 13.83 13.99  13.79  13.90  14.04  12.75  13.80
## 4 1883 13.81 13.70 13.92  13.66  13.78  13.98  13.72  13.43
## 5 1884 13.73 13.58 13.88  13.44  13.83  13.89  12.73  13.42
## 6 1885 13.69 13.59 13.79  13.39  13.83  13.80  12.81  13.30
```

3. Data Visualization

a. Global Temperature (1880-2014)

```
library(ggplot2)
ggplot(data, aes(x=Year, y=Glob)) +
  geom_line(color="red") +
  geom_hline(yintercept=14, color="yellow") +
  ylab("Temperature (Celcius)") +
```

```
geom_segment(aes(x = 1880, y = 13.81, xend = 1975, yend = 14)) +  
geom_segment(aes(x = 1975, y = 14, xend = 2014, yend = 14.75))
```

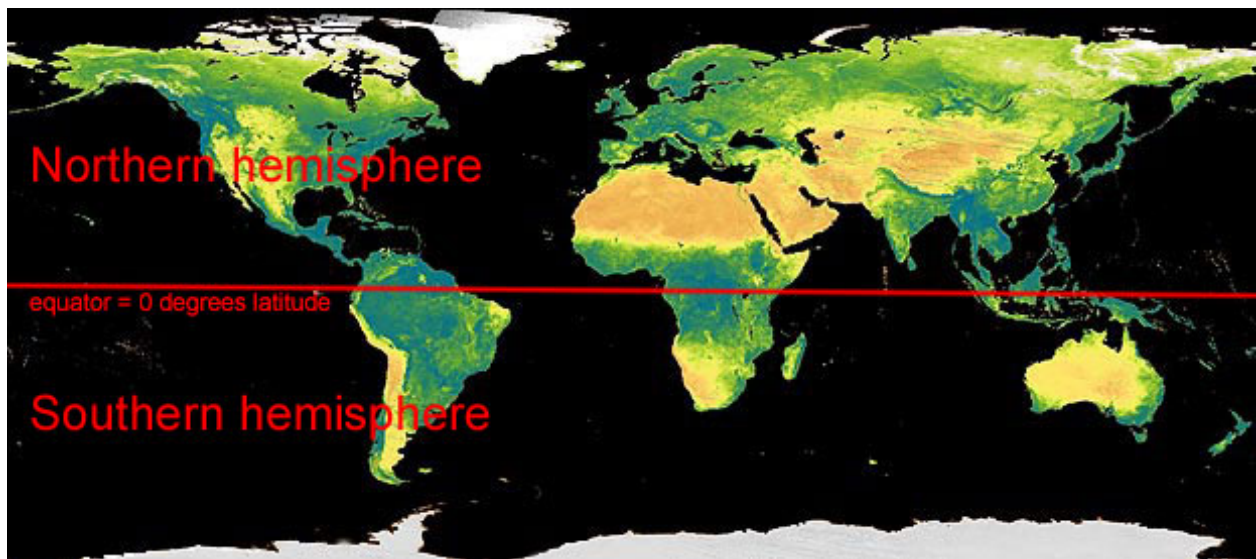
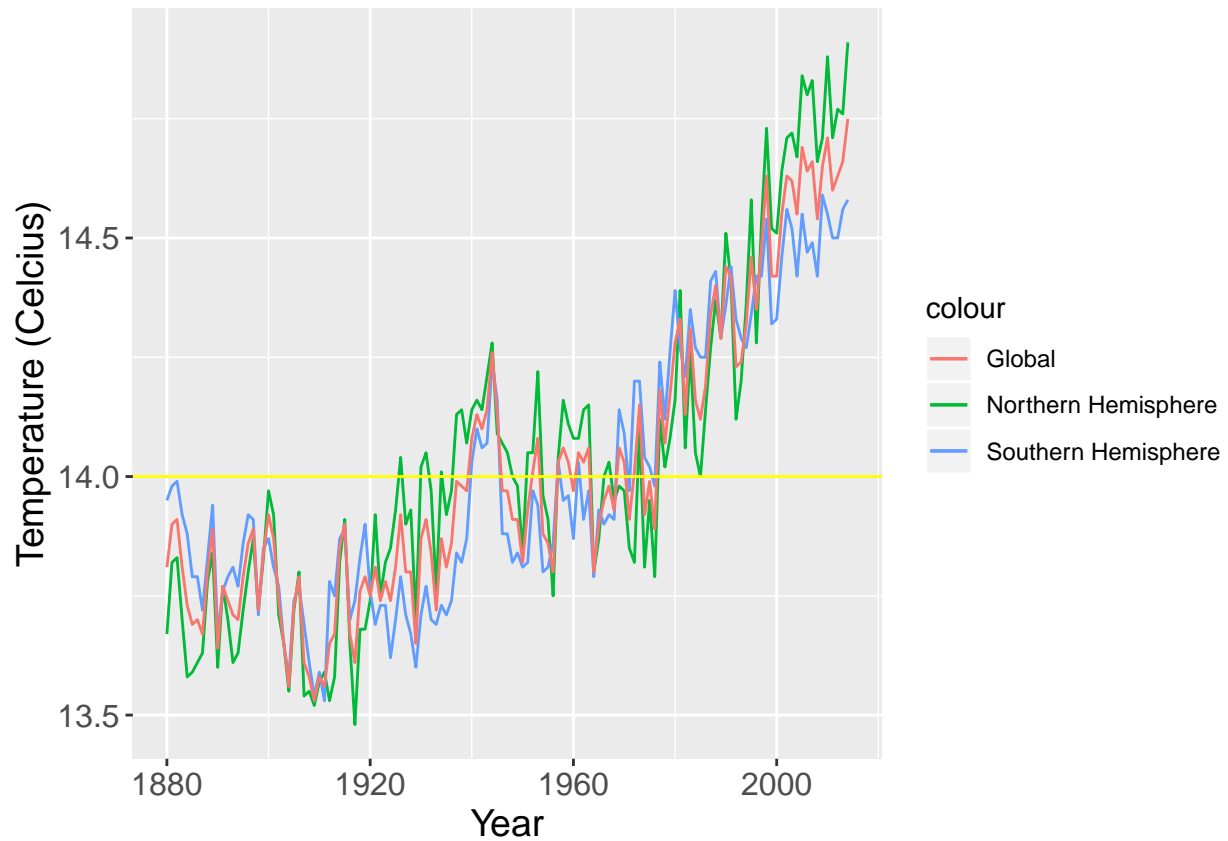


Observations

- Since 1880 the average Global temperature on Earth has increased by approximately **0.8°C**
- The rate of global temperature change has notably increased since 1975

b. Northern vs Southern Hemisphere Temperature (1880-2014)

```
ggplot(data, aes(x=Year)) +  
  geom_line(aes(y =NHem, colour = "Northern Hemisphere")) +  
  geom_line(aes(y =SHem, colour = "Southern Hemisphere")) +  
  geom_line(aes(y =Glob, colour = "Global")) +  
  geom_hline(yintercept=14, color="yellow") +  
  ylab("Temperature (Celcius)") +  
  theme(axis.text=element_text(size=12),  
        axis.title=element_text(size=14),  
        plot.title=element_text(size=20, face="bold"))
```

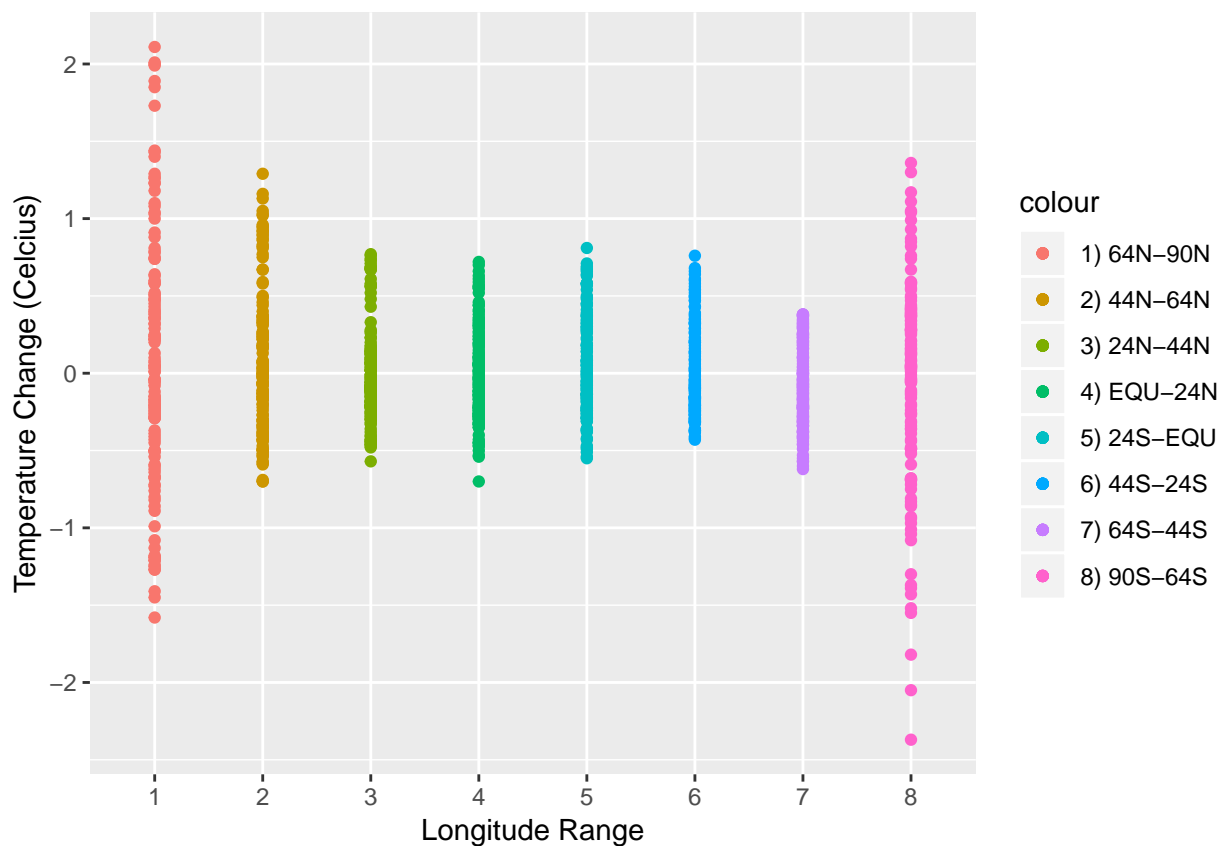


Observations

- Both the maximum and minimum global temperature peaks (since 1880) were recorded in the Northern Hemisphere.

c. Temperature Change vs Longitude (1880-2014)

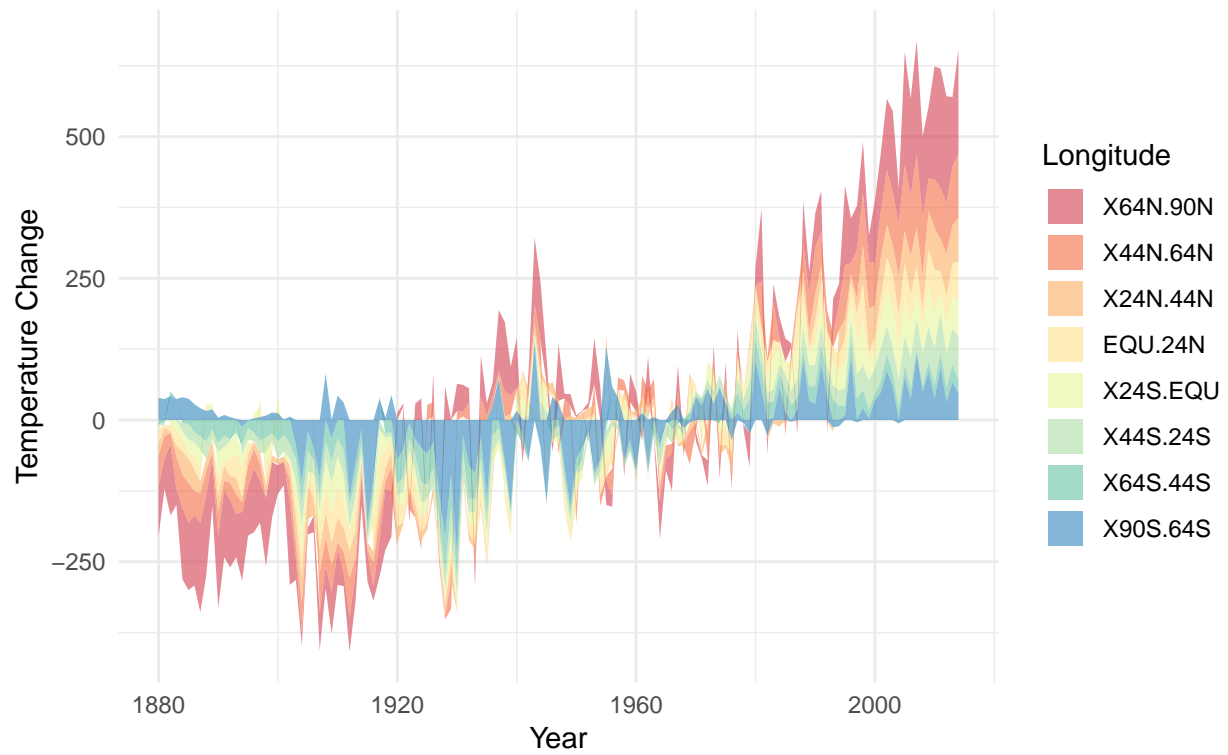
```
data1=read.csv("temp-year.csv", header = TRUE)
data1[, 2:15] <- data1[, 2:15] / 100
ggplot(data1) +
  geom_point(aes(x="1",y =X64N.90N, color="1) 64N-90N")) +
  geom_point(aes(x="2",y =X44N.64N, color="2) 44N-64N")) +
  geom_point(aes(x="3",y =X24N.44N, color="3) 24N-44N")) +
  geom_point(aes(x="4",y =EQU.24N, color="4) EQU-24N")) +
  geom_point(aes(x="5",y =X24S.EQU, color="5) 24S-EQU")) +
  geom_point(aes(x="6",y =X44S.24S, color="6) 44S-24S")) +
  geom_point(aes(x="7",y =X64S.44S, color="7) 64S-44S")) +
  geom_point(aes(x="8",y =X90S.64S, color="8) 90S-64S")) +
  ylab("Temperature Change (Celcius)") +
  xlab("Longitude Range")
```



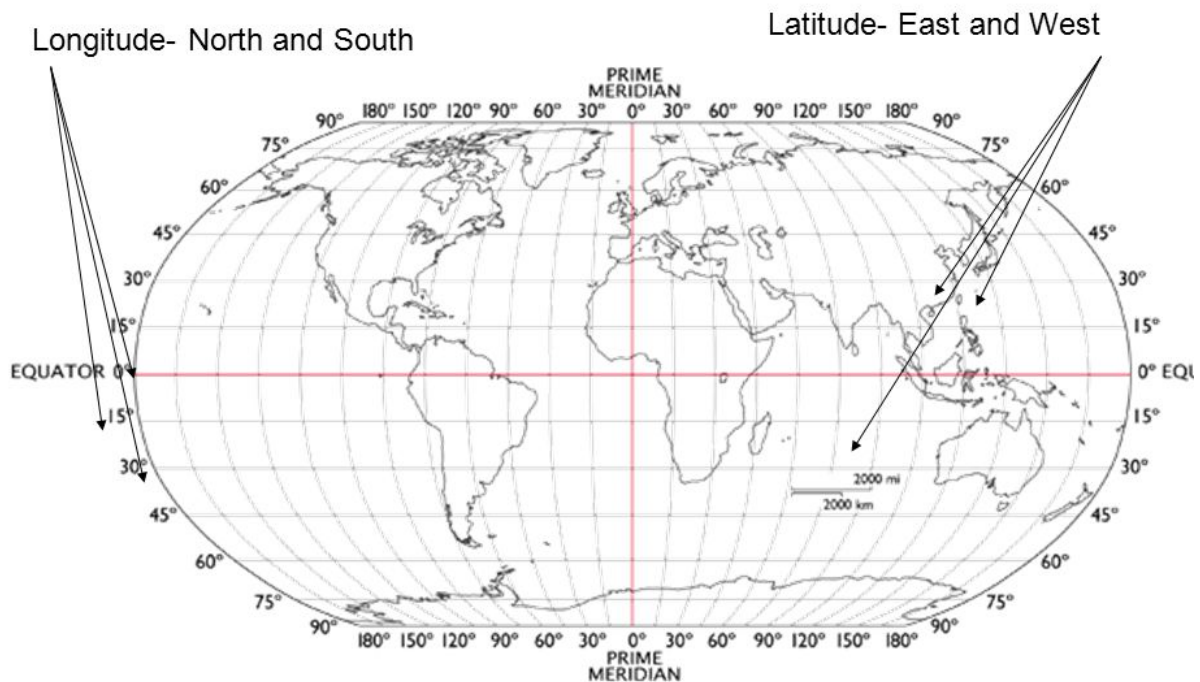
```
library(tidyr)
data3=read.csv("temp-year.csv", header = TRUE)
t <- gather(data3, value = "Temperature", key = "Longitude", c(X90S.64S, X64S.44S, X44S.24S, X24S.EQU, X24S.EQU, X44S.24S, X64S.44S, X90S.64S))
t$Longitude <- factor(t$Longitude, levels =c( 'X64N.90N', 'X44N.64N', 'X24N.44N', 'EQU.24N', 'X24S.EQU', 'X44S.24S', 'X64S.44S', 'X90S.64S'))
p <- ggplot(t, aes(x=Year, y=Temperature, fill=Longitude))
p +
  geom_area( size=2, alpha=.6) +
  theme_minimal() +
  scale_fill_brewer(palette='Spectral' ) +
  scale_y_continuous(name = "Temperature Change") +
  ggtitle('Global Warming', subtitle = 'Global temperature evolution since 1880')
```

Global Warming

Global temperature evolution since 1880



Longitude and Latitude

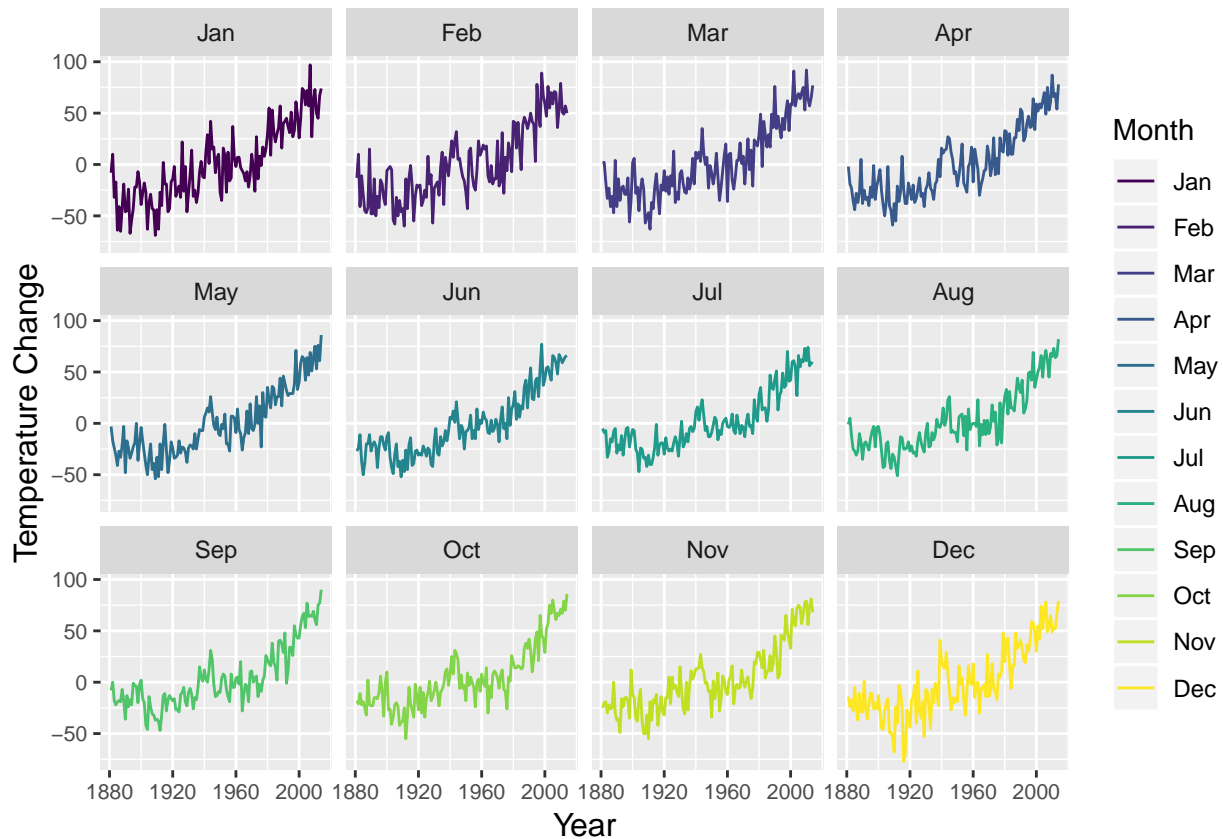


Observations

- Both the graphs above indicate that the global temperature tends to fluctuate significantly higher in regions close to the poles compared to the regions closer to the equator.

d. Monthly temperature changes (1880-2014)

```
data4=read.csv("temp-month.csv", header = TRUE)
data4=replace(data4, data4=="***", NA)
data4=replace(data4, data4=="****", NA)
data4=na.omit(data4)
t <- gather(data4, value = "Temperature", key = "Month", c(Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec))
t$Month <- factor(t$Month, levels =c( 'Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov', 'Dec'))
ggplot(t, aes(x=Year, y=Temperature, colour=Month)) + geom_line() + facet_wrap(~ Month) +
  ylab("Temperature Change") +
  theme(axis.text=element_text(size=8),
        axis.title=element_text(size=12),
        plot.title=element_text(size=20, face="bold"))
```



(NOTE FOR PROFESSOR: For some reason the `replace` & `na.omit` function doesn't work when I plot a graph in `ggplot2`. For this, I had to manually delete the rows with NA values.)

Observations

- The maximum fluctuations in the global temperature occurred in the months of January and December.

4. Acknowledgements

- [link] <http://ashgillman.github.io/Coursera-Data-Visualisation/assignment1.html>
- [link] <https://earthobservatory.nasa.gov/world-of-change/DecadalTemp>
- [link] http://rstudio-pubs-static.s3.amazonaws.com/98444_e07d34be6cc24294b0edfa66613c6c65.html
- [link] https://data.giss.nasa.gov/gistemp/tabledata_v3/GLB.Ts+dSST.txt
- [link] https://rpubs.com/abelenguer/Week2_Assignment1

```
library(raster)
```

```
## Loading required package: sp
```

```
##
```

```
## Attaching package: 'raster'
```

```
## The following object is masked from 'package:tidyr':
```

```
##
```

```
## extract
```

```
france = getData('GADM', country = 'FRA', level = 1)
plot(france)
```

