# Analysing Changes in Climate and Atmospheric Concentrations from 1983-2008

By Tri Huynh and Robby Born


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Is climate change to blame for severe weather outbreaks?

# Introduction:

Data collected from:
NASA, NOAA, Climate Research Unit University of East Anglia all on Kaggle

As climate change worsens, we wanted to see the data for ourselves

Data focuses on how temperature changes and atmospheric changes such as CO2, CH4, N2O, have changed over time from 1983-2008

See if data can give us insight to the causes and potential solutions for climate change

# Research Question:

Does data suggest that from 1983-2008, climate change has significantly impacted temperature, greenhouse gas concentrations, and other atmospheric effects? And if so, what are those effects?

# The data:

Important Columns:

- Year
- Month
- Temp
- CO2
- CH4
- N2O
- CFC-11
- CFC-12
- MEI

# The data:

```
> glimpse(climate_data)
Rows: 308
Columns: 11
$ Year      <dbl> 1983, 1983, 1983, 1983, 1983, 1983, 1983, 1983, 1984, 1984, …
$ Month     <dbl> 5, 6, 7, 8, 9, 10, 11, 12, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11…
$ MEI       <dbl> 2.556, 2.167, 1.741, 1.130, 0.428, 0.002, -0.176, -0.176, -0…
$ CO2       <dbl> 345.96, 345.52, 344.15, 342.25, 340.17, 340.30, 341.53, 343.…
$ CH4       <dbl> 1638.59, 1633.71, 1633.22, 1631.35, 1648.40, 1663.79, 1658.2…
$ N2O       <dbl> 303.677, 303.746, 303.795, 303.839, 303.901, 303.970, 304.03…
$ `CFC-11`  <dbl> 191.324, 192.057, 192.818, 193.602, 194.392, 195.171, 195.92…
$ `CFC-12`  <dbl> 350.113, 351.848, 353.725, 355.633, 357.465, 359.174, 360.75…
$ TSI       <dbl> 1366.102, 1366.121, 1366.285, 1366.420, 1366.234, 1366.059, …
$ Aerosols  <dbl> 0.0863, 0.0794, 0.0731, 0.0673, 0.0619, 0.0569, 0.0524, 0.04…
$ Temp      <dbl> 0.109, 0.118, 0.137, 0.176, 0.149, 0.093, 0.232, 0.078, 0.08…
>
```

# Summary, Analysis, and Findings

## Summary Statistics:

```
## # A tibble: 1 × 4
##   `mean(Temp[Year == 2008])` `mean(CO2[Year =… `mean(CH4[Year … `mean(N2O[Year …
##                        <dbl>              <dbl>             <dbl>             <dbl>
## 1                      0.329               386.              1799.              322.
```

```
## # A tibble: 1 × 8
##   mean_temp mean_CO2 mean_CH4 mean_N2O mean_CFC_11 mean_CFC_12 mean_MEI
##       <dbl>    <dbl>    <dbl>    <dbl>       <dbl>       <dbl>    <dbl>
## 1     0.257     363.    1750.     312.        252.        498.    0.276
## # … with 1 more variable: mean_Aerosols <dbl>
```

# Summary, Analysis, and Findings

## Correlations: between Year and other factors

```
climate_data %>%
  summarise(
    correlation = cor(Year, Temp)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.756
```

```
climate_data %>%
  summarise(
    correlation = cor(Year, CO2)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.985
```

```
climate_data %>%
  summarise(
    correlation = cor(Year, CH4)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.911
```

```
climate_data %>%
  summarise(
    correlation = cor(Year, N2O)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.995
```

```
climate_data %>%
  summarise(
    correlation = cor(Year, `CFC-12`)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.870
```

```
climate_data %>%
  summarise(
    correlation = cor(Year, `CFC-11`)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.461
```

# Summary, Analysis, and Findings

## Correlations: between Temp and other factors

```
climate_data %>%
  summarise(
    correlation = cor(Temp, CO2)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.749
```

```
climate_data %>%
  summarise(
    correlation = cor(Temp, CH4)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.700
```

```
climate_data %>%
  summarise(
    correlation = cor(Temp, N2O)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.743
```

```
climate_data %>%
  summarise(
    correlation = cor(Temp, `CFC-11`)
  )
```

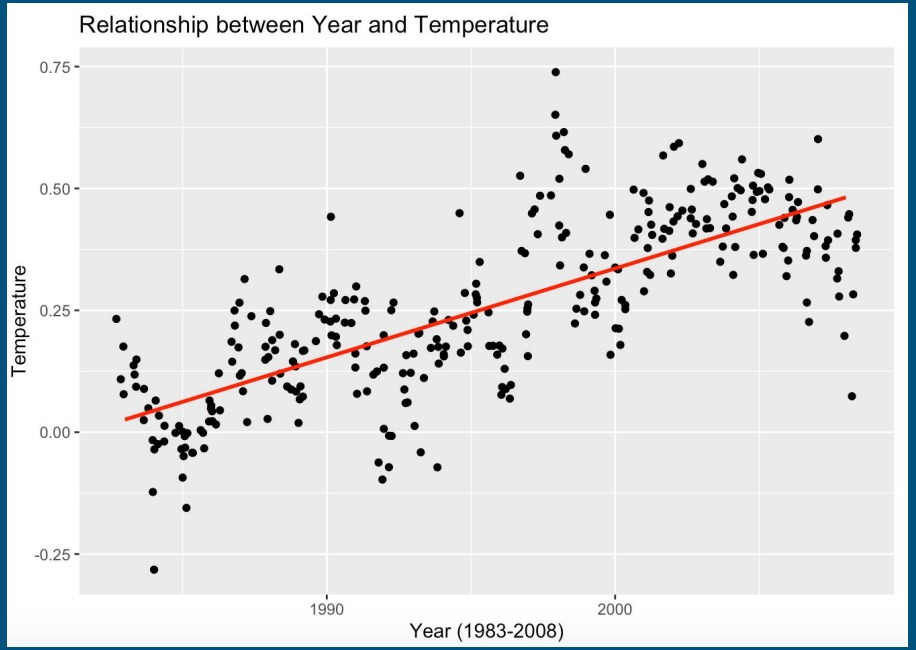
```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.380
```

```
climate_data %>%
  summarise(
    correlation = cor(Temp, `CFC-12`)
  )
```

```
## # A tibble: 1 × 1
##   correlation
##         <dbl>
## 1       0.689
```

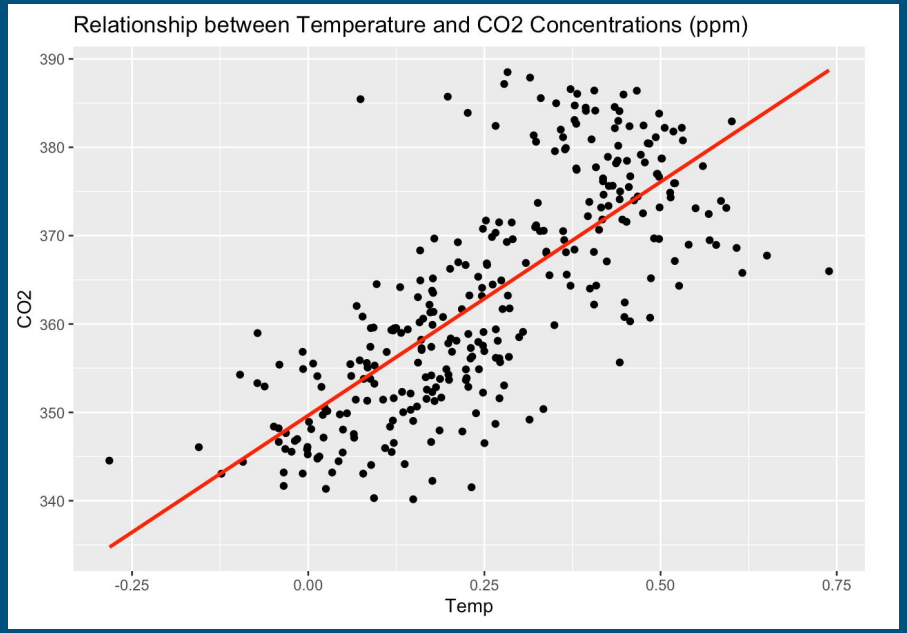
# Summary, Analysis, and Findings

## Graph of Year and Temp with regression line

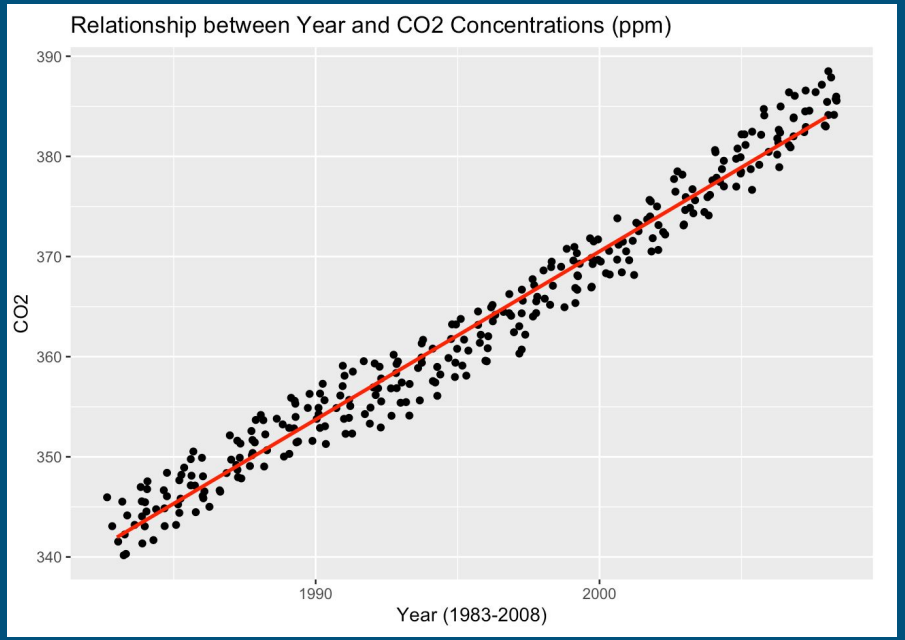


# Summary, Analysis, and Findings

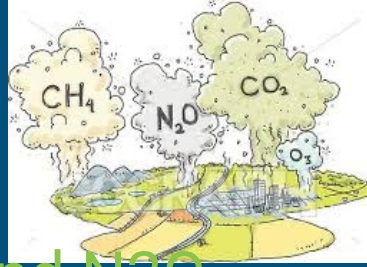
## Graph of Temperature and CO2 Concentrations



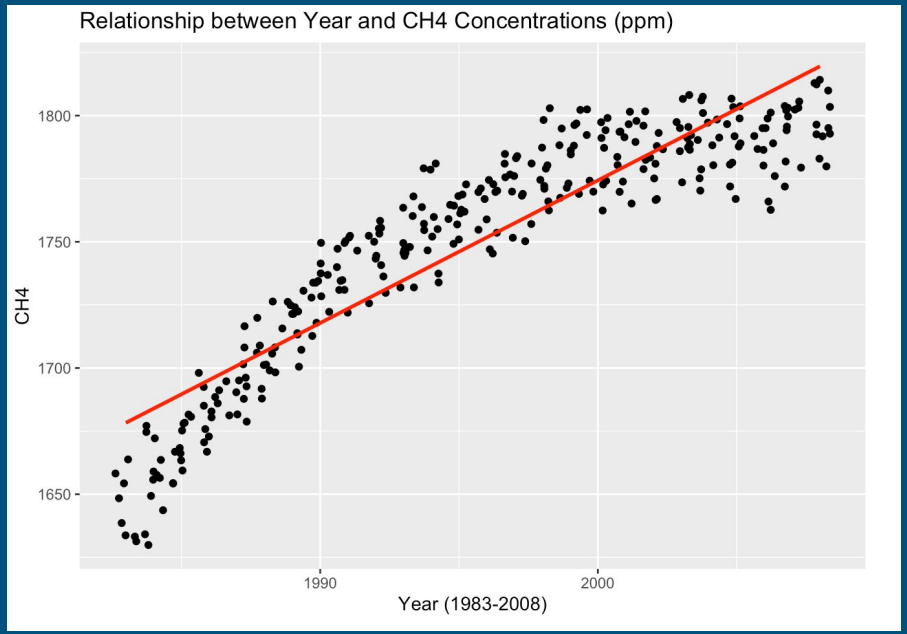

## Graph of Year and CO2 Concentrations



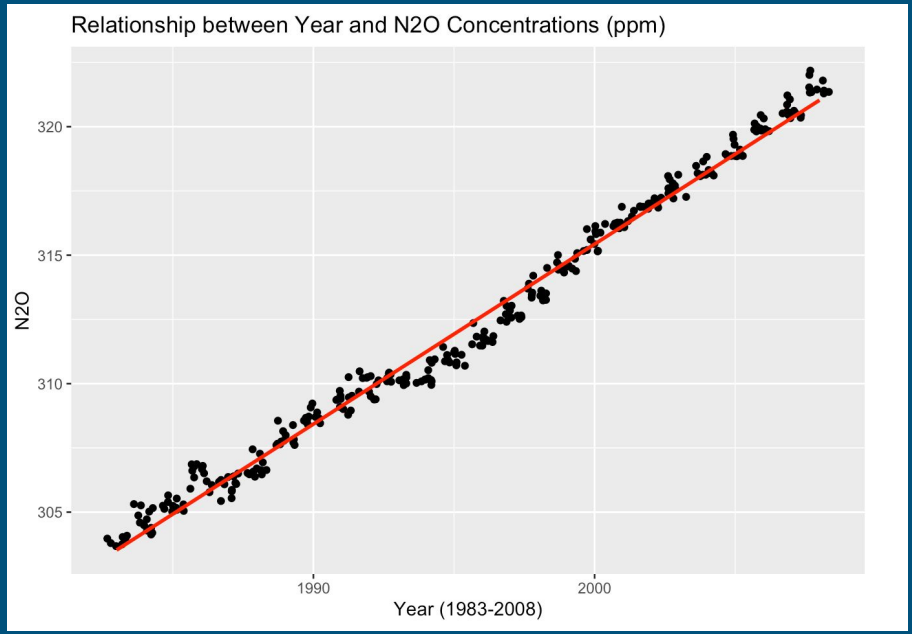
# Summary, Analysis, and Findings




## Graph of Year and CH4 Concentrations

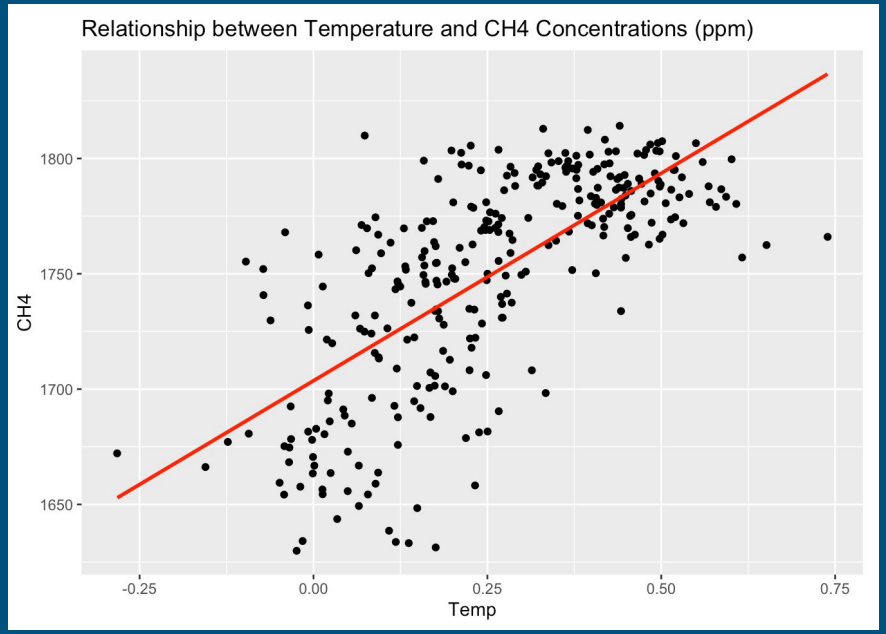



## Graph of Year and N2O Concentrations

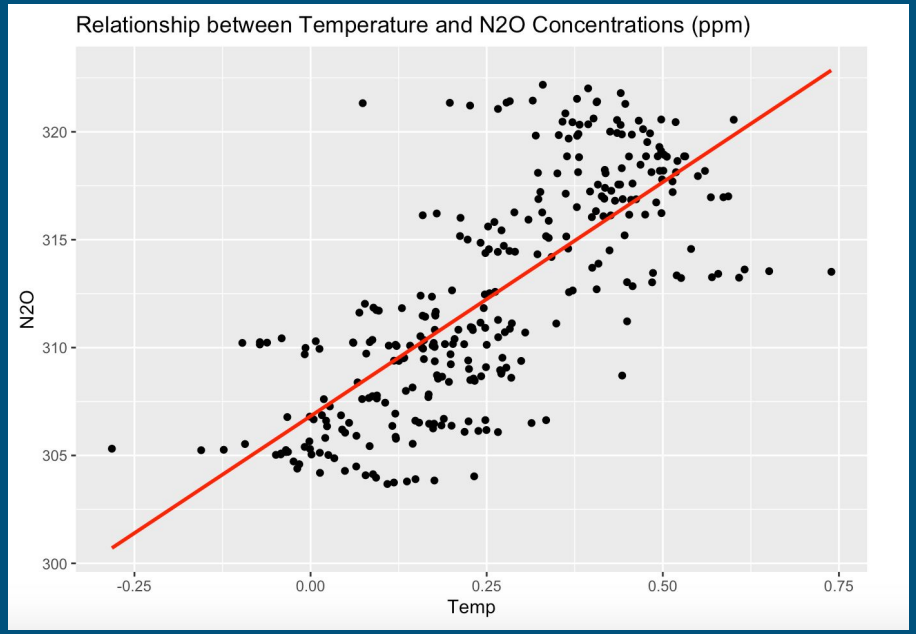


# Summary, Analysis, and Findings

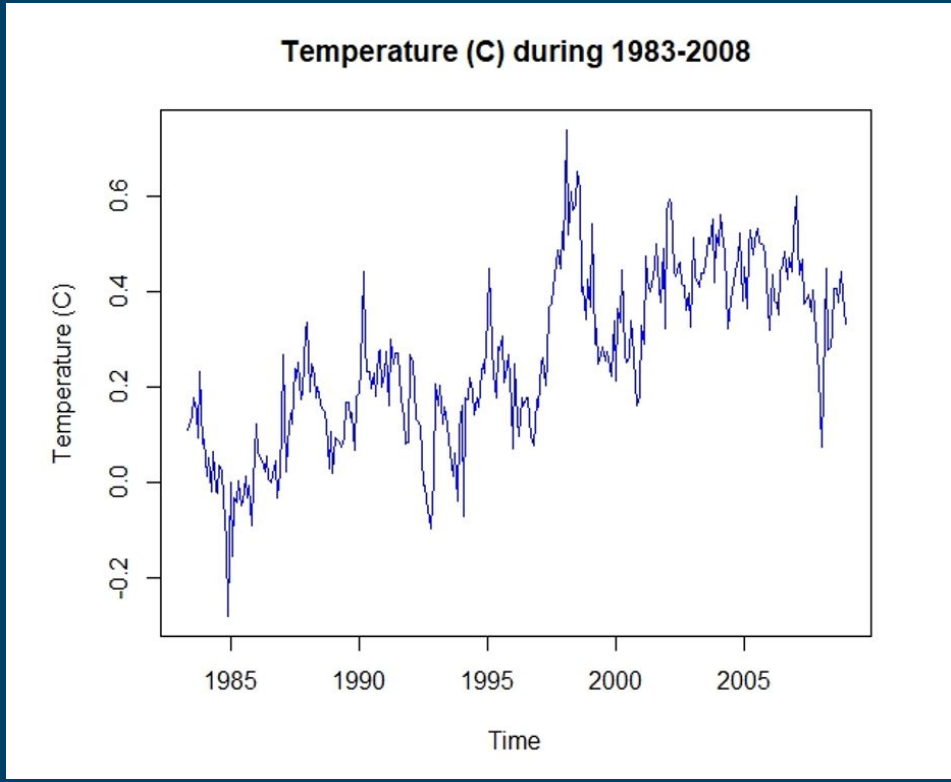
## Graph of Temperature and CH4 Concentrations



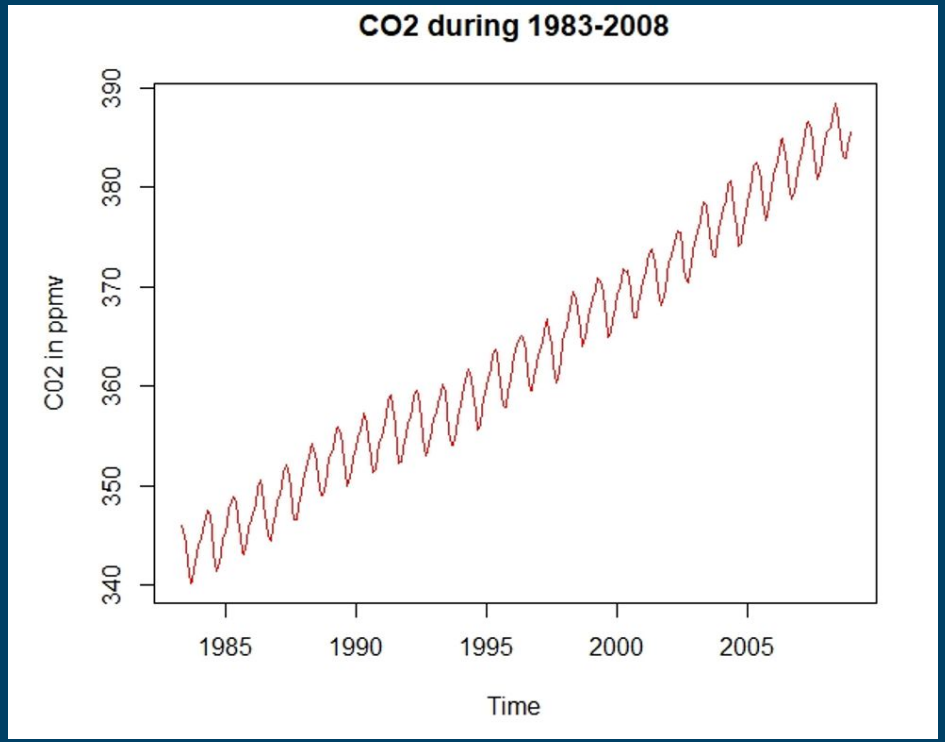

## Graph of Temperature and N2O Concentrations



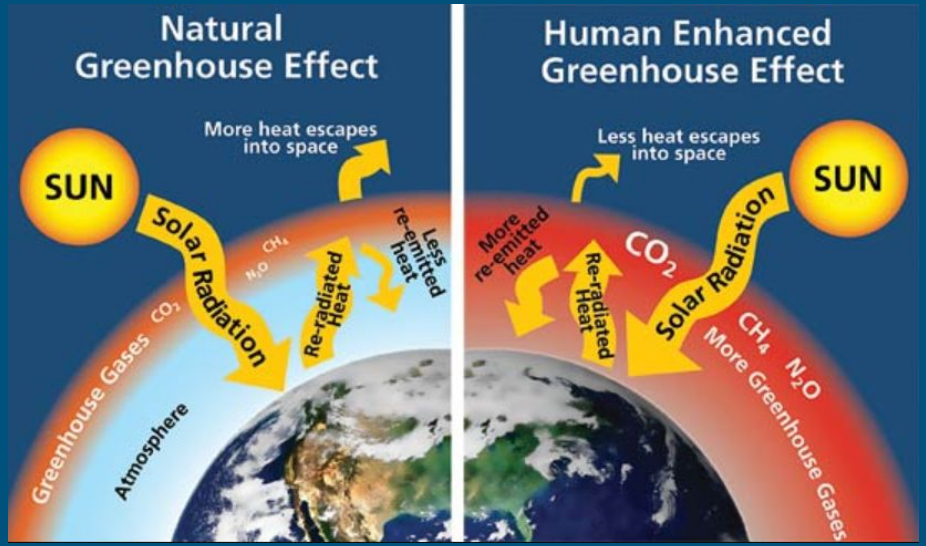
# Temperature & Time

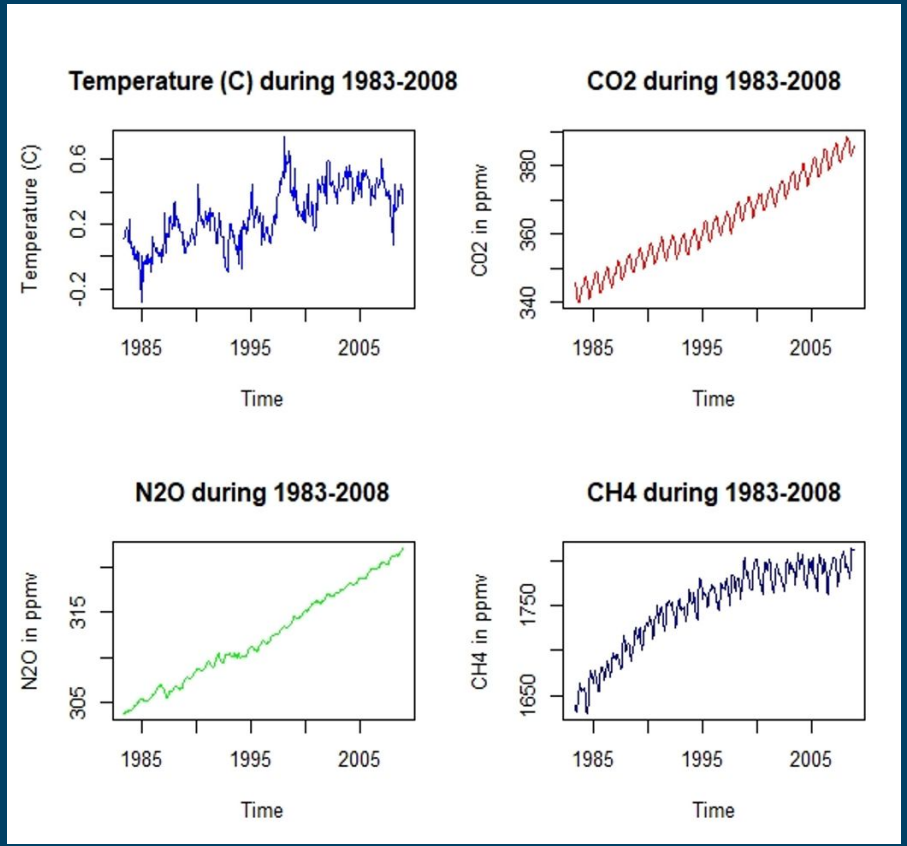


# $CO_2$ & Time

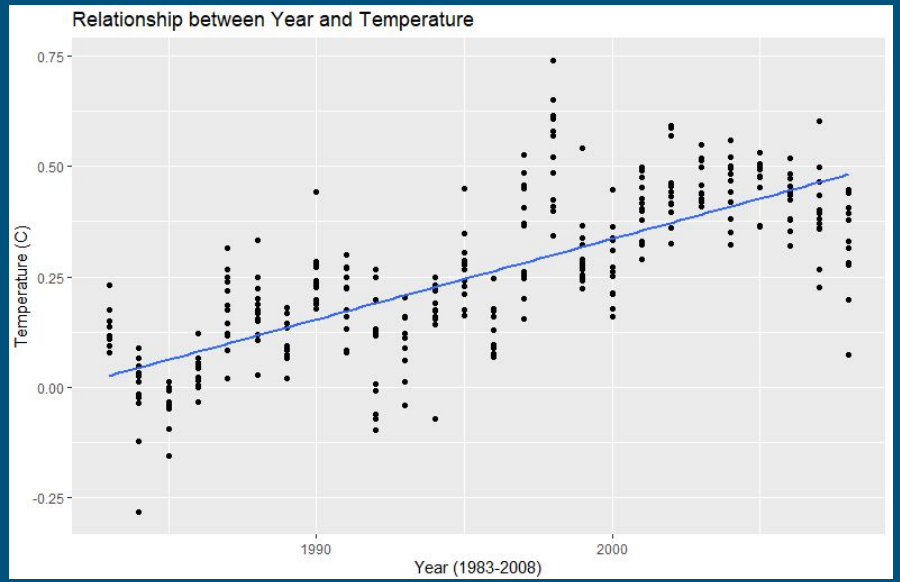

CO2 during 1983-2008
C02 in ppmv
340
350
360
370
380
390
1985
1990
1995
2000
2005
Time

# Greenhouse


Natural
Greenhouse Effect
More heat escapes
into space
SUN
Solar Radiation
Re-radiated
Heat
Less
re-emitted
heat
Greenhouse Gases
Atmosphere
Human Enhanced
Greenhouse Effect
Less heat escapes
into space
SUN
More
re-emitted
heat
Re-radiated
Heat
Solar Radiation
More Greenhouse Gases


Temperature (C) during 1983-2008
Temperature (C)
-0.2
0.2
0.6
1985
1995
2005
Time
CO2 during 1983-2008
CO2 in ppmv
340
360
380
1985
1995
2005
Time
N2O during 1983-2008
N2O in ppmv
305
315
1985
1995
2005
Time
CH4 during 1983-2008
CH4 in ppmv
1650
1750
1985
1995
2005
Time

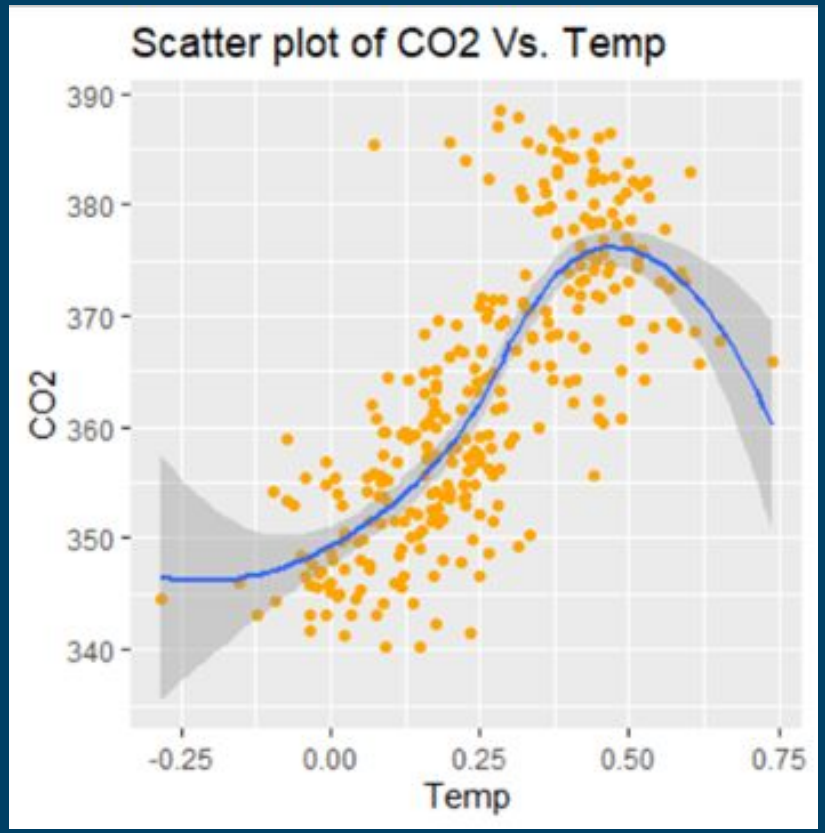
# Year ~ Temp




```
> model <- lm(Temp ~ Year, data = climate_data)
> summary(model)

Call:
lm(formula = Temp ~ Year, data = climate_data)

Residuals:
     Min       1Q   Median       3Q      Max
-0.40772 -0.07040 -0.00348  0.07292  0.43960

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -3.613e+01  1.802e+00  -20.04   <2e-16 ***
Year         1.823e-02  9.032e-04   20.19   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1175 on 306 degrees of freedom
Multiple R-squared:  0.5711,    Adjusted R-squared:  0.5697
F-statistic: 407.5 on 1 and 306 DF,  p-value: < 2.2e-16
```

# Temp ~ $CO_2$

```
> cor.test(Temp , CO2)

        Pearson's product-moment correlation

data:  Temp and CO2
t = 19.745, df = 306, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 0.6948736 0.7938557
sample estimates:
      cor
0.7485046
```




- Found strong positive correlations in data
- Clear indication from data that global temperatures are rising
- Need more data to be more accurate


- Limited data
- Compare current data with our predictions
- We should have accounted for other factors such as sea-level rise, glacial melting, and more as well

# Conclusion & Further Studies

Much more research will need to be conducted to understand the current threats climate change poses

How fast are greenhouse gases rising?

Find solutions to limit and curb the dramatic increase in the Earth’s temperature and greenhouse gas emissions

Prediction Models on best and worst case scenarios

# Thank You Professor and STAT 495!

# Summary, Analysis, and Findings

## Scatterplot with “best fitting” line of Year and other factors