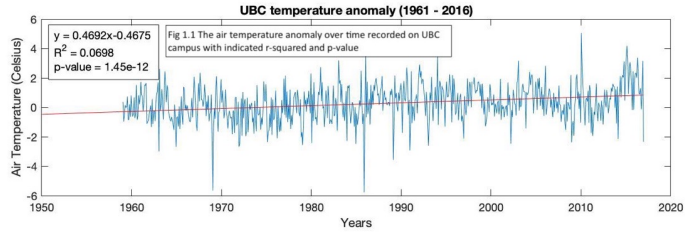
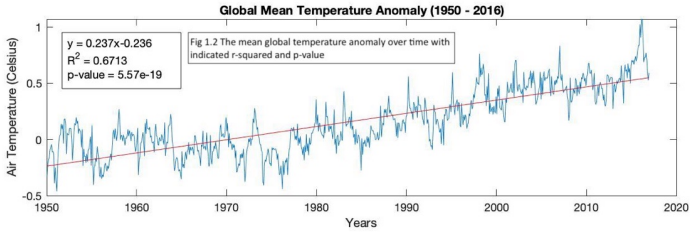
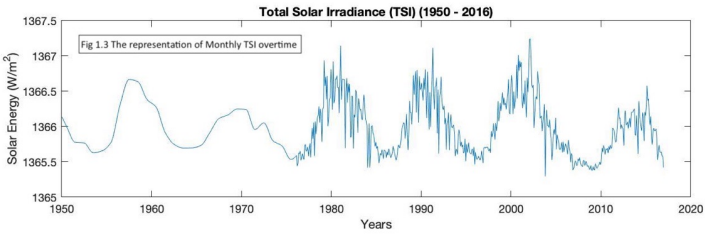
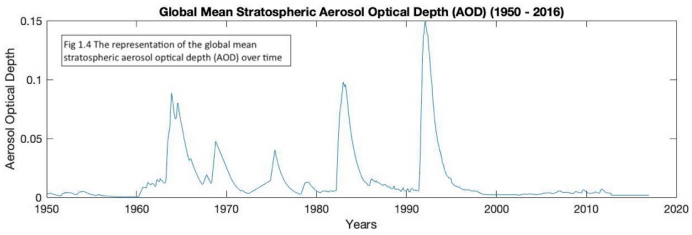
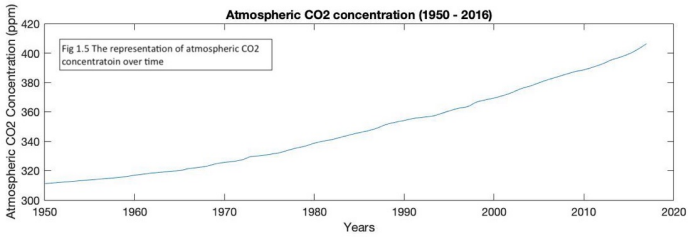
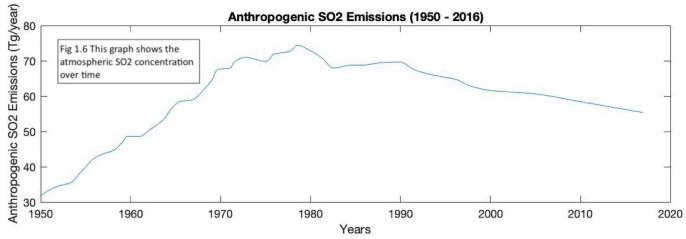

UBC temperature anomaly (1961 - 2016)
y = 0.4692x-0.4675
R2 = 0.0698
p-value = 1.45e-12
Fig 1.1 The air temperature anomaly over time recorded on UBC campus with indicated r-squared and p-value
Air Temperature (Celsius)
Years

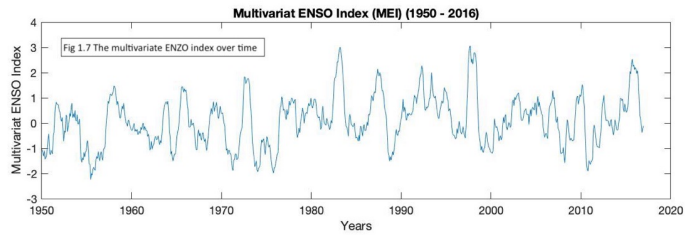

Global Mean Temperature Anomaly (1950 - 2016)
y = 0.237x-0.236
R2 = 0.6713
p-value = 5.57e-19
Fig 1.2 The mean global temperature anomaly over time with indicated r-squared and p-value
Air Temperature (Celsius)
Years

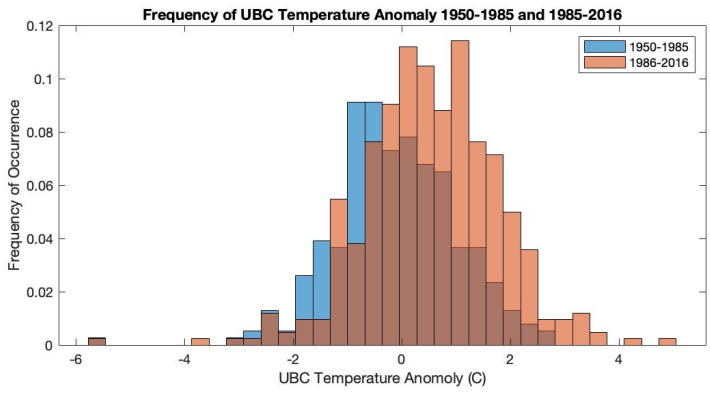

Total Solar Irradiance (TSI) (1950 - 2016)
Fig 1.3 The representation of Monthly TSI overtime
Solar Energy (W/m2)
Years

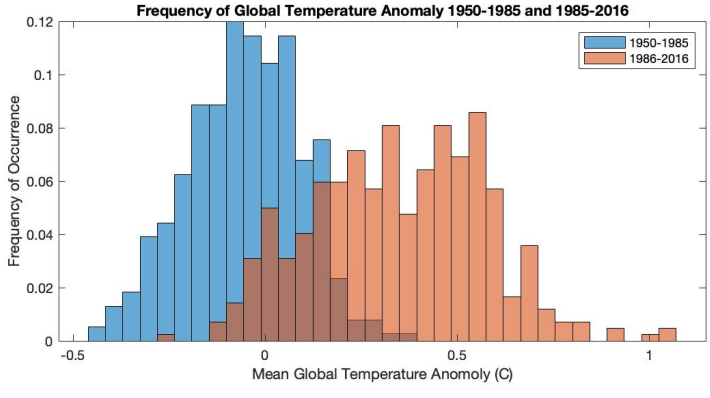

Global Mean Stratospheric Aerosol Optical Depth (AOD) (1950 - 2016)
Fig 1.4 The representation of the global mean stratospheric aerosol optical depth (AOD) over time
Aerosol Optical Depth
Years


Atmospheric CO2 concentration (1950 - 2016)
Fig 1.5 The representation of atmospheric CO2 concentratoin over time
Atmospheric CO2 Concentration (ppm)
Years


Anthropogenic SO2 Emissions (1950 - 2016)
Fig 1.6 This graph shows the atmospheric SO2 concentration over time
Anthropogenic SO2 Emissions (Tg/year)
Years


Multivariat ENSO Index (MEI) (1950 - 2016)
Fig 1.7 The multivariate ENZO index over time
Multivariat ENSO Index
Years


Frequency of UBC Temperature Anomaly 1950-1985 and 1985-2016
1950-1985
1986-2016
Frequency of Occurrence
UBC Temperature Anomoly (C)


Frequency of Global Temperature Anomaly 1950-1985 and 1985-2016
1950-1985
1986-2016
Frequency of Occurrence
Mean Global Temperature Anomoly (C)

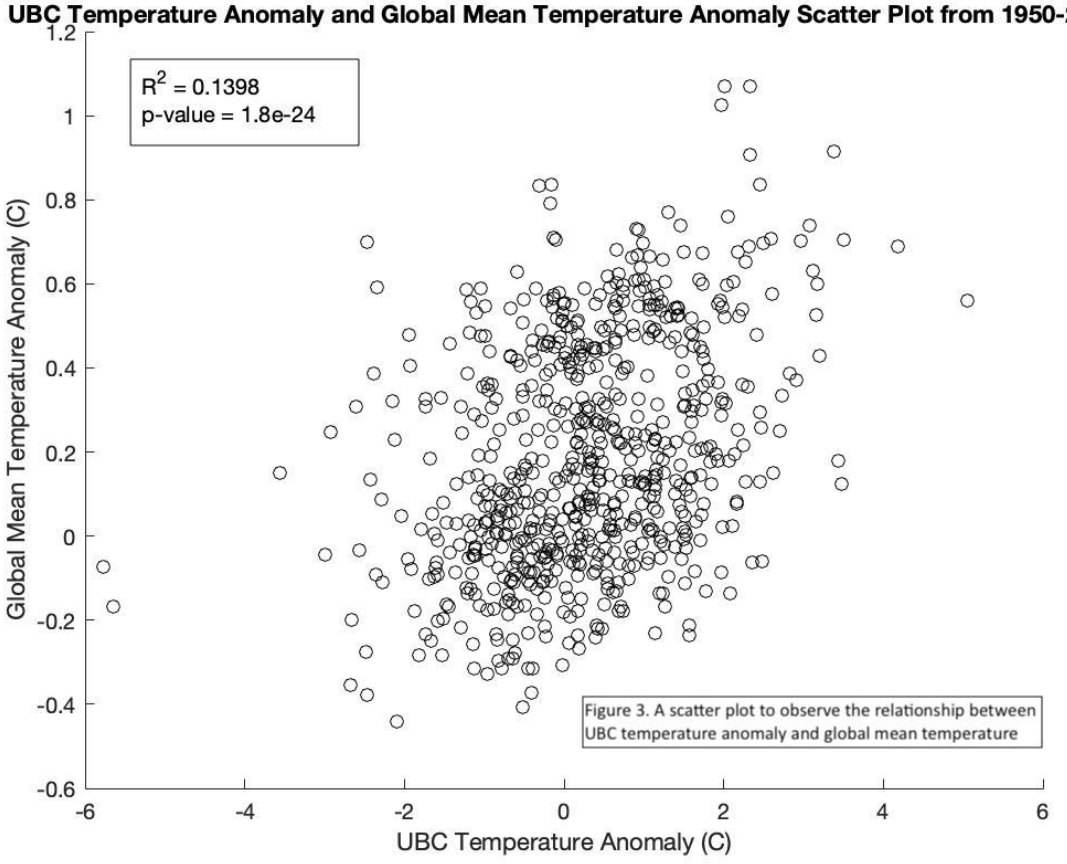
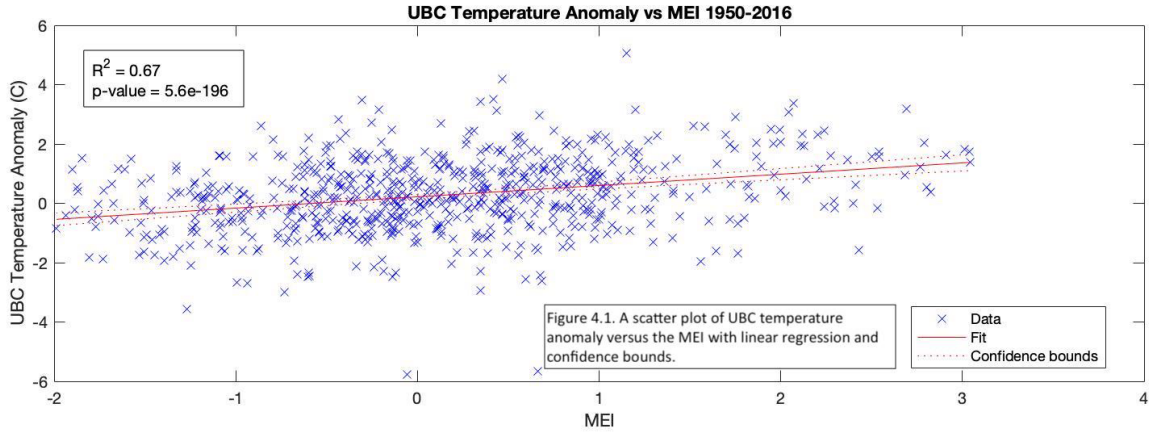
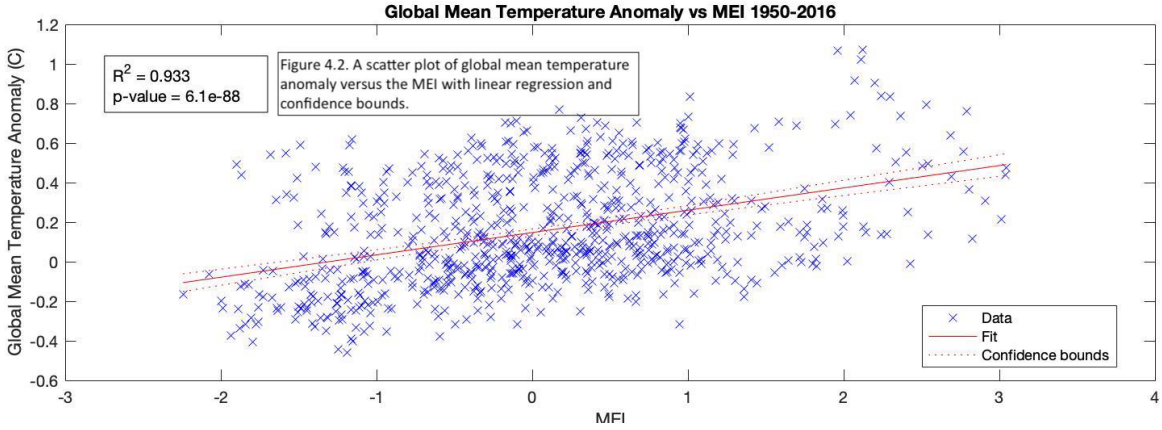
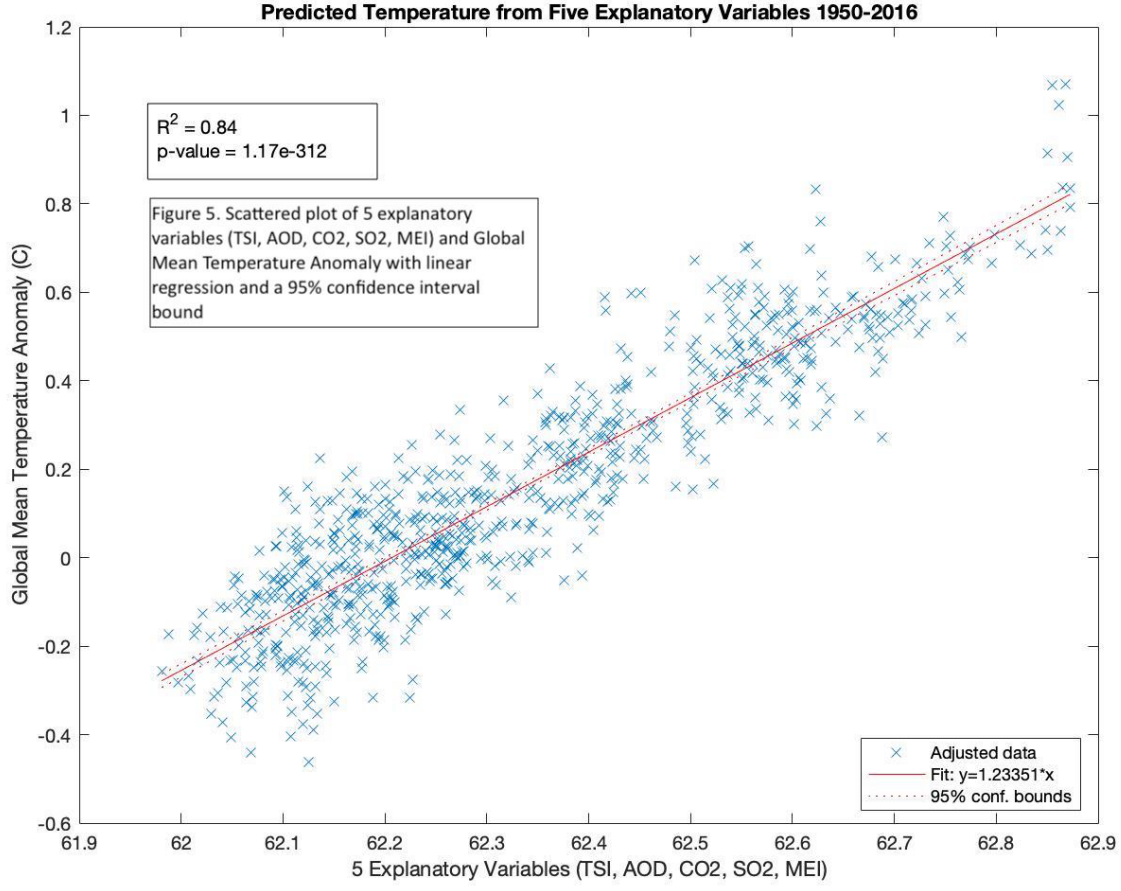


Figure 3. A scatter plot to observe the relationship between UBC temperature anomaly and global mean temperature


UBC Temperature Anomaly vs MEI 1950-2016
R2 = 0.67
p-value = 5.6e-196
Figure 4.1. A scatter plot of UBC temperature anomaly versus the MEI with linear regression and confidence bounds.
Data
Fit
Confidence bounds
UBC Temperature Anomaly (C)
MEI


Global Mean Temperature Anomaly vs MEI 1950-2016
R2 = 0.933
p-value = 6.1e-88
Figure 4.2. A scatter plot of global mean temperature anomaly versus the MEI with linear regression and confidence bounds.
Data
Fit
Confidence bounds
Global Mean Temperature Anomaly (C)
MEI


Predicted Temperature from Five Explanatory Variables 1950-2016
R2 = 0.84
p-value = 1.17e-312
Figure 5. Scattered plot of 5 explanatory variables (TSI, AOD, CO2, SO2, MEI) and Global Mean Temperature Anomaly with linear regression and a 95% confidence interval bound
Adjusted data
Fit: y=1.23351*x
95% conf. bounds
Global Mean Temperature Anomaly (C)
5 Explanatory Variables (TSI, AOD, CO2, SO2, MEI)

```
% Lab 3
clear
% loading the data for this lab
data=xlsread('lab3_data.xlsx');
% Create a vector of monthly dates
dates = data(:,1);

% ***** Section 1 *****

% Create vectors for variables:
UBC_avg_temp_monthly_anom = data(:,2);
CRU_avg_temp_monthly_anom = data(:,3);
TSI_time_series = data(:,4);
AOD = data(:,5);
Atmos_CO2_concentration = data(:,6);
Anthro_SO2_emissions = data(:,7);
MEI = data(:,8);

% Plot each times series in subplots
subplot(4,2,1);
plot(dates, UBC_avg_temp_monthly_anom);
title('UBC temperature anomaly (1961 - 2016)')
xlabel('Years')
ylabel('Air Temperature (Celsius)')
[b,bint,r,rint,stats]=regress(UBC_avg_temp_monthly_anom,[ones(size↙
(UBC_avg_temp_monthly_anom)) dates]);
MeanTemp1 = b(2)*dates + b(1);
hold on
plot(dates,MeanTemp1,'r')
%include lengend...

subplot(4,2,2);
plot(dates, CRU_avg_temp_monthly_anom);
title('Global Mean Temperature Anomaly (1950 - 2016)')
xlabel('Years')
ylabel('Air Temperature (Celsius)')
[b,bint,r,rint,stats]=regress(CRU_avg_temp_monthly_anom,[ones(size↙
(CRU_avg_temp_monthly_anom)) dates]);
MeanTemp2 = b(2)*dates + b(1);
hold on
plot(dates,MeanTemp2,'r')
%...

subplot(4,2,3);
plot(dates, TSI_time_series);
title('Total Solar Irradiance (TSI) (1950 - 2016)')
xlabel('Years')
ylabel('Solar Energy (W/m^2)')
%...

subplot(4,2,4);
plot(dates, AOD);
title('Global Mean Stratospheric Aerosol Optical Depth (AOD) (1950 - 2016)')
xlabel('Years')
ylabel('Aerosol Optical Depth')
%...

subplot(4,2,5);
```

```
plot(dates, Atmos_CO2_concentration);
title('Atmospheric CO2 concentration (1950 - 2016)')
xlabel('Years')
ylabel('Atmospheric CO2 Concentration (ppm)')
%...

subplot(4,2,6);
plot(dates, Anthro_SO2_emissions);
title('Anthropogenic SO2 Emissions (1950 - 2016)')
xlabel('Years')
ylabel('Anthropogenic SO2 Emissions (Tg/year)')
%...

subplot(4,2,7);
plot(dates, MEI);
title('Multivariat ENSO Index (MEI) (1950 - 2016)')
xlabel('Years')
ylabel('Multivariat ENSO Index')
%...

% Display Histograms
figure(2)
subplot(2,1,1)
histogram(UBC_avg_temp_monthly_anom(1:384),linspace(min(UBC_avg_temp_monthly_anom),max↙
(UBC_avg_temp_monthly_anom),35),'Normalization','probability')
hold on
histogram(UBC_avg_temp_monthly_anom(385:804),linspace(min(UBC_avg_temp_monthly_anom),max↙
(UBC_avg_temp_monthly_anom),35),'Normalization','probability')
title('Frequency of UBC Temperature Anomaly 1950-1985 and 1985-2016')
xlabel('UBC Temperature Anomoly (C)')
ylabel('Frequency of Occurrence')
legend('1950-1985','1986-2016')

subplot(2,1,2)
histogram(CRU_avg_temp_monthly_anom(1:384),linspace(min(CRU_avg_temp_monthly_anom),max↙
(CRU_avg_temp_monthly_anom),35),'Normalization','probability')
hold on
histogram(CRU_avg_temp_monthly_anom(385:804),linspace(min(CRU_avg_temp_monthly_anom),max↙
(CRU_avg_temp_monthly_anom),35),'Normalization','probability')
title('Frequency of Global Mean Temperature Anomaly 1950-1985 and 1985-2016')
xlabel('Global Mean Temperature Anomoly (C)')
ylabel('Frequency of Occurrence')
legend('1950-1985','1986-2016')

% ***** Section 2 *****
% Answer on Lab3 worksheet

% ***** Section 3 *****
% Plot UBC temperature anomaly vs Global Mean Temperature Anomaly
figure(3)
scatter(UBC_avg_temp_monthly_anom, CRU_avg_temp_monthly_anom, 'ko')
title('UBC Temperature Anomaly and Global Mean Temperature Anomaly Scatter Plot from↙
1950-2016')
xlabel('UBC Temperature Anomaly (C)')
ylabel('Global Mean Temperature Anomaly (C)')
stats = regstats(UBC_avg_temp_monthly_anom,CRU_avg_temp_monthly_anom);

% ***** Section 4 *****
```

```
% Perform regression of Global Mean Temp against TSI, AOD, CO2, SO2 and MEI
% Which variable is there a large confidence on the sign of the linear
% regression slope?

% Plot Global Mean Temperature anomaly vs MEI and UBC Temperature Anomaly vs MEI
% Perform linear regression for each pair; add regression line and slope
figure(4)
subplot(2,1,1)
mlr = fitlm(MEI,UBC_avg_temp_monthly_anom);
plot(mlr)
title('UBC Temperature Anomaly vs MEI 1950-2016')
xlabel('MEI')
ylabel('UBC Temperature Anomaly (C)')

subplot(2,1,2)
mlr = fitlm(MEI,CRU_avg_temp_monthly_anom);
plot(mlr)
%{
This code also works but NOT using it:
scatter(MEI,CRU_avg_temp_monthly_anom,'kx')
[b,bint,r,rint,stats] = regress(CRU_avg_temp_monthly_anom,[ones(size↙
(CRU_avg_temp_monthly_anom)) MEI]);
RegCRU = b(2)*MEI+b(1);
hold on
plot(MEI,RegCRU,'r')
%}
title('Global Mean Temperature Anomaly vs MEI 1950-2016')
xlabel('MEI')
ylabel('Global Mean Temperature Anomaly (C)')

% ***** Section 5 *****

% 5 Forcing variables: TSI, AOD, CO2, SO2 and MEI
% Multilinear regression of Global Mean Temperature Anomaly against the 5 variables
figure(5)
x = [TSI_time_series, AOD, Atmos_CO2_concentration, Anthro_SO2_emissions, MEI];
mlr = fitlm(x,CRU_avg_temp_monthly_anom);
plot(mlr)
title('Predicted Temperature from Five Explanatory Variables 1950-2016')
xlabel('5 Explanatory Variables (TSI, AOD, CO2, SO2, MEI)')
ylabel('Global Mean Temperature Anomaly (C)')
```