INTRODUCTION TO DATA ANALYSIS, STATISTICS & REPORTING

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Abstract:
This report uses a data set and analyzes the data set to show how climate change is affected by the deterioration of Arctic Sea Ice extent and some of the Earth's physical factors being changed over a period of time.

Introduction:
Climate change is a topic of concern for each and every living being (humans, plants, animals) on Earth. With the declining Arctic Sea ice, rise in temperature, increasing amounts of CO2 and many other factors the current global warming trend is significantly increasing. The data used in this report and the analysis provides an evidence to the question.

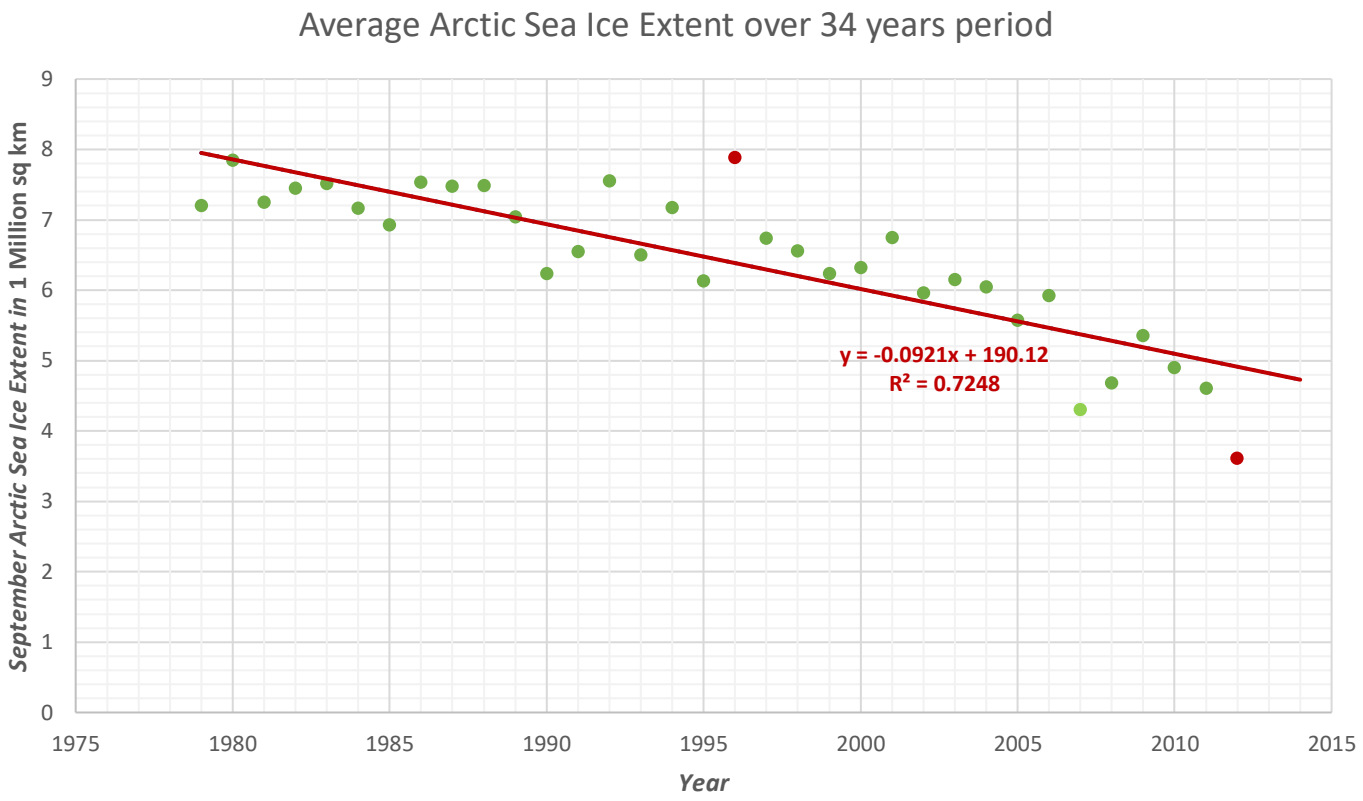
Method & Analysis:
We used the data set provided to produce graphs to draw conclusions and compare in our analysis.

Data Set:

There weren't any values recorded for Temperature, CO_2, Solar Irradiance for the years 2011 & 2012.

Year	September Arctic Sea Ice Extent (1,000,000 sq. km)	Temp (1/100 degree C)	CO2 (in ppm)	Solar Irradiance (W/m^2)
1979	7.2	8	336.67	1366.43
1980	7.85	19	338.57	1366.51
1981	7.25	26	339.92	1366.51
1982	7.45	4	341.3	1366.16
1983	7.52	25	342.71	1366.18
1984	7.17	9	344.24	1365.71
1985	6.93	4	345.81	1365.57
1986	7.54	12	347.11	1365.59
1987	7.48	27	348.72	1365.67
1988	7.49	31	351.04	1365.97
1989	7.04	19	352.68	1366.46
1990	6.24	36	353.97	1366.42
1991	6.55	35	355.37	1366.34
1992	7.55	13	356.18	1366.17
1993	6.5	13	356.69	1365.86
1994	7.18	23	358.14	1365.69
1995	6.13	37	360.02	1365.58
1996	7.88	29	361.95	1365.5
1997	6.74	39	363.18	1365.65
1998	6.56	56	365.19	1365.98
1999	6.24	31	367.86	1366.18
2000	6.32	33	368.83	1366.41
2001	6.75	47	370.43	1366.33
2002	5.96	56	372.01	1366.39
2003	6.15	55	374.45	1365.92
2004	6.05	48	376.77	1365.7
2005	5.57	63	378.3	1365.51
2006	5.92	55	380.83	1365.44
2007	4.3	58	382.56	1365.32
2008	4.68	44	384.39	1365.27
2009	5.36	57	386.34	1365.25
2010	4.9	63	388.13	1365.46
2011	4.61			
2012	3.61			

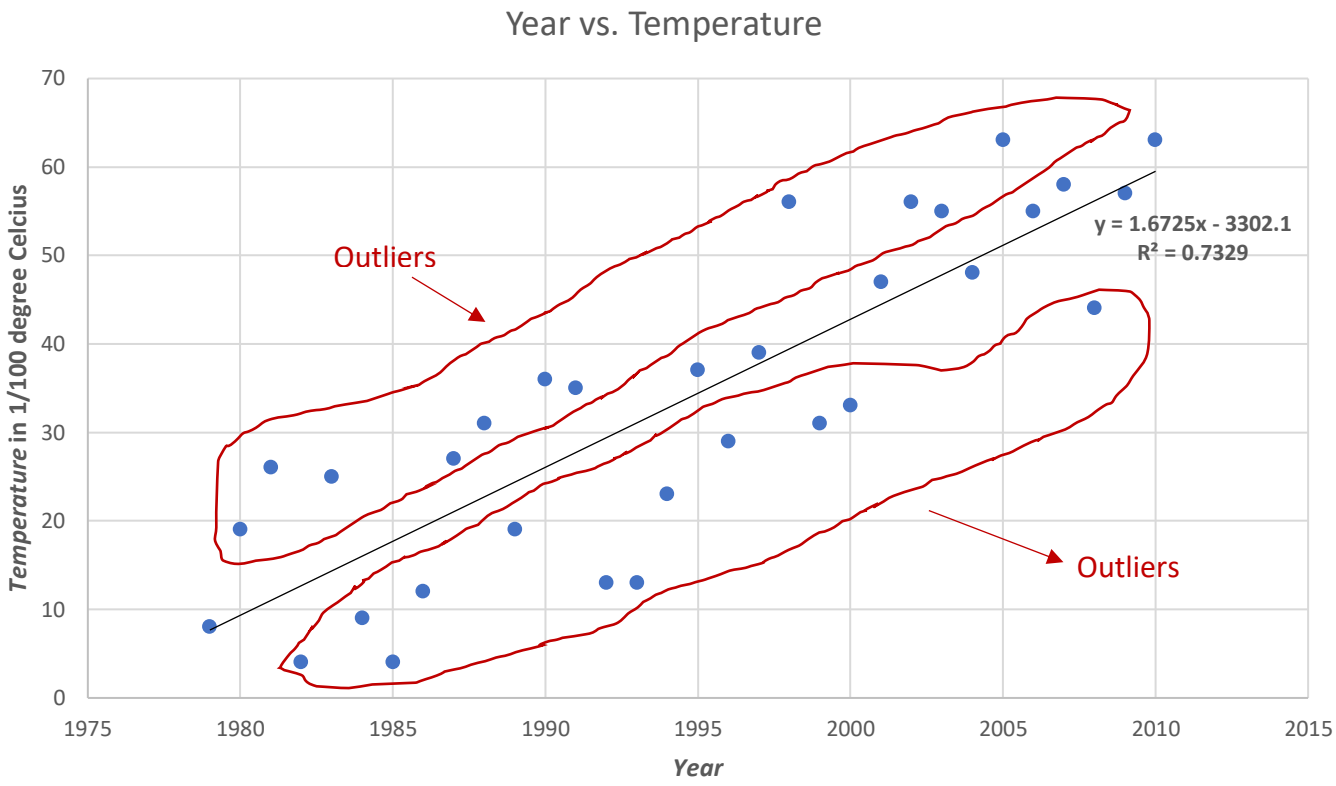
Declining Arctic Sea Ice Extent:



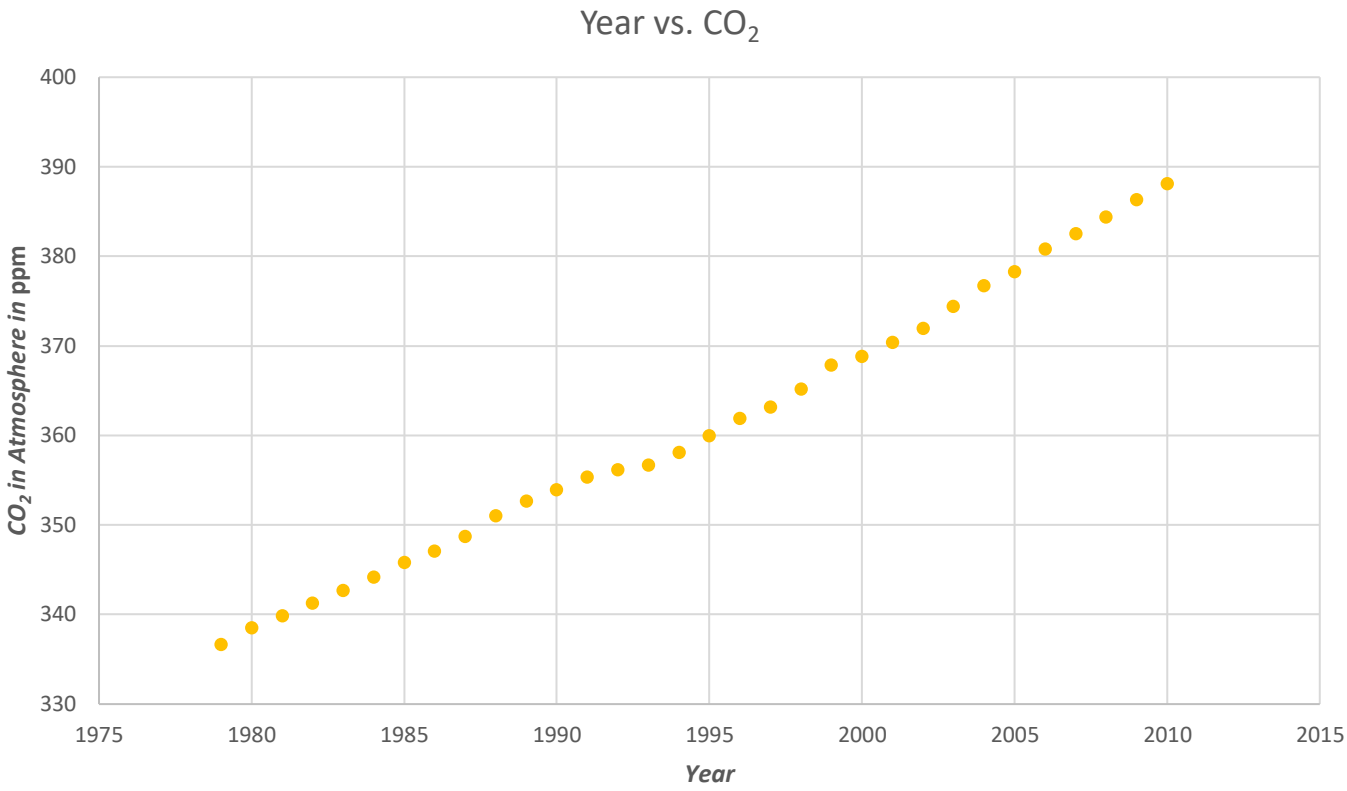
From the scatterplot above, the trendline depicts that the Arctic Sea Ice extent is decreasing significantly at a rate of -0.0921, which means about (0.0921 * 1,000,000 sq km) = **92,000 square kilometers of sea ice is decreasing every year.** Here, also the Squared Value of R is > 0 & < 1 which depicts that the values fixed in the plot contains some residuals but the data set fits the model (not completely) and is good for analyzing.

Rising Temperature, Increasing CO_2 & Solar Irradiance:

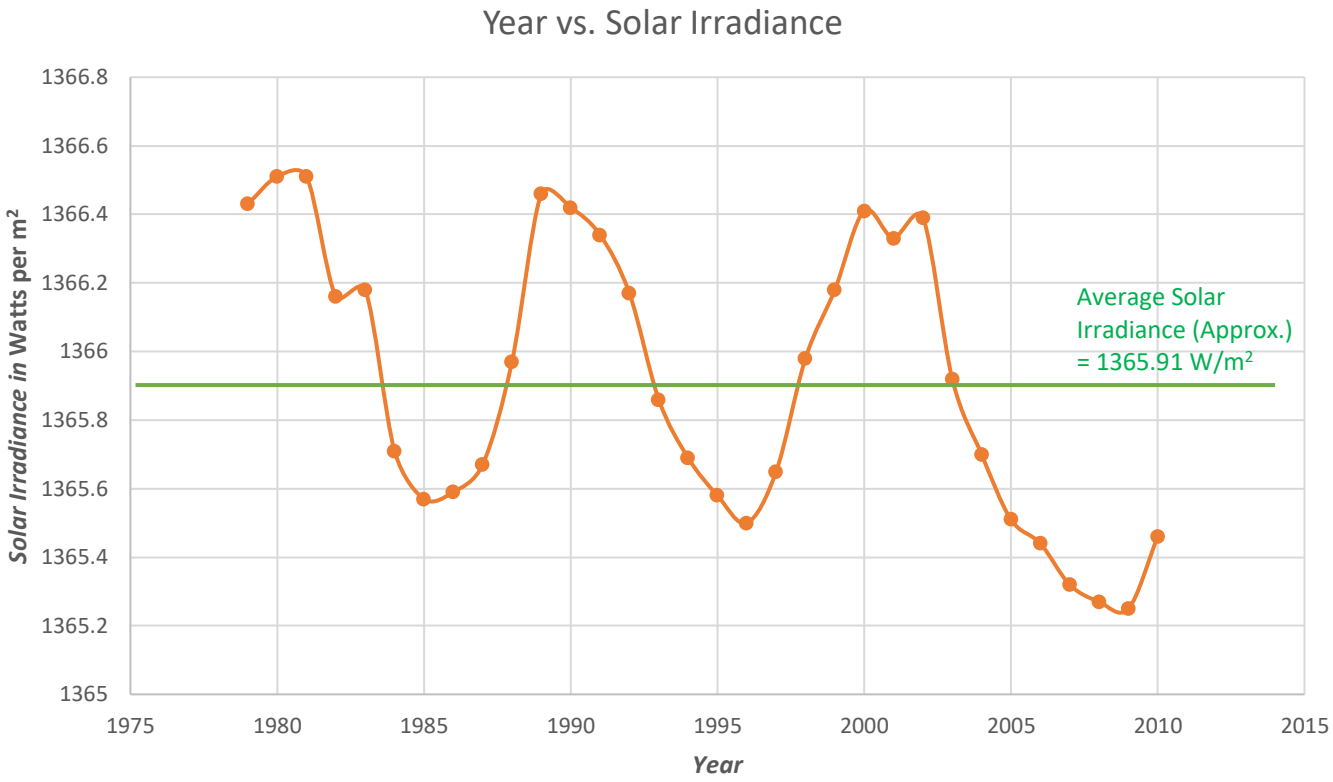
We all know what rising temperature and increasing amounts of CO_2 on Earth's atmosphere can mean, but what does Solar Irradiance shows? Well, Solar Irradiance is the power received by Earth's surface (Watts) from Sun per unit area (W/m^2).
At first, we already know that there have been a significant increase in Temperature over a period of time, the graph below depicts the same.



From the above graph, there can already be seen that not all points coincides with the line of regression, therefore they can be termed as outliers. Seeing from the above graph, we know that outliers should be treated differently because correlation and outliers are not related to each other. Therefore, the data used for the graph above doesn't fit the model perfectly although it has a value of R square between 0 and 1, it has many outliers!



From the graph above, we can clearly see a linear trend in increase in Carbon Dioxide in Earth's Atmosphere. It proves that the increase in CO_2 in Earth's atmosphere causes Greenhouse effect and results in increase of Methane & CO which in turn causes the Global Warming. Hence, it proves that the increase in CO_2 is resulting in the climate change.



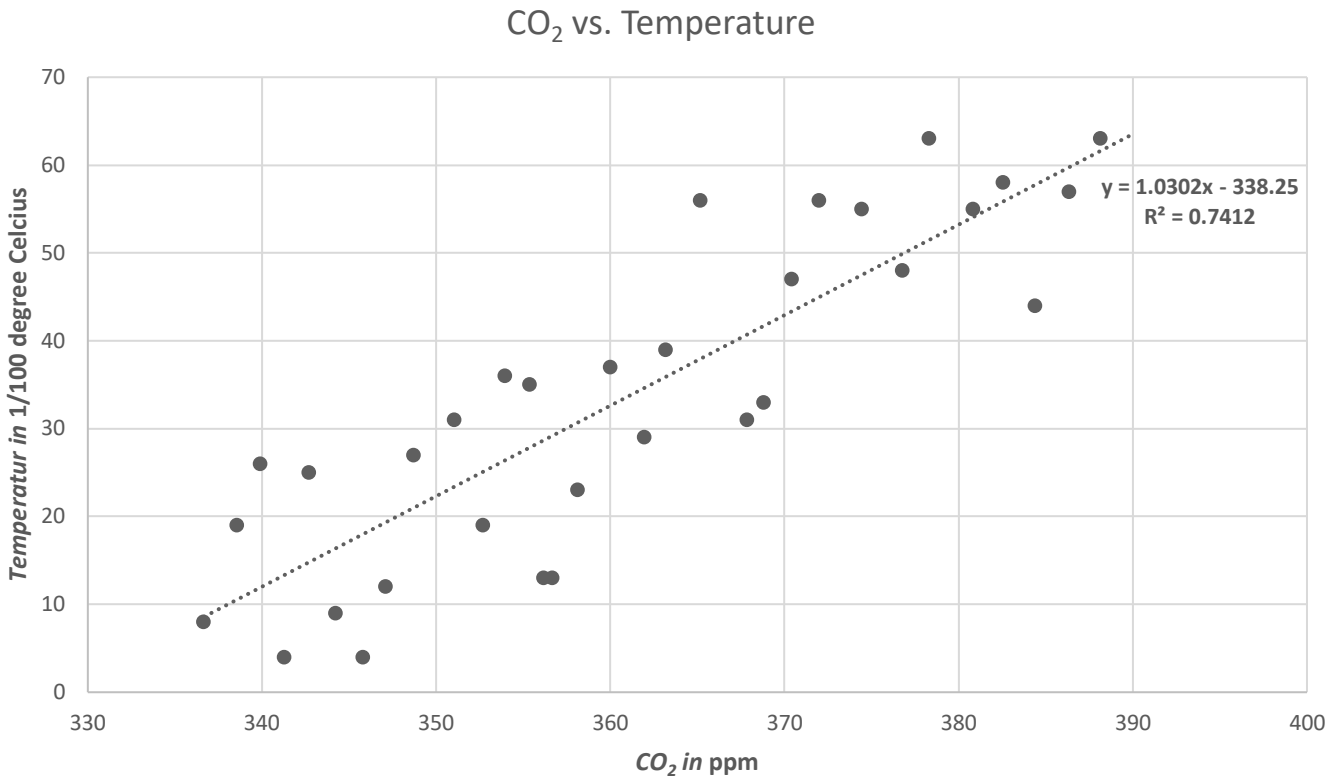
Now again, looking at the energy transmitted by Sun throughout a period of 32 years, we can clearly see no trends, it has been fluctuating throughout the period.

Here,

Average Solar Irradiance: (Sum of all Solar Irradiance)/(Number of sample) = 43709.13/32 = 1365.91 W/m^2

Standard Deviation: 0.41 W/m^2 (Calculated in Excel)

The Standard Deviation above depicts that the Solar Irradiance per year differed by only 0.41 W/m^2 over the period of time at an average.



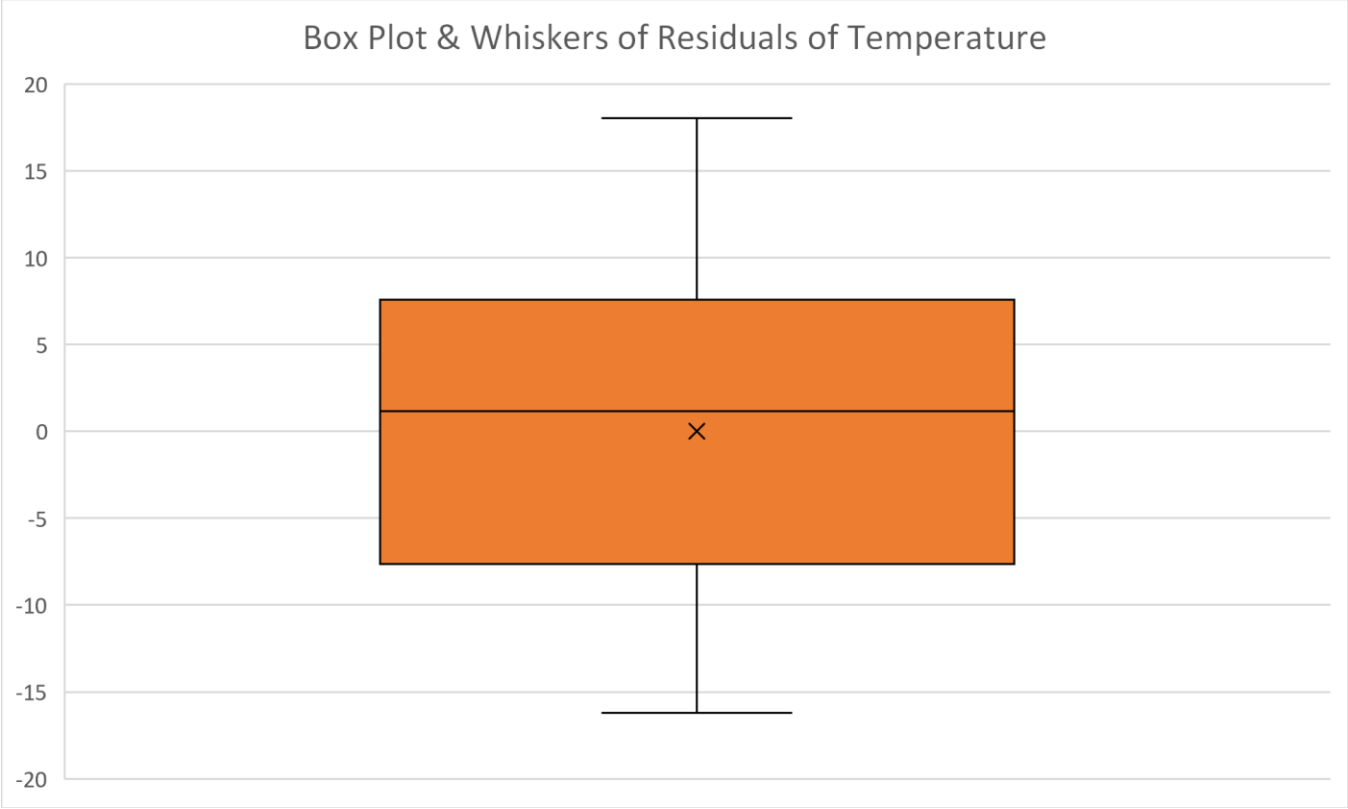
Now, looking at the comparison between the concentration of Carbon Dioxide in atmosphere and the surface temperature of Earth, it is clearly depicted that with the increase of CO_2 there is an effect on surface temperature, which increases, hence it is obvious to say that the increase of CO_2 causes the increase in temperature and results in Global Warming which in turn is a topic of concern for Climate Change.

In the above graph, we can also see there are a number of residuals present around the trendline.
We now calculated the residual points from the above graph using Predicted Temperature.
For each value of CO_2 as x, we found the value of 'y' which is predicted value of temperature and the subtracted it from the observed temperature to find residuals.

The data table of residual is listed below.

Temp	CO_2	Predicted Temp	Residual Temp
8	336.67	8.587434	-0.587434
19	338.57	10.544814	8.455186
26	339.92	11.935584	14.064416
4	341.3	13.35726	-9.35726
25	342.71	14.809842	10.190158
9	344.24	16.386048	-7.386048
4	345.81	18.003462	-14.003462
12	347.11	19.342722	-7.342722
27	348.72	21.001344	5.998656
31	351.04	23.391408	7.608592
19	352.68	25.080936	-6.080936
36	353.97	26.409894	9.590106
35	355.37	27.852174	7.147826
13	356.18	28.686636	-15.686636
13	356.69	29.212038	-16.212038
23	358.14	30.705828	-7.705828
37	360.02	32.642604	4.357396
29	361.95	34.63089	-5.63089
39	363.18	35.898036	3.101964
56	365.19	37.968738	18.031262
31	367.86	40.719372	-9.719372
33	368.83	41.718666	-8.718666
47	370.43	43.366986	3.633014
56	372.01	44.994702	11.005298
55	374.45	47.50839	7.49161
48	376.77	49.898454	-1.898454
63	378.3	51.47466	11.52534
55	380.83	54.081066	0.918934
58	382.56	55.863312	2.136688
44	384.39	57.748578	-13.748578
57	386.34	59.757468	-2.757468
63	388.13	61.601526	1.398474

Mean value of residual: -0.0056522 (approximately O)
Standard Deviation/Error: 9.323 (which is huge)
Median: 1.16 (Line dividing the orange colored area in next plot)
Q1: -7.705828 (Lower line of the rectangle in next plot)
Q3: 7.49161 (Upper line of the rectangle in next plot)
IQR: Q3-Q1 = 15.197438 (Orange Colored Area in the next Plot)



We can now also plot the Residual Temperature vs. other graphs. (which we think won't be necessary because we already got a conclusion from the above graphs).

Conclusion:

With the use of descriptive statistical knowledge, we can hereby conclude from the analysis above that over the years, the Arctic Sea Ice extent has deteriorated significantly, which means that there is a Climate change occurring in the Earth's Atmosphere. The degradation of Arctic Sea Ice Extent could have depended on many variables but one of the most obvious reason is the increase in Temperature which alarms Global Warming. With the increase of Carbon Dioxide in Earth's atmosphere, there is an increase in temperature, which again alarms Global Warming. The Solar irradiance index, from the above analysis did not differ much over the years, from which we couldn't find the relation of Solar irradiance with the Climate Change, since it has been fluctuating over the period. From the residuals of temperature with respect to CO_2 we found the standard deviation to be large, which depicts that the residuals of temperature increase with respect to CO_2 is differing by large amounts and still following a linear trend. We also could see from one of the graphs above where temperature was compared over the years that correlation is not causation.