Cape Grim Baseline Air Pollution Station

The Cape Grim Baseline Air Pollution Station is on the Northwest coast of Tasmania at Latitude 40.683°S, Longitude 144.689°E, elevation 94m. The facility is run jointly by the Australian CSIRO and Bureau of Meteorology [4]. Monthly CO_2 concentration data was available for the period May 1976 to November 2018, as shown in Figure 1 below:

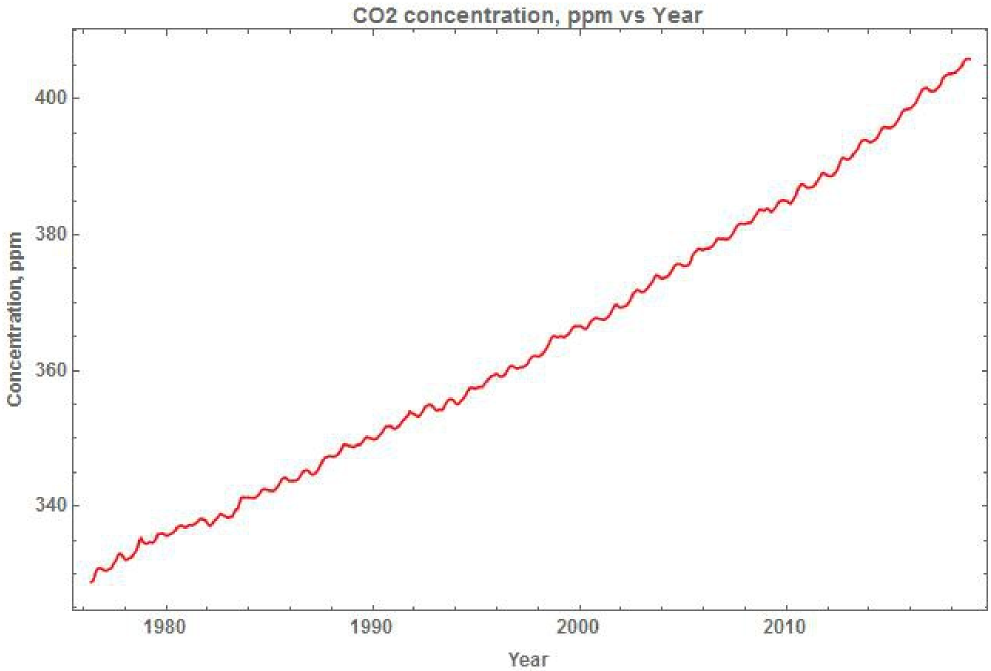


Figure 1

The graph shows a near- linear trend of +1.74 ppm per year over the period of 42 years and 7 months. Superimposed on this trend is a 12 month seasonal variation which ranges in amplitude from about 0.68 ppm to 1.77 ppm.

Applying the Cramér-von Mises statistical test to the detrended CO_2 concentration data gave a probability of 0.05% that it has a Normal distribution thereby rejecting a Normal distribution.

The seasonally corrected, monthly satellite lower troposphere temperature for the Southern Extension zone (20° South to 90° South latitude) from the University of Alabama, Huntsville, available from December 1978 onward is shown in Figure 2 below:

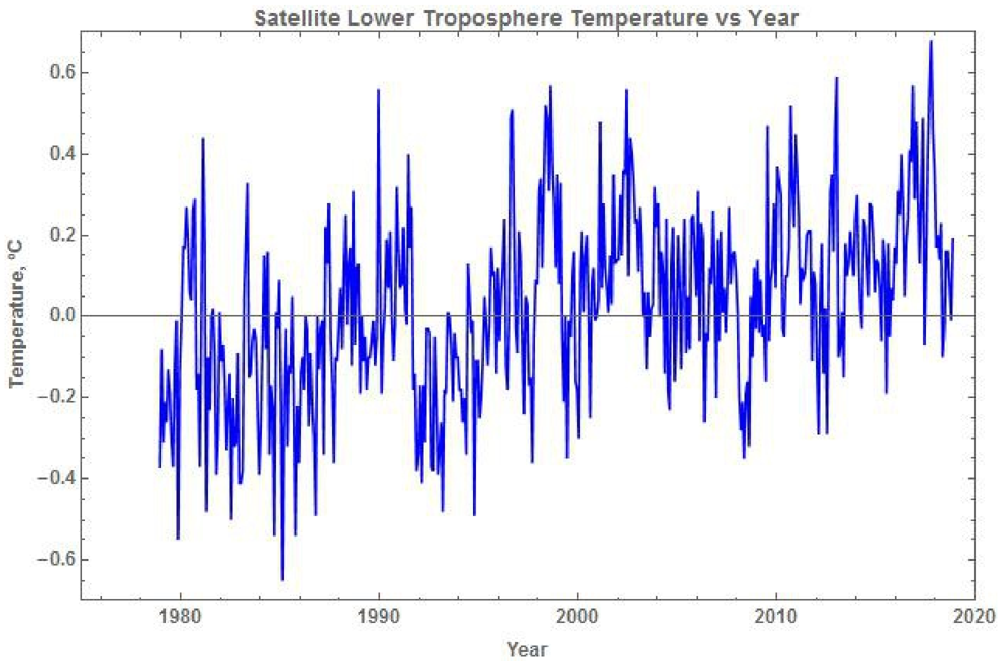


Figure 2

Applying the Cramér-von Mises statistical test to the detrended satellite lower troposphere temperature for the Southern Extension zone gave a probability of 37% that it has a Normal distribution thereby not rejecting a Normal distribution, although unlikely.

Calculation of the Pearson correlation coefficient between the measured pair of time series gave a value of 0.45, apparent in the following Figure 3:

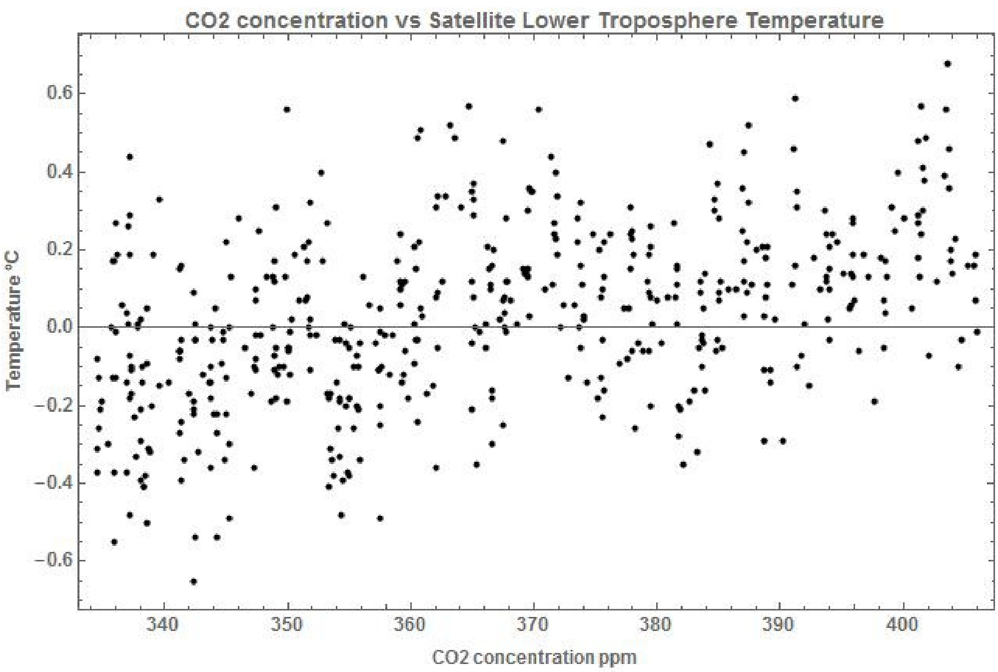


Figure 3

The Pearson correlation coefficient between the detrended CO_2 concentration and the detrended temperature was 0.017, however as the detrended CO_2 concentration was not Normally distributed, the Student t-test was not applicable and no probability could be assigned to the correlation value. A lack of correlation is clearly apparent in the following Figure 4:

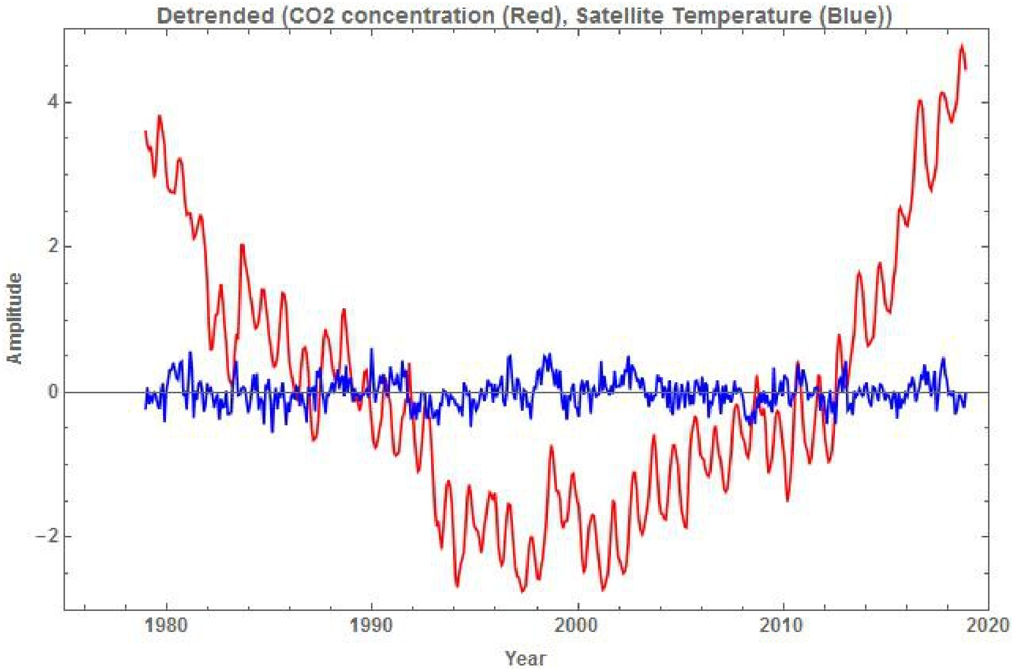


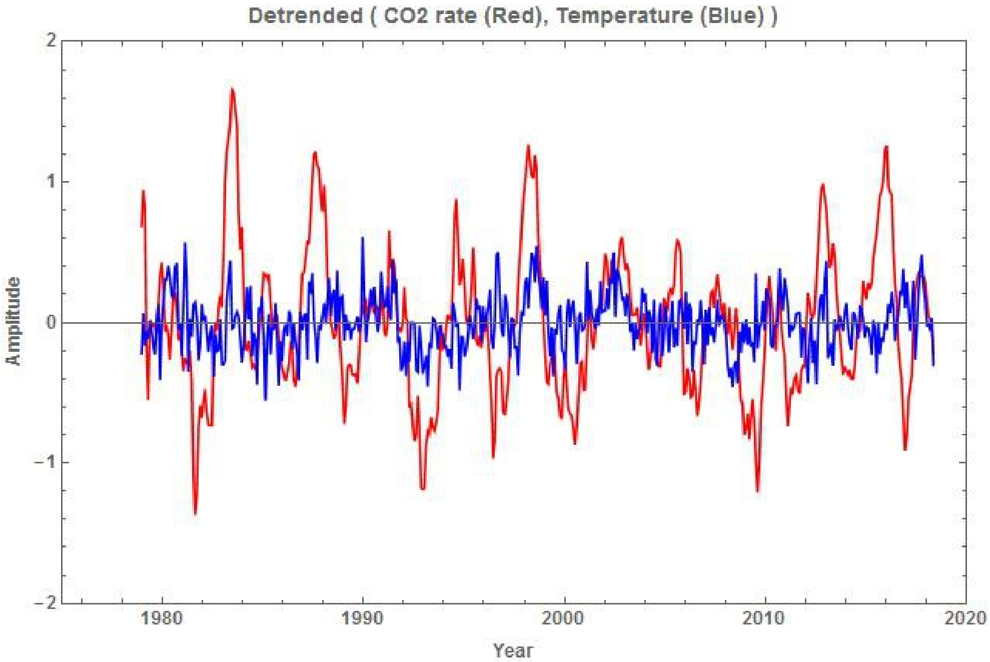
Figure 4

This indicates that it is the positive linear trend in original two series that gave rise to the moderate correlation value. The variation within each series, away from their linear trend, shows little in the way of correlation. Applying the Spearman Rank test of independence to the measured CO_2 concentration and temperature gave rho = +0.46 and a probability of the order of 10^{-26}, thereby rejecting the null hypothesis that the two series were independent. Applying the Spearman Rank test to the detrended CO_2 concentration and the detrended temperature gave rho = -0.01 and a probability of 80%, implying that the null hypothesis of independence, although likely, could not be rejected. This result supports the notion that it is their linear trends that cause the two series to appear to be interdependent.

As a linear trend can be determined for any time series, the above rejection of the null hypothesis does not mean that there is any level of causation between the time series.

Taking the difference between CO_2 measurements 12 months apart removed the seasonal variation in the time series, making it directly comparable with the satellite temperature series. The joint plot of the CO_2 rate, ppm pa, and the temperature level verses year, after detrending, is shown in Figure 5. It is obvious that the relationship between the two series is completely different to that between the detrended CO_2 concentration and temperature, Figure 4. This is supported by the Pearson correlation coefficient of 0.18 which is an order of magnitude greater than for the detrended CO_2 concentration and temperature which was 0.017. Once again, as the probabilities of the series, being 10% and 37% respectively, were insufficient to accept a Normal distribution, the Student t-test was not applicable.

Figure 5



Applying the Spearman Rank test of independence gave a positive rho value of +0.17 with a probability of 0.03% implying that the null hypothesis of independence was rejected. This is in contrast with the earlier test for the detrended CO_2 concentration and temperature which had a negative rho of -0.01% and a probability of 80% for the null hypothesis of independence.

It is concluded that there is reason to reject the notion of a causal relationship between the CO_2 concentration and temperature but accept the possibility of a direct or indirect causal relationship between the annual rate of change of CO_2 concentration and the corresponding satellite temperature.

The Oceanic Niño Index is issued by the US National Oceanic and Atmospheric Administration as part of its prediction service for El Niño events. It consists of monthly anomaly values from a three month running average of the sea surface temperature departures from the 30 year base temperature over an area of the central Pacific Ocean bounded by 5°S to 5°N latitudes and 120°W to 170°W longitudes, the Niño 3.4 region, that is, 1106 km N-S by 5566 km E-W, an area of 6.57 x 10^6 km^2.

The data subset used here was from a file list [ref. 9] that extended from January 1950 to October 2018.

The Cape Grim station is 8,360 km from the centre of the Niño 3.4 region and 4505km south of the Equator.

The joint plot of the CO_2 rate, ppm pa, and the Oceanic Niño Index verses year, after detrending, is shown in Figure 6. The Pearson Correlation Coefficient for the two detrended series was 0.37 but these series also did not fit a Normal distribution sufficiently well for a probability level to be assigned. The Spearman Rank test of independence gave a rho value of +0.35 with a probability of the order of 10^{-15}, once again rejecting the null hypothesis that the two series were independent.

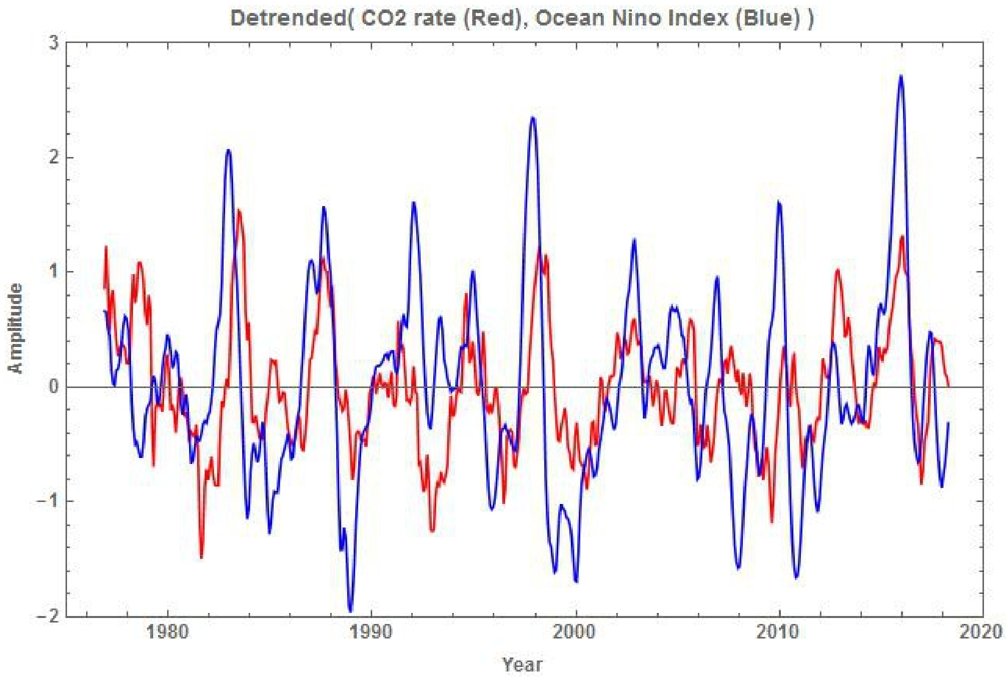


Figure 6

The area of the Oceanic Niño Index falls within the Tropics zone for which satellite temperature data is available from the UAH data series. The Tropics zone takes in the Equatorial circumference of the Earth, 40,075 km, and extends from 20°S to 20°N latitudes, a distance of 4425 km. That is, an area of 2.14 x 10^{8} km^{2} or about 33 times larger than the ONI 3.4 area.

In order to be comparable with the ONI 3.4, the three point moving average was calculated for the satellite lower troposphere Tropics temperature. The Pearson Correlation Coefficient for the detrended annual rate of change of the CO_2 concentration relative to the detrended, averaged temperature was 0.58. Applying the test of independence to the detrended annual rate of change of the CO_2 concentration relative to the detrended, averaged temperature gave a Spearman Rank statistic of 0.54 with a probability of the order of 10^{-37} thereby causing the null hypothesis of independence to be rejected. Figure 7 displays the relationship between the two variables.

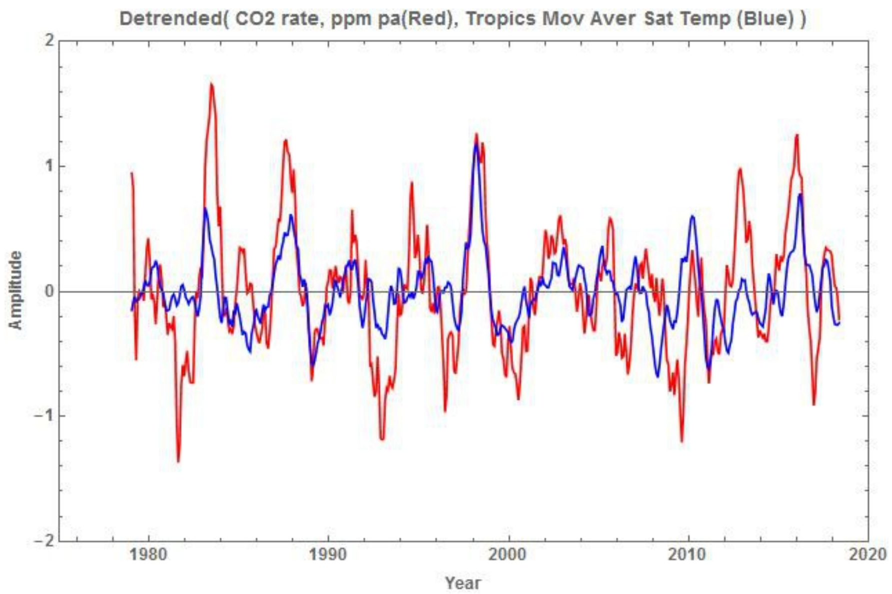


Figure 7

Confirmation of the relationship between the rate of change of CO_2 concentration and the Tropics temperature is demonstrated by the Fourier Amplitude spectrum for the detrended annual rate of change of the CO_2 concentration shown in Figure 8. It is practically identical to the Fourier Amplitude spectrum for the Tropics temperature with its dominant maximum at x-axis: 12, that is, frequency 0.0234 cycles per month, equivalent to a period of 42.7 months, the known El Niño period.

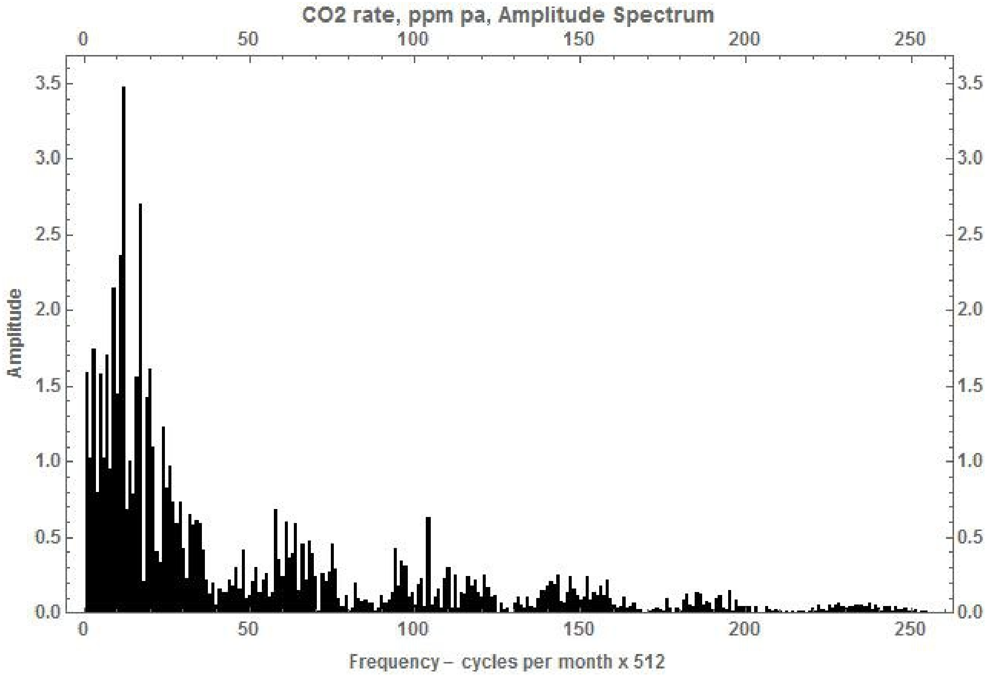


Figure 8

This also explains the highly significant probability for the rejection of the null hypothesis of independence between the annual rate of change of CO_2 and the Oceanic Niño Index3.4.

In summary, the direct comparison of the measured CO_2 and temperature gave a Pearson correlation coefficient of 0.45. The Spearman Rank test gave rho = +0.46 and a probability of independence of the order of 10^{-26}, thereby rejecting the null hypothesis that the two series were independent.

Comparison of the two time series after detrending gave a Pearson correlation coefficient of 0.017 and the Spearman Rank test gave a rho = -0.01 and a probability of independence of 80%, implying that the null hypothesis of independence, although likely, could not be rejected by the standard statistical measure of 5%.

Comparison of the annual rate of change of CO_2 and the measured temperature, after detrending, gave a Pearson correlation coefficient of 0.18 and a Spearman Rank test value of rho = +0.17 with a probability of 0.03% implying that the null hypothesis of independence was rejected.

Comparison of the annual rate of change of CO_2 and the Oceanic Niño Index, after detrending, gave a Pearson correlation coefficient of 0.37. The Spearman Rank test produced a value of rho = +0.35 and a probability of independence of the order of 10^{-15} thereby rejecting the null hypothesis that the two series were independent.

Comparison of the annual rate of change of CO_2 and the Tropics Moving Average satellite temperature, after detrending, gave a Pearson correlation coefficient of 0.58. The Spearman Rank test produced a value of rho = +0.54 and a probability of independence of the order of 10^{-37} thereby rejecting the null hypothesis that the two series were independent.

These results are interpreted as showing that the rate of change of CO_2 is either directly or indirectly determined by the temperature level. As the Equatorial zone has the greatest average temperature, it may be the source of the major proportion of the atmospheric CO_2 which then spreads towards the Poles as has been proposed in earlier studies reported here. The CO_2 concentration is increasing with time because the Equatorial zone temperature has been high enough to produce a positive CO_2 rate of change, possibly generated by the myriad life forms populating the zone. If so, then the rate of change of CO_2 may not reduce to zero until the temperature falls to a critical value, perhaps 0°C when water freezes and is no longer available to life

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The CO_2 concentration, Figure 1, shows a consistent seasonal variation known to be generated by biological sources via photosynthesis and more. This is supported by the significant correlation between the annual rate of change of CO_2 and the Oceanic Niño Index, another climate change event directly or indirectly causing a change in the CO_2 concentration. It is thus reasonable to suspect that the underlying near-linear trend is also generated from biological sources whereby changes in climate such as warmer and wetter conditions may increase the population of the biological sources. This is apparent from a comparison between the myriad of life forms in the Equatorial zone and the lack of life at the Poles.

Further evidence of climate change causing changes in the CO_2 concentration is apparent in the Fourier Amplitude spectrum for the rate of change of CO_2 concentration, shown in Figure 8, which mimics the spectrum for the Tropics satellite lower troposphere temperature.

The results indicate that CO_2 has not cause climate change. It is the climate that has caused the change in the CO_2 concentration. This is a complete contradiction of the IPCC claim that the increase in CO_2 concentration is man-made and that the atmospheric CO_2 has caused global warming and climate change.