EXAMINATION OF DATA ON GLOBAL WARMING USING GRAPHING CALCULATORS

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INTRODUCTON

It has been known for some time that the earth is in a cycle of global warming (1). It is not the intention of this paper to participate in the argument about global warming and the increase of carbon dioxide CO_2 in the atmosphere. The goal of this work is to demonstrate how data analysis using such sophisticated calculational methods and devices that we have today can enable us to make predictions and to analyze trends in data. From the data we can see the trends and make scientific predictions about what is taking place by using the scientific method and not relying on popular opinion.

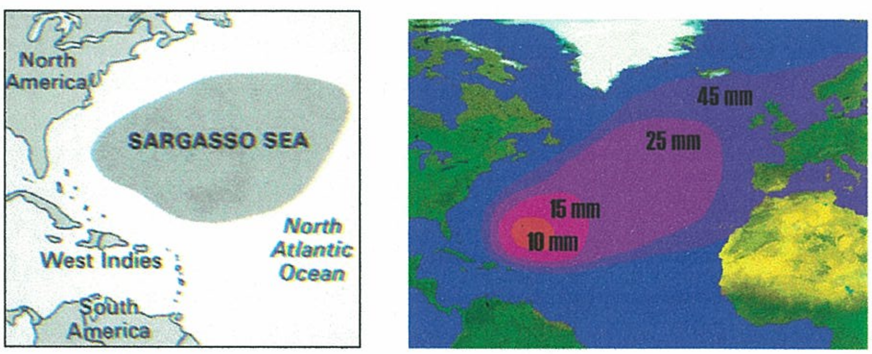
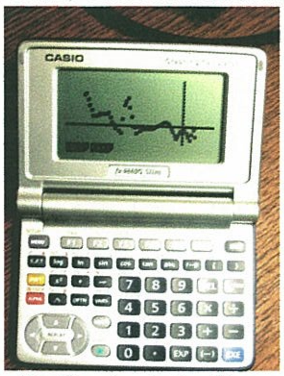


Figure 1. Two sketches of the Sargasso Sea and the extent of its area of expanse. Left. A sketch of the local area of the Sargasso Sea Adapted from World Book Encyclopedia (2). Right. See ref. (3).

Several signatures of data are available for analysis on the climate of the earth. These come from tree ring growth in old trees, sedimentary deposit core samples in the ocean bed, pollen analysis in ice core samples taken from the Arctic and Antarctic area, etc. Evidences are available for the history of the temperature changes in the Sargasso Sea over a period of 1000 years b. c. to 2000 years a. d. These numbers show interesting patterns which can be correlated with events in recorded history.

The energy that falls on the Earth comes primarily from the Sun. The Sun has provided energy in coal and petroleum deposits that we are consuming today. Long periods of time were required to deposit this energy that we are now using up at a rapid rate.

We may consider the Earth and Sun as two highly complex systems with the Sun driving the affairs on the Earth with a phase lag between the time at which the energy is released from the sun and when it makes changes in the Earth system. The Sargasso Sea can be considered as a part of the Earth system with events on the Sun indirectly affecting changes in the Sargasso Sea as a "System". This system is controlled by events within the Earth system. The Sun, Earth and parts of the Earth system can be assumed to be interacting in a complex way. Although we cannot determine the precise nature of the interaction, we can look at "average" behavior and make predictions from these averages. Often science operates on such assumptions that we must consider averages rather than specific cause-effect relationships. There is a region of uncertainty in macroscopic systems (treated by using dynamics) and the microscopic system (treated by using thermodynamics). We are considering the system in this activity as a chaotic system which lies in the region between dynamics and thermodynamics. In dynamics, well defined equations can be used and precise results determined. In thermodynamics the concept of probabililty has to be used and we consider "probabilities" rather than absolute cause-effect relationships.



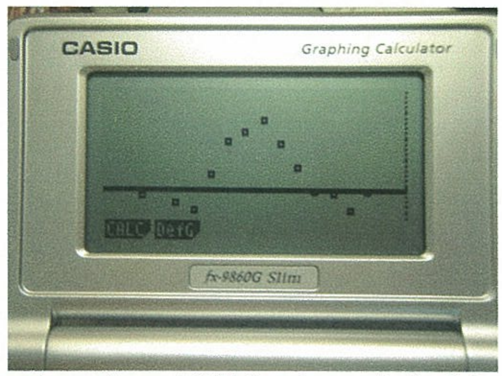


Figure 2. Left. A plot of temperature fluctuations about 73°F for the period of time -1000 b. c. to 129 a. d. Right. An enlarged plot of the period of time -682.7 b. c. to -452.9 b. c. The bold vertical line is "0" a. d. Note that the span of events is about 100 years.

We can assume that what happens in the Sargasso Sea can tell us about events on the Sun in that energy from the Sun operates on the Earth in a complex way. It is not easy to establish strong correlations of the events, but by assuming statistical behavior we can model events. The concept of "complexity matching" has been developed by the Center for Nonlinear Science at the University of North Texas and the systems are assumed to interact through complexity matching (4).

For about 100 years it has been known that the density of growth in tree rings over the years is correlated with a pattern of Sun spot activity. Pollen counts in the sedimentary deposits in core samples of the Earth show similar correlations. It is proposed that when data for tree ring density over time, fluctuations in temperature of the Earth and pollen count measurements in core samples taken from sedimentary deposits and ice cores from glaciers has been analyzed, similar patterns will emerge for all processes. These patterns will follow the short term eleven year cycle of the Sun spots. Over longer periods of time it can be shown that the "mini Ice Age" in Europe and the Maunder minimum in the Sun spot activity over the past 400 years are a part of the rhythm of the universe.

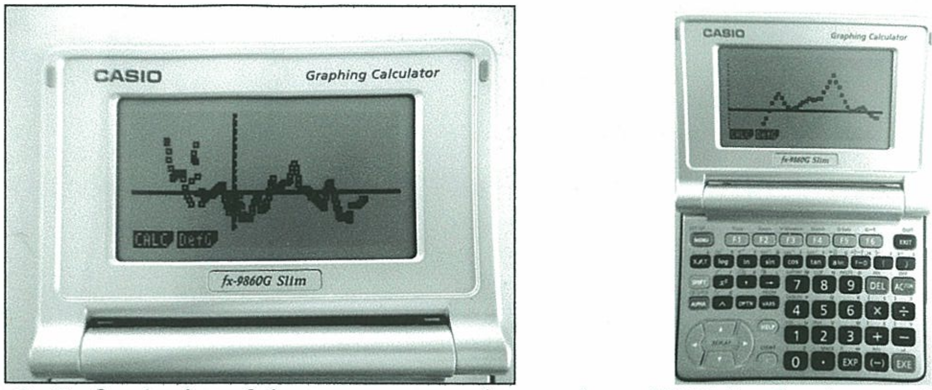


Figure 3. Left. A plot of the temperature change about 73° F for the time period -1000 b. c. to 2000 a. d. The bold vertical line is for "0" a. d. Right. A selected interval of time 517 a. d. to 1152 a. d. Note the intervals of rising temperature around 606 a. d. and another temperature rise near 920 a. d. During the period around 1000 a. d. Greenland was settled by Europeans and Leif Ericson came to the New World. This represented a time of mild temperatures predating the "mini Ice Age" in Europe.

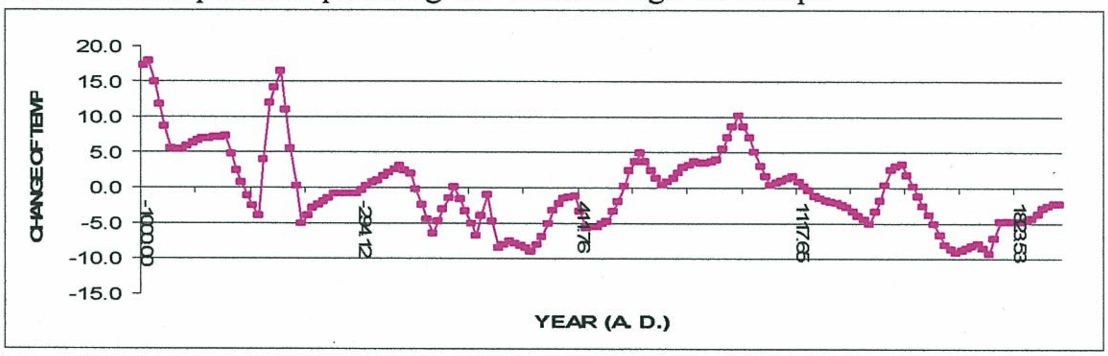


Figure 4. Temperature change relative to 73 deg F over time for the Sargasso Sea. Data adapted from Ref. (5).

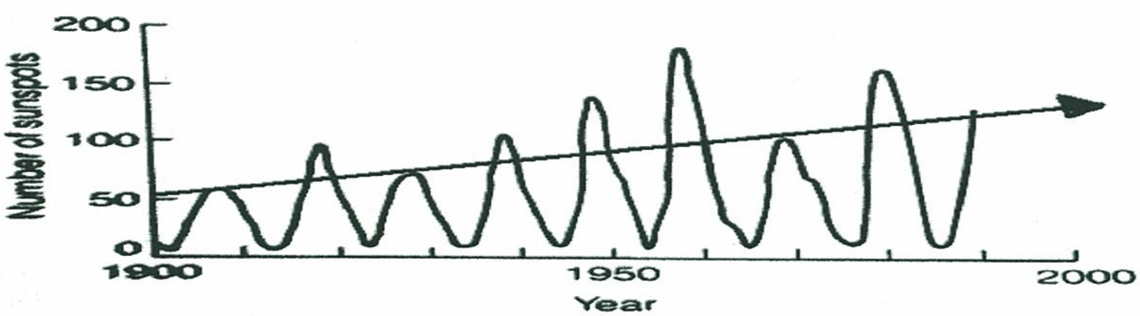


Figure 5. Sunspot cycles for the period of time 1900 to 2000 a. d. Note the steady rise in activity of the maxima. Compare this trend with figure 5D for temperature rise in the Sargasso Sea. See ref. (6). See ref. (7) for longer periods of patterns in the Sunspot cycle correlated with tree ring growth density.

CONCLUSION

Is global warming real? Yes. Is Pollution real? Yes. What is the major cause of global warming? More analysis is needed. If the temperature data fluctuations for the Sargasso

Sea represent global temperature change, we have had both global warming and global cooling cycles for the past 3000 years.

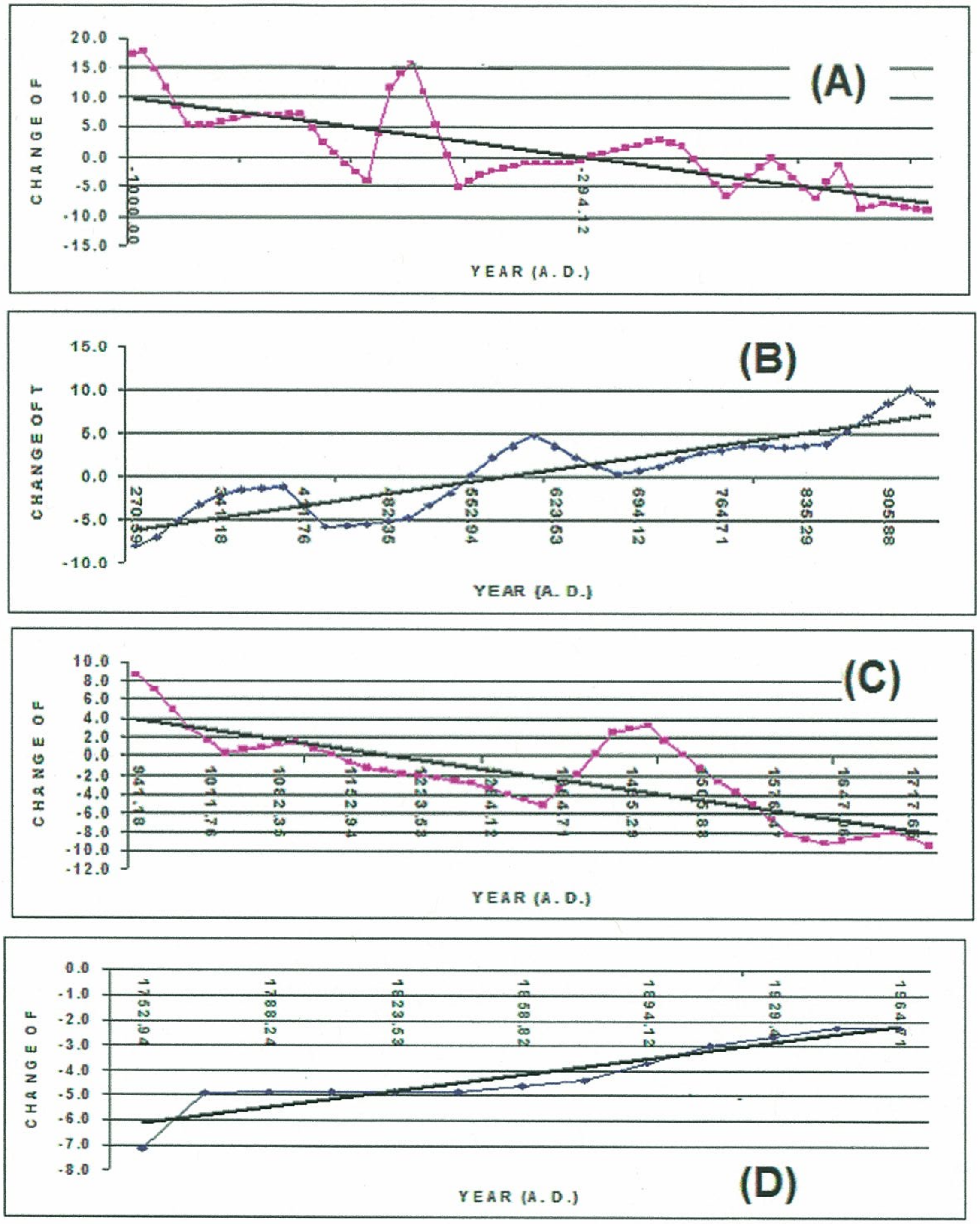


Figure 6. Segmented intervals of time for the temperature fluctuations in the Sargasso Sea. The linear regression data are entered for each interval chosen. Bold lines are linear least square regression lines with (A) -0.023°F/yr, (B) +0.019°F/yr, (C) -0.015°F/yr and (D) 0.035°F/yr and rising about 0.8°C in the past century.

TABLE 1. A table of temperature versus time for the period of time 1000 b. c. to 2000 a. d. The temperature change is taken relative to the average temperature 73° F. Ref. (5).

DATE(a d)	TEMP(+73)	DATE(a.d.)	TEMP(+73)	DATE(a.d.)	TEMP(+73)	DATE(a.d.)	TEMP(+73)
-1000.00	17.26	-223.53	1.50	552.94	0.15	1329.41	-4.55
-982.35	17.85	-205.88	2.00	570.59	2.30	1347.06	-5.10
-964.71	14.78	-188.24	2.50	588.24	3.55	1364.71	-3.45
-947.06	11.70	-170.59	3.00	605.88	4.80	1382.35	-1.80
-929.41	8.55	-152.94	2.40	623.53	3.55	1400.00	0.35
-911.76	5.40	-135.29	1.80	641.18	2.30	1417.65	2.50
-894.12	5.35	-117.65	-0.35	658.82	1.30	1435.29	2.90
-876.47	5.30	-100.00	-2.50	676.47	0.30	1452.94	3.30
-858.82	5.80	-82.35	-4.50	694.12	0.75	1470.59	1.75
-841.18	6.30	-64.71	-6.50	711.76	1.20	1488.24	0.20
-823.53	6.60	-47.06	-4.85	729.41	2.00	1505.88	-1.20
-805.88	6.90	-29.41	-3.20	747.06	2.80	1523.53	-2.60
-788.24	6.95	-11.76	-1.60	764.71	3.20	1541.18	-3.85
-770.59	7.00	5.88	0.00	782.35	3.60	1558.82	-5.10
-752.94	7.08	23.53	-1.70	800.00	3.50	1576.47	-6.65
-735.29	7.15	41.18	-3.40	817.65	3.40	1594.12	-8.20
-717.65	4.73	58.82	-5.15	835.29	3.65	1611.76	-8.70
-700.00	2.30	76.47	-6.90	852.94	3.90	1629.41	-9.20
-682.35	0.55	94.12	-4.01	870.59	5.45	1647.06	-8.90
-664.71	-1.20	111.76	-1.13	888.24	7.00	1664.71	-8.60
-647.06	-2.60	129.41	-4.86	905.88	8.60	1682.35	-8.25
-629.41	-4.00	147.06	-8.60	923.53	10.20	1700.00	-7.90
-611.76	3.90	164.71	-8.15	941.18	8.60	1717.65	-8.65
-594.12	11.80	182.35	-7.70	958.82	7.00	1735.29	-9.40
-576.47	14.10	200.00	-8.00	976.47	4.95	1752.94	-7.15
-558.82	16.40	217.65	-8.30	994.12	2.90	1770.59	-4.90
-541.18	10.90	235.29	-8.65	1011.76	1.60	1788.24	-4.88
-523.53	5.40	252.94	-9.00	1029.41	0.30	1805.88	-4.85
-505.88	0.15	270.59	-8.05	1047.06	0.60	1823.53	-4.85
-488.24	-5.10	288.24	-7.10	1064.71	0.90	1841.18	-4.85
-470.59	-4.05	305.88	-5.18	1082.35	1.20	1858.82	-4.63
-452.94	-3.00	323.53	-3.25	1100.00	1.50	1876.47	-4.40
-435.29	-2.50	341.18	-2.38	1117.65	0.85	1894.12	-3.70
-417.65	-2.00	358.82	-1.50	1135.29	0.20	1911.76	-3.00
-400.00	-1.50	376.47	-1.35	1152.94	-0.53	1929.41	-2.65
-382.35	-1.00	394.12	-1.20	1170.59	-1.25	1947.06	-2.30
-364.71	-1.00	411.76	-3.50	1188.24	-1.53	1964.71	-2.30
-347.06	-1.00	429.41	-5.80	1205.88	-1.80		
-329.41	-1.00	447.06	-5.70	1223.53	-2.03		
-311.76	-1.00	464.71	-5.60	1241.18	-2.25		
-294.12	-0.45	482.35	-5.20	1258.82	-2.55		
-276.47	0.10	500.00	-4.80	1276.47	-2.85		
-258.82	0.55	517.65	-3.40	1294.12	-3.43		
-241.18	1.00	535.29	-2.00	1311.76	-4.00		

1. http://en.wikipedia.org/wiki/Global_warming
2. Adapted from World Book Encyclopedia, Volume 17, page 111 (1979).
3. http://en.wikipedia.org/wiki/Sargasso_Sea
4. West, B. J. and Scafetta, N., "Is Climate Sensitive to Solar Variability?" Physics Today, March 2008, pp.50-51 (2008).
5. "Environmental Effects of Increased Atmospheric Caarbon Dioxide", A. B. Robinson, N. E. Robinson and W. Soon, Journal of American Physicians ans Surgeons (2007) **12**, 79-90.
6. Foundations of Astronomy, M. A. Seeds, Wadsworth, Inc., p 199 (1984) ISBN0-534-02953-1.)
7. "Correlation between ring growth in a giant redwood tree and the sun spot cycle" D. Thomas and J. A. Roberts, The Texas Science Teacher April 200, page 14-17.)