Fall 9-2006

Recent Global Warming: A New Approach to Interpreting Some of the Data

Stanley Schleifer
CUNY York College

Nazrul I. Khandaker
CUNY York College

Samuel Borenstein
CUNY York College

Che-Tsao Huang
CUNY York College

Thakur Chaturgan
CUNY York College

See next page for additional authors

Authors
Stanley Schleifer, Nazrul I. Khandaker, Samuel Borenstein, Che-Tsao Huang, Thakur Chaturgan, Feng Chan Liang, Mario Jo-Ramirez, Dorean J. Flores, Poonraj Persaud, and Selwyn N. Lebourne

RECENT GLOBAL WARMING: A NEW APPROACH TO INTERPRETING SOME OF THE DATA

[1]Stanley Schleifer, [1]Nazrul I. Khandaker, [1]Samuel Borenstein, [2]Che-Tsao Huang, [1]Thakur Chaturgan, [1]Feng Chan Liang, [1]Mario Jo-Ramirez, [1]Dorean J. Flores, [1]Poonraj Persaud, and [1]Selwyn N. Lebourne

[1]Department of Natural Sciences, York College of the City University of New York, Jamaica, NY 11451

[2]Department of Educational Technology, York College of the City University of New York, Jamaica, NY 11451

ABSTRACT: The authors have done an analysis of meteorological data which may add to the growing body of information addressing the cause or causes of recent global warming. If an augmented greenhouse effect, due to increasing atmospheric carbon dioxide concentrations, has been a significant factor producing global warming, then this should be indicated by an increase in the interval of time between the time of maximum insolation, and the time of maximum surface temperature, as well as a decrease in the interval of time between the time of minimum insolation and the time of minimum surface temperature, in the mid latitudes. However, the magnitude of this effect should not be as great during the Northern Hemisphere summer as during the Northern Hemisphere winter because of the reduction in atmospheric carbon dioxide due to increased photosynthesis. The authors have examined surface air temperature data from a mid-latitude, continental area to see if the above expected changes have, in fact, occurred. The results of this study indicate that global warming, during the ca. 50 year study period, is consistent with an increase in the concentration of carbon dioxide in the earth's atmosphere. A comparison of the summer vs winter lag data show that increases in heat retention have occurred mainly during the Northern Hemisphere winter, when annual carbon dioxide concentrations are greatest. The augmentation of the greenhouse effect appears to be mitigated during the Northern Hemisphere summer. The data suggest that factors other than anthropogenic increases in atmospheric carbon dioxide have also significantly influenced the heat budget at the surface of the earth during the period from 1950 to 2003.

Key words: carbon dioxide, global warming, anthropogenic, seasonal effects

INTRODUCTION

Many scientists in the field of earth and environmental sciences believe that the increase in earth surface temperatures, measured during the 20[th] century, is due, for the most part, to anthropogenic increases in the atmospheric concentration of infrared active gases (methane, oxides of nitrogen, chlorofluorocarbons, and particularly carbon dioxide). Others still believe that recent global warming may be a manifestation of natural cycles that are not anthropogenic (Jones and Heger 1998). The authors have done an analysis of some of the available meteorological data, which may add to the growing body of information addressing this question. In this study, we attempt to isolate carbon dioxide as a factor in the recent global warming.

During the winter time in either the Northern or the Southern Hemisphere of the earth, surface temperatures, all other things being equal, would decrease while the heat lost to space by radiation exceeds the heat gained by insolation (i.e., heat absorbed at the surface of the earth due to solar radiation, per unit area per unit time). At the end of this period, surface temperatures would be at their minimum for a given year. As the solar altitude increases after the winter solstice, insolation increases until it equals and then exceeds heat loss. At this time, surface temperatures begin to increase (Berger and Loutre 1997; Hasselmann 1997). During the summer, surface temperatures rise while insolation exceeds radiative heat loss. After the summer solstice, as the solar altitude decreases, insolation decreases. When radiative heat loss equals insolation, surface temperatures are at their maximum. Subsequently, as solar altitude and insolation continue to decrease, surface temperatures decrease.

The concentration of carbon dioxide in the earth's atmosphere has been increasing since the beginning of the Industrial Revolution (Jones and Briffa 1992; Jones and Mann 2004, Houghton et al. 1996, 2001; Ledley et al. 1999; Lutgens and Tarbuck 2005). If an augmented greenhouse effect, due to increasing atmospheric carbon dioxide concentration, has been a significant factor in producing recent global warming, then this should be indicated by a change in the interval of time between the time of maximum insolation (i.e. the summer solstice for either the Northern or the Southern Hemisphere), and the time of maximum surface temperature in the mid-latitudes of that hemisphere, as well as the interval of time between minimum insolation (i.e. the winter solstice for either the Northern or the Southern Hemisphere), and the time of minimum surface temperature in the mid latitudes of that hemisphere. Specifically, the interval of time from the winter solstice to the time of minimum surface temperature in a northern hemisphere, mid-latitude land area should decrease and the interval of time from the summer solstice to the time of maximum surface temperature in a northern hemisphere, mid-latitude land area should increase (**Fig. 1**). However, the magnitude of this effect should not be as great during the Northern Hemisphere summer as during the Northern Hemisphere winter because of the reduction in atmospheric carbon dioxide due to increased photosynthesis during the Northern Hemisphere summer.

UTILIZATION OF AVAILABLE ON-LINE DATA FOR STATISTICAL ANYLYSIS

The authors have examined surface air temperature data

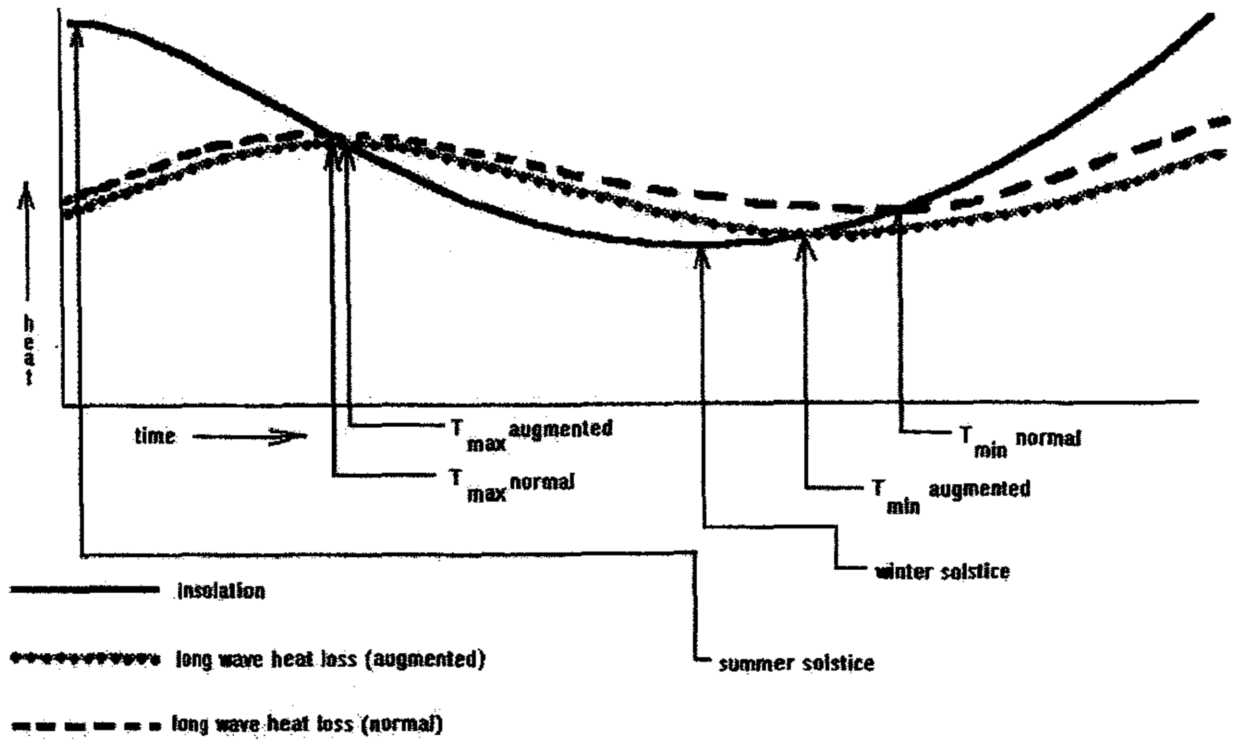

Figure 1. Hypothetical Heat Budget, with and without enhanced Greenhouse Effect.

from a mid-latitude, continental area to see if there has been a significant change in the interval of time between the summer solstice and the time of maximum surface temperature and the winter solstice and the time of minimum surface temperature, during periods of changing global surface temperatures, as expected according to the above hypothesis. Mid-latitude, continental areas were chosen for this study because the effects on air temperatures, due to changes in the heat budget at the surface of the earth are most easily observed in these areas [*NOAA NCEP-NCAR CDAS-1 DAILY Diagnostic above_ground temp: Temperature data online data base*].

It should be noted that similar changes in "lag time", to those illustrated above, between the solstices and times of maximum and minimum temperatures, respectively, would also result from increasing insolation or increasing retention of heat at the surface of the earth due to causes other than a carbon dioxide enhanced greenhouse effect. However, if this increased heat retention is due to increasing atmospheric carbon dioxide concentrations, then it would be mitigated during the Northern Hemisphere summer as discussed above, when atmospheric concentrations of carbon dioxide are reduced by increased photosynthesis. The annual low points, or troughs in the global atmospheric carbon dioxide concentration, occur during the Northern Hemisphere summer. Therefore, the effect on the "lag time", discussed above, should be reduced or mitigated during the Northern Hemisphere summer if it is primarily due to the effect of carbon dioxide as an infrared active gas (National Research Council 1982, 2001; National Academy of Sciences 1989; Mann et al. 1999).

METHODS

Surface temperature data was obtained from the *NOAA NCEP-NCAR CDAS-1 DAILY Diagnostic above ground temp: Temperature data online data base..* Information from November 1, 1950 to September 30, 2003 was used for this study. Interpolated daily temperatures, from 2 meters above the surface, were obtained from the above source for a contiguous Eurasian land area from approximately 40 degrees East Longitude to 120 degrees East Longitude, and from approximately 30 degrees North Latitude to 60 degrees North Latitude. Data grid points are 1.875 degrees apart both in latitude and longitude. The data obtained was loaded into spreadsheet programs for processing. (Microsoft Excel (2003) and Corel Quattro Pro (2001) programs were used.) The arithmetic mean of the daily temperature at each grid point, in the above referenced area, was computed for each day of the data set. Correction for grid area variation with latitude was applied by weighting each data point by the cosine of its latitude. To offset the effects of short term temperature variation, (noise), on the determination of seasonal temperature maxima and minima for the selected area, a 61 day traveling mean was computed for the summer and winter season of each year of the data set. The statistical coldest or warmest day, for the winter and summer (respectively), of each year of the data set, was then determined by inspection. The interval of time, in days, between an arbitrarily selected date, in the fall and in the spring, respectively, and the crossover day was determined for the summer and winter season of each year of the data set. [*NOAA NCEP-NCAR CDAS-1 DAILY Diagnostic above ground temp: Temperature data online data base.*]

RESULTS AND CONCLUSIONS

This study shows that the date of the statistically coldest winter day has gotten earlier, with time, during the second half of the 20th Century, in the study area **(Fig. 2)**. This is consistent with an increasing retention of heat, with time, during the winter season for the same period.

It also shows that the date of the statistical warmest summer day has not significantly changed, with time, during the second half of the 20th Century, in the same study area **(Fig. 3)**.

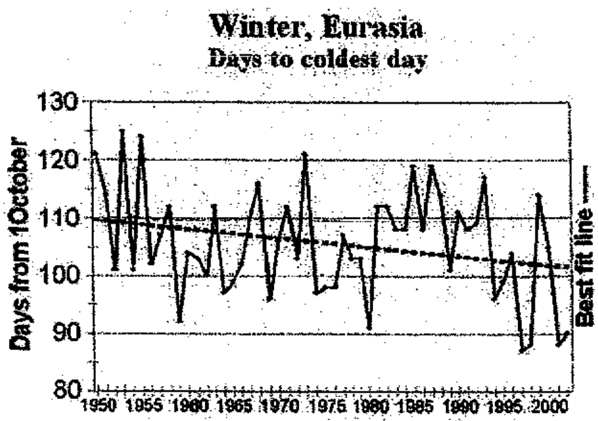

Figure 2. Eurasia Winter - Statistical Days to Coldest Day.

The results also indicate that, in the study area, for at least the latter half of the 20th Century, global warming has occurred during the Northern Hemisphere winter and not during the Northern Hemisphere summer. This is consistent with increases in atmospheric carbon dioxide being a major factor in this global warming (U.S. DOC/ NOAA 2004; U.S. EPA 2001, 2001b).

Increased photo-synthetic conversion of carbon dioxide during the Northern Hemisphere summer sequesters atmospheric carbon in the plant biomass, lowering carbon dioxide concentrations in the atmosphere (Schleifer et al. 2004). During the Northern Hemisphere winter, decreased photo-synthetic conversion of carbon dioxide along with increased burning of fossil fuels and wood, both containing carbon, as well as the decay of dead vegetation, raise the atmospheric concentration of carbon dioxide. This would augment the "greenhouse effect" during the Northern Hemisphere winter and mitigate or diminish it during the Northern Hemisphere summer (Watson 1998). This is consistent with the results of our study.

The data also indicate that things other than atmospheric carbon dioxide concentration have significantly influenced thermal equilibrium at the surface of the earth. **Figure 4** shows a steady year to year increase in globally averaged atmospheric carbon dioxide concentrations from before 1960 to after 1990.

This study also shows **(Fig. 5)** that the estimated globally averaged rate of temperature change was not constant, on land areas, from about 1950 to 2003 (GISS 2004). For the period of about 1960 to 1980, worldwide land temperatures were static or actually decreasing according to these studies. Since carbon dioxide concentrations were steadily increasing during this same period, other factors clearly affected the thermal balance on the earth. This is reflected in the winter lag times during the period of cooling, which

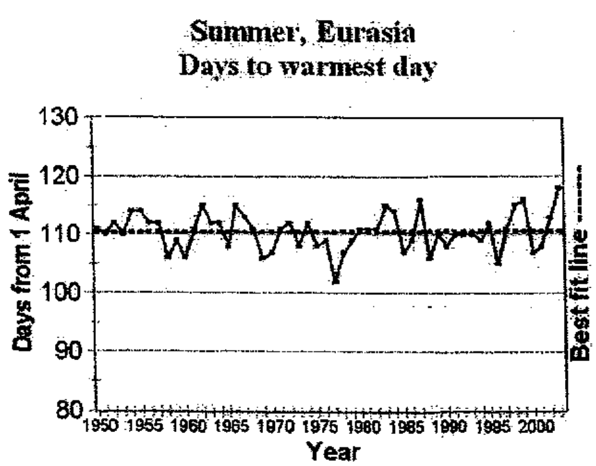

Figure 3. Eurasia Summer - Statistical Days to Warmest Day.

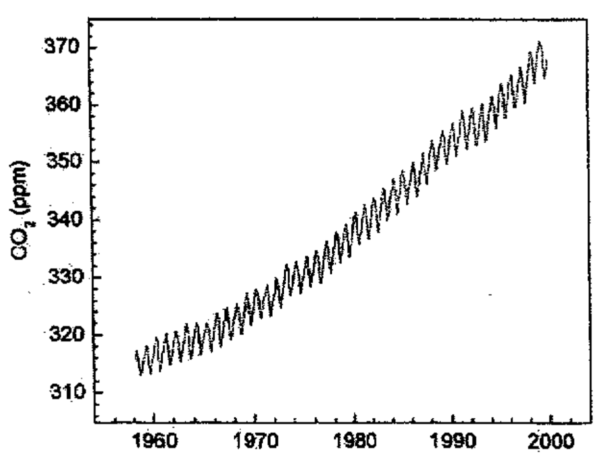

Figure 4. Atmospheric Carbon Dioxide Concentration, by year, Mauna Loa, Hawaii.

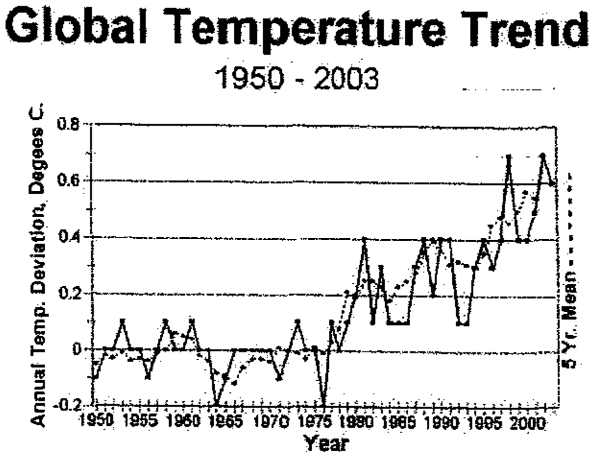

Figure 5. Global Temperature Trend - Deviation from 1950 - 1980 Mean.

are either constant or increasing with time, as shown in figure 2. Thereafter, there was relatively rapid warming. This is also indicated in figure 2 by rapidly decreasing lag times up to the end of the study period.

The mean slope of the change in lag time to the statistically coldest days, derived from the winter data, is approximately -0.16 days per year for the study period. For the last 15 years of the study, which was a period of very rapid global warming, (Fig. 5), the mean slope is approximately -1.3 days per year (Fig. 2). The slope of the change in lag time to the warmest days, for the summer data, for the study period, is essentially zero (Fig. 3). These results support the basic hypothesis of this investigation i. e. that increasing carbon dioxide in the atmosphere has been a significant factor in recent global warming. However, other parameters, including water vapor and cloud cover may significantly influence seasonal heat budgets in mid-latitude areas. In our future studies we plan to evaluate the seasonal effects of these factors on heat budgets as well.

ACKNOWLEDGEMENTS

The research leading to this article was done with the support of the National Aeronautics and Space Administration under NOVA - MUSPIN grant #49615.

The authors would like to acknowledge the help and support of the Department of Natural Sciences, York College of CUNY, without which this work would not have been possible.

The authors gratefully acknowledge the encouragement, critical review and constructive suggestions of Somdev Bhattacharji, Emeritus Professor of Geology, Brooklyn College of CUNY.

REFERENCES

BERGER, A. and LOUTRE, M., 1997, Long-term variations in insolation and their effects on climate, the LLN experiments: *Surveys in Geophysics*, v. 18, nos. 2-3, p. 147-161.

GODDARD INSTITUTE OF SPACE SCIENCES (online database), 2004, http://www.giss.nasa.gov/data/update/gistemp/GLB.Ts.txt

HASSELMANN, K., 1997, Climate change: Are we seeing global warming?: *Science*, v. 276, p. 914-915.

HOUGHTON, J., DING, Y., GRIGGS, D., NOGUER, P., VAN DER LINDEN, and XIASOU, D., eds., 2001, Intergovernmental Panel on Climate Change. Climate Change 2001: The Scientific Basis. Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, U.K.

HOUGHTON, J., MEIRA FILHO, L., CALLANDAR, B., HARRIS, N., KATTENBERG, A., and MASKELL, K., eds., 1996, Intergovernmental Panel on Climate Change. Climate Change 1995: The Science of Climate Change, Cambridge University Press, Cambridge, U.K., p. 4.

JONES, P. and BRIFFA, K., 1992, Global surface air temperature variations during the 20th century: *Holocene*, v.1, p.165 - 179.

JONES, P. and HEGERL, G., 1998, Comparisons of two methods of removing anthropogenically related variability from the near-surface observational temperature field : *Journal of Geophysical Research*, v.103, p.777-786.

JONES, P.D. and MANN, M.E., 2004, Climate over past millennia: *Reviews in Geophysics*, v. 42, p. 1029-1043.

LEDLEY, T., SUNDQUIST, E., SCHWARTZ, S., HALL, D., FELLOWS, J, and KILLEEN, T., 1999, Climate Change and Greenhouse Gases: *EOS, Transactions American Geophysical Union*, v. 80, p. 453.

LUTGENS, F. and TARBUCK, E., eds., 2005, An Introduction to Physical Geology. 8th ed., Pearson Prentice Hall, New Jersey, 711 p.

MANN, M., BRADLEY, R., and HUGHES, M., 1999, Northern hemisphere temperatures during the past millennium: Inferences, uncertainties, and limitations: *Journal of Geophysical Research Letters*, v. 26, p.759-762.

NATIONAL ACADEMY OF SCIENCES, 1989, Ozone Depletion, Greenhouse Gases and Climate Change. National Academy Press. Washington, D.C.

NATIONAL RESEARCH COUNCIL, 2001, Committee on the Science of Climate Change, Climate Change Science: An Analysis of Some Key Questions, National Academy Press, Washington, D.C. http://books.nap.edu/html/climatechange.

NATIONAL RESEARCH COUNCIL, 1982, Solar Variability, Weather and Climate. National Academy Press, Washington, D. C., p. 7.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) 2001, NCEP-NCAR CDAS-1 DAILY Diagnostic above ground temp: Temperature data online data base.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), 2004. www.mlo.noaa.gov.

SCHLEIFER, S., BORENSTEIN, S., KHANDAKER, N. I., HUANG, CHE-TSAO, LIANG, F., JO-RAMIREZ, M., FLORES, D., PERSAUD, P., and LEBOURNE, S., 2004, Involving undergraduates in research: measuring

& modeling on-line climate data. Geological Society of America, Abstracts with Programs, Northeastern and Southeastern Section Joint Meeting, v. 36, no. 2, p.122.

UNITED STATES DEPARTMENT OF COMMERCE (U.S. DOC)/ NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA), 2004, National Climate Data Center: Historical Climatology Series 5-1 (Asheville, NC: NOAA). http://www.ncdc.noaa.gov/ol/documentlibrary/hcs/hcs.html

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S. EPA), 2001, Inventory of U.S. Greenhouse Gas Emissions and Sinks:1990-1999, Report 2360R-01-001, U.S. EPA, Washington D.C. http://www.epa.gov/globalwarming/emissions/national

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (U.S. EPA), U.S. High GWP Emissions 1990-2010: Inventories, Projections, and Opportunities for Reductions, U.S. EPA, Washington D.C. www.epa.gov/ghginfo

WATSON, R., ET AL., eds., 1998, Intergovernmental Panel on Climate Change: The Regional Impacts of Climate Change: An assessment of vulnerability. Cambridge University Press, Cambridge, U.K.