On the Existence of a "Tropical Hot Spot" & The Validity of EPA's CO_2 Endangerment Finding

Abridged Research Report

Second Edition

Dr. James P. Wallace III

Dr. John R. Christy

Dr. Joseph S. D'Aleo

April 2017

The Undersigned Agree with the Conclusions of this Report:

Dr. Alan Carlin
Retired Senior Analyst and manager, US Environmental Protection Agency, Washington, DC.
Author, *Environmentalism Gone Mad*, Stairway Press, 2015.
Ph.D., Economics, Massachusetts Institute of Technology, Cambridge, MA.
BS, Physics, California Institute of Technology, Pasadena, CA.

Dr. Theodore R. Eck
Ph.D., Economics, Michigan State University
M.A, Economics, University of Michigan
Fulbright Professor of International Economics
Former Chief Economist of Amoco Corp. and Exxon Venezuela
Advisory Board of the Gas Technology Institute and Energy Intelligence Group

Dr. Craig D. Idso
Chairman, Center for the Study of Carbon Dioxide and Global Change
Ph.D., Geography, Arizona State University
M.S., Agronomy, University of Nebraska, Lincoln
B.S., Geography, Arizona State University

Dr. Richard A. Keen
Instructor Emeritus of Atmospheric and Oceanic Sciences, University of Colorado
Ph.D., Geography/Climatology, University of Colorado
M.S., Astro-Geophysics, University of Colorado
B.A., Astronomy, Northwestern University

Dr. Anthony R. Lupo
IPCC Expert Reviewer
Professor, Atmospheric Science, University of Missouri
Ph.D., Atmospheric Science, Purdue University
M.S., Atmospheric Science, Purdue University

Dr. Thomas P. Sheahen
Ph.D., Physics, M.I.T.
B.S., Physics, M.I.T.

Dr. George T. Wolff
Former Chair EPA's Clean Air Scientific Advisory Committee
Ph.D., Environmental Sciences, Rutgers University
M.S., Meteorology, New York University
B.S., Chemical Engineering, New Jersey Institute of Technology

This Pro Bono Research Is Dedicated to the Memory of

Dr. William M. Gray (Emeritus)

Professor of Atmospheric Science

Colorado State University

ABSTRACT

The objective of this research was to determine whether or not a straightforward application of the "proper mathematical methods" would support EPA's basic claim that CO_2 is a pollutant. These analysis results would appear to leave very, very little doubt but that EPA's claim of a Tropical Hot Spot (THS), caused by rising atmospheric CO_2 levels, simply does not exist in the real world. Also critically important, this analysis failed to find that the steadily rising Atmospheric CO_2 Concentrations have had a statistically significant impact on any of the 14 temperature data sets that were analyzed. The temperature data measurements that were analyzed were taken by many different entities using balloons, satellites, buoys and various land based techniques. Needless to say, if regardless of data source, the structural analysis results are the same, the analysis findings should be considered highly credible.

Thus, the analysis results invalidate each of the Three Lines of Evidence in its CO_2 Endangerment Finding. Once EPA's THS assumption is invalidated, it is obvious why the climate models EPA claims can be relied upon for policy analysis purposes, are also invalid. And, these results clearly demonstrate—14 separate and distinct times in fact--that once just the Natural Factor impacts on temperature data are accounted for, there is no "record setting" warming to be concerned about. In fact, there is no Natural Factor Adjusted Warming at all. Moreover, over the time period analyzed, these natural factors have involved historically quite normal solar, volcanic and ENSO activity. At this point, there is no statistically valid proof that past increases in atmospheric CO_2 concentrations have caused the officially reported rising, even claimed record setting temperatures.

Table of Contents

Preface

On December 15, 2009, EPA issued its Green House Gas (GHG) Endangerment Finding, which has driven very significant and costly regulations beginning with CO_2. Focusing primarily on the time period since 1950, EPA's Endangerment Finding predicated on Three Lines of Evidence, claims that Higher CO_2 Emissions have led to dangerously higher Global Average Surface Temperatures (GAST).

The objective of this research was to determine whether or not a straightforward application of the "proper mathematical methods" would support EPA's basic claim that CO_2 is a pollutant. Stated simply, their claim is that GAST is primarily a function of four explanatory variables: Atmospheric CO_2 Levels (CO_2), Solar Activity (SA), Volcanic Activity (VA), and a coupled ocean-atmosphere phenomenon called the El Niño-Southern Oscillation (ENSO.)

Under this assumption of the four explanatory variables, only the atmospheric CO_2 levels are deemed anthropogenic, that is, impacted by human activity such as the burning of any fossil fuel. The three other explanatory variables are considered "natural" factor variables. By natural is meant that each of the variables' values are not impacted by human activity. And, it is also appropriate to call each of these three natural factor variables "chaotic" here defined to mean that each variable has proven impossible to reliably forecast, say over the next ten years, due to the climate system's chaotic behavior. Thus, any analysis with the objective of climate/temperature change prediction must deal with the chaotic, that is unpredictable, behavior of these three natural factor climate model input variables. However, this difficulty regarding climate model forecasting does not rule out the mathematically proper validation of EPA's claim regarding CO_2.

Stated mathematically, EPA's claim is shown in equation 1 below:

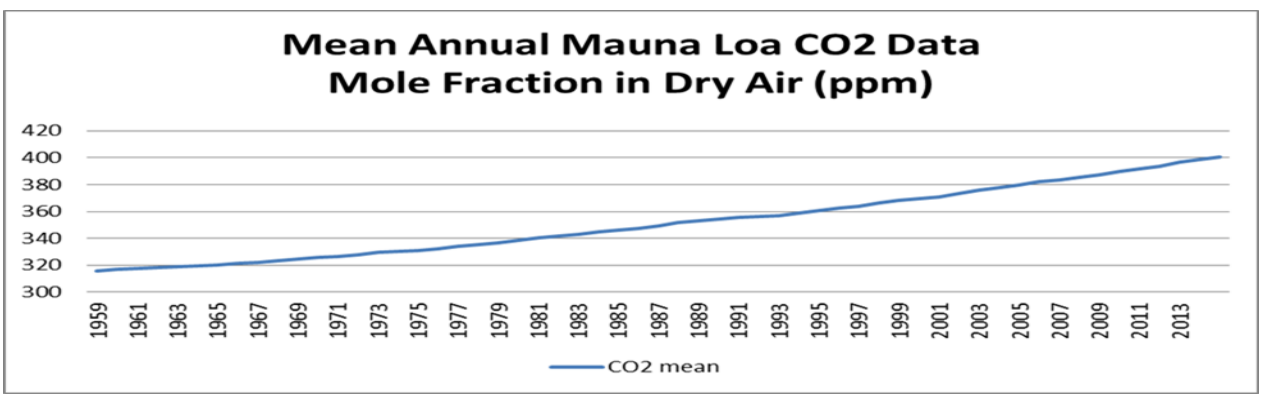
1.) GAST = $F_1(CO_2$, SA, VA, ENSO)

When subjected to Structural Analysis involving the proper mathematical hypothesis testing methods and using relevant and reliable real world temperature data, EPA's claim is that higher atmospheric CO_2 levels can be shown to have a positive and statistically significant impact on GAST. Unfortunately, carrying out this structural analysis is anything but straightforward because it requires the modeling of a very complicated climate system.

Since mathematical statistics, or more specifically, the mathematical approach used in econometrics, is used throughout this structural analysis work; for those readers not familiar with such techniques, it seemed appropriate to provide an overview of the rationale for the analytical approach taken herein.

There are fundamental mathematical issues facing any analyst seeking to validate EPA's claim. In structural analysis using econometric methods, there are two issues every analyst must consider. The first is called Multicollinearity; the second is called Simultaneity. Both can have extremely serious ramifications. In the testing of EPA's claim, both must be considered.

Figure P-1



Source: ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt

Multicollinearity issues result from the fact that the CO_2 variable is essentially just a positively sloped straight line when plotted from

1959 to date. See Figure P-1 above. This means that, even if using proper mathematical methods, CO_2 were found to have a statistically significant impact on GAST, it would be impossible to be sure that the estimated impact was really due to higher CO_2 levels--and, not due to one or more of other Linear Time Trend–like variables that were, say, unintentionally omitted from such analyses. Moreover, even assuming that this multicollinearity hurdle could be overcome analytically, hypothesis-testing challenges do not stop there.

To properly test EPA's hypothesis, it is necessary to also explicitly deal with the simultaneity issue. This issue arises in that it is a certainty that steadily rising global average surface temperatures virtually guarantee ocean temperatures are rising which, other things equal, are well known to lead to higher atmospheric CO_2 levels. Of course, so does burning more fossils fuels.

Mathematically, this may be stated as shown in equation 2:

2.) Annual Change in Atmospheric CO_2 Concentration = F_2(GAST, Fossil Fuel Consumption, Other Explanatory Variables)

Note that in the two equations above, by assumption, CO_2 concentration impacts GAST in 1.) And, higher GAST impacts CO_2 concentrations in 2.) Here, CO_2 is assumed to be an "independent variable" in equation 1 and the "dependent variable" in equation 2. Of course, the converse is true of GAST.

Very important to this analysis, CO_2 may be assumed to be an independent variable in equation 1 because it is a variable not directly dependent on any one of the other explanatory Natural Factor variables (i.e., SA, VA and ENSO) but assumed capable of impacting GAST. That is, via equation 1, changes in SA, VA and ENSO impact GAST values and then these GAST changes impact CO_2 via equation 2.

In statistics, the dependent variable is the variable predicted using, for example, a regression equation. Given this typically unavoidable, two equation climate modeling situation, the forecast values of CO_2 and GAST must be obtained by solving the two simultaneous equations.

Moreover, the econometric theory ramifications of ignoring this simultaneity issue are very serious. For example, it would never be mathematically proper to run regressions/direct least squares on equation 1 while ignoring equation 2 in an effort to determine whether CO_2 has a statistically significant impact on GAST – a mathematically improper approach that many analysts have used. To do so yields biased and inconsistent (i.e., worthless) parameter estimates. To obtain a statistically meaningful CO_2 equation 1 parameter estimate, that is to determine whether or not CO_2 has a statistically significant impact on GAST, a simultaneous equation parameter estimation technique must normally be applied[1]. **That is, if in fact increasing atmospheric CO_2 concentrations in reality do have a statistically significant impact on GAST, then the use of simultaneous equation parameter estimation techniques is unavoidable.**

Faced with the challenge of properly testing EPA's Tropical Hot Spot (THS) claim, which involved the analysis of many different tropical temperature time series, the authors of this research used an alternative approach which only works if CO_2 turns out to not have a statistically significant impact on GAST.

---

[1] See Theil, Henri. Introduction to Econometrics, Prentice-Hall, 1978, pages 328-342 and Goldberger, A.S., Econometric Theory, 1964, pages 329-348. See also Theil, Henri. Introduction to Econometrics, Prentice-Hall, 1978, pages 346-349 and Goldberger, A.S., Econometric Theory, 1964, pages 354-355.For a paper illustrating the application of such econometric methods to climate modeling see James P. Wallace, III, Anthony Finizza and Joseph D'Aleo, A Simple KISS Model to Examine the Relationship Between Atmospheric CO2 Concentration, and Ocean & Land Surface Temperatures, Taking into Consideration Solar and Volcanic Activity, As Well As Fossil Fuel Use. In: Evidence-Based Climate Science. Elsevier, Oxford, Amsterdam, pp. 353-382. ISBN: 9780123859563, Copyright © 2011 Elsevier Inc. All rights reserved, Elsevier.

Since atmospheric CO_2 concentration levels are independent of Natural Factor (i.e., SA, VA and ENSO) values in equation1 above, removing only the Natural Factor-related impacts on the temperature data time series does not require the specification of a more complicated (i.e., multi-equation) climate models and therefore the use of simultaneous equation parameter estimation techniques.

Hence, to seek validation of EPA's claim that CO_2 is a pollutant, two steps are taken. The first step removes the Natural Factor impacts on a Temperature time series. The second step then tests this Natural Factor Impact Adjusted Temperature time series for the possible impact of rising CO_2 levels. Since CO_2 and a Linear Time Trend are very highly correlated, testing for a CO_2 impact is very similar to testing the Natural Factor Impact Adjusted Temperature data for a statistically significant linear time trend. Hence, both tests were carried out to provide useful information regarding any aforementioned multicollinearity problems that might arise. The entire approach worked fine.

Finally, it should be noted that every effort was made to minimize complaints that this analysis was performed on so-called "cherry picked temperature time series". To avoid even the appearance of such activity, the authors divided up responsibilities, where Dr. Christy was tasked to provide a tropical temperature data set that he felt was most appropriate and credible for testing the THS hypothesis. All told, thirteen temperature time series (10 Tropics, 1 Contiguous U.S. and 3 Global) were analyzed in this research. The econometric analysis was done by Jim Wallace & Associates, LLC, and when completed, cross checked by the other authors. **Moreover, the authors have made it quite simple for others to cross check this work in that the report contains the summary output from literally all the quoted regression**

results and all of the data used in the analysis can be obtained by reaching out to the authors.

Section I. Relevance of this Research

The assumption of the existence of a "Tropical Hot Spot (THS)" is critical to all Three Lines of Evidence in EPA's GHG/CO_2 Endangerment Finding.

Stated simply, first, the THS is claimed to be a fingerprint or signature of atmospheric and Global Average Surface Temperatures (GAST) warming caused by increasing GHG/CO_2 concentrations[2].

Second, higher atmospheric CO_2 and other GHGs concentrations are claimed to have been the primary cause of the claimed record setting GAST over the past 50 plus years.

Third, this THS assumption is imbedded in all of the climate models that EPA still relies upon in its policy analysis supporting, for example, its Clean Power Plan--recently put on hold by a Supreme Court stay. These climate models are also critical to EPA's Social Cost of Carbon estimates used to justify a multitude of regulations across many U.S. Government agencies.

Section II. Objectives of the Research

---

[2] See http://icecap.us/images/uploads/ImportanceoftheHotSpot_093016_.pdf

See also U.S. Climate Change Science Program, Synthesis and Assessment Product 1.1, Temperature Trends in the Lower Atmosphere - Understanding and Reconciling Differences, Chapter 1, p. 18-19, https://www.gfdl.noaa.gov/bibliography/related_files/vr0603.pdf

Thus, the first objective of this research is to determine, based on the very considerable relevant and credible tropical temperature data evidence (see Table II-1,) whether or not the assumed THS actually exists in the real world.

Table II-1

	TEMPERATURE DATA ANALYZED				
	Data Window: 1959 to 2015				
Tropics					
	Balloon	Upper Trop.	AV3	150 & 200	
	Balloon	Lower Trop.	AV3	TLT & 500	
	Buoy	Upper		NINO 160E/80W	
	Buoy	Upper		NINO 3.4	
	SFC	Surface		NOAA	
Global					
	Balloon	Lower Trop	AV3	TLT	
	SFC	Surface	Hadley	HadCRUT4	
U.S.	SFC		NOAA	Contiguous	
	Data Window: 1979 to 2015				
Tropics					
	Satellite	Upper Trop	AV2	TMT	
	Satellite	Lower Trop	AV2	TLT	
	Satellite	Lower Trop	UAH Ocean	TLT	
Global					
	Satellite	Lower Trop	AV2	TLT	
NOTE: A Total of 14 Temperature Time Series were analyzed -					
	10 in the Tropics, 1 for U.S. and 3 Global				

The second related objective is to determine whether, adjusting ONLY for Natural Factor impacts, anything at all unusual with the Earth's temperatures seems to be occurring in the Tropics, Contiguous U.S. or Globally.

The third objective is to determine whether the rising atmospheric CO_2 concentrations alone can be shown to have had a statistically significant impact on the trend slopes of often -quoted temperature data.

Section III. Research Design

Unlike some research in this area, this research does not attempt to evaluate the existence of the THS in the real world by using the climate models. This would constitute a well-known error in mathematics and econometrics in that such climate models obviously must include all relevant theories, possibly including some not even known today; many, if not all, of which could impact tropical temperatures.

Thus, it is never mathematically proper to attempt to validate any theory embedded in a model using the model itself. Each such theory needs to be tested outside of the model construct.

Section IV. Tropical Hot Spot Hypothesis Testing

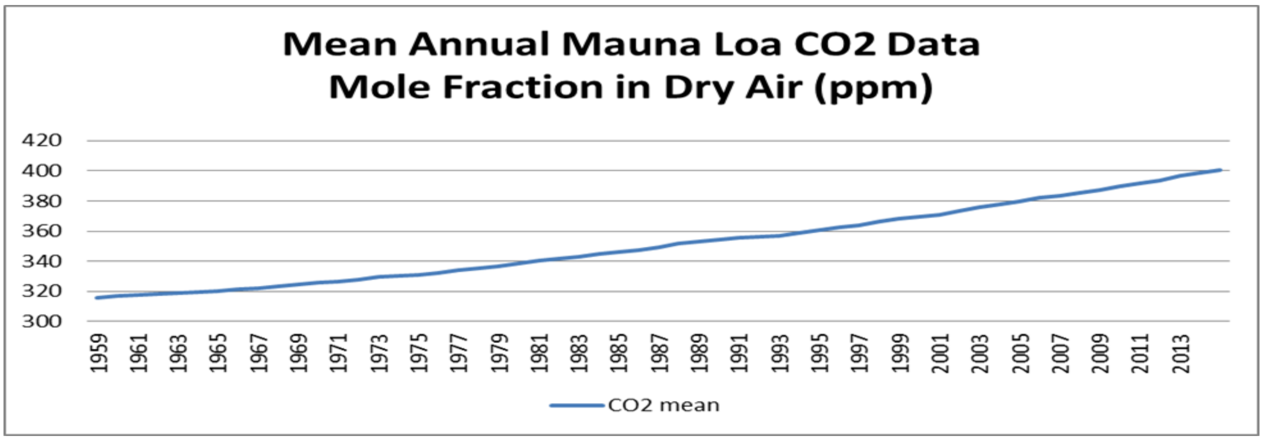
The proper test for the existence of the THS in the real world seem very simple. Are the slopes of the three trend lines (upper & lower troposphere and surface) all positive, statistically significant and do they have the proper top down rank order? Note that this is a necessary, but not sufficient, condition for THS theory validation. In fact, currently some tropical tropospheric temperature data sets do have statistically significant upward sloping trend slopes.

Section V. Sufficient Conditions for Rejection of the THS Hypothesis

This research utilized the following as “Sufficient Conditions”:

1.) After adjusting for the Natural Factor impacts, if all relevant temperature time series have linear trend slopes that are not positive and statistically significant; then rising atmospheric CO_2 concentrations are very unlikely to have impacted such temperatures. See Figure V-1 below. But an additional, even more rigorous test was also used herein.

Figure V-1



Source: ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt

2.) Once the Natural Factor Impacts have been removed, if all relevant THS –related temperature data show no positive, statistically significant relationship to rising atmospheric CO_2 concentrations, then the THS theory must be considered invalidated.

If both tests are met, rising atmospheric CO_2 concentrations must not be the cause of any statistically significant positive trend slopes in the published data. Blame the Natural Factor impacts.

Section VI. El Niño/Southern Oscillation (ENSO), Solar & Volcanic Activity Impact Adjustment

El Niño/Southern Oscillation (ENSO) Measurement

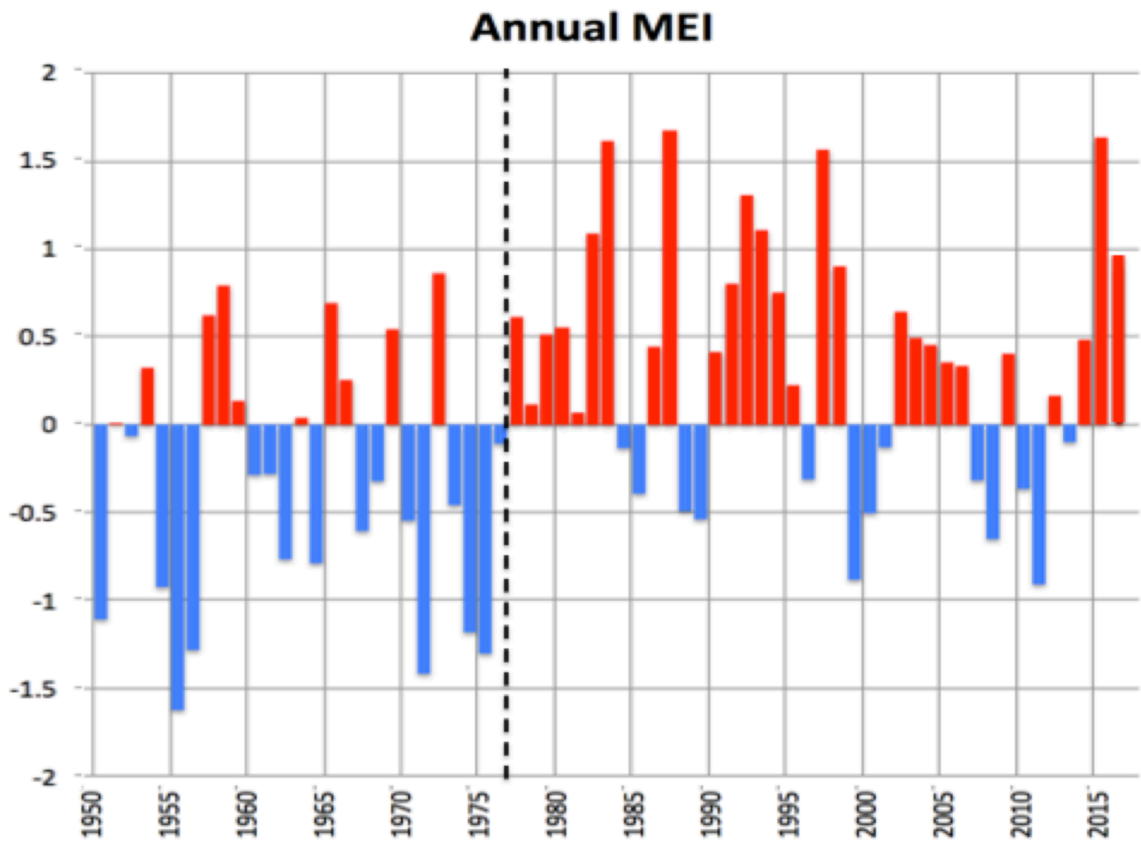
To quote from NOAA, “El Niño/Southern Oscillation (ENSO) is the most important coupled ocean-atmosphere phenomenon to cause global climate variability on inter-annual time scales. Here we attempt to monitor ENSO by basing the Multivariate ENSO Index (MEI) on the six main observed variables over the tropical Pacific. {Emphasis added} These six variables are: sea-level pressure (P), zonal (U) and meridional (V) components of the surface wind, sea surface temperature (S), surface air temperature (A), and total cloudiness fraction of the sky (C). These observations have been collected and published in {International Comprehensive Ocean-Atmosphere Data Set} ICOADS for many years. - - - -” {See, http://www.esrl.noaa.gov/psd/enso/mei/#discussion.}

Thus, the Multivariate ENSO Index, MEI, at a point in time, is a linear function of six variables, all measured in the Tropics. As a result, it would be expected a priori, that the MEI variable would be less important in explaining temperature variations outside the Tropics. Our analysis results comport with this viewpoint.

It is a well-known meteorological fact that, other things equal, El Ninos lead to a global scale warming and La Ninas a global scale cooling, whose magnitudes are related to their ENSO strengths. If El Ninos and La Ninas simply alternated, ENSO impacts as measured by the MEI would help explain the spikes and dips in GAST but not the behavior of the slope of its trend. However, there are multi-decadal cycles wherein the tropical Pacific Basin takes on a physical state that favors El Ninos alternating with multi-decadal periods favoring La Ninas. See Figure VI-1.

Indeed from 1947 to 1976, 14 years had La Ninas embedded, while just 6 years had El Ninos. After the 1977 Pacific Climate Shift during the subsequent period from 1977 to 1998, 10 El Ninos occurred with just 3 La Ninas. Since 1998, the Pacific Basin physical states have been more balanced but had 10 El Ninos compare to 8 La Ninas. See Figure VI-1 below.

Figure VI-1



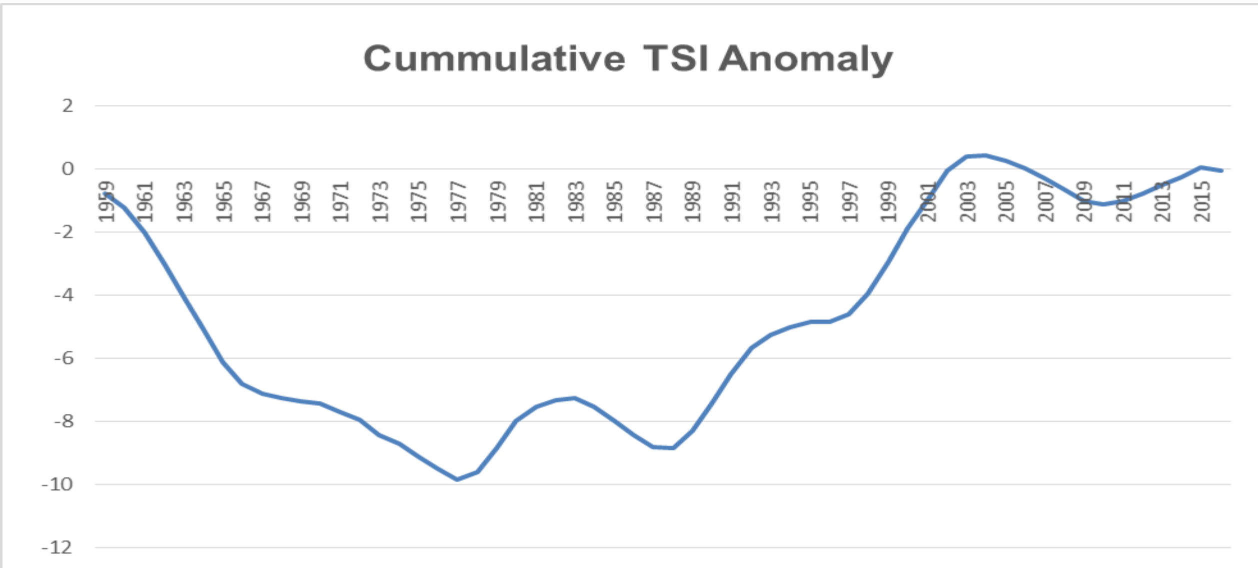
Source: https://www.esrl.noaa.gov/psd/data/correlation/mei.data

Since clearly both the relative number and the relative strength of these ENSO events matter, this strongly suggests the use of an ENSO Central Tendency variable (called D 77 CT herein) to capture such multi-decadal ENSO Trend impacts on temperatures. It is also well known that Strong El Ninos (called D Els herein) have a disproporiate impact on annual temperatures. Thus, in this analysis, three ENSO –related variables will be used: MEI, D 77 CT and D Els.

Solar Activity (SA) Measurement

This research report, as discussed in the 2016 edition, uses the Cumulative TSI Anomaly Natural Factor variable (called CTSIA herein) shown in Figure VI-2 below.

Figure VI-2



Source: TSI data are from Willie Soon (Hoyt and Schatten 1993, scaled to fit ACRIM.) From 2007, they are from Lean et al. See ftp://ftp.pmodwrc.ch/pub/data/irradiance/composite/DataPlots/

Volcanic Activity (VA) Measurement

For consistency, this research continued to use DVI+1 as its measure of Volcanic Activity where DVI +1 is the ' Weighted' Dust Veil Index from Mann et al 1998 shifted forward one year. Moreover, limited analysis suggested it performs at least as well as GISS data.

Section VII. Hypothesis Testing: Analytical Approach

In testing for the existence of a CO_2 –related THS, the approach followed in this study used straight forward, even common, econometric techniques of time series analysis and dealt with the time series relevant to measuring temperatures in the Upper and Lower Troposphere as well as the Surface. These measurements were taken using balloons, satellites, buoys and various land based techniques. Needless to say, if regardless of data source, the results are the same, the analysis findings would be highly credible. It will be seen below that such consistency of research findings was the case.

Regarding the specific analytical approach used here, the first step was to carry out a very careful time series decomposition of relevant Tropical Temperature time series as well as the MEI time series. This analysis led to some very important and very robust findings. Namely, it reconfirmed that a major event occurred in 1977 in all of the tropical temperature data analyzed as well as in the MEI data. Of course, as discussed in Section VI, this "1977 Pacific Climate Shift" phenomenon was already well known to climate scientists and its impact is quantified using the D 77 CT ENSO variable.

The analytical process used to remove the Natural Factor Impacts on temperature time series data always involved removing the ENSO, Solar and Volcanic Activity impacts. The ENSO impacts are removed using the three variable explained in Section VI above, namely MEI, D 77 CT and D Els. Of course, the D 77 CT variable is not used in analyzing the Satellite data since it begins in 1979.

Only two parameter estimation data windows were used in this research. (See Table II-1 above.) The annual satellite data starts in 1979, and all of the other data start dates were set at 1959 for two good reasons - including that the balloon data and best CO_2 data start there.

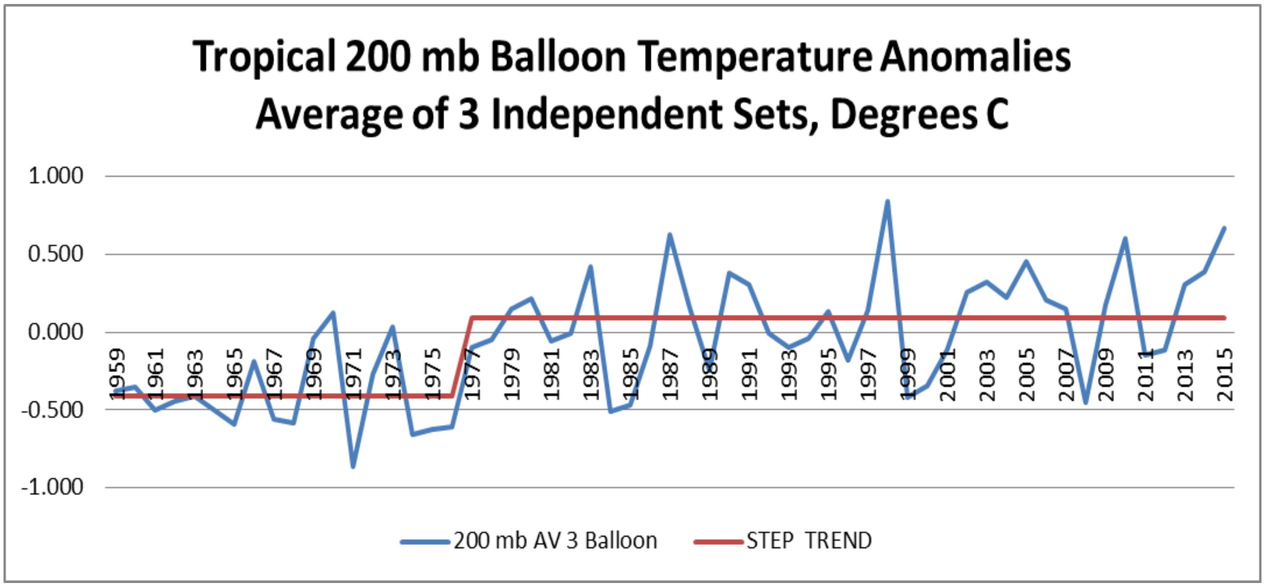
Finally, it is very important to note that no effort was made to optimize each of these models for the particular temperature time series. It was felt far more important to test whether or not the same basic model (.i.e., linear functional form and set of explanatory variables) worked well for all 14 time series – it did. As just one of many examples, outside the Tropics, the MEI variable has less power, but its coefficient is always positive.

One other relevant point here, “wild points” matter a lot in regression analysis. For example, the 1998 Strong El Nino was reflected in the D ELs dummy variable mentioned above. This lead to improved statistical performance of the structural analysis. Nevertheless, limited testing suggests that there is enormous upside potential for improving the statistical confidence in parameter estimates - both from an overall system and individual model perspective.

Section VIII. Tropical Upper Troposphere Balloon Data

The analysis results are shown first for Tropical Upper Troposphere Balloon (1959- 2015) data in Figures VIII-1-2 and Tables VIII-1-2 below. It is very Important to note that in this research, for each temperature time series, the first step was to determine via “time series decomposition” the “best fit trend line” among standard functional forms such as Linear, Ramp Step, Step, Multiple Step, etc. The selected trend lines were the best of those tested in the sense that they had the maximum Adjusted R Square value. Note the 1977 Shift is readily apparent in Figure VIII-1 below.

Figure VIII-1



Source: "AV3 = (RATPAC + UNSW + (RICH + RAOBCORE)/2)/3, where RICH and RAOBCORE data is produced under a single individual's leadership.
RATPAC: http://www1.ncdc.noaa.gov/pub/data/ratpac/ratpac-a/RATPAC-A-annual-levels.txt
UNSW: Sherwood, S. C. and N. Nishant, 2015: Atmospheric changes through 2012 as shown by iteratively homogenised radiosonde temperature and wind data (IUKv2). Env. Res. Lett., Vol. 10, 054007. The UNSW is not on a public URL, so it is necessary to contact their office and a grad student will put the data set out on an accessible site for 24 hours. This grad student sets up a transfer of the data: n.nidhi@student.unsw.edu.au.
RICH/RAOBCORE: the URLs below provide access to the grid data. Here are the netCDF files for the gridded data.
ftp://srvx7.img.univie.ac.at/pub/v1.5.1/raobcore15_gridded_2015.nc
ftp://srvx7.img.univie.ac.at/pub/v1.5.1/rich15obs_mean_gridded_2015.nc
Most of the URLs do not give a product for a specific need, say for TLT Tropics. It is necessary to download station or gridded data and calculate the tropical and global values from there. Here this process was carried out by Dr. John R. Christy, Distinguished Professor of Atmospheric Science, Alabama's State Climatologist and Director of the Earth Systems Center at The University of Alabama at Huntsville. Appendix H provides that entity specific data for all Balloon Temperature data analyzed herein."

Table VIII-1 below shows the complete set of analysis results that will be given for each of the Temperature data sets analyzed in this research. The first regression summary shows the results of regressing the 200 mb Tropical Temperatures on all five explanatory variables. Recall that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0.

The next steps were to regress the Model Residual on the Time trend and then on CO_2 variables. In this case, (and all others to follow,) the research results show that both the Time Trend and CO_2 have had no measureable impact on this critical upper troposphere data set.

For these two regressions, it is important to look both at the Adjusted R Square as well as the t Stat. A very low Adjusted R Square means the theory being tested simply does make statistical sense. Note that this is the case here.

Table VIII-1

Tropical 200 mb AV3 Balloon Temperature Anomalies

Regression Statistics	
Multiple R	0.85
R Square	0.73
Adjusted R Square	**0.70**
Standard Error	0.21
Observations	57
Durban-Watson	**2.11**

	Coefficients		*t Stat*
Intercept	-0.24		**-3.18**
MEI	0.28		**6.55**
CTSIA	0.01		**0.90**
D 77 CT	0.29		**4.30**
D EIs	0.61		**3.94**
DVI +1	0.00		**-3.09**

Model Residual regressed on Time

Regression Statistics	
Multiple R	0.09
R Square	0.01
Adjusted R Square	**-0.01**
Standard Error	0.20
Observations	57

	Coefficients		*t Stat*
Intercept	-2.27		-0.70
Time	**0.00**		**0.70**

Model Residual regressed on CO2

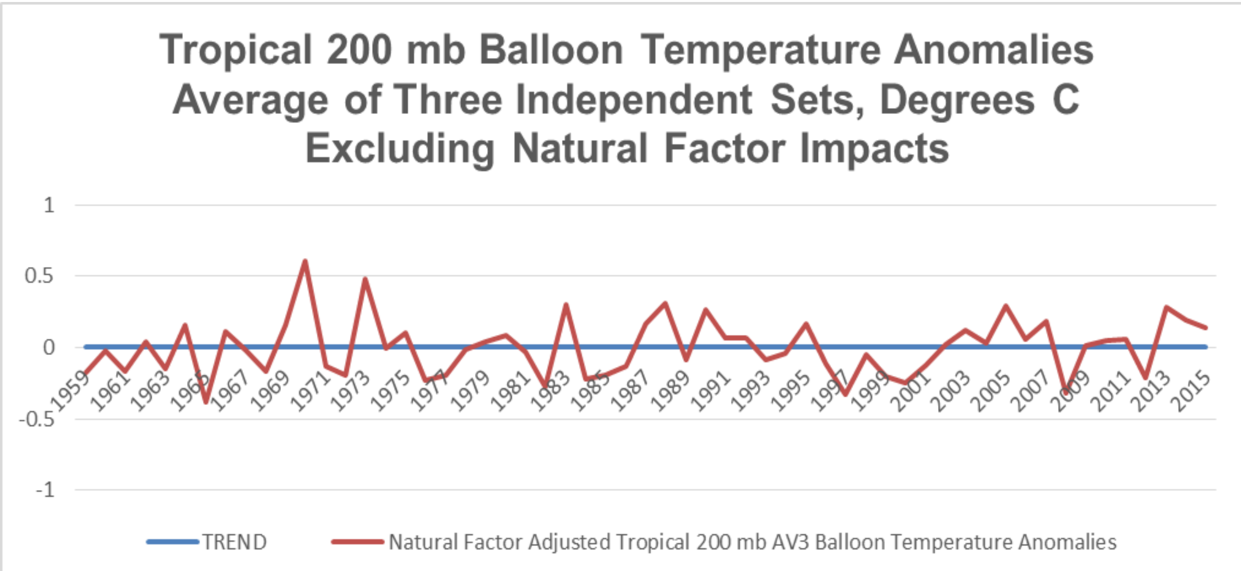
Regression Statistics	
Multiple R	0.10
R Square	0.01
Adjusted R Square	**-0.01**
Standard Error	0.20
Observations	57

	Coefficients		*t Stat*
Intercept	-0.29		-0.78
CO2	**0.00**		**0.78**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure VIII-2 below shows the Tropical 200mb Balloon data "Excluding Natural Factor Impacts." **It has a flat linear Trend and shows no CO_2 –related sensitivity.**

Figure VIII-2

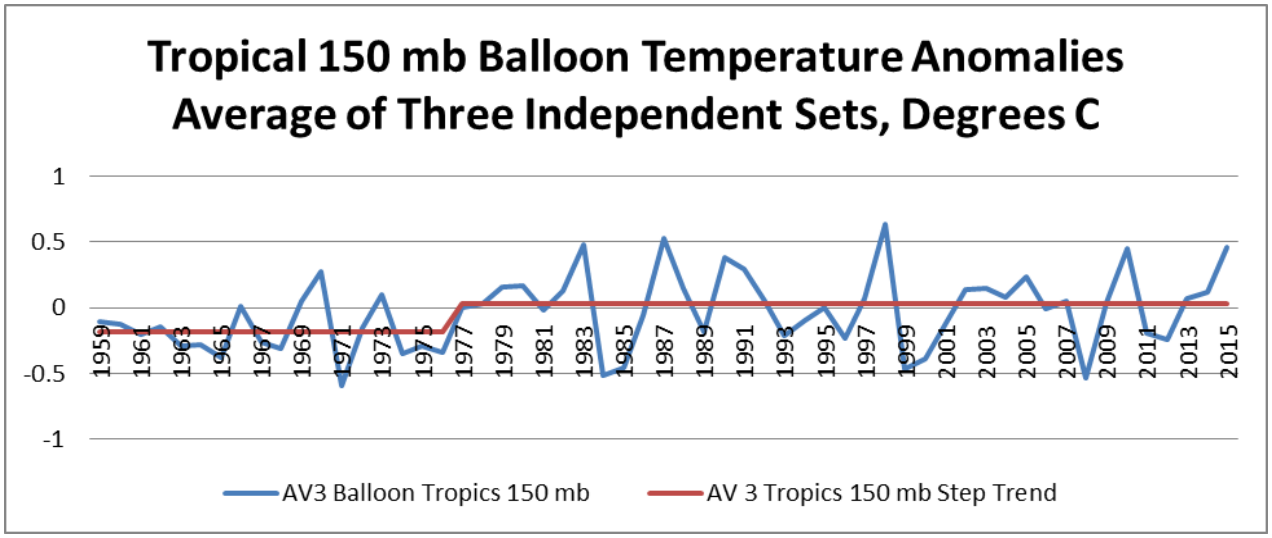


Source: See Figure VIII-1 source

NOTE: The analysis for all the remaining Temperature Data will be shown below to always yield the same result: namely, that the same model works remarkably well for each data set and CO_2 cannot be shown to impact any of these data sets. The model, as would be expected, performs least well in explaining stratospheric data.

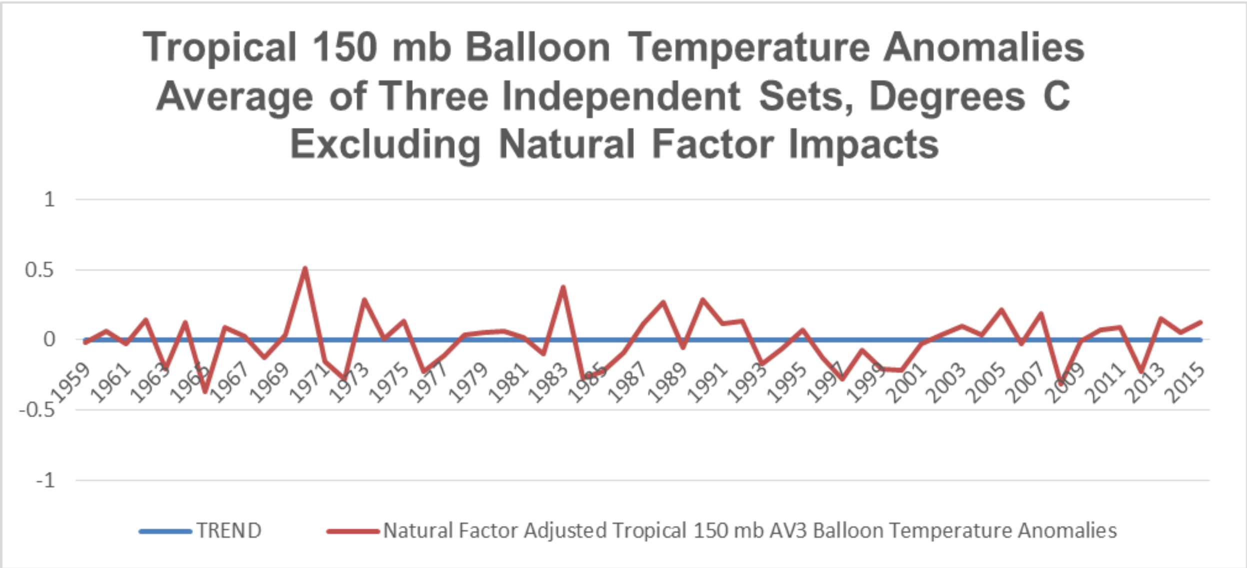
For comparison to the rest of the results presented in this report, Tropical Stratospheric 150 mb Balloon Data is shown next in Figure VIII-3. Interestingly, the 1977 shift is still evident. But not surprisingly, the overall model explanatory power is lower -see Table VIII-2. **Nevertheless, no impact of CO_2 is evident and the Trend in Figure VIII-4 is flat**.

Figure VIII-3



Source: See Figure VIII-1 source

Figure VIII-4



Source: See Figure VIII-1 source

Table VIII-2

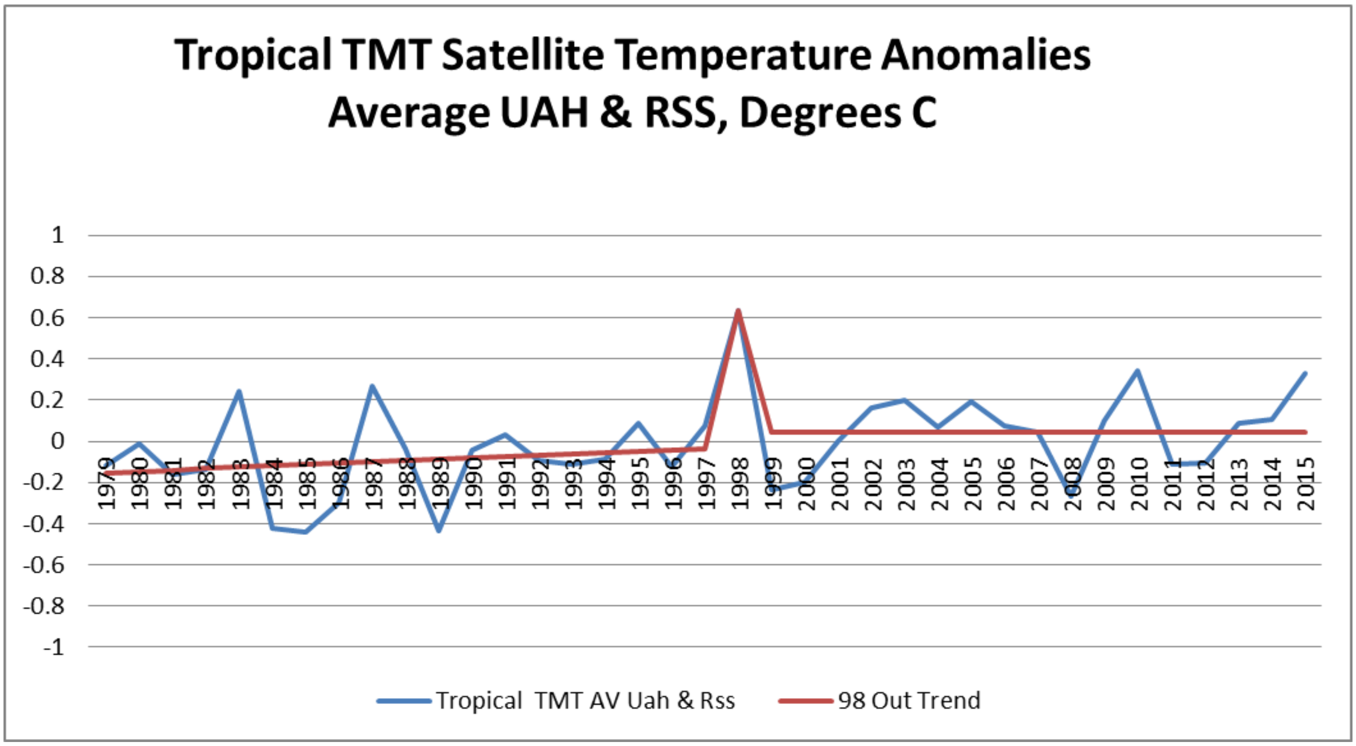
Tropical 150 mb AV3 Balloon Temperature Anomalies			
Regression Statistics			
Multiple R	0.77		
R Square	0.59		
Adjusted R Square	**0.55**		
Standard Error	0.19		
Observations	57		
Durban-Watson	**2.27**		
	Coefficients		*t Stat*
Intercept	-0.12		-1.87
MEI	**0.25**		**6.39**
CTSIA	-0.01		-0.88
D 77 CT	0.06		0.99
D Els	**0.52**		**3.78**
DVI +1	**0.00**		**-2.89**
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.01		
R Square	0.00		
Adjusted R Square	**-0.02**		
Standard Error	0.18		
Observations	57		
	Coefficients		*t Stat*
Intercept	-0.22		-0.08
Time	**0.00**		**0.08**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.02		
R Square	0.00		
Adjusted R Square	-0.02		
Standard Error	0.18		
Observations	57		
	Coefficients		*t Stat*
Intercept	-0.06		-0.17
CO2	**0.00**		**0.17**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Section IX. Tropical Upper Troposphere Satellite Data

In Figures IX 1-2 and Table IX-1 below are shown the analysis results for the Average of the UAH and RSS Satellite TMT data from 1979 through 2015. As with the balloon data above, the analysis began with time series decomposition and then moved on to removing the Natural Factor impacts. Table IX-1 shows **CO_2 not to have had a statistically significant impact.**

Figure IX-1



Source: http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tmt/uahncdc_mt_6.0beta5.txt

http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TMT_Anomalies_Land_and_Ocean_v03_3.txt

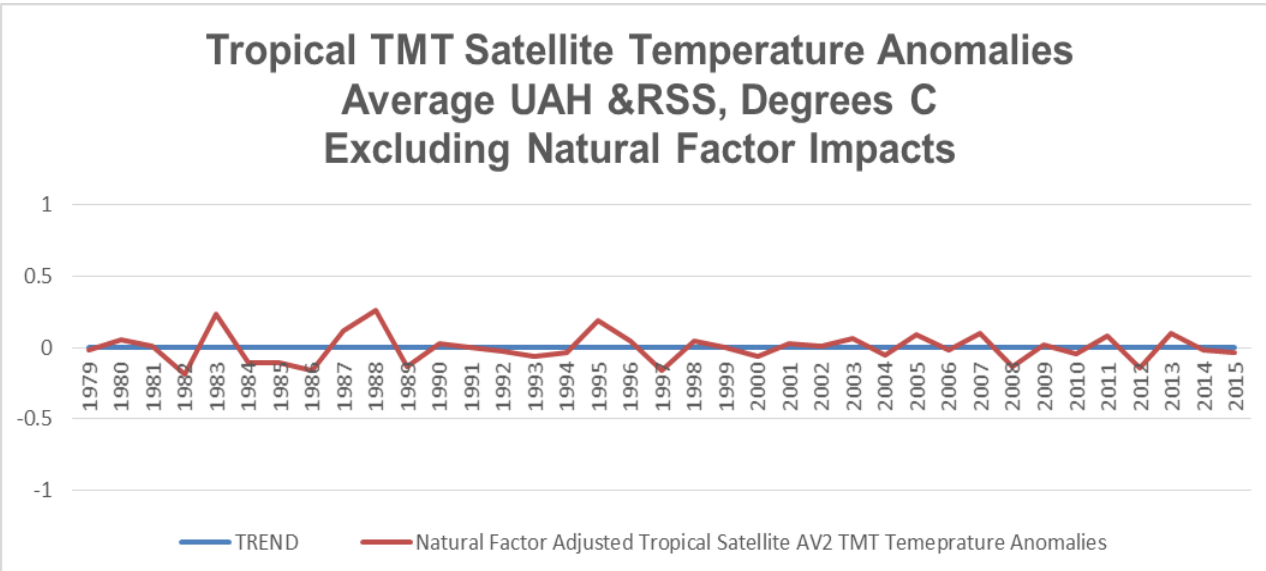
Table IX-1

Tropical TMT Satellite Temperature Anomalies			
Average UAH & RSS			
Regression Statistics			
Multiple R	0.88		
R Square	0.78		
Adjusted R Square	**0.75**		
Standard Error	0.11		
Observations	37		
Durban-Watson	**2.68**		
	Coefficients		t Stat
Intercept	0.02		**0.66**
MEI	0.21		**7.48**
CTSIA	0.02		**4.17**
D ELs	0.47		**5.73**
DVI+1	0.00		**-2.70**
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.00		
R Square	0.00		
Adjusted R Square	**-0.03**		
Standard Error	0.11		
Observations	37		
	Coefficients		*t Stat*
Intercept	0.04		0.01
Time	**0.00**		**-0.01**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.00		
R Square	0.00		
Adjusted R Square	**-0.03**		
Standard Error	0.11		
Observations	37		
	Coefficients		*t Stat*
Intercept	0.00		0.00
CO2	**0.00**		**0.00**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure IX-2 below shows that the Natural Factor Adjusted Tropical TMT Satellite Temperature Trend is also flat – again meaning that CO_2 is not the cause of the rise in the officially reported Tropical Satellite TMT temperature data.

Figure IX-2



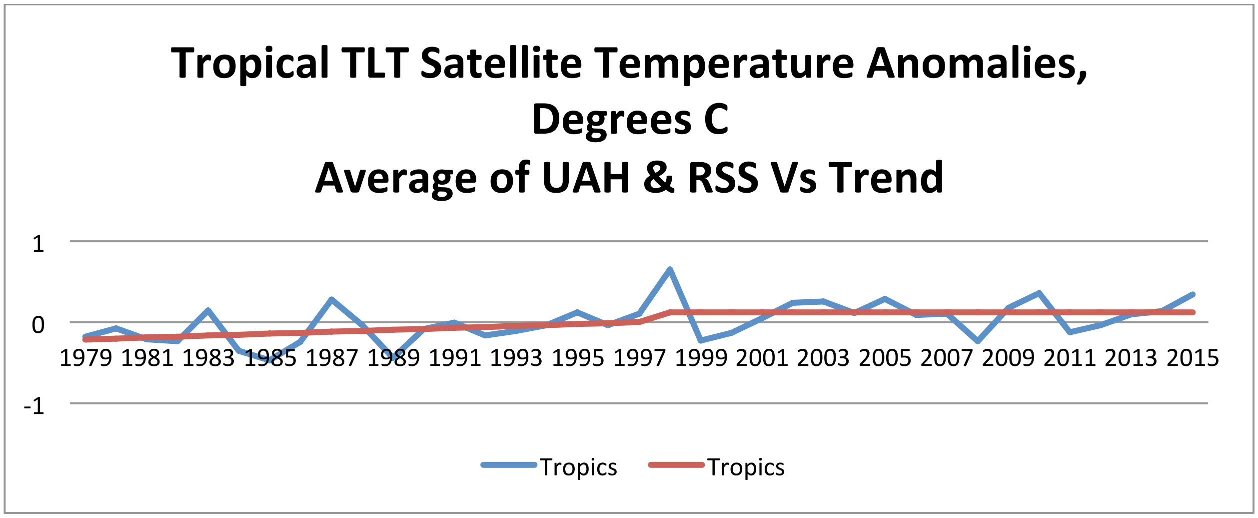
Source: See Figure IX-1 Source

Section X. Tropical Lower Troposphere Satellite Data

The same generic Natural Factor based model used above with 150 and 200 mb Balloon and TMT Satellite data also worked very well for TLT Satellite data as shown in Figures X-1-2 below. Note that Figure X-1 shows a flat trend in the Lower Troposphere Temperature over the last 18 years. And again, when the Natural Factor impacts are removed as shown in Figure X-2, the adjusted temperatures have a flat trend line. **This fact, along with the CO_2 impact results shown in Table X-1, means that rising CO_2**

concentration is not the cause of the rise in the reported Tropical Satellite TLT temperature data.

Figure X-1



Source: http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v03_3.txt

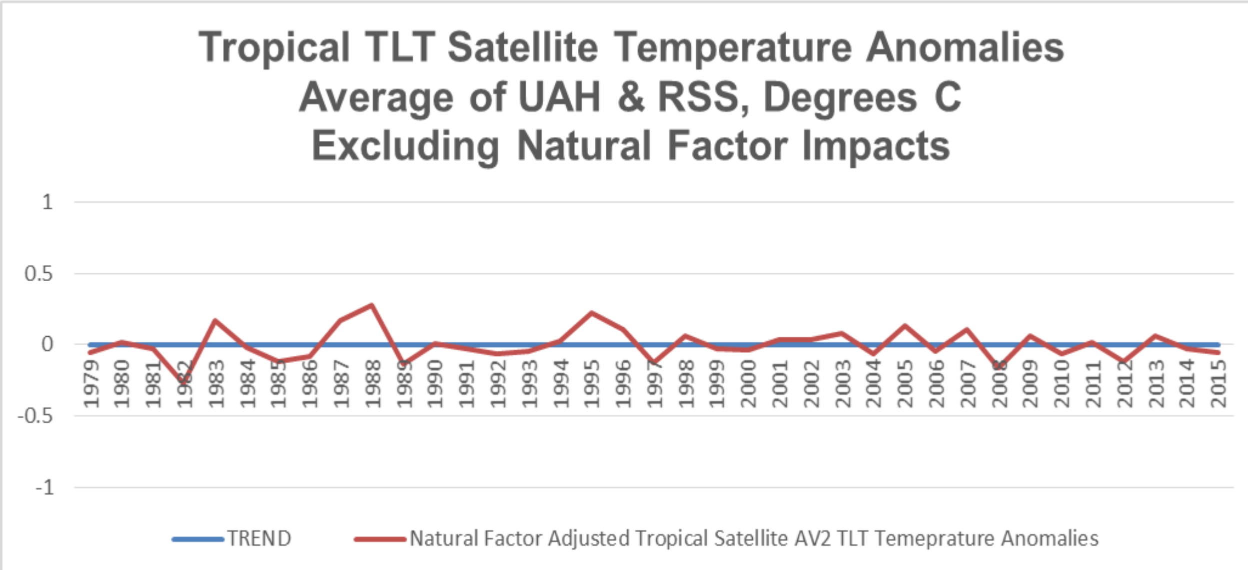
It should be noted that, from every perspective, the model results shown in Table X-1 below are remarkable. Absolutely no statistical games have been played here. Others will have the ability to crosscheck this work because all that is needed is access to Xcel and the data set which the authors will gladly provide upon request.

Table X-1

Tropical TLT Satellite Temperature Anomalies		
Average UAH & RSS		
Regression Statistics		
Multiple R	0.88	
R Square	0.78	
Adjusted R Square	**0.76**	
Standard Error	0.12	
Observations	37	
Durban-Watson	**2.39**	
	Coefficients	t Stat
Intercept	0.07	**2.39**
MEI	0.20	**6.80**
CTSIA	0.03	**5.32**
D ELs	0.46	**5.37**
DVI+1	0.00	**-2.84**
Model Residual regressed on Time		
Regression Statistics		
Multiple R	0.01	
R Square	0.00	
Adjusted R Square	**-0.03**	
Standard Error	0.11	
Observations	37	
TLT Temeprature An	*Coefficients*	*t Stat*
Intercept	-0.25	-0.07
Time	**0.00**	**0.07**
Model Residual regressed on CO2		
Regression Statistics		
Multiple R	0.00	
R Square	0.00	
Adjusted R Square	**-0.03**	
Standard Error	0.11	
Observations	37	
	Coefficients	*t Stat*
Intercept	0.00	0.00
CO2	**0.00**	**0.00**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure X-2

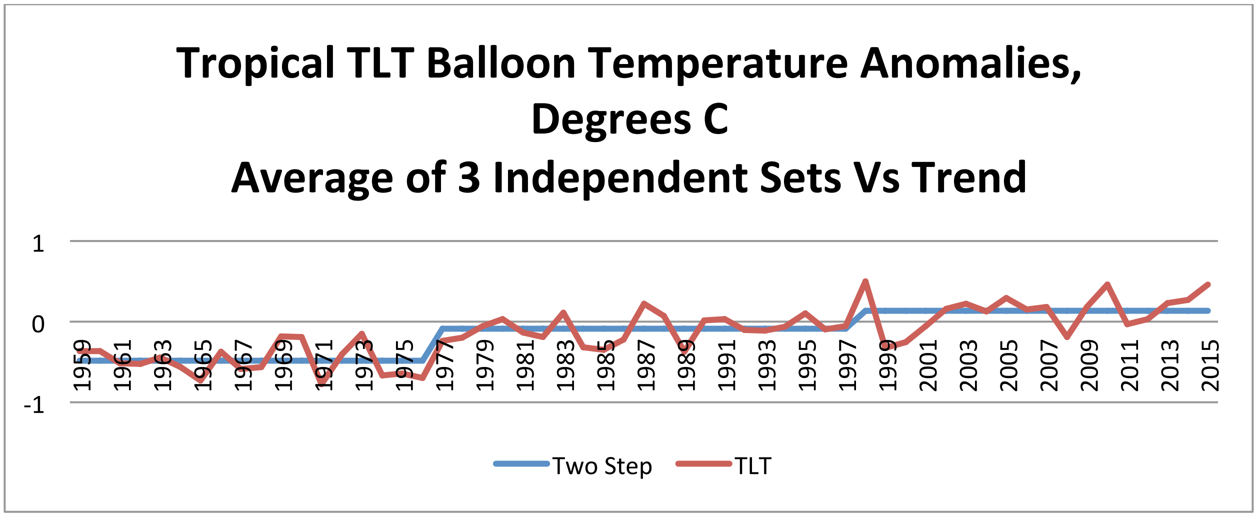


Source: See Figure X-1 source

Section XI. Tropical Lower Troposphere Balloon Data

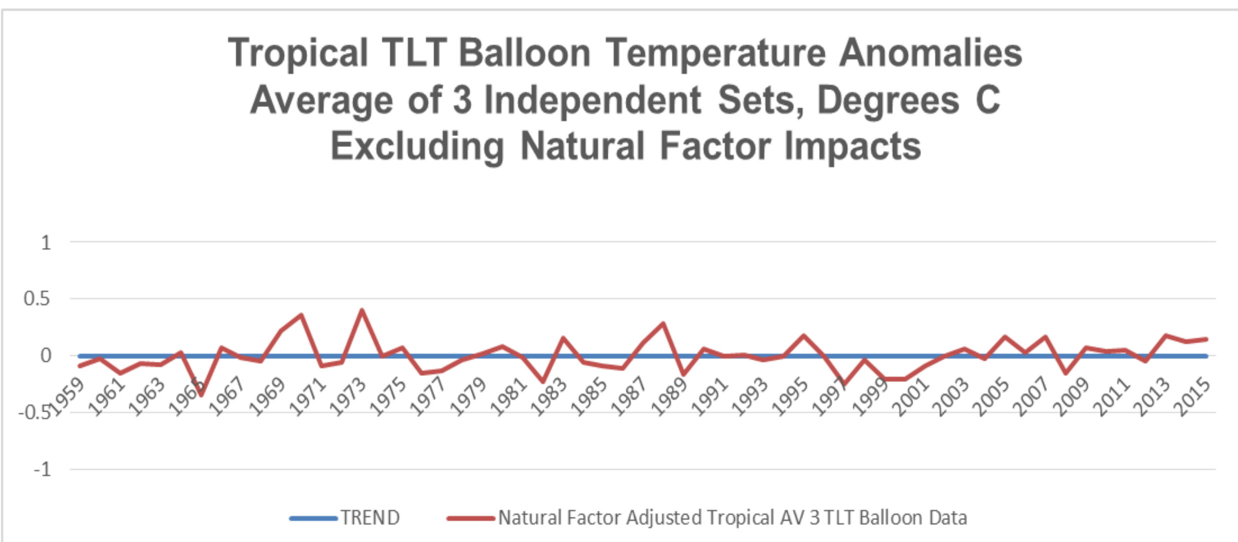
Figures XI-1- 3 and Tables XI-1 below show the results from carrying out the same analysis of the Tropical TLT balloon temperature data. Once again, when the Natural Factor (NF) impacts are removed, the Natural Factor adjusted temperatures have flat trend lines – and again, together with the results shown in Table XI-1, the **analysis results mean that rising atmospheric CO_2 concentration is not the cause of the rise in the reported Tropical TLT balloon temperature data.**

Figure XI-1



Source: See Figure VIII-1 source

Figure XI-2



Source: See Figure VIII-1 source

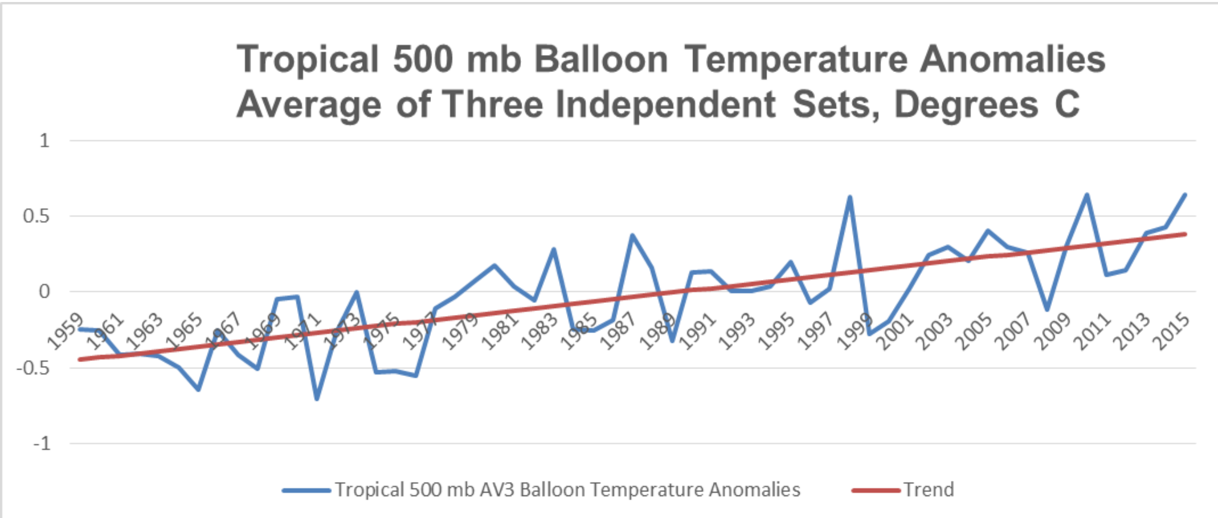
Table XI-1

Tropical AV 3 TLT Balloon Data		
Regression Statistics		
Multiple R	0.89	
R Square	0.79	
Adjusted R Square	**0.77**	
Standard Error	0.15	
Observations	57	
Durban-Watson	**1.92**	
	Coefficients	*t Stat*
Intercept	-0.27	**-5.16**
MEI	0.15	**4.71**
CTSIA	0.02	**3.77**
D 77 CT	0.35	**7.15**
D Els	0.43	**3.86**
DVI +1	0.00	**-2.33**
Model Residual regressed on Time		
Regression Statistics		
Multiple R	0.13	
R Square	0.02	
Adjusted R Square	**0.00**	
Standard Error	0.14	
Observations	57	
	Coefficients	*t Stat*
Intercept	-2.26	-0.98
Time	**0.00**	**0.98**
Model Residual regressed on CO2		
Regression Statistics		
Multiple R	0.14	
R Square	0.02	
Adjusted R Square	**0.00**	
Standard Error	0.14	
Observations	57	
	Coefficients	*t Stat*
Intercept	-0.28	-1.06
CO2	**0.00**	**1.07**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

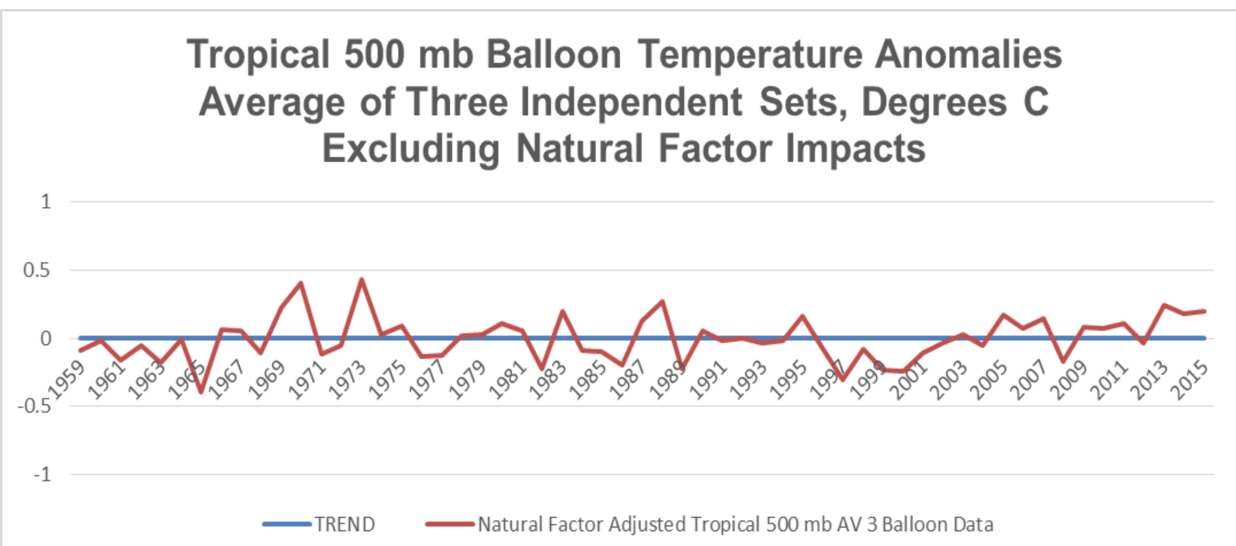
Once again these model results are remarkably good; as are those corresponding to the Tropical 500 mb Balloon Temperature analysis shown below in Figures XI-3-4 and Table XI-2.

Figure XI-3



Source: See Figure VIII-1 source

Figure XI-4



Source: See Figure VIII-1 source

Table XI-2

Tropical 500 mb AV 3 Balloon Data			
Regression Statistics			
Multiple R	0.87		
R Square	0.75		
Adjusted R Square	**0.73**		
Standard Error	0.17		
Observations	57		
Durban-Watson	**1.82**		
	Coefficients		*t Stat*
Intercept	-0.16		**-2.68**
MEI	0.16		**4.63**
CTSIA	0.02		**3.13**
D 77 CT	0.34		**6.02**
D Els	0.48		**3.78**
DVI +1	0.00		**-2.15**
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.14		
R Square	0.02		
Adjusted R Square	**0.00**		
Standard Error	0.16		
Observations	57		
	Coefficients		*t Stat*
Intercept	-2.73		-1.04
Time	**0.00**		**1.04**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.15		
R Square	0.02		
Adjusted R Square	**0.01**		
Standard Error	0.16		
Observations	57		
	Coefficients		*t Stat*
Intercept	-0.35		-1.15
CO2	**0.00**		**1.16**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Section XII. Issues regarding using these Models for Temperature Forecasting

Despite the fact the generic models utilized above have seemed to do very well for structural analysis tasks –in this case removing the impacts of the Natural Factors –this does not mean the models would do very well if the objective were to forecast future temperatures. There are a number reasons for caution**. (**But, given current Climate Models' performances, why not give them a try?)

First, the model's dependent variable, that is, the variable being "forecast" is actual temperatures. And, the model will assume that CO_2 will continue to have no impact. (Not a bad guess based on the results of this analysis.) Second, for its forecasts, this model requires inputs for three ENSO related variables, MEI, D 77 CT, and D EIs. All three are chaotic and annual MEI seems impossible. The other two are reasonable to work with.

Third, and perhaps most troubling, is the need for a TSI forecast. The CTSIA variable has made dramatic turns in the recent past - see Figure VI-2. And forecasting such turns is problematic to say the least. Currently, there is a very high level of uncertainty involving the Total Solar Intensity outlook – even the near term outlook. Nevertheless, econometric climate models do seem to have potential in longer term forecasting[3].

[3] See Page 378, Figure 20, James P. Wallace, III, Anthony Finizza and Joseph D' Aleo, A Simple KISS Model to Examine the Relationship Between Atmospheric C02 Concentration, and Ocean & Land Surface Temperatures Taking into Consideration Solar and Volcanic Activity As Well As Fossil Fuel Use. In: Evidence-Based Climate Science. Elsevier, Oxford, Amsterdam, pp. 353-382. ISBN: 9780123859563 Copyright © 2011 Elsevier Inc. All rights reserved Elsevier.

Section XIII. Tropical Pacific Temperatures: NINO Buoy Data

As shown in Figures XIII -1-3 below, these NINO buoy temperature data do NOT exhibit statistically significant trend slopes across the Tropical Central Pacific where the THS theory would be expected to show its sea surface temperature impact.

Figure XIII -1

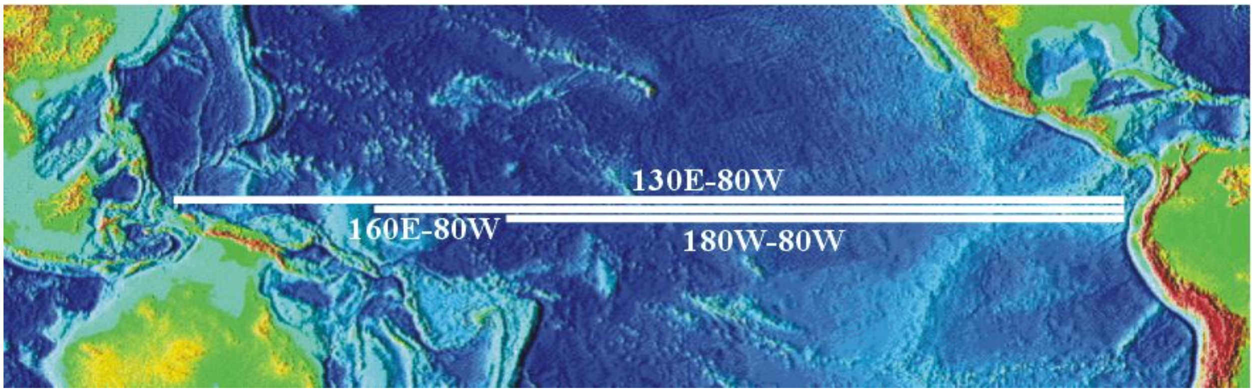
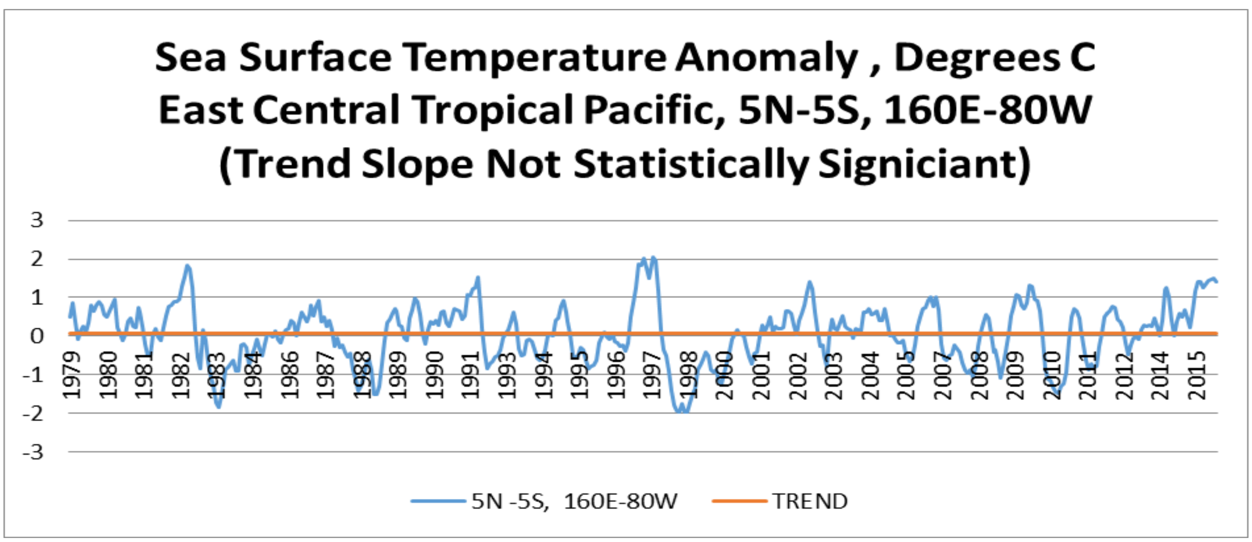


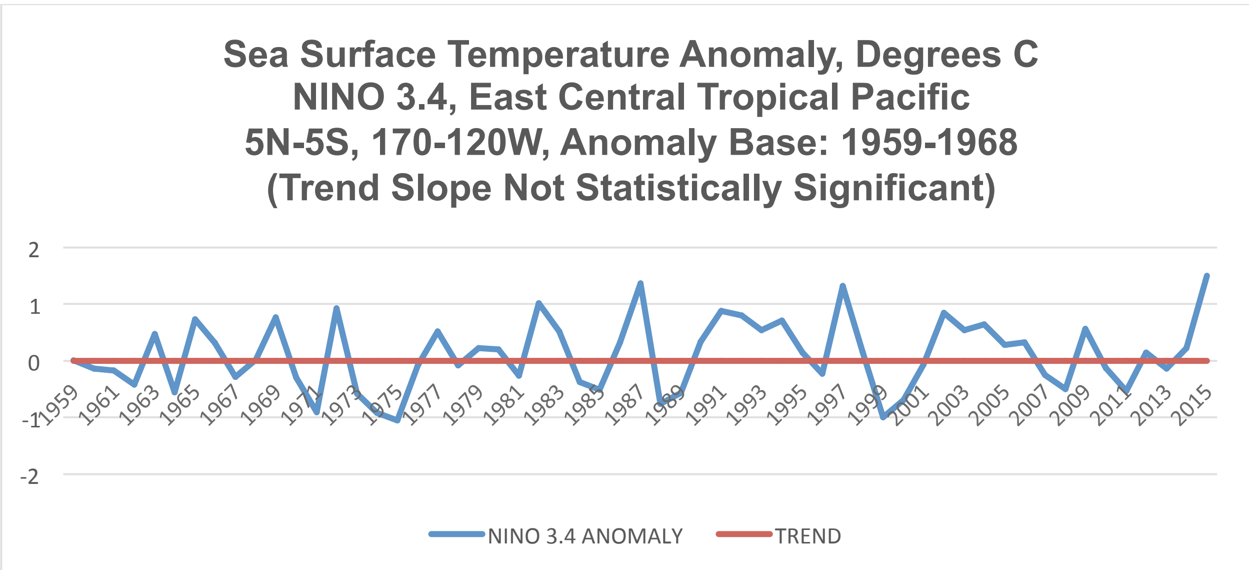
Figure XIII -2



Source:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ocean/index/heat_content_index.txt

NINO 3.4 Temperature shown in Figure XIII-3 below is considered highly relevant in measuring ENSO impacts but shows no GHG-related influence on its trend slope--which is not statistically significant. (See: http://www.esrl.noaa.gov/psd/data/climateindices/list/)

Figure XIII -3



Source: http://www.cdc.noaa.gov/data/correlation/nina34.data

To be more rigorous, Table XIII-1 shows the results of a number of relevant analyses. The first regression's results show that NINO 3.4 does not have a statistically significant time trend slope. The second regression shows that NINO 3.4 was impacted by the 77 shift – which is the only reason its linear trend is upward sloping. This is clear from the third regression in that once the impact of the 77 Shift (D 77 CT) is removed, CO_2 has no impact on the D 77 CT Adjusted NINO 3.4.

Table XII-1

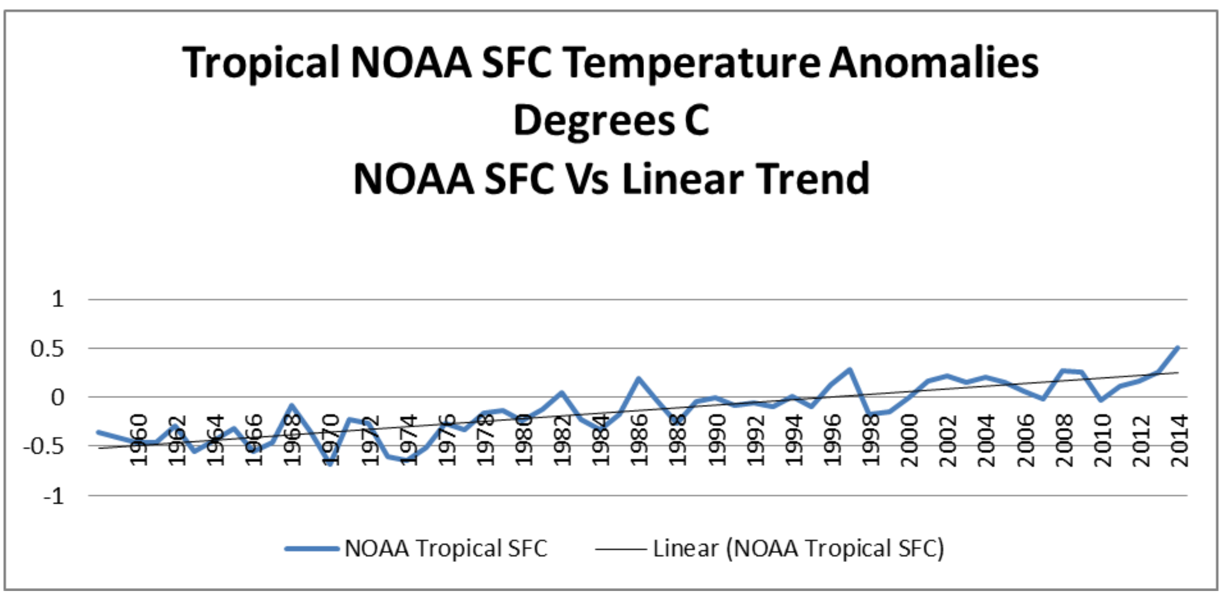
NINO 3.4 regressed on Time		
Regression Statistics		
Multiple R	0.21	
R Square	0.05	
Adjusted R Square	**0.03**	
Standard Error	0.62	
Observations	66	
	Coefficients	*t Stat*
Intercept	12.96	1.63
Time	0.01	**1.76**
NINO 3.4 Regressed on D 77CT		
Regression Statistics		
Multiple R	0.27	
R Square	0.07	
Adjusted R Square	**0.06**	
Standard Error	0.61	
Observations	66	
	Coefficients	*t Stat*
Intercept	26.79	226.67
D 77CT	**0.34**	**2.20**
NINO 3.4 D 77CT Adjusted regressed on CO2		
Regression Statistics		
Multiple R	0.04	
R Square	0.00	
Adjusted R Square	**-0.02**	
Standard Error	0.60	
Observations	57	
	Coefficients	*t Stat*
Intercept	0.30	0.27
CO2	**0.00**	**-0.27**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Section XIV. Tropical Surface Temperatures – NOAA

Regarding the issue of “Naïve” versus Model-based forecasts, the point was made in Section XII above that even climate model-based forecasts run into very serious problems due to the chaotic nature of the climate system. But climate modelers frequently make another serious, but avoidable error. For example, note the implied “forecast model” shown in Figure XIV-1 below. This Linear Trend Model even has an Adjusted R Square of 0.69. However, as shown in Table XIV-1 below, applying the generic model yields excellent results and a 25% higher Adjusted R Square of 0.86.

Figure XIV-1



Source: NOAA SFC data: Karl, T.R. et al., 2015: Possible artifacts of data biases in the recent global surface warming hiatus. Sciencexpress, 4 June 2015, doi:10.1126/science.aaa5632

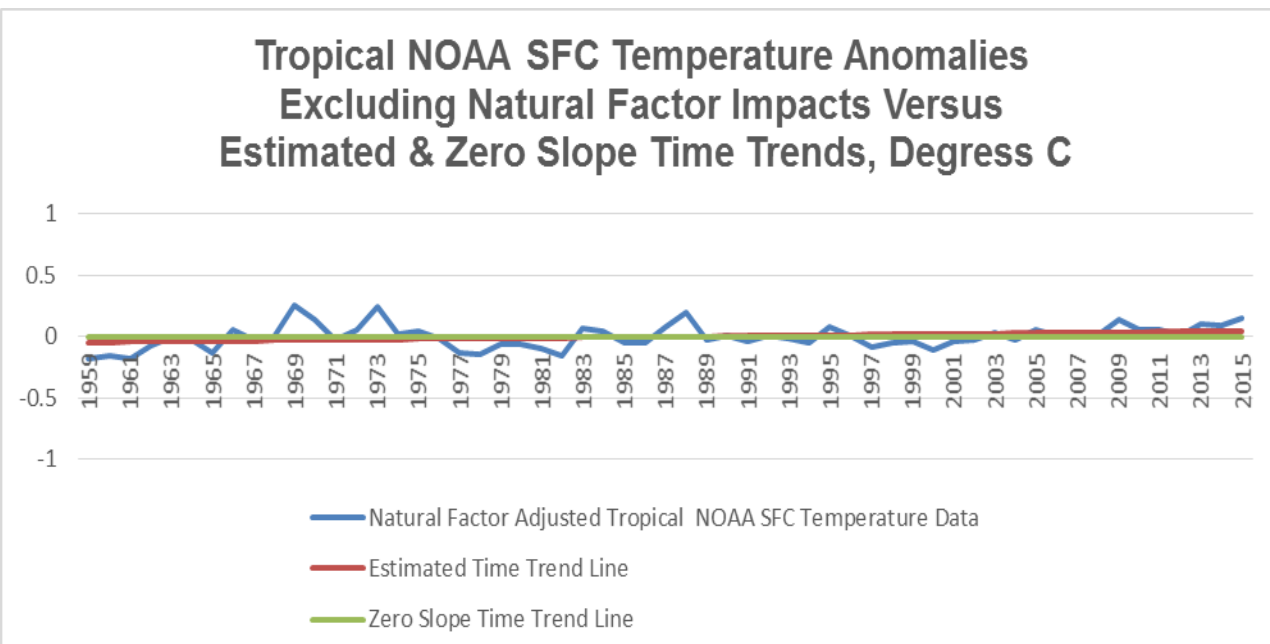
Table XIV-1

Tropical NOAA SFC Temperature Anomalies			
Regression Statistics			
Multiple R	0.94		
R Square	0.88		
Adjusted R Square	**0.86**		
Standard Error	0.10		
Observations	57		
Durban-Watson	**1.08**		
	Coefficients	*t Stat*	
Intercept	-0.18	**-5.05**	
MEI	0.16	**7.91**	
CTSIA	0.03	**6.89**	
D 77 CT	0.27	**8.28**	
D Els	0.21	**2.86**	
DVI +1	0.00	**-3.19**	
Model Residual regressed on TIME			
Regression Statistics			
Multiple R	0.28		
R Square	0.08		
Adjusted R Square	**0.06**		
Standard Error	0.09		
Observations	57		
	Coefficients		*t Stat*
Intercept	-3.26		-2.20
Time	**0.00**		**2.20**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.29		
R Square	0.08		
Adjusted R Square	**0.07**		
Standard Error	0.09		
Observations	57		
	Coefficients		*t Stat*
Intercept	-0.38		-2.23
CO2	**0.00**		**2.24**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

It is true that Table XIV-1 above shows statistically significant Time and CO2 coefficients running regressions using the NOAA Natural Factor Adjusted Temperature Data as the dependent variable. However, the very low R Bar Squares, at 0.06 and 0.07 respectively, are such that the hypotheses that this data has a statistically meaningful upward sloping trend and/or relationship with CO_2 must both be rejected. (Recall that the unadjusted data had a Linear trend Adjusted R Square of 0.69.) Nevertheless, along with the low, barely acceptable Durban-Watson, this trend slope finding result does suggest that some NOAA data manipulation may have taken place. That is, something "not natural" may have impacted this data. However, it can be seen in Figure XIV-2 below that the trend impact was so far inconsequential.

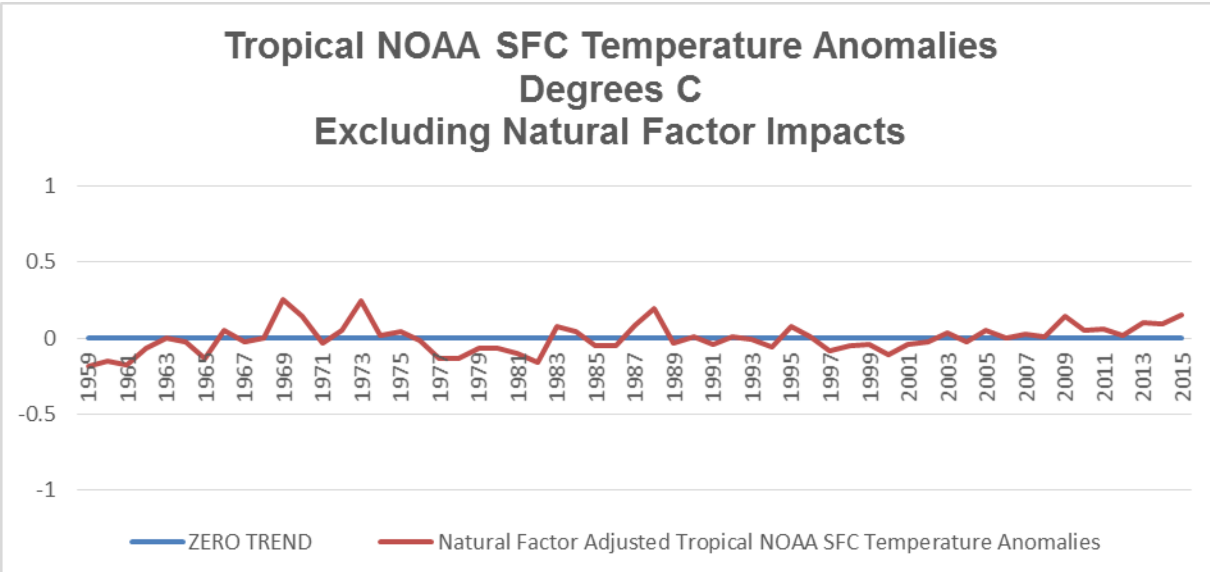
Figure XIV-2



Source: NOAA SFC data: Karl, T.R. et al., 2015: Possible artifacts of data biases in the recent global surface warming hiatus. Sciencexpress, 4 June 2015, doi:10.1126/science.aaa5632

Figure XIV-3 below shows the Natural Factor Adjusted Tropical NOAA SFC Anomaly Data and its zero Time Trend line.

Figure XIV-3



Source: NOAA SFC data: Karl, T.R. et al., 2015: Possible artifacts of data biases in the recent global surface warming hiatus. Sciencexpress, 4 June 2015, doi:10.1126/science.aaa5632

Section XV. <u>Temperature Forecasting Alternatives</u>

The analysis immediately above has illustrated two approaches regarding temperature forecasting which can be depicted mathematically as:

1.) T= a + b*Time Trend (or CO_2), where b=positive #, or

2.) T= c + d*F(Natural Factors), where d*F(NF) can go up and down.

However, above it has been shown many times over that there is no mathematical/statistical basis for equation 1. None of the Natural Factor Adjusted Temperature time series analyzed above were impacted by CO_2 and none had a statistically significant Trend Slope. With the equation 2 approach, it is all about the Natural Factor variables' outlook – so long as the forecaster is willing to assume that CO_2 will continue to have no role to play.

Section XVI. Structural Analysis Results re the THS

Adjusting for just the Natural Factor impacts, **NOT ONE** of the Nine (9) Tropical temperature time series analyzed above were consistent with the EPA's THS Hypothesis.

That is, adjusting for just the Natural Factor Impacts over their entire history; all nine of tropical temperature data analyzed above have non-statistically significant trend slopes—which invalidates the THS theory. Moreover, CO_2 did not even come close to having a statistically significant impact on a single one of these temperature data sets. From an econometric structural analysis standpoint, the generic model worked extremely well in all 9 cases

It is very important to note here though that the mathematical approach taken here would not have worked if CO_2 in fact did have a statistically significant impact on temperature. The fact that the approach showed nine times that CO_2 does not should provide great confidence in the result.

But, please note that had the Natural Factor Adjusted Temperatures had statistically significant Trend slopes and/or CO_2 regressions had had reasonably high Adjusted R Squares and CO_2 coefficient t statistics 2 or higher in one or more of the relevant Tables above, then to properly estimate the CO_2 coefficient in the temperature equations, simultaneous equation parameter estimation techniques would have had to be utilized. For example, econometric simultaneous equation parameter estimation techniques have been used to determine the relative importance of CO_2, solar, volcanic and ENSO impacts on Northern Hemispheric Temperatures[4]. This paper reported on research that did not find a statistically significant impact of CO_2 on the surface temperatures of three different Northern Hemisphere regions.

Section XVII. CONCLUSION re the THS

The analysis above has shown many times over that the THS simply does not exist. Recall from Section IV:

The proper test for the existence of the THS in the real world seem very simple. Are the slopes of the three trend lines (upper & lower troposphere and surface) all positive, statistically significant and do they have the proper top down rank order? Note that this

[4] see, for example, A Simple KISS {Keep it Simple Stupid} Model to Examine the Relationship Between Atmospheric CO2 Concentration, and Ocean & Land Surface Temperatures, Taking into Consideration Solar and Volcanic Activity, As Well As Fossil Fuel Use. In: Evidence-Based Climate Science. Elsevier, Oxford, Amsterdam, pp. 353-382. ISBN: 9780123859563 Copyright © 2011 Elsevier Inc. All rights reserved.

is a necessary, but not sufficient, condition for THS theory validation. In fact, currently some tropical tropospheric temperature data sets do have statistically significant upward sloping trend slopes.

Section V further states that the Sufficient Conditions used in this research report for THS Theory validation are:

1.) After adjusting for the Natural Factor impacts, if all relevant temperature time series have linear trend slopes that are not positive and statistically significant; then rising atmospheric CO_2 *concentrations are very unlikely to have impacted such temperatures. But an additional, even more rigorous test was also used herein.*

2.)Once the Natural Factor Impacts have been removed, if all relevant THS –related temperature data show no statistically significant relationship to changing atmospheric CO_2 *concentrations, then the THS theory must be considered invalidated.*

If both tests are met, rising atmospheric CO_2 *concentrations must not be the cause of any statistically significant positive trend slopes in the published data. Blame the Natural Factor impacts.*

As for the research results, quoting from Section XVI above:

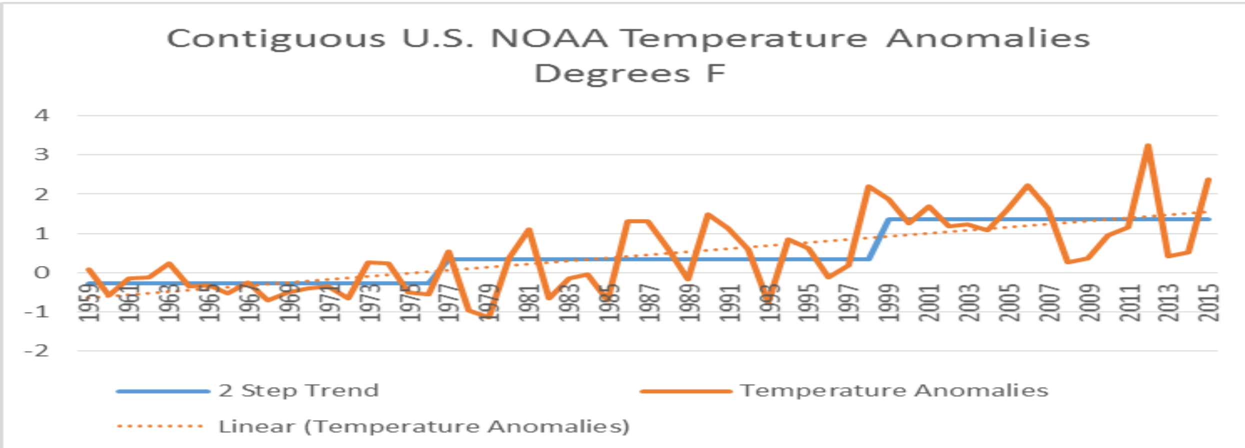
*Adjusting for just the Natural Factor impacts, **NOT ONE** of the Nine (9) Tropical temperature time series analyzed above were consistent with the EPA's THS Hypothesis.*

That is, adjusting for just the Natural Factor Impacts over their entire history; all nine of tropical temperature data analyzed above have non-statistically significant trend slopes—which invalidates *the THS theory. Moreover, CO_2 did not even come close to having a statistically significant impact on a single one of these temperature data sets. The generic model worked extremely well in all 9 cases from an econometric structural analysis standpoint. It delivered a highly credible set of consistent research results that invalidate the THS theory, the most important of the three lines of evidence in EPA's Endangerment Finding.*

Section XVIII. Contiguous U.S. NOAA Temperatures

Given its success with Tropical Temperature Data, it seemed reasonable to attempt to extend the same mathematical modeling approach to Contiguous U.S. and then to Global Temperature data. This was done despite the fact that the ENSO variables are most closely tied to the tropics. The analysis process for the Contiguous U.S. NOAA temperature data was the same as for the Tropics data, where the first step was to apply time series decomposition to get a feel for the best-fit-underlying-trend pattern. Figure XVIII-1 shows two trends – A linear trend and a two-step trend, both having a nearly identical R Bar Squares. So linear trend projection is particularly precarious here!

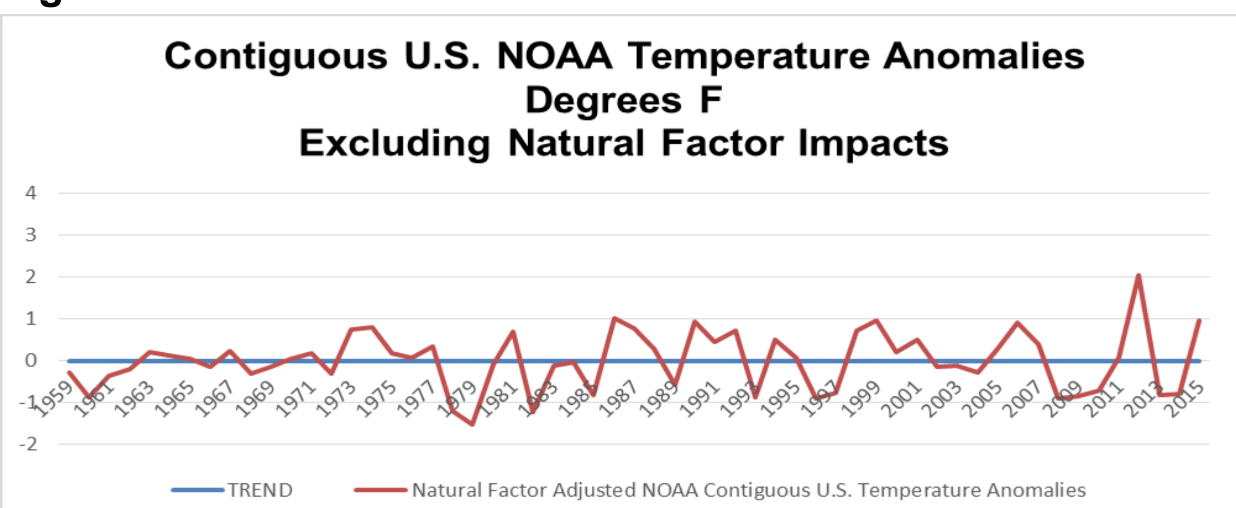
Figure XVIII-1



Source: http://www.ncdc.noaa.gov/cag/time-series/us/110/00/tavg/ytd/12/1895-2016.csv?base_prd=true&begbaseyear=1901&endbaseyear=2000
http://www.esrl.noaa.gov/psd/enso/mei/table.html

Figure XVIII-2 and Table XVIII-1 below show the results from carrying out the same analysis used above for the tropical data. Once again, when the Natural Factor impacts are removed, the Natural Factor adjusted temperatures have flat trend lines and here again CO_2 is shown not to be the cause of the rise in the reported temperature data shown in Figure XVIII-1 above.

Figure XVIII-2



Source: See Figure VIII-1 source

Table XVIII-1

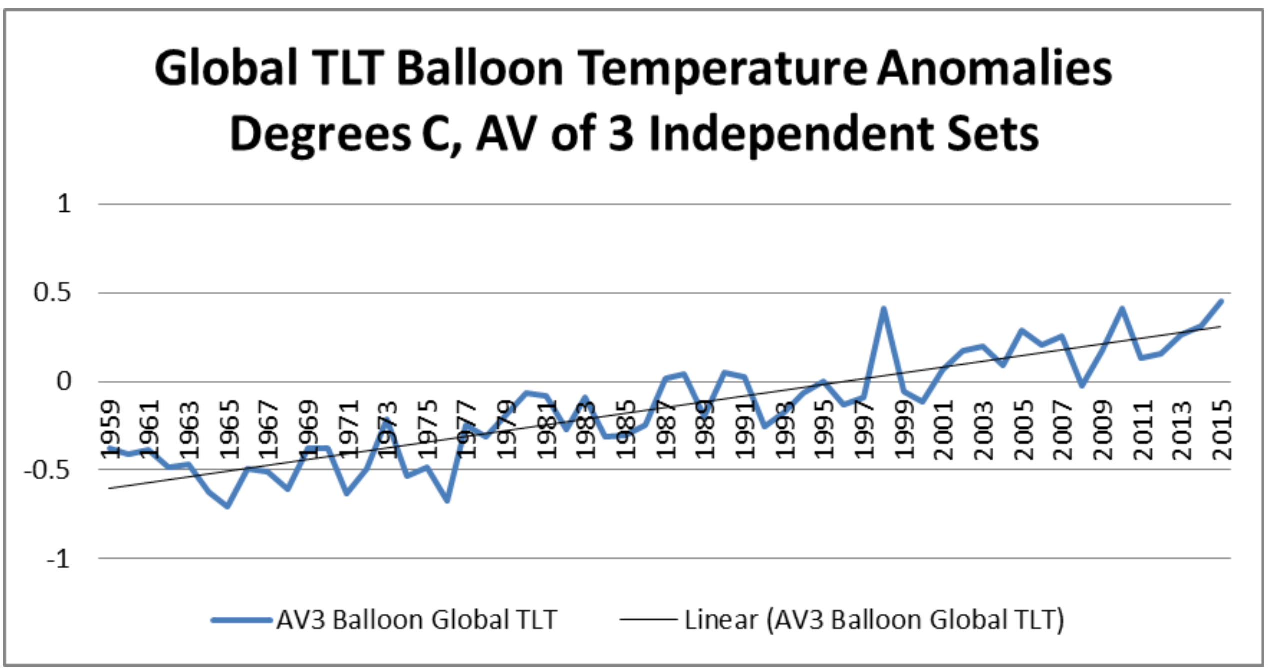
NOAA Contiguous U.S. Surface Temperature Anomalies			
Regression Statistics			
Multiple R	0.70		
R Square	0.50		
Adjusted R Square	**0.45**		
Standard Error	0.72		
Observations	57		
Durban-Watson	**1.81**		
	Coefficients	*t Stat*	
Intercept	0.44	**1.75**	
MEI	0.09	**0.58**	
CTSIA	0.10	**3.33**	
D 77 CT	0.84	**3.60**	
D EIs	0.54	**1.02**	
DVI +1	0.00	**-1.90**	
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.11		
R Square	0.01		
Adjusted R Square	**-0.01**		
Standard Error	0.69		
Observations	57		
	Coefficients	*t Stat*	
Intercept	-8.79	-0.80	
Time	**0.00**	**0.80**	
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.10		
R Square	0.01		
Adjusted R Square	**-0.01**		
Standard Error	0.69		
Observations	57		
	Coefficients	*t Stat*	
Intercept	-0.95	-0.75	
CO2	**0.00**	**0.75**	

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Section XIX. Global Temperature Analysis – Balloon Data

The analytical approach taken for Global temperature data is also exactly the same as that used above for the Tropical data. Figure XIX-1 below shows the Global TLT Balloon Data and the hopefully now fully discredited Naïve Linear Trend Forecast Model. Once again, as shown in Table XIX-1 and Figure XIX-2, when the Natural Factor impacts are removed, the Natural Factor adjusted temperatures have a flat trend line and here again CO_2 is shown not to be the cause of the rise in the reported temperature data shown in Figure XIX-1 below. Note that the Adjusted R Squares for the Time Trend and CO2 impacts are extremely low, at 0.03, making it very clear that neither impact is existent in the Natural Factor adjusted temperature data.

Figure XIX-1



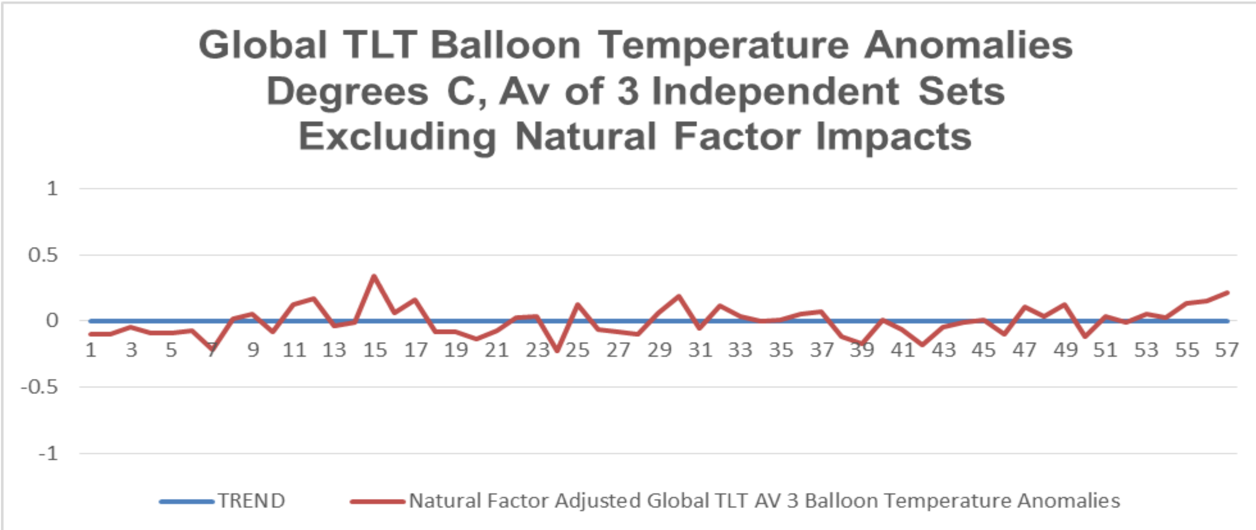
Source: See Figure VIII-1 source

Table XIX-1

Global TLT AV 3 Balloon Temperature Anomalies			
Regression Statistics			
Multiple R	0.93		
R Square	0.86		
Adjusted R Square	**0.85**		
Standard Error	0.12		
Observations	57		
Durban Watson	**1.60**		
	Coefficients		*t Stat*
Intercept	-0.26		**-6.24**
MEI	0.05		**2.09**
CTSIA	0.03		**6.26**
D 77 CT	0.41		**10.68**
D Els	0.33		**3.83**
DVI+1	0.00		**-3.58**
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.21		
R Square	0.04		
Adjusted R Square	**0.03**		
Standard Error	0.11		
Observations	57		
	Coefficients		*t Stat*
Intercept	-2.85		-1.60
Time	**0.00**		**1.61**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.22		
R Square	0.05		
Adjusted R Square	**0.03**		
Standard Error	0.11		
Observations	57		
	Coefficients		*t Stat*
Intercept	-0.35		-1.69
CO2	**0.00**		**1.69**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure XIX-2



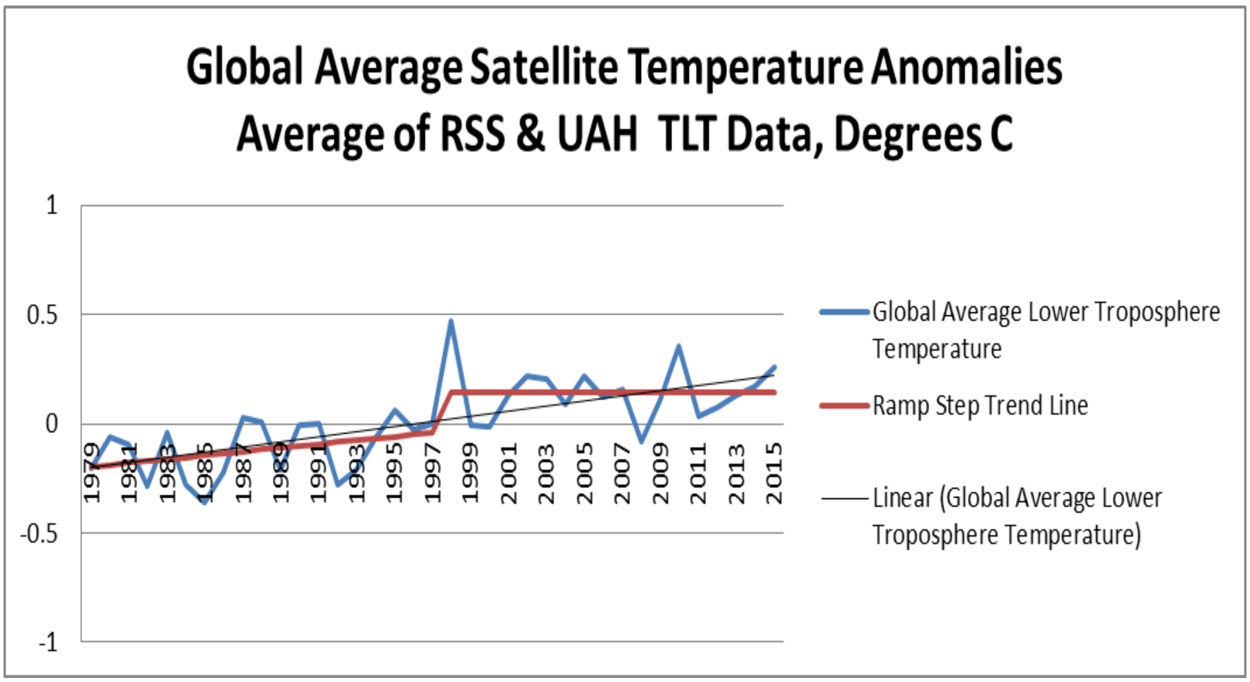
Source: See Figure VIII-1 source

It should be noted here that the results shown in Table XIX-1 above are truly remarkable. And, time series specific improvements in the quality of the parameter estimates are simply there for the taking by properly skilled analysts. Our objective was not to attempt such improvements in this research. Rather the focus here was to determine how well structural analyses could proceed constrained to ALWAYS use the same linear functional form and explanatory variables. Of course, considerable testing assisted the choice of the explanatory variables. And, sticking with the linear form has too many benefits to list here.

Section XX. Global Temperature Analysis – Satellite

Figure XX-1 below was specifically designed to depict how far wrong climate scientists can go if they cling to fitting linear trends to temperature time series. Using standard Dummy Variable Regression techniques allows rapid determination of the best fitting standard functional forms.

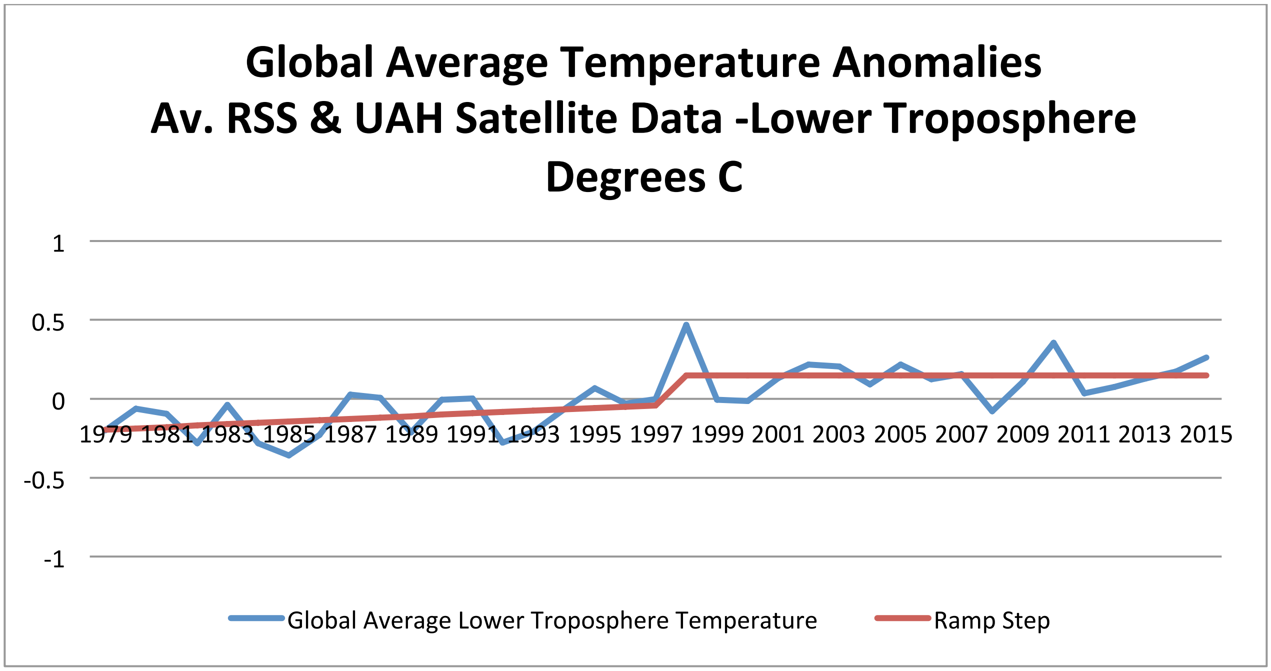
Figure XX-1



Source:
http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v03_3.txt
http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

The Satellite data begins in 1979, and the best fit decomposition is the Ramp Step. This implies rather than steadily trended up, Global temperatures have had a flat trend for at least the last eighteen years as shown more clearly in Figure XX-2 below.

Figure XX-2



Source:
http://data.remss.com/msu/monthly_time_series/RSS_Monthly_MSU_AMSU_Channel_TLT_Anomalies_Land_and_Ocean_v03_3.txt
http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

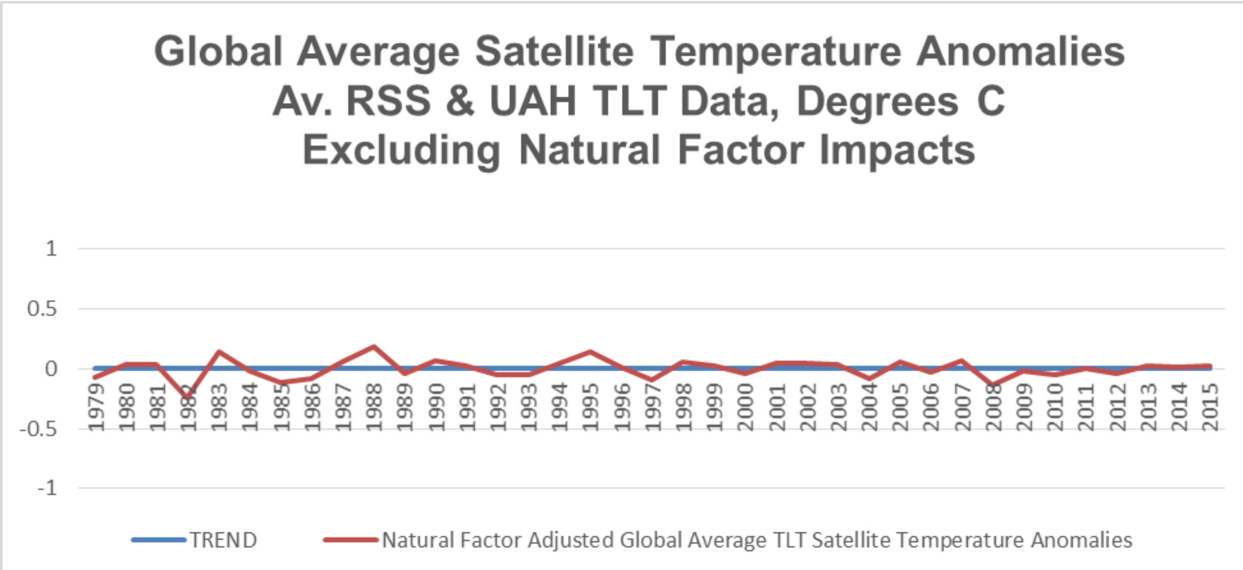
Once again, as shown in Table XX-1 and Figure XX-3 below, when the Natural Factor impacts are removed, the Natural Factor adjusted temperatures have a flat trend line and **here again CO_2 is shown not to be the cause of the rise in the reported temperature data shown in Figures XX-1-2 above.** Once again, the Adjusted R Squares for the Time Trend and CO2 impacts are extremely low, at 0.03, making it very clear that neither impact is existent in the Natural Factor adjusted temperature data. The Natural Factor adjusted data is shown with its flat Time trend in Figure XX-3 below.

TABLE XX-1

Global Average TLT Satellite Temperature Anomalies		
Regression Statistics		
Multiple R	0.90	
R Square	0.81	
Adjusted R Square	**0.79**	
Standard Error	0.09	
Observations	37	
Durban-Watson	**2.43**	
	Coefficients	*t Stat*
Intercept	0.12	**5.46**
MEI	0.07	**3.34**
CTSIA	0.03	**6.81**
D EIs	0.35	**5.47**
DVI +1	0.00	**-4.26**
Model Residual regressed on Time		
Regression Statistics		
Multiple R	0.03	
R Square	0.00	
Adjusted R Square	**-0.03**	
Standard Error	0.08	
Observations	37	
	Coefficients	*t Stat*
Intercept	-0.47	-0.19
Time	**0.00**	**0.19**
Model Residual regressed on CO2		
Regression Statistics		
Multiple R	0.03	
R Square	0.00	
Adjusted R Square	**-0.03**	
Standard Error	0.08	
Observations	37	
	Coefficients	*t Stat*
Intercept	-0.04	-0.16
CO2	**0.00**	**0.16**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure XX-3



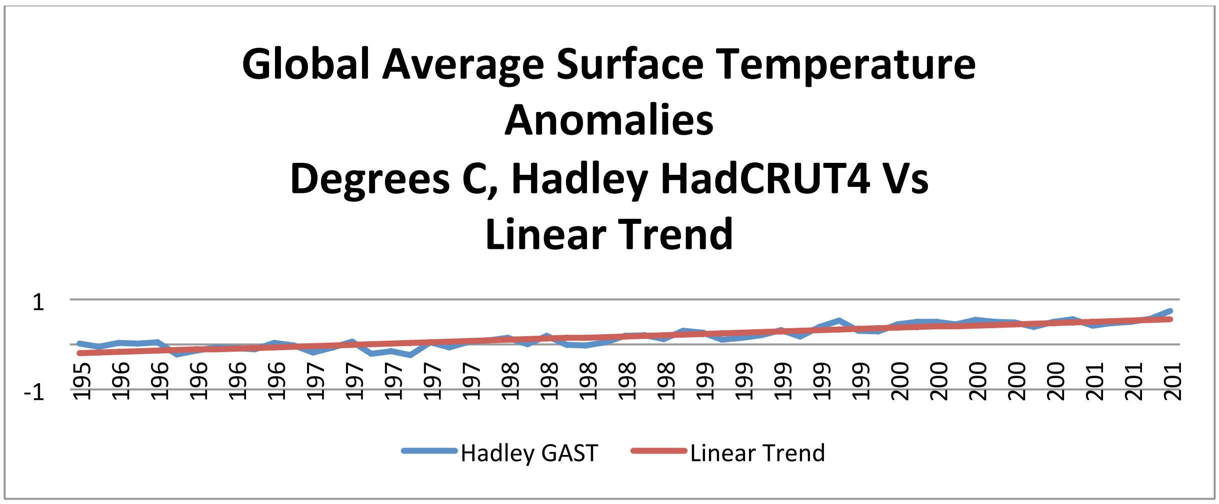
Source: see Figure XX-2 Source

Section XXI. Global Temperature Analysis – Hadley HadCRUT4 GAST

The analysis of this instrumental surface temperature record data followed exactly the same process as for the others discussed above, and the results were the same. (See below Figures XXI-1-2 and Table XXI-1) Namely, that when the data were adjusted for changes in the Natural Factors, there was no indication that CO_2 was having a statistically significant impact on the Global Hadley temperature data. Moreover, the Natural Factor adjusted Hadley Global Surface Temperature does not have a statistically significant trend slope. The model testing for such a trend has an Adjusted R Square of 0.06.

With respect to CO_2 impacts, this should not be surprising, assuming that this surface data is reasonably accurate, given that the EPA-assumed THS mechanism has been proven above to be nonexistent. There would have to be some new, not yet discovered mechanism by which higher atmospheric GHG/CO_2 concentration has been impacting GAST – so far no sign of one.

Figure XXI-1



Source:
http://www.metoffice.gov.uk/hadobs/hadcrut4/data/current/time_series/HadCRUT.4.4.0.0.annual_ns_avg.txt

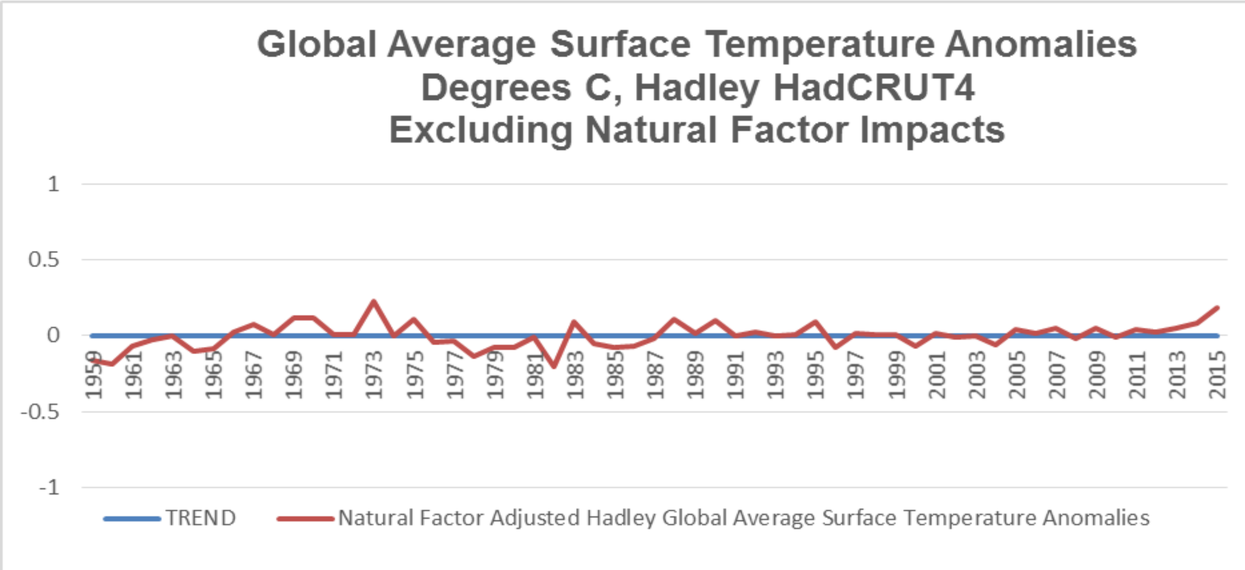
Finally, it should again be noted that the structural analysis model seemed to work remarkable well on this data. That is not to say that the tool does not suggest some possible data manipulation.

Table XXI-1

Hadley Global Average Surface Temperature Anomalies		
HadCRUT4		
Regression Statistics		
Multiple R	0.94	
R Square	0.89	
Adjusted R Square	**0.88**	
Standard Error	0.09	
Observations	57	
Durban-Watson	**1.38**	
	Coefficients	*t Stat*
Intercept	0.21	**6.80**
MEI	0.06	**3.11**
CTSIA	0.04	**10.88**
D 77 CT	0.26	**9.41**
D Els	0.16	**2.58**
DVI+1	0.00	**-3.80**
Model Residual regressed on Time		
Regression Statistics		
Multiple R	0.28	
R Square	0.08	
Adjusted R Square	**0.06**	
Standard Error	0.08	
Observations	57	
	Coefficients	*t Stat*
Intercept	-2.80	-2.19
Time	**0.00**	**2.19**
Model Residual regressed on CO2		
Regression Statistics		
Multiple R	0.28	
R Square	0.08	
Adjusted R Square	**0.06**	
Standard Error	0.08	
Observations	57	
	Coefficients	*t Stat*
Intercept	-0.32	-2.17
CO2	**0.00**	**2.18**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

Figure XXI-2



Source: see source XX1-1

Section XXII. Global Temperature Analysis Results

The above analysis of Global Balloon & Satellite atmospheric temperature as well as Contiguous U.S. and Hadley Global Average Surface Temperature data turned up no statistical support for suggesting that CO_2, even taken together with all other omitted variables, is the cause of the positve trend in the reported U.S. and Global temperature data.

In fact, it seems very clear that the Global Warming that has occurred over the period 1959 to date can be quite easily explained by Natural Factor impacts alone. Given the number of independent entities and differing instrumentation used in gathering the temperature data analyzed herein, it seems highly unlikely that these findings are in error.

Section XXIII. CO_2's Impact on Reported Temperature

Thus far in this analysis, it has been shown that simply adjusting temperature data for Natural Factor impacts yields results that very strongly suggest that natural factors alone can rather easily explain the positive trend slopes in officially reported temperature data over the last 50 years or so.

More specifically, a separate analysis of thirteen (13) as-reported temperature time series has demonstrated that not one of them showed a statistically significant impact of rising atmospheric CO_2 concentrations (or for that matter, any combination of omitted variables having a linear trend-like pattern.) It is critical to note here that, even if this particular structural analysis had found a possibly significant CO_2 impact, it would then have been necessary to utilize simultaneous equation parameter estimation techniques to obtain an "unbiased and consistent" (i.e., mathematically proper) estimate of CO_2's actual impact. Such an estimation technique is the only way to properly confirm the statistical significance of CO_2's parameter estimate in a temperature equation. The next Section will reconfirm this fact.

Moreover, there is another even more serious problem facing analysts attempting to definitively attribute the real warming that has been happening over the last 50 years or more to rising atmospheric CO_2 concentrations. As was pointed out in the Preface, it is the multicollinearity problem associated with fact that the CO_2 variable is very linear Time Trend-like. The results of regressing each of the Natural Factor Adjusted Temperatures separately on Time and CO_2 have been shown above and are summarized in Table XIII-1 below. As is readily apparent, the explanatory power of both variables can be seen to be nil (as measure by the Adjusted R Squares) but their statistical performance, measured by t Statistic values, is very similar.

Table XIII-1

CO2 Versus Time Trend Impact on Natural Factor Adjusted Temperature				
Temperature Data	**Model Residual Regessed on Time**		**Model Residual Regessed on CO2**	
Tropics	Adjusted R Square	t Statistic	Adjusted R Square	t Statistic
Balloon Upper Trop. 200 mb	-0.01	0.70	-0.01	0.78
Balloon Lower Trop.150 mb	-0.02	0.08	-0.02	0.17
Satellite Upper Trop TMT	-0.03	-0.01	-0.03	0.00
Balloon Lower Trop TLT	0.00	0.98	0.00	1.03
Balloon Lower Trop 500 mb	0.00	1.04	0.01	1.16
Satellite Lower Trop. TLT	-0.03	0.07	-0.03	0.00
Satellite Lower Trop Ocean TLT	-0.03	0.13	-0.03	0.06
NOAA SFC Surface	0.06	2.20	0.07	2.24
Contiguous U.S.				
NOAA SFC Surface	-0.01	0.80	-0.01	0.75
Global				
Balloon Lower Trop TLT	0.03	1.61	0.03	1.69
Hadley SFC Surfac	0.06	2.19	0.06	2.18
Satellite Lower Trop TLT	-0.03	0.19	-0.03	0.16
Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or more.				

Hence, any Linear Trend-like variable(s) (say, world population related) omitted from future structural analyses of this temperature data could be the actual cause of any future warming that is not readily explained by the Natural Factors utilized in this research. Currently this multicollinearity problem need not be dealt with; but if this situation changes, it will be quite a challenge.

Section XXIV. CO_2 Equation -Real World Validation

One final question remains that has not yet been explicitly dealt with herein. It is, can the existence of the CO_2 equation really be confirmed so that simultaneous equation parameter estimation techniques must be utilized to confirm CO_2's statistically significant impact on temperature? In the Preface, the authors referred to a specific paper for a proof[5]. Below very significant additional proof is provided.

With CO_2 determined to be not statistically significant in the structural analysis of the 13 temperature data sets as summarized in Section XXIII immediately above, the equation system described in the Preface can be seen to be recursive which permits parameter estimation of the CO_2 equation in the system by ordinary or direct least squares[6].

An explicit form of the CO_2 equation referred to in the Preface is:

[1] $(\Delta C - c_{fossil})_t = a + b^*T_t + c^* CO_{2,t-1}$

Where

$(\Delta C - c_{fossil})_t$, is the efflux of Net non-fossil fuel CO_2 emissions from the oceans and land into the atmosphere and c_{fossil} is CO_2 emissions from Fossil Fuel consumption.

[5] See pages 364-366 & 370, James P. Wallace, III, Anthony Finizza and Joseph D'Aleo, A Simple KISS Model to Examine the Relationship Between Atmospheric CO2 Concentration, and Ocean & Land Surface Temperatures, Taking into Consideration Solar and Volcanic Activity, As Well As Fossil Fuel Use. In: Evidence-Based Climate Science. Elsevier, Oxford, Amsterdam, pp. 353-382. ISBN: 9780123859563, Copyright © 2011 Elsevier Inc. All rights reserved, Elsevier.

[6] See Theil, Henri. Introduction to Econometrics, Prentice-Hall, 1978, pages 346-349 and Goldberger, A.S., Econometric Theory, 1964, pages 354-355.

T_t is UAH Tropical TLT Ocean temperature. The expected sign is positive.

$CO_{2,t-1}$ on the right-hand side is a proxy for Land use. The expected sign is negative, because as CO_2 levels rise, other things equal, the CO_2 absorption of the flora increase.

As shown in Table XXIV-1, applying ordinary least squares to this equation yields a high Adjusted R square (0.64.) The coefficients have the correct signs and are statistically significant at the 95% confidence level.

Table XXIV-1

SUMMARY OUTPUT			
Adjusted R Square	**0.64**		
Durban Watson	1.72		
	Coefficients	Standard Error	t Stat
Constant	-311.85	77.270	-4.0
UAH Tropical Ocean	1.18	0.285	4.1
CO2(-1)	-0.03	0.004	-7.7

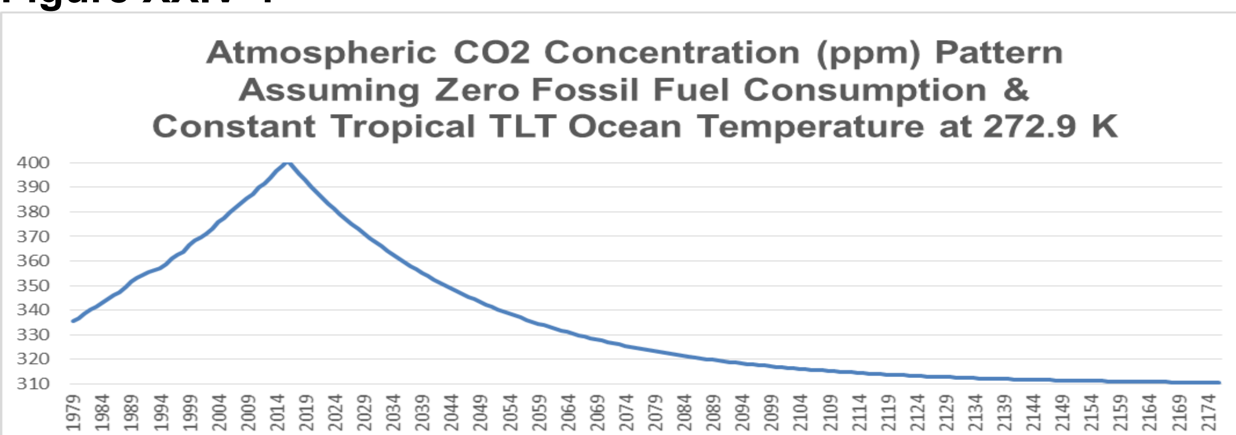
There is a useful validation test for all of the estimated parameters of this equation. In equilibrium, if there were no fossil fuel emissions and Tropical TLT Ocean temperatures were assumed to hold steady at their average value (which was 272.9 K) over the 1979 to 2013 model parameter estimation time period; then in equilibrium, there would be no change in the concentration of atmospheric CO_2, so that:

[2] $C_t = C_{t-1} = C_{equilibrium}$

Using equation [1], yields:
[3] $0 = a + b*T_0 + c*C_{equilibrium}$
Or, rearranging,
[4] $C_{equilibrium} = (a + b*T_0)/(-c)$
Substituting the estimated coefficients from Table XXIV-1 and substituting the average temperature observed over 1979 -2013 for T (272.9 K) into the equation [4], yields:

$C_{equilibrium} = (-311.845 + 1.1765*272.9)/(0.02976) = 310.1$
Thus, as shown in Figure XXIV-1, in equilibrium, without any Fossil Fuel consumption, and assuming a constant 272.9 K TLT Tropical Ocean temperature, atmospheric CO_2 concentrations would average around 310 ppm. But, it would take 50 years to get back down to just 330 ppm.

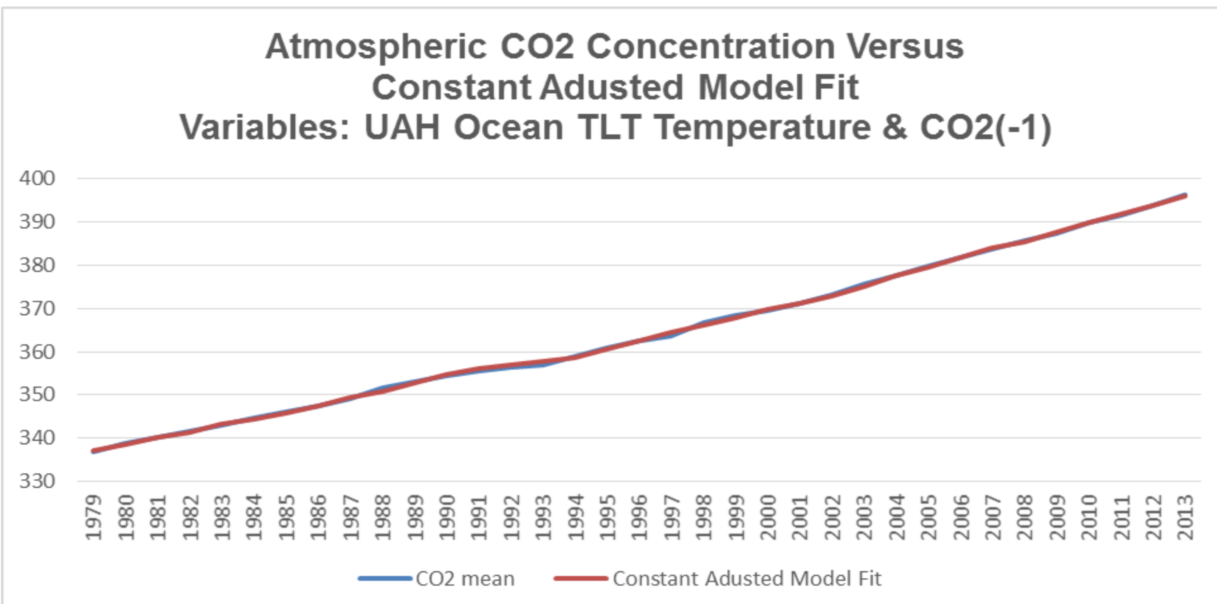
Figure XXIV-1



Using the same functional form for the CO_2 equation but very different measures of ocean temperature, the "KISS" paper referred to in the Preface calculated the $C_{equilibrium}$ at a very similar 300 ppm. Additionally, to quote from the KISS paper: *As an additional validation of the CO_2 equation, it can be shown that the equation suggests that the fraction {%} of CO_2 not absorbed by the land and ocean, that is, the fraction of CO_2 from fossil fuel emissions that remains in the atmosphere, is about 53%, which* *roughly speaking, agrees with historical observation - - - -.* Using a totally different temperature variable, this UAH Tropical TLT Ocean Temperature -based model implies a fraction of 53.4 %.

Figure XXIV-2 below shows the Model Fit versus Actual where the constant term has been adjusted up slightly (i.e., 1/4 of one standard error) to improve the fit. Based on all the evidence, the CO_2 equation seems quite robust and cannot be ignored.

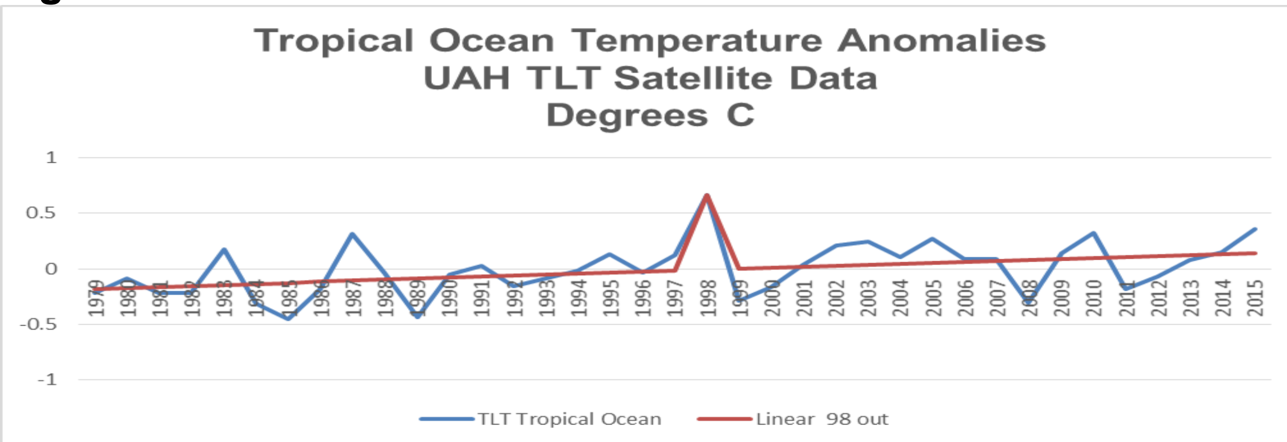
Figure XXIV-2



Sources: Fossil Fuel CO2 emissions:
http://cdiac.ornl.gov/ftp/ndp030/global.1751_2013.ems
ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt
http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

One final point should be made here, as shown below carrying out the same Natural Factor adjustment structural analysis of this tropical ocean data led to the same results as for the other 13 time series. The UAH data, as reported, is shown below in Figure XXIV-3.

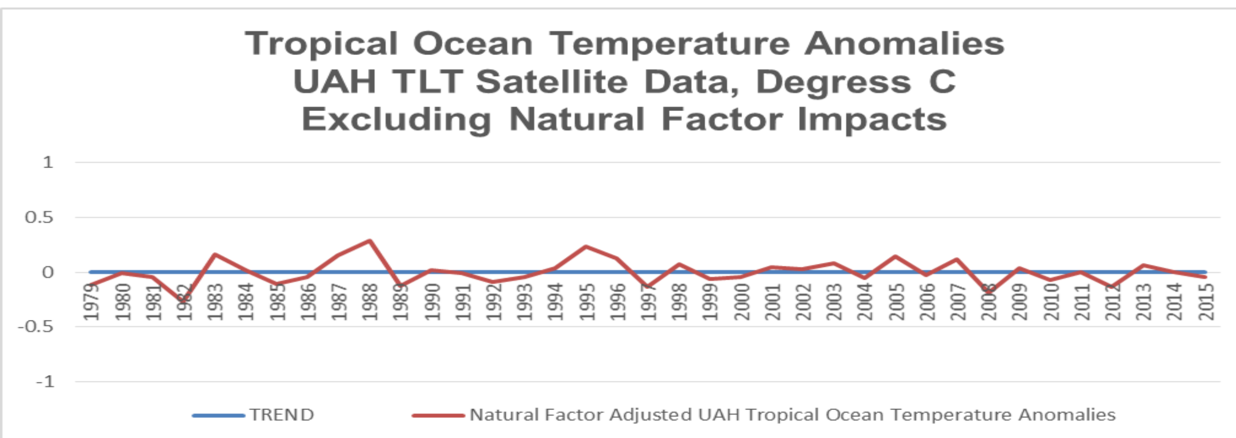
Figure XXIV-3



Source: http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

The Natural Factor adjusted tropical temperature data has a flat time trend. See Figure XXIV-4 below.

Figure XIV-4



Source: http://vortex.nsstc.uah.edu/data/msu/v6.0beta/tlt/uahncdc_lt_6.0beta5.txt

And, CO_2 does not have a statistically significant impact on this UAH Tropical Ocean Temperature. Table XXIV-1 below shows the results of utilizing the identical structural analysis process carried out on each of the 13 temperature data sets discussed above. Clearly, this structural analysis process works very well.

Table XXIV-1

UAH Tropical Ocean Temperature Anomalies			
Regression Statistics			
Multiple R	0.88		
R Square	0.77		
Adjusted R Square	**0.74**		
Standard Error	0.12		
Observations	37		
Durban-Watson	**2.27**		
	Coefficients		*t Stat*
Intercept	0.05		1.43
MEI	0.22		**7.22**
CTSIA	0.03		**4.45**
D Els	0.46		**5.14**
DVI +1	0.00		**-2.65**
Model Residual regressed on Time			
Regression Statistics			
Multiple R	0.02		
R Square	0.00		
Adjusted R Square	**-0.03**		
Standard Error	0.12		
Observations	37		
	Coefficients		*t Stat*
Intercept	-0.45		-0.13
Time	**0.00**		**0.13**
Model Residual regressed on CO2			
Regression Statistics			
Multiple R	0.01		
R Square	0.00		
Adjusted R Square	**-0.03**		
Standard Error	0.12		
Observations	37		
	Coefficients		*t Stat*
Intercept	-0.02		-0.06
CO2	**0.00**		**0.06**

Note that to be statistically significant with this number of degrees of freedom, the t stat must be 2 or better – as long as the Durban-Watson statistic is above 1.0

The analysis results covered in this section should make it very clear that validating that CO_2 has a statistically significant impact on GAST will require the use of simultaneous equation parameter estimation techniques. The structural analysis process used in this research only worked because CO_2, in fact, has not had a statistically significant impact on GAST, or any of the other 13 temperature data sets, over the past 50 years or so. Based on this research, the THS theory of global warming has been invalidated so that the Climate models based on the theory will never work. Finally GAST behavior, rather than abnormal, is fully explained by Natural Factors.

Section XXV. Bottom-line: On the Existence of a "Tropical Hot Spot "& The Validity of EPA's CO_2 Endangerment Finding

Given the potential significance of this research, it is appropriate to question everything about it. Questioning everything is fair game from 1) the selection, by one of the authors, of the particular 14 temperature time series for this structural analysis process to 2) the particular econometric parameter estimation/structural analysis methods utilized to 3) the actual models estimated. On all three issues, the authors have attempted to be completely open.

Regarding the model used for Natural Factor Impact Adjustment, recall that the exact same linear functional form and 5 Natural Factor explanatory variables were used in all 14 structural analyses, except that the 1977 Pacific Shift variable is dropped for the Satellite data modeling since its data history begins in 1979. Also, the two NINO Buoy data time series required less analysis because neither had statistical significant time trends to begin with. So that counting the UAH tropical ocean discussed in Section XXIV immediately above, a detailed structural analysis was performed on 12 (13+1-2) temperature data sets.

The econometric modeling/structural analysis process output turned out to be remarkable in that, for all 12 temperature time series so analyzed, the results were invariably the same:

> The identical (5 or 4 Natural Factor variables as appropriate for the data window) model worked very well for all 12 temperature data time series:
>
> 1.) Excluding (not surprisingly) the 150 mb stratosphere data model, literally all parameter estimates had the correct signs and very nearly all had quite high t Statistics easily confirming statistical significance. (The Durban-Watson statistics confirmed that all the reported t Statistics were reliable.) One exception involved the MEI variable outside the tropics -which was expected.
>
> 2.) The Natural Factor Adjustment Model Adjusted R Squares were all higher than relevant Naive forecasting models and very high (i.e., 0.70 -0.88) for such empirical work. Only the stratospheric and NOAA Contiguous U.S. temperature data models had lower Adjusted R Squares for the reasons discussed in Sections VIII and XVIII.
>
> 3.) The 14 time series analyzed constituted a robust test set in that they were produced by many different entities using different technologies involving Surface, Buoy, Balloon and Satellite temperature measurement.

These analysis results would appear to leave very, very little doubt but that EPA's claim of a Tropical Hot Spot, caused by rising atmospheric CO_2 levels, simply does not exist in the real world. Also critically important, this analysis failed to find that the steadily rising Atmospheric CO_2 Concentrations have had a statistically significant impact on any of the 14 temperature time series that were analyzed.

Thus, the analysis results invalidate each of the Three Lines of Evidence in its CO_2 Endangerment Finding. Once EPA's THS assumption is invalidated, it is obvious why the climate models they claim can be relied upon, are also invalid. And, these results clearly demonstrate—14 separate and distinct times in fact--that once just the Natural Factor impacts on temperature data are accounted for, there is no "record setting" warming to be concerned about. In fact, there is no Natural Factor Adjusted Warming at all. Moreover, over the time period analyzed, these natural factors have involved historically quite normal solar, volcanic and ENSO activity.

At this point, there is no statistically valid proof that past increases in Atmospheric CO_2 Concentrations have caused the officially reported rising, even claimed record setting temperatures. To validate such a claim will require mathematically credible, publically available structural analyses involving simultaneous equation parameter estimation techniques.

Finally, regarding the merits of the methodology used herein versus that used in developing the Climate Models relied

upon in EPA's Endangerment Finding, a quote[7] from Congressional testimony seems is order here:

"The advantage of the simple statistical treatment {used herein} is that the complicated processes such as clouds, ocean-atmosphere interaction, aerosols, etc., are implicitly incorporated by the statistical relationships discovered from the actual data. Climate models attempt to calculate these highly non-linear processes from imperfect parameterizations (estimates) whereas the statistical model directly accounts for them since the bulk atmospheric temperature is the response-variable these processes impact. It is true that the statistical model does not know what each sub-process is or how each might interact with other processes. But it also must be made clear: it is an understatement to say that no IPCC climate model accurately incorporates all of the nonlinear processes that affect the system. I simply point out that because the model is constrained by the ultimate response variable (bulk temperature), these highly complex processes are included.

The fact that this statistical model {typically} explains 75-90 percent of the real annual temperature variability, depending on dataset, using these influences (ENSO, volcanoes, solar) is an indication the statistical model is useful. - - - - This result promotes the conclusion that this approach achieves greater scientific (and policy) utility than results from elaborate climate models which on average fail to reproduce the real world's global average bulk temperature trend since 1979."

---

[7] U.S. House Committee on Science, Space & Technology
29 Mar 2017
Testimony of John R. Christy, pages 10-11
Professor of Atmospheric Science, Alabama State Climatologist
University of Alabama in Huntsville

Section XXVI. Research Report Endorsement

The authors of this research are very much interested in knowing the names and credentials of individuals who would like to add their names to the list of scientists whose names may appear in the report under the following statement: "The Undersigned Agree with the Conclusions of this Report."

After reading and thinking about this research report, if you would like to have your name added to the list, please send your name and credentials in a fashion similar to those listed in the August 2016 Research Report. See:
https://thsresearch.files.wordpress.com/2016/09/ef-cpp-sc-2016-data-ths-paper-ex-sum-090516v2.pdf

Please send this information to the following dedicated email address: thsresearch@aol.com.