

Comment on “*Examination of space-based bulk atmospheric temperatures used in climate research*” by John R. Christy et alⁱ

James P. Wallace III, Joseph S. D’Aleo & Craig D. Idso
Research Report,
Third Edition, May, 2018

Abstract

The Christy et al (2018) paper commented upon herein is very useful in that it provides analysts familiar with structural analysis using econometric methods with a far better feel for the quality and associated error analysis and correction issues associated with key temperature data sets. Moreover, the paper does not come to different basic conclusions on key structural analysis issues from those expressed in this Comment. For example, importantly, the paper demonstrated that the traditional Climate Models are invalid for regulatory analysis purposes, given their inability to properly fit historical data. The Christy et al (2018) paper does provide lower temperature trend slope estimates than do many others. However, the Christy et al (2018) work does not claim that this lower trend slope finding implies anything whatsoever about whether CO₂ has had a statistically significant impact on the Earth’s temperature over the last 50 years or so. Such a claim would be mathematically incorrect.

This Comment argues that such a claim must be addressed using appropriate mathematical methods. Such methods are used in this Comment to prove that increasing atmospheric CO₂ concentrations did not have a statistically significant impact on the UAH TLT 6.0 temperature data set over the period 1979 to 2016. In fact, this structural analysis demonstrates that there was a “Pause” in temperature trend increases over the 1995 to 2016 period. This is a time period over which atmospheric CO₂ concentrations increased by over 12.0%.

Furthermore, based on a well-known solar activity forecast and specific assumptions on other natural variables, the Comment also provides a long-term forecast of declining UAH TLT temperatures over the period through 2026. Finally, the Comment argues against the use of reanalysis data in structural analysis since its use makes rigorous hypothesis testing virtually impossible.

The Undersigned Agree with the Conclusions of this Comment

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Comment on “*Examination of space-based bulk atmospheric temperatures used in climate research*” by John R. Christy, Roy W. Spencer, William D. Braswell and Robert Junod, Earth System Science Center, The University of Alabama in Huntsville¹

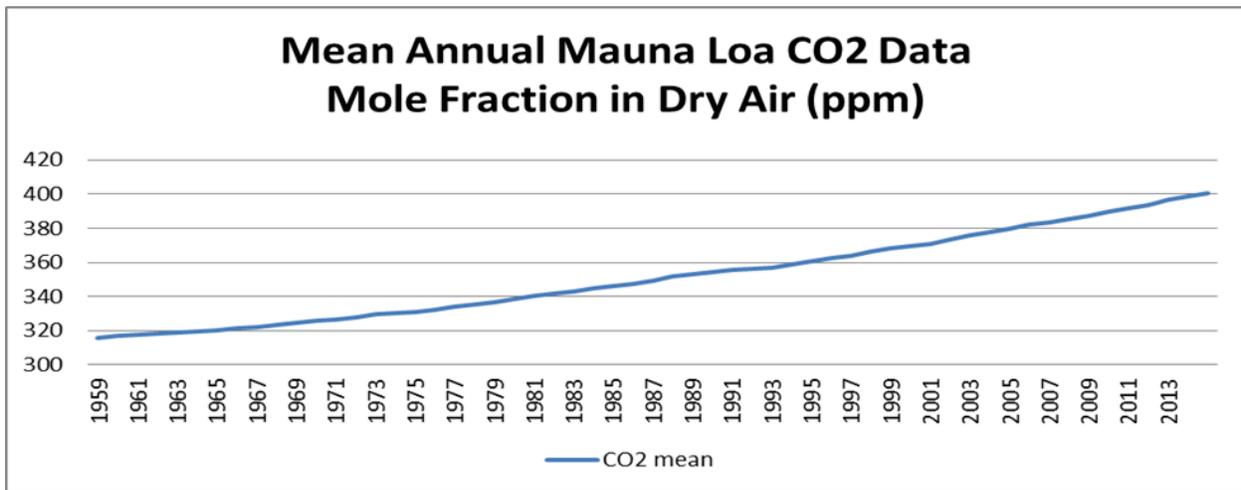
James P. Wallace III, Joseph S. D’Aleo & Craig D. Idso

One purpose of the Comment on this paper is to help clarify what the paper’s key takeaways are from the perspective of structural analysis of the Earth’s climate system. A second purpose of this Comment is to demonstrate how statistical methods traditionally used in econometrics can add substantial insight into key issues currently being debated by climate scientists. What the Christy et al (2018) paper certainly has done is to demonstrate that the UAH Satellite data seems to be the best Satellite data, for example, when tested against the best Balloon data. This finding seems very reasonable and thus UAH TLT 6.0 global temperature data will be used herein to demonstrate the validity of views expressed below regarding the causal relationship between CO₂ and temperature as well as the validity of the Tropical Hot Spot (THS) theory.

Given its objectives, the Christy et al (2018) paper does not address the issue of proving or disproving that increasing atmospheric CO₂ concentrations have had a statistically significant impact on Global Average Temperature, and the paper has not invalidated the so called THS theory. But importantly, the paper has demonstrated that the Climate Models are invalid for regulatory analysis purposes, given these models’ inability to properly fit historical data. As to the cause of this problem, the paper concludes with: “we would hypothesize that a misrepresentation of the basic model physics of the tropical

hydrologic cycle (i.e. water vapour, precipitation physics and cloud feedbacks) is a likely candidate.”

The first step in this Comment will be to make some general mathematical/statistical points followed by some points resulting from their application in general as well as the empirical results of their application to the issues at hand. CO₂, the supposed key explanatory variable in today’s climate science debate, is shown in the figure below.



Source:

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

Since over the Balloon and Satellite data availability window (beginning in 1959/79 respectively) CO₂ concentration can be seen to basically be a positively sloped linear time trend, it is not surprising that climate science has focused heavily on the Linear Time Trend components in the various temperature data sets and their slopes – which, it so happens over this time period, have nearly all had statistically significant positive slopes.

As a result, if an analyst simply regresses such a temperature data set on the CO₂ data depicted above, the computer regression program will generate a statistically

significant parameter estimate of the impact of CO₂ on temperature. Many analysts have done this for years. But such an approach was shown to be mathematically incorrect years agoⁱⁱ and reconfirmed twice since thenⁱⁱⁱ.

The relevant mathematical truism here is that a statistically significant correlation between two data sets does not prove causality. However, it is a necessary, but not sufficient, condition for such a proof. Moreover, climate researchers should 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. This issue is spelled out in detail in an aforementioned reference^{iv}. From this reference, see below how this point relates to THS Hypothesis Testing:

“The proper tests 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.

Sufficient Conditions for Rejection of the THS Hypothesis

This research utilized the following as “Sufficient Conditions”:

1.) *After adjusting for the Natural Factor {e.g., solar, volcanic & oceanic impacts,} if all relevant temperature time series have linear trend slopes that are not positive and statistically significant; then rising atmospheric CO₂ 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 positive, statistically significant relationship to rising atmospheric CO₂ concentrations, then the THS theory must be considered invalidated.*

If both tests are met, rising atmospheric CO₂ concentrations must not be the cause of any statistically significant positive trend slopes in the published data. Blame the Natural Factor impacts.”

The research cited aboveⁱⁱⁱ invalidated the THS using this approach, totally independent of any analysis associated with climate models.

Structural Analysis

While the research references cited above, each in their own way, invalidated the THS, each report also concluded that rising atmospheric CO₂ concentrations could not be shown to have a statistically significant impact on as many as 14 separate and distinct temperature data sets. But each report did so using mathematical methods familiar to applied statisticians and econometricians but not most climate scientists. The critical point here is that it is well known, and proven thrice in the aforementioned research papers, that atmospheric CO₂ concentration is impacted by ocean surface temperature. In the Tropics over 80% of the surface is water.

So, structural analysis involving CO₂ must deal with what econometricians call the Simultaneity Problem^v. That is, there are at least two equations involving temperature, at least one where it is the dependent variable and an another where it is an explanatory variable and CO₂ is the dependent variable. See all three references cited in footnotes above for consistent and credible estimates of the parameters of such a CO₂ equation.

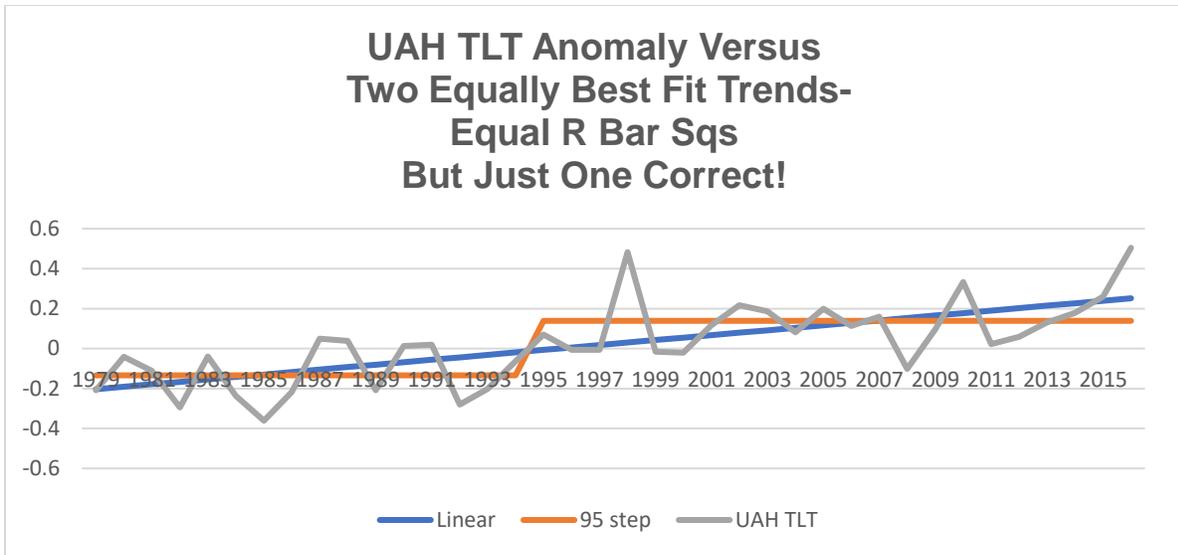
Structural Analysis using UAH TLT 6.0 data

An appropriate way to think about this structural analysis is that there are two generic equations: a CO₂ equation and a temperature equation:

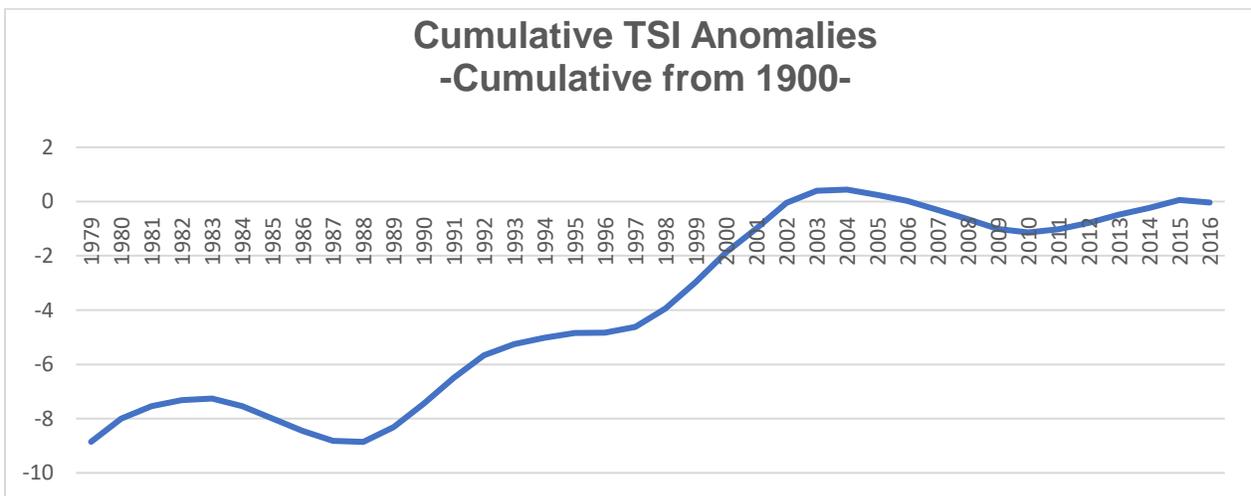
- 1.) CO₂ = F₁(T, other variables)
- 2.) T = F₂(Solar, Volcanic, Oceanic/ENSO variables, CO₂)

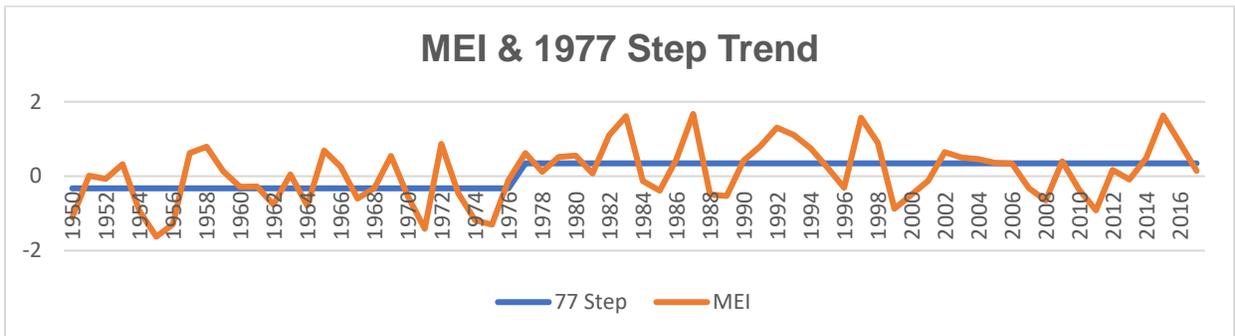
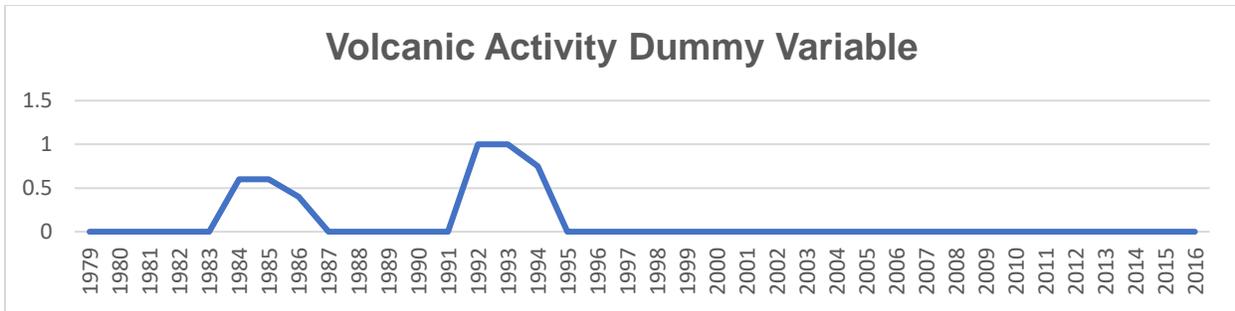
The solar, volcanic and oceanic activity variables are the so called key Natural Factors (NF) impacting temperature^{vi}. And, since they are not directly impacted by changes in CO₂, their impact on T can be statistically estimated to arrive at a NF Adjusted UAH temperature data set. If it turns out that this NF Adjusted T data does not have a statistically significant Trend then, CO₂ does not have a statistically significant impact on this data set. Note that if such is not the case, a simultaneous equation parameter estimation technique, such as **two-stage** least squares, would have to be used to confirm statistical significance and arrive at an unbiased and consistent parameter estimate for CO₂.

The first stage of a structural analysis should begin with a dependent variable time series decomposition. The results are shown below:

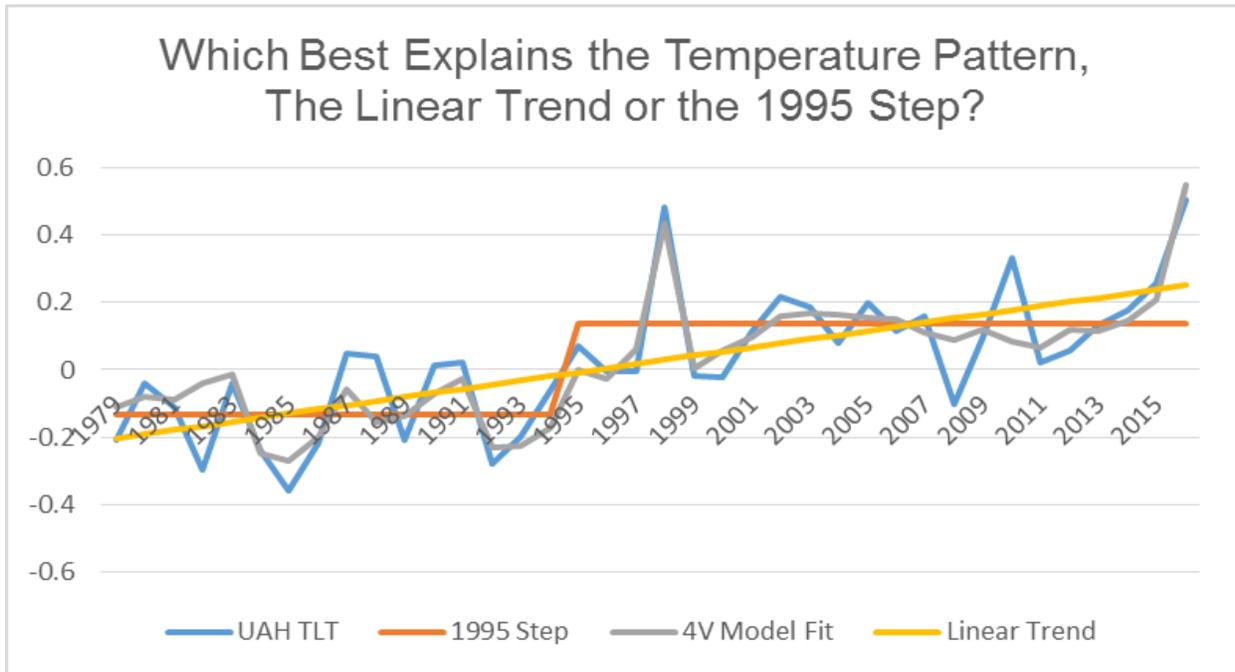


In this case, it just so happens that a linear time trend and a 1995 Step Trend have equally good Best Fit measurements. Hence, it is necessary to proceed to the next step in structural analysis to sort out which is really the best representation of reality. The three charts below show the solar, volcanic activity and MEI (measuring ENSO Impacts) Natural Factor explanatory variables that have been used while the years 1998 and 2016 have been designated as having very strong El Nino events.





The figure below again shows the actual data and the two different Trend lines but adds the model fit in grey.



The 1995 Step Trend provides a 13.4% better fit than the Linear Trend to the structural analysis model results implying over a 20-year Pause. But, how good are the structural analysis model results? Excellent, as shown below:

Model Fit Comparison

Model	R Bar SQ
Linear	0.46
Step in 1995	0.46
Linear with 2 Wild Points out	0.65
95 Step with 2 Wild Points out	0.65
MEI, CTSIA, 2 WP Out & Vol Dum*	0.76

* Model Residual Trend not SS
(t=0.59)

Memo: Step Models

1994	0.44
1995	0.46
1996	0.44

<i>Regression Statistics</i>	
Multiple R	0.89
R Square	0.79
Adjusted R Square	0.76
Standard Error	0.10
Observations	38

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	0.13	0.025	5.34
MEI	0.04	0.023	1.84
CTSIA	0.03	0.005	6.07
98/16 Dum	0.38	0.073	5.22
Vol Dum	-0.25	0.060	-4.16
Durban			
Watson	2.04		

It is also very important to note as shown below that the Natural Factor Adjusted UAH TLT data does not have a statistically significant trend slope. Hence, rising atmospheric CO₂ concentrations were shown not to have had a statistically significant impact on this key temperature data set, not even close as shown below.

<i>Regression Statistics</i>	
Multiple R	0.10
R Square	0.01
Adjusted R Square	-0.02
Standard Error	0.09
Observations	38

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>
Intercept	-1.62	2.73	-0.59
Time variable	0.00	0.00	0.59

Analysis of Results

As far back as 2011, it has been quite obvious why climate scientists have been getting statistically significant upward sloping temperature trends over the 1959 to date time period. As shown in the figure above, the cumulative solar activity rose until early 2000s and then leveled off. The Famous Pacific ENSO Central Tendency shift to a positive temperature impact happened in 1977, and there were two very strong volcanic activity events cooling the planet early in the post 1979 satellite period. Of course, despite these supportive Natural Factor impacts, CO₂ could still have had a statistically significant impact on temperature in the real world. However, in addition to the results cited above, the three research reports cited above in the footnotes have been unable to find it – either directly or via a validated THS.

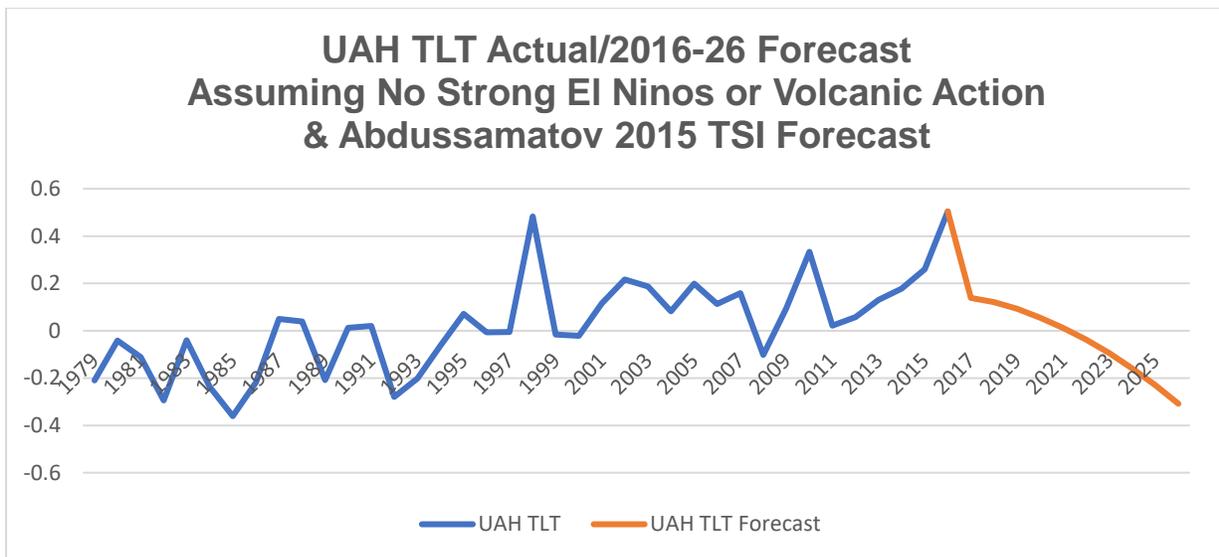
It is interesting to ask ourselves what the situation would now be if, starting back in 1975 and continuing through today, God had given us a steady decline in Cumulative TSI and held off on the 1977 Shift and the mid-1980s and early-1990s volcanic activity. Temperatures, accurately measured, would have gone down, accelerated by any post 2000 volcanic activity. Then, as occurred in the mid-1970s, there would have been growing public concern over a new ice age. In this scenario, does anyone really believe that many credible scientists would still be advocating for reduced CO₂ emissions?

Finally, it must be noted here that just because temperature data has a statistically significant downward sloping trend does not guarantee that CO₂ has not had a statistically significant positive impact on temperature. It simply would require the use of the proper mathematical tools to obtain the statistical results to prove it. This is why all the focus on the magnitude of the slope of

temperature trends by most climate scientists makes no sense to analysts experienced in econometrics-based structural analysis.

UAH Long-term Temperature Forecast

To get a feel for what the UAH model parameter estimates shown above might mean for the long-term global temperature outlook, the UAH TLT Temperature Forecast using the Abdussamatov, 2015 TSI forecast is shown below. The estimated temperature decline from 2016 to 2026 is -0.8 Degrees C or 1.44 Degrees F. This forecast is not inconsistent with such work by others^{vii}.



Source: TSI forecast from:

[http://www.doiserbia.nb.rs/\(X\(1\)A\(O911W9Dm0gEkAAAANjcxNWQ2NGEtM2ExNy00MTkwLWI3YTgtYTQ1N2QzMzI1NzgxAj7CGrxyf6_S075rvy0gkboWe-c1\)\)/img/doi/0354-9836/2015/0354-98361500018A.pdf](http://www.doiserbia.nb.rs/(X(1)A(O911W9Dm0gEkAAAANjcxNWQ2NGEtM2ExNy00MTkwLWI3YTgtYTQ1N2QzMzI1NzgxAj7CGrxyf6_S075rvy0gkboWe-c1))/img/doi/0354-9836/2015/0354-98361500018A.pdf), page S282

Temperature Data Measurement Error and its Reduction

A primary value of the Christy, et al (2018) work commented on here is that it gives structural analysts a better feel as to which temperature data set might best reflect reality. As shown in the Christy et al (2018) paper, the UAH data meets this criterion and, as shown above the UAH data, lends itself to being quite useful in the structural analysis process.

However, it is important to note that the statistical modeling approach used herein assumes that the major modeling errors are errors of omission (e.g., of important explanatory variables) as opposed to error in data measurement – particularly in this case involving the key dependent variable, temperature. It might seem reasonable to suggest that integrating structural analysis model fit results into the data correction process could prove useful.

For example, the Christy et al. (2018) paper expresses concern that UAH satellite data might be “spuriously” overstating warming in the 1990s. However, the model shown above using UAH TLT 6.0 data does fine over that period so that, in this particular case, this fact should just provide comfort to the UAH team.

Nevertheless, if the model results had supported the UAH concern, this fact should not encourage UAH to develop so called reanalysis data which explicitly incorporates such model results. Clearly, calibrating climate models of the type illustrated above to reanalysis data would mean that all of the associated parameter estimate hypothesis testing would be meaningless. Without having mathematically credible hypothesis test results, structural analysis is virtually impossible.

Conclusion

The Christy et al (2018) paper commented upon herein is very useful in that it provides analysts familiar with econometrics-type structural analysis methods with a far better feel for the quality and associated error analysis and correction issues associated with key temperature data sets. Moreover, the paper does not come to different basic conclusions on key structural analysis issues from those expressed in this Comment. For example, importantly, the paper demonstrated that the traditional Climate Models are invalid for regulatory analysis purposes, given their inability to properly fit historical data. The Christy et al (2018) paper does provide lower temperature trend slope estimates than do many others. However, the Christy et al (2018) paper does not claim that this lower trend slope finding implies anything whatsoever about whether CO₂ has had a statistically significant impact on the Earth's temperature over the last 50 years or so. Such a claim would be mathematically incorrect.

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analysis since its use makes hypothesis testing virtually impossible.

Regarding the merits of the methodology used in this Comment versus that used in developing the Climate Models relied upon in EPA's Endangerment Finding, a quote^{viii} from highly relevant Congressional testimony seems in 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."

ⁱ See: <https://www.tandfonline.com/doi/full/10.1080/01431161.2018.1444293>

ii 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.

iii On the Existence of a “Tropical Hot Spot” & The Validity of EPA’s CO₂ Endangerment Finding, Abridged Research Report, Dr. James P. Wallace III, Dr. John R. Christy, Dr. Joseph S. D’Aleo, August 2016. See:
<https://thsresearch.files.wordpress.com/2016/09/ef-cpp-sc-2016-data-ths-paper-ex-sum-090516v2.pdf>

On the Existence of a “Tropical Hot Spot” & The Validity of EPA’s CO₂ Endangerment Finding, Abridged Research Report, Second Edition; Dr. James P. Wallace III, Dr. John R. Christy, Dr. Joseph S. D’Aleo, April 2017. See:
<https://thsresearch.files.wordpress.com/2017/04/ef-data-research-report-second-editionfinal041717-1.pdf>

iv On the Existence of a “Tropical Hot Spot” & The Validity of EPA’s CO₂ Endangerment Finding, Abridged Research Report, Second Edition; Dr. James P. Wallace III, Dr. John R. Christy, Dr. Joseph S. D’Aleo, April 2017, Pages 14-16

v See the Preface in the Research Report cited in Footnote iv

vi Very important to this analysis, CO₂ may be assumed to be an independent variable in equation 2 because it is a variable not directly dependent on any one of the other explanatory Natural Factor variables but assumed capable of impacting T. That is, via equation 2, changes in NF Variables impact T values and then these T changes impact CO₂ via equation 1.

vii **Evans, 2016**

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